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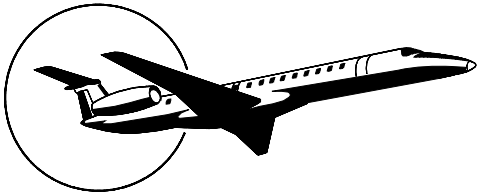

# AIRPLANE OPERATIONS MANUAL
# VOLUME 1

**EMBRAER S.A.**

This manual is applicable to the EMB-145 airplanes equipped with AE3007A1 engines operating under FAA certification.

THIS PUBLICATION IS INCOMPLETE WITHOUT AIRPLANE OPERATIONS MANUAL AOM–145/1114 VOLUME 2

**AOM–145/1114-105**
**OCTOBER 31, 1996**
**REVISION 46 – OCTOBER 28, 2024**

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**Airplane Operations Manual**
**AOM–145/1114**

Please use this Customer Comment Form to notify us of any discrepancies or problems you find in the Airplane Operations Manual. We would also welcome constructive suggestions on how we can further improve our documentation or service.

Your feedback will be acknowledged, and we will advise you of the action we intend to take.

Sincerely,
Flight Operations Engineering & Support

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# Airplane Operations Manual
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Section/Page/Code:_____ Date of Page:_____ Revision:____

Name:_____
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Proposed date for implementation: _____ Implemented: _____

# HIGHLIGHTS OF CHANGE

## REVISION 46 – OCTOBER 28, 2024

- 1-01-30 code 03 — Added information related to the EGPWS. Changed information related to the EGPWS functions and actions regarding the system.
- 1-01-56 code 02 — Added information related to the Autopilot limitations applicable to ERJ-140 and EMB-145 models except EMB-145 XR.
- 1-01-56 code 07 — Added information related to the Autopilot limitations applicable to ERJ-140 EMB-145 models.
- 1-02-37 code 01 — Deleted information related to the Gust Lock and added information related to the Elevator operation.
- 1-02-79 code 01 — Changed temperature reference for Engine Start during cold weather operations.
- 1-03-05 code 03 — Added step in the BAGGAGE COMPARTMENT SMOKE procedure, according to AFM.
- 1-03-36 code 03 — Added information prohibiting CAT III approaches if GPWS INOP or AURAL WARN FAIL message is displayed.
- 1-03-37 code 03 — Added information related to the altitude in the ELECTRICAL EMERGENCY ABNORMAL TRANSFER procedure, according to AFM.
- 1-03-48 code 03 — Added condition in the HYDRAULIC SYSTEM LOW QUANTITY and HYDRAULIC ENGINE PUMP FAILURE procedures.
- 1-03-50 code 03 — Changed ABNORMAL LANDING GEAR EXTENSION and LANDING GEAR AIR/GROUND SYSTEM FAILURE

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procedures, according to AFM.

- 1-04-05 code 01 — Changed the introduction of GEOMETRIC HEIGHT TO PRESSURE HEIGHT to specify the table applicability.
- 1-05-30 code 03 — Changed the Pressure Altitude to Geometric Altitude in the DRIFTDOWN TABLES introduction.
- 1-07-70 code 01 — Added information related to the Maximum Floor Distributed Load for all models. Changed drawing for editorial purpose.
- 1-07-70 code 02 — Added information related to the Maximum Floor Distributed Load for all models.
- 2-04-40 code 01 — Added information related to the TCAS software version.
- 2-18-35 code 01 — Added information related to the CDU-380 regarding to its functions, display, controls, and indicators.

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# LIST OF EFFECTIVE PAGES

# (VOLUME 1)

| | | |
|---|---|---|
| ORIGINAL | 0 | OCT 31, 1996 |
| REVISION | 1 | FEB 14, 1997 |
| REVISION | 2 | MAR 10, 1997 |
| REVISION | 3 | APR 15, 1997 |
| REVISION | 4 | MAY 08, 1997 |
| REVISION | 5 | JUL 10, 1997 |
| REVISION | 6 | SEP 19, 1997 |
| REVISION | 7 | NOV 28, 1997 |
| REVISION | 8 | FEB 02, 1998 |
| REVISION | 9 | APR 03, 1998 |
| REVISION | 10 | AUG 31, 1998 |
| REVISION | 11 | JAN 12, 1999 |
| REVISION | 12 | JUN 01, 1999 |
| REVISION | 13 | SEP 20, 1999 |
| REVISION | 14 | DEC 15, 1999 |
| REVISION | 15 | APR 28, 2000 |
| REVISION | 16 | SEP 29, 2000 |
| REVISION | 17 | MAR 30, 2001 |
| REVISION | 18 | JUN 29, 2001 |
| REVISION | 19 | AUG 24, 2001 |
| REVISION | 20 | OCT 02, 2001 |
| REVISION | 21 | JAN 21, 2002 |
| REVISION | 22 | MAR 28, 2002 |
| REVISION | 23 | JUN 28, 2002 |
| REVISION | 24 | DEC 20, 2002 |
| REVISION | 25 | JUN 30, 2003 |
| REVISION | 26 | DEC 30, 2003 |
| REVISION | 27 | JUN 30, 2004 |
| REVISION | 28 | NOV 30, 2004 |
| REVISION | 29 | JUN 30, 2005 |
| REVISION | 30 | NOV 30, 2005 |
| REVISION | 31 | JUN 30, 2006 |
| REVISION | 32 | NOV 30, 2006 |
| REVISION | 33 | JUN 29, 2007 |
| REVISION | 34 | NOV 30, 2007 |
| REVISION | 35 | JUN 30, 2008 |
| REVISION | 36 | DEC 19, 2008 |
| REVISION | 37 | OCT 30, 2009 |
| REVISION | 38 | AUG 15, 2011 |
| REVISION | 39 | OCT 22, 2012 |

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REVISION.....40 ..... NOV 14, 2013
REVISION.....41 ..... MAR 06, 2015
REVISION.....42 .....APR 05, 2017
REVISION.....43 .....APR 26, 2019
REVISION.....44 ..... AUG 14, 2020
REVISION.....45 ..... NOV 30, 2022
REVISION.....46 ..... OCT 28, 2024

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**NOTE:** The references to the deleted pages from the previous revisions (revision 45 and earlier) were removed from the LEP.



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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-LEP | **title** | 105 | * | REVISION 46 | AOM-145/1114-105 |
| 1-LEP | 1 | 105 | * | REVISION 46 | |
| 1-LEP | 2 | 105 | * | REVISION 46 | |
| 1-LEP | 3 | 105 | * | REVISION 46 | |
| 1-LEP | 4 | 105 | * | REVISION 46 | |
| 1-LEP | 5 | 105 | * | REVISION 46 | |
| 1-LEP | 6 | 105 | * | REVISION 46 | |
| 1-LEP | 7 | 105 | * | REVISION 46 | |
| 1-LEP | 8 | 105 | * | REVISION 46 | |
| 1-LEP | 9 | 105 | * | REVISION 46 | |
| 1-LEP | 10 | 105 | * | REVISION 46 | |
| 1-LEP | 11 | 105 | * | REVISION 46 | |
| 1-LEP | 12 | 105 | * | REVISION 46 | |
| 1-LEP | 13 | 105 | * | REVISION 46 | |
| 1-LEP | 14 | 105 | * | REVISION 46 | |
| 1-LEP | 15 | 105 | * | REVISION 46 | |
| 1-LEP | 16 | 105 | * | REVISION 46 | |
| 1-LEP | 17 | 105 | * | REVISION 46 | |
| 1-LEP | 18 | 105 | * | REVISION 46 | |
| 1-LEP | 19 | 105 | * | REVISION 46 | |
| 1-LEP | 20 | 105 | * | REVISION 46 | |
| 1-LEP | 21 | 105 | * | REVISION 46 | |
| 1-LEP | 22 | 105 | * | REVISION 46 | |
| 1-LEP | 23 | 105 | * | REVISION 46 | |
| 1-LEP | 24 | 105 | * | REVISION 46 | |
| 1-LEP | 25 | 105 | * | REVISION 46 | |
| 1-LEP | 26 | 105 | * | REVISION 46 | |
| 1-LEP | 27 | 105 | * | REVISION 46 | |
| 1-LEP | 28 | 105 | * | REVISION 46 | |

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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-LEP | 29 | 105 | * | REVISION 46 | |
| 1-LEP | 30 | 105 | * | REVISION 46 | |
| 1-LEP | 31 | 105 | * | REVISION 46 | |
| 1-LEP | 32 | 105 | * | REVISION 46 | |
| 1-LEP | 33 | 105 | * | REVISION 46 | |
| 1-LEP | 34 | 105 | * | REVISION 46 | |
| 1-LEP | 35 | 105 | * | REVISION 46 | |
| 1-LEP | 36 | 105 | * | REVISION 46 | |
| 1-LEP | 37 | 105 | * | REVISION 46 | |
| 1-LEP | 38 | 105 | * | REVISION 46 | |
| 1-LEP | 39 | 105 | * | REVISION 46 | |
| 1-LEP | 40 | 105 | * | REVISION 46 | |
| 1-LEP | 41 | 105 | * | REVISION 46 | |
| 1-LEP | 42 | 105 | * | REVISION 46 | |
| 1-LEP | 43 | 105 | * | REVISION 46 | |
| 1-LEP | 44 | 105 | * | REVISION 46 | |
| 1-LEP | 45 | 105 | * | REVISION 46 | |
| 1-LEP | 46 | 105 | * | REVISION 46 | |
| 1-LEP | 47 | 105 | * | REVISION 46 | |
| 1-LEP | 48 | 105 | * | REVISION 46 | |
| 1-LEP | 49 | 105 | * | REVISION 46 | |
| 1-LEP | 50 | 105 | * | REVISION 46 | |
| 1-TOC | 1 | 01 | | REVISION 25 | ALL |
| 1-TOC | 2 | 01 | | REVISION 23 | |
| 1-00-00 | 1 | 01 | | REVISION 43 | ALL |
| 1-00-00 | 2 | 01 | | REVISION 43 | |
| 1-00-00 | 3 | 01 | | REVISION 43 | |
| 1-00-00 | 4 | 01 | | REVISION 43 | |
| 1-00-00 | 5 | 01 | | REVISION 43 | |
| 1-00-00 | 6 | 01 | | REVISION 43 | |

* Asterisk indicates pages revised, added or deleted by the current revision.



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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-00-00 | 7 | 01 | REVISION 43 | |
| 1-00-00 | 8 | 01 | REVISION 43 | |
| 1-00-10 | 1 | 01 | REVISION 41 | ALL |
| 1-00-10 | 2 | 01 | REVISION 41 | |
| 1-00-10 | 3 | 01 | REVISION 41 | |
| 1-00-10 | 4 | 01 | REVISION 41 | |
| 1-00-10 | 5 | 01 | REVISION 41 | |
| 1-00-10 | 6 | 01 | REVISION 41 | |
| 1-00-10 | 7 | 01 | REVISION 41 | |
| 1-00-10 | 8 | 01 | REVISION 41 | |
| 1-00-10 | 9 | 01 | REVISION 41 | |
| 1-00-10 | 10 | 01 | REVISION 41 | |
| 1-00-10 | 11 | 01 | REVISION 41 | |
| 1-00-10 | 12 | 01 | REVISION 41 | |
| 1-00-10 | 13 | 01 | REVISION 41 | |
| 1-00-10 | 14 | 01 | REVISION 42 | |
| 1-00-10 | 15 | 01 | REVISION 41 | |
| 1-00-10 | 16 | 01 | REVISION 41 | |
| 1-00-20 | 1 | 01 | REVISION 25 | ALL |
| 1-00-20 | 2 | 01 | REVISION 13 | |
| 1-00-30 | 1 | 01 | REVISION 41 | ALL |
| 1-00-30 | 2 | 01 | REVISION 41 | |
| 1-00-30 | 3 | 01 | REVISION 41 | |
| 1-00-30 | 4 | 01 | REVISION 41 | |
| 1-00-30 | 5 | 01 | REVISION 41 | |
| 1-00-30 | 6 | 01 | REVISION 41 | |
| 1-00-30 | 7 | 01 | REVISION 41 | |
| 1-00-30 | 8 | 01 | REVISION 41 | |
| 1-00-30 | 9 | 01 | REVISION 41 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-00-30 | 10 | 01 | REVISION 43 | |
| 1-00-30 | 11 | 01 | REVISION 45 | |
| 1-00-30 | 12 | 01 | REVISION 45 | |
| 1-00-35 | 1 | 01 | REVISION 45 | ALL |
| 1-00-35 | 2 | 01 | REVISION 45 | |
| 1-00-35 | 3 | 01 | REVISION 45 | |
| 1-00-35 | 4 | 01 | REVISION 45 | |
| 1-00-35 | 5 | 01 | REVISION 45 | |
| 1-00-35 | 6 | 01 | REVISION 45 | |
| 1-01-00 | 1 | 02 | REVISION 31 | FAA |
| 1-01-00 | 2 | 02 | REVISION 13 | |
| 1-01-01 | 1 | 01 | REVISION 39 | ALL |
| 1-01-01 | 2 | 01 | REVISION 39 | |
| 1-01-05 | 1 | 07 | REVISION 31 | 145 FAA ER |
| 1-01-05 | 2 | 07 | REVISION 31 | |
| 1-01-05 | 3 | 07 | REVISION 31 | |
| 1-01-05 | 4 | 07 | REVISION 31 | |
| 1-01-05 | 5 | 07 | REVISION 31 | |
| 1-01-05 | 6 | 07 | REVISION 31 | |
| 1-01-05 | 1 | 08 | REVISION 45 | 145 FAA LR |
| 1-01-05 | 2 | 08 | REVISION 45 | |
| 1-01-05 | 3 | 08 | REVISION 45 | |
| 1-01-05 | 4 | 08 | REVISION 45 | |
| 1-01-05 | 5 | 08 | REVISION 45 | |
| 1-01-05 | 6 | 08 | REVISION 45 | |
| 1-01-05 | 1 | 20 | REVISION 26 | 145 FAA MP |
| 1-01-05 | 2 | 20 | REVISION 26 | |
| 1-01-05 | 3 | 20 | REVISION 26 | |
| 1-01-05 | 4 | 20 | REVISION 26 | |

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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-01-05 | 1 | 21 | | REVISION 45 | 145 FAA EP |
| 1-01-05 | 2 | 21 | | REVISION 45 | |
| 1-01-05 | 3 | 21 | | REVISION 45 | |
| 1-01-05 | 4 | 21 | | REVISION 45 | |
| 1-01-05 | 5 | 21 | | REVISION 45 | |
| 1-01-05 | 6 | 21 | | REVISION 45 | |
| 1-01-10 | 1 | 01 | | REVISION 41 | FAA |
| 1-01-10 | 2 | 01 | | REVISION 41 | |
| 1-01-10 | 3 | 01 | | REVISION 41 | |
| 1-01-10 | 4 | 01 | | REVISION 41 | |
| 1-01-10 | 5 | 01 | | REVISION 41 | |
| 1-01-10 | 6 | 01 | | REVISION 41 | |
| 1-01-10 | 7 | 01 | | REVISION 41 | |
| 1-01-10 | 8 | 01 | | REVISION 41 | |
| 1-01-12 | 1 | 03 | | REVISION 36 | ANAC/FAA - High Alt 8500ft |
| 1-01-12 | 2 | 03 | | REVISION 36 | |
| 1-01-12 | 1 | 05 | | REVISION 41 | FAA - High Alt 10000ft |
| 1-01-12 | 2 | 05 | | REVISION 41 | |
| 1-01-30 | 1 | 03 | * | REVISION 46 | FAA |
| 1-01-30 | 2 | 03 | * | REVISION 46 | |
| 1-01-32 | 1 | 01 | | SEP 20, 1999 | ALL |
| 1-01-32 | 2 | 01 | | SEP 20, 1999 | |
| 1-01-36 | 1 | 03 | | REVISION 41 | FAA ER EP MP |
| 1-01-36 | 2 | 03 | | REVISION 41 | |
| 1-01-36 | 1 | 04 | | REVISION 41 | LR FAA lb |
| 1-01-36 | 2 | 04 | | REVISION 41 | |
| 1-01-38 | 1 | 02 | | REVISION 39 | FAA |
| 1-01-38 | 2 | 02 | | REVISION 39 | |
| 1-01-40 | 1 | 05 | | REVISION 41 | 145 A1 FAA |

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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-01-40 | 2 | 05 | | REVISION 41 | |
| 1-01-40 | 3 | 05 | | REVISION 41 | |
| 1-01-40 | 4 | 05 | | REVISION 41 | |
| 1-01-48 | 1 | 01 | | SEP 20, 1999 | ALL |
| 1-01-48 | 2 | 01 | | SEP 20, 1999 | |
| 1-01-50 | 1 | 02 | | REVISION 45 | FAA |
| 1-01-50 | 2 | 02 | | REVISION 45 | |
| 1-01-52 | 1 | 01 | | JAN 21, 2002 | FAA |
| 1-01-52 | 2 | 01 | | SEP 20, 1999 | |
| 1-01-52 | 3 | 01 | | SEP 20, 1999 | |
| 1-01-52 | 4 | 01 | | SEP 20, 1999 | |
| 1-01-56 | 1 | 02 | | REVISION 43 | FAA AHRS |
| 1-01-56 | 2 | 02 | | REVISION 43 | |
| 1-01-56 | 3 | 02 | * | REVISION 46 | |
| 1-01-56 | 4 | 02 | * | REVISION 46 | |
| 1-01-56 | 5 | 02 | * | REVISION 46 | |
| 1-01-56 | 6 | 02 | * | REVISION 46 | |
| 1-01-56 | 1 | 07 | | REVISION 43 | FAA AHRS/IRS |
| 1-01-56 | 2 | 07 | | REVISION 43 | |
| 1-01-56 | 3 | 07 | | REVISION 43 | |
| 1-01-56 | 4 | 07 | * | REVISION 46 | |
| 1-01-56 | 5 | 07 | * | REVISION 46 | |
| 1-01-56 | 6 | 07 | * | REVISION 46 | |
| 1-01-60 | 1 | 02 | | REVISION 43 | FAA FMZ 2000 FMS |
| 1-01-60 | 2 | 02 | | REVISION 43 | |
| 1-01-60 | 3 | 02 | | REVISION 43 | |
| 1-01-60 | 4 | 02 | | REVISION 43 | |
| 1-01-60 | 5 | 02 | | REVISION 43 | |

* Asterisk indicates pages revised, added or deleted by the current revision.



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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-01-60 | 6 | 02 | REVISION 43 | |
| 1-01-60 | 1 | 04 | REVISION 38 | FAA UNS 1K FMS |
| 1-01-60 | 2 | 04 | REVISION 38 | |
| 1-01-60 | 3 | 04 | REVISION 38 | |
| 1-01-60 | 4 | 04 | REVISION 38 | |
| 1-01-60 | 1 | 09 | REVISION 45 | FMZ 2010 FMS (FMS 6.1.1) ANAC FAA |
| 1-01-60 | 2 | 09 | REVISION 45 | |
| 1-01-60 | 3 | 09 | REVISION 45 | |
| 1-01-60 | 4 | 09 | REVISION 45 | |
| 1-01-60 | 5 | 09 | REVISION 45 | |
| 1-01-60 | 6 | 09 | REVISION 45 | |
| 1-01-60 | 7 | 09 | REVISION 45 | |
| 1-01-60 | 8 | 09 | REVISION 45 | |
| 1-01-60 | 9 | 09 | REVISION 45 | |
| 1-01-60 | 10 | 09 | REVISION 45 | |
| 1-01-60 | 1 | 10 | REVISION 45 | FMZ 2010 FMS (FMS 6.1.1) / LPV / Baro-VNAV |
| 1-01-60 | 2 | 10 | REVISION 45 | |
| 1-01-60 | 3 | 10 | REVISION 45 | |
| 1-01-60 | 4 | 10 | REVISION 45 | |
| 1-01-60 | 5 | 10 | REVISION 45 | |
| 1-01-60 | 6 | 10 | REVISION 45 | |
| 1-01-60 | 7 | 10 | REVISION 45 | |
| 1-01-60 | 8 | 10 | REVISION 45 | |
| 1-01-60 | 9 | 10 | REVISION 45 | |
| 1-01-60 | 10 | 10 | REVISION 45 | |
| 1-01-60 | 11 | 10 | REVISION 45 | |
| 1-01-60 | 12 | 10 | REVISION 45 | |
| 1-01-70 | 1 | 01 | REVISION 25 | FAA ANAC cockpit security door |
| 1-01-70 | 2 | 01 | REVISION 25 | |

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User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-01-80 | 1 | 01 | REVISION 38 | FAA PRIMUS 1000 AFCS |
| 1-01-80 | 2 | 01 | REVISION 38 | |
| 1-01-82 | 1 | 02 | REVISION 41 | HGS |
| 1-01-82 | 2 | 02 | REVISION 41 | |
| 1-01-82 | 3 | 02 | REVISION 41 | |
| 1-01-82 | 4 | 02 | REVISION 41 | |
| 1-02-00 | 1 | 01 | REVISION 44 | ALL |
| 1-02-00 | 2 | 01 | REVISION 44 | |
| 1-02-00 | 3 | 01 | REVISION 44 | |
| 1-02-00 | 4 | 01 | REVISION 44 | |
| 1-02-01 | 1 | 01 | REVISION 41 | ALL |
| 1-02-01 | 2 | 01 | REVISION 43 | |
| 1-02-05 | 1 | 01 | REVISION 41 | ALL |
| 1-02-05 | 2 | 01 | REVISION 43 | |
| 1-02-05 | 3 | 01 | REVISION 43 | |
| 1-02-05 | 4 | 01 | REVISION 43 | |
| 1-02-09 | 1 | 01 | REVISION 41 | ALL |
| 1-02-09 | 2 | 01 | REVISION 41 | |
| 1-02-09 | 3 | 01 | REVISION 41 | |
| 1-02-09 | 4 | 01 | REVISION 41 | |
| 1-02-13 | 1 | 01 | REVISION 37 | ALL |
| 1-02-13 | 2 | 01 | REVISION 37 | |
| 1-02-13 | 3 | 01 | REVISION 37 | |
| 1-02-13 | 4 | 01 | REVISION 37 | |
| 1-02-13 | 5 | 01 | REVISION 37 | |
| 1-02-13 | 6 | 01 | REVISION 37 | |
| 1-02-13 | 7 | 01 | REVISION 37 | |
| 1-02-13 | 8 | 01 | REVISION 37 | |
| 1-02-17 | 1 | 01 | REVISION 37 | Panel I |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-02-17 | 2 | 01 | REVISION 37 | |
| 1-02-17 | 3 | 01 | REVISION 37 | |
| 1-02-17 | 4 | 01 | REVISION 37 | |
| 1-02-17 | 5 | 01 | REVISION 37 | |
| 1-02-17 | 6 | 01 | REVISION 37 | |
| 1-02-17 | 7 | 01 | REVISION 38 | |
| 1-02-17 | 8 | 01 | REVISION 37 | |
| 1-02-17 | 9 | 01 | REVISION 37 | |
| 1-02-17 | 10 | 01 | REVISION 40 | |
| 1-02-17 | 11 | 01 | REVISION 40 | |
| 1-02-17 | 12 | 01 | REVISION 37 | |
| 1-02-17 | 1 | 02 | REVISION 37 | Panel II |
| 1-02-17 | 2 | 02 | REVISION 37 | |
| 1-02-17 | 3 | 02 | REVISION 37 | |
| 1-02-17 | 4 | 02 | REVISION 37 | |
| 1-02-17 | 5 | 02 | REVISION 37 | |
| 1-02-17 | 6 | 02 | REVISION 37 | |
| 1-02-17 | 7 | 02 | REVISION 37 | |
| 1-02-17 | 8 | 02 | REVISION 37 | |
| 1-02-17 | 9 | 02 | REVISION 37 | |
| 1-02-17 | 10 | 02 | REVISION 37 | |
| 1-02-17 | 11 | 02 | REVISION 40 | |
| 1-02-17 | 12 | 02 | REVISION 40 | |
| 1-02-17 | 13 | 02 | REVISION 37 | |
| 1-02-17 | 14 | 02 | REVISION 37 | |
| 1-02-21 | 1 | 02 | REVISION 37 | FAA |
| 1-02-21 | 2 | 02 | REVISION 37 | |
| 1-02-21 | 3 | 02 | REVISION 37 | |
| 1-02-21 | 4 | 02 | REVISION 40 | |

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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-02-21 | 5 | 02 | | REVISION 37 | |
| 1-02-21 | 6 | 02 | | REVISION 37 | |
| 1-02-23 | 1 | 01 | | REVISION 42 | ALL |
| 1-02-23 | 2 | 01 | | REVISION 44 | |
| 1-02-23 | 3 | 01 | | REVISION 44 | |
| 1-02-23 | 4 | 01 | | REVISION 44 | |
| 1-02-29 | 1 | 01 | | REVISION 43 | ALL |
| 1-02-29 | 2 | 01 | | REVISION 44 | |
| 1-02-29 | 3 | 01 | | REVISION 44 | |
| 1-02-29 | 4 | 01 | | REVISION 44 | |
| 1-02-33 | 1 | 01 | | REVISION 41 | ALL |
| 1-02-33 | 2 | 01 | | REVISION 41 | |
| 1-02-33 | 3 | 01 | | REVISION 42 | |
| 1-02-33 | 4 | 01 | | REVISION 41 | |
| 1-02-37 | 1 | 01 | * | REVISION 46 | ALL |
| 1-02-37 | 2 | 01 | | REVISION 42 | |
| 1-02-40 | 1 | 01 | | REVISION 34 | ALL EXCEPT XR A1E |
| 1-02-40 | 2 | 01 | | REVISION 30 | |
| 1-02-45 | 1 | 02 | | REVISION 37 | All Except XR FAA ANAC |
| 1-02-45 | 2 | 02 | | REVISION 38 | |
| 1-02-49 | 1 | 01 | | REVISION 37 | ALL |
| 1-02-49 | 2 | 01 | | REVISION 37 | |
| 1-02-57 | 1 | 02 | | REVISION 37 | FAA |
| 1-02-57 | 2 | 02 | | REVISION 37 | |
| 1-02-57 | 3 | 02 | | REVISION 36 | |
| 1-02-57 | 4 | 02 | | REVISION 36 | |
| 1-02-61 | 1 | 01 | | REVISION 37 | ALL |
| 1-02-61 | 2 | 01 | | REVISION 37 | |
| 1-02-69 | 1 | 01 | | REVISION 43 | ALL |

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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-02-69 | 2 | 01 | | REVISION 43 | |
| 1-02-73 | 1 | 01 | | REVISION 42 | ALL |
| 1-02-73 | 2 | 01 | | REVISION 42 | |
| 1-02-73 | 3 | 01 | | REVISION 42 | |
| 1-02-73 | 4 | 01 | | REVISION 42 | |
| 1-02-77 | 1 | 01 | | REVISION 43 | Panel I |
| 1-02-77 | 2 | 01 | | REVISION 43 | |
| 1-02-77 | 1 | 02 | | REVISION 43 | Panel II |
| 1-02-77 | 2 | 02 | | REVISION 43 | |
| 1-02-78 | 1 | 01 | | REVISION 33 | ALL |
| 1-02-78 | 2 | 01 | | REVISION 33 | |
| 1-02-79 | 1 | 01 | | REVISION 41 | ALL |
| 1-02-79 | 2 | 01 | | REVISION 41 | |
| 1-02-79 | 3 | 01 | | REVISION 43 | |
| 1-02-79 | 4 | 01 | | REVISION 43 | |
| 1-02-79 | 5 | 01 | * | REVISION 46 | |
| 1-02-79 | 6 | 01 | | REVISION 41 | |
| 1-02-79 | 7 | 01 | | REVISION 41 | |
| 1-02-79 | 8 | 01 | | REVISION 41 | |
| 1-02-79 | 9 | 01 | | REVISION 41 | |
| 1-02-79 | 10 | 01 | | REVISION 41 | |
| 1-02-79 | 11 | 01 | | REVISION 41 | |
| 1-02-79 | 12 | 01 | | REVISION 42 | |
| 1-02-79 | 13 | 01 | | REVISION 41 | |
| 1-02-79 | 14 | 01 | | REVISION 41 | |
| 1-02-79 | 15 | 01 | | REVISION 41 | |
| 1-02-79 | 16 | 01 | | REVISION 41 | |
| 1-02-79 | 17 | 01 | | REVISION 41 | |
| 1-02-79 | 18 | 01 | | REVISION 41 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-02-79 | 19 | 01 | REVISION 42 | |
| 1-02-79 | 20 | 01 | REVISION 42 | |
| 1-02-79 | 21 | 01 | REVISION 41 | |
| 1-02-79 | 22 | 01 | REVISION 41 | |
| 1-02-79 | 23 | 01 | REVISION 41 | |
| 1-02-79 | 24 | 01 | REVISION 41 | |
| 1-02-79 | 25 | 01 | REVISION 41 | |
| 1-02-79 | 26 | 01 | REVISION 41 | |
| 1-02-79 | 27 | 01 | REVISION 41 | |
| 1-02-79 | 28 | 01 | REVISION 41 | |
| 1-02-79 | 29 | 01 | REVISION 41 | |
| 1-02-79 | 30 | 01 | REVISION 41 | |
| 1-02-79 | 31 | 01 | REVISION 41 | |
| 1-02-79 | 32 | 01 | REVISION 41 | |
| 1-02-79 | 33 | 01 | REVISION 44 | |
| 1-02-79 | 34 | 01 | REVISION 44 | |
| 1-02-79 | 35 | 01 | REVISION 44 | |
| 1-02-79 | 36 | 01 | REVISION 44 | |
| 1-02-80 | 1 | 01 | REVISION 45 | ANAC/FAA FMZ 2000 / FMZ 2010 FMS (NZ 6.1.1) |
| 1-02-80 | 2 | 01 | REVISION 45 | |
| 1-02-80 | 3 | 01 | REVISION 45 | |
| 1-02-80 | 4 | 01 | REVISION 45 | |
| 1-02-80 | 5 | 01 | REVISION 45 | |
| 1-02-80 | 6 | 01 | REVISION 45 | |
| 1-02-80 | 7 | 01 | REVISION 45 | |
| 1-02-80 | 8 | 01 | REVISION 45 | |
| 1-02-80 | 9 | 01 | REVISION 45 | |
| 1-02-80 | 10 | 01 | REVISION 45 | |
| 1-02-80 | 11 | 01 | REVISION 45 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-02-80 | 12 | 01 | REVISION 45 | |
| 1-02-80 | 13 | 01 | REVISION 45 | |
| 1-02-80 | 14 | 01 | REVISION 45 | |
| 1-02-80 | 15 | 01 | REVISION 45 | |
| 1-02-80 | 16 | 01 | REVISION 45 | |
| 1-02-80 | 17 | 01 | REVISION 45 | |
| 1-02-80 | 18 | 01 | REVISION 45 | |
| 1-02-80 | 19 | 01 | REVISION 45 | |
| 1-02-80 | 20 | 01 | REVISION 45 | |
| 1-02-80 | 21 | 01 | REVISION 45 | |
| 1-02-80 | 22 | 01 | REVISION 45 | |
| 1-02-80 | 23 | 01 | REVISION 45 | |
| 1-02-80 | 24 | 01 | REVISION 45 | |
| 1-02-80 | 25 | 01 | REVISION 45 | |
| 1-02-80 | 26 | 01 | REVISION 45 | |
| 1-02-80 | 27 | 01 | REVISION 45 | |
| 1-02-80 | 28 | 01 | REVISION 45 | |
| 1-02-80 | 29 | 01 | REVISION 45 | |
| 1-02-80 | 30 | 01 | REVISION 45 | |
| 1-02-80 | 1 | 02 | REVISION 44 | ANAC/FAA UNS-1K FMS |
| 1-02-80 | 2 | 02 | REVISION 44 | |
| 1-02-80 | 3 | 02 | REVISION 44 | |
| 1-02-80 | 4 | 02 | REVISION 44 | |
| 1-02-80 | 5 | 02 | REVISION 44 | |
| 1-02-80 | 6 | 02 | REVISION 44 | |
| 1-02-80 | 7 | 02 | REVISION 44 | |
| 1-02-80 | 8 | 02 | REVISION 44 | |
| 1-02-80 | 9 | 02 | REVISION 44 | |
| 1-02-80 | 10 | 02 | REVISION 44 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-02-80 | 11 | 02 | REVISION 44 | |
| 1-02-80 | 12 | 02 | REVISION 44 | |
| 1-02-80 | 13 | 02 | REVISION 44 | |
| 1-02-80 | 14 | 02 | REVISION 44 | |
| 1-02-80 | 15 | 02 | REVISION 44 | |
| 1-02-80 | 16 | 02 | REVISION 44 | |
| 1-02-80 | 17 | 02 | REVISION 44 | |
| 1-02-80 | 18 | 02 | REVISION 44 | |
| 1-02-80 | 19 | 02 | REVISION 44 | |
| 1-02-80 | 20 | 02 | REVISION 44 | |
| 1-02-80 | 21 | 02 | REVISION 44 | |
| 1-02-80 | 22 | 02 | REVISION 44 | |
| 1-02-80 | 23 | 02 | REVISION 44 | |
| 1-02-80 | 24 | 02 | REVISION 44 | |
| 1-02-80 | 25 | 02 | REVISION 44 | |
| 1-02-80 | 26 | 02 | REVISION 44 | |
| 1-02-81 | 1 | 01 | REVISION 44 | ALL |
| 1-02-81 | 2 | 01 | REVISION 42 | |
| 1-02-81 | 3 | 01 | REVISION 42 | |
| 1-02-81 | 4 | 01 | REVISION 42 | |
| 1-02-81 | 5 | 01 | REVISION 44 | |
| 1-02-81 | 6 | 01 | REVISION 42 | |
| 1-02-82 | 1 | 01 | REVISION 28 | ALL |
| 1-02-82 | 2 | 01 | REVISION 28 | |
| 1-02-83 | 1 | 02 | REVISION 42 | ANAC/FAA |
| 1-02-83 | 2 | 02 | REVISION 42 | |
| 1-02-83 | 3 | 02 | REVISION 42 | |
| 1-02-83 | 4 | 02 | REVISION 42 | |
| 1-02-85 | 1 | 01 | REVISION 39 | HGS |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-02-85 | 2 | 01 | REVISION 39 | |
| 1-02-85 | 3 | 01 | REVISION 39 | |
| 1-02-85 | 4 | 01 | REVISION 39 | |
| 1-02-85 | 5 | 01 | REVISION 39 | |
| 1-02-85 | 6 | 01 | REVISION 39 | |
| 1-02-85 | 7 | 01 | REVISION 39 | |
| 1-02-85 | 8 | 01 | REVISION 39 | |
| 1-02-87 | 1 | 01 | REVISION 41 | High Alt |
| 1-02-87 | 2 | 01 | REVISION 41 | |
| 1-02-92 | 1 | 01 | REVISION 31 | 8500 ft operation |
| 1-02-92 | 2 | 01 | REVISION 31 | |
| 1-02-94 | 1 | 01 | REVISION 39 | ALL |
| 1-02-94 | 2 | 01 | REVISION 39 | |
| 1-02-95 | 1 | 05 | REVISION 42 | ALL |
| 1-02-95 | 2 | 05 | REVISION 42 | |
| 1-02-95 | 3 | 05 | REVISION 42 | |
| 1-02-95 | 4 | 05 | REVISION 42 | |
| 1-02-95 | 5 | 05 | REVISION 42 | |
| 1-02-95 | 6 | 05 | REVISION 42 | |
| 1-02-95 | 7 | 05 | REVISION 42 | |
| 1-02-95 | 8 | 05 | REVISION 42 | |
| 1-02-95 | 9 | 05 | REVISION 42 | |
| 1-02-95 | 10 | 05 | REVISION 42 | |
| 1-02-95 | 11 | 05 | REVISION 42 | |
| 1-02-95 | 12 | 05 | REVISION 42 | |
| 1-02-95 | 13 | 05 | REVISION 42 | |
| 1-02-95 | 14 | 05 | REVISION 42 | |
| 1-02-95 | 15 | 05 | REVISION 42 | |
| 1-02-95 | 16 | 05 | REVISION 42 | |

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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-02-95 | 17 | 05 | | REVISION 42 | |
| 1-02-95 | 18 | 05 | | REVISION 42 | |
| 1-02-95 | 19 | 05 | | REVISION 42 | |
| 1-02-95 | 20 | 05 | | REVISION 42 | |
| 1-03-00 | 1 | 01 | | REVISION 39 | ANAC/FAA |
| 1-03-00 | 2 | 01 | | REVISION 39 | |
| 1-03-00 | 3 | 01 | | REVISION 39 | |
| 1-03-00 | 4 | 01 | | REVISION 39 | |
| 1-03-01 | 1 | 03 | | REVISION 40 | FAA |
| 1-03-01 | 2 | 03 | | REVISION 40 | |
| 1-03-02 | 1 | 03 | | REVISION 43 | FAA |
| 1-03-02 | 2 | 03 | | REVISION 43 | |
| 1-03-02 | 3 | 03 | | REVISION 44 | |
| 1-03-02 | 4 | 03 | | REVISION 43 | |
| 1-03-03 | 1 | 03 | | REVISION 40 | FAA |
| 1-03-03 | 2 | 03 | | REVISION 40 | |
| 1-03-03 | 3 | 03 | | REVISION 40 | |
| 1-03-03 | 4 | 03 | | REVISION 40 | |
| 1-03-05 | 1 | 03 | | REVISION 43 | FAA |
| 1-03-05 | 2 | 03 | | REVISION 43 | |
| 1-03-05 | 3 | 03 | | REVISION 43 | |
| 1-03-05 | 4 | 03 | | REVISION 43 | |
| 1-03-05 | 5 | 03 | * | REVISION 46 | |
| 1-03-05 | 6 | 03 | | REVISION 43 | |
| 1-03-07 | 1 | 03 | | REVISION 40 | 145 except XR FAA |
| 1-03-07 | 2 | 03 | | REVISION 36 | |
| 1-03-09 | 1 | 03 | | REVISION 40 | FAA |
| 1-03-09 | 2 | 03 | | REVISION 40 | |
| 1-03-11 | 1 | 03 | | REVISION 42 | FAA |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-03-11 | 2 | 03 | REVISION 42 | |
| 1-03-11 | 3 | 03 | REVISION 42 | |
| 1-03-11 | 4 | 03 | REVISION 42 | |
| 1-03-11 | 5 | 03 | REVISION 42 | |
| 1-03-11 | 6 | 03 | REVISION 42 | |
| 1-03-11 | 7 | 03 | REVISION 42 | |
| 1-03-11 | 8 | 03 | REVISION 42 | |
| 1-03-14 | 1 | 03 | REVISION 45 | FAA |
| 1-03-14 | 2 | 03 | REVISION 45 | |
| 1-03-20 | 1 | 03 | REVISION 40 | FAA |
| 1-03-20 | 2 | 03 | REVISION 40 | |
| 1-03-20 | 3 | 03 | REVISION 40 | |
| 1-03-20 | 4 | 03 | REVISION 40 | |
| 1-03-20 | 5 | 03 | REVISION 40 | |
| 1-03-20 | 6 | 03 | REVISION 40 | |
| 1-03-20 | 7 | 03 | REVISION 40 | |
| 1-03-20 | 8 | 03 | REVISION 40 | |
| 1-03-20 | 9 | 03 | REVISION 40 | |
| 1-03-20 | 10 | 03 | REVISION 40 | |
| 1-03-24 | 1 | 03 | REVISION 40 | FAA |
| 1-03-24 | 2 | 03 | REVISION 40 | |
| 1-03-24 | 3 | 03 | REVISION 40 | |
| 1-03-24 | 4 | 03 | REVISION 40 | |
| 1-03-26 | 1 | 03 | MAR 30, 2001 | FAA |
| 1-03-26 | 2 | 03 | MAR 30, 2001 | |
| 1-03-30 | 1 | 03 | REVISION 43 | FAA |
| 1-03-30 | 2 | 03 | REVISION 43 | |
| 1-03-30 | 3 | 03 | REVISION 43 | |
| 1-03-30 | 4 | 03 | REVISION 43 | |

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44



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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-03-35 | 1 | 03 | | REVISION 29 | FAA |
| 1-03-35 | 2 | 03 | | REVISION 17 | |
| 1-03-36 | 1 | 03 | * | REVISION 46 | FAA |
| 1-03-36 | 2 | 03 | * | REVISION 46 | |
| 1-03-37 | 1 | 03 | * | REVISION 46 | FAA |
| 1-03-37 | 2 | 03 | * | REVISION 46 | |
| 1-03-37 | 3 | 03 | * | REVISION 46 | |
| 1-03-37 | 4 | 03 | * | REVISION 46 | |
| 1-03-37 | 5 | 03 | * | REVISION 46 | |
| 1-03-37 | 6 | 03 | * | REVISION 46 | |
| 1-03-38 | 1 | 03 | | OCT 02, 2001 | FAA |
| 1-03-38 | 2 | 03 | | MAR 30, 2001 | |
| 1-03-39 | 1 | 03 | | REVISION 40 | FAA |
| 1-03-39 | 2 | 03 | | REVISION 40 | |
| 1-03-40 | 1 | 03 | | REVISION 40 | 145 FAA except XR |
| 1-03-40 | 2 | 03 | | REVISION 40 | |
| 1-03-40 | 3 | 03 | | REVISION 40 | |
| 1-03-40 | 4 | 03 | | REVISION 40 | |
| 1-03-41 | 1 | 03 | | REVISION 40 | FAA |
| 1-03-41 | 2 | 03 | | REVISION 40 | |
| 1-03-45 | 1 | 03 | | REVISION 43 | FAA |
| 1-03-45 | 2 | 03 | | REVISION 43 | |
| 1-03-45 | 3 | 03 | | REVISION 43 | |
| 1-03-45 | 4 | 03 | | REVISION 43 | |
| 1-03-45 | 5 | 03 | | REVISION 43 | |
| 1-03-45 | 6 | 03 | | REVISION 43 | |
| 1-03-45 | 7 | 03 | | REVISION 43 | |
| 1-03-45 | 8 | 03 | | REVISION 43 | |
| 1-03-45 | 9 | 03 | | REVISION 43 | |

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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-03-45 | 10 | 03 | | REVISION 43 | |
| 1-03-45 | 11 | 03 | | REVISION 43 | |
| 1-03-45 | 12 | 03 | | REVISION 43 | |
| 1-03-45 | 13 | 03 | | REVISION 43 | |
| 1-03-45 | 14 | 03 | | REVISION 43 | |
| 1-03-45 | 15 | 03 | | REVISION 43 | |
| 1-03-45 | 16 | 03 | | REVISION 43 | |
| 1-03-48 | 1 | 03 | | REVISION 42 | FAA |
| 1-03-48 | 2 | 03 | | REVISION 43 | |
| 1-03-48 | 3 | 03 | | REVISION 42 | |
| 1-03-48 | 4 | 03 | | REVISION 42 | |
| 1-03-48 | 5 | 03 | * | REVISION 46 | |
| 1-03-48 | 6 | 03 | | REVISION 42 | |
| 1-03-50 | 1 | 03 | * | REVISION 46 | FAA |
| 1-03-50 | 2 | 03 | * | REVISION 46 | |
| 1-03-50 | 3 | 03 | * | REVISION 46 | |
| 1-03-50 | 4 | 03 | * | REVISION 46 | |
| 1-03-50 | 5 | 03 | * | REVISION 46 | |
| 1-03-50 | 6 | 03 | * | REVISION 46 | |
| 1-03-50 | 7 | 03 | * | REVISION 46 | |
| 1-03-50 | 8 | 03 | * | REVISION 46 | |
| 1-03-53 | 1 | 03 | | REVISION 40 | FAA |
| 1-03-53 | 2 | 03 | | REVISION 40 | |
| 1-03-53 | 3 | 03 | | REVISION 40 | |
| 1-03-53 | 4 | 03 | | REVISION 40 | |
| 1-03-53 | 5 | 03 | | REVISION 40 | |
| 1-03-53 | 6 | 03 | | REVISION 40 | |
| 1-03-53 | 7 | 03 | | REVISION 40 | |
| 1-03-53 | 8 | 03 | | REVISION 40 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-03-56 | 1 | 03 | REVISION 41 | FAA |
| 1-03-56 | 2 | 03 | REVISION 41 | |
| 1-03-56 | 3 | 03 | REVISION 41 | |
| 1-03-56 | 4 | 03 | REVISION 41 | |
| 1-03-56 | 5 | 03 | REVISION 44 | |
| 1-03-56 | 6 | 03 | REVISION 41 | |
| 1-03-56 | 7 | 03 | REVISION 41 | |
| 1-03-56 | 8 | 03 | REVISION 41 | |
| 1-03-56 | 9 | 03 | REVISION 41 | |
| 1-03-56 | 10 | 03 | REVISION 41 | |
| 1-03-56 | 11 | 03 | REVISION 41 | |
| 1-03-56 | 12 | 03 | REVISION 41 | |
| 1-03-57 | 1 | 03 | REVISION 40 | FAA |
| 1-03-57 | 2 | 03 | REVISION 40 | |
| 1-03-57 | 3 | 03 | REVISION 40 | |
| 1-03-57 | 4 | 03 | REVISION 40 | |
| 1-03-57 | 5 | 03 | REVISION 40 | |
| 1-03-57 | 6 | 03 | REVISION 40 | |
| 1-03-57 | 7 | 03 | REVISION 40 | |
| 1-03-57 | 8 | 03 | REVISION 40 | |
| 1-03-58 | 1 | 03 | DEC 20, 2002 | FAA |
| 1-03-58 | 2 | 03 | MAR 30, 2001 | |
| 1-03-59 | 1 | 03 | REVISION 45 | FAA |
| 1-03-59 | 2 | 03 | REVISION 45 | |
| 1-03-59 | 3 | 03 | REVISION 45 | |
| 1-03-59 | 4 | 03 | REVISION 45 | |
| 1-03-59 | 5 | 03 | REVISION 45 | |
| 1-03-59 | 6 | 03 | REVISION 45 | |
| 1-03-59 | 7 | 03 | REVISION 45 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-03-59 | 8 | 03 | REVISION 45 | |
| 1-03-59 | 9 | 03 | REVISION 45 | |
| 1-03-59 | 10 | 03 | REVISION 45 | |
| 1-03-59 | 11 | 03 | REVISION 45 | |
| 1-03-59 | 12 | 03 | REVISION 45 | |
| 1-03-59 | 13 | 03 | REVISION 45 | |
| 1-03-59 | 14 | 03 | REVISION 45 | |
| 1-03-59 | 15 | 03 | REVISION 45 | |
| 1-03-59 | 16 | 03 | REVISION 45 | |
| 1-03-59 | 17 | 03 | REVISION 45 | |
| 1-03-59 | 18 | 03 | REVISION 45 | |
| 1-03-60 | 1 | 03 | DEC 20, 2002 | FAA |
| 1-03-60 | 2 | 03 | MAR 30, 2001 | |
| 1-03-65 | 1 | 03 | REVISION 25 | FAA |
| 1-03-65 | 2 | 03 | REVISION 25 | |
| 1-03-65 | 3 | 03 | REVISION 31 | |
| 1-03-65 | 4 | 03 | REVISION 25 | |
| 1-03-66 | 1 | 01 | REVISION 40 | HGS |
| 1-03-66 | 2 | 01 | REVISION 40 | |
| 1-03-70 | 1 | 03 | REVISION 43 | FAA |
| 1-03-70 | 2 | 03 | REVISION 43 | |
| 1-03-70 | 3 | 03 | REVISION 43 | |
| 1-03-70 | 4 | 03 | REVISION 43 | |
| 1-03-70 | 5 | 03 | REVISION 43 | |
| 1-03-70 | 6 | 03 | REVISION 43 | |
| 1-03-70 | 7 | 03 | REVISION 43 | |
| 1-03-70 | 8 | 03 | REVISION 43 | |
| 1-03-70 | 9 | 03 | REVISION 43 | |
| 1-03-70 | 10 | 03 | REVISION 43 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-03-70 | 11 | 03 | REVISION 43 | |
| 1-03-70 | 12 | 03 | REVISION 43 | |
| 1-03-70 | 13 | 03 | REVISION 43 | |
| 1-03-70 | 14 | 03 | REVISION 43 | |
| 1-03-70 | 15 | 03 | REVISION 43 | |
| 1-03-70 | 16 | 03 | REVISION 43 | |
| 1-03-70 | 17 | 03 | REVISION 43 | |
| 1-03-70 | 18 | 03 | REVISION 43 | |
| 1-03-70 | 19 | 03 | REVISION 43 | |
| 1-03-70 | 20 | 03 | REVISION 43 | |
| 1-03-70 | 21 | 03 | REVISION 43 | |
| 1-03-70 | 22 | 03 | REVISION 43 | |
| 1-03-70 | 23 | 03 | REVISION 43 | |
| 1-03-70 | 24 | 03 | REVISION 43 | |
| 1-03-70 | 25 | 03 | REVISION 43 | |
| 1-03-70 | 26 | 03 | REVISION 43 | |
| 1-03-70 | 27 | 03 | REVISION 43 | |
| 1-03-70 | 28 | 03 | REVISION 43 | |
| 1-03-70 | 29 | 03 | REVISION 43 | |
| 1-03-70 | 30 | 03 | REVISION 43 | |
| 1-03-70 | 31 | 03 | REVISION 43 | |
| 1-03-70 | 32 | 03 | REVISION 43 | |
| 1-03-70 | 33 | 03 | REVISION 43 | |
| 1-03-70 | 34 | 03 | REVISION 43 | |
| 1-03-70 | 35 | 03 | REVISION 43 | |
| 1-03-70 | 36 | 03 | REVISION 43 | |
| 1-03-70 | 37 | 03 | REVISION 43 | |
| 1-03-70 | 38 | 03 | REVISION 43 | |
| 1-03-70 | 39 | 03 | REVISION 43 | |
| 1-03-70 | 40 | 03 | REVISION 43 | |

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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-03-70 | 41 | 03 | | REVISION 43 | |
| 1-03-70 | 42 | 03 | | REVISION 43 | |
| 1-03-70 | 43 | 03 | | REVISION 43 | |
| 1-03-70 | 44 | 03 | | REVISION 43 | |
| 1-03-70 | 45 | 03 | | REVISION 43 | |
| 1-03-70 | 46 | 03 | | REVISION 43 | |
| 1-03-70 | 47 | 03 | | REVISION 43 | |
| 1-03-70 | 48 | 03 | | REVISION 43 | |
| 1-03-95 | 1 | 03 | | SEP 29, 2000 | FAA |
| 1-03-95 | 2 | 03 | | SEP 29, 2000 | |
| 1-03-95 | 3 | 03 | | SEP 29, 2000 | |
| 1-03-95 | 4 | 03 | | APR 28, 2000 | |
| 1-03-97 | 1 | 01 | | REVISION 42 | ALL |
| 1-03-97 | 2 | 01 | | REVISION 42 | |
| 1-03-97 | 3 | 01 | | REVISION 42 | |
| 1-03-97 | 4 | 01 | | REVISION 42 | |
| 1-04-00 | 1 | 01 | | REVISION 26 | ALL |
| 1-04-00 | 2 | 01 | | REVISION 13 | |
| 1-04-03 | 1 | 01 | | REVISION 43 | Noise Levels |
| 1-04-03 | 2 | 01 | | REVISION 43 | |
| 1-04-03 | 3 | 01 | | REVISION 43 | |
| 1-04-03 | 4 | 01 | | REVISION 43 | |
| 1-04-05 | 1 | 01 | * | REVISION 46 | ALL |
| 1-04-05 | 2 | 01 | * | REVISION 46 | |
| 1-04-05 | 3 | 01 | * | REVISION 46 | |
| 1-04-05 | 4 | 01 | * | REVISION 46 | |
| 1-04-05 | 5 | 01 | * | REVISION 46 | |
| 1-04-05 | 6 | 01 | * | REVISION 46 | |
| 1-04-10 | 1 | 01 | | REVISION 27 | 145 A1 |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-04-10 | 2 | 01 | REVISION 27 | |
| 1-04-10 | 3 | 01 | REVISION 27 | |
| 1-04-10 | 4 | 01 | REVISION 27 | |
| 1-04-10 | 5 | 01 | REVISION 27 | |
| 1-04-10 | 6 | 01 | REVISION 27 | |
| 1-04-10 | 7 | 01 | REVISION 27 | |
| 1-04-10 | 8 | 01 | REVISION 27 | |
| 1-04-10 | 9 | 01 | REVISION 27 | |
| 1-04-10 | 10 | 01 | REVISION 27 | |
| 1-04-10 | 11 | 01 | REVISION 27 | |
| 1-04-10 | 12 | 01 | REVISION 28 | |
| 1-04-10 | 13 | 01 | REVISION 27 | |
| 1-04-10 | 14 | 01 | REVISION 27 | |
| 1-04-10 | 15 | 01 | REVISION 27 | |
| 1-04-10 | 16 | 01 | REVISION 27 | |
| 1-04-10 | 17 | 01 | REVISION 27 | |
| 1-04-10 | 18 | 01 | REVISION 27 | |
| 1-04-10 | 19 | 01 | REVISION 27 | |
| 1-04-10 | 20 | 01 | REVISION 27 | |
| 1-04-10 | 21 | 01 | REVISION 27 | |
| 1-04-10 | 22 | 01 | REVISION 27 | |
| 1-04-10 | 23 | 01 | REVISION 27 | |
| 1-04-10 | 24 | 01 | REVISION 27 | |
| 1-04-10 | 25 | 01 | REVISION 27 | |
| 1-04-10 | 26 | 01 | REVISION 27 | |
| 1-04-15 | 1 | 02 | REVISION 20 | 145 A1 FAA lb |
| 1-04-15 | 2 | 02 | REVISION 32 | |
| 1-04-15 | 3 | 02 | REVISION 32 | |
| 1-04-15 | 4 | 02 | REVISION 32 | |
| 1-04-15 | 5 | 02 | REVISION 32 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-04-15 | 6 | 02 | REVISION 26 | |
| 1-04-15 | 7 | 02 | REVISION 28 | |
| 1-04-15 | 8 | 02 | REVISION 28 | |
| 1-04-15 | 9 | 02 | REVISION 28 | |
| 1-04-15 | 10 | 02 | REVISION 28 | |
| 1-04-15 | 11 | 02 | REVISION 28 | |
| 1-04-15 | 12 | 02 | REVISION 28 | |
| 1-04-15 | 13 | 02 | REVISION 28 | |
| 1-04-15 | 14 | 02 | REVISION 28 | |
| 1-04-15 | 15 | 02 | REVISION 28 | |
| 1-04-15 | 16 | 02 | REVISION 28 | |
| 1-04-15 | 17 | 02 | REVISION 28 | |
| 1-04-15 | 18 | 02 | REVISION 28 | |
| 1-04-20 | 1 | 02 | REVISION 42 | 145 lb |
| 1-04-20 | 2 | 02 | REVISION 42 | |
| 1-04-20 | 3 | 02 | REVISION 42 | |
| 1-04-20 | 4 | 02 | REVISION 42 | |
| 1-04-20 | 5 | 02 | REVISION 42 | |
| 1-04-20 | 6 | 02 | REVISION 42 | |
| 1-04-20 | 7 | 02 | REVISION 42 | |
| 1-04-20 | 8 | 02 | REVISION 42 | |
| 1-04-20 | 9 | 02 | REVISION 42 | |
| 1-04-20 | 10 | 02 | REVISION 42 | |
| 1-04-20 | 11 | 02 | REVISION 42 | |
| 1-04-20 | 12 | 02 | REVISION 42 | |
| 1-04-20 | 13 | 02 | REVISION 42 | |
| 1-04-20 | 14 | 02 | REVISION 42 | |
| 1-04-20 | 15 | 02 | REVISION 42 | |
| 1-04-20 | 16 | 02 | REVISION 42 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-04-20 | 17 | 02 | REVISION 42 | |
| 1-04-20 | 18 | 02 | REVISION 42 | |
| 1-04-20 | 19 | 02 | REVISION 42 | |
| 1-04-20 | 20 | 02 | REVISION 42 | |
| 1-04-20 | 21 | 02 | REVISION 42 | |
| 1-04-20 | 22 | 02 | REVISION 42 | |
| 1-04-20 | 23 | 02 | REVISION 42 | |
| 1-04-20 | 24 | 02 | REVISION 42 | |
| 1-04-25 | 1 | 02 | REVISION 36 | 145 A1 FAA lb |
| 1-04-25 | 2 | 02 | REVISION 36 | |
| 1-04-25 | 3 | 02 | REVISION 39 | |
| 1-04-25 | 4 | 02 | REVISION 36 | |
| 1-04-30 | 1 | 02 | REVISION 41 | 135/145 FAA lb |
| 1-04-30 | 2 | 02 | REVISION 41 | |
| 1-04-30 | 3 | 02 | REVISION 41 | |
| 1-04-30 | 4 | 02 | REVISION 41 | |
| 1-04-30 | 5 | 02 | REVISION 41 | |
| 1-04-30 | 6 | 02 | REVISION 41 | |
| 1-04-30 | 7 | 02 | REVISION 41 | |
| 1-04-30 | 8 | 02 | REVISION 41 | |
| 1-04-30 | 9 | 02 | REVISION 41 | |
| 1-04-30 | 10 | 02 | REVISION 41 | |
| 1-04-30 | 11 | 02 | REVISION 41 | |
| 1-04-30 | 12 | 02 | REVISION 41 | |
| 1-04-30 | 13 | 02 | REVISION 41 | |
| 1-04-30 | 14 | 02 | REVISION 41 | |
| 1-04-30 | 15 | 02 | REVISION 41 | |
| 1-04-30 | 16 | 02 | REVISION 41 | |
| 1-04-30 | 17 | 02 | REVISION 41 | |
| 1-04-30 | 18 | 02 | REVISION 43 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-04-30 | 19 | 02 | REVISION 43 | |
| 1-04-30 | 20 | 02 | REVISION 41 | |
| 1-04-30 | 21 | 02 | REVISION 41 | |
| 1-04-30 | 22 | 02 | REVISION 41 | |
| 1-04-30 | 23 | 02 | REVISION 41 | |
| 1-04-30 | 24 | 02 | REVISION 41 | |
| 1-04-30 | 25 | 02 | REVISION 41 | |
| 1-04-30 | 26 | 02 | REVISION 41 | |
| 1-04-30 | 27 | 02 | REVISION 41 | |
| 1-04-30 | 28 | 02 | REVISION 41 | |
| 1-04-30 | 29 | 02 | REVISION 41 | |
| 1-04-30 | 30 | 02 | REVISION 41 | |
| 1-04-30 | 31 | 02 | REVISION 41 | |
| 1-04-30 | 32 | 02 | REVISION 41 | |
| 1-04-30 | 33 | 02 | REVISION 41 | |
| 1-04-30 | 34 | 02 | REVISION 41 | |
| 1-04-30 | 35 | 02 | REVISION 41 | |
| 1-04-30 | 36 | 02 | REVISION 41 | |
| 1-04-30 | 37 | 02 | REVISION 41 | |
| 1-04-30 | 38 | 02 | REVISION 41 | |
| 1-04-30 | 39 | 02 | REVISION 41 | |
| 1-04-30 | 40 | 02 | REVISION 41 | |
| 1-04-30 | 41 | 02 | REVISION 41 | |
| 1-04-30 | 42 | 02 | REVISION 41 | |
| 1-04-30 | 43 | 02 | REVISION 41 | |
| 1-04-30 | 44 | 02 | REVISION 41 | |
| 1-04-30 | 45 | 02 | REVISION 41 | |
| 1-04-30 | 46 | 02 | REVISION 41 | |
| 1-04-30 | 47 | 02 | REVISION 41 | |
| 1-04-30 | 48 | 02 | REVISION 41 | |

* Asterisk indicates pages revised, added or deleted by the current revision.

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-04-30 | 49 | 02 | REVISION 41 | |
| 1-04-30 | 50 | 02 | REVISION 41 | |
| 1-04-30 | 51 | 02 | REVISION 41 | |
| 1-04-30 | 52 | 02 | REVISION 41 | |
| 1-04-30 | 53 | 02 | REVISION 41 | |
| 1-04-30 | 54 | 02 | REVISION 41 | |
| 1-04-30 | 55 | 02 | REVISION 41 | |
| 1-04-30 | 56 | 02 | REVISION 41 | |
| 1-04-30 | 57 | 02 | REVISION 41 | |
| 1-04-30 | 58 | 02 | REVISION 41 | |
| 1-04-30 | 59 | 02 | REVISION 41 | |
| 1-04-30 | 60 | 02 | REVISION 41 | |
| 1-04-30 | 61 | 02 | REVISION 41 | |
| 1-04-30 | 62 | 02 | REVISION 41 | |
| 1-04-30 | 63 | 02 | REVISION 41 | |
| 1-04-30 | 64 | 02 | REVISION 41 | |
| 1-05-00 | 1 | 01 | REVISION 36 | ALL |
| 1-05-00 | 2 | 01 | REVISION 36 | |
| 1-05-05 | 1 | 02 | REVISION 42 | 145 A1 and A1P lb |
| 1-05-05 | 2 | 02 | REVISION 42 | |
| 1-05-05 | 3 | 02 | REVISION 42 | |
| 1-05-05 | 4 | 02 | REVISION 42 | |
| 1-05-05 | 5 | 02 | REVISION 42 | |
| 1-05-05 | 6 | 02 | REVISION 42 | |
| 1-05-05 | 7 | 02 | REVISION 42 | |
| 1-05-05 | 8 | 02 | REVISION 42 | |
| 1-05-05 | 9 | 02 | REVISION 42 | |
| 1-05-05 | 10 | 02 | REVISION 42 | |
| 1-05-05 | 11 | 02 | REVISION 42 | |
| 1-05-05 | 12 | 02 | REVISION 42 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-05-05 | 13 | 02 | REVISION 42 | |
| 1-05-05 | 14 | 02 | REVISION 42 | |
| 1-05-05 | 15 | 02 | REVISION 42 | |
| 1-05-05 | 16 | 02 | REVISION 42 | |
| 1-05-07 | 1 | 02 | DEC 20, 2002 | lb |
| 1-05-07 | 2 | 02 | DEC 20, 2002 | |
| 1-05-10 | 1 | 02 | REVISION 40 | 145 A1 and A1P lb |
| 1-05-10 | 2 | 02 | REVISION 40 | |
| 1-05-10 | 3 | 02 | REVISION 40 | |
| 1-05-10 | 4 | 02 | REVISION 40 | |
| 1-05-10 | 5 | 02 | REVISION 40 | |
| 1-05-10 | 6 | 02 | REVISION 40 | |
| 1-05-10 | 7 | 02 | REVISION 40 | |
| 1-05-10 | 8 | 02 | REVISION 40 | |
| 1-05-10 | 9 | 02 | REVISION 40 | |
| 1-05-10 | 10 | 02 | REVISION 40 | |
| 1-05-10 | 11 | 02 | REVISION 40 | |
| 1-05-10 | 12 | 02 | REVISION 40 | |
| 1-05-10 | 13 | 02 | REVISION 40 | |
| 1-05-10 | 14 | 02 | REVISION 40 | |
| 1-05-10 | 15 | 02 | REVISION 40 | |
| 1-05-10 | 16 | 02 | REVISION 40 | |
| 1-05-10 | 17 | 02 | REVISION 40 | |
| 1-05-10 | 18 | 02 | REVISION 40 | |
| 1-05-10 | 19 | 02 | REVISION 40 | |
| 1-05-10 | 20 | 02 | REVISION 40 | |
| 1-05-10 | 21 | 02 | REVISION 40 | |
| 1-05-10 | 22 | 02 | REVISION 40 | |
| 1-05-15 | 1 | 02 | REVISION 40 | 145 A1 and A1P lb |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-05-15 | 2 | 02 | REVISION 40 | |
| 1-05-15 | 3 | 02 | REVISION 40 | |
| 1-05-15 | 4 | 02 | REVISION 40 | |
| 1-05-15 | 5 | 02 | REVISION 40 | |
| 1-05-15 | 6 | 02 | REVISION 40 | |
| 1-05-15 | 7 | 02 | REVISION 40 | |
| 1-05-15 | 8 | 02 | REVISION 40 | |
| 1-05-15 | 9 | 02 | REVISION 40 | |
| 1-05-15 | 10 | 02 | REVISION 40 | |
| 1-05-15 | 11 | 02 | REVISION 40 | |
| 1-05-15 | 12 | 02 | REVISION 40 | |
| 1-05-15 | 13 | 02 | REVISION 40 | |
| 1-05-15 | 14 | 02 | REVISION 40 | |
| 1-05-15 | 15 | 02 | REVISION 40 | |
| 1-05-15 | 16 | 02 | REVISION 40 | |
| 1-05-15 | 17 | 02 | REVISION 40 | |
| 1-05-15 | 18 | 02 | REVISION 40 | |
| 1-05-15 | 19 | 02 | REVISION 40 | |
| 1-05-15 | 20 | 02 | REVISION 40 | |
| 1-05-15 | 21 | 02 | REVISION 40 | |
| 1-05-15 | 22 | 02 | REVISION 40 | |
| 1-05-20 | 1 | 02 | REVISION 40 | 145 A1 and A1P lb |
| 1-05-20 | 2 | 02 | REVISION 40 | |
| 1-05-20 | 3 | 02 | REVISION 40 | |
| 1-05-20 | 4 | 02 | REVISION 40 | |
| 1-05-25 | 1 | 02 | REVISION 40 | 145 A1 and A1P lb |
| 1-05-25 | 2 | 02 | REVISION 40 | |
| 1-05-25 | 3 | 02 | REVISION 40 | |
| 1-05-25 | 4 | 02 | REVISION 40 | |
| 1-05-25 | 5 | 02 | REVISION 40 | |

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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 1-05-25 | 6 | 02 | | REVISION 40 | |
| 1-05-25 | 7 | 02 | | REVISION 40 | |
| 1-05-25 | 8 | 02 | | REVISION 40 | |
| 1-05-30 | 1 | 03 | * | REVISION 46 | 145 A1 and A1P FAA |
| 1-05-30 | 2 | 03 | * | REVISION 46 | |
| 1-05-30 | 3 | 03 | * | REVISION 46 | |
| 1-05-30 | 4 | 03 | * | REVISION 46 | |
| 1-05-30 | 5 | 03 | * | REVISION 46 | |
| 1-05-30 | 6 | 03 | * | REVISION 46 | |
| 1-05-30 | 7 | 03 | * | REVISION 46 | |
| 1-05-30 | 8 | 03 | * | REVISION 46 | |
| 1-05-30 | 9 | 03 | * | REVISION 46 | |
| 1-05-30 | 10 | 03 | * | REVISION 46 | |
| 1-05-30 | 11 | 03 | * | REVISION 46 | |
| 1-05-30 | 12 | 03 | * | REVISION 46 | |
| 1-05-30 | 13 | 03 | * | REVISION 46 | |
| 1-05-30 | 14 | 03 | * | REVISION 46 | |
| 1-05-30 | 15 | 03 | * | REVISION 46 | |
| 1-05-30 | 16 | 03 | * | REVISION 46 | |
| 1-05-35 | 1 | 02 | | REVISION 39 | 145 A1, A1P Ib |
| 1-05-35 | 2 | 02 | | REVISION 39 | |
| 1-05-35 | 3 | 02 | | REVISION 39 | |
| 1-05-35 | 4 | 02 | | REVISION 39 | |
| 1-05-35 | 5 | 02 | | REVISION 39 | |
| 1-05-35 | 6 | 02 | | REVISION 39 | |
| 1-05-35 | 7 | 02 | | REVISION 39 | |
| 1-05-35 | 8 | 02 | | REVISION 39 | |
| 1-05-35 | 9 | 02 | | REVISION 39 | |
| 1-05-35 | 10 | 02 | | REVISION 39 | |

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User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-05-35 | 11 | 02 | REVISION 39 | |
| 1-05-35 | 12 | 02 | REVISION 39 | |
| 1-05-35 | 13 | 02 | REVISION 39 | |
| 1-05-35 | 14 | 02 | REVISION 39 | |
| 1-05-35 | 15 | 02 | REVISION 39 | |
| 1-05-35 | 16 | 02 | REVISION 39 | |
| 1-05-35 | 17 | 02 | REVISION 39 | |
| 1-05-35 | 18 | 02 | REVISION 39 | |
| 1-05-35 | 19 | 02 | REVISION 39 | |
| 1-05-35 | 20 | 02 | REVISION 39 | |
| 1-05-35 | 21 | 02 | REVISION 39 | |
| 1-05-35 | 22 | 02 | REVISION 39 | |
| 1-05-35 | 23 | 02 | REVISION 39 | |
| 1-05-35 | 24 | 02 | REVISION 39 | |
| 1-05-35 | 25 | 02 | REVISION 39 | |
| 1-05-35 | 26 | 02 | REVISION 39 | |
| 1-05-40 | 1 | 02 | MAR 28, 2002 | 145 A1, A1P lb |
| 1-05-40 | 2 | 02 | MAR 28, 2002 | |
| 1-05-40 | 3 | 02 | MAR 28, 2002 | |
| 1-05-40 | 4 | 02 | MAR 28, 2002 | |
| 1-05-40 | 5 | 02 | MAR 28, 2002 | |
| 1-05-40 | 6 | 02 | MAR 28, 2002 | |
| 1-05-40 | 7 | 02 | MAR 28, 2002 | |
| 1-05-40 | 8 | 02 | MAR 28, 2002 | |
| 1-05-40 | 9 | 02 | MAR 28, 2002 | |
| 1-05-40 | 10 | 02 | MAR 28, 2002 | |
| 1-05-40 | 11 | 02 | MAR 28, 2002 | |
| 1-05-40 | 12 | 02 | MAR 28, 2002 | |
| 1-05-40 | 13 | 02 | MAR 28, 2002 | |
| 1-05-40 | 14 | 02 | MAR 28, 2002 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-05-40 | 15 | 02 | MAR 28, 2002 | |
| 1-05-40 | 16 | 02 | MAR 28, 2002 | |
| 1-05-40 | 17 | 02 | MAR 28, 2002 | |
| 1-05-40 | 18 | 02 | MAR 28, 2002 | |
| 1-05-40 | 19 | 02 | MAR 28, 2002 | |
| 1-05-40 | 20 | 02 | MAR 28, 2002 | |
| 1-05-45 | 1 | 06 | REVISION 39 | 145 A1 and A1P FAA lb |
| 1-05-45 | 2 | 06 | REVISION 39 | |
| 1-05-45 | 3 | 06 | REVISION 39 | |
| 1-05-45 | 4 | 06 | REVISION 39 | |
| 1-05-45 | 5 | 06 | REVISION 39 | |
| 1-05-45 | 6 | 06 | REVISION 39 | |
| 1-05-45 | 7 | 06 | REVISION 39 | |
| 1-05-45 | 8 | 06 | REVISION 39 | |
| 1-05-50 | 1 | 02 | REVISION 38 | 145 A1 and A1P FAA lb |
| 1-05-50 | 2 | 02 | REVISION 38 | |
| 1-05-50 | 3 | 02 | REVISION 38 | |
| 1-05-50 | 4 | 02 | REVISION 38 | |
| 1-05-50 | 5 | 02 | REVISION 38 | |
| 1-05-50 | 6 | 02 | REVISION 38 | |
| 1-05-50 | 7 | 02 | REVISION 38 | |
| 1-05-50 | 8 | 02 | REVISION 38 | |
| 1-05-50 | 9 | 02 | REVISION 38 | |
| 1-05-50 | 10 | 02 | REVISION 38 | |
| 1-05-50 | 11 | 02 | REVISION 38 | |
| 1-05-50 | 12 | 02 | REVISION 38 | |
| 1-05-50 | 13 | 02 | REVISION 38 | |
| 1-05-50 | 14 | 02 | REVISION 38 | |
| 1-05-50 | 15 | 02 | REVISION 38 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-05-50 | 16 | 02 | REVISION 38 | |
| 1-05-50 | 17 | 02 | REVISION 38 | |
| 1-05-50 | 18 | 02 | REVISION 38 | |
| 1-05-50 | 19 | 02 | REVISION 38 | |
| 1-05-50 | 20 | 02 | REVISION 38 | |
| 1-05-50 | 21 | 02 | REVISION 38 | |
| 1-05-50 | 22 | 02 | REVISION 38 | |
| 1-06-00 | 1 | 01 | REVISION 34 | ALL |
| 1-06-00 | 2 | 01 | REVISION 17 | |
| 1-06-10 | 1 | 01 | SEP 20, 1999 | ALL |
| 1-06-10 | 2 | 01 | SEP 20, 1999 | |
| 1-06-10 | 3 | 01 | SEP 20, 1999 | |
| 1-06-10 | 4 | 01 | SEP 20, 1999 | |
| 1-06-15 | 1 | 02 | REVISION 37 | 135/140/145 lb |
| 1-06-15 | 2 | 02 | REVISION 37 | |
| 1-06-15 | 3 | 02 | REVISION 37 | |
| 1-06-15 | 4 | 02 | REVISION 37 | |
| 1-06-15 | 5 | 02 | REVISION 37 | |
| 1-06-15 | 6 | 02 | REVISION 37 | |
| 1-06-15 | 7 | 02 | REVISION 37 | |
| 1-06-15 | 8 | 02 | REVISION 39 | |
| 1-06-15 | 9 | 02 | REVISION 37 | |
| 1-06-15 | 10 | 02 | REVISION 37 | |
| 1-06-15 | 11 | 02 | REVISION 37 | |
| 1-06-15 | 12 | 02 | REVISION 38 | |
| 1-06-15 | 13 | 02 | REVISION 38 | |
| 1-06-15 | 14 | 02 | REVISION 37 | |
| 1-06-30 | 1 | 02 | REVISION 42 | lb |
| 1-06-30 | 2 | 02 | REVISION 42 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-06-30 | 3 | 02 | REVISION 42 | |
| 1-06-30 | 4 | 02 | REVISION 42 | |
| 1-06-30 | 5 | 02 | REVISION 42 | |
| 1-06-30 | 6 | 02 | REVISION 42 | |
| 1-06-30 | 7 | 02 | REVISION 42 | |
| 1-06-30 | 8 | 02 | REVISION 42 | |
| 1-06-30 | 9 | 02 | REVISION 42 | |
| 1-06-30 | 10 | 02 | REVISION 42 | |
| 1-06-30 | 11 | 02 | REVISION 42 | |
| 1-06-30 | 12 | 02 | REVISION 42 | |
| 1-06-30 | 13 | 02 | REVISION 42 | |
| 1-06-30 | 14 | 02 | REVISION 42 | |
| 1-06-40 | 1 | 03 | REVISION 31 | FAA lb |
| 1-06-40 | 2 | 03 | REVISION 29 | |
| 1-06-40 | 3 | 03 | REVISION 29 | |
| 1-06-40 | 4 | 03 | REVISION 29 | |
| 1-06-40 | 5 | 03 | REVISION 29 | |
| 1-06-40 | 6 | 03 | REVISION 29 | |
| 1-06-40 | 7 | 03 | REVISION 29 | |
| 1-06-40 | 8 | 03 | REVISION 29 | |
| 1-06-40 | 9 | 03 | REVISION 29 | |
| 1-06-40 | 10 | 03 | REVISION 29 | |
| 1-06-40 | 11 | 03 | REVISION 29 | |
| 1-06-40 | 12 | 03 | REVISION 29 | |
| 1-06-40 | 13 | 03 | REVISION 29 | |
| 1-06-40 | 14 | 03 | REVISION 29 | |
| 1-06-40 | 15 | 03 | REVISION 29 | |
| 1-06-40 | 16 | 03 | REVISION 29 | |
| 1-06-40 | 17 | 03 | REVISION 29 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-06-40 | 18 | 03 | REVISION 29 | |
| 1-06-40 | 19 | 03 | REVISION 29 | |
| 1-06-40 | 20 | 03 | REVISION 29 | |
| 1-06-40 | 21 | 03 | REVISION 29 | |
| 1-06-40 | 22 | 03 | REVISION 29 | |
| 1-06-40 | 23 | 03 | REVISION 29 | |
| 1-06-40 | 24 | 03 | REVISION 29 | |
| 1-06-50 | 1 | 01 | SEP 20, 1999 | Balance Chart |
| 1-06-50 | 2 | 01 | SEP 20, 1999 | |
| 1-06-50 | 3 | 01 | JUN 28, 2002 | |
| 1-06-50 | 4 | 01 | SEP 20, 1999 | |
| 1-07-00 | 1 | 01 | REVISION 38 | ALL |
| 1-07-00 | 2 | 01 | REVISION 38 | |
| 1-07-10 | 1 | 40 | REVISION 23 | 145 |
| 1-07-10 | 2 | 40 | REVISION 26 | |
| 1-07-10 | 3 | 40 | MAR 30, 2001 | |
| 1-07-10 | 4 | 40 | JUN 28, 2002 | |
| 1-07-20 | 1 | 01 | SEP 20, 1999 | ALL |
| 1-07-20 | 2 | 01 | SEP 20, 1999 | |
| 1-07-30 | 1 | 41 | REVISION 38 | 145 Interior 1A |
| 1-07-30 | 2 | 41 | REVISION 38 | |
| 1-07-30 | 1 | 42 | REVISION 37 | 145 Interior 2 |
| 1-07-30 | 2 | 42 | REVISION 37 | |
| 1-07-30 | 1 | 43 | REVISION 38 | 145 Interior 3 |
| 1-07-30 | 2 | 43 | REVISION 38 | |
| 1-07-30 | 1 | 44 | REVISION 37 | 145 Interior 4 |
| 1-07-30 | 2 | 44 | REVISION 37 | |
| 1-07-30 | 1 | 45 | REVISION 38 | 145 Interior 5 |
| 1-07-30 | 2 | 45 | REVISION 38 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-07-30 | 1 | 46 | REVISION 42 | 145 Interior 6 |
| 1-07-30 | 2 | 46 | REVISION 42 | |
| 1-07-30 | 1 | 47 | REVISION 38 | 145 Interior Std |
| 1-07-30 | 2 | 47 | REVISION 38 | |
| 1-07-30 | 1 | 48 | REVISION 26 | 145 BAF corporate |
| 1-07-30 | 2 | 48 | REVISION 25 | |
| 1-07-30 | 3 | 48 | REVISION 26 | |
| 1-07-30 | 4 | 48 | REVISION 26 | |
| 1-07-30 | 1 | 49 | REVISION 26 | 145 BAF shuttle |
| 1-07-30 | 2 | 49 | REVISION 26 | |
| 1-07-30 | 1 | 50 | REVISION 26 | 145 BAF medevac |
| 1-07-30 | 2 | 50 | REVISION 26 | |
| 1-07-30 | 3 | 50 | REVISION 26 | |
| 1-07-30 | 4 | 50 | REVISION 26 | |
| 1-07-30 | 1 | 61 | REVISION 38 | 145 Interior 4A |
| 1-07-30 | 2 | 61 | REVISION 38 | |
| 1-07-30 | 1 | 70 | REVISION 36 | 145 Interior 1 +145 XR |
| 1-07-30 | 2 | 70 | REVISION 36 | |
| 1-07-30 | 3 | 70 | REVISION 36 | |
| 1-07-30 | 4 | 70 | REVISION 36 | |
| 1-07-30 | 1 | 71 | REVISION 38 | 145 Interior 1B |
| 1-07-30 | 2 | 71 | REVISION 38 | |
| 1-07-30 | 1 | 72 | REVISION 38 | 145 Interior XZ |
| 1-07-30 | 2 | 72 | REVISION 38 | |
| 1-07-30 | 1 | 73 | REVISION 38 | 145 Interior CZ |
| 1-07-30 | 2 | 73 | REVISION 39 | |
| 1-07-30 | 1 | 74 | REVISION 31 | 145 Configuration FAB VIP |
| 1-07-30 | 2 | 74 | REVISION 31 | |
| 1-07-30 | 1 | 75 | REVISION 36 | 145 Configuration 6A |

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| Page Block | Page | Code | | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|---|
| 1-07-30 | 2 | 75 | | | REVISION 38 | |
| 1-07-30 | 1 | 76 | | | REVISION 39 | 145 Configuration 7 |
| 1-07-30 | 2 | 76 | | | REVISION 38 | |
| 1-07-30 | 1 | 79 | | | REVISION 36 | 145 Configuration 8 |
| 1-07-30 | 2 | 79 | | | REVISION 36 | |
| 1-07-30 | 1 | 81 | | | REVISION 37 | 145 Interior 4B |
| 1-07-30 | 2 | 81 | | | REVISION 37 | |
| 1-07-50 | 1 | 01 | | | REVISION 19 | ALL |
| 1-07-50 | 2 | 01 | | | REVISION 25 | |
| 1-07-60 | 1 | 01 | | | OCT 02, 2001 | ALL |
| 1-07-60 | 2 | 01 | | | SEP 20, 1999 | |
| 1-07-70 | 1 | 01 | * | | REVISION 46 | All but cart stowage unit |
| 1-07-70 | 2 | 01 | * | | REVISION 46 | |
| 1-07-70 | 3 | 01 | * | | REVISION 46 | |
| 1-07-70 | 4 | 01 | * | | REVISION 46 | |
| 1-07-70 | 5 | 01 | * | | REVISION 46 | |
| 1-07-70 | 6 | 01 | * | | REVISION 46 | |
| 1-07-70 | 7 | 01 | * | | REVISION 46 | |
| 1-07-70 | 8 | 01 | * | | REVISION 46 | |
| 1-07-70 | 1 | 02 | * | | REVISION 46 | Cart stowage unit |
| 1-07-70 | 2 | 02 | * | | REVISION 46 | |
| 1-07-70 | 3 | 02 | * | | REVISION 46 | |
| 1-07-70 | 4 | 02 | * | | REVISION 46 | |
| 1-07-70 | 5 | 02 | * | | REVISION 46 | |
| 1-07-70 | 6 | 02 | * | | REVISION 46 | |
| 1-07-70 | 7 | 02 | * | new | REVISION 46 | |
| 1-07-70 | 8 | 02 | * | new | REVISION 46 | |
| 1-07-80 | 1 | 01 | | | DEC 20, 2002 | ALL |
| 1-07-80 | 2 | 01 | | | DEC 20, 2002 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-07-80 | 3 | 01 | DEC 20, 2002 | |
| 1-07-80 | 4 | 01 | DEC 20, 2002 | |
| 1-07-80 | 5 | 01 | DEC 20, 2002 | |
| 1-07-80 | 6 | 01 | DEC 20, 2002 | |
| 1-07-80 | 7 | 01 | DEC 20, 2002 | |
| 1-07-80 | 8 | 01 | DEC 20, 2002 | |
| 1-07-90 | 1 | 01 | REVISION 30 | ALL |
| 1-07-90 | 2 | 01 | REVISION 30 | |
| 1-07-90 | 3 | 01 | REVISION 30 | |
| 1-07-90 | 4 | 01 | REVISION 30 | |
| 1-07-95 | 1 | 01 | REVISION 39 | 135, 140, 145 |
| 1-07-95 | 2 | 01 | REVISION 39 | |
| 1-08-00 | 1 | 01 | REVISION 40 | ALL |
| 1-08-00 | 2 | 01 | REVISION 40 | |
| 1-08-00 | 3 | 01 | REVISION 40 | |
| 1-08-00 | 4 | 01 | REVISION 40 | |
| 1-08-06 | 1 | 01 | REVISION 36 | ANAC/FAA |
| 1-08-06 | 2 | 01 | REVISION 36 | |
| 1-08-06 | 3 | 01 | REVISION 38 | |
| 1-08-06 | 4 | 01 | REVISION 36 | |
| 1-08-06 | 5 | 01 | REVISION 36 | |
| 1-08-06 | 6 | 01 | REVISION 36 | |
| 1-08-06 | 7 | 01 | REVISION 36 | |
| 1-08-06 | 8 | 01 | REVISION 36 | |
| 1-08-06 | 9 | 01 | REVISION 36 | |
| 1-08-06 | 10 | 01 | REVISION 36 | |
| 1-08-23 | 1 | 02 | REVISION 40 | FAA/EASA |
| 1-08-23 | 2 | 02 | REVISION 39 | |
| 1-08-28 | 1 | 01 | REVISION 40 | ALL |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-08-28 | 2 | 01 | REVISION 36 | |
| 1-08-28 | 3 | 01 | REVISION 36 | |
| 1-08-28 | 4 | 01 | REVISION 36 | |
| 1-08-32 | 1 | 01 | REVISION 27 | ALL |
| 1-08-32 | 2 | 01 | REVISION 27 | |
| 1-08-33 | 1 | 01 | REVISION 40 | ALL |
| 1-08-33 | 2 | 01 | REVISION 40 | |
| 1-08-33 | 3 | 01 | REVISION 40 | |
| 1-08-33 | 4 | 01 | REVISION 40 | |
| 1-08-33 | 5 | 01 | REVISION 40 | |
| 1-08-33 | 6 | 01 | REVISION 40 | |
| 1-08-33 | 7 | 01 | REVISION 40 | |
| 1-08-33 | 8 | 01 | REVISION 40 | |
| 1-08-49 | 1 | 01 | REVISION 27 | ALL |
| 1-08-49 | 2 | 01 | REVISION 27 | |
| 1-08-52 | 1 | 01 | REVISION 27 | ALL |
| 1-08-52 | 2 | 01 | REVISION 27 | |
| 1-08-54 | 1 | 01 | REVISION 27 | ALL |
| 1-08-54 | 2 | 01 | REVISION 27 | |
| 1-08-54 | 3 | 01 | REVISION 27 | |
| 1-08-54 | 4 | 01 | REVISION 13 | |
| 1-08-55 | 1 | 01 | REVISION 27 | ALL |
| 1-08-55 | 2 | 01 | REVISION 27 | |
| 1-08-55 | 3 | 01 | REVISION 27 | |
| 1-08-55 | 4 | 01 | REVISION 27 | |
| 1-08-55 | 5 | 01 | REVISION 27 | |
| 1-08-55 | 6 | 01 | REVISION 27 | |
| 1-08-57 | 1 | 01 | REVISION 27 | ALL |
| 1-08-57 | 2 | 01 | REVISION 27 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-08-57 | 3 | 01 | REVISION 27 | |
| 1-08-57 | 4 | 01 | REVISION 27 | |
| 1-08-57 | 5 | 01 | REVISION 27 | |
| 1-08-57 | 6 | 01 | REVISION 27 | |
| 1-08-78 | 1 | 01 | REVISION 27 | ALL |
| 1-08-78 | 2 | 01 | REVISION 27 | |
| 1-09-00 | 1 | 03 | REVISION 36 | ALL |
| 1-09-00 | 2 | 03 | REVISION 36 | |
| 1-10-00 | 1 | 01 | REVISION 30 | ALL |
| 1-10-00 | 2 | 01 | REVISION 13 | |
| 1-10-05 | 1 | 01 | REVISION 36 | ALL except shuttle |
| 1-10-05 | 2 | 01 | REVISION 36 | |
| 1-10-05 | 3 | 01 | REVISION 36 | |
| 1-10-05 | 4 | 01 | REVISION 36 | |
| 1-10-05 | 5 | 01 | REVISION 36 | |
| 1-10-05 | 6 | 01 | REVISION 36 | |
| 1-10-05 | 7 | 01 | REVISION 36 | |
| 1-10-05 | 8 | 01 | REVISION 36 | |
| 1-10-08 | 1 | 01 | SEP 29, 2000 | 145 Interior 1 - 50 pax |
| 1-10-08 | 2 | 01 | SEP 29, 2000 | |
| 1-10-08 | 1 | 02 | SEP 29, 2000 | 145 Interior 2 - 50 pax |
| 1-10-08 | 2 | 02 | SEP 29, 2000 | |
| 1-10-08 | 1 | 03 | SEP 29, 2000 | 145 Interior 3 - 50 pax |
| 1-10-08 | 2 | 03 | SEP 29, 2000 | |
| 1-10-08 | 1 | 04 | SEP 29, 2000 | 145 Interior 3 - 50 pax |
| 1-10-08 | 2 | 04 | SEP 29, 2000 | |
| 1-10-08 | 1 | 05 | SEP 29, 2000 | 145 Interior 4 - 49 pax |
| 1-10-08 | 2 | 05 | SEP 29, 2000 | |
| 1-10-08 | 1 | 06 | SEP 29, 2000 | 145 Interior 4 - 49 pax |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-10-08 | 2 | 06 | SEP 29, 2000 | |
| 1-10-08 | 1 | 07 | SEP 29, 2000 | 145 Interior 5 - 48 pax |
| 1-10-08 | 2 | 07 | SEP 29, 2000 | |
| 1-10-08 | 1 | 08 | SEP 29, 2000 | 145 Interior 5 - 48 pax |
| 1-10-08 | 2 | 08 | SEP 29, 2000 | |
| 1-10-08 | 1 | 09 | SEP 29, 2000 | 145 Interior 6 - 50 pax |
| 1-10-08 | 2 | 09 | SEP 29, 2000 | |
| 1-10-08 | 1 | 12 | SEP 29, 2000 | 145 Interior 4 - 49 pax |
| 1-10-08 | 2 | 12 | SEP 29, 2000 | |
| 1-10-08 | 1 | 13 | SEP 29, 2000 | 145 Interior 6 - 50 pax |
| 1-10-08 | 2 | 13 | SEP 29, 2000 | |
| 1-10-08 | 1 | 17 | DEC 20, 2002 | 145 Interior 1 - 50 pax |
| 1-10-08 | 2 | 17 | DEC 20, 2002 | |
| 1-10-08 | 1 | 20 | REVISION 30 | 145 FAB |
| 1-10-08 | 2 | 20 | REVISION 30 | |
| 1-10-08 | 1 | 21 | REVISION 33 | 145 Interior 6A - 50 pax |
| 1-10-08 | 2 | 21 | REVISION 33 | |
| 1-10-08 | 1 | 22 | REVISION 33 | 145 Interior Option 3 |
| 1-10-08 | 2 | 22 | REVISION 33 | |
| 1-10-08 | 1 | 23 | REVISION 34 | 145 Interior Option 2A |
| 1-10-08 | 2 | 23 | REVISION 34 | |
| 1-10-10 | 1 | 01 | REVISION 13 | ALL |
| 1-10-10 | 2 | 01 | REVISION 31 | |
| 1-10-15 | 1 | 01 | DEC 20, 2002 | ALL |
| 1-10-15 | 2 | 01 | DEC 20, 2002 | |
| 1-10-15 | 3 | 01 | DEC 20, 2002 | |
| 1-10-15 | 4 | 01 | DEC 20, 2002 | |
| 1-10-20 | 1 | 01 | SEP 20, 1999 | ELT 110-4 (ARTEX) |
| 1-10-20 | 2 | 01 | SEP 20, 1999 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-10-20 | 3 | 01 | SEP 20, 1999 | |
| 1-10-20 | 4 | 01 | SEP 20, 1999 | |
| 1-10-20 | 1 | 02 | REVISION 34 | ELT 96 OR 97 (SATORI) |
| 1-10-20 | 2 | 02 | REVISION 13 | |
| 1-10-20 | 3 | 02 | REVISION 34 | |
| 1-10-20 | 4 | 02 | REVISION 13 | |
| 1-10-20 | 1 | 03 | REVISION 31 | ELT C406-2 |
| 1-10-20 | 2 | 03 | REVISION 31 | |
| 1-10-20 | 3 | 03 | REVISION 31 | |
| 1-10-20 | 4 | 03 | REVISION 31 | |
| 1-10-25 | 1 | 01 | SEP 20, 1999 | ALL |
| 1-10-25 | 2 | 01 | SEP 20, 1999 | |
| 1-10-30 | 1 | 01 | SEP 20, 1999 | ALL except Shuttle |
| 1-10-30 | 2 | 01 | SEP 20, 1999 | |
| 1-10-35 | 1 | 01 | REVISION 30 | ALL |
| 1-10-35 | 2 | 01 | REVISION 30 | |
| 1-10-35 | 3 | 01 | REVISION 31 | |
| 1-10-35 | 4 | 01 | REVISION 31 | |
| 1-11-00 | 1 | 01 | REVISION 26 | ALL |
| 1-11-00 | 2 | 01 | REVISION 13 | |
| 1-11-05 | 1 | 02 | REVISION 30 | FAA |
| 1-11-05 | 2 | 02 | REVISION 13 | |
| 1-11-40 | 1 | 03 | REVISION 31 | Airstair/Jetway |
| 1-11-40 | 2 | 03 | REVISION 29 | |
| 1-11-40 | 3 | 03 | REVISION 19 | |
| 1-11-40 | 4 | 03 | REVISION 35 | |
| 1-11-40 | 5 | 03 | REVISION 19 | |
| 1-11-40 | 6 | 03 | REVISION 29 | |
| 1-11-40 | 7 | 03 | AUG 24, 2001 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-11-40 | 8 | 03 | SEP 20, 1999 | |
| 1-11-40 | 9 | 03 | REVISION 31 | |
| 1-11-40 | 10 | 03 | REVISION 30 | |
| 1-11-40 | 11 | 03 | REVISION 30 | |
| 1-11-40 | 12 | 03 | REVISION 25 | |
| 1-11-40 | 13 | 03 | REVISION 30 | |
| 1-11-40 | 14 | 03 | REVISION 30 | |
| 1-11-45 | 1 | 01 | REVISION 18 | ALL |
| 1-11-45 | 2 | 01 | REVISION 33 | |
| 1-11-45 | 3 | 01 | REVISION 31 | |
| 1-11-45 | 4 | 01 | REVISION 18 | |
| 1-12-00 | 1 | 01 | REVISION 42 | ALL |
| 1-12-00 | 2 | 01 | REVISION 42 | |
| 1-12-00 | 3 | 01 | REVISION 42 | |
| 1-12-00 | 4 | 01 | REVISION 42 | |
| 1-12-05 | 1 | 01 | REVISION 31 | ALL |
| 1-12-05 | 2 | 01 | REVISION 13 | |
| 1-12-05 | 3 | 01 | OCT 02, 2001 | |
| 1-12-05 | 4 | 01 | SEP 20, 1999 | |
| 1-12-05 | 5 | 01 | SEP 20, 1999 | |
| 1-12-05 | 6 | 01 | SEP 20, 1999 | |
| 1-12-10 | 1 | 01 | REVISION 39 | ALL |
| 1-12-10 | 2 | 01 | REVISION 39 | |
| 1-12-10 | 3 | 01 | REVISION 39 | |
| 1-12-10 | 4 | 01 | REVISION 39 | |
| 1-12-10 | 5 | 01 | REVISION 39 | |
| 1-12-10 | 6 | 01 | REVISION 39 | |
| 1-12-10 | 7 | 01 | REVISION 39 | |
| 1-12-10 | 8 | 01 | REVISION 39 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-12-10 | 9 | 01 | REVISION 39 | |
| 1-12-10 | 10 | 01 | REVISION 39 | |
| 1-12-10 | 11 | 01 | REVISION 39 | |
| 1-12-10 | 12 | 01 | REVISION 39 | |
| 1-12-15 | 1 | 01 | REVISION 30 | ALL |
| 1-12-15 | 2 | 01 | REVISION 23 | |
| 1-12-15 | 3 | 01 | APR 28, 2000 | |
| 1-12-15 | 4 | 01 | APR 28, 2000 | |
| 1-12-20 | 1 | 01 | REVISION 42 | ALL |
| 1-12-20 | 2 | 01 | REVISION 42 | |
| 1-12-20 | 3 | 01 | REVISION 42 | |
| 1-12-20 | 4 | 01 | REVISION 42 | |
| 1-12-20 | 5 | 01 | REVISION 42 | |
| 1-12-20 | 6 | 01 | REVISION 42 | |
| 1-12-20 | 7 | 01 | REVISION 42 | |
| 1-12-20 | 8 | 01 | REVISION 42 | |
| 1-12-20 | 9 | 01 | REVISION 42 | |
| 1-12-20 | 10 | 01 | REVISION 42 | |
| 1-12-20 | 11 | 01 | REVISION 42 | |
| 1-12-20 | 12 | 01 | REVISION 42 | |
| 1-12-20 | 13 | 01 | REVISION 42 | |
| 1-12-20 | 14 | 01 | REVISION 42 | |
| 1-12-25 | 1 | 04 | REVISION 38 | All with and without Stub Tank except XR |
| 1-12-25 | 2 | 04 | REVISION 38 | |
| 1-12-25 | 3 | 04 | REVISION 38 | |
| 1-12-25 | 4 | 04 | REVISION 38 | |
| 1-12-25 | 5 | 04 | REVISION 38 | |
| 1-12-25 | 6 | 04 | REVISION 38 | |
| 1-12-25 | 7 | 04 | REVISION 38 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-12-25 | 8 | 04 | REVISION 38 | |
| 1-12-25 | 9 | 04 | REVISION 38 | |
| 1-12-25 | 10 | 04 | REVISION 38 | |
| 1-12-25 | 11 | 04 | REVISION 38 | |
| 1-12-25 | 12 | 04 | REVISION 38 | |
| 1-12-25 | 13 | 04 | REVISION 38 | |
| 1-12-25 | 14 | 04 | REVISION 38 | |
| 1-12-25 | 15 | 04 | REVISION 38 | |
| 1-12-25 | 16 | 04 | REVISION 38 | |
| 1-12-25 | 17 | 04 | REVISION 38 | |
| 1-12-25 | 18 | 04 | REVISION 38 | |
| 1-12-25 | 19 | 04 | REVISION 38 | |
| 1-12-25 | 20 | 04 | REVISION 38 | |
| 1-12-30 | 1 | 01 | REVISION 38 | ALL |
| 1-12-30 | 2 | 01 | REVISION 37 | |
| 1-12-30 | 3 | 01 | REVISION 37 | |
| 1-12-30 | 4 | 01 | REVISION 37 | |
| 1-12-35 | 1 | 01 | REVISION 37 | ALL |
| 1-12-35 | 2 | 01 | REVISION 37 | |
| 1-12-40 | 1 | 01 | SEP 20, 1999 | ALL |
| 1-12-40 | 2 | 01 | SEP 20, 1999 | |
| 1-12-40 | 3 | 01 | DEC 20, 2002 | |
| 1-12-40 | 4 | 01 | DEC 20, 2002 | |
| 1-12-40 | 5 | 01 | DEC 20, 2002 | |
| 1-12-40 | 6 | 01 | DEC 20, 2002 | |
| 1-12-43 | 1 | 01 | REVISION 42 | ALL |
| 1-12-43 | 2 | 01 | REVISION 42 | |
| 1-12-45 | 1 | 01 | REVISION 38 | ALL |
| 1-12-45 | 2 | 01 | REVISION 38 | |

* Asterisk indicates pages revised, added or deleted by the current revision.



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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-12-50 | 1 | 01 | REVISION 29 | ALL |
| 1-12-50 | 2 | 01 | REVISION 13 | |
| 1-12-50 | 3 | 01 | SEP 20, 1999 | |
| 1-12-50 | 4 | 01 | SEP 20, 1999 | |
| 1-12-60 | 1 | 01 | REVISION 42 | ALL |
| 1-12-60 | 2 | 01 | REVISION 42 | |
| 1-12-60 | 3 | 01 | REVISION 42 | |
| 1-12-60 | 4 | 01 | REVISION 42 | |
| 1-12-60 | 5 | 01 | REVISION 42 | |
| 1-12-60 | 6 | 01 | REVISION 42 | |
| 1-12-60 | 7 | 01 | REVISION 42 | |
| 1-12-60 | 8 | 01 | REVISION 42 | |
| 1-12-60 | 9 | 01 | REVISION 42 | |
| 1-12-60 | 10 | 01 | REVISION 42 | |
| 1-12-60 | 11 | 01 | REVISION 42 | |
| 1-12-60 | 12 | 01 | REVISION 42 | |
| 1-12-60 | 13 | 01 | REVISION 42 | |
| 1-12-60 | 14 | 01 | REVISION 42 | |
| 1-12-60 | 15 | 01 | REVISION 42 | |
| 1-12-60 | 16 | 01 | REVISION 42 | |
| 1-12-60 | 17 | 01 | REVISION 42 | |
| 1-12-60 | 18 | 01 | REVISION 42 | |
| 1-12-60 | 19 | 01 | REVISION 42 | |
| 1-12-60 | 20 | 01 | REVISION 42 | |
| 1-12-60 | 21 | 01 | REVISION 42 | |
| 1-12-60 | 22 | 01 | REVISION 42 | |
| 1-12-60 | 23 | 01 | REVISION 42 | |
| 1-12-60 | 24 | 01 | REVISION 42 | |
| 1-12-60 | 25 | 01 | REVISION 42 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 1-12-60 | 26 | 01 | REVISION 42 | |
| 1-12-60 | 27 | 01 | REVISION 42 | |
| 1-12-60 | 28 | 01 | REVISION 42 | |
| 1-12-60 | 29 | 01 | REVISION 42 | |
| 1-12-60 | 30 | 01 | REVISION 42 | |
| 1-12-60 | 31 | 01 | REVISION 42 | |
| 1-12-60 | 32 | 01 | REVISION 42 | |

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44



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# TABLE OF CONTENTS

## AOM - VOLUME 1

**1-00 - GENERAL INFORMATION AND DEFINITION OF TERMS**

**1-01 - LIMITATIONS**

**1-02 - NORMAL PROCEDURES**

**1-03 - EMERGENCY AND ABNORMAL PROCEDURES**

**1-04 - PERFORMANCE**

**1-05 - FLIGHT PLANNING**

**1-06 - WEIGHT AND BALANCE**

**1-07 - LOADING**

**1-08 - CONFIGURATION DEVIATION LIST**

**1-09 - DISPATCH DEVIATIONS PROCEDURES MANUAL**

**1-10 - EMERGENCY INFORMATION**

**1-11 - EMERGENCY EVACUATION**

**1-12 - GROUND SERVICING**

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

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# SECTION 1-00

# GENERAL INFORMATION AND DEFINITION OF TERMS

TABLE OF CONTENTS

Page Block

General Information ..... 1-00-00
Definition of Terms ..... 1-00-10
Units Conversion ..... 1-00-20
EICAS Versions ..... 1-00-30
Service Bulletin Table ..... 1-00-35

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# GENERAL INFORMATION

This Airplane Operations Manual provides useful information to complement the Airplane Flight Manual, Weight and Balance Manual and the Master Minimum Equipment List. It must be used in combination with those publications to safe and efficiently operate the airplane.

The information contained herein is based on the airplane as delivered and further modifications developed and supplied by Embraer, as well as customizations requested by the original owner/operator.

It is the owner/operator sole responsibility to guarantee that Embraer has complete and accurate information on any modifications made to the delivered configuration. Any modifications, improvements, add-ons or any other changes made to the airplane without the involvement of Embraer will not be reflected in this AOM.

This AOM is not suitable to be used for any other airplanes and it may not be appropriate for use if the airplanes are transferred to other owners/operators. In this case, its applicability shall be confirmed with Embraer.

Owners/operators are solely responsible for ensuring that the operational documentation used is complete and accurate and corresponds entirely to the current configuration of the operated airplanes.

In case of conflicting information between this AOM and the AFM, the AFM must prevail.

The Airplane Operations Manual philosophy and structure are described on the next pages.

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In the EMBRAER Operational Manuals, the Brazilian Civil Aviation authority is identified as both ANAC and CTA. Therefore, whenever you find either, it corresponds to Brazilian certification. This is because since March 21, 2006, the Brazilian Civil Aviation authority was replaced by Civil Aviation National Agency (ANAC) instead of CTA.

Similarly, the European Aviation Safety Agency is identified as both EASA and JAA. Therefore, whenever you find either, it corresponds to European certification. This is because since September 28, 2003, EASA took over responsibility for the airworthiness and environmental certification of all aeronautical products, parts, and appliances designed, manufactured, maintained or used by persons under the regulatory oversight of EU Member States. This includes all post-certification activities, such as the approval of changes to aeronautical products and their components. Therefore, the revisions issued after that date were approved by EASA instead of JAA. The original approval was made by JAA.

**INDENTATION**

Indentation exists when the information is displaced to the right relative to the paragraph that immediately precedes it. The indentation is used to establish a relationship between the indented and the preceding information.

An indented information is normally preceded by a condition (e.g. “during landing”, “if something is true”, “when something happens”). When this is the case, observe the indented information when the preceding condition is satisfied.

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# OPERATIONAL REQUIREMENTS AND THE AIRPLANE OPERATIONS MANUAL

The existence of fleets composed of airplanes or other kind of airplane made by different manufacturers, led the Airworthiness Authorities to require operators' certification, in addition to the airplane's certification.

The idea is to standardize manuals, training and operation, so as to make it easier for a pilot to change equipment. As an example, if a pilot used to fly an EMBRAER airplane (ERJ-145) is scheduled to fly another EMBRAER airplane (EMBRAER 170/175/190/195), the training syllabus required for both airplane families/models needs to be very similar; the operator's normal, abnormal and emergency procedures presentation must be similar for all airplanes even when there are different AFMs with different presentation for those procedures, as well as the manuals for both airplanes. By doing so, the operator will assure that human factors/errors are minimized.

Some operational requirements just define the main subjects that must be presented in an Airplane Operations Manual matter. However, even detailing the Airplane Operations Manual at that level, all the requirements let the operators free to use different Airplane Operations Manual structures, depending on the manuals that have been already issued. Therefore, EMBRAER has developed this Airplane Operations Manual trying to cover, in the best possible way, the most currently used requirements. By doing so, it is possible for an operator to use the EMBRAER Airplane Operations Manual by just adding some missing information that is specific to that operator.

Following is a suggested Airplane Operations Manual structure to comply with most of the Operation Requirements:

## PART A

Presents operator's administrative information, such as who are the president , vice-president, the managers, who is the chief pilot for the EMB-145, who is the responsible for revising manuals, where the offices and bases are located, etc.

## PART B

Presents airplane related information, like procedures, performance, dispatch procedures, Weight and Balance, bulletins and systems description.

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**PART C**

Presents the operator's airport and route information (performance and navigation).

**PART D**

Presents training information.

## EMBRAER AIRPLANE OPERATIONS MANUAL

This EMBRAER Airplane Operations Manual covers only Part B. Parts A and D should be generated by the operator only. Part C can be generated by the operator with the help of EMBRAER operations software (runway analysis, driftdown and route analysis).

## AIRPLANE OPERATIONS MANUAL STRUCTURE

The EMBRAER Airplane Operations Manual is organized in two volumes, with the following contents:

- Volume 1:
  - 1-00 General Information and Definition of Terms
  - 1-01 Limitations
  - 1-02 Normal Procedures
  - 1-03 Emergency and Abnormal Procedures
  - 1-04 Performance
  - 1-05 Flight Planning
  - 1-06 Weight and Balance
  - 1-07 Loading
  - 1-08 Configuration Deviation List
  - 1-09 Dispatch Deviations Procedures Manual
  - 1-10 Emergency Information
  - 1-11 Emergency Evacuation
  - 1-12 Ground Servicing

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- Volume 2:
  - 2-1 Airplane Description
  - 2-2 Equipment and Furnishings
  - 2-3 Emergency Equipment
  - 2-4 Crew Awareness
  - 2-5 Electrical
  - 2-6 Lighting
  - 2-7 Fire Protection
  - 2-8 Fuel
  - 2-9 Auxiliary Power Unit
  - 2-10 Powerplant
  - 2-11 Hydraulic
  - 2-12 Landing Gear and Brakes
  - 2-13 Flight Controls
  - 2-14 Pneumatics, Air Conditioning and Pressurization
  - 2-15 Ice and Rain Protection
  - 2-16 Oxygen
  - 2-17 Flight Instruments
  - 2-18 Navigation and Communication
  - 2-19 Autopilot

Each of the above sections may be divided into smaller parts, called blocks. Such blocks are identified by the number of the section followed by a two-digit number.

For example:

Section 1-04 can be divided as follows:

- 1-04-00 Introduction
- 1-04-05 Wind and altitude
- 1-04-10 Thrust Setting
- 1-04-15 Takeoff
- 1-04-20 Supplementary Takeoff
- 1-04-25 Approach
- 1-04-30 Landing

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The page numbering of each part is independent from the remaining parts. Each page number is presented just to the right of the block number.

As a complement, a code number is provided, to help identifying to which configuration each block is applicable. Some codes may be applicable to more than one configuration, whilst more than one code may be specific to one configuration.

As an example, there could be:

| Block | Codes | Number of pages | Numbering |
|---|---|---|---|
| 1-04-00 | 01 | 2 | 1 to 2 |
| 1-04-05 | 01 | 6 | 1 to 6 |
| 1-04-10 | 01 | 20 | 1 to 20 |
| | 02 | 20 | 1 to 20 |
| | 03 | 20 | 1 to 20 |
| 1-04-15 | 01 | 6 | 1 to 6 |
| | 02 | 6 | 1 to 6 |
| | 03 | 10 | 1 to 10 |
| | 04 | 4 | 1 to 4 |
| 1-04-20 | 01 | 24 | 1 to 24 |
| | 02 | 24 | 1 to 24 |
| | 05 | 20 | 1 to 20 |
| 1-04-25 | 01 | 4 | 1 to 4 |
| | 03 | 4 | 1 to 4 |
| | 04 | 4 | 1 to 4 |
| | 07 | 4 | 1 to 4 |
| 1-04-30 | 01 | 6 | 1 to 6 |
| | 02 | 4 | 1 to 4 |
| | 03 | 6 | 1 to 6 |
| | 04 | 4 | 1 to 4 |

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## REVISIONS

EMBRAER may revise this manual periodically as required to update information or to provide information not available at the time of printing the original issue. Revised data may result from EMBRAER approved airplane modifications or from improved techniques gained through operational experience. They are either replacements or additional pages. A vertical line in the outside margin indicates changes to the text.

A vertical line adjacent to the page number indicates relocated or rearranged text or illustrations.

The basic issuance date of this Manual is presented in the title page. The revisions affecting this Manual to be issued from the basic issuance date onwards, will be numbered sequentially (Rev. 1, 2, 3 etc.), even for such pages bearing those earlier revision-denoting symbols.

## LIST OF EFFECTIVE PAGES

A list of Effective Pages for all Sections is located at the beginning of this Manual. This list presents the issuance date of each page and it is revised together with the Manual. Its purpose is to check if all the revised pages of a revision have been correctly sent to the purchaser.

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# DEFINITION OF TERMS

The following definitions apply to the terms below:

**WARNING:** **OPERATING PROCEDURES, TECHNIQUES AND OTHER RELATED INFORMATION WHICH MAY RESULT IN PERSONAL INJURY OR LOSS OF LIFE, IF NOT CAREFULLY FOLLOWED.**

**CAUTION:** OPERATING PROCEDURES, TECHNIQUES AND OTHER RELATED INFORMATION WHICH MAY RESULT IN DAMAGE OR DESTRUCTION OF EQUIPMENT, IF NOT CAREFULLY FOLLOWED.

**NOTE:** Operating procedures, techniques and other related information which are considered essential to emphasize.

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# ABBREVIATIONS AND ACRONYMS

| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| ºC | Degree Celsius |
| ºF | Degree Fahrenheit |
| ft | Feet |
| g | Gravity Acceleration |
| h | Hour |
| Hz | Hertz |
| in.Hg | Inches of Mercury |
| kg | Kilogram |
| km | Kilometer |
| kph | Kilograms per Hour |
| kt | Knot |
| lb | Pounds |
| m | Meter |
| mb | Milibar |
| min | Minute |
| mm | Millimeter |
| mph | Miles per Hour |
| nm | Nautical Mile |
| psi | Pound per Square Inch |
| sec | Second |
| **A** | |
| A | Ampere |
| A/C | Aircraft |
| AC | Alternating Current |
| ACM | Air Cycle Machine |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| ACOC | Air Cooled Oil Cooler |
| ACT | Actuation, Active |
| ADC | Air Data Computer |
| ADF | Automatic Direction Finder |
| ADJ | Adjustment |
| ADV | Advance |
| AFM | Airplane Flight Manual |
| AFS | Autoflight System |
| AGL | Above Ground Level |
| AHC | Attitude and Heading Computer |
| AHRS | Attitude and Heading Reference System |
| AIL | Aileron |
| ALC | APU Line Contactor |
| ALT | Altitude |
| ALTN | Alternate |
| AM | Amplitude Modulation |
| ANAC | Agência Nacional de Aviação Civil (Brazilian Civil Aviation Authority) |
| ANR | Automatic Navigation Realignment |
| ANT | Antenna |
| AOA | Angle of Attack |
| AP | Autopilot |
| API | Antenna Position Indicator |
| APR | Automatic Power Reserve |
| APU | Auxiliary Power Unit |
| ASC | APU Starting Contactor |
| ATC | Air Traffic Control |
| ATDT, ATTD | Attendant |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| ATS | Air Turbine Starter |
| ATT | Attitude |
| ATTCS | Automatic Takeoff Thrust Control System |
| AUTO | Automatic |
| AUX | Auxiliary |
| AVAIL | Available |
| AWU | Aural Warning Unit |
| **B** | |
| B/C | Back Course |
| BACV | Bleed Air Check Valve |
| BAGG | Baggage |
| BATT | Battery |
| BBC | Backup Battery Contactor |
| BC | Battery Contactor |
| BCU | Brake Control Unit |
| BCV | Brake Control Valve |
| BFO | Beat Frequency Oscillator |
| BIT | Built In Test |
| BKUP INPH | Back-Up Interphone |
| BLD | Bleed |
| BTC | Bus Tie Contactor |
| BTL | Bottle |
| **C** | |
| CAB EMERG | Cabin Emergency |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| CAS | Calibrated Airspeed, Crew Alerting System |
| CBV | Cross Bleed Valve |
| CCDL | Cross-Channel Data Link |
| CDH | Clearance Delivery Head |
| CDL | Configuration Deviation List |
| CCW | Counterclockwise |
| CG | Center of Gravity |
| CIS | Cabin Interphone System |
| CL | Climb |
| CLB | Climb |
| CLR | Clear |
| CLSD | Closed |
| CMC | Central Maintenance Computer |
| COMM, COM | Communication |
| CON | Continuous |
| CPAM | Cabin Pressure Acquisition Module |
| CPCS | Cabin Pressure Control System |
| CR | Cruise |
| CRZ | Cruise |
| CVG | Compressor Variable Geometry |
| CVR | Cockpit Voice Recorder |
| CW | Clockwise |
| **D** | |
| DAP | Digital Audio Panel |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| DAU | Data Acquisition Unit |
| DC | Direct Current, Digital Controller |
| DEC | Decrease |
| DET | Detector |
| DFDR | Digital Flight Data Recorder |
| DG | Directional Gyro |
| DH | Decision Height |
| DISC | Disconnect |
| DME | Distance Measurement Equipment |
| DMU | Data Management Unit |
| DN | Down |
| **E** | |
| EADI | Electronic Attitude Director Indicator |
| EBC | Essential Bus Contactor |
| EBV | Engine Bleed Valve |
| ECM | Electronic Control Module |
| ECS | Environmental Control System |
| ECU | Environmental Control Unit |
| EDL | Electrical Distribution Logic |
| EDS | Electrical Distribution System |
| EFIS | Electronic Flight Instrument System |
| EGPWS | Enhanced Ground Position Warning System |
| EGT | Exhaust Gas Temperature |
| EHSI | Electronic Horizontal Situation Indicator |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| EIC | Essential Interconnection Contactor |
| EICAS | Engine Indication and Crew Alerting System |
| ELEC | Electrical |
| ELEV | Elevator |
| ELT | Emergency Locator Transmitter |
| EMG, EMERG | Emergency |
| EMER PILOT | Emergency Pilot |
| ENG | Engine |
| ERR | Error |
| ESU | Electronic Sequence Unit |
| ET | Elapsed Time |
| EXT | External |
| EXTG | Extinguish |
| **F** | |
| FADEC | Full Authority Digital Electronic Control |
| FCOC | Fuel Cooled Oil Cooler |
| FDAU | Flight Data Acquisition Unit |
| FDRS | Flight Data Recorder System |
| FECU | Flap Electronic Control Unit |
| FLC | Flight Level Change Mode |
| FLX | Flexible |
| FMS | Flight Management System |
| FPDU | Flap Power and Drive Unit |
| FPLN | Flight Plan |
| FPMU | Fuel Pump and Metering Unit |
| FQIS | Fuel Quantity Indicating System |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| FR | Fuel Remaining |
| FSBY | Forced Standby |
| FTB | Flap Transmission Brake |
| FU | Fuel Used |
| FVS | Flap Velocity Sensor |
| FWD | Forward |
| **G** | |
| G/S, GS | Glide Slope |
| GCU | Generator Control Unit |
| GI | Ground Idle |
| GLC | Generator Line Contactor |
| GMAP | Ground Mapping |
| GMT | Greenwich Mean Time |
| GND | Ground |
| GPC | Ground Power Contactor |
| GPS | Global Positioning System |
| GPU | Ground Power Unit |
| GPWS | Ground Proximity Warning System |
| **H** | |
| HDG | Heading |
| HF | High Frequency |
| HP | High Pressure |
| hPa | HectoPascal |
| HSCU | Horizontal Stabilizer Control Unit |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| HSI | Horizontal Situation Indicator |
| HSV | High Stage Valve |
| HYDR | Hydraulic |
| **I** | |
| IAC | Integrated Avionics Computer |
| IAS | Indicated Airspeed |
| IC | Integrated Computer |
| ICAO | International Civil Aviation Organization |
| ICU | Integrated Communication Unit<br>Interphone Control Unit |
| IFR | Instrument Flight Rules |
| IFOG | Interferometer Fiber Optic Gyros |
| ILS | Instrument Landing System |
| IM | Integrated Computer Configuration Module |
| INBD | Inboard |
| INC | Increase |
| INOP | Inoperative |
| INTPH | Interphone |
| INU | Integrated Navigation Unit |
| IPS | Inches Per Second |
| IRS | Inertial Reference System |
| IRU | Inertial Reference Unit |
| ISA | International Standard Atmosphere |
| ISIS | Integrated Standby Instrument System |
| ITT | Interturbine Temperature |
| **K** | |
| KCAS | Calibrated Airspeed in Knots |
| KEAS | Equivalent Airspeed in Knots |
| kHz | Kilohertz |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| **K** | |
| KIAS | Indicated Airspeed in Knots |
| **L** | |
| LAV | Lavatory |
| LEI | Local Engine Inoperative |
| LGEU | Landing Gear Electronic Unit |
| LH | Left-hand |
| LOC | Localizer |
| LOGO | Logotype |
| LP | Low Pressure |
| LRN | Long Range |
| LSB | Lower Sideband |
| LSS | Lightning Sensor System |
| LX | Lightning Detection |
| **M** | |
| M | Mach |
| MAC | Mean Aerodynamic Chord |
| MAN | Manual |
| MAX | Maximum |
| MB | Marker Beacon |
| MEA | Minimum Enroute Altitude |
| MFD | Multifunction Display |
| MFDU | Magnetic Flux Detector Unit |
| MHz | Megahertz |
| MIN | Minimum |
| MKR | Marker |
| MLS | Microwave Landing System |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| MLW | Maximum Design Landing Weight |
| MMEL | Master Minimum Equipment List |
| $M_{MO}$ | Maximum Operating Mach |
| MOW | Maximum Design Operating Weight |
| MRW | Maximum Design Ramp Weight |
| MSU | Mode Select Unit |
| MTOW | Maximum Design Takeoff Weight |
| MZFW | Maximum Design Zero Fuel Weight |
| **N** | |
| N1 | Fan Speed |
| N2 | High-Pressure-Rotor Shaft Speed |
| NAV | Navigation |
| NB | Narrow Bandwidth |
| NDB | Non-directional Beacon |
| **O** | |
| OM | Operations Manual |
| OUTBD | Outboard |
| OVHT | Overheating |
| OVLD | Overload |
| OVPRESS | Overpressure |
| OXY | Oxygen |
| **P** | |
| PAA | Passenger Address Amplifier |
| PAS | Passenger Address System |
| PAST | Pilot Activated Self Test |
| PAX | Passenger |
| PBE | Protective Breathing Equipment |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| PCU | Power Control Unit |
| PDSV | Pressure Drop Spill Valve |
| PFD | Primary Flight Display |
| PMA | Permanent Magnet Alternator |
| POST | Power On Self Test |
| PRCS | Process |
| PRESS | Pressure |
| PRV | Pressurizing Valve |
| PSU | Passenger Service Unit |
| PTT | Press To Transmit |
| **Q** | |
| QFE | Question Field Elevation - Field Elevation Pressure (Q-code) |
| QNE | Question Normal Elevation - Standard Pressure (1013 hPa/29.92 in.Hg) (Q-code) |
| QNH | Question Normal Height - Sea Level Pressure (Q-code) |
| QTY | Quantity |
| **R** | |
| RA | Radio Altimeter |
| RTA | Receiver/Transmitter/Antenna |
| REACT | Rain Echo Attenuation Compensation Technique |
| REF | Reference |
| REI | Remote Engine Inoperative |
| RH | Right-hand |
| RMI | Radio Magnetic Indicator |
| RMS | Radio Management System |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| RMU | Radio Management Unit |
| RNG | Range |
| RPM | Revolution Per Minute |
| RSB | Radio System Bus |
| **S** | |
| SAT | Static Air Temperature |
| SBC | Shed Bus Contactor |
| SCV | Starting Control Valve |
| SELCAL | Selective Call |
| SL | Sea Level |
| SLVD | Slaved |
| SOV | Shutoff Valve |
| SPC | Stall Protection Computer |
| SPS | Stall Protection System |
| SQ | Squelch |
| STAB | Stabilizer |
| STBY | Stand By |
| SRN | Short Range |
| SSB | Single Sideband |
| **T** | |
| TA | Traffic Advisory |
| TAS | True Airspeed |
| TAT | Total Air Temperature |
| TCAS | Traffic Alert and Collision Avoidance System |
| TDR | Transponder |
| TACAN | Tactical Air Navigation Aid |
| TEMP | Temperature |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| TGT | Target |
| TKNB | Turn Knob |
| TLA | Thrust Lever Angle |
| TO | Takeoff |
| TRB | Turbulence |
| TST | Test |
| TWA | Time Weighted Average |
| **U** | |
| U.S. NAS | U.S. National Airspace System |
| **V** | |
| V | Volt |
| $V_1$ | Decision Speed |
| $V_2$ | Takeoff Safety Speed |
| VA | Volt-Ampere |
| VAPP | VOR Approach Mode |
| $V_A$ | Design Maneuvering Speed |
| $V_{EF}$ | Critical Engine Failure Speed |
| $V_{FE}$ | Maximum Flaps Extended Speed |
| VFR | Visual Flight Rules |
| VHF | Very High Frequency |
| $V_{LE}$ | Maximum Landing Gear Extended Speed |
| VLF | Very Low Frequency |
| $V_{LO}$ | Maximum Landing Gear Operating Speed |
| $V_{LOF}$ | Lift Off Speed |
| VLV | Valve |
| VMC | Visual Meteorological Conditions |
| $V_{MCA}$ | Air Minimum Control Speed |

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| ABBREVIATIONS OR ACRONYMS | MEANING |
|---|---|
| $V_{MCG}$ | Ground Minimum Control Speed |
| $V_{MO}$ | Maximum Operating Speed |
| VOR | VHF Omnidirectional Range |
| $V_R$ | Rotation Speed |
| $V_{REF}$ | Landing Reference Speed |
| $V_{REFXX}$ | Landing Reference Speed associated to the flap setting XX |
| $V_S$ | Stall Speed |
| VS | Vertical Speed |
| **W** | |
| W/S | Windshield |
| WB | Weight and Balance |
| WB | Wide Bandwidth |
| WG | Wing |
| WX | Weather Detection |
| **X** | |
| X | Cross |
| XFR | Transfer |

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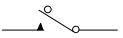
## SYMBOLS AND NOTATIONS

| SYMBOL | MEANING |
|---|---|
| | SHUTOFF VALVE, PRIORITY VALVE |
| | CHECK VALVE |
| | RESTRICTOR |
| | RELIEF VALVE |
| | OPTIONAL EQUIPMENT |
| | SYSTEM MODULE |
|  | COMMUNICATION LINE |
| | ELECTRIC PUMP |
| | MECHANIC PUMP |
| | ACCUMULATOR |
| | ELECTRIC CONTACTOR (OPEN POSITION) |
|  | SWITCH |
| | NACA AIR INLET |

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# UNITS CONVERSION

| TO CONVERT | INTO | MULTIPLY BY | AND ADD |
|---|---|---|---|
| Degree Celsius (ºC) | Degree Fahrenheit (ºF) | 1.8000 | +32 |
| Degree Fahrenheit (ºF) | Degree Celsius (ºC) | 0.5556 | -17.7778 |
| Feet (ft) | Meter (m) | 0.3048 | - |
| Inches (In) | Millimeter (mm) | 25.4000 | - |
| Inches of Mercury (in.Hg) | Millibar (mb) | 33.8636 | - |
| Kilogram (kg) | Pounds (lb) | 2.2046 | - |
| Kilogram force per Square meter ($kgf/m^2$) | Pound per Square Inch (psi) | 0.0014 | - |
| Kilometer (km) | Nautical Mile (nm) | 0.5396 | - |
| Kilometer per hour (km/h) | Knot (kt) | 0.5396 | - |
| Knot (kt) | Kilometer per hour (km/h) | 1.8532 | - |
| Pounds (lb) | Kilogram (kg) | 0.4536 | - |
| Meter (m) | Feet (ft) | 3.2808 | - |
| Millibar (mb) | Inches of Mercury (in.Hg) | 0.0295 | - |
| Millimeter (mm) | Inches (In) | 0.0394 | - |
| Nautical Mile (nm) | Kilometer (km) | 1.8532 | - |
| Pound per Square Inch (psi) | Kilogram force per Square meter ($kgf/m^2$) | 703.0740 | - |

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# EICAS VERSIONS

### VERSIONS 14A AND 15A

- Fix the Pitch Trim Runaway Monitoring logic (airplanes equipped with EICAS 14 or 15 are not allowed to use the Autopilot below 1500 ft).

### VERSION 14

- CAT II capability.

### VERSION 15

- Oil pressure green indication increased to 95 psi and red above it (on EICAS 14 it was green up to 90 psi and amber above it).
- Higher brake temperature limits for LR brakes.
- ICE/SPS ADVANCED renamed SPS/ICE SPEEDS.
- Flaps 18 capability.
- Autopilot “wing rocking” improvements.

### VERSION 15B

- Fixes the nuisance “Check PFD” message.

### VERSION 16

- ENG1 (2) REV DISAGREE message logic improved in order to avoid spurious alarms.
- RUD HDOV PROT FAIL message logic improved in order to avoid spurious alarms.
- Enhanced engine Time Limited Dispatch (TLD) incorporated:
  - E1 (2) CTL A (B) DEGRAD removed;
  - E1 (2) CTL A (B) FAIL revised (indicates loss of CVG/MMV control);
  - E1 (2) NO DISP incorporated;
  - E1 (2) SHORT DISP incorporated.

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- Improvements in other engine messages not TLD related:
  - E1 (2) LOW N1 revised (available only for takeoff below V1-15);
  - ENG1 (2) OUT incorporated;
  - ENG 1-2 OUT incorporated;
  - ENG1 (2) TLA FAIL revised;
  - FADEC ID NO DISP incorporated;
  - CHECK xxx PERF incorporated;
  - E1 (2) ADC DATA FAIL removed.
- New FD control laws with different gain programming for FD modes in order to improve the Flight Director capture speed.
- Incorporation of the VERTICAL and LATERAL MODE OFF messages.
- IC CONFIG FAIL cyan message (dispatchable) created to indicate a IM-600 failure and use by the IC-600 of the latest IM-600 valid data.
- CONFIG MISMATCH cyan message (no takeoff) created to indicate that there is a discrepancy in the configuration module (IM-600) of each IC-600. The configuration module stores several aircraft configuration parameters.

**VERSION 16.5**

- Anti-Icing system improvements (new messages and logic):
  - A/I LOW CAPACITY incorporated;
  - WG1 (2) A/ICE FAIL and WG ASYMETRY removed;
  - WG A/ICE FAIL incorporated;
  - ENG A/ICE OVERPRES incorporated;
  - ENG1 (2) A/ICE FAIL renamed to E1 (2) A/ICE FAIL.
- TAT 1-2 HEAT INOP logic changed to improve TAT and SAT indications and to increase the probes life.
- Brake messages logic changed to avoid failure messages due to power drop during APU start on ground.
- A1P and A1/3 thrust labels renamed from ALT T/O and T/O, to T/O and T/O RSV respectively.
- ATTCS NO MRGN improvements for the A3 engine.
- Support to the 8.33 kHz tune function in the FMZ 2000 FMS.
- APU FUEL LO PRESS logic changed to avoid spurious messages during APU pressure transients.
- Support to Inertial System (IRS) as an AHRS replacement.
- Improvement in the Cabin Pressure Control System (CPCS) indication in order to avoid unnecessary amber indication on the EICAS.

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- Correction of Autopilot disconnection logic discrepancy when a windshear condition is detected (removes the AFM limitation regarding use of Autopilot coupled to FD#2 below 1500 ft).
- Flight Director Altitude Pre-selection Mode Capture logic improved.
- LNAV Flight Director logic changed when PFD FMS NAV source is changed from FMS 1 to 2 or vice-versa, in order to drop the LNAV FD mode. This change makes the FMS lateral navigation modes consistent with the VOR & LOC FD modes.
- Correction of nuisance LATERAL/VERTICAL MODE OFF messages when both FD are deselected by the pilots.
- Correction of nuisance LATERAL MODE OFF message when the pilot actuates the Turn Knob with a lateral mode (HDG, NAV, APR) active.
- CHK IC CONFIG amber message (no takeoff) created to replace the CONFIG MISMATCH message in case of discrepancy between the following information stored in the IM-600: 135 or 145, Engine Type, Long Range Fuel Tank or English/Metric Units. CONFIG MISMATCH is still active in case of discrepancy of the other parameters that do not trigger the CHK IC CONFIG message.
- Oil pressure green indication increased to 115 psi in takeoff mode.

**VERSION 17**

- Provides interface with the Head-Up Guidance System to allow CAT IIIa operation.
- Inclusion of FDR additional parameters according to FAR 121.344.
- Autopilot improvement in the FD VOR mode capture and tracking for VOR stations without an associated DME.
- Provides crosscheck of the CAT 2 annunciators in both PFD, avoiding a green CAT 2 indication on one side and an amber CAT 2 indication on the opposite side.
- Automatic Radio Altimeter reversion in the case of one RA inop on aircraft equipped with two RA's.
- Adjustments to the Fuel Quantity indication on the MFD, adjusting scale according to the airplane version.
- Inclusion of several messages related to IRS system.
- ATTCS NO MRGN message logic improvements.
- Electrical system display improvements : valid GPU 0V voltage and valid Generator 0A amperage.
- Oil Pressure limits presented in both amber and red bands above the green one.

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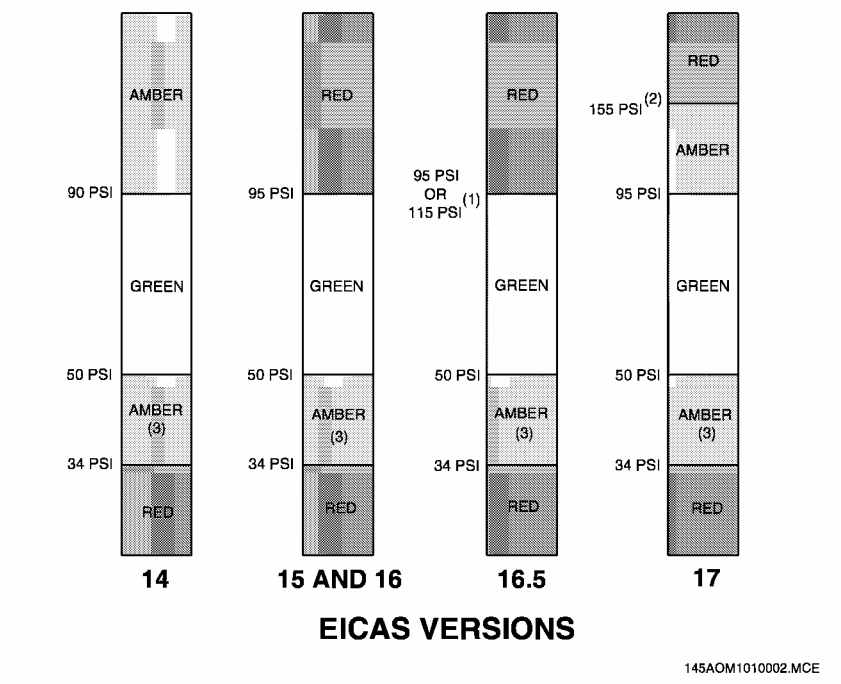
## OIL PRESSURE INDICATION




(1) For any takeoff thrust mode selected and TLA higher than 65º or with thrust levers set to firewall (go-around), the upper limit of the green band is 115 psi. In all other thrust ratings it is 95 psi.

(2) For EICAS version 17 with FADEC B 5.1.1 the amber band upper limit is 155 psi.

(3) For N2 < 88% the amber band between 34 psi and 50 psi does not exist, and the green band lower limit is 34 psi.

(4) For EICAS 14, a placard is installed in the cockpit allowing the operation in the amber band, between 91 and 115 psi, during the takeoff and go-around phases, time limited to 5 minutes.

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**VERSION 18 AND 18.5**

- Pitch Trim System:
  - New caution messages PTRIM CPT SW FAIL, PTRIM F/O SW FAIL and PTRIM BKP SW FAIL;
  - PTRIM 1(2) INOP renamed to PTRIM MAIN INOP and PTRIM BACKUP INOP.
- Autopilot system improvements:
  - Improved localizer capture performance using AP/FD, especially when under crosswind conditions;
  - Roll Command inbound during LOC capture;
  - New Roll Rate limit (7.5 degrees/sec) and Bank Angle limit (30.0 degrees) for ILS Approach mode and LNAV mode in Terminal and Approach phases;
  - Cancellation of APR light on Flight Guidance Controller (GC550) when glide slope mode is cancelled;
  - Inhibition of VERTICAL MODE OFF message if the FD mode is cancelled by changing the preselected altitude;
  - Inhibition of VERTICAL MODE OFF and/or LATERAL MODE OFF messages if a lateral and/or a vertical FD mode is cancelled by transferring the FD control to the cross-side;
  - Improvements in the Autopilot system to prevent the AP from disconnecting when the speed brake is deployed while operating in Touch Control Steering (TCS) mode;
  - Inhibition of LATERAL MODE OFF message when the navigation source is changed from one FMS to the cross-side FMS when LNAV mode is armed.
- HGS:
  - Modification on the expanded localizer scale/display on the PFD to help pilot in Cat IIIa operations;
  - Information to HGS that TOGA button was pressed;
  - Change of HGS FAIL from ADVISORY to AMBER (caution) to comply with AC 120-28D requirements.
- AHRS:
  - New advisory messages AHRS 1-2 NO PPOS, AHRS 1-2 NO MAG HDG.

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**VERSION 19**

The EICAS 19 features implemented in the software are described below:

Air conditioning system

- The Bleed Temperature Pointers were modified to remain amber at all the times that the messages BLD 1(2) LOW TEMP are displayed.

Brake System

- New digital brake temperature indication on MFD **(if IM-600 Digital BRK TEMP parameter is enabled).**

EICAS Internal Logic

- New message DAU AC ID MISCMP.

Electrical System

- GPU Voltage Indication modified in order to avoid dashes when the indication should be 0 V.

Flap System

- Flap 22 indication in red on EICAS display and NO TAKEOFF CONFIG message when the aircraft is not certified to take off with flaps 22º.

Fuel System

- New Message FUEL EQ XFEED OPN to inform that the imbalance was correct and the crossfeed valve is still open.
- Fuel Test Page units label modified in order to show the correct English/Metric configuration.

General Changes

- Synchronization of the Speed Target Bug with the previous selected Speed Target instead of synchronizing with the current aircraft's speed shown on the Speed Tape when VS Vertical Flight Director Mode is de-selected.
- Windshear indication on PFD always in red when RA test button is pressed.
- Due to mandatory installation of IM-600 on this EICAS version and on, the CAT II Operation is available and indicated.

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Anti Ice System

- PITOT 1-2-3 INOP messages modified in order to avoid spurious occurrences during APU starting.

Powerplant System

- ENG NO TO DATA message modified in order to avoid an unlikely scenario of a takeoff performed with only one engine running.
- New messages :
  - CHECK A1E PERF **(only applicable to EMB-145 XR model)**,
  - E1-2 FPMU NO DISP **(only applicable to EMB-145 XR model)**,
  - E1-2 EXCEEDANCE.
- A1E thrust rating modes included on EICAS/RMU/MFD.
- New upper range limit for fuel flow indication due to A1E engine.
- ITT and N2 Dynamic Redlines.
- Oil Pressure Indication modified in order to avoid spurious indication of low oil pressure values.
- ENG 1-2 REV DISAGREE message change in order to avoid a failure without indication on EICAS.

Pressurization System

- Changes to Cabin Altitude Rate.
- New function HIGH ALT on MFD Bezel **(only applicable to EMB-145 XR model).**
- New message HI ALT LDG-T/O **(only applicable to EMB-145 XR model).**
- Changes to cabin altitude indication on EICAS display.

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**VERSION 20.5**

The EICAS 20.5 features implemented in the software are described below:

Air conditioning system

- "BLEED 1(2) VLV CLSD" message logic improved in order to avoid spurious alarms.

Fuel System

- "FUEL VENT OPEN" and "FUEL XFER INOP" messages logic improved in order to avoid spurious alarms **(only applicable to EMB-145 XR model)**.

Powerplant System

- "ENG1(2) REV DISAGREE" message logic improved in order to avoid spurious alarms.

Pressurization System

- "HI ALT LDG-T/O" message changed from caution to advisory **(only applicable to airplanes properly equipped for High Altitude Operation)**.

Navigation System

- The Radio Altimeter indication was modified in order to reduce the discrepancy between the current altitude of the airplane and the PFD Radio Altitude indication.

Autopilot System

- Pitch Wheel Command Integrator - Correction to avoid poor Autopilot response when using the Pitch Wheel while coupled to the copilot's Flight Director, which may cause the Autopilot logic to reset an integrator, resulting in sluggish Autopilot response.
- Pitch Axes - Correction to avoid Autopilot nuisance disconnection due to the Pitch Primary Monitor during the Coupled Autopilot Go-Around test **(only applicable to EMB-145 XR model)**.

General Changes

- New AZ-950 MADC Maintenance Page on PFD.

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**VERSION 20.7**

The EICAS 20.7 features implemented in the software are described below:

Autopilot:

- Autopilot disengagement without aural warning Correction: It was verified that under certain circumstances the autopilot can disengage without aural warning. It occurs when autopilot is engaged and TCS button pressed. If any pitch trim switch is commanded while the TCS is being released the autopilot disengages with no aural warning. The same situation can occurs when deploying/retracting speed brake simultaneously to TCS releasing, due to the automatic pitch trim command during speed brake actuation.
- Symbol Generator Reversion Correction: It was verified an abnormal behavior in the Automatic Flight Control System when a Symbol Generator reversion occurs on the pilot side. In this case the Autopilot reverts to basic mode and automatically couples to the co-pilot Flight Director as expected. If a vertical mode is selected to either climbing or descending following the Symbol Generator reversion, the Autopilot will not hold the pre-selected altitude although the Flight Director bars indicate level off and the PFD shows the correct mode transition from the selected vertical mode to ASEL mode and from ASEL mode to ALT HOLD mode.
- CAT II operation at Providence Airport: Automatic Flight Control System changes were required in order to allow CAT II operation at Providence Airport, which has a RA Minimums of 80 ft. The current RA Minimums interval does not include 80 ft. Therefore, the 80 ft RA Minimums was included in the CAT II logic to allow proper operation in this airport.
- Roll Oscillation Solution at high altitudes: Yaw Damper control law was modified in order to minimize the roll oscillation observed at high altitudes when autopilot is engaged. This modification is enabled only in the 135 family airplane (EMB-135ER, EMB-135LR and EMB-135BJ) via IM-600 new parameter called RUDDER BIAS.

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HGS:

- HGS compatibility issue: version 20.7 (Phase 10.7) shall correct the compatibility issue between EICAS Version 20.5 (Phase 10.5) and HGS equipped airplane. Therefore the RA value shall be displayed again on the HGS combiner. There will be no modifications on the HGS system.

Ice Protection:

- "ICE COND-A/I INOP" message logic change: in the previous logic, under ice condition on the ground, this message may undesirably appear because the Anti-Ice protection is not activated. In the current logic, on ground, if the Thrust Lever is positioned below Thrust Set, and N2 is below 53.6%, then the message is inhibited. Besides, it was included a time delay of 5 seconds to activate the message.

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**VERSION 24 (ONLY APPLICABLE TO AIRPLANES POST-MOD. SB 145-34-0125)**

The EICAS 24 features implemented in the software are described below:

Navigation and Communication systems

- New message:
  - CHECK XPDR.
- TCAS OFF and TCAS FAIL annunciations on PFD/MFD flash for 10 s and remain steady displayed as long as the condition persists.

Landing Gear and Brakes system

- With the conditions for Landing Gear in Transit position unchanged for more than 20 seconds, the following occurs:
  - The indication crosshatched in amber and black turns to red and black, and
  - The EICAS message LG/LEVER DISAGREE is displayed.

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# SERVICE BULLETIN TABLE

| SB | SUBJECT |
|---|---|
| SB 145-00-0025 | Installation of a placard containing the Maximum Zero Fuel Weight (MZFW) increased from 15600 kg (34392 lb) to 16000 kg (35274 lb). |
| SB 145-00-0028 | Increases the MTOW of the EMB-135ER Model. |
| SB 145DGR-34-0002 | Installation of the ADS-B (Automatic Dependent Surveillance - Broadcast) out system (Universal FMS). |
| SB 145-00-0031 | Configures airplane for Operations on Runways up to 8500 ft. |
| SB 145-00-0032 | Modifications to meet increased MTOW and MZFW requirements. |
| SB 145-00-0033 | Installation of a placard stating certification for Operations on Runways up to 8500 ft. |
| SB 145-21-0006 | Replaces the Air Conditioning Digital Controller. |
| SB 145-21-0011 | Improves the air conditioning in the Passenger Cabin. |
| SB 145-21-0050 | Modification for airplane Operations on Runways up to 10000 ft. |
| SB 145-22-0001 | Configures airplane for CAT II Operation. |
| SB 145-23-0003 | Introduces VHF Channel Spacing of 8.33 KHz. |
| SB 145-23-0028 | Incorporates aural alert for CMU message. |
| SB 145-25-0261 | Baggage Compartment Liner reinforcement. |
| SB 145-25-0287 | Installs cut out access to unlock jammed Slide Door. |
| SB 145-25-0302 | Improvements on the Lavatory Bifold Door. |
| SB 145-26-0004 | Replacement of the Smoke Detector Sensor in the Baggage Compartment for Class “C”. |
| SB 145-26-0007 | Engine and APU Fire Extinguish Bottle Monitoring Systems - modification to Electrical Circuitry. |

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# SERVICE BULLETIN TABLE

| SB | SUBJECT |
|---|---|
| SB 145-26-0014 | Smoke Detector Sensor replacement. |
| SB 145-27-0015 | Inclusion of movable primary stop on Rudder Control System. |
| SB 145-27-0100 | HSCU replacement. |
| SB 145-27-0101 | Electromechanical Gust Lock new logic. |
| SB 145-27-0115 | Electromechanical Gust Lock Lever redesign. |
| SB 145-27-0125 | Electromechanical Gust Lock Caution Light new operation logic. |
| SB 145-27-0126 | Electromechanical Gust Lock Lever redesign. |
| SB 145-28-0018 | Installation of High Level Exceeding Indication System. |
| SB 145-30-0019 | Improves the Piccolo Burst Monitoring System. |
| SB 145-30-0021 | Replaces the Anti-Icing System Valves. |
| SB 145-30-0028 | Installs the new TAT Sensor Heater Electrical Configuration. |
| SB 145-30-0033 | Incorporates changes to the Windshield Heating System. |
| SB 145-30-0054 | Cockpit Windshield Wiper System removal and rain repellent coating application. |
| SB 145-30-0055 | Cockpit Windshield Wiper System reinstallation. |
| SB 145-31-0009 | Incorporates EICAS 15A Version. |
| SB 145-31-0016 | Incorporates EICAS 16.5 Version. |
| SB 145-31-0020 | Incorporates EICAS 17 Version. |
| SB 145-31-0021 | Includes a new Oil Pressure Sensor. |
| SB 145-31-0022 | Improves the strap for CAT II configuration for EICAS 16.5 Version. |
| SB 145-31-0028 | Replaces AWU. |

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# SERVICE BULLETIN TABLE

| SB | SUBJECT |
|---|---|
| SB 145-31-0038 | Incorporates Modifications to Extend the Speed Envelope of the EMB-145XR Model. |
| SB 145-31-0040 | Configures the EMB-145XR Model for CAT II Operation. |
| SB 145-31-0042 | Incorporates EICAS 20.5 Version. |
| SB 145-31-0051 | Replaces AWU-5 and previous versions by AWU-6. |
| SB 145-31-0057 | IC-600 upgrade to version 24. |
| SB 145-32-0002 | Changes the Travel Limits of the Nose Wheel Steering System. |
| SB 145-32-0030 | Replaces Brakes, Tires and Wheels for the LR Version. |
| SB 145-32-0057 | Nose Wheel Steering Disengagement Switch installation. |
| SB 145-32-0065 | Incorporates the use of Towbarless Tug. |
| SB 145-32-0086 | Incorporates the use of Towbarless Tug. |
| SB 145-32-0102 | Incorporates the use of Towbarless Tug. |
| SB 145-32-0104 | Changes Nose Wheel Steering System logic. |
| SB 145-33-0040 | Provides instructions to disable temporarily and enable the Dim Mode of the Cabin Lighting System. |
| SB 145-34-0046 | Improves TCAS/AWU interface. |
| SB 145-34-0049 | Changes the Integrated Standby Instrument System (ISIS) into new P/N C16221GC03 - Amendment A. |
| SB 145-34-0088 | Introduces time delay in the transition from Landing to Go-Around configuration. |
| SB 145-34-0089 | Incorporates modifications related to Mode S Elementary Surveillance Transponders. |

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# SERVICE BULLETIN TABLE

| SB | SUBJECT |
|---|---|
| SB 145-34-0096 | Incorporates modifications related to Mode S Enhanced Surveillance Transponders. |
| SB 145-34-0106 | Reconfiguration of the TCAS Performance Limit. |
| SB 145-34-0112 | Direct connect EGPWS to GPS Universal information and upgrades EGPWS software version to -228. |
| SB 145-34-0116 | Electronic Flight Bag (EFB) Upgrade from WINDOWS XP to WINDOWS 7. |
| SB 145-34-0117 | EGPWS upgrade to PN 965-0976-003-228-228. |
| SB 145-34-0118 | Installs the ADS-B Out on airplanes equipped with Honeywell FMS (FMZ2000). |
| SB 145-34-0121 | Installs the ADS-B Out on airplanes equipped with Universal FMS (UNS-1K). |
| SB 145-34-0123 | Installs the FMZ2010 Honeywell FMS (FMS 6.1.1). |
| SB 145-34-0125 | Installs LPV and Baro-VNAV. |
| SB 145-35-0008 | Rework of the Oxygen Module Assembly. |
| SB 145-36-0028 | Changes EBV S/O Valve by a Pressure Regulator Valve. |
| SB 145-36-0030 | Improves the Bleed Air Leak Detection System. |
| SB 145-49-0010 | Improves the Auxiliary Power Unit (APU). |
| SB 145-49-0012 | Changes Auxiliary Power Unit (APU) Electronic Sequence Unit (ESU) feeder bus. |
| SB 145-49-0014 | Replaces the APU Air Inlet Frame. |
| SB 145-49-0025 | Improvement of APU starting conditions. |
| SB 145-52-0040 | Lock Pin installation. |
| SB 145-53-0064 | Increases the MZFW of the EMB-145ER and EP Models. |
| SB 145-53-0065 | Reduces MTOW of the EMB-145LR Model. |
| SB 145-53-0066 | Updates MTOW of the EMB-145LR Model. |

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# SERVICE BULLETIN TABLE

| SB | SUBJECT |
|---|---|
| SB 145-53-0068 | Increases the maximum gross weights of the EMB-145LR Model. |
| SB 145-71-0003 | Implements the Protection Guard for the Engine Start Switches. |
| SB 145-73-0010 | Incorporates FADEC B5.1.1 Version on AE3007A and A1/1 Engines. |
| SB 145-73-0011 | Incorporates FADEC B5.1.1 Version on AE3007A1 Engines. |
| SB 145-73-0012 | Incorporates FADEC B5.1.1 Version on AE3007A1P Engines. |
| SB 145-73-0013 | Incorporates FADEC B5.1.1 Version on AE3007A1/3 Engines. |
| SB 145-73-0014 | Incorporates FADEC B5.1.1 Version on AE3007A3 Engines. |
| SB 145-73-0021 | Incorporates FADEC B7.6 Version on AE3007A and A1/1 Engines. |
| SB 145-73-0022 | Incorporates FADEC B7.6 Version on AE3007A1 Engines. |
| SB 145-73-0023 | Incorporates FADEC B7.6 Version on AE3007A1P Engines. |
| SB 145-73-0024 | Incorporates FADEC B7.6 Version on AE3007A1/3 Engines. |
| SB 145-73-0025 | Incorporates FADEC B7.6 Version on AE3007A3 Engines. |
| SB 145-73-0026 | Incorporates FADEC B7.6 Version on AE3007A1E Engines. |
| SB 145-73-0027 | Incorporates FADEC B8.0 Version on AE3007A1P Engines. |
| SB 145-73-0028 | Incorporates FADEC B8.0 Version on AE3007A1E Engines. |
| SB 145-73-0029 | Incorporates FADEC B8.0 Version on AE3007A1 Engines. |

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# SERVICE BULLETIN TABLE

| SB | SUBJECT |
|---|---|
| SB 145-73-0030 | Incorporates FADEC B8.0 Version on AE3007A1/1 Engines. |
| SB 145-73-0031 | Incorporates FADEC B8.0 Version on AE3007A1/3 Engines. |
| SB 145-77-0002 | Includes Placard for 95 psi Oil Pressure Limit. |
| SB 145-77-0003 | Includes Placard for 115 psi Oil Pressure Limit. |
| SB 145-77-0004 | New EICAS N2 Red Line Margin for A1 and A1/3 Engines. |
| SB T-62T-49-152 | Incorporates Modification to Permit APU Start Above 25000 ft. |

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# SECTION 1-01

# LIMITATIONS

TABLE OF CONTENTS

Page Block

Introduction ..... 1-01-00
General Limitations ..... 1-01-01
Weight and CG ..... 1-01-05
Operational Limitations ..... 1-01-10
Supplementary Operational Limitations (*) ..... 1-01-12
Systems:
- Crew Alerting ..... 1-01-30
- Electrical ..... 1-01-32
- Fuel ..... 1-01-36
- APU ..... 1-01-38
- Powerplant ..... 1-01-40
- Pressurization ..... 1-01-48
- Ice and Rain Protection ..... 1-01-50
- Ozone Concentration ..... 1-01-52
- Navigation, Communication and Autopilot ..... 1-01-56
- FMS ..... 1-01-60
- Doors (*) ..... 1-01-70

Cat II Operation ..... 1-01-80

**NOTE:** Items marked with an asterisk (*) may not be present in this manual.

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# INTRODUCTION

The airplane must be operated in accordance with the limitations presented in this Section. These limitations also apply to operations in accordance with an approved Supplement or Appendix to the AFM, except as modified by such Supplement or Appendix.

The information contained in this section is derived from the Approved Airplane Flight Manual.

Flight crewmembers should have all limitations committed to memory (except tables and charts). Some items may not be included herein, as they may be identified in a panel/placard or annunciated by some kind of alarm/warning. Compliance to the Emergency and Abnormal Procedures will also assure that certain limitations are complied with.

In the event that a limitation in this manual disagrees with the AFM limitation, the AFM must prevail.

In the event that a placard or instrument marking disagrees with the limitations shown in this manual, the more restrictive limitation must prevail.

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# GENERAL

## MINIMUM CREW

Minimum Flight Crew ..... PILOT AND COPILOT

## KINDS OF OPERATION

This airplane may be flown day and night in the following conditions, when the appropriate equipment and instruments required by airworthiness and operating regulations are approved, installed and in an operable condition:

- Visual (VFR);
- Instrument (IFR);
- Icing conditions.

## MAXIMUM NUMBER OF SEATS (NON-AFM)

The maximum number of available seats is 42 on the EMB-135, 49 on the ERJ-140, and 55 on the EMB-145. It includes 2 seats for pilots, 2 for attendants (1 optional), 1 for cockpit observer, and up to 37 passenger seats on the EMB-135, up to 44 passenger seats on the ERJ-140, and up to 50 passenger seats on the EMB-145.

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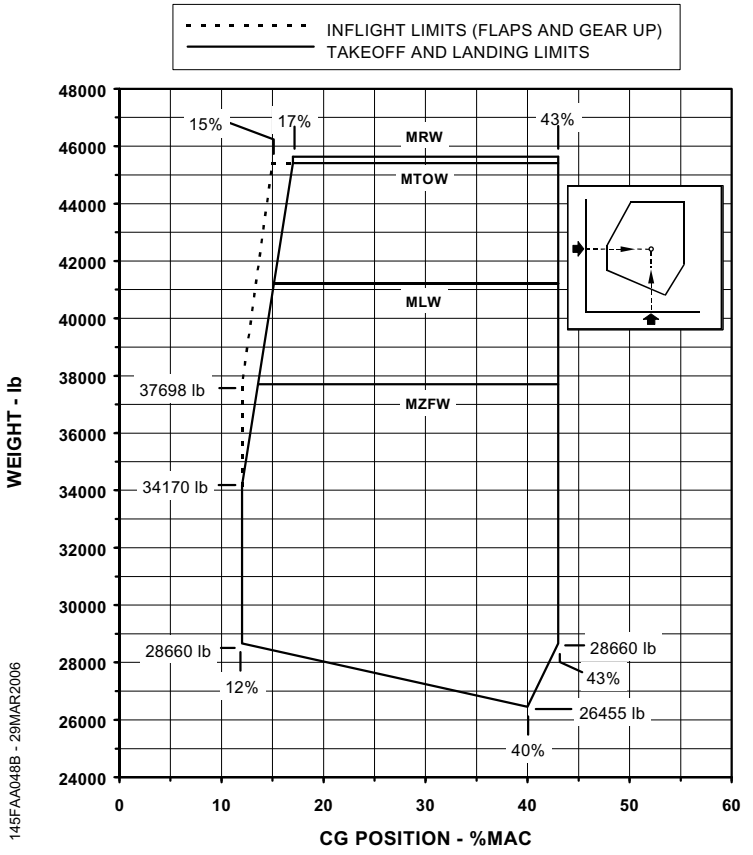
# WEIGHT AND CENTER OF GRAVITY

## EMB-145 ER MODEL - TAKEOFF WITH FLAPS 9°

APPLICABLE TO AIRPLANES PRE-MOD. SB 145-53-0064.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 45635 lb | 45414 lb | 41226 lb | 37698 lb |

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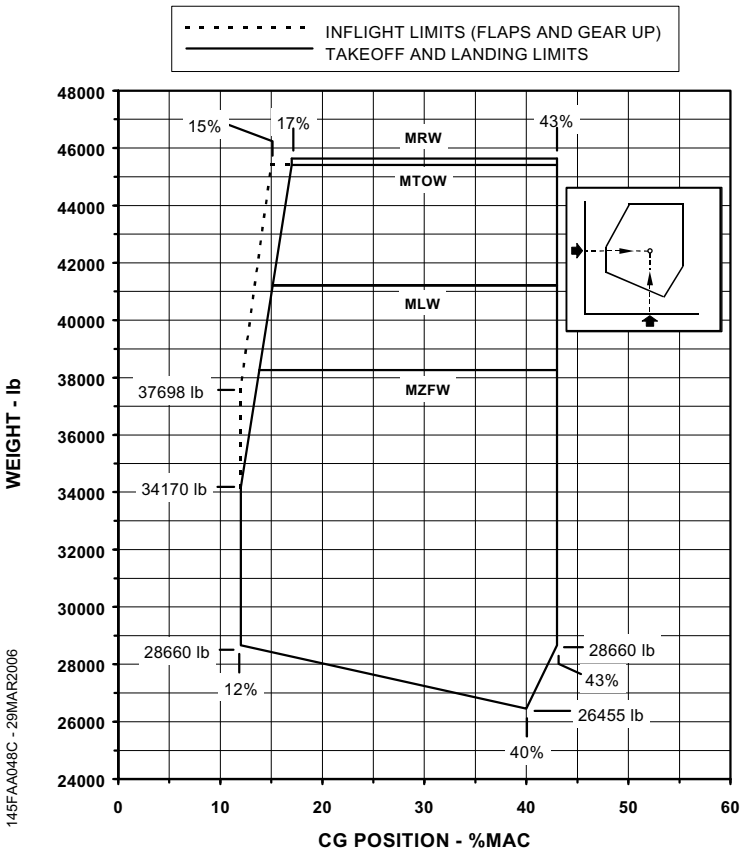
APPLICABLE TO AIRPLANES POST-MOD. SB 145-53-0064 OR EQUIPPED WITH AN EQUIVALENT MODIFICATION FACTORY INCORPORATED.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 45635 lb | 45414 lb | 41226 lb | 38250 lb |

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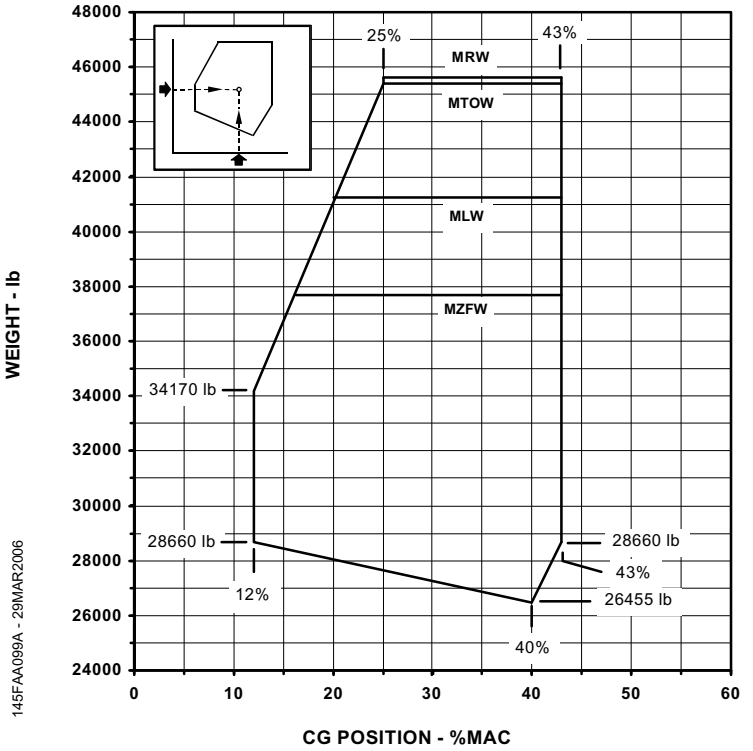
## EMB-145 ER MODEL - TAKEOFF WITH FLAPS 22°

APPLICABLE TO AIRPLANES PRE-MOD. SB 145-53-0064.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 45635 lb | 45414 lb | 41226 lb | 37698 lb |




**NOTE:** For inflight and landing limits refer to standard CG Envelope.

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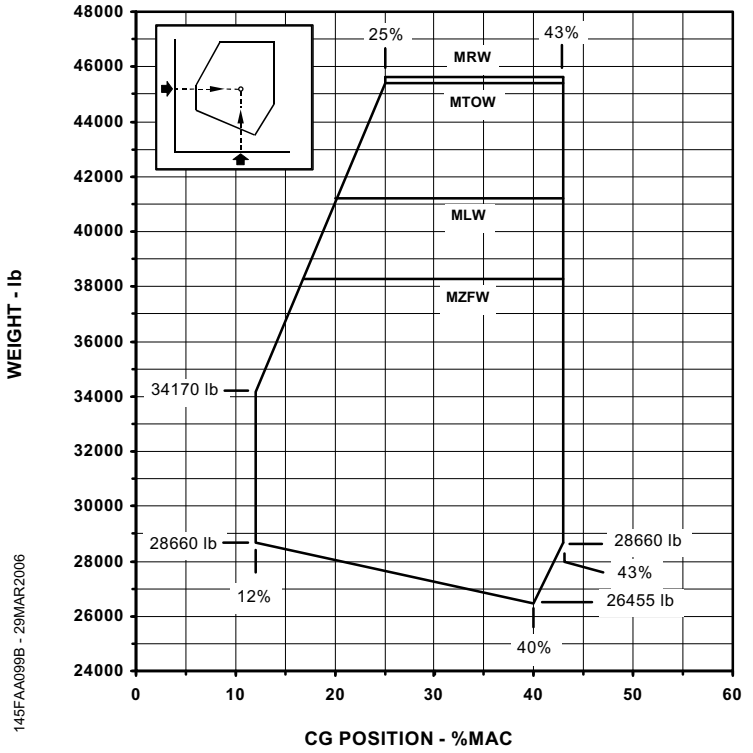
APPLICABLE TO AIRPLANES POST-MOD. SB 145-53-0064 OR EQUIPPED WITH AN EQUIVALENT MODIFICATION FACTORY INCORPORATED.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 45635 lb | 45414 lb | 41226 lb | 38250 lb |




**NOTE:** For inflight and landing limits refer to standard CG Envelope.

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To comply with the performance and operating limitations of the regulations, the maximum allowable takeoff and landing operational weights may be equal to, but not greater than, the design limits.

The takeoff weight (weight at brake release or at start of takeoff run) is the lowest among MTOW and the following weights:

- Maximum takeoff weight for altitude and temperature determined from Maximum Takeoff Weight - Climb Limited chart.
- Maximum takeoff weight, as limited by runway length and determined from Maximum Takeoff Weight - Field Length Limited chart.
- Maximum takeoff weight, as limited by brake energy and determined from Maximum Takeoff Weight - Brake Energy Limited chart.
- Maximum takeoff weight, as limited by obstacle clearance, enroute, and landing operating requirements.

The landing weight is the lowest among MLW and the following weights:

- Maximum approach and landing weight for altitude and temperature determined from Maximum Landing Weight - Climb Limited charts.
- Maximum landing weight, as limited by runway length and determined from Maximum Landing Weight - Field Length Limited chart.

## LOADING

The airplane must be loaded in accordance with the information contained in the Weight and Balance Manual.

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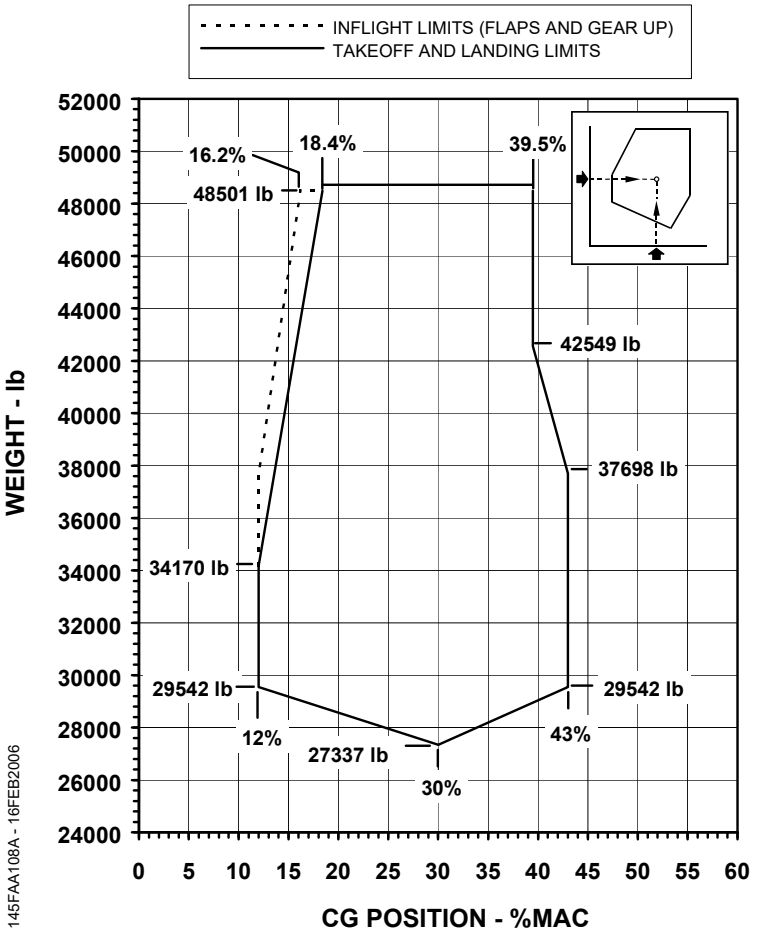
# WEIGHT AND CENTER OF GRAVITY

## EMB-145 LR MODEL - TAKEOFF WITH FLAPS 9° OR 18º

APPLICABLE TO AIRPLANES PRE-MOD. SB 145-53-0068.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 48722 lb | 48501 lb | 42549 lb | 39462 lb |

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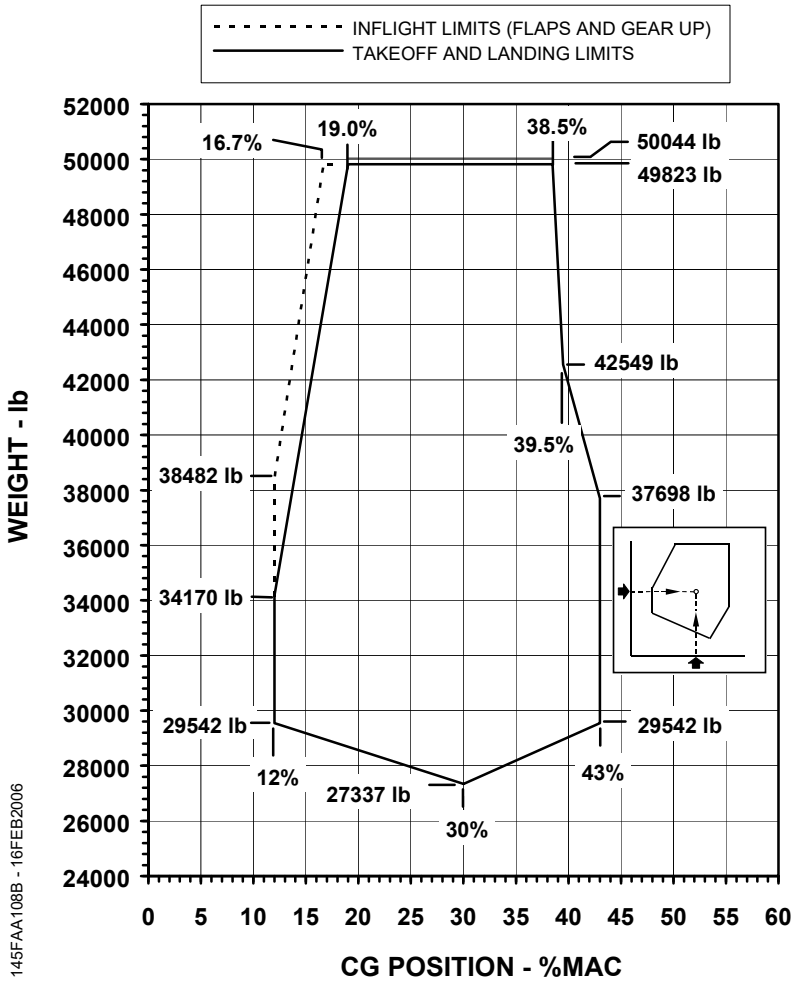
APPLICABLE TO AIRPLANES POST-MOD. SB 145-53-0068 OR EQUIPPED WITH AN EQUIVALENT MODIFICATION FACTORY INCORPORATED.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 50044 lb | 49823 lb | 43651 lb | 40564 lb |

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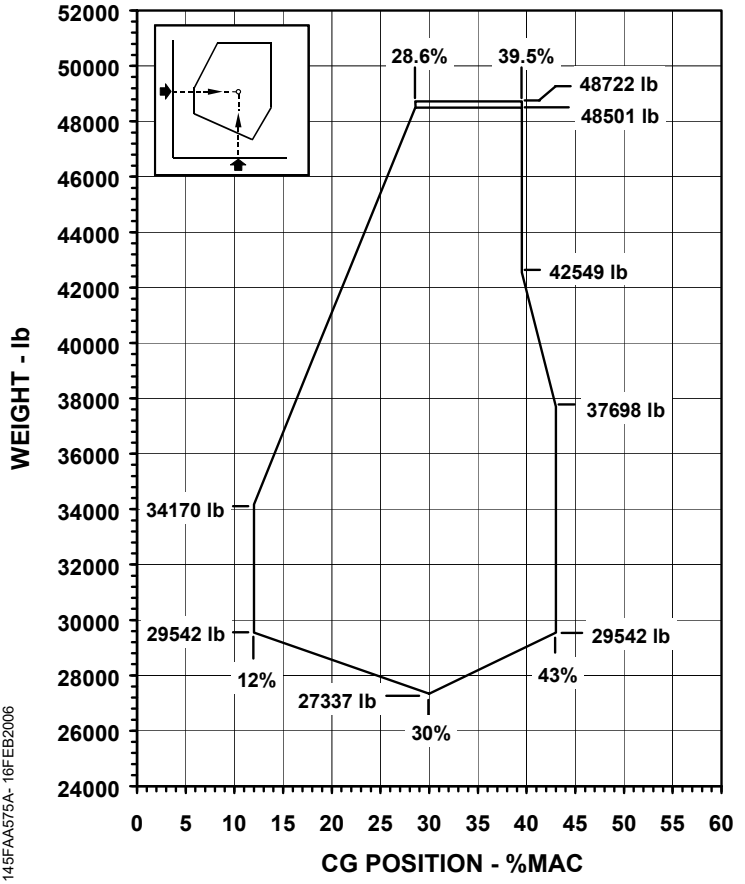
## EMB-145 LR MODEL - TAKEOFF WITH FLAPS 22°

APPLICABLE TO AIRPLANES PRE-MOD. SB 145-53-0068.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 48722 lb | 48501 lb | 42549 lb | 39462 lb |




**NOTE:** For inflight and landing limits refer to standard CG Envelope.



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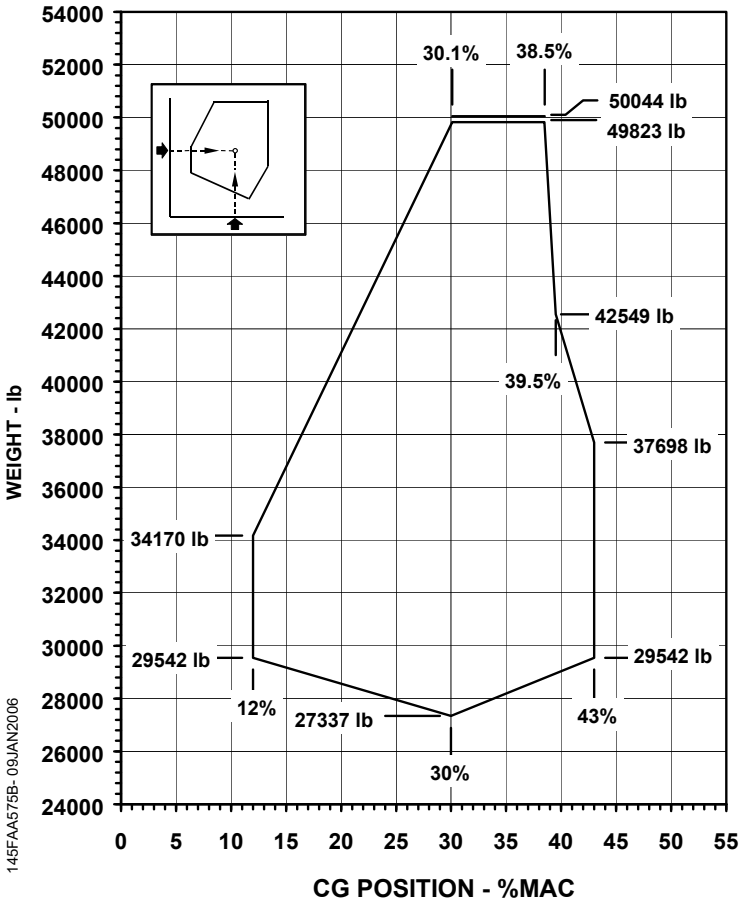
APPLICABLE TO AIRPLANES POST-MOD. SB 145-53-0068 OR EQUIPPED WITH AN EQUIVALENT MODIFICATION FACTORY INCORPORATED.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 50044 lb | 49823 lb | 43651 lb | 40564 lb |

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To comply with the performance and operating limitations of the regulations, the maximum allowable takeoff and landing operational weights may be equal to, but not greater than, the design limits.

The takeoff weight (weight at brake release or at start of takeoff run) is the lowest among MTOW and the following weights:

- Maximum takeoff weight for altitude and temperature determined from Maximum Takeoff Weight - Climb Limited chart.
- Maximum takeoff weight, as limited by runway length and determined from Maximum Takeoff Weight - Field Length Limited chart.
- Maximum takeoff weight, as limited by brake energy and determined from Maximum Takeoff Weight - Brake Energy Limited chart.
- Maximum takeoff weight, as limited by obstacle clearance, enroute, and landing operating requirements.

The landing weight is the lowest among MLW and the following weights:

- Maximum approach and landing weight for altitude and temperature determined from Maximum Landing Weight - Climb Limited charts.
- Maximum landing weight, as limited by runway length and determined from Maximum Landing Weight - Field Length Limited chart.
-

## LOADING

The airplane must be loaded in accordance with the information contained in the Weight and Balance Manual.

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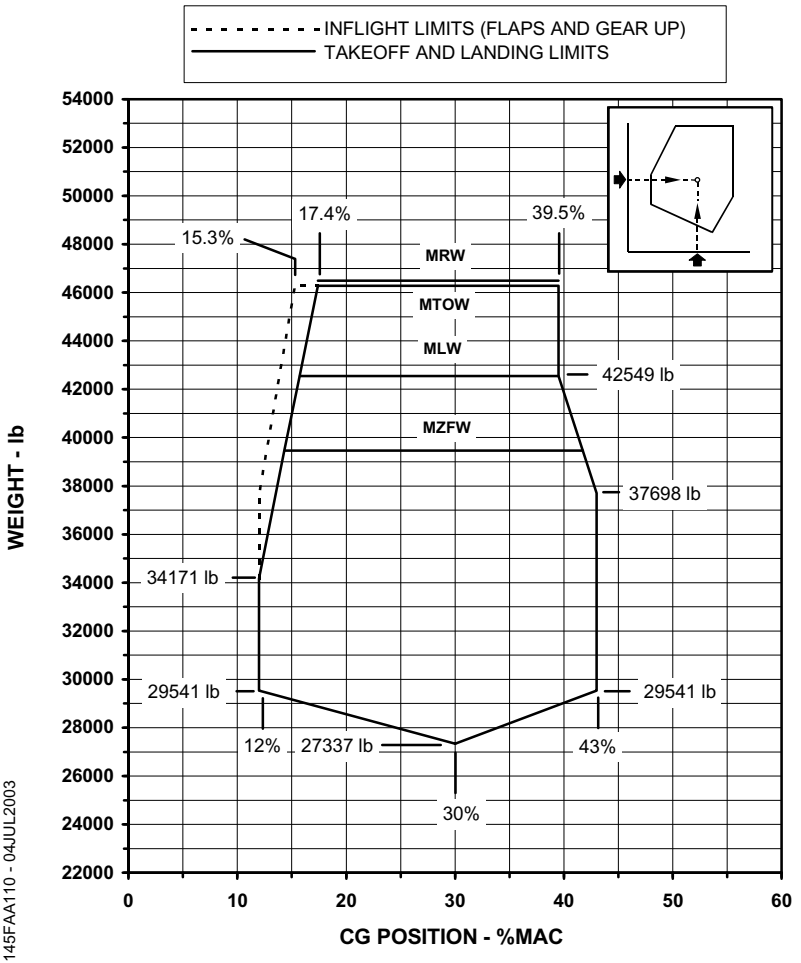
# WEIGHT AND CENTER OF GRAVITY

## EMB-145 MP MODEL - TAKEOFF WITH FLAPS 9°

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| Max. Ramp Weight (MRW) | Max. Takeoff Weight (MTOW) | Max. Landing Weight (MLW) | Max. Zero Fuel Weight (MZFW) |
| 46495 lb | 46275 lb | 42549 lb | 39462 lb |

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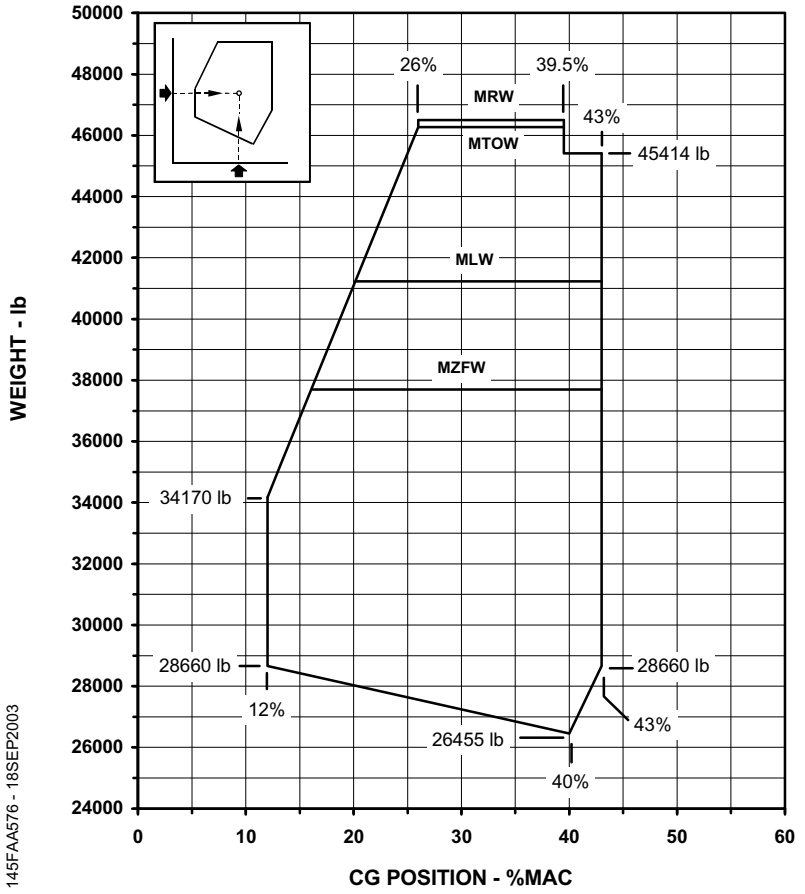
## EMB-145 MP MODEL - TAKEOFF WITH FLAPS 22°

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| Max. Ramp Weight (MRW) | Max. Takeoff Weight (MTOW) | Max. Landing Weight (MLW) | Max. Zero Fuel Weight (MZFW) |
| 46495 lb | 46275 lb | 42549 lb | 39462 lb |

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To comply with the performance and operating limitations of the regulations, the maximum allowable takeoff and landing operational weights may be equal to, but not greater than, the design limits.
The takeoff weight (weight at brake release or at start of takeoff run) is the lowest among MTOW and the following weights:

- Maximum takeoff weight for altitude and temperature determined from Maximum Takeoff Weight - Climb Limited chart.
- Maximum takeoff weight, as limited by (dry or wet) runway length and determined from Maximum Takeoff Weight - Field Length Limited chart (if applicable, determined from Takeoff Distance on Contaminated Runway and Accelerate Stop Distance on Contaminated Runway charts).
- Maximum takeoff weight, as limited by brake energy and determined from Maximum Takeoff Weight - Brake Energy Limited chart.
- Maximum takeoff weight, as limited by obstacle clearance, enroute, and landing operating requirements.

The landing weight is the lowest among MLW and the following weights:

- Maximum approach and landing weight for altitude and temperature determined from Maximum Landing Weight - Climb Limited charts.
- Maximum landing weight, as limited by (dry or wet) runway length and determined from Maximum Landing Weight - Field Length Limited chart (if applicable, determined from Landing Distance on Contaminated Runway charts).

## LOADING

The airplane must be loaded in accordance with the information contained in the Weight and Balance Manual.

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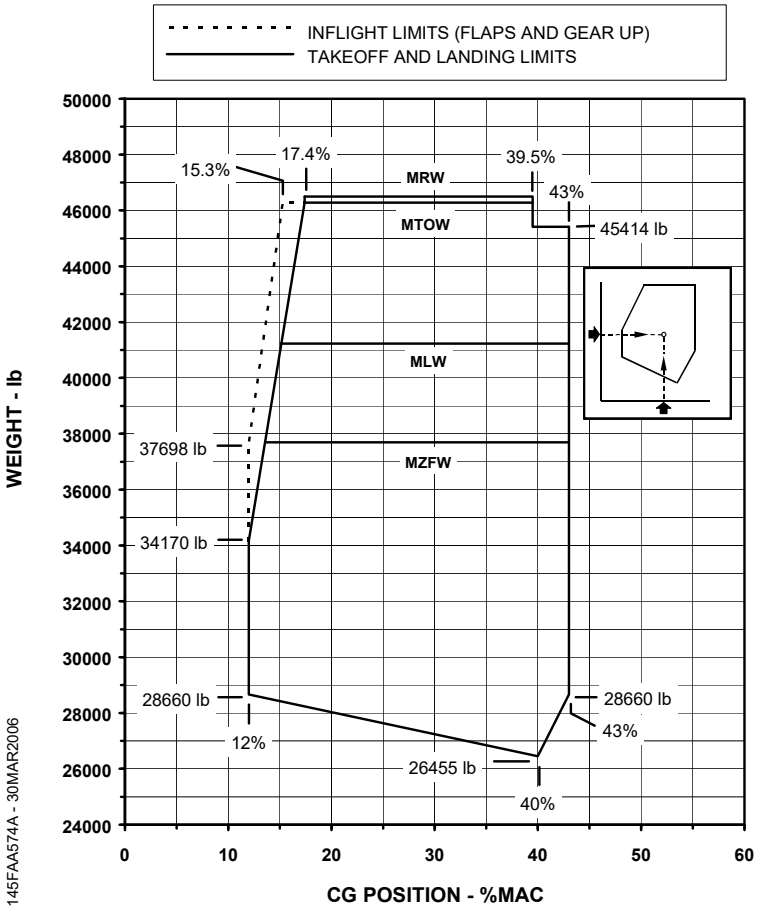
# WEIGHT AND CENTER OF GRAVITY

## EMB-145 EP MODEL - TAKEOFF WITH FLAPS 9° OR 18º

APPLICABLE TO AIRPLANES PRE-MOD. SB 145-53-0064.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 46495 lb | 46275 lb | 41226 lb | 37698 lb |

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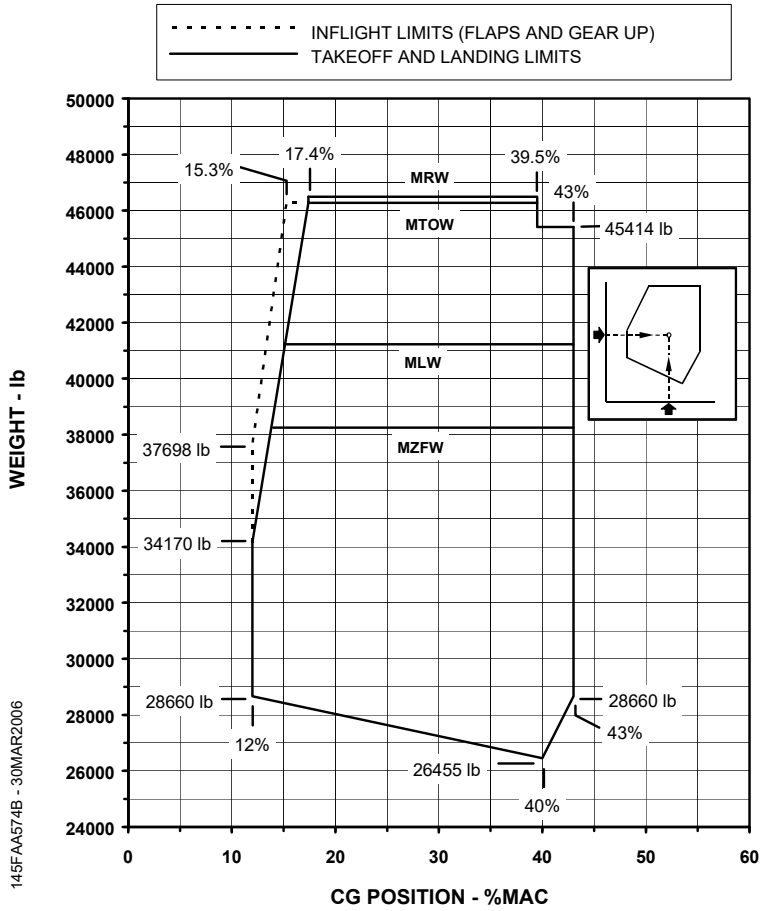
| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 46495 lb | 46275 lb | 41226 lb | 38250 lb |

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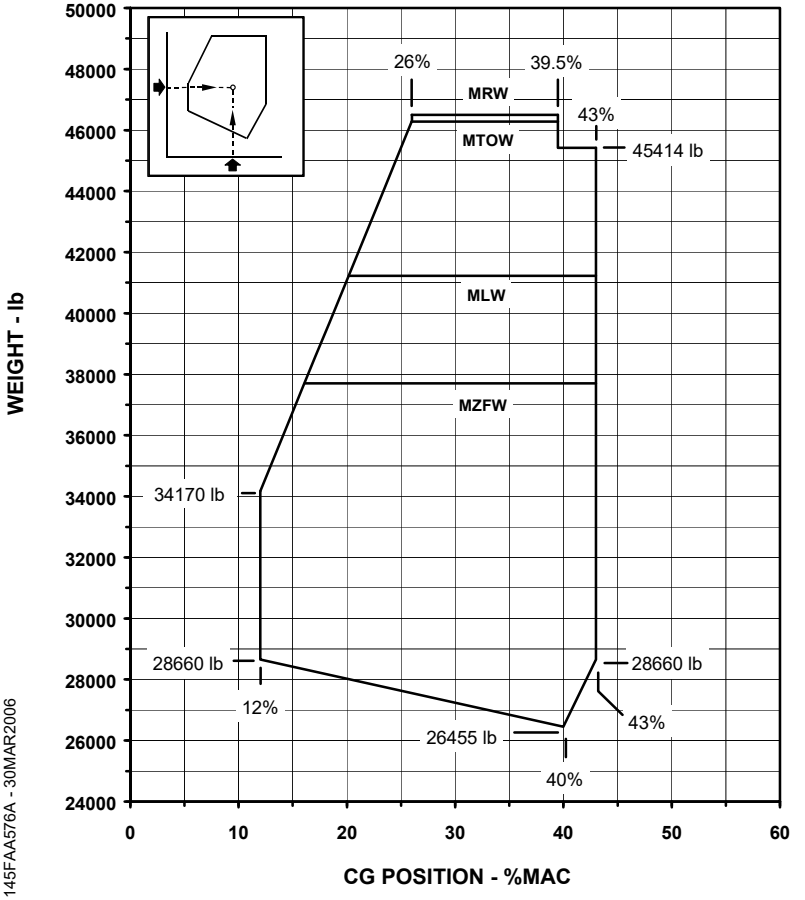
## EMB-145 EP MODEL - TAKEOFF WITH FLAPS 22°

APPLICABLE TO AIRPLANES PRE-MOD. SB 145-53-0064.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 46495 lb | 46275 lb | 41226 lb | 37698 lb |




**NOTE:** For inflight and landing limits refer to standard CG Envelope.

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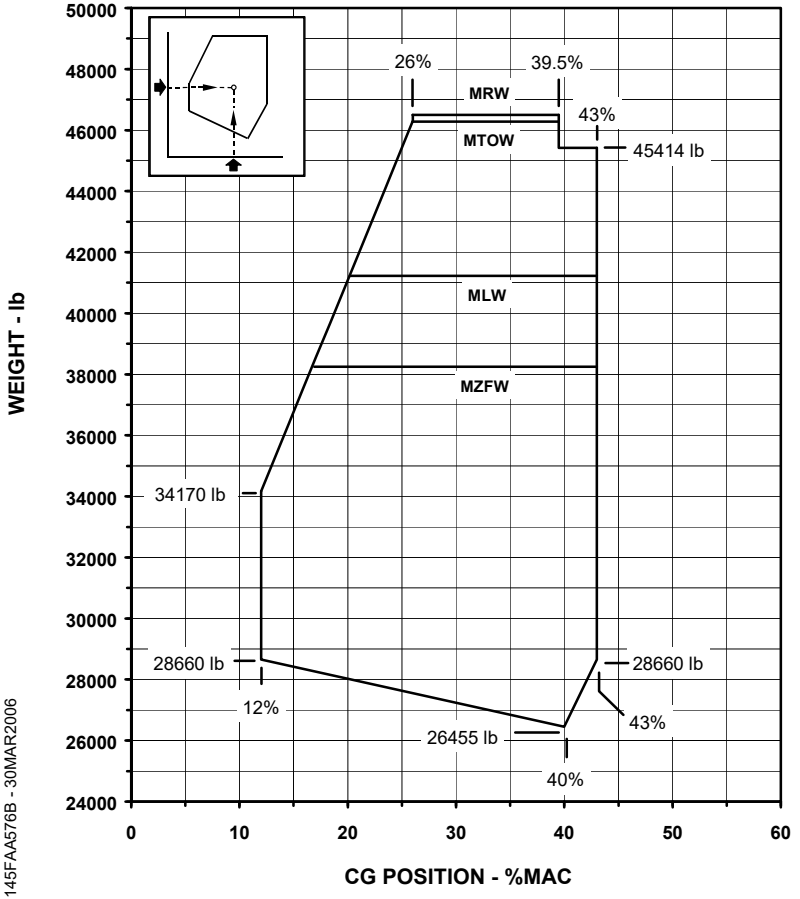
APPLICABLE TO AIRPLANES POST-MOD. SB 145-53-0064 OR EQUIPPED WITH AN EQUIVALENT MODIFICATION FACTORY INCORPORATED.

| MAXIMUM WEIGHT | | | |
|---|---|---|---|
| **Max. Ramp Weight (MRW)** | **Max. Takeoff Weight (MTOW)** | **Max. Landing Weight (MLW)** | **Max. Zero Fuel Weight (MZFW)** |
| 46495 lb | 46275 lb | 41226 lb | 38250 lb |




145FAA576B - 30MAR2006

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To comply with the performance and operating limitations of the regulations, the maximum allowable takeoff and landing operational weights may be equal to, but not greater than, the design limits.

The takeoff weight (weight at brake release or at start of takeoff run) is the lowest among MTOW and the following weights:

- Maximum takeoff weight for altitude and temperature determined from Maximum Takeoff Weight - Climb Limited chart.
- Maximum takeoff weight, as limited by (dry or wet) runway length and determined from Maximum Takeoff Weight - Field Length Limited chart (if applicable, determined from Takeoff Distance on Contaminated Runway and Accelerate Stop Distance on Contaminated Runway charts).
- Maximum takeoff weight, as limited by brake energy and determined from Maximum Takeoff Weight - Brake Energy Limited chart.
- Maximum takeoff weight, as limited by obstacle clearance, enroute, and landing operating requirements.

The landing weight is the lowest among MLW and the following weights:

- Maximum approach and landing weight for altitude and temperature determined from Maximum Landing Weight - Climb Limited charts.
- Maximum landing weight, as limited by (dry or wet) runway length and determined from Maximum Landing Weight - Field Length Limited chart (if applicable, determined from Landing Distance on Contaminated Runway charts).

## LOADING

The airplane must be loaded in accordance with the information contained in the Weight and Balance Manual.

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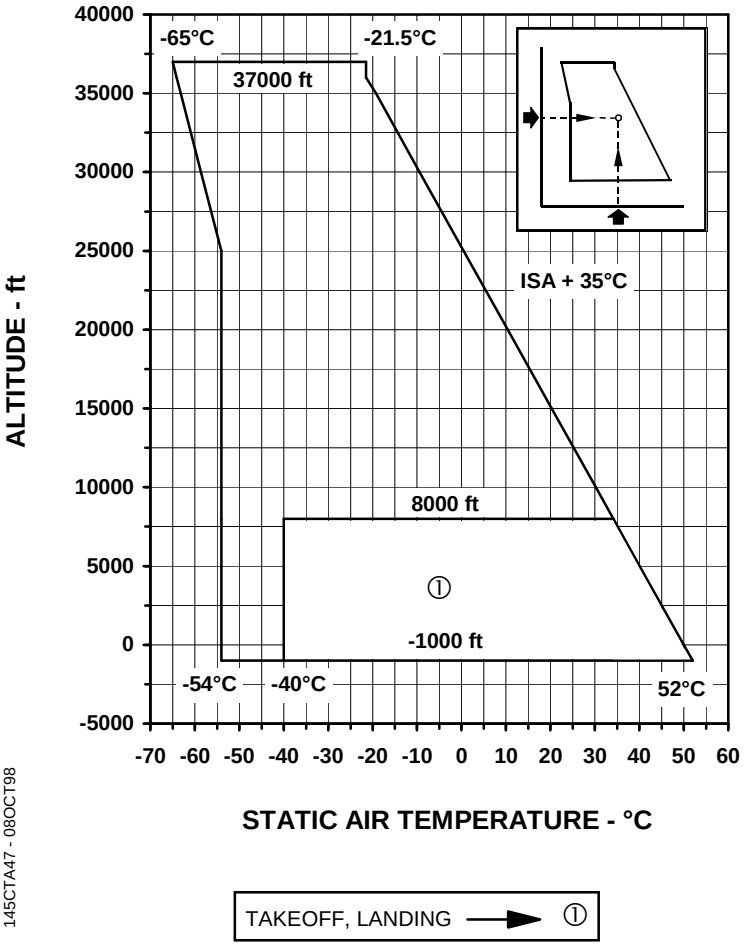
# OPERATIONAL LIMITATIONS

## OPERATIONAL ENVELOPE




**NOTE:** - In the event of a landing below -40°C, the airplane may not takeoff without further maintenance inspection.

- Total Air Temperature in cruise flight above 25000 ft is limited to -45°C. However, if momentary deviations happen to temperature up to -50°C, no maintenance action is required.

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# AIRSPEEDS

## LANDING GEAR OPERATION/EXTENDED SPEED ($V_{LO}$ AND $V_{LE}$)

$V_{LO}$ for retraction ..... 200 KIAS
$V_{LO}$ for extension ..... 250 KIAS
$V_{LE}$ ..... 250 KIAS

**NOTE: -** $V_{LO}$ for retraction is the maximum speed at which the landing gear can be safely retracted.
- $V_{LO}$ for extension is the maximum speed at which the landing gear can be safely extended.
- $V_{LE}$ is the maximum speed at which the airplane can be safely flown with the landing gear extended and locked.

## MANEUVERING SPEED ($V_A$)

$V_A$ ..... 200 KIAS

**NOTE:** Maneuvers that involve angle of attack near the stall or full application of rudder, elevator, and aileron controls should be confined to speeds below $V_A$. In addition, the maneuvering flight load factor limits, presented in this Section, should not be exceeded.

**WARNING: RAPID AND LARGE ALTERNATING CONTROL INPUTS, ESPECIALLY IN COMBINATION WITH LARGE CHANGES IN PITCH, ROLL, OR YAW (E.G.LARGE SIDE SLIP ANGLES) MAY RESULT IN STRUCTURAL FAILURES AT ANY SPEED, EVEN BELOW $V_A$.**

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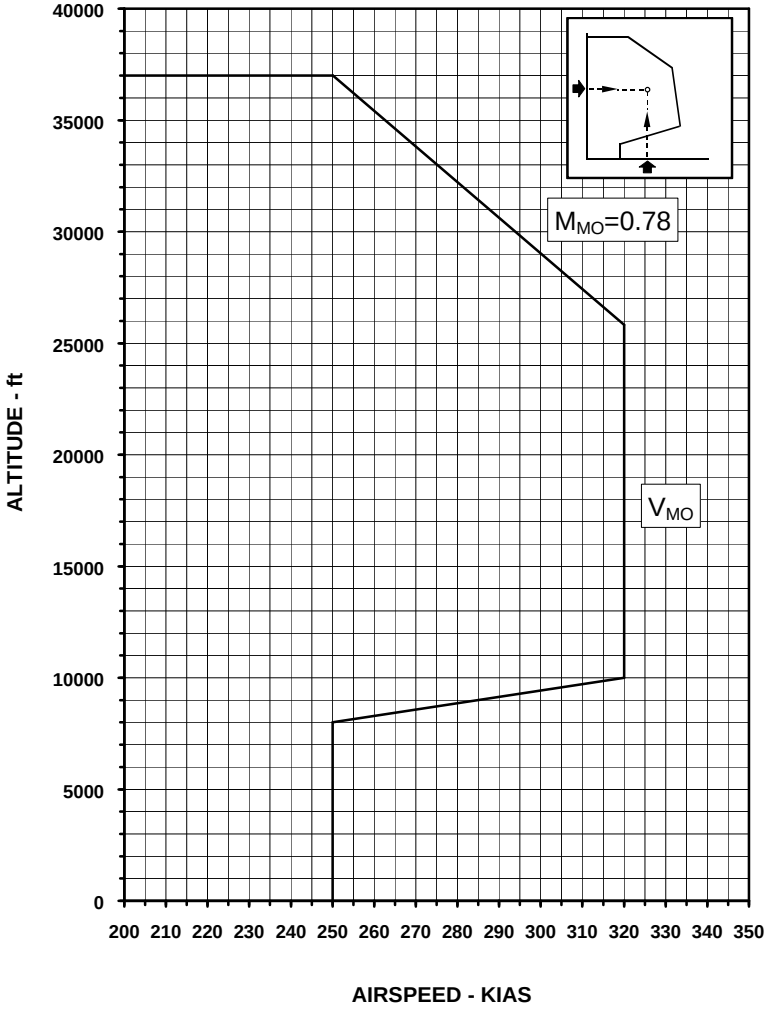
## MAXIMUM OPERATING SPEED

## APPLICABLE TO ALL MODELS EXCEPT EMB-145 XR MODEL POST-MOD. SB 145-31-0038




145CTA49 - 27JAN1997

**NOTE:** The $V_{MO}/M_{MO}$ may not be deliberated exceeded in any regime of flight (climb, cruise, or descent).



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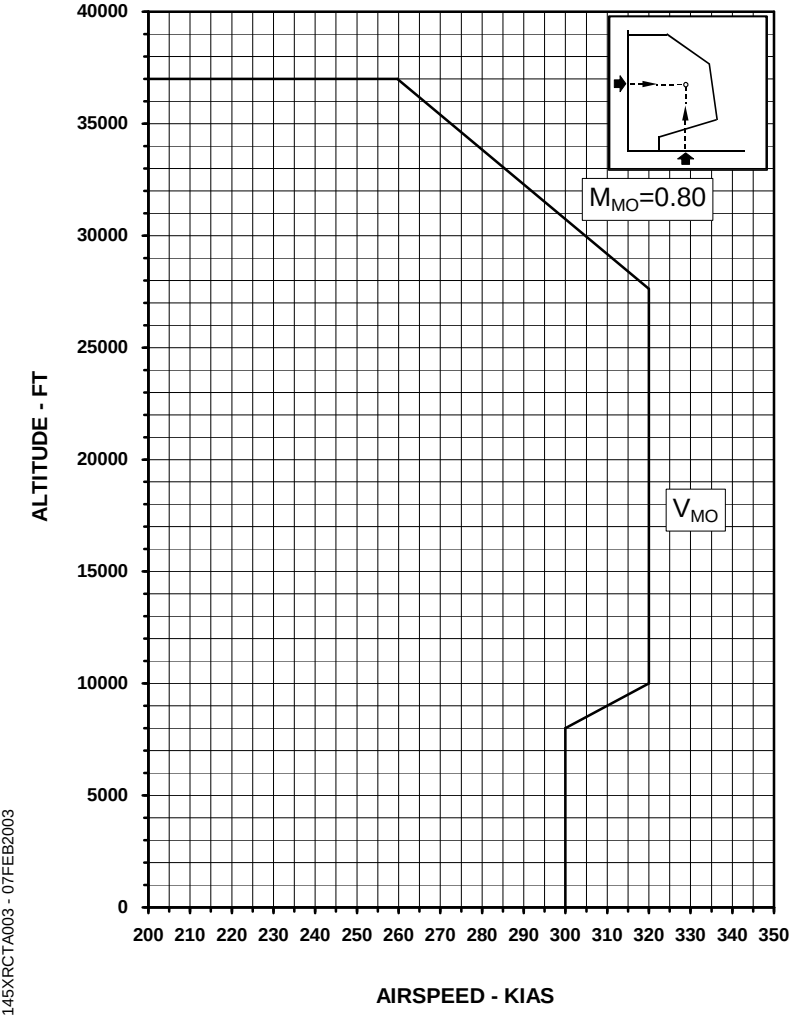
**APPLICABLE TO EMB-145 XR MODEL POST-MOD. SB 145-31-0038 OR WITH AN EQUIVALENT MODIFICATION FACTORY INCORPORATED**




**NOTE:** The $V_{MO}/M_{MO}$ may not be deliberated exceeded in any regime of flight (climb, cruise, or descent).

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# FLIGHT CONTROLS

## MAXIMUM FLAP EXTENDED SPEED ($V_{FE}$) - FOR EMB-135, ERJ-140 AND EMB-145 MODELS, EXCEPT EMB-145 XR

Flaps 9° ..... 250 KIAS
Flaps 18° ..... 200 KIAS
Flaps 22° ..... 200 KIAS
Flaps 45° ..... 145 KIAS

## MAXIMUM FLAP EXTENDED SPEED ($V_{FE}$) - FOR EMB-145 XR MODEL

Flaps 9° ..... 250 KIAS
Flaps 18° ..... 200 KIAS
Flaps 22° ..... 200 KIAS
Flaps 45° ..... 160 KIAS

Above 10000 ft with Yaw Damper disengaged:

Flaps 22° ..... 180 KIAS
Flaps 45° ..... 145 KIAS

## ELECTROMECHANICAL GUST LOCK

Each time electromechanical gust lock lever is set to unlocked (FREE) position elevator movement must be checked. This check must be performed at least 10 seconds after positioning the gust lock lever to the unlocked (FREE) position by moving the control column from the full up stop to the full down stop and back to the full up stop position.

## MAXIMUM FLAP EXTENDED ALTITUDE

Maximum Altitude for Flap Extension ..... 20000 ft

## PITCH TRIM

Maximum Airspeed after Takeoff/During Climb
without Retrimming..... 160 KIAS

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## TAILWIND

Maximum Takeoff and Landing Tailwind Component..... 10 kt

## DIRECT VISION WINDOW (AFM PROCEDURES)

Maximum recommended speed to remove direct vision windows is 140 KIAS.

## UNPRESSURIZED FLIGHT (NON-AFM)

Maximum altitude for operation after an in-flight depressurization, is 10000 ft MSL unless MEA or otherwise required.

Maximum altitude for dispatch for an unpressurized flight is 10000 ft.

## TURBULENT AIR PENETRATION SPEED (AFM PROCEDURES)

At or below 10000 ft..... 200 KIAS

Above 10000 ft..... 250 KIAS/0.63M, WHICHEVER IS LOWER

## MAXIMUM RECOMMENDED CROSSWIND (NON-AFM)

Embraer aerodynamics analysis have resulted in the following maximum recommended crosswinds for takeoff and landing:

Dry runway..... 30 kt

Wet runway..... 30 kt

Runway with Compacted Snow..... 25 kt

Runway with Standing Water/Slush/Dry Snow..... 20 kt

Runway with Ice (no melting) ..... 10 kt

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## MANEUVERING FLIGHT LOAD FACTORS

These corresponding accelerations limit the bank angle during turns and limit the pull-up maneuvers.

| LOAD FACTOR LIMIT | FLAPS UP | FLAPS DOWN (9°,18°, 22° and 45°) |
|---|---|---|
| Positive | 2.50 g | 2.00 g |
| Negative | -1.00 g | 0 g |

## RUNWAY

Runway Slope ..... -2% TO +2%

Runway Surface Type ..... PAVED

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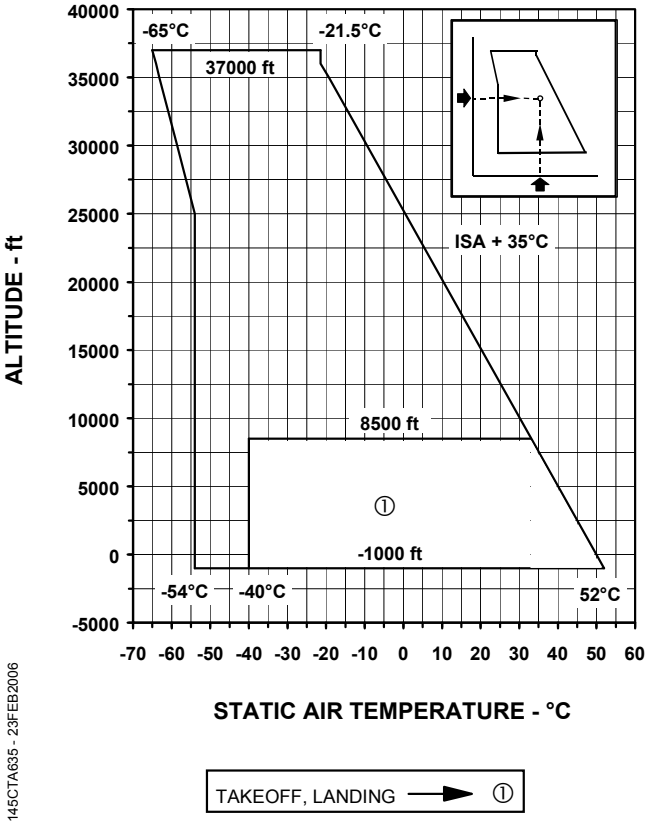
# SUPPLEMENTARY OPERATIONAL LIMITATIONS

## OPERATIONAL ENVELOPE

APPLICABLE ONLY TO EMB-145ER, EP, EU AND MP MODELS POST-MOD. SB 145-00-0031 OR EQUIPPED WITH AN EQUIVALENT MODIFICATION FACTORY INCORPORATED




**NOTE:** - In the event of a landing below -40°C, the airplane may not takeoff without further hard landing maintenance inspection (Refer to AMM Task 5-50-02).

- Minimum Total Air Temperature in cruise flight above 25000 ft is -45°C.

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# SUPPLEMENTARY OPERATIONAL LIMITATIONS

## OPERATIONAL ENVELOPE

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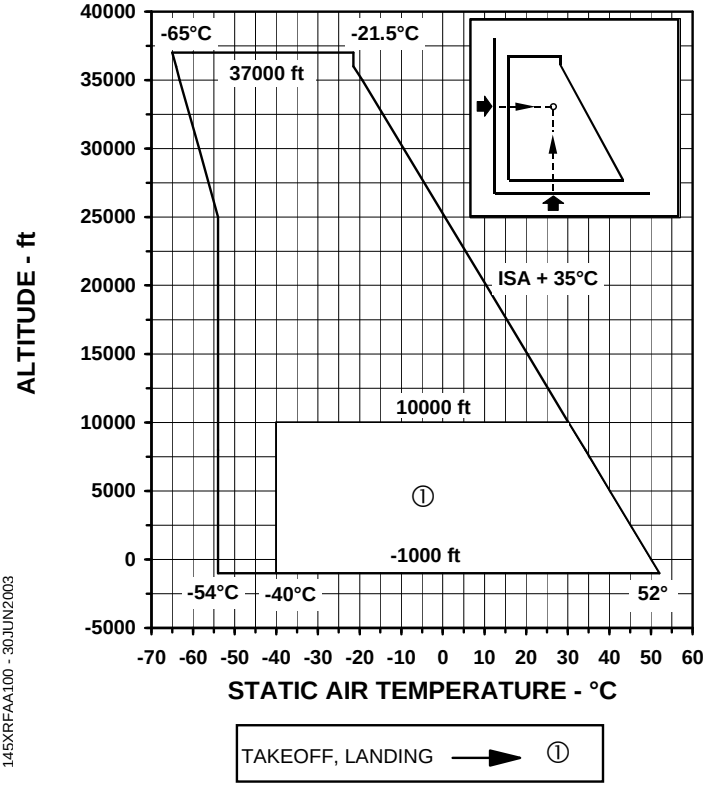


**NOTE:** - In the event of a landing below -40°C, the airplane may not takeoff without further hard landing maintenance inspection (Refer to AMM Task 5-50-02).

- Minimum Total Air Temperature in cruise flight above 25000 ft is -45°C.
- Only APU T-62T-40C14 is allowed for operations on ground above 8000 ft.

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# ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)

The following limitations are applicable to the Enhanced Ground Proximity Warning System (EGPWS):

- The Allied-Signal Enhanced Ground Proximity Warning System Pilot's Guide, Document Number 060-4241-000, March 1997 edition (or later revision of the manual) or accepted Operating Manual, must be available to the flight crew.
- Allied-Signal Application Software version 202 and Configuration Software version 202 or later must be installed.
- Navigation is not to be predicated on the use of the Terrain Awareness Display.
- The Terrain Display is intended to be used as a situational tool only and may not provide the accuracy and/or fidelity on which to solely base terrain avoidance maneuvering.
- The EGPWS data base, displays, and alerting algorithms currently do not account for man-made obstructions.
- The EGPWS must be inhibited in the following conditions:

  **NOTE:** To inhibit the Terrain Awareness Alerting and Display function, press the TERRAIN SYS OVRD button.

  - Within 15 NM of takeoff or landing at airports that have no approved instrument approach procedure or not included in the EGPWS Allied Signal database (encompasses airports which runways are shorter than 1070 m).
  - When FMS is operating in Dead Reckoning Mode.

    **NOTE:** This will not affect the basic GPWS functions (modes 1 to 7). If the FMS is restored after a period of inadequacy, the EGPWS may be enabled by pressing again the TERRAIN SYS OVRD button.

  - If GPS data is unavailable or inoperative, the use of predictive EGPWS software functions should be manually inhibited during QFE operations.
  - For airplanes equipped with FMS Honeywell and with EGPWS software prior to version 216, Terrain Awareness Alerting and Display functionality must be manually inhibited when below the

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transition altitude while flying QFE on approach into an airport which is more than 200 ft above or below Sea Level.

**NOTE:** QFE operation with EGPWS enable is allowed with FMS Honeywell when featuring EGPWS software versions - 216 and on or with FMS Universal Post-Mod. SB 145-34-0112.

- Pilots are authorized to deviate from their current Air Traffic Control (ATC) clearance to the extent necessary to comply with an EGPWS warning.
- In case of a conflict between the terrain alerts and an auto popped-up picture, pilots must check:
  - The sweeping marker movement on the horizontal line below the terrain picture. If the marker is frozen, the MFD terrain indication must be deselected on MFD bezel panel.
  - The MDF 2 terrain information. If the terrain picture bus fail is not annunciated (TERR amber annunciation), the MDF 2 must be used as terrain picture reference.

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# ELECTRICAL

Maximum Load on Main Generator ..... 400 A

Maximum Load on APU Generator:

Up to 30000 ft ..... 400 A

Above 30000 ft..... 300 A

Maximum Battery Temperature ..... 70°C

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# FUEL

**(ER, EP, MP MODEL)**

| | |
|---|---|
| Maximum usable quantity per tank | 679.8 US Gal (4600 lb) |
| Unusable quantity per tank | 7.1 US Gal (48 lb) |
| Unusable quantity per tank (Any electric fuel pump inoperative) | 39.3 US Gal (266 lb) |

Maximum permitted imbalance between tanks ..... 800 lb

**NOTE: -** When the EICAS fuel quantity is zero in level flight, any fuel remaining in the tanks can not be used safely in flight.
- The values above have been determined for an adopted fuel density of 6.767 lb/US Gal.
- When performing pressure refueling, the usable fuel quantity in each tank may be reduced by 7.9 US Gal maximum.

## FUEL SPECIFICATION

Brazilian Specification..... QAV1
ASTM Specification ..... D1655-JET A AND JET A-1
American Specification ..... MIL-T-83133A-JP8 AND MIL-DTL-5624-JP5

**NOTE:** The use of Red Dye contaminated fuel is restricted to emergency conditions and must comply with Rolls-Royce's recommendations.

## FUEL TANK TEMPERATURE

Minimum ..... -40°C
Maximum ..... 52°C

**NOTE:** If fuel does not contain an icing inhibitor, the temperature of fuel leaving FCOC must be above 4°C. If this condition is satisfied, the caution message "E1(2) LO TEMP" is not presented (refer to FUEL LOW TEMPERATURE Procedure).

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# FUEL (LR MODEL)

| | |
|---|---|
| Maximum usable quantity per tank | 844.9 US Gal (5717 lb) |
| Unusable quantity per tank | 5.8 US Gal (39 lb) |
| Unusable quantity per tank (Any electric fuel pumps inoperative) | 53.9 US Gal (365 lb) |

Maximum permitted imbalance between tanks ..... 800 lb

**NOTE: -** When the EICAS fuel quantity is zero in level flight, any fuel remaining in the tanks can not be used safely in flight.
- The values above have been determined for an adopted fuel density of 6.767 lb/US Gal.
- When performing pressure refueling, the usable fuel quantity in each tank may be reduced by 13.2 US Gal maximum.

## FUEL SPECIFICATION

Brazilian Specification..... QAV1
ASTM Specification ..... D1655-JET A AND JET A-1
American Specification ..... MIL-T-83133A-JP8 AND MIL-DTL-5624-JP5

**NOTE:** The use of Red Dye contaminated fuel is restricted to emergency conditions and must comply with Rolls-Royce's recommendations.

## FUEL TANK TEMPERATURE

Minimum ..... -40°C
Maximum ..... 52°C

**NOTE:** If fuel does not contain an icing inhibitor, the temperature of fuel leaving FCOC must be above 4°C. If this condition is satisfied, the caution message "E1(2) LO TEMP" is not presented (refer to FUEL LOW TEMPERATURE Procedure).

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# AUXILIARY POWER UNIT

**OPERATIONAL LIMITS**

| APU Model | T-62T-40C11 | | T-62T-40C14 | |
|---|---|---|---|---|
| **PARAMETER** | **MIN** | **MAX** | **MIN** | **MAX** |
| TEMPERATURE (3) | -54°C | - | - | - |
| ALTITUDE FOR START | - | 25000 ft or | - | - |
| | - | 30000 ft (2) | - | 30000 ft |
| OPERATION ALTITUDE | - | 37000 ft | - | 37000 ft |
| ROTOR SPEED | - | 108% | - | 108% (5) |
| EGT: | - | - | - | - |
| START | - | 884°C (1) | - | 884°C |
| CONTINUOUS | - | 680°C (6) | - | 680°C (6) |

**NOTE: 1)** May be exceeded up to 925°C above 25000 ft during 10 seconds.

**2)** For airplanes Post-Mod. SB 145-49-0010 or equipped with an equivalent modification factory incorporated. In this case, the minimum temperature for APU start is -54°C up to 30000 ft.

**3)** Minimum battery temperature for starting the APU by batteries is -20°C.

**4)** Refer to Fuel Tank Temperature limitations for other APU starting related limits.

**5)** The APU automatically shuts down at 104% rotor speed.

**6)** The APU EGT may be exceeded up to 717°C for 5 minutes maximum.

## APU STARTER LIMITS

Cooling period between each starting attempt:

Between Three Consecutive Attempts..... 1 MINUTE OFF
Between Two Series of
Three Consecutive Attempts..... 30 MINUTES OFF

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# POWER PLANT

**WARNING: ALL FOUR FADECS INSTALLED ON THE AIRPLANE MUST BE THE SAME PART NUMBER. INCORRECT ENGINE OPERATION CAN RESULT FROM USING FADECS WITH TWO DIFFERENT PART NUMBERS.**

## OPERATIONAL LIMITS (ROLLS-ROYCE AE3007A1)

| PARAMETER (1) | MIN | MAX |
|---|---|---|
| N1 | - | 100% |
| N2 | - | 102.4% (2)(3) |
| ITT: | | |
| START | - | 800°C |
| TAKEOFF MODES | - | 948°C (4) |
| CONTINUOUS | - | 901°C |
| OIL PRESSURE: | | |
| BELOW 88% N2 | 34 psi | 95 psi (5)(6)<br>110 psi (5)(7) |
| AT OR ABOVE 88% N2 | 50 psi (8) | 95 psi (6)(7)<br>110 psi (7) |
| OIL TEMPERATURE | 21°C (9) | 126°C |
| FUEL TEMPERATURE | -54°C | 52°C |
| VIBRATION: | | |
| LP SPOOL | - | 1.8 IPS (10) |
| HP SPOOL | - | 1.1 IPS (10) |

**NOTE: 1)** Any engine exceedance or peak must be monitored and logged by the crew.

**2)** For airplanes Pre-Mod. SB 145-73-0029 the N2 limit is 102.5%.

**3)** For airplanes Post-Mod. SB 145-77-0004 the N2 limit is 105.0%.

**4)** Takeoff thrust is time limited to 5 minutes.

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**5)** May be exceeded during starts if oil temperature is below 21°C. The engine must remain at IDLE until the oil pressure is less than 95 psi (110 psi for airplanes Post-Mod. SB 145-73-0022 or equipped with an equivalent modification factory incorporated).

**6)** Operation in oil pressure amber range between 96 and 115 psi is permitted in all operational modes and time limited to 5 minutes, or between 116 and 155 psi in all operational modes time limited to 2 minutes. Total time above 95 psi may not exceed 5 minutes.

**7)** For airplanes Post-Mod. SB 145-73-0022 or equipped with an equivalent modification factory incorporated the upper limit of the oil pressure green band is 110 psi. Operation in oil pressure amber range is permitted between 111 and 115 psi in all operational modes time limited to 5 minutes, or between 116 and 155 psi in all operational modes time limited to 2 minutes. Total time above 110 psi may not exceed 5 minutes.

**8)** While this is an abnormal condition, operation between 50 psi and 34 psi is permitted during takeoff and go-around phases.

**9)** Minimum oil temperature for starting is -40°C for lubrication oil specified by MIL-L-23699D and -54°C for lubrication oil specified by MIL-L-7808K.

**10)** Vibration in the amber range below 2.5 IPS is time limited to 5 minutes during the takeoff or go-around phases or 10 seconds during the remainder flight phases. High vibration indicates a malfunction which may worsen and increase vibration severity. Therefore, continuous engine operation with vibration in the amber range is not recommended. According to engine vibration limits, the pilot may elect not to reduce TLA for vibration below 2.5 IPS time limited to 5 minutes during takeoff or go-around or 10 seconds during the remainder flight phases. If vibration returns to the green range within 5 minutes, the flight may continue but vibration causes should be investigated before the next flight. Vibration in any flight phase in the amber range up to 1.5 IPS for less than 30 seconds does not require maintenance action.

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## STARTER LIMITS

On Ground:

Starting or Dry Motoring ..... UP TO 5 MINUTES ON, 5 MINUTES OFF

OR

First to Fourth Cycles ..... 1 MINUTE ON, 1 MINUTE OFF

Following Cycles ..... 1 MINUTE ON, 5 MINUTES OFF

In Flight:

Maximum Continuous Operation Time ..... 5 MINUTES ON

**NOTE:** No cool down time is required should an in-flight start be re-attempted.

## AUTOMATIC TAKEOFF THRUST CONTROL SYSTEM (ATTCS)

ATTCS must be operative to select ALT T/O-1 mode.

For airplanes equipped with FADEC versions previous than B8.0:

At least once a week a Thrust Assurance Check must be performed by selecting maximum takeoff mode during takeoff and checking engine parameters.

The Thrust Assurance Check is not required if the owner/operator actively participate in Engine Condition Monitoring, as described Chapter 5 of the AE3007A Series Engine Maintenance Manual.

For airplanes equipped with FADEC versions B8.0 and on, the Thrust Assurance Check is not required.

## THRUST REVERSER

Thrust reversers are intended for use during rejected takeoff or landing only. Do not attempt a go-around procedure after deployment of the thrust reversers following a landing.

Selection of thrust reversers in flight or their preselection before touchdown is prohibited.

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## ENGINE WARM-UP

Prior to takeoff, the engines must be allowed to run at low thrust to stabilize the engine temperatures before takeoff thrust is selected.

After start, the engines must run at idle or taxi thrust for at least 4 minutes for cold engines or 2 minutes for warm engines.

Before takeoff, to increase N2 above 83% the engine oil temperature must be at 40°C minimum. In lieu of this limit, it is acceptable to either:

- run the engine for at least 8 minutes in idle or taxi thrust and check if the temperature is at least 21°C or,
- for airplanes Pre-Mod. Rolls-Royce SB AE3007A-79-025, complete a static run-up to 88% N2, stabilize, and check to ensure that oil pressure is equal to or less than 83 psi.

**NOTE:** The engine is considered cold if it has been shutdown for more than 90 minutes.

## ENGINE COOL DOWN

The engines must run for at least 1 minute at idle or taxi thrust before shutdown.

# PERFORMANCE

## APPROACH CLIMB GRADIENT AND APPROACH CLIMB LIMITED WEIGHTS

Airplanes equipped with FADEC software version B5.1.1 must decrease the Approach Climb Gradient by 1% and decrease the Approach Climb Limited Weight by 1920 lb.

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# PNEUMATIC, AIR CONDITIONING AND PRESSURIZATION

## PRESSURIZATION

Maximum differential pressure..... 7.8 psi

Maximum differential overpressure..... 8.1 psi

Maximum differential negative pressure ..... -0.3 psi

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# ICE AND RAIN PROTECTION

## OPERATION IN ICING CONDITIONS

Maximum Temperature for Anti-icing Operation ..... 10°C
Minimum Temperature for Manual Anti-Icing Operation ..... -40°C
Single engine or single bleed maximum altitude operation in icing conditions..... 15000 ft
Holding configuration:
Landing Gear..... UP
Flaps..... UP
Minimum Airspeed..... 200 KIAS

**NOTE: -** There is no temperature limitation for anti-icing system automatic operation.

- Use Static Air Temperature (SAT) on ground or for takeoff operations and Total Air Temperature (TAT) for operations in flight.
- Icing conditions may exist whenever the Static Air Temperature (SAT) on the ground or for takeoff, or Total Air Temperature (TAT) in flight, is 10°C or below and visible moisture in any form is present (such as clouds, fog with visibility of one mile or less, rain, snow, sleet, and ice crystals).
- Icing conditions may also exist when the SAT on the ground and for takeoff is 10°C or below when operating on ramps, taxi ways, or runways where surface snow, ice, standing water, or slush may be ingested by the engines, or freeze on engines, nacelles, or engine sensor probes.
- Takeoff is prohibited with frost, ice, snow or slush adhering to wings, control surfaces, engine inlets, or other critical surfaces (refer to the applicable requirements).
- There are many methods to ensure the wing is clear of ice. If visual inspection or installed clear ice detectors do not indicate wing contamination, a tactile (hand on surface) check of the wing leading edge and the upper surface must be accomplished prior to takeoff. The tactile check must also be performed when the holdover time is exceeded after airplane de/anti-icing fluids are applied. This check should be performed whenever the outside temperature is less than 6°C or if it cannot be ascertained that the wing fuel temperature is above 0°C, and:
  - there is visible moisture,
  - water is present on the wing,

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- the difference between the dew point and the outside air temperature is 3°C or less, or
- the atmospheric conditions have been conducive to frost formation.

**CAUTION:**
- ON GROUND, DO NOT RELY ON VISUAL ICING EVIDENCE OR ICE DETECTOR ACTUATION TO TURN ON THE ANTI-ICING SYSTEM. USE THE TEMPERATURE AND VISUAL MOISTURE CRITERIA AS SPECIFIED ABOVE. DELAYING THE USE OF THE ANTI-ICING SYSTEM UNTIL ICE BUILD-UP IS VISIBLE FROM THE COCKPIT MAY RESULT IN ICE INGESTION AND POSSIBLE ENGINE DAMAGE OR FLAME-OUT.
- DO NOT USE APU BLEED AS PNEUMATIC SOURCE FOR ANTI-ICING SYSTEM.

## WINDSHIELD WIPER OPERATION

Maximum Airspeed for Windshield Wiper Operation .... 170 KIAS

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# OZONE CONCENTRATION

The tables below show the airplane altitude limitations due to ozone concentration in atmosphere.

**NOTE: -** These tables are based on FAA ADVISORY CIRCULAR 120.38.

- The tables show altitude limitations calculated for constant ozone concentration, cabin stabilized at 8000 ft, and both recirculation fans turned on.
- For conditions other than those specified in item 2 above, an optimized flight plan must be approved by regulatory agencies.
- For longitudes, the following apply:

  W = Western

  E = Eastern

  Reference = 100°W longitude

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## NORTH AMERICA - MAXIMUM OZONE CRITERIA

| FLIGHT LEVEL | JAN | | FEB | | MAR | | APR | | MAY | | JUN | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LATITUDE | W | E | W | E | W | E | W | E | W | E | W | E |
| 80°N | - | 330 | - | 330 | - | 320 | - | 320 | - | - | - | 340 |
| 75°N | - | 330 | - | 330 | - | 330 | - | 320 | - | 320 | - | 340 |
| 70°N | - | 350 | - | 330 | - | 330 | - | 330 | - | 320 | - | 340 |
| 65°N | - | 360 | 340 | 330 | 330 | 340 | 330 | 330 | 330 | 330 | 340 | 350 |
| 60°N | - | - | 360 | 350 | 340 | 340 | 330 | 330 | 340 | 330 | 350 | 350 |
| 55°N | - | - | - | 360 | 350 | 350 | 340 | 340 | 340 | 340 | 350 | - |
| 50°N | - | - | - | - | - | 360 | 340 | 350 | 340 | 350 | - | - |
| 45°N | - | - | - | - | - | - | 360 | 360 | 360 | - | - | - |
| 40°N | - | - | - | - | - | - | - | - | - | - | - | - |
| 35°N | - | - | - | - | - | - | - | - | - | - | - | - |

| FLIGHT LEVEL | JUL | | AUG | | SEP | | OCT | | NOV | | DEC | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LATITUDE | W | E | W | E | W | E | W | E | W | E | W | E |
| 80°N | - | 350 | - | - | - | - | - | - | - | - | - | - |
| 75°N | - | 360 | - | - | - | - | - | - | - | - | - | - |
| 70°N | - | - | - | - | - | - | - | - | - | - | - | - |
| 65°N | 360 | - | - | - | - | - | - | - | - | - | - | - |
| 60°N | 360 | - | - | - | - | - | - | - | - | - | - | - |
| 55°N | - | - | - | - | - | - | - | - | - | - | - | - |
| 50°N | - | - | - | - | - | - | - | - | - | - | - | - |
| 45°N | - | - | - | - | - | - | - | - | - | - | - | - |
| 40°N | - | - | - | - | - | - | - | - | - | - | - | - |
| 35°N | - | - | - | - | - | - | - | - | - | - | - | - |

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## NORTH AMERICA - TWA OZONE CRITERIA

**NOTE:** Values below are the altitude limitations in which the airplane is allowed to fly more than 3 continuous hours.

| FLIGHT LEVEL | JAN | | FEB | | MAR | | APR | | MAY | | JUN | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LATITUDE | W | E | W | E | W | E | W | E | W | E | W | E |
| 80°N | - | 290 | - | 290 | - | - | - | - | - | - | - | 270 |
| 75°N | - | 290 | - | 290 | - | 270 | - | 270 | - | - | - | 270 |
| 70°N | - | 300 | - | 290 | - | 270 | - | 270 | - | - | - | 290 |
| 65°N | 320 | 310 | 310 | 270 | 310 | 290 | 300 | 270 | 270 | 270 | 310 | 290 |
| 60°N | 330 | 310 | 310 | 290 | 310 | 300 | 290 | 270 | 270 | 270 | 310 | 290 |
| 55°N | 340 | 310 | 330 | 300 | 310 | 300 | 290 | 290 | 290 | 290 | 310 | 300 |
| 50°N | 350 | 320 | 350 | 310 | 320 | 310 | 270 | 290 | 290 | 290 | 310 | 320 |
| 45°N | 350 | 330 | 320 | 320 | 320 | 320 | 290 | 310 | 310 | 310 | 330 | 330 |
| 40°N | 340 | 350 | - | 320 | 320 | 330 | 310 | 310 | 330 | 330 | 350 | 350 |
| 35°N | - | - | - | - | 350 | - | - | 350 | - | 350 | - | - |
| 30°N | - | - | - | - | - | - | - | - | - | - | - | - |

| FLIGHT LEVEL | JUL | | AUG | | SEP | | OCT | | NOV | | DEC | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LATITUDE | W | E | W | E | W | E | W | E | W | E | W | E |
| 80°N | - | 270 | - | 310 | - | 310 | - | 310 | - | 300 | - | 310 |
| 75°N | - | 290 | - | 330 | - | 320 | - | 310 | - | 310 | - | 310 |
| 70°N | - | 290 | - | 330 | - | 330 | - | 320 | - | 310 | - | 310 |
| 65°N | 310 | 310 | 340 | 340 | 350 | 330 | 330 | 330 | 350 | 310 | 330 | 310 |
| 60°N | 310 | 320 | 340 | 350 | 350 | 350 | 330 | 330 | 350 | 310 | 330 | 320 |
| 55°N | 310 | 320 | 340 | 350 | - | 350 | 350 | 350 | 350 | 330 | 350 | 330 |
| 50°N | 320 | 330 | 340 | 350 | - | - | - | - | 350 | 350 | - | 350 |
| 45°N | 330 | 350 | - | - | - | - | - | - | - | - | - | 350 |
| 40°N | - | - | - | - | - | - | - | - | - | - | - | 350 |
| 35°N | - | - | - | - | - | - | - | - | - | - | - | - |
| 30°N | - | - | - | - | - | - | - | - | - | - | - | - |

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# NAVIGATION EQUIPMENT

## RADAR

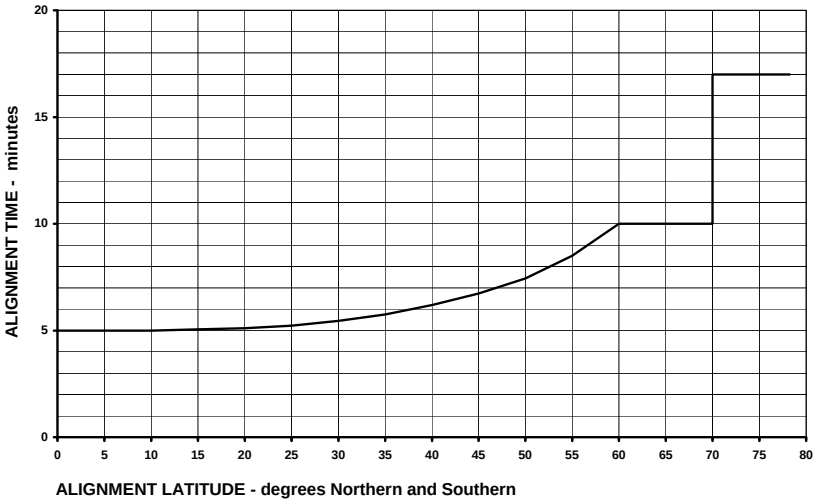
Do not operate weather radar during refueling, near fuel spills or people.

## ATTITUDE AND HEADING REFERENCE SYSTEM

Airplane must not be moved until all attitude and heading information presented on PFD is valid.

For the AH-900 AHRS version the following limits are applicable:

- Maximum latitude for alignment .....78°15' Northern and Southern
- AHRS alignment will complete only after a valid airplane present position (latitude and longitude) is received from the FMS.
- Time to Alignment:

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- The airplanes may not be operated within the following North and South magnetic polar cut-out regions:

| MAGNETIC CUT-OUT REGIONS | LATITUDE | LONGITUDE |
|---|---|---|
| North | Between 70°N and 82°N | Between 80°W and 135°W |
| | North of 82°N | Between 0° and 180°W/E |
| South | Between 60°S and 82°S | Between 118°30'E and 160°E |
| | South of 82°S | Between 0° and 180°W/E |

**NOTE:** Within the magnetic polar cut-out regions AHRS heading data is not available.

## INSTRUMENT LANDING SYSTEM (ILS)

This limitation applies to airplanes equipped with Mod. L of the Honeywell Primus II NV-850 Navigation Receiver Module P/N 7510134-831; which is part of the Honeywell Primus II RNZ-851 Integrated Navigation Unit P/N 7510100-831, -832, -833 and -834.

When crossing the Outer Marker on glideslope, the altitude must be verified with the value on the published procedure.

For airplanes with a single operating glideslope receiver, the approach may be flown using normal procedures no lower than Localizer Only Minimum Descent Altitude (MDA).

For airplanes with two operating glideslope receivers, the airplane may be flown to the published minimums for the approach using normal procedures if both glideslope receivers are tuned to the approach and both crew members are monitoring the approach using independent data and displays.

## INTEGRATED STANDBY INSTRUMENT SYSTEM (ISIS)

Maximum duration of ISIS when operating on batteries only is 40 minutes.

**NOTE:** The maximum duration of battery power can be extended to 45 minutes if the Pitot 3 Sensor Heating Button is turned off when not operating in icing conditions.

Airplane must not be moved during power-up initialization.
Do not cage attitude in turning flight.

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# COMMUNICATION EQUIPMENT

## HF

- Do not rely on ADF indications shown on PFD while transmitting in HF.
- Do not transmit through HF Radio during airplane fueling.

## TRANSPONDER MODE S ENHANCED SURVEILLANCE

For airplanes Post-Mod. SB 145-34-0096 or equipped with an equivalent modification factory incorporated, the installed Mode S system satisfies the data requirements of ICAO Doc 7030/4, Regional Supplementary Procedures for SSR Mode S Enhanced Surveillance in designated European airspace.

The system is not capable to transmit the Track Angle Rate parameter.

# AUTOPILOT (APPLICABLE TO ERJ-140)

The following limitations are applicable to the Autopilot:

Minimum Decision Altitude During
ILS Approach ..... 200 ft AGL

Minimum Engagement Height
(Takeoff or Go-around) ..... 500 ft

Minimum Use Height..... 160 ft

Malfunction altitude loss:

- Cruise ..... 50 ft
- Maneuver ..... 40 ft
- ILS Approach..... 15 ft

Descent below Minimum Descent Altitude on a non-precision approach with autopilot engaged is prohibited.

Single engine go-around with autopilot engaged is prohibited.

Approach mode selection during Localizer capture is allowed only when airplane is inbound.

**NOTE**: Coupled go-around height loss may be 40 ft.

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# AUTOPILOT (APPLICABLE TO ERJ-145 MODELS EXCEPT EMB-145 XR)

The following limitations are applicable to the Autopilot:

For airplanes Pre-Mod. SB 145-31-0016, the use of the Autopilot below 1500 ft AGL is only permitted when coupled to the captain's Flight Director.

Minimum Decision Altitude During
ILS Approach..... 200 ft AGL

Minimum Engagement Height
(Takeoff or Go-around)..... 500 ft

Minimum Use Height ..... 160 ft

Malfunction altitude loss:

- Cruise..... 80 ft
- Maneuver..... 40 ft
- ILS Approach ..... 15 ft

Descent below Minimum Descent Altitude on a non-precision approach with autopilot engaged is prohibited.

Single engine go-around with autopilot engaged is prohibited.

Approach mode selection during Localizer capture is allowed only when airplane is inbound.

For airplanes Pre-Mod. SB 145-31-0014, go-around in basic mode (roll and pitch) is allowed only with wings level.

**NOTE:** Coupled go-around height loss may be 75 ft.

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# AUTOPILOT (APPLICABLE TO EMB-145 XR MODEL ONLY)

The following limitations are applicable to the Autopilot:

- Minimum Decision Altitude During
  ILS Approach ..... 200 ft AGL
- Minimum Engagement Height
  (Takeoff or Go-around) ..... 500 ft
- Minimum Use Height..... 160 ft
- Malfunction altitude loss:
  Cruise..... 80 ft
  Maneuver ..... 40 ft
  ILS Approach ..... 35 ft
- Descent below Minimum Decision Altitude on a non-precision approach with autopilot engaged is prohibited.
- Single engine go-around with autopilot engaged is prohibited.
- Approach mode selection during Localizer capture is allowed only when airplane is inbound.

**NOTE:** Coupled go-around height loss may be 40 ft.

## AUTOMATIC DEPENDENT SURVEILLANCE - BROADCAST (ADS-B) OUT

For airplanes Post-Mod. SB 145-34-0118 or Post-Mod. SB 145-34-0121, or equipped with an equivalent modification factory incorporated, the installed ADS-B Out system complies with FAA AC 20-165B. The installed ADS-B Out system has also been shown to meet the equipment requirements of 14 CFR 91.227.

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# NAVIGATION EQUIPMENT

## RADAR

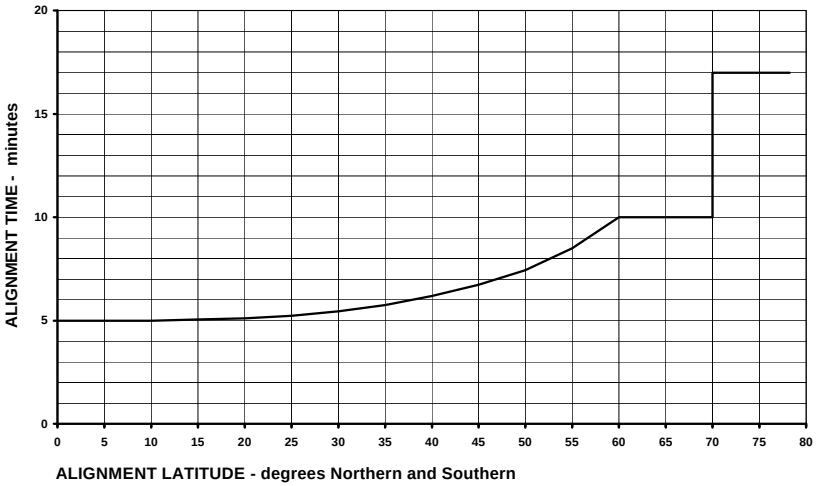
Do not operate weather radar during refueling, near fuel spills or people.

## ATTITUDE AND HEADING REFERENCE SYSTEM

Airplane must not be moved until all attitude and heading information presented on PFD is valid.

For the AH-900 AHRS version the following limits are applicable:

- Maximum latitude for alignment..... 78°15' Northern and Southern
- AHRS alignment will complete only after a valid airplane present position (latitude and longitude) is received from the FMS.
- Time to Alignment:

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– The airplanes may not be operated within the following North and South magnetic polar cut-out regions:

| MAGNETIC CUT-OUT REGIONS | LATITUDE | LONGITUDE |
|---|---|---|
| North | Between 70°N and 82°N | Between 80°W and 135°W |
| | North of 82°N | Between 0° and 180°W/E |
| South | Between 60°S and 82°S | Between 118°30'E and 160°E |
| | South of 82°S | Between 0° and 180°W/E |

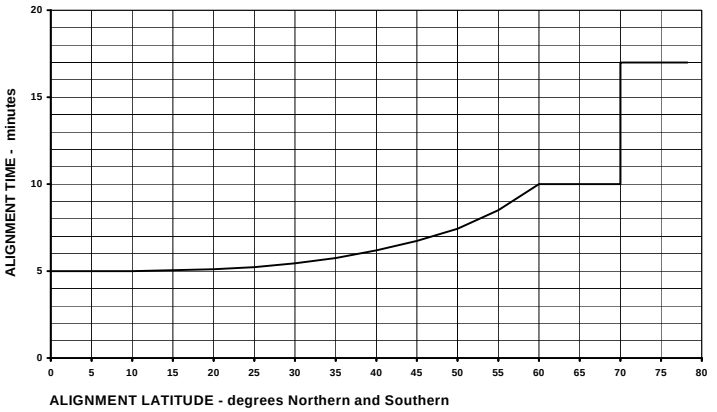
**NOTE:** Within the magnetic polar cut-out regions AHRS heading data is not available.

## INERTIAL REFERENCE SYSTEM

– Maximum latitude for alignment ..... 78°15' Northern and Southern

– IRS alignment will complete only after a valid airplane present position (latitude and longitude) is received from the FMS.

– Time to Alignment:

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– The airplanes may not be operated within the following North and South magnetic polar cut-out regions:

| MAGNETIC CUT-OUT REGIONS | LATITUDE | LONGITUDE |
|---|---|---|
| North | Between 70°N and 82°N | Between 90°W and 120°W |
| | North of 82°N | Between 0° and 180°W/E |
| South | Between 60°S and 82°S | Between 120°E and 160°E |
| | South of 82°S | Between 0° and 180°W/E |

**NOTE:** Within the magnetic polar cut-out regions IRS heading data is not available.

## INSTRUMENT LANDING SYSTEM (ILS)

This limitation applies to airplanes equipped with Mod. L of the Honeywell Primus II NV-850 Navigation Receiver Module P/N 7510134-831; which is part of the Honeywell Primus II RNZ-851 Integrated Navigation Unit P/N 7510100-831, -832, -833 and -834.

When crossing the Outer Marker on glideslope, the altitude must be verified with the value on the published procedure.

For airplanes with a single operating glideslope receiver, the approach may be flown using normal procedures no lower than Localizer Only Minimum Descent Altitude (MDA).

For airplanes with two operating glideslope receivers, the airplane may be flown to the published minimums for the approach using normal procedures if both glideslope receivers are tuned to the approach and both crew members are monitoring the approach using independent data and displays.

## INTEGRATED STANDBY INSTRUMENT SYSTEM (ISIS)

Maximum duration of ISIS when operating on batteries only is 40 minutes.

**NOTE:** The maximum duration of battery power can be extended to 45 minutes if the Pitot 3 Sensor Heating Button is turned off when not operating in icing conditions.

Airplane must not be moved during power-up initialization.
Do not cage attitude in turning flight.

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# COMMUNICATION EQUIPMENT

## HF

- Do not rely on ADF indications shown on PFD while transmitting in HF.
- Do not transmit through HF Radio during airplane fueling.

## TRANSPONDER MODE S ENHANCED SURVEILLANCE

For airplanes Post-Mod. SB 145-34-0096 or equipped with an equivalent modification factory incorporated, the installed Mode S system satisfies the data requirements of ICAO Doc 7030/4, Regional Supplementary Procedures for SSR Mode S Enhanced Surveillance in designated European airspace.
The system is not capable to transmit the Track Angle Rate parameter.

# AUTOPILOT (APPLICABLE TO ERJ-140 MODELS)

The following limitations are applicable to the Autopilot:

Minimum Decision Altitude During
ILS Approach ..... 200 ft AGL

Minimum Engagement Height
(Takeoff or Go-around) ..... 500 ft

Minimum Use Height ..... 160 ft

Malfunction altitude loss:

- Cruise ..... 50 ft
- Maneuver ..... 40 ft
- ILS Approach ..... 15 ft

Descent below Minimum Descent Altitude on a non-precision approach with autopilot engaged is prohibited.

Single engine go-around with autopilot engaged is prohibited.

Approach mode selection during Localizer capture is allowed only when airplane is inbound.

**NOTE**: Coupled go-around height loss may be 40 ft.

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# AUTOPILOT (APPLICABLE TO EMB-145 MODELS)

The following limitations are applicable to the Autopilot:

For airplanes Pre-Mod. SB 145-31-0016, the use of the Autopilot below 1500 ft AGL is only permitted when coupled to the captain's Flight Director.

Minimum Decision Altitude During

ILS Approach ..... 200 ft AGL

Minimum Engagement Height

(Takeoff or Go-around) ..... 500 ft

Minimum Use Height ..... 160 ft

Malfunction altitude loss:

- Cruise ..... 80 ft
- Maneuver ..... 40 ft
- ILS Approach..... 15 ft

Descent below Minimum Descent Altitude on a non-precision approach with autopilot engaged is prohibited.

Single engine go-around with autopilot engaged is prohibited.

Approach mode selection during Localizer capture is allowed only when airplane is inbound.

For airplanes Pre-Mod. SB 145-31-0014, go-around in basic mode (roll and pitch) is allowed only with wings level.

**NOTE:** Coupled go-around height loss may be 75 ft.

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## AUTOMATIC DEPENDENT SURVEILLANCE - BROADCAST (ADS-B) OUT

For airplanes Post-Mod. SB 145-34-0118 or Post-Mod. SB 145-34-0121, or equipped with an equivalent modification factory incorporated, the installed ADS-B Out system complies with FAA AC 20-165B. The installed ADS-B Out system has also been shown to meet the equipment requirements of 14 CFR 91.227.

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# FMZ2000 FLIGHT MANAGEMENT SYSTEM

The following limitations are applicable to the FMS:

- The Honeywell Flight Management System (FMS) Pilot's Operating Manual, Honeywell Publication Number A28-1146-122-00, August 1997 edition (or later revision of the manual) for the software version NZ4.8, Honeywell Publication Number A28-1146-133-00, February 1999 edition (or later revision of the manual) for the software version NZ5.2 or FAA accepted Operating Manual, must be immediately available to the flight crew whenever navigation is predicated on the use of the FMS. The software status stated in the Pilot's Manual must match that displayed on the FMS Control Display Unit (CDU).
- Honeywell software version NZ4.8 or NZ5.2 must be installed.
- FMS instrument approaches must be accomplished in accordance with approved instrument approach procedures that are retrieved from the FMS navigation data base. The FMS data base must incorporate the current update cycle.
- Use of FMS guidance for conducting instrument approach procedures is prohibited with the FMS operating in the degrade or dead reckoning mode (DGR or DR annunciation set on PFD).
- Operation above 72° 30.0' north latitude and below 59° 30.0' south latitude is prohibited due to unreliable magnetic heading.
- The pilot must review the complete transition-approach, comparing the waypoints and altitudes displayed on the FMS with those on the published procedure prior to activation to insure that the correct procedure and transition are selected.
- The Flight Director must be coupled to the LNAV mode (autopilot coupled or not coupled), to accomplish GPS only approaches.

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- When using FMS guidance for conducting instrument approach procedures that do not include a GPS reference in the title of the published procedure, the flight crew must verify that the procedure specified navaid and associated avionics are operational.
- For airplanes equipped with single FMS, when using FMS guidance for conducting instrument approach procedures, the procedure navaid must be tuned and valid, and the raw data must be displayed in the cockpit, under the following conditions:
  - For VOR approaches (where the procedure specified navaid is a VOR only navaid - no DME capability) and NDB approaches, without GPS (GPS failed or RAIM out of limits or unavailable).
  - For any instrument approach (other than a GPS stand alone approach), outside the Brazilian Airspace, with GPS as the navigation sensor.
- ILS, LOC, LOC-BC, LDA, SDF and MLS approaches, using the FMS for guidance, are prohibited.
- When flying to an airport where GPS (non-overlay) is the intended approach, prior to dispatch, the crew is required to verify that the predictive RAIM at the destination ETA is within the approach criteria. This information (RAIM AVAILABLE), is displayed on the PREDICTIVE RAIM page, accessed via the GPS STATUS page.
- When the approach at the destination is based on GPS and an alternate airport is required by the applicable operating rules, the alternate must be served by an approach based on a navigation aid other than GPS. The navigation aid must be operational and the airplane must have operational equipment capable of using that navigation aid.
- IFR non-precision approach approval is limited to published approaches in the WGS-84 coordinate datum within US airspace. Approaches to airports in other airspace are not approved unless authorized by the appropriate governing authority.

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- The FMS is approved for those oceanic and North Atlantic (NAT) Minimum Navigation Performance Specification (MNPS) routes requiring only a single FMS and a single GPS in accordance with AC 20-130A.
- The pilot must check for leg gaps in the Flight Plan Display on EFIS and input waypoints to fill in any gaps as necessary.
- IFR enroute and terminal navigation is prohibited unless the pilot verifies the currency of the data base or verifies each selected waypoint for accuracy by reference to current approved data.
- The fuel flow and fuel used presented on the FMS are supplementary information only. The flight crew must use fuel information primarily from the MFD and EICAS display.
- Coupled FMS vertical guidance is not available. Therefore, during FMS operation with Autopilot coupled, the pilot must use the Flight Guidance Controller for vertical control. Advisory vertical guidance is available only in descent.
- During oceanic, North Atlantic (NAT) Minimum Navigation Performance Specification (MNPS), enroute and terminal area operation with DR or DGR annunciated on the PFD, the flight crew must verify the FMS position using VOR/DME raw data or other appropriate means.
- The airplane must have other navigation equipment installed and operating, appropriate to the route of flight.
- The FMS approaches and missed approaches are prohibited for airplanes with NZ4.8 Mod A software installed.
- FMS missed approaches using the CDU Mode Select Button is prohibited.

**NOTE:** The NZ4.8 Mod C software version may be identified by checking if the RTN TO SRVC maintenance page is available. This page may be accessed by pressing the NAV mode select button, then NEXT, then selecting the MAINTENANCE submode through the respective line select button, and finally pressing the NEXT mode select button twice. This page is not available for NZ4.8 Mod A.

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# NAVIGATION OPERATIONAL APPROVALS

The single Honeywell FMZ2000 Flight Management System, with the software version NZ4.8 Mod A or Mod C, and the single or dual Honeywell FMZ2000 Flight Management System software version NZ5.2 Mod B, Mod C, Mod D and Mod E have been demonstrated capable of and have been shown to meet the requirements for the following operations:

## OCEANIC AND REMOTE

In accordance with AC 20-130A and FAA Notice 8110.60 the dual FMS is approved as a two independent Long Range Navigation (LRN) System on these routes, provided it is receiving usable signals from the GPS which meets requirements of AC 90-94 for use as the only LRN System sensor. The dual FMZ2000 installation with dual GPS sensors as installed has been found to comply with the requirements for GPS primary means of navigation in oceanic and remote airspace, when used in conjunction with Honeywell Off Line RAIM prediction program. For single FMS installation, in accordance with AC 20-130A, along routes requiring a single Long Range Navigation (LRN) System, provided it is receiving usable signals from the GPS which meets requirements of AC 90-94 for use as the only LRN System sensor on these routes.

## NORTH ATLANTIC (NAT) MINIMUM NAVIGATION PERFORMANCE SPECIFICATION (MNPS) AIRSPACE

- Provided two FMS installations are operating with each receiving information from two inertial reference systems (IRS) or from two global positioning systems (GPS) when used in conjunction with Honeywell Off Line RAIM prediction program, the FMS is capable of unrestricted flight into North Atlantic (NAT) Minimum Navigation Performance Specification (MNPS) airspace and has been shown to meet the accuracy specification in accordance with AC 120-33 or AC 91-49.
- For single FMS installation as defined in AC 91-49 and AC 91-70, along the special routes requiring a single LRN (Long Range Navigation System), provided it is receiving usable signals from the GPS which meets requirements of AC 90-94 for use as the only LRN System sensor on these routes.

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## RNP-10 - REQUIRED NAVIGATION PERFORMANCE

- The dual FMZ2000 installation with dual Global Positioning System (GPS) sensors as installed has been found to comply with the requirements of FAA Order 8400.12A, as amended, as a primary means of navigation with no time limitation, when used in conjunction with Honeywell Off Line RAIM prediction program.
- The dual FMZ2000 installation with dual Inertial Reference Systems (IRS) as installed has been found to comply with the requirements of FAA Order 8400.12A, as amended, as a primary means of navigation for flights up to 6.2 hours after the system is placed in the navigation mode.
- The dual FMZ2000 installation with dual Global Positioning System (GPS) sensors and dual Inertial Reference Systems (IRS) as installed has been found to comply with the requirements of FAA Order 8400.12A, as amended, as a primary means of navigation with no time limitation.

## ENROUTE AND TERMINAL

In accordance with AC 20-130A, TSO C129a C1, TSO C145c and TSO C146c provided it is receiving usable signals from:

- One VOR/DME or multiple DME's;
- GPS.

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## NON-PRECISION APPROACH

In accordance with AC 20-130A, TSO C129a C1, TSO C145c, TSO C146c and AC 90-94 (Phase II and III overlay approaches and GPS only approaches), provided:

- The APP annunciation is set on the PFD at the Final Approach Fix.
- The DGR or DR is not annunciated on the PFD.
- The flight director is coupled to the LNAV mode (GPS only approaches).

**NOTE:** AC 90-94 deals with the use of GPS in the US National Airspace System (NAS) and in oceanic areas. The general approval to use GPS to fly overlay instrument approaches as described in the AC, is initially limited to the NAS. Refer to Limitations Section of this Supplement, for use of GPS for non-precision approaches outside the NAS.

## RNAV OPERATION

In accordance with AC 90-100A, provided FMS is receiving automatic update from GPS or DME/DME/IRS.

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# UNS-1K FLIGHT MANAGEMENT SYSTEM

- The Universal UNS1 Operator's Manual or an Operating Manual accepted by the Certification Authority must be immediately available to the flight crew whenever navigation is predicated on the use of FMS. The software status stated in the Operator's Manual must match that displayed on the FMS Control Display Unit (CDU).
- Universal FMS Software version 603.0 (or later approved version) must be installed.
- FMS instrument approaches must be accomplished in accordance with approved instrument approach procedures that are retrieved from the FMS navigation data base. The FMS data base must incorporate the current update cycle.
- Instrument approaches must be conducted in the approach mode, and GPS integrity monitoring (when using GPS for approach guidance) must be available at the Final Approach Fix, as indicated to the pilot by the INTEG amber annunciator being off and APP annunciator displayed on PFD.
- Use of FMS guidance for conducting instrument approach procedures is prohibited with the FMS operating in the dead reckoning mode (DR annunciation set on PFD).
- The pilot must review the complete transition-approach, comparing the waypoints and altitudes displayed on the FMS with those on the published procedure prior to activation to insure that the correct procedure and transition are selected.
- VNAV is advisory only, and the aircraft altimeter should be the primary source of altitude information at all times.
- When using FMS guidance for conducting instrument approach procedures that do not include a GPS reference in the title of the published procedure, the flight crew must verify that the procedure specified navaid and associated avionics are operational.

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- For airplanes equipped with single FMS, when using FMS guidance for conducting instrument approach procedures, the procedure navaid must be tuned and valid, and the raw data must be displayed in the cockpit, under the following conditions:
  - For VOR approaches (where the procedure specified navaid is a VOR only navaid no-DME capability) and NDB approaches, without GPS (GPS failed or RAIM out of limits or unavailable).
  - For any instrument approach (other than GPS stand alone approach), outside the airspace of countries operating under FAA jurisdiction, with the GPS as the navigation sensor.
- ILS, LDA, SDF and MLS approaches, using the FMS for guidance, are prohibited.
- When conducting FMS guided missed approach procedures, autopilot coupled operation is prohibited until the flight crew has established a rate of climb that ensures all altitudes requirements of the procedure will be met.
- When flying to an airport where GPS (non-overlay) is the intended approach, prior to dispatch, the flight crew is required to verify that the predictive RAIM at the destination ETA is within the approach criteria.
- When the approach at the destination is based on GPS and an alternate airport is required by the applicable operating rules, the alternate airport must be served by an approach based on a navigation aid other than GPS. The navigation aid must be operational and the aircraft must have operational equipment capable of using that navigation aid.
- IFR non-precision approach approval is limited to published approaches within the airspace of countries operating under FAA jurisdiction. Approaches to airports in other airspace are not approved unless authorized by the appropriate governing authority.
- IFR enroute and terminal navigation is prohibited unless the pilot verifies the currency of the data base or verifies each selected waypoint for accuracy by reference to current approved data.
- The fuel flow and fuel used presented on the FMS are supplementary information only. The flight crew must use fuel information primarily from the MFD and EICAS display.

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- Coupled FMS vertical guidance is not available. Therefore, during FMS operation with Autopilot coupled, the pilot must use the Flight Guidance Controller for vertical control. Advisory vertical guidance is available only in descent.
- During oceanic, North Atlantic (NAT) Minimum Performance Specification (MNPS), enroute and terminal area operation with DR annunciated on the PFD, the flight crew must verify the FMS position using VOR/DME raw data or other appropriate means.
- The airplane must have other navigation equipment installed and operating, appropriate to the route of flight.
- Operation above 73° north latitude and below 60° south latitude is prohibited due to unreliable magnetic heading.
- FMS PVOR outbound function is prohibited.
- FMS missed approach using the CDU Mode Select Buttons is prohibited.
- During FMS Fuel Management initialization, the flight crew must enter manually the fuel on board data.

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## NAVIGATION OPERATIONAL APPROVALS

The Universal UNS-1K Flight Management System, with the version 603.X software, has been demonstrated capable of and has been shown to meet the requirements for the following operations:

- **Oceanic and Remote** - In accordance with AC 20-130A, along routes requiring a Long Range Navigation (LRN) System, provided it is receiving usable signals from the GPS which meets requirements of AC 90-94 for use as the only LRN System sensor on these routes.
- **North Atlantic (NAT) Minimum Navigation Performance Specification (MNPS) airspace** - As defined in AC 91-49 and AC 91-70, along the special routes requiring a single LRN, provided it is receiving usable signals from the GPS which meets requirements of AC 90-94 for use as the only LRN System sensor on these routes.
- **Enroute and Terminal** - In accordance with AC 20-130A and TSO C129a B1 provided it is receiving usable signals from:
  - One VOR/DME or multiple DME's.
  - GPS.
- **Instrument Approach** - LOC and BC approaches in accordance with AC 25-15 and RNAV, VOR, VOR/DME, NDB and GPS approaches in accordance with AC 20-130A, TSO C129a B1, TSO C115b and AC 90-94 (Phase II and III overlay approaches and GPS only approaches), provided:
  - The APP annunciation is set on the PFD at the Final Approach Fix.
  - The DR is not annunciated on the PFD.
  - The flight director is coupled to the LNAV mode (GPS only approaches).

**NOTE:** AC 90-94 deals with the use of GPS in the US National Airspace System (NAS) and in oceanic areas. The general approval to use GPS to fly overlay instrument approaches as described in the AC, is initially limited to the NAS. Refer to LIMITATIONS Section of this Supplement, for use of GPS for non-precision approaches outside the NAS.

- **RNAV Operation -** In accordance with AC 90-100A, provided FMS is receiving automatic update from GPS.

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# FMZ 2010 FLIGHT MANAGEMENT SYSTEM

## GENERAL LIMITATIONS

The following limitations are applicable to Honeywell Flight Management System version NZ 6.1.1:

- The Honeywell Flight Management System (FMS) Pilot's Operating Manual, Honeywell Publication Number D200802000002 (or later revision of the manual) for the software version NZ 6.1.1 or an Operating Manual accepted by the certification authority, must be immediately available to the flight crew whenever navigation is predicated on the use of the FMS. The software status stated in the Pilot's Manual must match that displayed on the FMS Control Display Unit (CDU).
- Honeywell software version NZ 6.1.1 must be installed.
- RNAV equipment has a performance limitation necessitating alternate airport flight planning operational mitigation.
- Availability of suitable approved backup navigation equipment to divert and land at an alternate destination is required for RNP terminal and approach operations with single FMS or single GPS.
- Approved GPS FDE availability prediction program and suitable backup navigation to divert and land at an alternate destination is required for RNP operations with TSO-C129/129a sensor and to TSO-C145c/146c sensor operating outside SBAS coverage area. Operations requiring use of GPS enroute/remote coverage prediction must rely on approved offline prediction program.
- GPS/SBAS service availability is required to be confirmed for RNP operations with TSO-C145c/146c sensor operating within SBAS coverage area.
- The Flight Director must be coupled to the LNAV mode (autopilot coupled or not coupled), to accomplish instrument RNAV operations based on FMS guidance.
- RNAV/RNP operations must not be performed following the guidance from HGS Model 3300.

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- FMS-coupled vertical guidance is not available. During FMS operation with autopilot engaged, the pilot must select the appropriate vertical guidance mode through the Flight Guidance Controller.
- Advisory vertical guidance deviation information is only an aid to help pilots comply with altitude restrictions. When using advisory vertical guidance, the pilot must use the primary barometric altimeter to ensure compliance with all altitude restrictions, particularly during instrument approach operations.
- It is required coordination with the ATC prior to employing the temperature compensation feature.
- FMS instrument approaches must be accomplished in accordance with approved instrument approach procedures that are retrieved from the FMS navigation database. The FMS database must incorporate the current update cycle.
- IFR operation based on FMS guidance is prohibited unless the pilot verifies the currency of the database or verifies each selected waypoint for accuracy by reference to current approved data.
- The pilots must compare any procedures/route retrieved from the FMS database with those published on the procedure charts. Differences between the charts and the FMS information up to 3° are acceptable. Otherwise, the coded procedure must not be used.
- Operation in the following region using FMS as primary navigation source is prohibited: north of 72°30.0' N and south of 59°30.0' S.
- For areas in which the magnetic database error may differ in more than 3° from the published charts, the following functions must be performed using true heading:
  - Manual creation of waypoints by place/bearing/distance,
  - Manual creation of waypoints by place/bearing/place/bearing,
  - Holding inbound course,

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- FIX INFO bearings, and
- DIRECT-TO with intercept course.

**NOTE:** To define course and bearing references to TRUE north in the FMS, insert the character "T" after the course/bearing value.

- The regions where the magnetic database error may differ in more than 3° from published charts are the following:

| Until December 31, 2024 | |
|---|---|
| **LATITUDE** | **LONGITUDE** |
| North of 55°00' N | East of 180°00' W<br>West of 105°00' W |
| North of 58°30' N | East of 100°00' W<br>West of 020°00' W |
| North of 65°00' N | East of 020°00' W<br>West of 005°00'E |
| North of 65°00' N | East of 170°00' E<br>West of 180°00' E |
| South of 50°00' S | East of 120°00' E<br>West of 165°00' E |

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| From January 01, 2025, until December 31, 2029 | |
|---|---|
| **LATITUDE** | **LONGITUDE** |
| North of 50°00' N | East of 180°00' W<br>West of 130°00' W |
| North of 55°00' N | East of 130°00' W<br>West of 080°00' W |
| North of 47°30' N | East of 080°00' W<br>West of 000°00' |
| North of 55°00' N | East of 000°00'<br>West of 030°00' E |
| North of 65°00' N | East of 030°00' E<br>West of 070°00' E |
| North of 70°00' N | East of 110°00' E<br>West of 125°00' E |
| North of 60°00' N | East of 140°00' E<br>West of 170°00' E |
| North of 55°00' N | East of 170°00' E<br>West of 180°00' E |
| South of 10°00' S<br>North of 30°00' S | East of 075°00' W<br>West of 057°00' W |
| South of 05°00' S<br>North of 30°00' S | East of 010°00' W<br>West of 015°00' E |
| South of 50°00' S | East of 115°00' E<br>West of 180°00' E |

- RNAV/RNP operations with DGR or DR annunciated on the PFD are prohibited.
- FMS performance management information is only supplementary. The flight crew must use fuel information primarily from the MFD and EICAS display.
- Use of the UNDO function is prohibited with departure and arrival procedures and approaches linked in the flight plan.
- Airplane is not approved for RNP less than 0.3 operations.
- Airplane is not approved for RNP AR operations.
- Airplane is not approved for procedures containing RF legs.
- Airplane is not approved for FRT leg transitions.

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- Airplane is not approved for pre-planned parallel offsets.
- Airplane is not approved for TOAC.
- Airplane is not approved for RNAV Holding.
- For operations using RNP 1 to RNP less than 2 the use of Flight Director is required.
- For operations using RNP 0.3 to RNP less than 1 the use of GPS and Flight Director is required.
- Airplane is not approved for missed approach operations less than RNP 1.

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## APPROACH LIMITATIONS

- LP, LNAV/VNAV, LPV, ILS, LOC, LOC-BC, LDA, SDF, and MLS approaches, using the FMS for guidance, are prohibited.
- Approved GPS FDE availability prediction program and suitable backup navigation to divert and land at an alternate destination is required for RNP approach operations with TSO-C129/129a sensor and to TSO-C145c/146c sensor operating outside SBAS coverage area.
- GPS/SBAS service availability is required to be confirmed for RNP approach operations with dual FMS and dual TSO-C145c/146c GPS sensor operating within SBAS coverage area.
- Use of FMS guidance for conducting instrument approach operations is conditioned to the display of the APP annunciator set on PFD once within 2 NM from the final approach fix.
- Use of FMS guidance for conducting instrument approach procedures is prohibited with the FMS operating in the degrade or dead-reckoning mode (DGR or DR annunciation set on PFD).
- The pilot must review the complete transition-approach, comparing the waypoints and altitudes displayed on the FMS with those on the published procedure prior to activation to insure that the correct procedure and transition are selected.
- The Flight Director must be coupled to the LNAV mode (autopilot coupled or not coupled), to accomplish approach operations based on FMS guidance.
- Advisory vertical guidance deviation information is only an aid to help pilots comply with altitude restrictions. When using advisory vertical guidance, the pilot must rely on the altimeter as the primary vertical reference during the final approach segment, including step down fixes.
- FMS Missed Approaches using the CDU Mode Select Button during the final approach segment is prohibited.

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## REMOTE OPERATIONS LIMITATIONS

- RNP remote operations are conditioned by approved dispatch GPS FDE availability prediction for airplanes not equipped with optional dual IRS configuration. The maximum allowable for a predicted loss of GPS FDE capability is 34 minutes. Operations requiring use of GPS enroute/remote coverage prediction must rely on approved offline prediction program.
- RNP 10 operations for airplanes equipped with optional dual IRS configuration meet the applicable performance criteria for up to 6.2 hours of flight time without GPS position update.

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# NAVIGATION OPERATIONAL APPROVALS

The Honeywell Flight Management System, with the software version NZ 6.1.1 (identified on the FMS NAV IDENT PAGE) has been demonstrated capable of and has been shown to meet the requirements for the following operations:

## ENROUTE, TERMINAL, AND APPROACH OPERATIONS

The installed single or dual FMZ 2010 equipment complies with FAA AC 20-138D for navigation using GPS and GPS/SBAS (within the coverage of a satellite-based augmentation system complying with ICAO Annex 10) for enroute, terminal area, non-precision approach, when the following equipment is installed and operative:

- For RNAV 1 and 2, and RNP 1:
  - 1 FMS,
  - 1 AHRS/IRS,
  - 1 CDU,
  - 4 Displays Units,
  - 1 GPS (1),
  - 1 VOR/DME module (1), and
  - 1 Flight Director.

**NOTE: 1)** Requirement for VOR/DME may be replaced by dual FMS and dual GPS/SBAS equipment.

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- For RNP 2:
  - 2 FMS,
  - 2 AHRS/IRS,
  - 2 CDU,
  - 4 Displays Units,
  - 2 GPS (1), and
  - 1 Flight Director.

  **NOTE: 1)** Dual GPS is the primary navigation system to support RNP 2.

- For RNP APCH operations with LNAV minima:
  - 1 FMS (1),
  - 1 AHRS/IRS,
  - 1 CDU (2),
  - 4 Displays Units,
  - 1 GPS (1),
  - 1 VOR/DME module (1), and
  - 1 Flight Director.

  **NOTE: 1)** GPS is the only approved sensor for RNP APCH operation. Although replacing the requirement for retaining VOR/DME as backup navigation equipment by dual FMS and dual GPS/SBAS may be considered acceptable by some local authorities.

  **2)** In case of dispatch with single FMS, the available CDU must control the available FMS.

**REMOTE/OCEANIC OPERATIONS**

The installed dual FMZ 2010 equipment complies with the requirements of the FAA AC 20-138D regarding multi-sensor system operation in remote and oceanic flight, when the following equipment is installed and operative:

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- For RNP 4 and RNP 10 (1):
  - 2 FMS,
  - 2 AHRS/IRS (2),
  - 2 CDU,
  - 4 Displays Units,
  - 2 GPS (2), and
  - 1 Flight Director.

**NOTE: 1)** The term RNP 10 must be understood as RNAV 10 as per ICAO nomenclature.

**2)** Two long range sensors are required. Dual GPS is the primary navigation system to support RNP 4. Dual GPS and/or dual IRS meet the criteria for RNP 10 operations.

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# FMZ 2010 FLIGHT MANAGEMENT SYSTEM

## GENERAL LIMITATIONS

The following limitations are applicable to Honeywell Flight Management System version NZ 6.1.1:

- The Honeywell Flight Management System (FMS) Pilot's Operating Manual, Honeywell Publication Number D200802000002 (or later revision of the manual) for the software version NZ 6.1.1 or an Operating Manual accepted by the certification authority, must be immediately available to the flight crew whenever navigation is predicated on the use of the FMS. The software status stated in the Pilot's Manual must match that displayed on the FMS Control Display Unit (CDU).
- Honeywell software version NZ 6.1.1 must be installed.
- RNAV equipment has a performance limitation necessitating alternate airport flight planning operational mitigation.
- Availability of suitable approved backup navigation equipment to divert and land at an alternate destination is required for RNP terminal and approach operations with single FMS or single GPS.
- Approved GPS FDE availability prediction program and suitable backup navigation to divert and land at an alternate destination is required for RNP operations with TSO-C129/129a sensor and to TSO-C145c/146c sensor operating outside SBAS coverage area. Operations requiring use of GPS enroute/remote coverage prediction must rely on approved offline prediction program.
- If GPS/SBAS service availability can be confirmed through service provider services (e.g.: NOTAM), then the use of prediction programs may not be required for RNP/RNAV operations with TSO-C145c/146c sensor operating within SBAS coverage area.
- For airplanes Pre-Mod. SB145-34-0125, the Flight Director must be coupled to the LNAV mode (autopilot coupled or not coupled), to accomplish instrument RNAV operations based on FMS guidance.
- RNAV/RNP/Baro-VNAV operations must not be performed following the indications from HGS (raw data or flight director guidance).

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- For airplanes Pre-Mod. SB145-34-0125, FMS-coupled vertical guidance is not available. During FMS operation with autopilot engaged, the pilot must select the appropriate vertical guidance mode through the Flight Guidance Controller.
- Advisory vertical guidance deviation information is only an aid to help pilots comply with altitude restrictions. When using advisory vertical guidance, the pilot must use the primary barometric altimeter for all flight operations to ensure compliance with all altitude restrictions.
- The Flight Director must be coupled to the VNAV mode (autopilot coupled or not coupled), for coupled Baro-VNAV operations.
- During takeoff and go-around, the Baro-VNAV must not be coupled to the flight director below 400 ft or prior to reaching the applicable acceleration altitude, whichever is higher.
- Baro-VNAV must not be used with altimeter adjustments referencing height above a ground location (QFE) rather than mean sea-level (QNH).
- The FMS does not correct the speed targets during Baro-VNAV operation, including approach and go-around speeds for flap and landing gear positions, ice accretion or non-normal conditions. It is the pilot responsibility to ensure that the speeds are within the limits during all operations.
- It is required coordination with the ATC prior to employing the temperature compensation feature.
- FMS instrument approaches must be accomplished in accordance with approved instrument approach procedures that are retrieved from the FMS navigation database. The FMS database must incorporate the current update cycle.
- IFR operation based on FMS guidance is prohibited unless the pilot verifies the currency of the database or verifies each selected waypoint for accuracy by reference to current approved data.
- The pilots must compare any procedures/route retrieved from the FMS database with those published on the procedure charts. Differences between the charts and the FMS information up to 3° are acceptable. Otherwise, the coded procedure must not be used.

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- Operation in the following region using FMS as primary navigation source is prohibited: north of 72°30.0' N and south of 59°30.0' S.
- For areas in which the magnetic database error may differ in more than 3° from the published charts, the following functions must be performed using true heading:
  - Manual creation of waypoints by place/bearing/distance,
  - Manual creation of waypoints by place/bearing/place/bearing,
  - Holding inbound course,
  - FIX INFO bearings, and
  - DIRECT-TO with intercept course.

**NOTE:** To define course and bearing references to TRUE north in the FMS, insert the character "T" after the course/bearing value.

- The regions where the magnetic database error may differ in more than 3° from published charts are the following:

| Until December 31, 2024 | |
|---|---|
| **LATITUDE** | **LONGITUDE** |
| North of 55°00' N | East of 180°00' W<br>West of 105°00' W |
| North of 58°30' N | East of 100°00' W<br>West of 020°00' W |
| North of 65°00' N | East of 020°00' W<br>West of 005°00' E |
| North of 65°00' N | East of 170°00' E<br>West of 180°00' E |
| South of 50°00' S | East of 120°00' E<br>West of 165°00' E |

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| From January 01, 2025, until December 31, 2029 | |
|---|---|
| **LATITUDE** | **LONGITUDE** |
| North of 50°00' N | East of 180°00' W<br>West of 130°00' W |
| North of 55°00' N | East of 130°00' W<br>West of 080°00' W |
| North of 47°30' N | East of 080°00' W<br>West of 000°00' |
| North of 55°00' N | East of 000°00'<br>West of 030°00' E |
| North of 65°00' N | East of 030°00' E<br>West of 070°00' E |
| North of 70°00' N | East of 110°00' E<br>West of 125°00' E |
| North of 60°00' N | East of 140°00' E<br>West of 170°00' E |
| North of 55°00' N | East of 170°00' E<br>West of 180°00' E |
| South of 10°00' S<br>North of 30°00' S | East of 075°00' W<br>West of 057°00' W |
| South of 05°00' S<br>North of 30°00' S | East of 010°00' W<br>West of 015°00' E |
| South of 50°00' S | East of 115°00' E<br>West of 180°00' E |

- RNAV/RNP operations with DGR or DR annunciated on the PFD are prohibited.
- FMS performance management information is only supplementary. The flight crew must use fuel information primarily from the MFD and EICAS display.
- Use of the UNDO function is prohibited with departure and arrival procedures and approaches linked in the flight plan.
- Airplane is not approved for RNP less than 0.3 operations.
- Airplane is not approved for RNP AR operations.
- Airplane is not approved for procedures containing RF legs.
- Airplane is not approved for FRT leg transitions.

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- Airplane is not approved for pre-planned parallel offsets.
- Airplane is not approved for TOAC.
- Airplane is not approved for RNAV Holding.
- For airplanes Pre-Mod. SB145-34-0125, operations using RNP 1 to RNP less than 2 require the use of Flight Director.
- For operations using RNP 0.3 to RNP less than 1 the use of GPS is required. For airplanes Pre-Mod. SB145-34-0125, the use of the Flight Director is also required.
- Airplane is not approved for missed approach operations less than RNP 1.

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## APPROACH LIMITATIONS

- LP, ILS, GLS, LOC, LOC-BC, LDA, SDF, and MLS approaches, using the FMS for guidance, are prohibited.
- For airplanes Pre-Mod. SB145-34-0125, LNAV/VNAV and LPV approaches, using the FMS for guidance, are prohibited.
- Approved GPS FDE availability prediction program and suitable backup navigation to divert and land at an alternate destination is required for RNP approach operations with TSO-C129/129a sensor and to TSO-C145c/146c sensor operating outside SBAS coverage area.
- If GPS/SBAS service availability can be confirmed through service provider services (e.g.: NOTAM), then the use of prediction programs may not be required for RNP/RNAV operations with TSO-C145c/146c GPS sensor operating within SBAS coverage area.
- Use of FMS guidance for conducting instrument approach operations is conditioned to the display of the APP annunciator set on PFD once within 2 NM from the final approach fix.
- Use of FMS guidance for conducting instrument approach procedures is prohibited with the FMS operating in the degrade or dead-reckoning mode (DGR or DR annunciation set on PFD).
- The pilot must review the complete transition-approach, comparing the waypoints and altitudes displayed on the FMS with those on the published procedure prior to activation to ensure that the correct procedure and transition are selected.
- For airplanes Pre-Mod. SB145-34-0125, the Flight Director must be coupled to the LNAV mode (autopilot coupled or not coupled), to accomplish approach operations based on FMS guidance.
- The Flight Director must be coupled to the LNAV/VGP mode (autopilot coupled or not coupled) to perform instrument approach operations to LNAV/VNAV or LPV line of minima.

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- Advisory vertical guidance deviation information is only an aid to help pilots comply with altitude restrictions. When using advisory vertical guidance, the pilot must rely on the altimeter as the primary vertical reference for compliance with all altitude restrictions associated with the instrument approach procedure, including compliance with all associated step-down fixes.
- Only the LNAV/VNAV or LPV line of minima on an approach chart can guarantee the vertical path. For airplanes Post-Mod. SB145-34-0125, when performing an approach to LNAV minimums and the approach chart also contains LNAV/VNAV line of minima with step-down fixes, vertical path is not guaranteed. When performing an approach to LNAV only minimums, VNAV guidance provided by the Baro-VNAV function must be considered as advisory only. The pilot must ensure compliance with ATC clearances and altitude restrictions by using the primary barometric altimeter.
- Use of Baro-VNAV to the LNAV/VNAV minimum may not be authorized at airports with remote altimeter setting. In this case, use the LNAV minimum.
- The use of temperature compensation feature is required if Baro-VNAV operation outside the temperature limits published on approach procedure chart is intended.
- FMS Missed Approaches using the CDU Mode Select Button during the final approach segment is prohibited.

## REMOTE OPERATIONS LIMITATIONS

- RNP remote operations are conditioned by approved dispatch GPS FDE availability prediction for airplanes not equipped with optional dual IRS configuration. The maximum allowable for a predicted loss of GPS FDE capability is 25 minutes for RNP 4 operation and 34 minutes for RNP 10 operation. Operations requiring use of GPS enroute/remote coverage prediction must rely on approved offline prediction program.
- RNP 10 operations for airplanes equipped with optional dual IRS configuration meet the applicable performance criteria for up to 6.2 hours of flight time without GPS position update.

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## AUTOPILOT (AIRPLANES POST-MOD. SB145-34-0125)

The Minimum Use Height (MUH) during LPV approach is 160 ft.

## NAVIGATION OPERATIONAL APPROVALS

The Honeywell Flight Management System, with the software version NZ 6.1.1 (identified on the FMS NAV IDENT PAGE) has been demonstrated capable of and has been shown to meet the requirements for the following operations:

### ENROUTE, TERMINAL, AND APPROACH OPERATIONS

The installed single or dual FMZ 2010 equipment complies with FAA AC 20-138D for navigation using GPS and GPS/SBAS (within the coverage of a satellite-based augmentation system complying with ICAO Annex 10) for enroute, terminal area, non-precision approach, and for airplanes Post-Mod. SB145-34-0125 approach procedures with vertical guidance operations when the following equipment is installed and operative:

- For RNAV 1 and 2, and RNP 1:
  - 1 FMS,
  - 1 AHRS/IRS,
  - 1 CDU,
  - 4 Displays Units,
  - 1 GPS (1),
  - 1 VOR/DME module (1), and
  - 1 Flight Director for airplanes Pre-Mod. SB145-34-0125.

**NOTE: 1)** Requirement for VOR/DME may be replaced by dual FMS and dual GPS/SBAS equipment.

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- For RNP 2:
  - 2 FMS,
  - 2 AHRS/IRS,
  - 2 CDU,
  - 4 Displays Units,
  - 2 GPS (1), and
  - 1 Flight Director for airplanes Pre-Mod. SB145-34-0125.

  **NOTE: 1)** Dual GPS is the primary navigation system to support RNP 2.

- For RNP APCH operations with LNAV minima:
  - 1 FMS (1),
  - 1 AHRS/IRS,
  - 1 CDU (2),
  - 4 Displays Units,
  - 1 GPS (1),
  - 1 VOR/DME module (1), and
  - 1 Flight Director for airplanes Pre-Mod. SB145-34-0125.

  **NOTE: 1)** GPS is the only approved sensor for RNP APCH operation. Although replacing the requirement for retaining VOR/DME as backup navigation equipment by dual FMS and dual GPS/SBAS may be considered acceptable by some local authorities.

  **2)** In case of dispatch with single FMS, the available CDU must control the available FMS.

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- For RNP APCH operations to LNAV/VNAV minima (airplanes Post-Mod. SB145-34-0125):
  - 1 FMS (1),
  - 1 AHRS/IRS,
  - 1 CDU (1),
  - 4 Displays Units,
  - 1 GPS,
  - 2 ADS RVSM compliant,
  - 1 TAT, and
  - 1 Flight Director.

  **NOTE: 1)** In case of dispatch with single FMS, the available CDU must control the available FMS.
- For RNP APCH operations to LPV minima (airplanes Post-Mod. SB145-34-0125):
  - 2 FMS,
  - 2 AHRS/IRS,
  - 2 CDU,
  - 4 Displays Units,
  - 2 GPS,
  - 2 ADS RVSM compliant,
  - 1 TAT, and
  - 2 Flight Directors.

**REMOTE/OCEANIC OPERATIONS**

The installed dual FMZ 2010 equipment complies with the requirements of the FAA AC 20-138D regarding multi-sensor system operation in remote and oceanic flight, when the following equipment is installed and operative:

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- For RNP 4 and RNP 10 (1):
  - 2 FMS,
  - 2 AHRS/IRS (2),
  - 2 CDU,
  - 4 Displays Units,
  - 2 GPS (2), and
  - 1 Flight Director for airplanes Pre-Mod. SB145-34-0125.

**NOTE: 1)** The term RNP 10 must be understood as RNAV 10 as per ICAO nomenclature.

**2)** Two long range sensors are required. Dual GPS is the primary navigation system to support RNP 4. Dual GPS and/or dual IRS meet the criteria for RNP 10 operations.

**BAROMETRIC VERTICAL NAVIGATION (AIRPLANES POST-MOD. SB145-34-0125)**

The airplanes Post-Mod. SB145-34-0125 have been demonstrated compliant with the requirements of the FAA AC 20-138D, regarding the barometric vertical navigation (Baro-VNAV) coupled to the Flight Director in enroute, terminal, and non-precision approach operations, when used in accordance with the limitations and operational procedures contained in this manual.

**TEMPERATURE COMPENSATION (AIRPLANES POST-MOD. SB145-34-0125)**

The temperature compensation feature complies with RTCA/DO-283B, Appendix H.

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# DOORS

## COCKPIT SECURITY DOOR

On airplanes equipped with a cockpit security door, two crewmembers must be in the cockpit during all flight phases.

If one of the pilots leaves the flight deck, he must be replaced in the cockpit by another crewmember.

Positive identification of the person wishing to enter the flight deck must be obtained before opening the door.

The security cockpit door must be kept closed and locked at all times during flight except to permit access and egress according to the operator's procedures for opening, closing and locking the door.

Any time that cockpit door is opened in flight, a challenge and response closing and locking verification procedure must be used to verify that the door is closed and locked.

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# CAT II OPERATION WITH PRIMUS 1000 AUTOMATIC FLIGHT CONTROL SYSTEM

## MINIMUM EQUIPMENT REQUIRED

The performance of Category II approaches requires that the following equipment and instruments be in proper operating conditions:

- 2 Attitude and Heading Reference Systems;
- 1 Yaw Damper System;
- 1 Autopilot (not required for EMB-135 and EMB-145XR models);
- 2 Flight Director Systems;
- 2 Primary Flight Displays (PFD);
- Windshield Wipers;
- 2 VHF/NAV Systems;
- 1 VHF/COMM System;
- Both Engines;
- Cat II Checklist Logic;
- 1 Electrical Trim System;
- 1 Radio Altimeter;
- 1 Ground Proximity Warning System (GPWS or EGPWS);
- 1 Aural Warning Unit (AWU) Channel;
- 2 Air Data Systems (ADS);
- 1 Standby Attitude Indicator;
- 1 Standby Airspeed Indicator;
- 1 Standby Altimeter.

**NOTE:** Cat II operation shall be performed by the pilot who has the Flight Director coupled to the Autopilot.

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## AUTOPILOT SYSTEM

Minimum Decision Height (DH)..... 100 ft

**NOTE:** Although the radio altitude setting may be adjusted down to 80 ft, if requested by an ILS Cat II Approved Chart, the Decision Height (DH) is limited to 100 ft above ground level.

Minimum Use Height (MUH) ..... 50 ft

Runway Visual Range (RVR)..... 1200 ft

Maximum Tailwind (except for EMB-145XR model) ..... 10 kt

Maximum Crosswind (except for EMB-145XR model) ..... 25 kt

Maximum Tailwind (EMB-145XR model)..... 9 kt

Maximum Crosswind (EMB-145XR model) ..... 10 kt

**NOTE: -** Flight Director monitored manual approaches are restricted to Category I minimums (not applicable to EMB-135 and to EMB-145XR models).

**-** Coupled go-around height loss may be 50 ft.

## APPROACH AND LANDING FLAPS

CAT II approach and landing must be performed with flaps 22°.

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# HGS OPERATION

## SYSTEM CAPABILITY LIMITATIONS

### DEMONSTRATED MINIMUM VISIBILITY TAKEOFF LIMITS

Runway Visual Range (RVR)..... 75 m

### DEMONSTRATED MINIMUM AIII MODE LIMITS

Decision Height (DH) ..... 50 ft
Runway Visual Range (RVR)..... 180 m

### WIND COMPONENTS

For Low Visibility Takeoff operations the following wind components must not be exceeded:

Headwind..... 25 kt
Tailwind..... 10 kt
Crosswind ..... 15 kt

For AIII mode operations the following wind components must not be exceeded:

Headwind..... 25 kt
Tailwind..... 10 kt
Crosswind ..... 15 kt

AIII mode operations initiated with one engine inoperative has been demonstrated and following wind components must not be exceeded:

Headwind..... 25 kt
Tailwind..... 10 kt
Crosswind ..... 11 kt

**NOTE:** The maximum wind limits listed above include gusts.

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# AIRPLANE EQUIPMENT LIMITATIONS

## AIRPLANE SUN VISOR

With the HGS Combiner deployed, airplane sun visors must not be placed in a position, during takeoff, approach or landing, that will prevent the correct operation of the forward fly-away movement of the Combiner.

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## MINIMUM EQUIPMENT REQUIRED

The performance of Low Visibility Takeoff requires that the following equipment and instruments be in operating conditions:

- Head-Up Guidance System (HGS);
- 1 Inertial Reference System (IRS);

  **NOTE:** IRS 1 must be operative in case of dual IRS installation.

- 2 Air Data Computers (ADC);
- 3 VHF/NAV Systems;
- 2 Integrated Computers (IC);
- 2 Attitude and Heading Reference System (AHRS);

  **NOTE:** AHRS is not applicable in case of dual IRS installation.

- Windshield Wipers;

  **NOTE:** For airplanes Pre-Mod. SB 145-30-0055 and Post-Mod SB 145-30-0054 (or with an equivalent modification factory incorporated), the Rain Repellent Coating replace the Windshield Wipers. Approved Rain Repellent Coatings are listed in AMM chapter 30-41-04.

- 2 Primary Flight Displays (PFD).

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The performance of AIII mode approaches requires that the following equipment and instruments be in operating conditions:

- Head-Up Guidance System (HGS);
- 2 Inertial Reference Systems (IRS);

**NOTE:** 1 IRS required in case of single IRS installation.

- 2 Air Data Computers (ADC);
- 3 VHF/NAV Systems;
- 2 Radio Altimeters;
- 2 Integrated Computers (IC);
- 2 Attitude and Heading Reference System (AHRS);

**NOTE:** AHRS is not applicable in case of dual IRS installation.

- Windshield Wipers;

**NOTE:** For airplanes Pre-Mod. SB 145-30-0055 and Post-Mod SB 145-30-0054 (or with an equivalent modification factory incorporated), the Rain Repellent Coating replace the Windshield Wipers. Approved Rain Repellent Coatings are listed in AMM chapter 30-41-04.

- Primary Flight Display (PFD 2);
- 1 Enhanced/Ground Proximity Warning System (EGPWS/GPWS);
- 1 Aural Warning Unit (AWU) Channel;
- 1 GPS (GPS 2 in case of dual GPS configuration).

**NOTE:** GPS is not required in case of dual IRS configuration.

## APPROACH AND LANDING FLAPS

AIII mode approaches and landings must be performed with flaps 22°.

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# SECTION 1-02

# NORMAL PROCEDURES

TABLE OF CONTENTS

Page Block

Introduction ..... 1-02-00
Checklist ..... 1-02-01
Normal Procedures
- External Safety Inspection ..... 1-02-05
- Internal Safety Inspection ..... 1-02-09
- Power Up ..... 1-02-13
- Before Start - First Flight ..... 1-02-17
- Before Start - Through Flight ..... 1-02-21
- Engine Start ..... 1-02-23
- After Start ..... 1-02-29
- Before Takeoff ..... 1-02-33
- Cleared Into Position ..... 1-02-37
- Takeoff ..... 1-02-40
- After Takeoff ..... 1-02-45
- Descent ..... 1-02-49
- Approach ..... 1-02-57
- Before Landing ..... 1-02-61
- After Landing ..... 1-02-69
- Shutdown ..... 1-02-73
- Leaving the Airplane ..... 1-02-77

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Supplementary Procedures Page Block

Fuel
Crossfeed Operation ..... 1-02-78
Environmental
Operation in Icing Conditions ..... 1-02-79
Turbulent Air Penetration ..... 1-02-79
Volcanic Ash ..... 1-02-79
Lightning Strike ..... 1-02-79
Pressurization in Manual Mode ..... 1-02-79
Bird or Hail Strike ..... 1-02-79
Navigation
Flight Management System ..... 1-02-80
RVSM Operation ..... 1-02-80
Enhanced/Ground Proximity Warning ..... 1-02-80
Windshear Prevention/Recovery ..... 1-02-80
Traffic and Collision Avoidance ..... 1-02-80
Transponder (*) ..... 1-02-80
RNP Approach ..... 1-02-80
Performance Based Navigation (PBN) ..... 1-02-80
Engine
Engine Start with Airplane Batteries and Low Pressure Unit (LPU) ..... 1-02-81
Cross Start ..... 1-02-81
Engine Start Assisted by APU ..... 1-02-81
Single Engine Taxi ..... 1-02-81
Flight Instruments
Altimeter Miscompare Tolerances ..... 1-02-82
CAT II Operation (*) ..... 1-02-83
QFE Operation (*) ..... 1-02-84
HGS Operation (*) ..... 1-02-85
High Altitude Operation (*) ..... 1-02-87
Steep Approach Operation (*) ..... 1-02-90
Operation in Airports Up to 8500 ft (*) ..... 1-02-92
Bounced Landing Recovery ..... 1-02-94
Profiles ..... 1-02-95

**NOTE:** Items marked with an asterisk (*) may not be present in this manual.

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# INTRODUCTION

The operating procedures defined in this section have been defined with the purpose of providing expanded normal procedures that should be used by trained flight crew to ensure that the airplane is in a proper condition and correctly configured for each phase of flight.

The source document for all procedures contained herein is the approved Airplane Flight Manual (AFM). In the event that any procedure disagrees with the AFM, the AFM will prevail. In the event that any of the procedures are missing or unusable, operations may be continued provided the approved AFM is available for use.

The normal procedures established are based on the assumption that all equipment is operating normally. It is the crew's responsibility to verify proper system response. In case improper indications are observed, verification of the appropriate controls position, checking of circuit breakers and testing of the related system should be performed to determine whether the condition affects dispatch or compliance with the MMEL, and whether any requires maintenance action is required.

* Items marked with an asterisk are to be performed at least once a day, by flight crew or maintenance personnel, at the operator's discretion.

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# CHECKLIST

## INTERNAL SAFETY INSPECTION

Maintenance Status ..... CKD
Cockpit
Emergency Equip ..... CKD
Reinforced Cockpit Door
Vent Louver
(if applicable) ..... OPN
Circuit Breakers ..... CKD
ELECTRIC Panel ..... SET
Emergency Lights ..... OFF
Fire Extinguishing
Handle 1 ..... PUSHED IN
FUEL Panel ..... SET
APU ..... SET
Ignitions ..... AUTO
START /
STOP Selectors ..... STOP
Fire Extinguishing
Handle 2 ..... PUSHED IN
Ailerons & Rudders
Shutoff ..... PUSHED IN
HYDRAULIC Panel ..... SET
Windshield Heating ..... PUSHED OUT
Sensors ..... PUSHED IN
Ice Detection Override . AUTO
AIR COND /
PNEUM Panel ..... SET
Windshield Wipers
(if installed) ..... OFF
Lights ..... OFF
ELT ..... ARMED
Weather Radar ..... OFF
Landing Gear Lever ..... DOWN
Crew Oxygen ..... ON
PASSENGER OXYGEN
Panel ..... SET
Gust Lock ..... LOCKED
Speed Brake ..... CLSD
Emergency /
Parking Brake ..... AS RQRD
FLAPS
Selector Lever ..... VERIFY POS
Alternate Gear Extension
Compartment ..... CKD

## POWER UP

Batteries 1 & 2 ..... AUTO
Avionics Master 1 or 2.. PUSHED IN
* Batteries Voltage ..... CKD
* Backup Battery
(EMB XR only) ..... CKD
GPU Voltage
(if available) ..... CKD
Avionics Master 1 & 2... PUSHED OUT
GPU (if available) ..... PUSHED IN
Fuel Pump
Power Tank 2 ..... AS RQRD
Navigation Light ..... ON
* FIRE EXTINGUISHER
Panel ..... CKD
APU ..... AS RQRD

Avionics Master 1 & 2... PUSHED IN

With APU Power

GPU (if available) ..... PUSHED OUT

3 minutes After APU Start

APU Bleed ..... PUSHED IN
Air Conditioning ..... AS RQRD

## BEFORE START

Manuals & Documents .ON BOARD
CVR ..... CKD
Electrical Panel ..... SET
Emergency Lights ..... ARM
Push Button Lights
Test (if installed) ..... CKD
♦ Fuel Panel ..... SET
* Fire Detection ..... CKD
Fire Extinguisher Panel CKD
Powerplant Panel ..... SET
* Elec Pump Sys 1 & 2.... CKD
Elec Pump Sys 1 & 2.... OFF
♦ Pax Signs Panel ..... SET
Ice Protection Panel ..... SET
AIR COND/PNEUM Panel . SET
Oxy Masks & Regulators ... CKD
Weather Radar ..... TST/STBY
Pitch Trim
Cutout Buttons ..... CKD
Display Control Panel ... SET
♦ Flight Number &
Clocks ..... SET
AHRS (if applicable) ..... SET
IRS (if applicable) ..... NAV
Autopilot ..... CKD
Gust Lock ..... LOCKED
Reversionary Panel ..... SET
♦ Flight Instruments ..... SET/X-CKD

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- ♦ RMU ..... SET
  Thrust Levers ..... IDLE
- ♦ Stall Protection System CKD
  Trim Panel ..... CKD
- ♦ Pressurization Panel .... SET
- ♦ FMS ..... SET

---

- ♦ Fuel QTY ..... CKD
- ♦ FMS ..... SET
- ♦ Speed Bugs ..... SET
- ♦ TRIM Panel ..... ___SET/ ZERO/ZERO
- ♦ Doors & Windows ..... CLSD
- ♦ Takeoff Briefing ..... COMPLETED
- ♦ Fuel Pump Power ..... ON
- ♦ Red Beacon ..... ON
- ♦ Emergency/Parking Brake AS RQRD
- ♦ Steering ..... AS RQRD

  Safety Pins ..... ON BOARD

## AFTER START

Ground Equipment ..... REMOVED
Electrical Panel ..... SET
APU ..... AS RQRD
FADEC ..... RST/ALTN
Elec Hyd Pumps ..... AUTO
Windshield Heating ..... AS RQRD
AIR COND/PNEUM Panel SET
FLAPS ..... ___SET
Flight Controls ..... CKD
Taxi Lights ..... ON

## BEFORE TAKEOFF

Takeoff Briefing ..... PERFORM

Ice Protection Test ..... AS RQRD

Brakes Temperature .... CKD
EICAS ..... CKD
Transponder ..... TA/RA
Takeoff Configuration .. CKD
Gust Lock ..... UNLOCKED
Elevator ..... CKD

## AFTER TAKEOFF

Landing Gear ..... UP
FLAPS ..... 0
Thrust Rating ..... CLB
Windshield Heating ..... AS RQRD
AIR COND/PNEUM Panel SET
Altimeters ..... SET/X-CKD
Pressurization ..... CKD
APU ..... AS RQRD

## DESCENT

Windshield Heating ..... PUSHED IN
Approach Briefing ..... COMPLETED
Speed Bugs ..... SET
PRESSURIZATION Panel SET

---

External Lights ..... ON
Pax Signs ..... SET

## APPROACH

PASS SIGNS Panel ..... SET
Altimeters ..... SET/X-CKD
Approach Aids ..... SET/X-CKD

## BEFORE LANDING

Landing Gear ..... DOWN
FLAPS ..... ___SET
Lights ..... AS RQRD
AP/YD ..... OFF

## SHUTDOWN

Thrust Levers ..... IDLE
Emergency/Parking Brake SET
GPU/APU Generators .. PUSHED IN
Shed Buses ..... AS RQRD
START/STOP Selectors ... STOP
Red Beacon ..... OFF
FSTN BELTS ..... OFF
Fuel Pump Pwr ..... AS RQRD
Elec Hyd Pumps ..... OFF
Ice Protection Sys ..... OFF
AIR COND/PNEUM Panel SET

## LEAVING THE AIRPLANE

IRS (if applicable) ..... OFF
Avionics
  Master 1 & 2 ..... PUSHED OUT
Emergency Lights ..... OFF
External &
  Internal Lights ..... OFF
Pax Signs Panel ..... OFF

Weather Radar ..... OFF
Standby Attitude
  (if applicable) ..... CAGED
GPU/APU ..... OFF
AIR COND /
  PNEUM Panel ..... SET
Fuel Pumps ..... OFF
Batteries ..... OFF

**♦ ON THROUGH FLIGHTS CHECKLITS.**

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# NORMAL PROCEDURES

## EXTERNAL SAFETY INSPECTION

When approaching the airplane, take time to watch the area where the airplane is parked. Evaluate if there is room for the taxi-out or push back maneuver. Make sure that there will be enough clearance throughout the maneuver.

Also take time to have a look at the airplane as a whole from a reasonable distance. See if the airplane looks good, level and normal. Experience shows that this "initial look" can reveal details that will otherwise go unnoticed such as fluid spots on the ground, unexpected things attached to the airplane, bent or unaligned airframe components, etc.

Make sure that the airplane has the chocks and safety pins on as required. If not, advise the ground staff immediately.

The External Safety Inspection must be carried out prior to the first flight of the day or whenever the crew-airplane combination changes. The external lights must be turned on for inspection with the exception of the ones that may be a nuisance to other people in the vicinity of the airplane. The lights must be checked and switched off before commencing the walk around.

The first officer normally accomplishes the external safety inspection, although either or both crew members may complete it.

The inspection can be done according to the following list:

Wheel Chocks..... IN PLACE

**NOSE SECTION**

Access Doors and Panels ..... SECURED
Static Ports ..... NO OBSTRUCTION
Sensors and Pitot Tubes ..... CONDITION, NO OBSTRUCTION
Windshield Wipers (or Rain Repellent Coating)..... CONDITION
Air Inlets..... NO OBSTRUCTION

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Radome..... SECURED
Nose Gear..... CHECK
Check if the nose wheel position indication mark is within the nose wheel position indication scale limits.
Wheels and Tires..... CONDITION
Tires should not be worn past the bottom of the tire grooves.
Gear Struts/Wheelwell/Doors ..... CONDITION, NO LEAKS
Gear Uplock Hook ..... UNLOCKED
If the uplock hook is in the LOCKED position, cycle the freefall lever to reposition the uplock to the UNLOCKED position.
Ground Locking Pin ..... REMOVED
Static Discharger ..... CONDITION
Ensure the static discharger is present. Otherwise, refer to the CDL for dispatch with missing items.
Landing and Taxi Lights..... CONDITION
Hydraulic Compartment (right side)..... NO LEAKS
Oxygen Disc and Recharging Panel (right side) ..... CHECK
Check oxygen overpressure green disc in place.

**FUSELAGE**

Access Doors and Panels..... SECURED
Fueling Compartment Door (right side) ..... SECURED
Inspection Lights ..... CONDITION
Air Inlets and Outlets..... NO OBSTRUCTION
Red Beacon ..... CONDITION
Antennas..... CONDITION
Ram Air Inlet ..... NO OBSTRUCTION
Fluid Drain Holes ..... NO LEAKS

**WINGS**

Landing Lights..... CONDITION
Emergency Lights ..... CONDITION
Wing Leading Edge..... CONDITION
Access Doors and Panels..... SECURED
Direct Measuring Sticks ..... PUSHED IN
Air Inlets, Outlets and Vents ..... NO OBSTRUCTION

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Vortilons and Vortex Generators ..... NUMBER AND CONDITION
Navigation and Strobe Lights ..... CONDITION
Static Dischargers ..... NUMBER AND CONDITION
Refer to the CDL for dispatch with missing items.
Flight Control Surfaces and Fairings ..... CONDITION
Flaps must be retracted and spoilers closed.
Main Gear ..... CHECK
Wheels and Tires ..... CONDITION
Gear Uplock Hook ..... UNLOCKED
If the uplock hook is in the LOCKED position, cycle the freefall lever to reposition the uplock to the UNLOCKED position.
Gear Struts/Wheelwells ..... CONDITION, NO LEAKS
Ground Locking Pins ..... REMOVED
Brake Wear Indicators ..... CHECK
Wear indicators should be no less than flush with the housing.

**TAIL CONE SECTION**

Air Inlets and Outlets ..... NO OBSTRUCTION
Antennas ..... CONDITION
Access Doors and Panels ..... SECURED
Pylons ..... CONDITION
Engines ..... CHECK
Check engines for leaks and obstructions in the air inlets.
Thrust Reverser Doors ..... FLUSH WITH NACELLE
Horizontal Stabilizer ..... CONDITION
Logo Lights ..... CONDITION
Flight Control Surfaces ..... CONDITION
Static Dischargers ..... NUMBER AND CONDITION
Refer to the CDL for dispatch with missing items.

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| | |
|---|---|
| APU | CONDITION |
| Pressurization Static Ports | NO OBSTRUCTION |
| Baggage Door | LATCHED/ LOCK PANEL CLOSED |

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# INTERNAL SAFETY INSPECTION

The Internal Safety Inspection must be carried out by the copilot prior to the first flight of the day, when the airplane is due to return to service after maintenance, or whenever the crew-airplane combination changes.

The internal safety inspection should be accomplished with electrical power supplied from APU or GPU. In the event that APU or GPU are not available, batteries may be used.

**NOTE:** Using batteries for an extended period will discharge them.

Maintenance Status ..... CHECK

Cockpit Emergency Equipment ..... CHECKED

Check for the availability, status and proper location of the following equipment:

- Escape ropes;
- Oxygen masks;
- Smoke goggles;
- Portable Breathing Equipment (PBE);
- Fire extinguishers;
- Crash Axe;
- Flashlights;
- Life vests.

Reinforced Cockpit Door Vent Louver (if applicable) ... OPEN

Circuit Braker Panels ..... CHECKED

Verify all circuit breakers IN at the overhead panel, behind the CPT seat and behind the F/O seat. If any CB is pulled verify the reason for it and if there is any operational implication advise the other pilot.

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Switches and knobs on the overhead panel must be set as follows:

Generators ..... IN
GPU ..... OUT
APU GEN ..... IN
BATT 1 & 2. ..... OFF
Essential Power ..... GUARDED
OUT
Bus Ties & Shed Buses ..... AUTO

Shed Buses must be set to OVRD to operate the recirculation fans when the electrical system is energized by the APU generator.

AC Power ..... IN
Back-up ..... IN
Avionics Master 1&2 ..... OUT
Emergency Lights ..... OFF
Fire Extinguishing Handle 1 ..... IN
Fuel Crossfeed ..... OFF
Pump Power 1&2 ..... OFF
ICU Panel ..... OUT
Exterior Lights ..... OFF
APU Fire Extinguishing ..... GUARDED
OUT
APU Master ..... OFF
APU Fuel Shutoff ..... GUARDED
OUT
Ignitions ..... AUTO
Start/Stop Selectors ..... STOP
Fire Extinguishing Handle 2 ..... IN
Ailerons & Rudders Shutoff ..... IN
Engine Pump Shutoff ..... GUARDED
OUT
Electric Hydraulic Pumps ..... OFF

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Windshield Heating ..... OFF
Sensors ..... IN
Ice Protection Buttons ..... IN
Ice Detection Override Knob ..... AUTO
Recirculation & Gasper ..... IN
Packs 1 & 2 ..... OUT
Engine & APU Bleed ..... OUT
Windshield Wipers (if installed) ..... OFF
Logo Light ..... OFF
Dome Light ..... AS REQUIRED
Pax Signs ..... OFF

Switches on the main panel must be set as follows:

ELT ..... ARMED
AHRS ..... SET
MFD Reversion ..... NORMAL
ADC, AHRS, SG Reversion ..... OUT
DAU 1&2 ..... OUT

Radar ..... OFF
Gear Lever ..... DOWN
Crew Oxygen ..... ON

Make sure that the Shutoff/Regulator Valve is in the ON position.

Passenger Oxygen ..... AUTO
Gust Lock ..... LOCKED

**CAUTION:** NEVER MOVE CONTROL SURFACES SUCH AS FLAPS AND SPOILERS WITHOUT FIRST MAKING SURE THAT THE AREA IS CLEAR.

Speed Brake ..... CLOSED

Emergency/Parking Brake ..... ON

If the airplane is to be pushed back for start and if start is to be performed with the APU, the crew may leave the parking brake released as long as the chocks are in place.

**NOTE:** To prevent hydraulic fluid transfer between systems: To apply the parking brake first press the brake pedals to full deflection, then pull the emergency/parking brake handle. To release the parking brake, first press the brake pedals to full deflection then release the emergency/parking brake handle.

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Flaps Selector Lever ..... UP

Make sure that the selected position is consistent with the position observed during external inspection. If not, be aware that, once the airplane is energized, if the handle is lifted from the detent, the flaps will move to the commanded position.

Free Fall Lever Compartment ..... CHECKED

The OVERRIDE switch must be in the NORMAL position and guarded.

The FREE FALL lever must be full down.

**NOTE:** If, during the external inspection, one of the gear uplock hooks is found mispositioned, the free fall lever may be pulled for uplock hook repositioning. This procedure must be carried out with gear pins in place.

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# POWER UP

## APU START RECOMMENDATIONS

For APU start and operation the following is recommended:

Starting cycle:

After First Attempt.....60 SECONDS OFF

After Second Attempt.....60 SECONDS OFF

After Third Attempt..... 30 MINUTES OFF

In case of an unsuccessful APU start or if BATT 1 OFF BUS followed by APU GEN OFF BUS messages are displayed on EICAS, the APU master switch must be set to OFF position and time intervals as stated above shall be observed before the next start attempt.

If during start ignition is not detected at about 30% engine speed, the starter generator is de-energized. When the engine decelerates to about 5% engine speed, the starter is automatically re-energized for another start attempt (Swing Start). Swing Start is limited to one time per start attempt.

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## APU START WITH BATTERIES

Internal Safety Inspection ..... COMPLETED

Batteries 1 & 2..... AUTO

Immediately after the batteries are switched ON the aural message “AURAL UNIT OK” can be heard.

Avionics Master 1 or 2 ..... ON

∗ Batteries Voltage ..... CHECKED

Check battery voltage on MFD.

If battery voltage is below 19 V it must be replaced. If battery voltage is below 24 V report to the maintenance personnel or recharge the affected battery by using the APU generator. In case of recharging, it is recommended that battery 1 be turned OFF before APU start. After APU start wait 3 minutes then select battery 1 to AUTO.

The minimum time for battery recharging is 30 minutes.

For cold soak operation, refer to Operation in Icing Conditions section.

Once the batteries are on, the pilot must concentrate on starting up the APU shortly, so as to save the batteries. Avoid, for example, taking time to adjust the seat or to look at documents. Plan to do these things after starting the APU and its generator is on.

∗ Backup Battery (EMB-145 XR only) ..... CHECKED

Release the Backup Battery Button momentarily and check if ISIS remains operating normally.

Avionics Master 1 & 2 ..... OFF

Once the battery charge is checked, Avionics Master 1 & 2 must be switched OFF before starting the APU.

PUMP PWR ..... ON

Select one of the TANK 2 electric fuel pumps and switch the Pump Pwr Tank 2 to on. However, if TANK 1 has more fuel than TANK 2, use XFEED and select one of the TANK 1 pumps plus the Pump Pwr Tank 1 instead.

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∗ Fire Detection ..... CHECKED

Press and hold (for at least 2 seconds) the Fire Detection Test button while observing the following events:

EICAS messages:

Warning: APU FIRE, ENG 1 (2) FIRE, BAGG SMOKE (*)
Caution: APU FIREDET FAIL, E1 (2) FIREDET FAIL
(*) for class C compartment only.

Fire Extinguisher handles illuminated.

BAGG EXTG button illuminated (for airplanes with baggage hold extinguishing only).

Fire aural warning.

APU Master ..... ON/WAIT 3 SECONDS/ START/THEN ON

Turn the knob to ON, wait 3 seconds, and then momentarily to START. Monitor APU EGT and RPM increasing within limits. The APU generator will come on line after RPM exceeds 95%.

**NOTE:** For airplanes equipped with AHRS-900 or IRS, do not start the APU before 30 seconds after airplane energization to prevent disturbances in the AHRS/IRS initialization.

Avionics Master 1 & 2 ..... ON

Switch the avionics master to ON. Verify APU voltage and amperage on electrical page. Amperage may be greater than 400 A (APU GEN OVLD may appear on the EICAS) at first while the APU recharges the batteries. Do not bring any additional load on line until amperage is below 400 A. Allow few seconds for the APU GEN OVLD message to disappear before switching the avionics master to ON.

Turn the NAV lights ON, be it day time or night time. NAV lights ON show the ramp personnel that the airplane is powered up, and also make wingtips and tail end more visible to people driving vehicles in the proximity of the airplane.

The LOGO light may also be switched ON during night time.

Allow 3 minutes for the APU to warm up before adding pneumatic load.

**NOTE:** Following every APU start attempt, allow 3 minutes of APU warm-up before adding pneumatic load. This is particularly important after unsuccessful APU start attempts, so as to permit that excessive fuel accumulated during the previous start attempts is burned, preventing fuel odor inside the cabin/cockpit.

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APU Bleed..... OPEN

Air Conditioning..... AS REQUIRED

Should it be necessary to climatize the airplane:

- Both Packs ON;
- XBLEED to OPEN;
- Set both temperature controls to AUTO. If control of the Pack 2 by the cabin attendant is desired, select the corresponding knob to ATTD. Recirculation fans and gaspers will be ON;
- Shed Buses must be set to OVRD to operate the recirculation fans when the electrical system is energized by the APU generator.

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## APU START WITH GPU

Internal Safety Inspection ..... COMPLETED

Batteries 1 & 2 ..... AUTO

Immediately after the batteries are switched ON the aural message “AURAL UNIT OK” can be heard.

Avionics Master 1 or 2 ..... ON

∗ Batteries Voltage ..... CHECKED

Check battery voltage on MFD.
If battery voltage is below 19 V it must be replaced. If battery voltage is below 24 V report to the maintenance personnel or recharge the affected battery by using the APU generator. In case of recharging, it is recommended that battery 1 be turned OFF before GPU disconnection. After GPU disconnection wait 3 minutes then select battery 1 to AUTO.

While GPU is ON, batteries will not be recharged.
The minimum time for battery recharging is 30 minutes.
For cold soak operation, refer to Operation In Icing Conditions section.

GPU Voltage ..... CHECKED

Check the ELEC page on the MFD if voltage is within 28.0 V (-2.0 V +1.0 V).

Avionics Master 1 & 2 ..... OFF

Once the GPU voltage is checked, Avionics Master bars 1 & 2 must be switched OFF.

GPU ..... ON

When the GPU switch is selected, the “GPU AVAIL” message on it goes off and its yellow stripe lights up.

PUMP PWR ..... ON

Switch on one of the TANK 2 electric fuel pumps. However, if TANK 1 has more fuel than TANK 2, use XFEED and switch one of the TANK 1 pumps instead.

∗ Fire Detection ..... CHECKED

Press and hold (for at least 2 seconds) the Fire Detection Test button while observing the following:

EICAS messages:
Warning: APU FIRE, ENG 1 (2) FIRE, BAGG SMOKE
Caution: APU FIREDET FAIL, E1 (2) FIREDET FAIL

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Fire Extinguisher handles illuminated.
BAGG EXTG button illuminated (applies to airplane with baggage hold extinguishing only).
Aural fire warning.

APU Master..... ON/WAIT 3 SECONDS/ START/THEN ON

Turn the knob to ON, wait 3 seconds, and then momentarily to START. Monitor APU EGT and RPM increasing within limits. The APU generator will come on line after RPM exceeds 95%.

GPU ..... OFF

Crew must deselect the GPU as soon as the APU is running and stable to prevent the ground crew from disconnecting it while still selected, which causes an unwanted transient.

Avionics Master 1 & 2 ..... ON

Switch the avionics master to ON. Verify APU voltage and amperage on electrical page. Amperage may be greater than 400 A (APU GEN OVLD may appears on the EICAS) at first while the APU recharge the batteries. Do not bring any additional load on line until amperage is below 400 A. Allow a few seconds for the APU GEN OVLD message to disappear before switching the avionics master to ON.

Turn the NAV lights ON, be it daytime or nighttime. NAV lights ON show the ramp personnel that the airplane is powered up, and also make wingtips and tail end more visible to people driving vehicles in the proximity of the airplane.

The LOGO light may also be switched ON during nighttime.

Allow 3 minutes of APU warm up before adding pneumatic load.

APU Bleed..... OPEN

Air Conditioning..... AS REQUIRED

Should it be necessary to cool down the cabin:

- Both Packs ON;
- XBLEED to OPEN;
- Set both temperature controls to AUTO. If control of the PACK 2 by the cabin attendant is desired, select the corresponding knob to ATTD. Recirculation and gaspers fans will be on;
- Shed Buses must be set to OVRD to operate the recirculation fans when the electrical system is energized by the APU generator.

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## GPU POWER (NO APU)

Internal Safety Inspection ..... COMPLETED

Batteries 1 and 2 ..... AUTO

Immediately after the batteries are switched ON the aural message ”AURAL UNIT OK” can be heard.

Avionics Master 1 or 2 ..... ON

Batteries Voltage ..... CHECKED

If battery voltage is below 19 V it must be replaced. If battery voltage is below 24 V report to the maintenance personnel or recharge the affected battery by using the generators. In case of recharging, it is recommended that battery 1 be turned OFF before GPU disconnection. After GPU disconnection wait 3 minutes then select battery 1 to AUTO.

While GPU is ON, batteries will not be recharged.

For cold soak operation, refer to Operation In Icing Conditions section.

GPU Voltage..... CHECKED

Check in the ELEC page, on the MFD, if the voltage is within 28.0 V (-2.0 V +1.0 V).

GPU ..... ON

When GPU button is selected, the “GPU AVAIL” message on it goes off and its yellow stripe lights up.

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INTENTIONALLY BLANK

# BEFORE START - FIRST FLIGHT

To begin the cockpit preparation the EXTERNAL SAFETY INSPECTION and the INTERNAL SAFETY INSPECTION must have been completed and the airplane must be powered up.

Airplane Manual & Documents ..... ON BOARD

Check the local regulations and company policy for the required on-board operational documents.

Typically the company has an approved Airplane Operating Manual with required operational information that must be on board. Additionally an approved MEL and a Route Manual may also be required, if not already part of the AOM.

The Company QRH must be on board.

Data such as runway analyses, driftdown analyses (if applicable), enroute diversion data, etc must also be on board.

Make sure that documents which are legally required to be on board are really on board, such as:

- Certificate of Airworthiness.
- Copy of the Insurance Policy.
- Airplane weighing document.
- The Cabin Crew, except for specific cases when the passenger documents must legally be handed to the Captain, handles documents such as General Declaration and passenger documentation.

Oxygen Masks ..... CHECKED/100%

Both pilots must check their respective masks for supply of oxygen and for microphone functionality. The masks must be set to 100% oxygen.

This oxygen pressure must be enough for the intended flight.
Carry out the test as follows:

- Select the MASK position on the Audio Panel;
- Set the mask to 100%;
- Select SPKR on the Audio Panel and set the volume to mid-range;

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- Select HOT MIC on the control wheel communication switch;
- Actuate the test button on the mask stowage location. Check that the blinker changes color; (*)
- The OXY ON flag must appear on the stowage box; (*)
- For EROS masks: While maintaining the RESET TEST lever (TEST/SHUTOFF sliding control) depressed, check that the blinker changes color momentarily, and then depress the PRESS-TO-TEST regulator for 1 second; or

For Puritan Bennett or B/E Aerospace masks: Set the regulator's control knob to EMERGENCY and momentarily actuate the test button on the mask stowage location;

- Check that the blinker changes color;
- The OXY ON flag must appear on the box; (*)
- The sound of oxygen flowing must be heard momentarily on the speaker, thereby assuring the microphone electrical integrity;
- Set the mask to 100%; (*)
- After finishing the test, select the BOOM position on the Audio Panel.

(*) Applicable only to Puritan Bennett or B/E Aerospace masks.

If there is an observer on the jump seat, check the observer oxygen mask as follows:

- Select the MASK position on the observer Audio Panel;
- Set the mask to 100%;
- Select SPKR on the Audio Panel and set the volume to mid-range;
- Select HOT MIC on the control wheel communication switch;
- For EROS masks: Depress the PRESS-TO-TEST regulator for 1 second; or

For Puritan Bennett or B/E Aerospace masks: Turn the regulator knob to the EMERGENCY position momentarily and then turn back the knob to 100% position;

- The sound of oxygen flowing must be heard momentarily on the speaker, thereby assuring the microphone electrical integrity;
- After finishing the test, select the BOOM position on the Audio Panel.

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CVR ..... CHECKED

Press the CVR TEST button and check the STATUS LED illuminated for about one second.

Batteries 1 & 2 ..... AUTO

Immediately after the batteries are switched ON the aural message ”AURAL UNIT OK” can be heard.

Electrical Panel ..... SET

Check if:

- All four generator buttons and the APU generator button are pressed;
- The ESSENTIAL POWER button is guarded and not pressed;
- The BUS TIES selector is set to AUTO;
- The SHED BUSES selector is set to OVRD in case of the galley ovens and recirculation fans are to be used and check also if the source of electrical power is the APU. If the source is a GPU, then set the selector to AUTO;
- The AC PWR, BACKUP and AVIONICS MASTER buttons are pressed.

Emergency Lights ..... ARMED

Switch the EMERG LT to ARM.

Photoluminescent Emergency Lights (if applicable) ..... CHARGED

For airplanes equipped with Photoluminescent Emergency Lights, make sure that the system was properly charged.

Push Button Lights (If installed) ..... CHECKED

Moving the switch to the TEST position will illuminate all the bars and button annunciators. The fire handles, APU fire extinguish button, BAGG EXTG button, electromechanical GUST LOCK indication lights, GPU AVAIL annunciator, digital pressurization control button and ATDT CALL button will not illuminate and will not be tested.

Overhead Panel Lights ..... AS REQUIRED

Engine 1 Fire Handle ..... PUSHED IN

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Fuel System ..... SET

Select the fuel pumps according to the alternating policy in use.

If the APU is running, feed it from the tank that has more fuel.

Reset the used fuel readout on the MFD.

PC Power System (if installed) ..... AS REQUIRED

If the PC Power supply is desired turn on the system releasing the PC Power button on IFE overhead panel.

Ventral Tank Transfer

Knob (EMB-145 XR only) ..... AUTO

Check if the knob is in the AUTO position.

* Fire Detection ..... CHECKED

Check the fire detection system if it has not been checked yet.

To do the test, press and hold for at least 2 seconds the Fire Detection Test button while observing the following:

EICAS messages:

Warning: APU FIRE, ENG 1 (2) FIRE, BAGG SMOKE(*)
Caution: APU FIREDET FAIL, E1 (2) FIREDET FAIL

Fire Extinguisher handles illuminated.

BAGG EXTG button illuminated(*).

Aural fire warning.

**NOTE: -** On the ground, if Fire Detection Test button is held for more than 10 seconds with the APU running, it will cause automatic APU shutdown.

- If it is necessary to repeat the test, wait at least 6 seconds to press the test button(*).
- If Fire Detection Test button is held for less than 2 seconds the BAGG EXTG button may remain illuminated. Should this happen, just repeat the test by pressing and holding the Fire Detection Test button for at least 2 seconds. After that the BAGG EXTG button should be not illuminated(*).

(*) Applicable to airplane with class C baggage compartment only

FIRE EXTINGUISHER Panel..... CHECK

- APU fire extinguishing Button OFF and no lights.
- BAGG fire extinguishing Button OFF and no lights.

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APU CONTROL Panel..... CHECK

APU MASTER Selector..... AS REQUIRED

APU FUEL SHUTOFF Button ..... OFF

- Verify APU FUEL SHUTOFF Button OFF, guarded and no striped bars illuminated.

Ignition ..... AUTO

Verify both switches set to AUTO.

Takeoff Data ..... STORED

As a general guideline, the lower thrust rating should always be used if the airplane's performance for the prevailing ambient conditions and the intended departure runway allows it.

Proceed as follows to enter the takeoff data:

- Select the T/O page on the MFD.
- Press the STORE button once and verify the white mark besides T/O MODE, which means that it is prompting for the selection of takeoff mode.
- Use the DEC/INC knob to select the takeoff mode. Press the STORE button one more time and the white mark will move to the REF TO TEMP line.
- Use the DEC/INC knob again to select the reference local temperature. Each movement of the knob will change the reference temperature by 1°C. Press the STORE button one more time and the white mark will move to the A-ICE mode selection line.
- Use the DEC/INC knob to select ANTI-ICE ON or OFF. Press the STORE a last time and the TAKEOFF DATA entry is complete.
- Also verify on the MFD T/O page that the level of lubricating oil in each engine is in the normal range.

**Ref. Anti-Ice Policy:** the following criteria must be observed when setting ref. Anti-ice to ON or to OFF:

Whenever temperature on ground is at or below 10°C and there is visible moisture in the air, it must be assumed that icing conditions are present. Under these circumstances the use of engine anti-ice (anti-ice override switch to ENG) is mandatory.

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The ERJ145/135 anti-ice system is such that if any ice is detected at a speed above 25 Kt the whole ice protection system goes ON.

If chances are that ice will be encountered during takeoff then REF A/ICE must be set to ON so that the FADEC allows a ITT margin for the anti-ice ON condition.

If REF A/ICE is set to ON then the takeoff performance-limited weight must be based on the anti-ice ON condition.

EXTERIOR LIGHTS Panel ..... AS REQUIRED

Engine 2 Fire Handle ..... PUSHED IN

FLIGHT CONTROLS Panel ..... CHECK

AILERON SHUTOFF SYS 1 and 2 Buttons ..... PUSHED IN

RUDDER SHUTOFF SYS 1 and 2 Buttons ..... PUSHED IN

Electric Hydraulic Pumps ..... CHECKED & OFF

Select the MFD HYD page and switch both electric hydraulic pumps to AUTO. Verify that the indicated pressures are within 2900 $\pm$ 200 psi. Check also the hydraulic fluid level of systems 1 and 2 are within normal range.

Switch both electric hydraulic pumps to ON and verify that the indicated pressures are within 2900 $\pm$ 200 psi.

**NOTE:** The electric hydraulic pumps should never be switched ON if the battery is the sole source of electrical power. If the batteries are the sole source of electrical power, wait until the APU or a GPU is available before switching ON the electric hydraulic pumps.

After both pumps have been checked, turn them OFF.

LOGO and DOME Lights ..... AS REQUIRED

Pax Signs ..... ON

Switch the FSTN BELTS and NO SMKG signs ON.

Ice Protection ..... SET

Make sure that the ENG, WING and STAB buttons are pressed. If some of them are not pressed, press them now. The SENSORS buttons must also be pressed. The WINDSHIELD buttons need to be pressed only if the windshield needs defogging.

The ICE DETECTION OVERRIDE knob must be in AUTO.

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Air Conditioning ..... AS REQUIRED

If air conditioning is desired and if the APU has been running for more than 3 minutes (5 minutes is preferable) open the CROSSBLEED and select both PACKS to OPEN. The recirculation fans (RECIRC button) must be ON.

If the passengers are not to board the airplane through a jetway, then it is recommended that PACK 1 be switched OFF thus reducing the external noise at the main passenger door for the sake of passenger comfort. If PACK 2 only is capable of keeping a comfortable cabin temperature, PACK 1 can be left OFF until after both engines are running (after going through the After Start Checklist).

HGS Combiner (if installed)..... SET

Crew/Passenger Oxygen Pressure ..... CHECKED

Check on the MFD ECS page if the minimum pressure for flight crew is 1500 psi for three occupants or 1100 psi for two occupants.

For airplanes equipped with gaseous passenger oxygen system check on the MFD ECS page if the minimum pressure for passenger system is 1150 psi.

**NOTE:** The minimum oxygen pressure for dispatch was calculated at an ambient temperature of 21°C (70°F). For other temperatures, refer to Oxygen Pressure Correction Chart on section 2-16.

Glareshield Lights Control Panel..... AS REQUIRED

Weather Radar ..... TEST & STBY

Both pilots must select RADAR to SBY on their panels.

If there is just one radar panel, then the CPT must do it.

Display Control ..... SET

Both pilots must select the following information on their panels:

- PFD format (full compass format or arc format);
- PFD source (NAV or FMS);
- Bearing pointer source (VOR, ADF or FMS);
- Select DH on the PFD as appropriate.

Flight Number & Clocks..... SET

The crew must enter the flight number into the appropriate place in the clock at his side.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

AHRS ..... SET

AH-800 AHRS: both pilots must check if the respective AHRS is set to SLVD.

AH-900 AHRS: enter the present position through the FMS CDU.

Flight Guidance Controller ..... SET

Autopilot ..... CHECKED

The crew assigned for the flight must carry out the AUTOPILOT check as follows:

- Release the GUST LOCK, bring the control column to its midcourse position between full up and full down;
- Select the AP to his side and engage it, verifying the "AP" and "YD" indications on the PFD;
- Press the AP/PUSHER/TRIM button on the control wheel and verify the disengagement of the AP and the disappearance of the respective indications on the PFD;
- Set the gust lock again.

**NOTE:** When the wind is strong enough to force the horizontal stabilizer, an automatic pitch trim action may occur if the airplane is on the ground and the autopilot is engaged.

Gust Lock ..... LOCKED

DIGITAL AUDIO Panel ..... AS REQUIRED

Select the microphone and audio reception buttons as required and adjust the volume levels.

Reversionary Panels ..... NORMAL

Both pilots must check that their respective MFD Selector Knobs are set to NORM.

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Flight Instruments ..... SET & X-CHECKED

Both pilots must set their respective altimeters to the local QNH. They must also select an initial course as per the expected departure procedure. The CPT must also set the HDG bug according to the intended runway heading.

Once these actions are complete, the pilots must carry out an instrument crosscheck as follows:

- Both AIRSPEED TAPES not showing speed;
- EADI's level and flag-free;
- Both ALTIMETERS with their QNH set, and reading consistent with altitudes. If the crew already has the predeparture clearance, they can select the initial assigned altitude on the ASEL;
- Both VERTICAL SPEED INDICATORS showing zero;
- EHSI's with the courses selected according to the intended departure procedure, showing the same magnetic heading, flag-free and with the heading bug set to the intended runway heading.

**NOTE:** In case of heading split, check if there are ferrous structures or other magnetic interference sources close to the airplane, and/or move the airplane to a different location.

Standby Instruments..... SET

Uncage the STANDBY ATTITUDE indicator, if it is caged, and observe that the red flag is removed and the horizon is steady.

Compare its indication with the main attitude indicators. Set the QNH and compare its readout with one of the main altitude tapes.

MFD SYS Pages..... CHECK

RMU..... SET

The PF assigned for the flight must set the COMM and NAV frequencies as appropriate for the expected SID or departure procedure.

The use of the VHF COMM sets must follow the arrangement described below:

COMM 1: ATC

COMM 2: Company frequency, ATIS, VOLMET, etc.

COMM 3 (if available): Distress (121.5) and air-to-air broadcast.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Verify if the ATC/TCAS window is in SBY. Select the ABOVE function.

Test the TCAS by placing the yellow cursor box over the code. Press the RMU test button for 5 to 7 seconds until the test OK message on the RMU and "TCAS TEST, PASSED" aural annunciation is heard.

Enter the flight number or CALL SIGN on the appropriated window into the RMU.

Verify that BACK-UP TUNING is set to NORMAL and is copying RMU2.

Flight Control DISCONNECT Handles ..... CHECK

Speed Brake Lever ..... CLOSED

Thrust Levers ..... IDLE

Stall Protection System ..... CHECKED

The AHRS should be aligned.

CUTOUT 1 and 2 buttons must be guarded and not illuminated and QUICK DISCONNECT BUTTON must be released.

Carry out the Stall Protection System test as follows:

- Pull the control column all the way back and momentarily press the SPS TEST button (the TEST button must not be kept pressed beyond the shaker actuation). Both stick shakers and stick pusher will actuate, the caution and warning lights will illuminate and an aural warning will be heard.
- Lightly counteract the control column tendency to move forward.
- The test takes about 5 seconds and is valid if the amber light on the TEST button extinguishes.
- Press the caution and warning light buttons to turn them off.

Trims ..... CHECKED

Verify that the aileron, rudder, main and backup pitch trims are operating properly both ways up to the 3 seconds automatic stop; leave the aileron and rudder trims to the neutral and the pitch trim to the green band.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

BACK-UP TUNING (if installed) ..... SET

Set to NORMAL and copying RMU2.

COMM 3 (if installed) ..... SET

Press the transfer button in case of an error message on the radio display.

Pressurization ..... SET

Set the system to the destination airport elevation and verify that the DUMP and AUTOMAN switches are guarded and were not pushed (if they have been pushed the white mark on the buttons will be lit). The manual controller knob must be set to the green mark (DN position) to enable automatic pressurization control.

FMS ..... SET

The PF assigned for the flight must enter all the data that does not depend on the final ship papers. So the FMS initialization including the check if the DATABANK is still valid, check for correct date and time and check for possible messages related to the status of the FMS. Also if the flight plan needs to be entered, it can be done now.

**NOTE:** For UNIVERSAL FMS operations, in order to prevent CDU DATA BUS FAIL massage from occurring, a crossfill operation should be performed only after the airplane is energized by its generators (APU and/or engines), provided that airplanes buses are stable and already supplying power to the systems (GPU is disconnected).

AFTER THE FINAL SHIP PAPERS ARRIVE ON BOARD – SHORTLY BEFORE STARTUP:

FUEL QTY ..... CHECK

Confirm if onboard fuel quantity matches required fuel for the intended flight.

FMS ..... SET

The LSP must complete data entry into the FMS including TOTAL FUEL, CARGO DATA and PAX NUMBER.

Speed Bugs ..... SET

Set $V_1$, $V_R$, $V_2$ and $V_{APP}$ on the MFD. Set $V_{FS}$ on the PFD.
In case of Noise Abatement procedure set $V_2$+10 on the PFD.

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HF (if installed) ..... SET

Pitch Trim ..... SET/ZERO/ ZERO

Pitch Trim must be set as per the CG position stated in the weight and balance sheet.

Doors & Windows ..... CLOSED

Both pilots must verify that their respective cockpit window is closed and the RSP should select MFD T/O page to check all airplane doors closed indications.

Check the cockpit door securely closed.

Both pilots should select TCAS page on MFD for takeoff.

Takeoff Briefing ..... COMPLETED

The briefing should describe the departure procedures, taxi out routes, power reductions, weather, terrain/MSA, noise abatement procedures, low visibility procedures, inoperative airplane components, runway in use/condition, return alternate airports, NOTAMs and any required operational procedures that differ from the normal procedures. It is recommended to perform the takeoff briefing before engine start.

Fuel Pump Power ..... ON

Red Beacon ..... ON

Ground Equipment ..... AS REQUIRED

Emergency/Parking Brake ..... ON

Check that the PARKING BRAKE is ON and the corresponding ON light is lighted. If the EMRG BRK LO PRESS shows on the EICAS then switch on the electric hydraulic pump 2 momentarily to repressurize the accumulator.

Steering ..... AS REQUIRED

Safety Pins ..... ON BOARD

Verify that the safety pins are on board, behind the CPT seat.

Locking Pins (if applicable) ..... ON BOARD

Verify that the locking pins are on board, behind the CPT seat.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# BEFORE START - FIRST FLIGHT

To begin the cockpit preparation the EXTERNAL SAFETY INSPECTION and the INTERNAL SAFETY INSPECTION must have been completed and the airplane must be powered up.

Airplane Manual & Documents ..... ON BOARD

Check the local regulations and company policy for the required on-board operational documents.

Typically the company has an approved Airplane Operating Manual with required operational information that must be on board. Additionally an approved MEL and a Route Manual may also be required, if not already part of the AOM.

The Company QRH must be on board.

Data such as runway analyses, driftdown analyses (if applicable), enroute diversion data, etc must also be on board.

Make sure that documents which are legally required to be on board are really on board, such as:

- Certificate of Airworthiness.
- Copy of the Insurance Policy.
- Airplane weighing document.
- The Cabin Crew, except for specific cases when the passenger documents must legally be handed to the Captain, handles documents such as General Declaration and passenger documentation.

Oxygen Masks ..... CHECKED/100%

Both pilots must check their respective masks for supply of oxygen and for microphone functionality. The masks must be set to 100% oxygen.

This oxygen pressure must be enough for the intended flight.

Carry out the test as follows:

- Select the MASK position on the Audio Panel;
- Set the mask to 100%;
- Select SPKR on the Audio Panel and set the volume to mid-range;

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

- Select HOT MIC on the control wheel communication switch;
- Actuate the test button on the mask stowage location. Check that the blinker changes color; (*)
- The OXY ON flag must appear on the stowage box; (*)
- For EROS masks: While maintaining the RESET TEST lever (TEST/SHUTOFF sliding control) depressed, check that the blinker changes color momentarily, and then depress the PRESS-TO-TEST regulator for 1 second; or

For Puritan Bennett or B/E Aerospace masks: Set the regulator's control knob to EMERGENCY and momentarily actuate the test button on the mask stowage location;

- Check that the blinker changes color;
- The OXY ON flag must appear on the box; (*)
- The sound of oxygen flowing must be heard momentarily on the speaker, thereby assuring the microphone electrical integrity;
- Set the mask to 100%; (*)
- After finishing the test, select the BOOM position on the Audio Panel.

(*) Applicable only to Puritan Bennett or B/E Aerospace masks.

If there is an observer on the jump seat, check the observer oxygen mask as follows:

- Select the MASK position on the observer Audio Panel;
- Set the mask to 100%;
- Select SPKR on the Audio Panel and set the volume to mid-range;
- Select HOT MIC on the control wheel communication switch;
- For EROS masks: Depress the PRESS-TO-TEST regulator for 1 second; or

For Puritan Bennett or B/E Aerospace masks: Turn the regulator knob to the EMERGENCY position momentarily and then turn back the knob to 100% position;

- The sound of oxygen flowing must be heard momentarily on the speaker, thereby assuring the microphone electrical integrity;
- After finishing the test, select the BOOM position on the Audio Panel.

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

CVR ..... CHECKED

Press the CVR TEST button and check the STATUS LED illuminated for about one second.

Batteries 1 & 2 ..... AUTO

Immediately after the batteries are switched ON the aural message ”AURAL UNIT OK” can be heard.

Electrical Panel ..... SET

Check if:

- All four generator buttons and the APU generator button are pressed;
- The ESSENTIAL POWER button is guarded and not pressed;
- The BUS TIES selector is set to AUTO;
- The SHED BUSES selector is set to OVRD in case of the galley ovens and recirculation fans are to be used and check also if the source of electrical power is the APU. If the source is a GPU, then set the selector to AUTO;
- The AC PWR, BACKUP and AVIONICS MASTER buttons are pressed.

Emergency Lights ..... ARMED

Switch the EMERG LT to ARM.

Photoluminescent Emergency Lights (if applicable) ..... CHARGED

For airplanes equipped with Photoluminescent Emergency Lights, make sure that the system was properly charged.

Push Button Lights (If installed) ..... CHECKED

Moving the switch to the TEST position will illuminate all the bars and button annunciators. The fire handles, APU fire extinguish button, BAGG EXTG button, electromechanical GUST LOCK indication lights, GPU AVAIL annunciator, digital pressurization control button and ATDT CALL button will not illuminate and will not be tested.

Overhead Panel Lights ..... AS REQUIRED

Engine 1 Fire Handle ..... PUSHED IN

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Fuel System ..... SET

Select the fuel pumps according to the alternating policy in use.

If the APU is running, feed it from the tank that has more fuel.

Reset the used fuel readout on the MFD.

PC Power System (if installed) ..... AS REQUIRED

If the PC Power supply is desired turn on the system releasing the PC Power button on IFE overhead panel.

Ventral Tank Transfer
Knob (EMB-145 XR only) ..... AUTO

Check if the knob is in the AUTO position.

* Fire Detection ..... CHECKED

Check the fire detection system if it has not been checked yet.

To do the test, press and hold for at least 2 seconds the Fire Detection Test button while observing the following:

EICAS messages:

Warning: APU FIRE, ENG 1 (2) FIRE, BAGG SMOKE(*)
Caution: APU FIREDET FAIL, E1 (2) FIREDET FAIL

Fire Extinguisher handles illuminated.

BAGG EXTG button illuminated(*).

Aural fire warning.

**NOTE: -** On the ground, if Fire Detection Test button is held for more than 10 seconds with the APU running, it will cause automatic APU shutdown.

- If it is necessary to repeat the test, wait at least 6 seconds to press the test button(*).
- If Fire Detection Test button is held for less than 2 seconds the BAGG EXTG button may remain illuminated. Should this happen, just repeat the test by pressing and holding the Fire Detection Test button for at least 2 seconds. After that the BAGG EXTG button should be not illuminated(*).

(*) Applicable to airplane with class C baggage compartment only.

FIRE EXTINGUISHER Panel ..... CHECK

- APU fire extinguishing Button OFF and no lights.
- BAGG fire extinguishing Button OFF and no lights.

APU CONTROL Panel..... CHECK

APU MASTER Selector..... AS REQUIRED

APU FUEL SHUTOFF Button ..... OFF

Verify APU FUEL SHUTOFF Button OFF, guarded and no striped bars illuminated.

Ignition ..... AUTO

Verify both switches set to AUTO.

Takeoff Data ..... STORED

As a general guideline, the lower thrust rating should always be used if the airplane's performance for the prevailing ambient conditions and the intended departure runway allows it.

Proceed as follows to enter the takeoff data:

- Select the T/O page on the MFD.
- Press the STORE button once and verify the white mark besides T/O MODE, which means that it is prompting for the selection of takeoff mode.
- Use the DEC/INC knob to select the takeoff mode. Press the STORE button one more time and the white mark will move to the REF TO TEMP line.
- Use the DEC/INC knob again to select the reference local temperature. Each movement of the knob will change the reference temperature by 1°C. Press the STORE button one more time and the white mark will move to the A-ICE mode selection line.
- Use the DEC/INC knob to select ANTI-ICE ON or OFF. Press the STORE a last time and the TAKEOFF DATA entry is complete.
- Also verify on the MFD T/O page that the level of lubricating oil in each engine is in the normal range.

**Ref. Anti-Ice Policy:** the following criteria must be observed when setting ref. Anti-ice to ON or to OFF:
Whenever temperature on ground is at or below 10°C and there is visible moisture in the air, it must be assumed that icing conditions are present. Under these circumstances the use of engine anti-ice (anti-ice override switch to ENG) is mandatory.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

The ERJ145/135 anti-ice system is such that if any ice is detected at a speed above 25 Kt the whole ice protection system goes ON.

If chances are that ice will be encountered during takeoff then REF A/ICE must be set to ON so that the FADEC allows a ITT margin for the anti-ice ON condition.

If REF A/ICE is set to ON then the takeoff performance-limited weight must be based on the anti-ice ON condition.

EXTERIOR LIGHTS Panel ..... AS REQUIRED

Engine 2 Fire Handle ..... PUSHED IN

FLIGHT CONTROLS Panel ..... CHECK

AILERON SHUTOFF SYS 1 and 2 Buttons ..... ON

RUDDER SHUTOFF SYS 1 and 2 Buttons ..... ON

Electric Hydraulic Pumps ..... CHECKED & OFF

Select the MFD HYD page and switch both electric hydraulic pumps to AUTO. Verify that the indicated pressures are within 2900 $\pm$ 200 psi. Check also the hydraulic fluid level of systems 1 and 2 are within normal range.

Switch both electric hydraulic pumps to ON and verify that the indicated pressures are within 2900 $\pm$ 200 psi.

**NOTE:** The electric hydraulic pumps should never be switched ON if the battery is the sole source of electrical power. If the batteries are the sole source of electrical power, wait until the APU or a GPU is available before switching ON the electric hydraulic pumps.

After both pumps have been checked, turn them OFF.

LOGO and DOME Lights ..... AS REQUIRED

Pax Signs ..... ON

Switch the FSTN BELTS and NO SMKG signs ON.

Ice Protection ..... SET

Make sure that the ENG, WING and STAB buttons are pressed. If some of them are not pressed, press them now. The SENSORS buttons must also be pressed. The WINDSHIELD buttons need to be pressed only if the windshield needs defogging.

The ICE DETECTION OVERRIDE knob must be in AUTO.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Air Conditioning ..... AS REQUIRED

If air conditioning is desired and if the APU has been running for more than 3 minutes (5 minutes is preferable) open the CROSSBLEED and select both PACKS to OPEN. The recirculation fans (RECIRC button) must be ON.

If the passengers are not to board the airplane through a jetway, then it is recommended that PACK 1 be switched OFF thus reducing the external noise at the main passenger door for the sake of passenger comfort. If PACK 2 only is capable of keeping a comfortable cabin temperature, PACK 1 can be left OFF until after both engines are running (after going through the After Start Checklist).

HGS Combiner (if installed) ..... SET

Lower the combiner to its operating position and check if the simbology is displayed. Following, the simbology may be stowed or may be cleared if not desired during any remaining pre-flight or taxi-out.

Crew/Passenger Oxygen Pressure ..... CHECKED

Check on the MFD ECS page if the minimum pressure for flight crew is 1500 psi for three occupants or 1100 psi for two occupants.

For airplanes equipped with gaseous passenger oxygen system check on the MFD ECS page if the minimum pressure for passenger system is 1150 psi.

**NOTE:** The minimum oxygen pressure for dispatch was calculated at an ambient temperature of 21°C (70°F). For other temperatures, refer to Oxygen Pressure Correction Chart on section 2-16.

Glareshield Lights Control Panel ..... AS REQUIRED

Weather Radar ..... STANDBY

Both pilots must select RADAR to SBY on their panels.
If there is just one radar panel, then the CPT must do it.

Display Control ..... SET

Both pilots must select the following information on their panels:

- PFD format (full compass format or arc format);
- PFD source (NAV or FMS);
- Bearing pointer source (VOR, ADF or FMS);
- Select DH on the PFD as appropriate.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Flight Number & Clocks ..... SET

The crew must enter the flight number into the appropriate place in the clock at his side.

AHRS (if installed)..... SET

AH-800 AHRS: both pilots must check if the respective AHRS is set to SLVD.

AH-900 AHRS: enter the present position through the FMS CDU.

IRS (if installed)..... NAV

The initial alignment must be performed by setting the MSU switch to NAV. Make sure that the airplane is not moved or bumped during the alignment process. Alignment time varies with latitude. It is necessary to enter the airplane present position through the FMS CDU to complete the initial alignment.

**NOTE:** The IRS knob should never be moved to ATT on ground. If for any reason it is set to ATT, restart the alignment process from scratch by setting the knob to OFF then back to NAV.

Flight Guidance Controller ..... SET

Autopilot ..... CHECKED

The crew assigned for the flight must carry out the AUTOPILOT check as follows:

- Release the GUST LOCK, bring the control column to its midcourse position between full up and full down;
- Select the AP to his side and engage it, verifying the "AP" and "YD" indications on the PFD;
- Press the AP/PUSHER/TRIM button on the control wheel and verify the disengagement of the AP and the disappearance of the respective indications on the PFD;
- Set the gust lock again.

**NOTE:** When the wind is strong enough to force the horizontal stabilizer, an automatic pitch trim action may occur if the airplane is on the ground and the autopilot is engaged.

Gust Lock ..... LOCKED

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

DIGITAL AUDIO Panel ..... AS REQUIRED

Select the microphone and audio reception buttons as required and adjust the volume levels.

Reversionary Panels..... NORMAL

Both pilots must check that their respective MFD Selector Knobs are set to NORM.

Flight Instruments ..... SET & X-CHECKED

Both pilots must set their respective altimeters to the local QNH. They must also select an initial course as per the expected departure procedure. The CPT must also set the HDG bug according to the intended runway heading.

Once these actions are complete, the pilots must carry out an instrument crosscheck as follows:

- Both AIRSPEED TAPES not showing speed;
- EADI's level and flag-free;
- Both ALTIMETERS with their QNH set, and reading consistent with altitudes. If the crew already has the predeparture clearance, they can select the initial assigned altitude on the ASEL;
- Both VERTICAL SPEED INDICATORS showing zero;
- EHSI's with the courses selected according to the intended departure procedure, showing the same magnetic heading, flag-free and with the heading bug set to the intended runway heading.

**NOTE:** In case of heading split, check if there are ferrous structures or other magnetic interference sources close to the airplane, and/or move the airplane to a different location.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Standby Instruments ..... SET

Conventional Standby Instruments:

Uncage the STANDBY ATTITUDE indicator, if it is caged, and observe that the red flag is removed and the horizon is steady. Compare its indication with the main attitude indicators. Set the QNH and compare its readout with one of the main altitude tapes.

Integrated Standby Instrument System:

Ensure airplane is not moved until ISIS is initialized. Initialization occurs within 90 seconds after airplane power-up.

Compare its indication with the main attitude indicators. Set the QNH and compare its readout with the main altitude tapes. Check no ALT or SPD flags displayed.

MFD SYS Pages ..... CHECK

RMU ..... SET

The PF assigned for the flight must set the COMM and NAV frequencies as appropriate for the expected SID or departure procedure.

The use of the VHF COMM sets must follow the arrangement described below:

COMM 1: ATC

COMM 2: Company frequency, ATIS, VOLMET, etc.

COMM 3 (if available): Distress (121.5) and air-to-air broadcast.

Verify if the ATC/TCAS window is in SBY. Select the ABOVE function.

Test the TCAS by placing the yellow cursor box over the code. Press the RMU test button for 5 to 7 seconds until the test OK message on the RMU and “TCAS TEST, PASSED” aural annunciation is heard.

Enter the flight number or CALL SIGN on the appropriated window into the RMU.

Verify that BACK-UP TUNING is set to NORMAL and is copying RMU2.

Flight Control DISCONNECT Handles ..... CHECK

Speed Brake Lever ..... CLOSED

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Thrust Levers ..... IDLE

Stall Protection System..... CHECKED

The AHRS/IRS should be aligned.

CUTOUT 1 and 2 buttons must be guarded and not illuminated and QUICK DISCONNECT BUTTON must be released.

Carry out the Stall Protection System test as follows:

- Pull the control column all the way back and momentarily press the SPS TEST button (the TEST button must not be kept pressed beyond the shaker actuation). Both stick shakers and stick pusher will actuate, the caution and warning lights will illuminate and an aural warning will be heard.
- Lightly counteract the control column tendency to move forward.
- The test takes about 5 seconds and is valid if the amber light on the TEST button extinguishes.
- Press the caution and warning light buttons to turn them off.

Trims ..... CHECKED

Verify that the aileron, rudder, main and backup pitch trims are operating properly both ways up to the 3 seconds automatic stop; leave the aileron and rudder trims to the neutral and the pitch trim to the green band.

BACK-UP TUNING (if installed) ..... SET

Set to NORMAL and copying RMU2.

COMM 3 (if installed)..... SET

Press the transfer button in case of an error message on the radio display.

Pressurization ..... SET

Set the system to the destination airport elevation and verify that the DUMP and AUTOMAN switches are guarded and were not pushed (if they have been pushed the white mark on the buttons will be lit). The manual controller knob must be set to the green mark (DN position) to enable automatic pressurization control.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

FMS..... SET

The PF assigned for the flight must enter all the data that does not depend on the final ship papers. So the FMS initialization including the check if the DATABANK is still valid, check for correct date and time and check for possible messages related to the status of the FMS. Also if the flight plan needs to be entered, it can be done now.

**NOTE:** For UNIVERSAL FMS operations, in order to prevent CDU DATA BUS FAIL massage from occurring, a crossfill operation should be performed only after the airplane is energized by its generators (APU and/or engines), provided that airplanes buses are stable and already supplying power to the systems (GPU is disconnected).

HGS Control Panel (if installed)..... SET

Verification of the proper operation of all HCP displays can be accomplished by performing na HCP Display Test.
Enter runway length and TDZE for possible return for landing.
Enter glideslope angle for the the expected runway.
Select or verify the primary (PRI) mode on the HCP.

AFTER THE FINAL SHIP PAPERS ARRIVE ON BOARD – SHORTLY BEFORE STARTUP:

FUEL QTY..... CHECK

Confirm if onboard fuel quantity matches required fuel for the intended flight.

FMS..... SET

The LSP must complete data entry into the FMS including TOTAL FUEL, CARGO DATA and PAX NUMBER.

Speed Bugs..... SET

Set $V_1$, $V_R$, $V_2$ and $V_{APP}$ on the MFD. Set $V_{FS}$ on the PFD.
In case of Noise Abatement procedure set $V_2$+10 on the PFD.

HF (if installed)..... SET

Pitch Trim..... CKD/SET

Pitch Trim must be set as per the CG position stated in the weight and balance sheet.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Doors & Windows ..... CLOSED

Both pilots must verify that their respective cockpit window is closed and the RSP should select MFD T/O page to check all airplane doors closed indications.

Check the cockpit door securely closed.

Both pilots should select TCAS page on MFD for takeoff.

Takeoff Briefing..... COMPLETED

The briefing should describe the departure procedures, taxi out routes, power reductions, weather, terrain/MSA, noise abatement procedures, low visibility procedures, inoperative airplane components, runway in use/condition, return alternate airports, NOTAMs and any required operational procedures that differ from the normal procedures. It is recommended to perform the takeoff briefing before engine start.

Fuel Pump Power ..... ON

Red Beacon ..... ON

Ground Equipment..... AS REQUIRED

Emergency/Parking Brake..... ON

Check that the PARKING BRAKE is ON and the corresponding ON light is lighted. If the EMRG BRK LO PRESS shows on the EICAS then switch on the electric hydraulic pump 2 momentarily to repressurize the accumulator.

Steering ..... AS REQUIRED

FMS ..... COMPLETED

The PF assigned for the flight must complete the data entry into the FMS including PAX number and cargo data.

In case of dual FMS installation, the flight plan must be copied by the PF from his FMS to the other so as to ensure consistency among flight plans.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Safety Pins ..... ON BOARD

Verify that the safety pins are on board, behind the CPT seat.

Locking Pins (if applicable) ..... ON BOARD

Verify that the locking pins are on board, behind the CPT seat.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# BEFORE START - THROUGH FLIGHT

Fuel System and Quantity ..... CHECKED
lb/kg

The CPT must alternate the fuel pumps, reset the used fuel reading and check the fuel on board is not less than the required fuel for the next flight. The copilot must also reset the used fuel reading on his MFD.

PC Power System (if installed) ..... AS REQUIRED

If the PC Power supply is desired turn on the system releasing the PC Power button on IFE overhead panel.

Takeoff Data ..... STORED

As a general guideline, the lower thrust rating should always be used if the airplane's performance for the prevailing ambient conditions and the intended departure runway allow it.

Proceed as follows to enter the takeoff data:

- Select the T/O page on the MFD.
- Press the STORE button once and verify the white mark besides T/O MODE, which means that it is prompting for the selection of takeoff mode.
- Use the DEC/INC knob to select the takeoff mode. Press the STORE button one more time and the white mark will move to the REF TO TEMP line.
- Use the DEC/INC knob again to select the reference local temperature. Each movement of the knob will change the reference temperature by one degree Celsius. Press the STORE button one more time and the white mark will move to the A-ICE mode selection line.
- Use the DEC/INC knob to select ANTI-ICE ON or OFF. Press the STORE for the last time and the TAKEOFF DATA entry is complete.

Also verify on the MFD T/O page that the level of lubricating oil in each engine is in the normal range.

Pax Signs..... ON

Once all disembarking passengers have left the airplane, the FSTN BELTS sign must be switched ON again. The NO SMKG sign should be already ON. If not, it must be switched ON at this time.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

HGS Combiner (if applicable) ..... SET

Lower the combiner to its operating position and check to verify that symbology is displayed. Following the combiner check, it may be stowed or the symbology may be cleared if not desired during any remaining pre-flight or taxi-out.

Oxygen Pressure ..... CHECK

Both pilots must check their respective masks for supply of oxygen and for microphone functionality. The masks must be set to 100% oxygen.

Check on the MFD ECS page if the minimum pressure for flight crew is 1500 psi for three occupants or 1100 psi for two occupants.

For airplanes equipped with gaseous passenger oxygen system check on the MFD ECS page if the minimum pressure for passenger system is 1150 psi.

This oxygen pressure must be enough for the intended flight.

Carry out the test as described in the Before Start-First Flight procedures.

Flight Number and Clocks..... SET

The CPT sets the number of the next flight onto his clock if it is different from the previous flight number.

The CPT must also change the flight number on the RMU too, if necessary.

IRS (if applicable)..... NAV

Perform a quick alignment during intermediate stops. Set the knob to ALIGN and back to NAV without delay.

**NOTE:** The IRS knob should never be moved to ATT on ground. If for any reason it is set to ATT, restart the alignment process from scratch by setting the knob to OFF then back to NAV.

Flight Instruments ..... X-CHECKED

Both pilots must set their respective altimeters to the local QNH. They must also select an initial course as per the expected departure procedure. The CPT must also set the HDG bug according to the intended runway heading.

User: fhhernaof - Printed By myTechCare - Nov 21/24 - 00:45:44

Once these actions are completed, the pilots must carry out an instrument crosscheck as follows:

- Both AIRSPEED TAPES not showing speed;
- EADI's level and flag-free;
- Both ALTIMETERS with their QNH set, and reading consistent altitudes;
- Both VERTICAL SPEED INDICATORS showing zero;
- EHSI's with the courses selected according to the intended departure procedure, showing the same magnetic heading, flag-free and with the heading bug set to the intended runway heading;
- If the crew already has obtained predeparture clearance, they can select the initial assigned altitude on the ASEL; if the clearance is not available yet, the requested altitude minus 100 ft or yet the most probable altitude can be set;
- The 100 ft decrement is a reminder that the selected altitude has not been authorized by ATC yet.

Standby Instruments..... SET

Set the QNH or QFE on the standby altimeter.

RMU..... SET

The PF assigned for the flight must select the applicable COMM and NAV frequencies for the intended departure and select ABOVE and a proper range on the TCAS. Also, the PF should change the Flight Number. If necessary.

Stall Protection System..... CHECKED

The AHRS/IRS should be aligned.

CUTOUT 1 and 2 buttons must be guarded and not illuminated and QUICK DISCONNECT BUTTON must be released.

Carry out the Stall Protection System test as follows:

- Pull the control column all the way back and momentarily press the SPS TEST button (the TEST button must not be kept pressed beyond the shaker actuation). Both the stick shaker and the stick pusher will actuate and an aural warning will be heard.
- Lightly counteract the control column tendency to move forward.
- The test takes about 5 seconds and is valid if the amber light on the TEST button extinguishes.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

HGS Control Panel (if applicable)..... SET

Enter runway length and TDZE for possible return for landing.

Enter glideslope angle for the expected runway.

Select or verify the primary (PRI) mode on the HCP.

Pressurization ..... SET

Select the elevation of the destination airport.

FMS..... SET

The PF assigned for the flight must enter all the data that does not depend on the final ship papers. So the FMS initialization including the check if the DATABANK is still valid, check for correct date and time and check for possible messages related to the status of the FMS. If the flight plan needs to be entered, it can be done now.

**NOTE:** For UNIVERSAL FMS operations, in order to prevent CDU DATA BUS FAIL massage from occurring, a crossfill operation should be performed only after the airplane is energized by its generators (APU and/or engines), provided that airplanes buses are stable and already supplying power to the systems (GPU is disconnected).

AFTER THE FINAL SHIP PAPERS ARRIVE ON BOARD – SHORTLY BEFORE STARTUP:

FUEL QTY..... CHECK

FMS..... COMPLETED

The PF assigned for the flight must complete the data entry into the FMS including PAX number and cargo data.

In case of dual FMS installation, the flight plan must be copied by the PF from his FMS to the other so as to ensure consistency among flight plans.

Speed Bugs..... SET

Once all the dispatch papers are on board, set $V_1$, $V_R$ and $V_2$ on the MFD as per the runway analysis. Set the $V_{AP}$ bug to $V_{REF45°}$ plus 5 knots (or plus wind correction, whichever is greater) so if an air return is to be carried out, the final approach speed is already set.

The wind correction added to the $_{VAP}$ is limited to 15 Kt.

The $V_{FS}$ (Final Segment Speed) shows at the upper left corner on the PFD and is set through the SPD button.

HF (if installed)..... SET

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Pitch Trim..... SET/ZERO/ ZERO

Pitch Trim must be set as per the CG position stated in the weight and balance sheet.

Doors & Windows ..... CLOSED

Both pilots must verify that their respective cockpit window is closed and the RSP should select MFD T/O page to check all airplane doors closed indications.

Check the cockpit door securely closed.

Both pilots should select TCAS page on MFD for takeoff.

Takeoff Briefing..... COMPLETED

- The takeoff briefing should be performed by the PF and the left seat pilot must state the Reject Takeoff procedures.
- The briefing should describe the departure procedures, taxi out routes, power reductions, weather, terrain/MSA, noise abatement procedures, low visibility procedures, inoperative airplane components, runway in use/condition, return alternate airports, NOTAMs and any required operational procedures that differ from the normal procedures. It is recommended to perform the takeoff briefing before engine start.

Fuel Pump Power ..... ON

Red Beacon ..... ON

Parking Brake ..... ON

The CPT must verify on the MFD that the brake temperature is within the green range. If so, then he can apply the parking brake; otherwise, the parking brake must be left released until the brakes cool down as appropriate. If the brake temperature is in the yellow range, the next flight cannot commence since the accelerate-stop performance would fall short of the published performance.

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Steering..... AS REQUIRED

Push-back required: DISENGAGE pressing the trigger on the yoke and observe STEERING INOP message on EICAS.

No push-back required or after push-back: ENGAGE pressing STEERING HANDWELL and observe STEERING INOP message disappear on EICAS.

**NOTE:** Steering handle actuation with nose wheels beyond their operational limits may cause damage to the nose wheel steering system.

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# ENGINE START

Either engine 1 or engine 2 may be started first. However, the following considerations are important before the engine start:

- Starting engine 1 during towing operations: to avoid damage to the nose landing gear while towing, disengage the steering. The steering is disengaged through the steering disengage button on the control wheel. For airplanes Post-Mod. SB 145-32-0057 the steering is disengaged alternatively on ground. Refer to AOM sections 1-12-10 and 2-12-15 for details.
- Single engine taxi: the gust lock lever was designed to allow extra travel for one of the thrust levers. The gust lock extra travel is only adjustable for airplanes Post-Mod. SB 145-27-0115 or Post-Mod. SB 145-27-0126 or with an equivalent modification factory incorporated. In this case, the pilot may choose the thrust lever to have extra travel.
- Logistic regarding passengers boarding and ground personal clearance, according to local authority allowances.
- For engine start using APU or LPU, refer to AOM section 1-2-81.

Start/Stop Selector..... START, THEN RUN

Turn the start selector to RUN for 2 seconds, then turn the switch to the START position momentarily (signals the initiate start sequence to the FADEC) and then to RUN, and start the stopwatch.

Increase in N2..... CHECKED

Verify increase in N2 RPM within 10 seconds of start selection.

Make sure N2 accelerates normally.

Ignition is activated when N2 is at approximately 14% N2. Fuel is injected when N2 is at approximately 31.5% (28.5% for airplanes equipped with FADEC B7.4 and on) or 12 seconds after ignition is activated.

IGN A (B) annunciation..... CHECKED

Observe the annunciation IGN A (B) at about 14% N2.

With ignition in AUTO, only the FADEC in control activates the ignition system. FADEC in control is alternated on every subsequent ground start. Only one ignition channel is activated on grounds starts. Ignition channels are also alternated every subsequent start.

If ignition is set to OFF, FADEC neither activates ignition nor actuates the fuel valve to open, thus allowing dry motoring. However, a dry motoring procedure must not be performed if one of the FADECs is declared incapable.

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FF/ITT ..... CHECKED OFF

Observe the fuel flow and ITT indications raise at about 31.5% N2 (28.5% for airplanes equipped with FADEC B7.4 and on).
For airplanes equipped with FADEC older than B8.0, there is no automatic shut-down by the FADEC for an overtemperature on start. FADEC B8.0 and on has an automatic shut-down as an backup protection. Independently of the FADEC version, the pilot must keep his hands on START/RUN/STOP switch and manualy abort the engine start if necessary.

IGN A (B) annunciation ..... CHECKED OFF

Verify the annunciation IGN A (B) go OFF at about 57% N2.
The start cycle ends at approximately 57% N2, which can be observed when IGNITION A or B annunciation on EICAS disappears. After start is completed, engine stabilizes at about 64% N2 (70% N2 for airplanes equipped with FADEC 9.4.1 and on) and 24% N1.

Engine parameters..... CHECKED

Verify that the engine stabilizes at about 64% N2 (70% N2 for airplanes equipped with FADEC 9.4.1 and on) and 24% N1. Verify ITT, fuel flow and oil pressure for normal indications.

**CAUTION:** ABORT THE ENGINE START BY SELECTING THE START/STOP SELECTOR TO STOP IF AN ABNORMAL ENGINE START IS DETECTED.

**NOTE: -** Light-ups at 28% N2 will be achieved with systems meeting minimum performance requirements. If light-ups are occurring below 28%, the airplane should be scheduled for maintenance to avoid disruptions to passenger service.

- If light-ups are occurring later than 5 seconds after the first fuel flow indication, the airplane should be scheduled for maintenance to avoid disruptions to passenger service.
- If the light-up occurs between 5 and 10 seconds after the first fuel flow indication, smoke and a momentary flash of combustion may be produced.
- Routine operations may continue subsequent to any light-up achieved within 10 seconds after the first fuel flow indication.

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Repeat the procedure for the other engine.

If any starting limit is exceeded prior to aborting a start, do not attempt further starts and report to the maintenance personnel.

If a hung or no start occurs, accomplish the Dry Motoring Procedure before attempting another start.

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# AFTER START

Ground Equipment..... REMOVED

Do not start taxiing before receiving confirmation from the ground crew that the airplane is free to taxi. Then acknowledge that and switch OFF the cockpit dome lights.

It is recommended that the taxi light be ON during taxi even during daytime.

**NOTE:** The steering handle engagement actuation with the Nose wheels beyond their operational limits may cause damage to the Nose Wheel Steering System.

Electrical System ..... SET

If the SHED BUSES are set to OVRD, switch them to AUTO.

APU..... AS REQUIRED

Set the APU ON or OFF according to the electrical and pressurization systems. The APU usage shall be defined for a specific operation in order to minimize the overall costs.

FADEC..... RESET/ALTN

This swapping of the FADECs is important because it ensures that both the controlling and the standby FADECs are properly set.

Electric Hydraulic Pumps..... AUTO

Set the electric hydraulic pumps to AUTO after start.

Windshield Heating..... AS REQUIRED

Turn Windshield Heating ON if icing conditions or windshield fogging is encountered or anticipated.

For airplanes equipped with PPG windshield, the windshield heating system may be selected ON during all flight phases.

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AIR COND/PNEUMATIC Panel ..... SET

| CONDITION | ENGINE MODE | ENGINE BLEED | APU BLEED | CROSSBLEED |
|---|---|---|---|---|
| No icing | ALT T/O | Open | Closed | Auto |
| | T/O (1) | Closed | Open | Open |
| | E T/O | Closed | Open | Open |
| Icing | ALT T/O | Open | Closed | Auto |
| | T/O | Open | Closed | Auto |
| | E T/O | Open | Closed | Auto |

Takeoff Data ..... CHECKED

Check the ATTCS annunciation on EICAS.

Transponder ..... AS REQUIRED

Select the transponder mode in accordance with local requirements. The use of TA/RA or TA only modes on ground may trigger TCAS POP UP on MFD.

FLAPS ..... SET__

Adjust FLAPS to a setting consistent with the intended takeoff configuration and performance.

Flight Controls ..... CHECK

Release the gust lock and check AILERON and ELEVATOR free travel. Once this check is complete, the gust lock should be once again applied.

Each time electromechanical gust lock lever is set to unlocked (FREE) position elevator movement must be checked. This check must be performed at least 10 seconds after positioning the gust lock lever to the unlocked (FREE) position by moving the control column from the full up stop to the full down stop and back to the full up stop position.

Check the RUDDER by pressing the steering disengage button on the control wheel and moving the pedals from full right to full left.

Taxi Lights ..... ON

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Steering ..... CHECK

Verify the STEER INOP message displayed on the EICAS.

Press and hold for 5 seconds the steering handwheel maintaining it in the neutral position. Verify that the STEER INOP message is removed and, after handwheel is released, the message is not displayed again.

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# BEFORE TAKEOFF

**NOTE: -** Ensure that a “cold” engine operates at least 4 minutes before increasing N2 above 83%. An engine is considered “cold” if it has not run for the previous 90 minutes.

- Ensure that a “warm” engine operates at least 2 minutes before increasing N2 above 83%. An engine is considered “warm” if it has run for the previous 90 minutes.
- Should the pilot observes any noticeable change in the weather conditions or total time between setting of the T/O data and takeoff roll is expected to be longer than 20 minutes, it is recommended that the temperature stored in the T/O data setting be updated shortly before takeoff.
- To increase N2 above 83% the engine oil temperature must be at 40°C minimum. If the oil temperature is below 40°C after 4 minutes, the engine should be run an additional 4 minutes before advancing the Thrust Levers for takeoff.

Takeoff Briefing..... COMPLETED

It is recommended that the briefing be performed before engine start if there is time for that and if there is enough information about the cleared departure procedure.

If briefing is performed before engine start and there are clearance amendments afterwards or if there are any new facts that may cause significant changes in the departure procedure, the briefing must be amended.

**NOTE:** It is highly recommended that the briefing be performed with the active participation of both pilots. Techniques such as reading back or posing questions to each other enhance this participation. Briefings consisting of mechanical repetition of a memorized speech without having the mind set on the subject are useless.

Cabin Crew ..... ADVISE

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Ice Protection Test ..... AS REQUIRED

The ice protection test must be carried out once a day (not necessarily at the first flight of the day) when icing conditions are forecast.

The test may be carried out completely on the ground, or in 2 separate phases (first phase on the ground and second phase in flight), depending on weather conditions and crew discretion. For ice protection test information, refer to AOM Supplementary Procedures, Environmental, section 1-02-79.

Crossfeed ..... OFF

PC Power System (if installed) ..... OFF

The PC Power System must be turned off until the airplane reaches 10000 ft.

Lights ..... ON

Brakes Temperature ..... CHECKED

Verify on the MFD HYD page that the brakes temperature are within the green range. Takeoff cannot be attempted with brake temperatures outside the green range.

EICAS ..... CHECK

Check:

- No EICAS messages displayed.
- Thrust rate mode.

Transponder ..... TA/RA

Takeoff Configuration ..... CHECK

Right Seat Pilot presses the T/O CONFIG Button and “TAKEOFF OK” synthetic message shall be heard.

Flight Director ..... SET

Verify that the AUTOPILOT is selected to his side then press the FD button and select GO AROUND by pressing the respective button at the thrust lever head. Check that the flight director bar on T/O mode became visible on the PFD.

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Flaps ..... ___° SET

Move the flap to the setting consistent with the intended takeoff configuration and performance. The flap position must be indicated on the EICAS.

The flap must be checked for deflection consistent with the takeoff performance being considered.

Thrust Rating ..... CHECKED

Flight Controls..... CHECKED

The flight controls must be checked close to the holding point if a prolonged taxi in cold soak conditions occur or in any wheather that may possibly cause flight control problems due to freezing or due to accumulation of snow or slush.

Release the gust lock and check AILERON and ELEVATOR free travel. Once this check is complete, the gust lock should be once again applied.

Each time electromechanical gust lock lever is set to unlocked (FREE) position elevator movement must be checked. This check must be performed at least 10 seconds after positioning the gust lock lever to the unlocked (FREE) position by moving the control column from the full up stop to the full down stop and back to the full up stop position.

With the airplane taxiing on a straight line or standing still, check the RUDDER by pressing the steering disengage button on the control wheel and moving the pedals from full right to full left, and pressing the steering handle to reconnect the steering.

Gust Lock..... UNLOCKED

If Electromechanical Gust Lock is installed, wait 10 seconds to perform ELEVATOR check.

Elevator..... CHECK

**NOTE:** For airplanes Post-Mod. SB 145-27-0125 or with an equivalent modification factory incorporated, the Gust Lock Caution Lights remain blinking until unlocking cycle is completed. This cycle is completed with the gust lock lever at unlocked position (full forward).

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Cabin..... READY

This item is checked after the cabin attendant reported that the cabin is ready for departure.

**NOTE: -** If the ENGINE has not been running in the previous 90 minutes (“Cold” Engine) ensure at least 4 minutes to warm-up before apply takeoff power.

- If the ENGINE has been running in the previous 90 minutes (“Warm” Engine) ensure at least 2 minutes to warm-up before apply takeoff power.
- To increase N2 above 83% the engine oil temperature must be at least 40°C.

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# CLEARED INTO POSITION

External Lights ..... ON

The following lights must be turned on by the CPT prior to entering the runway: LDG 1, NOSE, LDG 2, TAXI (if not ON yet) and STROBE.

It is advisable to have strobe lights ON whenever entering or crossing an active runway.

EICAS Messages..... CHECKED

Make sure that there are no CAUTION or WARNING messages on the EICAS. If there is any ADVISORY message, evaluate the associated condition and its effects on the takeoff.

**NOTE:** The ADVISORY message CHECK XXX PERF is displayed to inform pilots about the engine model installed on the airplane, on ground and with parking brakes ON, so that the correct performance numbers for takeoff, landing, and flight planning can be used.

Transponder ..... TA/RA

Verify that the TCAS is set to ABOVE and that a proper range has been selected. He must also check that the transponder code is the correct one and is set to TA/RA.

Gust Lock..... UNLOCKED

Elevator..... CHECKED

The elevator movement must be checked after the Gust Lock Lever is in the unlocked (FREE) position. For airplanes equipped with electromechanical gust lock system the elevator movement must be checked at least 10 seconds after positioning the Gust Lock Lever to the unlocked (FREE) position by moving the control column from the full up stop to the full down stop and back to the full up stop position.

Takeoff Configuration ..... CHECKED

The Takeoff Configuration Test button must be pressed once runway line up is authorized. The “TAKEOFF OK” aural message should be heard. If any other announcement is heard, the airplane is out of the normal configuration, and must be properly configured prior to takeoff.

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# TAKEOFF

## (APPLICABLE TO ALL ENGINES EXCEPT AE3007A1P AND AE3007A1E)

Thrust Levers ..... THRUST SET

If an Alternate Takeoff Mode has been selected, check green ATTCS indication presented on EICAS.

**NOTE: -** If the runway is considered to be limiting, a static takeoff must be accomplished. In this case, release brakes after engine has reached the target N1.

- For rolling takeoffs, performance data is valid from the point where takeoff thrust is achieved.
- During takeoff run, pedals should be used to steer the airplane.

Engine Parameters ..... MONITOR

**NOTE:** High vibration indicates a malfunction which may worsen and increase vibration severity. Therefore, continuous engine operation with vibration in the amber range is not recommended. According to engine vibration limits, the pilot may elect not to reduce TLA for vibration below 2.5 IPS time limited to 5 minutes. If vibration returns to the green range within 5 minutes, the flight may continue but vibration causes should be investigated before the next flight. According to Rolls-Royce AE3007A Series Operation Manual, vibration in any flight phase in the amber range up to 1.5 IPS for less than 30 seconds does not require maintenance action.

At $V_R$, rotate the airplane to 14° (flaps 9°), 13° (flaps 18°) or 12° (flaps 22°) or follow the Flight Director guidance.

With positive rate of climb:

Landing Gear ..... UP

Command gear up on request, after confirming that the rate of climb is positive. Confirm the three white UP indications on the EICAS.

Do not apply brakes after becoming airborne. The main wheels will stop automatically.

Minimum Airspeed ..... $V_2$

If maneuvering is required, maintain a minimum airspeed of $V_2$ + 10 KIAS with a maximum bank of 25°.

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At level off height altitude:
For takeoff with flaps 9°:
At $V_2$ + 15 KIAS or higher.....FLAPS UP
For takeoff with flaps 18°:
At $V_2$ + 10 KIAS or higher.....FLAPS 9°
At $V_2$ + 30 KIAS or higher.....FLAPS UP
For takeoff with flaps 22°:
At $V_2$ + 5 KIAS or higher.....FLAPS 9°
At $V_2$ + 25 KIAS or higher.....FLAPS UP

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# AFTER TAKEOFF

**NOTE:** Keep the airplane trimmed to avoid excessive loads on the Horizontal Stabilizer Actuator (HSA). The airplane should be trimmed before 160 KIAS. Failure to accomplish the above procedure may lead to an inoperative trim condition not associated with any EICAS message.

Landing Gear ..... UP

PNF commands landing gear up after PF has requested and confirms the three white UP indications on the EICAS.

FLAPS ..... 0

PNF retracts FLAPS at acceleration altitude according Normal takeoff for Flaps 9, 18 or 22° schedule.

Thrust Rating ..... CLIMB

Select CLB mode on the THRUST RATING panel and confirm on the EICAS the CLB indication.

Internal and External Lights ..... AS REQUIRED

Windshield Heating ..... AS REQUIRED

Turn Windshield Heating ON if icing conditions or windshield fogging is encountered or anticipated.

For airplanes equipped with PPG windshield, the windshield heating system may be selected ON during all flight phases.

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Air Conditioning..... SET

Once CLB thrust is set the air conditioning should be set as follows:

- If the takeoff was performed on APU BLEED then both engine BLEEDS must be selected to OPEN, the CROSS BLEED must be set to AUTO and the APU bleed must be CLOSED.
- If the takeoff was performed on ENGINE BLEED, depending on the takeoff mode and on the temperature an ECS OFF signal may be generated. In this case, both PACKS must be reset, preferably one at a time, one shortly after the other for the sake of passenger comfort.

Altimeters ..... SET & XCHECKED

Upon passing the transition altitude, the altimeters are set to QNE by the respective pilots if it is an operation in ICAO airspace.

Pressurization ..... CHECKED

Once the air conditioning system is set, verify that the pressurization is functioning properly. Verify the cabin altitude, the differential pressure and the cabin rate of climb on the EICAS.

APU..... AS REQUIRED

Shut down the APU IMMEDIATELY after the engine bleed valves are open, that is, without any cool down period.

ABOVE 10000 FT

External Lights ..... OFF

Upon passing 10000 ft switch the external lights OFF except strobe and red beacon. The logo light must also be switched OFF.

Fasten Belts ..... AS REQUIRED

Switch the FSTN BELTS OFF if conditions permit.

PC Power System (if installed) ..... AS REQUIRED

If PC Power supply is desired release the PC Power button on IFE overhead panel to turn on the system for passengers use.

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# DESCENT

Windshield Heating ..... ON

The system must be switched ON to prevent fog and ice formation on the windshield inner layer.

Approach Briefing ..... COMPLETED

The crew must review the descent, approach and landing procedures.

HGS Combiner (if installed) ..... SET

If the combiner has been installed, position the combiner in the operating position.

HGS Control Panel (if installed) ..... SET

Enter on HCP, the touchdown zone elevation for the landing runway.

Enter on the HCP the glideslope angle for the landing runway.

Select the desired mode.

Speed Bugs ..... SET

Check on the FMS the expected landing weight and set $V_{REF}$, $V_{APP}$, $V_{APP}$ CLB, $V_{FS}$ on the MFD:

$V_{APP} = V_{REF}$ + wind correction.

Wind correction = ½ steady headwind component + gust increment above steady wind.

For Flaps 45° landing, the minimum wind correction is 5 KIAS and the maximum is 15 KIAS.

For Flaps 22° landing, the minimum wind correction is 5 KIAS and the maximum is 20 KIAS.

For $V_{APP\ CLB}$, set the $V_{APP\ CLB}$ or the $V_{APP}$, the greatest.

For $V_{FS}$, set $V_{FS}$ or the $V_{APP}$, the greatest.

EXAMPLE:

- $V_{REF}$ = 118 kt
- Reported wind = 16 kt, gusting to 25 kt
- The wind correction would be ½ (16) + (25 - 16) = 17 kt

However the maximum wind correction is 15 kt (Flaps 45°), thus:

- $V_{APP}$ = 118 kt + 15 kt = 133 kt

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Pressurization ..... CHECKED

Verify that the digital controller was set to the destination airport elevation.

BELOW 10000 FT

External Lights ..... ON

The following lights must be turned ON upon crossing 10000 ft:

- LDG1, NOSE AND LDG2.

During night time, the LOGO light must also be turned ON.

Fasten Belts ..... ON

Switch the FASTEN BELTS light upon crossing 10000 ft, if it is not ON yet.

PC Power System (if Installed) ..... OFF

Below 10000 ft the PC Power System must be turned off by pressing the PC Power button on IFE overhead panel.

Curtains..... STOWED

Any curtain used during flight must be stowed for landing.

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# APPROACH

XFEED ..... OFF

PASS SIGNS Panel ..... SET

AIR COND/PNEUMATIC Panel ..... SET

Altimeters ..... SET & XCHECKED

When the altimeters are set to QNH (passing the Transition Level) the Approach Checklist should be called for, if it is a flight in ICAO airspace. If the flight is in other than ICAO airspace, checklist must be called for at an altitude established as operational standard.

Verify that both altimeters and the standby altimeter are set to QNH.

Approach Aids ..... SET & XCHECKED

**NOTE:** The VAPP mode should be selected only on final approach segment, below 2500 ft AGL. Therefore, the outbound segment should be flown using any other mode.

Both pilots must verify that the frequencies and courses that were selected are correct for the intended approach. Ensure that both PFD's are displaying appropriate information.

They must also verify that the radio altimeter alert (DH) and the FMS are properly selected for the type of approach in mind.

**CAUTION:** RADIO ALTIMETER-BASED DECISION HEIGHTS ARE NOT RECOMMENDED ON CAT I APPROACHES. THE DECISION ON A CAT I APPROACH HAS TO BE BASED ON THE ALTIMETER RATHER THAN ON THE RADIO ALTIMETER. THE DH ALERT IN THESE CASES IS A REFERENCE ONLY THAT MUST BE USED WITH CARE AND ITS VALIDITY DEPENDS ON THE PILOTS' KNOWLEDGE OF THE TERRAIN BEFORE THE RUNWAY. ALTIMETER-BASED DECISIONS ARE NOT ALLOWED ON CAT II APPROACHES. THE DECISION ON THESE APPROACHES HAS TO BE BASED ON THE RADIO ALTIMETER.

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The tables below shows the flap maneuvering speeds during a visual approach or during an instrument approach:

**ALL ENGINES EXCEPT EMB-145XR MODEL**

| | | FLAP MANEUVERING SPEED (KIAS) | | | |
|---|---|---|---|---|---|
| | | BELOW MSLW* | | ABOVE MSLW* | |
| FLAPS | GEAR | NO ICING CONDITIONS | WITH ICING CONDITIONS | NO ICING CONDITIONS | WITH ICING CONDITIONS |
| 0° | Up | 180 | 200 | 180 | 200 |
| 9° | Up/Dn | 160 | | | |
| 18°/22° | Up/Dn | 140 | 150 | | |
| 45° | Dn | 140 | | | |

*Maximum Structural Landing Weight as specified on Limitations Section.

**ONLY APPLICABLE TO EMB-145XR MODEL**

| | | FLAP MANEUVERING SPEED (KIAS) | | | |
|---|---|---|---|---|---|
| | | BELOW MSLW* | | ABOVE MSLW* | |
| FLAPS | GEAR | NO ICING CONDITIONS | WITH ICING CONDITIONS | NO ICING CONDITIONS | WITH ICING CONDITIONS |
| 0° | Up | 180 | 200 | 180 | 200 |
| 9° | Up/Dn | 160 | | | 170 |
| 18°/22° | Up/Dn | 150 | 160 | | |
| 45° | Dn | 140 | 150 | | |

*Maximum Structural Landing Weight as specified on Limitations Section.

Thrust Rating..... T/O

If fuel consumption is a consideration, consult the In-flight performance software for maximum endurance speeds.

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**NOTE: -** The maximum flap 45° extended speed ($V_{FE}$) of 145 KIAS must not be exceeded in any condition. However, if momentary deviations happen to speeds up to 160 KIAS during transition to or flight with flaps 45°, no maintenance action is required. This information does not constitute authorization to operate above $V_{FE}$.

For the EMB-145 XR model, any exceedance of the flap 45° extended speed ($V_{FE}$) – 160 KIAS – requires maintenance action.

- The maximum flap 22° and 18° extended speed ($V_{FE}$) of 200 KIAS must not be exceeded in any condition. However, if momentary deviations happen to speeds up to 210 KIAS during transition to or flight with flaps 22° or 18°, no maintenance action is required. This information does not constitute authorization to operate above $V_{FE}$.
- The maximum flap 9° extended speed ($V_{FE}$) of 250 KIAS must not be exceeded in any condition. However, if momentary deviations happen to speeds up to 260 KIAS during transition to or flight with flaps 9°, no maintenance action is required. This information does not constitute authorization to operate above $V_{FE}$.

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## MISSED APPROACH

Go Around Button ..... PRESS

Press the Go Around buttons at the thrust levers and check if Flight Director goes to pitch 10° nose up. Rotate or verify that autopilot rotates the airplane following the Flight Director.

Thrust Levers ..... MAX

Advance the thrust levers to MAX position and verify the engines parameter.

Flaps ..... 9°

Select the flaps control to 9° position.

With positive rate of climb:

Landing Gear ..... UP

Select the landing gear lever to the up position.

Minimum Airspeed ..... APPROACH CLIMB SPEED

Maintain the pitch as commanded by the Flight Director or pitch 10° if Go Around is being performed on raw data to maintain the airplane airspeed above the minimum airspeed (approach climb speed selected on the MFD).

Once the acceleration height is reached check that the speed is consistent with the flap retraction speed, reduces the thrust levers to Thrust Set position. Select flap controls to zero position and select Climb Mode at the Thrust Rating panel.

**NOTE: -** For coupled Go-Around the altitude loss may be 75 ft.

**-** During the GO-AROUND procedure, the DON'T SINK aural warning may sound. In this case monitor the sink rate and follow the GO-AROUND guidance.

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# BEFORE LANDING

Landing Gear ..... DOWN

Command gear down and check whether the speed is within limits for landing gear extension. Also check the three green lights before this item is confirmed.

Speed Brake ..... CLOSE

Flaps ..... ___°SET

Check that the flap position is the intended one for landing.

Landing Lights ..... AS REQUIRED

Auto Pilot & Yaw Damper ..... OFF

**CAUTION:** YAW DAMPER ON DURING LANDING MAKES THE DIRECTIONAL CONTROLLABILITY OF THE AIRPLANE ON THE RUNWAY MORE DIFFICULT ESPECIALLY WITH GUSTS AND CROSS WINDS.

SPD Button (Flight Guidance Controller)..... SET
APPROACH
CLIMB SPEED

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# AFTER LANDING

Thrust Levers ..... AS REQUIRED

If taxi is not required, thrust levers should be set to idle.

Brakes ..... AS REQUIRED

Windshield Heating ..... AS REQUIRED

Turn windshield heating OFF if it is not required to defog or de-ice the windshield.

For airplanes equipped with PPG windshield, the windshield heating system may be selected ON during all flight phases.

Air Conditioning and Pneumatic System ..... AS REQUIRED

Pressurization ..... CHECK

External Lights ..... SET

Turn ON the taxi light, that must remain ON throughout the taxi regardless of the time of the day. The strobe lights must be turned OFF as soon as the airplane leaves the runway.

Radar ..... STBY

Verify that both radar selectors are set to Standby.

Flaps ..... 0°

The flaps must be retracted to a zero-degree position.

**NOTE:** Flap retraction from 22° to 0° following landing on a contaminated runway or after operation in icing condition should be delayed until flap gaps and actuators have been checked to be free of contamination and ice.

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Pitch Trim ..... SET

Reset the PITCH TRIM back in the green range (approx. 7.0 UP).

APU ..... AS REQUIRED

If the intention is to start the APU, do it now. Do not use the APU BLEED until the airplane is parked and with blocks on (wait at least 3 minutes for use APU bleed). This will maximize the APU life.

**NOTE:** To prevent spurious overcurrents in the electrical system, engines must not be shut down concurrently with the starting of the APU. A minimum one-minute interval between those two procedures is recommended.

Transponder ..... AS REQUIRED

Set the Transponder to Standby or in accordance with local regulations.

Gust Lock ..... LOCKED

The GUST LOCK must be applied immediately after the airplane leaves the runway.

**NOTE:** In case of an overcurrent protection is actuated, and the EICAS message DC BUS 2 OFF (PFD 2 and MFD 1 blank and MFD 2 displaying a red X) is displayed after a commanded engine 2 shutdown during taxi, the following actions must be carried out:

- Stop the airplane.
- Restart the engine 2.
- Taxi the airplane normally to the appropriate area.
- To shut the airplane down and reset the overcurrent protection, refer to Shutdown Procedures.

**CAUTION:** DURING TAXI, THE ENGINE 2 MUST NOT BE SHUT DOWN JUST BEFORE OR DURING A TURN, AS THIS MAY CAUSE STEERING COMMAND LOSS (STEERING IS SUPPLIED BY DC BUS 2).

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# SHUTDOWN

Thrust Levers ..... IDLE

Emergency/Parking Brake ..... ON

Typically when approaching the parking position and turning towards the marshal, turn OFF the taxi light. This is especially important during nighttime.

Pull the Emergency/Parking Brake and twist it to the set position after airplane has stopped. Make sure that the airplane is static before pulling the Emergency/Parking Brake.

The crew should verify the brake temperatures. If the brakes are hot, release the Emergency/Parking Brake as soon as the chocks are ON.

**NOTE:** To avoid hydraulic fluid transference from system 1 to system 2 first apply brakes using the pedals and after pull the emergency/parking brake handle. To release the emergency/parking brake, do the same procedure.

GPU/APU ..... AS REQUIRED

If the APU is not running yet, then start it up before the engines are shut down. If the APU (or the APU generator) is unserviceable and there is a GPU available, select the GPU before shutting down the engine. Check the GPU voltage on the MFD ELEC page before selecting it.

Shed Buses ..... AS REQUIRED

If the electrical system is being powered by the APU after the shut down of both engines and galley power is necessary, switch the shed buses to OVRD.

If the electrical system is being powered by a GPU after shutdown, the shed buses can be left in AUTO.

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Start/Stop Selectors ..... STOP

Once the Emergency/Parking Brake is applied, shut down the engines by selecting the engine start knobs to STOP.

**NOTE: -** Associated engine BLEED must be CLOSED before selecting the engine START/STOP Selectors to STOP;

**-** The engines will not shut down with START/STOP Selectors unless Thrust Levers are first moved to IDLE. If STOP is selected before Thrust Lever is retarded to IDLE, momentarily cycle START/STOP Selector to RUN and back to STOP;

**-** It is recommended to keep the engine running at idle during 1 minute to permit engine thermal stabilization prior to shutdown. Time of operation at or near idle, such as taxiing, is included in this 1-minute period.

**-** To prevent spurious overcurrents in the electrical system, engines must not be shut down concurrently with the starting of the APU. A minimum one-minute interval between those two procedures is recommended.

**-** If the GPU is required and it was not connected prior to engine shutdown, wait until N2 reaches 0% to connect the GPU. This is necessary to prevent transients in the electrical system.

**NOTE:** If the overcurrent protection is actuated, the airplane will enter in electrical emergency when both engines are shut down (both PFDs and MFDs deenergized, but EICAS display energized). In this case, the following steps must be accomplished:

- Batteries 1 and 2.....OFF
- Bus Ties .....OFF
- Properly trained personnel must reset the electrical system through ELEC SW switch on the Maintenance Panel behind the pilot's seat.
- If the failure persists, the related fault isolation task (FIM TASK 24-60-00-810-820-A) should be accomplished.

Red Beacon ..... OFF

The red beacon should be switched OFF after the engines are shut down. The use of the Red Beacon should be associated with engine(s) running or airplane in movement.

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Fasten Belts.....OFF

The FSTN BELTS lights should be switched OFF by crew as soon as the airplane is static and the engines are shut down. This will be a signal to cabin crew to initiate the procedures for deplanning of the passengers.

PUMP PWR..... AS REQUIRED

If the APU is running, keep the right fuel pump ON (or the left pump ON and CROSSFEED open).

If the APU is not running, turn both fuel pumps OFF.

Elec. Hydraulic Pumps.....OFF

Once the airplane is parked and the parking brake is applied, the copilot must switch both electric hydraulic pumps to OFF.

Ice Protection System.....OFF

Air Conditioning .....SET

If passengers are to be disembarked through means other than a jetway, the crew must switch APU BLEED to ON, CROSSBLEED to OPEN, and switch PACK 1 to OFF, thus reducing the external noise in the vicinity of the main passenger door, for better passenger comfort.

If better cooling is required after disembarkation is finished, PACK 1 can be switched ON again.

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# LEAVING THE AIRPLANE

Avionics Master 1 & 2 .....OFF

Select the AVIONICS MASTER 1 & 2 OFF prior to switching GPU or APU OFF. If the airplane is equipped with UNIVERSAL FMS installation, switch the FMS's OFF prior to switching OFF AVIONICS MASTER 1 & 2.

Emergency Lights .....OFF

The emergency lights must be switched from ARM to OFF before the batteries are switched OFF. Otherwise the emergency lights will illuminate and drain their batteries.

External & Internal Lights.....OFF

Make sure that all internal and external lights are switched OFF (with the exception of the cockpit dome light at night) before switching OFF GPU or APU.

Passenger Signs Panel .....OFF

Set EMERG LT, STERILE, NO SMKG (NO ELEC DEVICES in some configurations) and FSTN BELTS to OFF.

Weather Radar .....OFF

Switch the radar from STBY to OFF.

Standby Attitude (if applicable).....CAGED

Cage the standby horizon. Make sure it is caged by checking whether its red flag is visible.

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GPU/APU ..... OFF

Shut APU down by pressing the STOP button on its panel. Verify the shutdown on the EICAS. Wait until APU rotation drops to 5% before switching APU MASTER OFF.

**NOTE:** Do not close the air conditioning packs before shutting down the APU. Shutting down the APU while bleed air is coming out of it helps extending APU life.

If a GPU is the source of electrical power, switch it OFF through the GPU button on the Electrical System panel.

Never leave the airplane unattended and energized. A member of the maintenance team, familiar with the airplane, should always be left in charge before they leave.

Air Conditioning ..... OFF

Set the PACK and BLEED buttons on the Air Conditioning/Pneumatic panel to CLOSED, if they are not in this position already. The XBLEED valve should be left in AUTO. The RECIRC and GASPER buttons should be left pressed (this is their normal state).

PUMP PWR ..... OFF

Fuel pumps are needed only as long as the APU is in use. Once the APU is shut down the fuel pumps are not needed any more. So if the airplane is being powered by the GPU or solely by the batteries the pumps are not needed.

Main and Backup Batteries ..... OFF

Switch both batteries OFF.

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# LEAVING THE AIRPLANE

IRS (If installed) .....OFF

The manual switching of the IRS ensures proper finalization of the IRS software. Wait a minimum of ten seconds before removing the input power.

Avionics Master 1 & 2 .....OFF

Select the AVIONICS MASTER 1 & 2 OFF prior to switching GPU or APU OFF. If the airplane is equipped with UNIVERSAL FMS installation, switch the FMS's OFF prior to switching OFF AVIONICS MASTER 1 & 2.

Emergency Lights .....OFF

The emergency lights must be switched from ARM to OFF before the batteries are switched OFF. Otherwise the emergency lights will illuminate and drain their batteries.

External & Internal Lights.....OFF

Make sure that all internal and external lights are switched OFF (with the exception of the cockpit dome light at night) before switching OFF GPU or APU.

Passenger Signs Panel .....OFF

Set EMERG LT, STERILE, NO SMKG (NO ELEC DEVICES in some configurations) and FSTN BELTS to OFF.

HGS Combiner (If installed).....STOWED

Stow the combiner with the cover.

Weather Radar .....OFF

Switch the radar from STBY to OFF.

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Standby Attitude (if applicable) ..... CAGED

Cage the standby horizon. Make sure it is caged by checking whether its red flag is visible.

GPU/APU ..... OFF

Shut APU down by pressing the STOP button on its panel. Verify the shutdown on the EICAS. Wait until APU rotation drops to 5% before switching APU MASTER OFF.

**NOTE:** Do not close the air conditioning packs before shutting down the APU. Shutting down the APU while bleed air is coming out of it helps extending APU life.

If a GPU is the source of electrical power, switch it OFF through the GPU button on the Electrical System panel.

Never leave the airplane unattended and energized. A member of the maintenance team, familiar with the airplane, should always be left in charge before they leave.

Air Conditioning..... OFF

Set the PACK and BLEED buttons on the Air Conditioning/Pneumatic panel to CLOSED, if they are not in this position already. The XBLEED valve should be left in AUTO. The RECIRC and GASPER buttons should be left pressed (this is their normal state).

PUMP PWR ..... OFF

Fuel pumps are needed only as long as the APU is in use. Once the APU is shut down the fuel pumps are not needed any more. So if the airplane is being powered by the GPU or solely by the batteries the pumps are not needed.

Main and Backup Batteries ..... OFF

Switch both batteries OFF.

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# CROSSFEED OPERATION

**NOTE:** Crossfeed must be OFF during takeoff and landing.

If fuel imbalance is verified:
- Attitude ..... WINGS LEVELED
- If left wing presents lower level:
  - Crossfeed Selector ..... LOW1
- If right wing presents lower level:
  - Crossfeed Selector ..... LOW2
- Avoid rapid thrust levers movement.
- Monitor fuel imbalance.
- When the desired balance is achieved:
  - Crossfeed Selector ..... OFF

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# OPERATION IN ICING CONDITIONS

This Section contains amplified procedures to Operation in Icing Conditions, Cold Weather Operation and Cold Soak Operation that supplement those procedures published in the AFM. In case of disagree, the AFM shall prevail.

## EXTERNAL SAFETY INSPECTION

Operating regulations clearly state that no takeoff is allowed when snow, ice or frost is adhering to the airplane.

The responsibility for ensuring a clean airplane rests with the flight crew. The primary method for the flight crew to ensure a clean airplane is through close visual and physical inspection of the critical surfaces prior to takeoff. Visually check the wing, control surfaces, engines and fuselage prior to takeoff. In addition, as no frozen contamination is allowed on the wing upper surface, carry out a physical (hands-on) inspection to ensure that there is no ice accretion. Do not touch the surfaces with bare hands, as the skin may stick to a freezing surface. Even at intermediate stops, an external walk around is necessary due to the possibility of ice forming after landing from either cold soaking frost, conventional frost or precipitation freezing on the airplane.

During the pre-flight walk-around, ensure that the pitot tubes, static ports, TAT probe, AOA vanes, all inlets, outlets and vents are clear of ice and unobstructed.

A 3 mm (1/8 in) frost layer is permitted on the underwing surfaces. Frost is not permitted on the lower or upper surface of the horizontal stabilizer or the upper surface of the wing.

If the airplane has become cold soaked as a result of flight at very cold temperatures, fuel might be at a subfreezing temperature. This can cause ice accretion if the airplane is subjected to high humidity, fog, drizzle or rain even when the outside air temperature is substantially above freezing.

At the completion of the walk-around, if ice, snow or frost is discovered, de-icing, and possibly anti-icing will be required. The check for ice accumulation should be done in a well-lit area.

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All Protective Covers..... REMOVE

Remove covers from engine air inlet/outlet, APU air outlet, pitot tubes, TAT probes and wheels.

Fuselage, Wing, Tail and Control Surfaces ..... FREE OF FROST, ICE OR SNOW

Check that the fuselage, wing upper and lower surfaces, tail and control surfaces are free of frost, ice or snow. Inspect control surfaces, gaps and hinges for signs of residual fluid or gel.

A thin layer of hoarfrost is permitted on the fuselage provided the layer is thin enough to distinguish surface features underneath, such as painting and markings. Frost is not permitted on the lower/upper surface of the horizontal stabilizer or the upper surface of the wing.

Pitot Tubes, TAT, Static Ports and AOA Vanes ..... CLEAR OF ICE

Engine/APU Air Inlet ..... CLEAR OF ICE OR SNOW

Check that the engine inlet and the APU air inlet is clear of ice or snow. Fluid applied close to the APU inlet area may be ingested and cause a flameout and result in APU internal parts damage. Preferably, all soft snow should be mechanically removed by blowing cold air across the airplane surface, using brooms or soft hand scrappers.

Landing Gear ..... CLEAR OF ICE, UNOBSTRUCTED

Check that doors, gear locks and mechanisms are unobstructed and clear of ice and snow. Check that no leakage exists.

Air Conditioning Inlets and Outlets ..... CLEAR OF ICE

Fuel Tank Vents..... CLEAR OF ICE OR SNOW

Batteries..... INSTALLED

Certain temperatures require batteries removal to prevent cold soaking. Verify that batteries have been re-installed.

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## INTERNAL SAFETY INSPECTION

Batteries..... CHECKED

If battery voltage is below 24 V and battery temperature is colder than -15°C (5°F), replace the battery, as it may not recharge under very low temperatures.

APU..... START

Observe fuel and oil limitations before APU starting. Minimum fuel temperature is -40°C (-40°F). Minimum MIL-L-23699 oil temperature is -43°C (-45°F). Minimum MIL-L-7808 oil temperature is -54°C (-65°F).

Minimum battery temperature to start the APU is -20°C (-4°F). Minimum temperature to start APU using external electrical power is -54°C (-65°F).

If APU cannot be started, apply heat from a ground cart directly into the APU compartment. Do not allow the hot air from the ground heating cart to exceed 93°C (200°F), as it may damage the components inside the compartment.

Observe RPM and EGT during starting. If the APU flames out, make sure that ice or snow deposits are cleared before attempting a second start.

After the APU has been started, RPM and EGT fluctuation may be an indication of fluid ingestion into the APU. Record any discrepancy in the logbook.

Air Conditioning ..... SET

Turn both air conditioning packs on, bleeding air from the APU (or from a ground conditioned air cart, with packs off) to warm up the interior of the airplane. The warm-up should be accomplished with all doors closed, if possible.

Turn recirculation fans on.

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In very cold days, Embraer recommends a gradual warming of the cabin, as follows:

- Set air conditioning control to manual mode;
- Put the cockpit temperature selection knob in the 9 o'clock position;
- Wait approximately 3 minutes;
- Change control to automatic mode;
- Wait another 2 minutes before controlling temperature as required.

**CAUTION:**

- MANTAIN CABIN AT THE FIELD ELEVATION. DO NOT PRESSURIZE THE AIRPLANE.
- WITH PACKS OPERATING AND DOORS CLOSED, DO NOT LEAVE THE AIRPLANE UNATTENDED.

Main Panel ..... CHECK

Check proper operation of all instruments and systems. Liquid Cristal Display may not be readable at temperature below -20°C.

Electric Hydraulic Pumps ..... ON

Check hydraulic pressure. If pressure does not rise to normal values, warm up the hydraulic reservoir compartment with hot air and keep the electric hydraulic pumps running for 15 minutes.
Do not allow the hot air from the ground cart to exceed 93°C (200°F), as it may damage the components inside the compartment.

Flight Controls ..... CHECK

Check control wheel, control column and rudder pedals for freedom of movement and full travel. Control forces can be increased at low temperatures.
Operate all trim systems, including back up pitch trim system, checking for freedom of movement and full travel. If any flight control is suspected of restricted movement or jamming, report to maintenance personnel.

Flaps ..... CHECK

Extend and retract the flaps. Make sure the flaps are free from snow or ice before moving them. Leave flaps UP if application of anti-icing/deicing fluids is expected.

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## ENGINE START

SPS/ICE SPEEDS message will remain displayed after icing encounter. Before next takeoff the message must be removed by testing the Stall Protection System.

Do not start the engine until it has been checked that all ice deposits have been removed from the air inlet.

Fuel and oil temperature limits are the same as those prescribed for APU start.

Proceed with normal engine start.

In cold weather conditions, the usage of dual ignition (ignition switch rotated to the ON position) is highly recommended for the first engine start of the day or if the engine has not been run in the previous 90 minutes. This procedure may reduce the time from fuel introduction to light-up.

As a reference, this procedure can be used for temperatures below 5°C, or at operator's discretion.

After a successful start the Ignition Switch must be switched to the AUTO position.

If the engine does not start, ground heating may be necessary to warm the nacelle, Air Turbine Starter (ATS) and Starting Control Valve (SCV).

Do not allow the hot air from the ground cart to exceed 93°C (200°F), as it may damage the components inside the nacelle.

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## AFTER START

Ice Detection Override Knob ..... ENG

The Ice Detection Override Knob must be at ENG during all ground operations (in icing conditions) except during ice protection system test. Wing and stabilizer anti-icing must be kept off.

Crossbleed ..... AUTO

**CAUTION:**
- BOTH ENGINE BLEEDS MUST BE OPEN, IN ORDER TO ASSURE BLEED AIR FLOW THROUGH THE LEADING EDGES. APU BLEED MUST NOT BE USED.
- DELAYING THE USE OF THE ENGINE ANTI-ICING SYSTEM UNTIL ICE BUILD-UP IS VISIBLE FROM THE COCKPIT MAY RESULT IN ICE INGESTION AND POSSIBLE ENGINE DAMAGE OR FLAME-OUT.

**NOTE:**
- When thrust is set to below 83% N2, the ENG 1-2 A/ICE FAIL message may appear due to the low pressure available for anti-icing. Moving thrust levers forward will cause the message to disappear.
- On airplanes Pre-Mod. SB 145-30-0028, when Ice Detector Override Knob is at ENG on the ground, TAT heating is on. TAT and SAT reading may increase and cause an invalid indication (amber dashes) to appear. If TAT invalid indication causes the AHRS reversion to Basic Mode, continue the mission. The TAT invalid indication and AHRS reversion will remain until the airplane attains sufficient speed to bring the TAT sensors within the normal range of operation.
- AHRS BASIC MODE is inhibited on the ground for airplanes modified to EICAS version 16.5.
- On airplanes Post-Mod. SB 145-30-0028 or S/N 145.180 and on, TAT heating is on when Thrust Levers are set above 65° position or when the airplane is airborne.

Engine Instruments ..... MONITOR

Continue to monitor engine instruments, mainly oil pressure and temperature. Apply associated abnormal procedure if any failure arises.

Main Panel ..... CHECK

Check proper operation of all instruments and systems.

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## AIRPLANE ANTI-ICING/DEICING FLUID APPLICATION WITH ENGINES/APU RUNNING

**WARNING: APU OPERATION IS NOT RECOMMENDED DURING THE AIRPLANE DEICING/ANTI-ICING PROCEDURE. IF THE APU IS KEPT IN OPERATION DURING THE DEICING/ANTI-ICING PROCEDURE, DAMAGE CAN OCCUR TO IT. IF APU OPERATION IS ABSOLUTELY NECESSARY, MAKE SURE THAT THE APU BLEED AIR VALVE IS CLOSED, PACKS ARE SET TO OFF, AND THE DEICING/ANTI-ICING FLUID IS NOT APPLIED DIRECTLY TO OR NEAR THE APU AIR INLET.**

Parking Brake ..... ON
Thrust Levers ..... IDLE
Gust Lock ..... ENGAGE
Doors ..... CLSD
Flaps ..... 0°

Pitch Trim ..... AS REQUIRED

To avoid APU fluid ingestion, it is recommended that pitch trim should be set from 0° to FULL NOSE DOWN, hence fluid cascades downwards and aft, keeping the stabilizer leading edge free from the fluid drip that could be ingested by the APU.

However, operators are reminded to frequently inspect surfaces for residue, as prescribed in the SNL 145-30-0006. This is applicable mainly to fluid Types II, III and IV which may leave residue on the aerodynamic quiet areas.

Engine Bleed ..... CLOSED
APU Bleed ..... CLOSED
Air Conditioning Packs ..... OFF

Packs should be off to avoid contamination of cabin air with fumes generated from ingestion of fluids in engine/APU.

Ice Detection Override Knob ..... ENG

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After Deicing/Anti-icing Procedure is complete:

Wait 1 minute.
ENG Bleeds ..... OPEN
Wait 3 more minutes.
Packs ..... OPEN
APU Bleed..... REMAIN CLOSED DURING T/O AND INITIAL CLIMB

Wait at least one minute to open engine bleed, and three minutes to turn air conditioning packs on, thereby avoiding contaminating the airframe air conditioning system with deicing/anti-icing fluid gases.

The deicing/anti-icing fluid shall drop out after initial climb then allowing the APU bleed valve opening.

Ice Detection Override Knob..... ENG

The Ice Detection Override Knob must be at ENG during all ground operations in icing conditions.

Pitch Trim ..... SET

Pitch Trim must be set as per CG position stated in the Weight and Balance sheet.

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## TAXI

The maximum recommended wind speeds for airplane towing, pivoting, turning and taxi are:

- Dry Runways ..... 50 kt
- Wet Runways ..... 45 kt
- Snow Covered Runways ..... 30 kt
- Ice Covered Runways ..... 10 kt

Power backs are not allowed. Use minimum thrust to avoid blowing snow or slush on personnel or airplanes nearby.

During taxi, “cold set” (the condition where the tire retains the flat shape it had while parked) may induce vibration in the airplane. Vibration should disappear as the tires recover their elasticity during taxi. Do not initiate your takeoff run before the cold set disappears.

Maintain a greater than normal distance behind other airplanes while taxiing in snow-covered runways, to avoid contamination by snow blown by jet blasts.

Do not apply reverse thrust during taxi, unless it is strictly necessary.

Flaps ..... AS REQUIRED

When taxiing through slush or standing water, flaps should be retracted to avoid snow and slush contamination from the main gear wheels.

**CAUTION:**
- IF FLAPS WERE LEFT UP DURING TAXI, COMPLETE AFTER START CHECKLIST BEFORE TAKEOFF.
- TAXI AT REDUCED SPEED IN ICE-COVERED RUNWAYS TO AVOID SKIDDING THE AIRPLANE.

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## BEFORE TAKEOFF

Ice Protection Test:

**NOTE:** - The ice protection test must be carried out once a day (not necessarily at the first flight of the day) when icing conditions are forecast.

- The test may be carried out completely on the ground, or in 2 separate phases (first phase on the ground and second phase in flight), depending on weather conditions and crew discretion. For takeoffs when icing conditions exist or are anticipated for takeoff or climb, the tests in paragraph A must be performed.

On ground, if engine vibration increases, advance thrust levers, one at a time, to obtain at least 60% N1 for 5 seconds and then return to the former setting.

A - When actual icing conditions exist or are anticipated for takeoff and climb, proceed:

Thrust Levers ..... 83% N2
Ice Detection Override Knob ..... ALL
Anti-Icing Buttons (engine, wing and stabilizer) ..... PRESSED
Ice Detection Test Knob ..... 1, THEN 2

Test knob must be held at least 10 seconds in each test position but no more than 15 seconds.

For each side separately, check that OPEN inscriptions in the buttons are illuminated and that, ICE DET 1 (or 2) FAIL and BLD 1 (or 2) LOW TEMP caution messages and ICE CONDITION advisory message are displayed on EICAS. The CROSS BLD OPEN advisory message may also be displayed.

**NOTE:** - Wait for the messages go out of view after each release of the Test knob.

- For the EMB-145 XR model, when the Ice Detection Test Knob is selected to 1, the CLR ICE 1, CLR ICE 2, CLR/I INOP 1 and CLR/I INOP 2 caution messages are displayed on the EICAS and the lights CLR ICE 1 and CLR ICE 2 illuminate; when the Ice Detection Test Knob is selected to 2, none of those caution messages are displayed on the EICAS.

Thrust Levers ..... IDLE
Ice Detection Override Knob ..... ENG

**CAUTION:** ICE DETECTION OVERRIDE KNOB MUST NOT BE SET TO "ALL" ON GROUND, EXCEPT DURING TEST.



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**NOTE:** In case of first attempt of Ice Protection Test method A is unsuccessful, thrust levers should be set to IDLE and a second attempt can be performed, following the same procedures.

B - For flight when no actual icing conditions exist or are anticipated for takeoff and climb, proceed:

Before engines start, perform the on ground test:

Air Conditioning Packs ..... OPEN
APU Bleed ..... CLOSE
Engine Bleed ..... CLOSE
Anti-Icing Buttons (engine, wing and stabilizer) ..... PRESSED
Ice Detection Override Knob ..... AUTO
Ice Detection Test Knob ..... 1, THEN 2

Test knob must be held at least 10 seconds in each test position.

For each side separately, check that ICE DET 1 (or 2) FAIL and BLD 1 (or 2) LOW TEMP caution messages and ICE CONDITION advisory message are displayed on EICAS. The CROSS BLD OPEN advisory message and/or the PACK 1 (2) VLV FAIL caution message may also be displayed.

**NOTE:** For the EMB-145 XR model, when the Ice Detection Test Knob is selected to 1, the CLR ICE 1, CLR ICE 2, CLR/I INOP 1 and CLR/I INOP 2 caution messages are displayed on the EICAS and the lights CLR ICE 1 and CLR ICE 2 illuminate; when the Ice Detection Test Knob is selected to 2, none of those caution messages are displayed on the EICAS.

During climb, perform the inflight test:

Engine Bleeds ..... OPEN
Thrust Lever ..... THRUST SET
Altitude ..... FROM 2000 ft TO 23000 ft
TAT ..... LESS THAN 10°C
Ice Detection Override Knob ..... ALL FOR 20 SECONDS

Check that OPEN inscriptions in the buttons are illuminated and NO ICE-A/ICE ON caution message is displayed on EICAS. The CROSS BLD OPEN advisory message may also be displayed.

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Ice Detection Override Knob ..... AUTO (AFTER 20 SECONDS)

**NOTE: -** The ice protection test must be fully accomplished before entering icing conditions and before reaching 23000 ft.

**-** In case the first attempt of the inflight test is unsuccessful, a second attempt can be performed following the same procedures.

**NOTE:** Do not reset/alternate a FADEC after the Anti-Ice System test.

After completion of the test, set the Ice Detection Override Knob to ENG. Check that engine REF A/ICE on MFD takeoff page is set to ON.

Ignition..... ON

Turn ignition on when standing water, ice, or snow is present on the takeoff runway.

Takeoff Briefing..... COMPLETE

Confirm $V_1/V_R/V_2$ and $V_{FS}$ speeds for the associated runway or takeoff condition.

Flight Controls..... CHECK

Check freedom of movement and full travel of all flight controls (including trims).

Flaps ..... TAKEOFF SETTING

Set flaps to takeoff setting (if flaps were left up after starting).

Takeoff Configuration..... CHECK

Ice Accumulation..... CHECK

Continuously monitor ice accumulation, by checking windshield and, if installed, windshield wiper. High winds and jet blast may cause anti-icing fluid to flow off and many other factors contribute to reduce fluid effectiveness.

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## TAKEOFF

Takeoff in a normal manner. Check thrust rating mode. T/O-1 mode gives the maximum weight and thrust for the associated runway.

Do not apply static takeoff technique on an icy or slippery runway, as the airplane may begin to slide when thrust lever is advanced with brakes applied. In this case, release brakes and advance thrust levers simultaneously.

However, appropriate assessment of the takeoff distance is required as performance data available in the AFM for slippery runways is predicted on the use of static takeoff technique only. For rolling takeoffs, performance data is valid from the point where takeoff thrust is achieved.

Check N1 indication consistent with takeoff thrust setting tables (check AFM performance tables which have dedicated thrust setting tables for takeoff in icing conditions). Check N1 pointer reaching N1 target.

Apply light forward pressure on control column to increase nose wheel steering effectiveness.

Check engine stable operation during takeoff run. Rotate the airplane at VR smoothly to takeoff attitude. After lift-off, smooth flight control inputs should be applied if any tendency in pitch and roll are felt. Use of flight director takeoff sub-mode is recommended (on those certifications which allow the use of flight director during takeoff).

Flight controls forces may be heavier than normal, without causing any difficult in controllability.

Increased V2 procedures (if available in the approved AFM) may be used if runway length is not a limiting factor.

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## AFTER TAKEOFF

Ice Protection Test (if applicable) ..... COMPLETE

Ice Detection Override Knob..... AUTO

Monitor weather conditions for an encounter with ice for the remainder of the flight. Closely monitor the static air temperature indication so that when moisture is present, a look at the windshield and, if installed, the windshield wiper will indicate if ice is accumulating. Notwithstanding installation of the ice detector, the crew remains responsible for monitoring icing conditions and for manual activation of the ice protection system whenever necessary.

Ignition..... AS REQUIRED

## CLIMB/CRUISE

If engine vibration increases, advance thrust levers, one at a time, to obtain 60% N1 minimum for 5 seconds, and then return to the former setting.

If ITT increases beyond limits, reduce Thrust Levers as required to maintain ITT within limits.

When flying in icing conditions or after flying in icing conditions, ice accretion on unprotected areas may cause vibration at high speeds. If vibration and/or buffeting occurs, a change in the current airspeed will eliminate these effects. At high speeds reduce the airspeed as required, limited to a minimum of 200 KIAS. Observe normal (including operation in icing conditions) procedures contained in the approved AFM.

No special technique is required to fly with the autopilot on or off. Climb using FLC mode provides enough speed margin to stall. SPD and VS modes may also be used, provided that the airspeed is not allowed to decrease below 200 KIAS (when flying IAS) or 0.56 M (when flying Mach). During autopilot operation, monitor pitch attitude and speed continuously.

If BLD 1 (2) LOW TEMP message appears, advance Thrust Lever until the message disappears and check bleed temperature pointer (MFD ECS and Pneumatic page) in the green range.

During cruise, observe minimum fuel tank temperature (-40°C). If fuel temperature is reaching the limit, apply the FUEL LOW TEMPERATURE procedure in the AFM.

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## HOLDING

Landing Gear ..... UP
Flaps ..... UP
Minimum Airspeed ..... 200 KIAS

**CAUTION:** MAINTAIN A MINIMUM AIRSPEED OF 200 KIAS SINCE EVEN SMALL ACCUMULATIONS OF ICE ON THE WING LEADING EDGE MAY CHANGE THE STALL CHARACTERISTICS OR THE STALL PROTECTION SYSTEM WARNING MARGIN.

## DESCENT

Observe normal (including operation in icing conditions) procedures contained in the approved AFM.

When using the autopilot, monitor pitch attitude and speed continuously.

If approaching the terminal area in icing conditions, an increased rate of descent may be necessary. In this case, a combination of flaps set at 9° and speed brakes open may be used.

**NOTE:** Engine and Wing Ice Protection Systems operation is automatic and based on the primary ice detection system. However, the crew remains responsible for monitoring icing conditions and for manual activation of the ice protection system if icing conditions are present and the ice detection system is not activating the ice protection system.

## APPROACH AND LANDING

Observe normal (including operation in icing conditions) approach/landing procedures contained in the approved AFM.

When landing below -40°C (-40°F), ensure that rate of descent before touchdown is less than 300 ft/min. After landing, report to the maintenance personnel.

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**NOTE:** During approach and landing with engines and anti-icing system on, the FADEC logic automatically reduces the Flight Idle thrust when landing gear is lowered. On airplanes equipped with an EICAS version earlier than the 16.5, the WG 1(2) A/ICE FAIL, WG A/ICE ASYMMETRY and/or STAB A/ICE FAIL messages may be presented due to low bleed pressure available. If these messages appear, the OPEN inscription on the buttons may still be illuminated. To avoid those messages from appearing, it is recommended to maintain a minimum of 55% N1 during descent and landing phases when landing gear is down. Reducing N1 below 55% is recommended only when needed for landing.

## LANDING ON WET OR SLIPPERY RUNWAYS

Wet runways can cause airplane hydroplaning, the technical term used to express slipperiness. The factors that influence the occurrence of this phenomenon are high speed, standing water and poor runway macrotexture. When hydroplaning occurs, it causes a substantial loss of tire friction and wheel spin-up may not occur.

Icy runways can be very slippery at all speeds depending on temperature.

Stopping the airplane with the least landing run must be emphasized when landing on wet or slippery runways.

- Anticipate the approach procedures and speeds: a well-planned and executed approach, flare and touchdown minimize the landing distance.
- Immediately after touchdown, check the ground spoiler automatic deployment when thrust levers are reduced to IDLE.
- Lower nose wheel immediately to the runway. It will decrease lift and will increase main gear loading.
- Apply thrust reversers judiciously to observe how the airplane responds before full reverse is used. Normal procedure is to move the thrust levers out of reverse when ground speed is reduced to 50 kt. In an emergency, reverse thrust may be used to bring the airplane to a full stop.
- Do not use asymmetric reverse thrust on slippery and icy runways.
- Apply brakes with moderate-to-firm pressure, smoothly and symmetrically, and let the anti-skid do its job.

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– If no braking action is felt, hydroplanning is probably occurring. Do not apply Emergency/Parking Brake, as it will cut anti-skid protection and may cause the spoilers to close. Maintain runway centerline and keep braking until airplane is decelerated.

**TAXI-IN AND PARKING**

Ice Detection Override Knob ..... ENG

**NOTE:** Make sure the flaps are free from snow, ice or slush.

Flaps ..... UP

**CAUTION:** TAXI AT REDUCED SPEED IN ICE-COVERED RUNWAYS TO AVOID SKIDDING THE AIRPLANE.

**THROUGH-FLIGHTS**

Doors and Windows..... CLOSED

Whenever possible, to maintain the cabin warm, keep the passenger, baggage and service doors closed at intermediate stops.

APU..... ON

APU should be on to provide bleed air to maintain cabin warm.

Air Conditioning Packs..... ON
Recirculation Fans ..... ON

Walk around the airplane and check the following items:

Wing, Tail and Control Surfaces..... FREE OF FROST, ICE OR SNOW
Pitot Tubes, TAT, Static Ports and AOA Vanes..... CLEAR OF ICE
Engine/APU Air Inlet..... CLEAR OF ICE OR SNOW
Landing Gear ..... CLEAR OF ICE, UNOBSTRUCTED
Air Conditioning Inlets and Outlets ..... CLEAR OF ICE
Fuel Tank Vents..... CLEAR OF ICE OR SNOW

Ask for deice/anti-ice fluid application, if necessary.

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## LEAVING THE AIRPLANE - SECURING FOR COLD SOAK OR AN EXTENDED PERIOD

The procedures below should be performed in the event of extended airplane exposure at low temperatures. In the event that the airplane is off the maintenance base, the crew should ensure that all actions have been accomplished.

Wheel Chocks ..... IN PLACE

Emergency/Parking Brakes ..... AS REQUIRED

For an icy ramp, leave Emergency/Parking Brakes applied. Otherwise, Emergency/Parking Brakes must not be applied to avoid freezing of the brakes.

Pitch Trim ..... FULL NOSE DOWN

As high precipitation may occur during overnights, it is recommended that pitch trim be left at full nose down position.

Gust Lock ..... LOCKED

Protective Covers ..... INSTALLED

Install protective covers at engines and APU inlets/outlets, pitot, TAT probes, and wheels.

Water and Waste System ..... DRAINED

Drain water and waste from all water tanks, if cold soak temperature is expected to be below 0°C (32°F).

Batteries ..... REMOVED

As the batteries may not fully recharge under very low temperatures, batteries should be removed whenever the temperature forecast during the overnight is below -15°C (5°F).

Doors and Windows ..... CLOSED

All doors and windows must be closed to prevent snow and humidity from entering into the airplane.

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## GENERAL REMARKS WHEN FLYING IN ICING CONDITIONS

- Continuously monitor engine parameters, airplane pitch attitude and airspeed.
- Closely monitor the SAT indication and presence of moisture. If environmental ice conditions exist, even intermittent, check the windshield, windshield wiper (if installed), and wing surface for ice accumulation. To visualize ice formation, if necessary, use a flashlight on the windshield and the wing inspection light on the wing. If any ice formation is detected or suspected, select the anti-ice protection system override knob to ALL. When flying in detected or suspected ice conditions, use ice speeds as reference.
- Be careful for any mistrimmed condition that may be masked by the autopilot - keep the airplane trimmed at all times. Consider turning the autopilot off if you suspect you are flying in severe icing conditions.
- Monitor anti-ice systems for proper operation. Apply the associated AFM abnormal procedure in case of system failure. If the failure persists, exit and avoid icing conditions. Make the air traffic controller know you are requesting a change due to icing conditions and keep him informed about it.
- Strictly follow AFM Operation In Icing Condition normal procedures.
- Avoid landing in an airport where icing conditions exist or are anticipated if anti-ice system, brakes, thrust reverse, ground spoilers, nosewheel steering or flight controls have failed.
- Do not hesitate to leave icing conditions when icing cannot be handled, even with anti-ice system operating properly.

**NOTE:** Engine and Wing Ice Protection Systems operation is automatic and based on the primary ice detection system. However, the crew remains responsible for monitoring icing conditions and for manual activation of the ice protection system if icing conditions are present and the ice detection system is not activating the ice protection system.

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## FREEZING RAIN AND FREEZING DRIZZLE

Atmospheric conditions involving freezing rain or freezing drizzle associated to supercooled large droplets (SLD), may present a condition that is beyond those for which the airplane was certified. Both freezing rain and freezing drizzle can exist down to ground level and cause ice to form quite rapidly on all surfaces even during short exposures and on areas not normally known to be subjected to ice accretion. This means that the airplane is not designed to fly under freezing rain/drizzle (SLD) conditions.

If the crew notices abnormal ice formation on areas not usually affected by this phenomenon, or ice formation on the previously treated upper surface of the wings, they must consider to be flying under severe icing conditions. In this case, the anti-ice system is failing to reduce or control ice formation. The crew must then exit freezing rain/drizzle conditions as soon as possible since continuous flight under such conditions is, indeed, quite hazardous.

## FLAP OPERATION UNDER ICING CONDITIONS

Ice accretion on an airplane depends mainly on the cloud type encountered, the cloud liquid water content and droplet size, and weather conditions. Icing should be expected when flying in visible precipitation, such as rain or cloud droplets, with a temperature between +2°C and -10°C (between 35.6°F and 14°F).

Regardless of the airplane type, the wing, horizontal stabilizer, and engine inlets are typically critical airplane parts for ice accretion and are protected with anti-icing or de-icing systems. The wing flaps are not equipped with a anti-icing or de-icing system and, therefore, if they remain extended for a long period of time in icing conditions, ice may build up on the flaps leading edge. This ice may cause difficulties in retracting the flaps.

For a certain flight time in different weather conditions, the ice accretion intensity may vary, being either trace, light, moderate, or severe. Because of the varying conditions, it is not possible to state a reliable time figure that would cover all situations.

Therefore, as a general policy, the use of flaps in icing conditions should be avoided or minimized whenever possible.

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# TURBULENT AIR PENETRATION

Flight through severe turbulence must be avoided, if possible.
If not possible, reduce altitude to increase buffet margin.
The recommended procedures for turbulent air penetration are:

**1. AIRSPEED**

At or Below 10000 ft ..... 200 KIAS
Above 10000 ft ..... 250 KIAS/ 0.63 M, WHICHEVER IS LOWER

Severe turbulence will cause large and often rapid variations in indicated airspeed. Do not chase the airspeed.

**2. ATTITUDE**

Maintain wings level and proper pitch attitude. Use attitude indicator as the primary instrument. In extreme drafts, large attitude changes may occur. Do not use sudden large control inputs.

**3. PITCH TRIM**

Maintain control of the airplane with the elevators. After establishing the trim setting for penetration speed, do not change pitch trim.

**4. ALTITUDE**

Large altitude variations are possible in severe turbulence. Sacrifice altitude in order to maintain the desired attitude. Do not chase altitude.

**5. THRUST SETTING**

Make an initial thrust setting for the target airspeed. Change thrust setting only in case of extreme airspeed variation.
In case of inadvertent negative-g condition, reduce thrust levers.

**NOTE:** Do not extend flaps except for approach and landing.

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# VOLCANIC ASH

Flight in areas of known volcanic activity must be avoided. This is particularly important during hours of darkness or daytime instrument meteorological conditions when volcanic dust may not be visible. When a flight is planned into an area with a known potential for volcanic activity, it is recommended that all NOTAMs and air traffic control directives be reviewed for current status of volcanic activity. If volcanic activity is reported, the planned flight should remain well clear of the area and, if possible, stay on the upwind side of the volcanic dust.

The airplane's weather radar is not capable of detecting volcanic ash/dust clouds and is therefore not reliable under these circumstances. The presence of volcanic ash/dust may be indicated by:

- Smoke of dust appearing inside the airplane;
- An acrid odor similar to electrical smoke or burnt dust or sulfur;
- Engine malfunctions such as power loss, engine stalls, increasing ITT, fluctuating engine RPM, etc;
- At night, Saint Elmo's fire/static discharges may be observed around the windshield or windows;
- Orange glow from engine inlets.

Flight into volcanic ash/dust clouds can result in the degradation of airplane and engine performance. The adverse effects cause by volcanic ash/dust encounters may be:

- Rapid erosion and damage to the internal engine components;
- Ash/dust buil-up and blockage of the guide vanes and cooling holes, which may cause surge, loss of thrust and/or high ITT;
- Ash/dust blockage of the pitot system, resulting in unreliable airspeed indications;
- The abrasive properties of volcanic material may cause serious damage to the engines, wing and tail leading edge surfaces, windshields, landing lights, etc;
- Windshield and windows may become opaque, reducing the visibility.

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## ON GROUND OPERATIONS

The following recommendations apply to starting and operating engines on airports where volcanic ash has fallen and ground contamination is present:

- When the airplane is parked install engine covers or reposition the airplane to limit blowing ash accumulation from wind and jet blasts from other airplane.
- During preflight, check that the engine inlet and exhaust areas have been cleared of volcanic ash;
- Check that all volcanic ash has been cleaned away from the area within 25 ft of the engine inlets;
- Use APU for engine starting only, not for air conditioning;
- Prior to starting, dry motor the engine for one minute in order to blow out any ash that may have entered the engine bypass duct area;
- Use minimum required thrust for breakaway and taxi; Avoid single engine taxi;
- Keep bleed valves closed during taxi. Use the cleanest taxiways whenever possible;
- Be aware of loose ash being blown by the exhaust wake of other airplane. Maintain adequate ground separation and allow for dust to set on the runway before starting the takeoff roll;
- Use a rolling takeoff technique. Avoid setting high thrust at low airspeeds;
- After landing at an airport contaminated with volcanic ash, minimize the use of reverse thrust to prevent any recirculation ingestion;
- Avoid static engine operation above idle;
- Use APU for engine starting only, not for air conditioning.

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## IN FLIGHT OPERATIONS

Flight operations in volcanic ash are extremely hazardous and must be avoided. However, volcanic ash/dust clouds may sometimes extend for hundreds of miles, reaching altitudes above 60000 ft and an encounter may be unavoidable.

In case of an inadvertent encounter, proceed as follows:

Volcanic Ash Area..... EXIT/AVOID

Consider performing a 180º turn. Due to the dimensions of the Ash clouds a 180º turn could be the fastest way to exit an Ash cloud.

Oxygen Masks (if necessary)..... Don, 100%

If a significant amount of volcanic ash fills the cockpit or if there is a strong smell of sulphur, don an oxygen mask and select 100%.

APU ..... START
Ignitions..... ON
Thrust Lever (if altitude permits) ..... IDLE
Anti-Icing Buttons (engine, wing and stabilizer)..... PRESSED
Ice Detection Override Knob..... ALL

This action will increase bleed air extraction from the engines and further improve the engine stall margin.

ITT..... MONITOR

If the ITT is still increasing even with the thrust levers in idle:

Affected Engine..... Shutdown

If it becomes necessary to shutdown an engine to prevent exceeding ITT limits, restart the engine once it has cooled down. If the engine fails to start, repeated attempts should be made immediately.

**NOTE:** A successful start may not be possible until the airplane is clear of the volcanic ash/dust, and the airspeed and altitude is within the airstart envelope. Take note that engines can be very slow to accelerate to idle at high altitudes and this could be interpreted as a failure to start or as an engine malfuntion.

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After exiting the area of volcanic ash/dust cloud and the engine(s) restarted, restore systems to normal operation. Inform ATC of the encounter.

Airspeed..... MONITOR

Monitor airspeed for any abnormal indication. If necessary perform the Unreliable Airspeed procedure.

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# LIGHTNING STRIKE

Even though the airplane is adequately protected against lightning strikes effects, operating procedures should be established in an attempt to avoid such phenomenon.

Avoid penetration of thunderstorms. In-flight lightning avoidance is closely associated with thunderstorm avoidance. Maintain visual contact with thunderstorms during the daytime and lightning at night.

Check the radar for precipitation, review all available types of weather information, examine other pilot reports and follow ATC instructions. Even with a good weather report received and understood, pay close attention to those storms that develop rapidly along the route in a given area and that cannot be predicted. While enroute, constantly update the previous weather briefing through radio contact and airborne equipment for actual storm avoidance.

Remember that radar detects only liquid droplets, not the cloud itself. Only rain suspended in the cloud will produce a radar echo, which may lead to occasional encounters with hail and lightning.

Circumnavigate the detected thundercloud or area, if possible by more than 25 miles when traffic conditions permit. Flying over the top of the thunderclouds is preferable.

Be aware that lightning can strike an airplane miles away from the extreme side of a developed thunderstorm. Reports of airplane receiving strikes in clear air at 25 or more miles from the nearest storm are common.

The following paragraphs summarize the conditions in which strikes are most common:

- Meteorological conditions: incident reports show that an airplane must be within or beneath a cloud to receive a strike, or in or near regions of precipitation. Incident reports show that in over 80% of the strikes, the airplane was within a cloud and experiencing some precipitation and turbulence. But other strikes may occur in a cloud where there is no precipitation nearby, in clear air reasonably distant from a thundercloud, during snowstorms and in clouds over erupting volcanoes. Flight through or in the vicinity of cold front, warm front, stationary front, unstable air or squall line are indicators of imminent lightning strikes. Incident reports also show that lightning strikes occur most commonly under light or heavy turbulence conditions.
- Flight regime: Takeoff, climb, level flight, descent or approach.

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- Altitude: strikes are more intercepted between 5000 and 15000 ft, but may occur at virtually all flight altitudes. Lightning strike incidents at lower altitudes are far more frequent since at higher altitudes airplanes can divert around thunderclouds with greater ease.
- Outside air temperature: most strike incidents have occurred when the airplane is flying in temperatures near or at freezing level. Strikes may also occur at temperatures as high as 25°C, or as low as -45°C.

Metal airplanes produce a phenomenon called Faraday Cage effect, which distributes electrical charges along the airframe in such a manner that occupants and internal components will not receive the high current that causes injury and damage. There seems to be no record of any case of crew incapacitation due to lightning, although flash blindness can occur for a few seconds.

Direct effects which result from lightning current attachment to and flow through the airplane may be:

- Pit marks are often seen along the fuselage or holes in the trailing edge of wing and tail tips.
- Melting of rivets.
- Puncturing of nonmetallic structures.
- Puncturing and de-lamination of composites.
- Slight deformation of metal skins and structure.
- Welding or roughening of moveable hinges and bearings.
- Damage to other parts that may conduct lightning current other than the airframe, such as bonding or diverted straps and pitot tubes.

Effects caused by the flash-induced electromagnetic field and the increase of the voltage due to the current at the airplane structure are defined as indirect effects and may be:

- Interruption of instruments and navigation equipment.
- Damage to electronic and electrical equipment.
- Popping of circuit breakers.
- Loss of electrical power.
- Engine flame-out.

In case of lightning strike, report the incident to the maintenance personnel, by filling out the LIGHTNING STRIKE REPORT (Abnormal Procedures - Section 1-03-70 - Miscellaneous).

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# IN FLIGHT OPERATIONS

## IF LIGHTNING STRIKE IS SUSPECTED TO OCCUR

An imminent lightning strike event may be indicated to flight crews by the buildup of static discharge which causes interference on ADF indicators or noise in communication receivers. Another indication is St. Elmo's Fire, which is visible at night as small electrical discharges running across the windshields and sparking on the wings.

Consider wearing sunglasses to protect your eyes from the flash or have one pilot keep eyes downward.

All Cockpit Lights ..... ON/FULL BRIGHTNESS

## IF THE AIRPLANE HAS BEEN HIT BY LIGHTNING

If situation is under control after a lightning strike, apply the following procedure to ascertain whether the flight may be proceed.

Circuit Breakers ..... CHECK

Compass/Heading System ..... CHECK

Check magnetic compass and heading system for normal indication.

Engine Indication ..... CHECK

Check engine for normal indication and apply associated procedure if any failure arises after strike attachment.

In case of engine shutdown, the flight crew shall analyze the circumstances of the event and consider an engine airstart.

Pressurization ..... CHECK

Check pressurization system for normal indication.

If loss of pressurization is presented, structural damage may be considered. In this case, the associated procedure must be accomplished.

Flight Controls ..... CHECK

Check all flight controls for freedom of movement. Verify that flaps and speed brakes are working properly (refer to flaps and speed brakes operating limits).

Fuel System ..... CHECK

Check fuel system for normal operation. Monitor fuel remaining and fuel consumption to ascertain that no fuel leak exists.

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All Other Airplane Systems..... CHECK

Check all airplane instrument following a panel scan sequence to ascertain that flight safety prevails.

The display colors may be changed, however the display information remains valid.

Apply the associated emergency/abnormal procedure if any failure arises after a lightning strike. Consider discontinuing the flight and land at the nearest suitable airport if any unsafe condition is revealed after checking system operation and general airplane condition.

## ON GROUND OPERATIONS

### ON THE GROUND

Approaching and landing an airplane during a thunderstorm is strongly not recommended. The human body may provide the grounding that is otherwise lacking. If you are in the cockpit, do not attempt to communicate with ground through a wire handset, and stay inside the airplane until the storm has passed.

### IF THE AIRPLANE HAS BEEN HIT BY LIGHTNING

#### External safety inspection

Check for holes, punctures, discoloration and de-lamination throughout the whole airframe.

Verify for loose, melted or missing rivets.

Check that all static dischargers are in place or in accordance with the CDL.

Verify the integrity of the lights installed on tail, wing, fuselage and landing gear.

Verify all antennas, ice detectors, pitot tubes, angle-of-attack vanes, TAT probes and static ports for condition.

Report to maintenance personnel any detected damage or failure. Perform SECTION 05-50-01 (AMM) for detailed procedures to carry out a general inspection after a lightning strikes the airplane. Make sure that these procedures are carried out before flying the airplane again.

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# PRESSURIZATION IN MANUAL MODE

This section contains additional information to assist pressurization operation in manual mode. If necessary, consult AOM Section 2-14-15 - Pressurization System. Procedures are intented to supplement the procedures published in the QRH.

Procedures herein are valid for dispatch with the pressurization system automatic mode inoperative (MEL item 21-30-00) or in case of loss of automatic mode in flight. For rapid loss of pressurization, refer to the RAPID CABIN DEPRESSURIZATION procedure in the QRH.

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## GENERAL

It has been observed that cabin altitude indication may vary under manual mode operation. Therefore, it is recommended to wait until cabin altitude indication stabilizes, when the manual controller should be operated as required to control cabin altitude.

In manual mode, crew selection of the cabin rate and proper monitoring of cabin differential pressure is required to maintain appropriate cabin pressurization. With relation to the 12 o'clock position, clockwise rotation of the controller will induce a positive cabin rate of climb, and a counter-clockwise rotation will induce a negative cabin rate of climb.

The manual controller gain is very sensitive and the response time to the command may take few seconds. Avoid fast and large displacement of the controller.

After making cabin rate changes, wait a few seconds for the system to stabilize and then verify if the result is the desired one.

If necessary repeat the procedure until the desired result is achieved.

## RECEIVING/BEFORE DOOR CLOSING

Pressurization Manual Controller..... FULL UP
Pressurization Mode Selector Button ..... MANUAL

Check that MAN inscription illuminates inside the button.

Pack ..... ONLY ONE PACK ON

This setting allows one outflow valve to be fully open and reduces cabin airflow, thus avoiding uncomfortable pressure changes when the doors are closed or during engine starts.



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## TAXI OUT/BEFORE TAKEOFF

Pressurization Manual Controller ..... FULL UP

This setting will make the cabin altitude remain stable during taxi, independent of any variation in bleed.

Just before take-off:

Manual Controller ..... 11 O'CLOCK POSITION

This position will guarantee an acceptable pressurization during climb out.

## AFTER TAKEOFF/CLIMB

Just after the initial climb:

Pressurization Manual Controller ..... BETWEEN 11 AND 12 O'CLOCK

Keeping the manual controller within the white mark allows a null or slightly positive rate for the cabin altitude.

Passing 10000 ft pressure altitude:

Manual Controller ..... TURN CLOCKWISE

Identify the resulting cabin rate. Usually a 400 to 500 ft/min will be sufficient for this situation.

Above 10000 ft:

QRH Table ..... CHECK

Search for the LOSS OF PRESSURIZATION INDICATION procedure in the QRH and use the table contained therein. Maintain the cabin altitude consistent with the airplane altitude specified on the table by close monitoring differential pressure and intermittent setting of the manual controller.

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## CRUISE

Once cruise level is established, or a step in the climb is desired:

QRH Table ..... CHECK

Manual Controller..... NULL RATE

Allow the cabin to climb (or descend) to the value specified on the QRH table, then set null rate. Cabin altitude and ΔP must be consistent with the table. Keeping the manual controller close to the 12 o'clock position to keep a null rate is a good position for the rest of the cruise. However, minor adjustments might be required.

## DESCENT

Just after initiating descent:

Manual Controller..... SLOWLY TURN COUNTER CLOCKWISE

Initially, set -400 ft/min rate, which corresponds to a position between 12 and 11 o'clock in the manual controller.

During descent:

Set a cabin rate that will meet the required landing altitude upon landing. Allow the cabin to descend slowly towards the desired landing altitude so that upon landing ΔP reads zero.

During holding at any flight altitude:

Manual Controller..... SET AROUND 12 O'CLOCK POSITION

Keep the manual controller close to the 12 o'clock position to keep a null rate. However, minor adjustments might be required.

## TAXI-IN

On the ground:

Differential Pressure ..... ZERO

Once ΔP reads zero:

Manual Controller..... FULL UP

In this position, the outflow valve will be kept fully open, which will equalize outside and inside cabin pressure. After that, cockpit side windows and airplane doors can be opened.

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# BIRD OR HAIL STRIKE

This procedure contains the information to perform an external inspection of the airplane structure after a suspected bird or hail strike.

This inspection consists of a General Visual Inspection (GVI) similar to the External Inspection, plus the attention points described in the procedure. The operator must assure that the Flight Crew understands these points and is capable of performing the Bird or Hail Strike Inspection.

The information contained herein do not constitute an operational approval. If Local Regulatory Authority approval is required, it should be obtained by the Operator.

## BIRD OR HAIL STRIKE INSPECTION PROCEDURE

### NO-GO FINDINGS

During the inspection, the occurrence of the following items requires maintenance intervention:

- Stains of blood and other bird remains that can not be cleaned from the airplane surfaces,
- Evidence of the ingress of bird remains into the engine, openings or intakes regardless if they can be cleaned,
- Any obvious damages such as:
  - Buckling, wrinkles, cracks, dents, nicks, and damaged paint finish,
  - Bent, twisted or loosened parts,
  - Loose or pulled fasteners,
  - Missing or pulled apart structures,
  - Hydraulic line leakage, and
  - General misalignment of the structure and assemblies.
- Any technical malfunction that could be related to a Bird or Hail strike occurrence.

**NOTE:** If bad smell through the bleeding system or abnormal engine parameters are noticed anytime after the suspected bird or hail strike, maintenance intervention is required.

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## PREPARING FOR THE INSPECTION

External Lights ..... AS REQUIRED
Emergency/Parking Brake ..... ON
Visual/Access Blockers ..... REMOVE

Remove any objects that may block access to the airplane and its parts such as ground support equipment and ice and snow accumulation.

Flap ..... 45°
Flashlight ..... AS REQUIRED

## BIRD OR HAIL STRIKE INSPECTION

**WARNING: WHILE CONDUCTING THE INSPECTION, BE AWARE OF MOVING VEHICLES IN THE AIRPLANE SURROUNDINGS.**

During the inspection, wipe any detected bird remains from the airplane surfaces with detergent.

**WARNING: TO AVOID BIOLOGICAL HAZARDS, LOCAL REGULATIONS MUST BE FOLLOWED IN DEALING AND DISCARDING ANIMAL REMAINS.**

Perform the inspection as follows:

Nose Section/Fwd Fuselage ..... CHECK

Verify radome, windshields, direct vision window, fuselage skin, probes, sensors, and detectors.

Antennas ..... CHECK

Verify upper and lower fuselage.

Landing Gear (NLG and MLG) ..... CHECK

Verify doors, components, assembly, and compartments.



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Wings ..... CHECK

Verify wing leading edges, flap surfaces, flap track fairings, winglet/wingtip, spoilers, ailerons, wing-to-fuselage fairings, and wing lower skin.

Horizontal/Vertical Stabilizers ..... CHECK

Verify leading edges, surface and attachments, including rudder and elevators.

Engines ..... CHECK

Verify pylon fairings, engine nacelle, reverser doors, exhaust nozzle, air intake module (inlet cowl, lipskin, inner and outer barrels), spinner and fan module (leading and trailing edges).

If any item listed as a NO-GO FINDING is detected during the inspection, no operation is allowed and maintenance intervention is required. Otherwise, if no item is detected, the airplane can return to service.

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# FMZ 2000 FLIGHT MANAGEMENT SYSTEM

The information contained herein supplements the information of the basic AOM Normal Procedures.

## HOLDING

If a Holding Pattern entering is necessary:

FMS ..... AS REQUIRED

The pilot must check the entry type and turn direction of holding pattern before entering it. For entry types other than the direct one, the pilot must activate the procedure holding pattern as soon as the approach procedure is retrieved from the Navigation Data Base.

**NOTE:** The FMS normal operating procedures are contained in the Honeywell Flight Management System (FMS) Pilot's Operating Manual, Honeywell Publication Number A28-1146-122-00, August 1997 edition (or later revision of the manual) for the software version NZ4.8 and in the Honeywell Publication Number A28-1146-133-00, February 1999 edition (or later revision of the manual) for the software version NZ5.2.

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**FMS SOURCE SELECTION**

Flight Plan ..... SELECT OR CREATE

FMS Source ..... SELECT

The FMS can be selected as the navigation source through the FMS Selector Button located on the Display Control Panel.

FMS Label ..... CHECK

The FMS label appears on the associated PFD and MFD.

On PFD:

For airplanes Pre-Mod. SB 145-22-0001 or Post-Mod. SB 145-31-0009 or equipped with an equivalent modification factory-incorporated, if the FMS is the navigation source for only one side the color will be magenta, otherwise it will be amber.

For airplanes Post-Mod. SB 145-22-0001 or equipped with an equivalent modification factory incorporated, the FMS label will be always magenta.

On MFD the label will be always magenta.

For FMS coupling to the Autopilot/Flight Director:

NAV Mode (Flight Guidance Controller) ..... SELECT

The FMS will be coupled to the Autopilot/Flight Director when is selected and valid at the on side EHSI and crew selects the NAV mode on the associated Flight Guidance Controller. Once coupled the autopilot will follow the preselected flight plan on the FMS.

## APPROACH

**CAUTION:** FOR AIRPLANES UNDER FAA AND JAA CERTIFICATION, ONLY PERMITTED WITH SOFTWARE NZ4.8 MOD C OR NZ5.2 MOD B OR LATER SOFTWARE VERSION INSTALLED.

The FMS GPS, NDB, RNAV, VOR, VOR/DME and VFR approaches may be linked into the flight plan and laterally coupled to the autopilot/Flight Director.

ILS approaches can be retrieved from the navigation data base and linked to the flight plan, but cannot be armed or activated as FMS approaches. The FMS can be used to provide navigation up to the final approach course at the point that the PFD must be changed to display raw ILS data.

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## TRANSITION FROM FMS TO AUTOPILOT ILS APPROACH

ILS Frequency ..... SELECT AS REQUIRED
Radio Altitude ..... SELECT AS REQUIRED
HDG Mode (Flight Guidance Controller) ..... SELECT
Before selection, set the desired interception course on heading bug.

Navigation Source ..... SELECT
Select the NAV source on the Display Control Panel (LOC course selected on the PFD).

Autopilot/Flight Director ..... AS REQUIRED
When cleared for Approach:
APR Mode (Flight Guidance Controller)..... SELECT

## ARC DME APPROACH USING FMS

Pilot Not-Flying ..... CHECK DME
During Arc DME approach using FMS the pilot not-flying must check DME Raw Data.

## MISSED APPROACH

**CAUTION:** ONLY PERMITTED FOR AIRPLANES WITH SOFTWARE NZ4.8 MOD C OR NZ5.2 MOD B OR LATER SOFTWARE VERSION INSTALLED.

Go-Around Button..... PRESS
Thrust Levers..... MAX
Verify that airplane rotates to 10° nose up wings level (Pitch Mode) and changes to Speed Hold Mode after 20 seconds.

Flaps ..... 9°
With positive rate of climb:
Landing Gear..... UP
Airspeed..... APPROACH CLIMB SPEED OR ABOVE

**NOTE:** During the GO-AROUND procedure, the DON'T SINK aural warning may sound. In this case monitor the sink rate and follow the GO-AROUND guidance.

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NAV Mode (Flight Guidance Controller) ..... SELECT

Reselecting the NAV mode the airplane will regain the lateral guidance from the FMS to fly the missed approach legs to the missed holding point and to enter holding, as required.

# FMZ 2010 FLIGHT MANAGEMENT SYSTEM

The information contained herein supplements the information of the basic AOM Normal Procedures.

## BEFORE START

FMS..... AS REQUIRED

## HOLDING

If a Holding Pattern entering is necessary:

FMS ..... AS REQUIRED

The pilot must check the entry type and turn direction of holding pattern before entering it. For entry types other than the direct one, the pilot must activate the procedure holding pattern as soon as the approach procedure is retrieved from the navigation database.

### FMS SOURCE SELECTION

Flight Plan ..... SELECT OR CREATE

FMS Source ..... SELECT

The FMS can be selected as the navigation source through the FMS Selector Button located on the Display Control Panel.

FMS Label..... CHECK

The FMS label appears on the associated PFD and MFD.
On PFD and MFD the FMS label will be always magenta.

For FMS coupling to the Autopilot/Flight Director:

NAV Mode (Flight Guidance Controller) ..... SELECT

The FMS will be coupled to the Autopilot/Flight Director when is selected and valid at the on side EHSI and crew selects the NAV mode on the associated Flight Guidance Controller. Once coupled the autopilot will follow the preselected flight plan on the FMS.

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# APPROACH

The FMS GPS, NDB, RNAV, VOR, VOR/DME, and VFR approaches may be linked into the flight plan and laterally coupled to the Autopilot/Flight Director.

ILS approaches can be retrieved from the navigation database and linked to the flight plan, but cannot be armed or activated as FMS approaches. The FMS can be used to provide navigation up to the final approach course at the point that the PFD must be changed to display raw ILS data.

## TRANSITION FROM FMS TO AUTOPILOT ILS APPROACH

ILS Frequency ..... SELECT AS REQUIRED

Radio Altitude ..... SELECT AS REQUIRED

HDG Mode (Flight Guidance Controller) ..... SELECT

Before selection, set the desired interception course on heading bug.

Navigation Source ..... SELECT

Select the NAV source on the Display Control Panel (LOC course selected on the PFD).

Autopilot/Flight Director ..... AS REQUIRED

When cleared for Approach:

APR Mode (flight guidance controller)..... SELECT

## ARC DME APPROACH USING FMS

Pilot Not-Flying ..... CHECK DME

During Arc DME approach using FMS the pilot not-flying must check DME Raw Data.

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**LPV APPROACH (AIRPLANES POST-MOD. SB145-34-0125)**

Prior to the IAF:

Approach Procedure ..... LOAD

Prior to the FAF:

VNV Button ..... PRESS
APR Button ..... PRESS
LPV Armed ..... VERIFY

After the FAF:

LPV Active ..... VERIFY

**NOTE:** LPV indications will be not displayed if the navigation source is copied (FMS 2 is selected on PFD 1 or FMS 1 is selected on PFD 2 as the navigation source).

**LNAV/VNAV APPROACH (AIRPLANES POST-MOD. SB145-34-0125)**

Prior to the IAF:

Approach Procedure ..... LOAD

Prior to the FAF:

VNV Button ..... PRESS
APR Button ..... PRESS
VGP Armed ..... VERIFY

After the FAF:

VGP Active ..... VERIFY

**MISSED APPROACH**

Go-Around Button ..... PRESS
Thrust Levers ..... MAX

Verify that airplane rotates to 10° nose up wings level (Pitch Mode) and changes to Speed Hold Mode after 20 seconds.

Flaps ..... 9°

With positive rate of climb:

Landing Gear ..... UP
Airspeed ..... APPROACH CLIMB SPEED OR ABOVE



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**NOTE:** During the GO-AROUND Procedure DON'T SINK aural warning may sound. In this case monitor the sink rate and follow the GO-AROUND guidance.

For airplanes Pre-Mod. SB145-34-0125

NAV Mode (Flight Guidance Controller)..... SELECT

Reselecting the NAV mode the airplane will regain the lateral guidance from the FMS to fly the missed approach legs to the missed holding point and to enter holding, as required.

For airplanes Post-Mod. SB145-34-0125

LNAV Mode (flight guidance controller)..... CHECK IF ARMED

When flying an ILS or non-RNAV approach, by reselecting the FMS source the airplane will regain the lateral guidance from the FMS to fly the missed approach legs to the missed holding point and to enter holding, as required.

## BEFORE LANDING (AIRPLANES POST-MOD. SB145-34-0125)

PFD Speed ..... SET $V_{APP\ CL}$

Set Approach Climb Speed via Speed Intervention function on FMS.

## LATERAL DEVIATION SCALE

When the FMS is selected as the navigation source the cross track deviation scale and pointer, if valid, will be displayed. The lateral deviation scale is defined by the FMS according to the values displayed on the RNP SETTINGS page. The PROGRESS 1/3 page displays the active RNP value, which is the two dots deviation on the lateral scale. For airplanes Post-Mod. SB145-34-0125 such information is also displayed on the PFD.

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## VERTICAL DEVIATION SCALE

When the FMS is selected as the navigation source the vertical track deviation scale and pointer, if valid, will be displayed. The vertical deviation values are the following:

| DEVIATION | ENROUTE (ft) | TERMINAL (ft) | APPROACH (ft) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 1 dot | 250 | 250 | 75 |
| 2 dots | 500 | 500 | 150 |

For airplanes Post-Mod. SB145-34-0125 the vertical deviation full-scale value readout is displayed below the scale on the PFD.

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# RVSM OPERATION

The RVSM operation reduces the EMB-145 minimum vertical separation from 2000 ft to 1000 ft between FL 290 and FL 370.

Airworthiness approval alone does not authorize flight into airspace for which an RVSM operational approval is required by an ICAO Regional Navigation Agreement.

## LIMITATIONS

### MINIMUM EQUIPMENT REQUIRED

During RVSM operation it is necessary that the following equipment and instruments be in proper operating condition:

- 2 Primary Altitude Measurement Systems;
- 1 Autopilot with Altitude Hold Mode operative;
- 1 Altitude Alerter;
- 1 Transponder.

**NOTE: -** An operating transponder may not be required for entry into all designated RVSM airspace. The operator should determine the requirement for an operational transponder in each RVSM area where operations are intended. The operator should also determine the transponder requirements for transition areas next to RVSM airspace.

**-** Should any of the required equipment fail prior to the airplane entering RVSM airspace, the pilot should request a new clearance to avoid entering this airspace.

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# EMERGENCY AND ABNORMAL PROCEDURES

The procedures presented in the basic AOM Emergency/Abnormal Procedures remain unchanged, except as amended herein.

- In case of emergency or abnormal situation or contingencies (equipment failures, weather, etc.) which affect the ability to maintain the cleared flight level, notify ATC and co-ordinate an action plan that is appropriate to the airspace concerned;
- Notify ATC when encountering greater than moderate turbulence;
- If unable to notify ATC and obtain an ATC clearance prior to deviating from the cleared flight level, follow any established contingency procedures and obtain ATC clearance as soon as possible.

# NORMAL PROCEDURES

The procedures presented in the basic AOM Normal Procedures remain unchanged, except as amended herein.

### EXTERNAL SAFETY INSPECTION - NOSE SECTION

Sensors, Pitot Tubes and Static Ports ..... CONDITION, NO OBSTRUCTION

Particular attention should be paid to the condition of static sources and to the marked area on the fuselage skin near each primary static source.

### BEFORE TAKEOFF

Altimeters ..... SET TO THE AIRFIELD QNH

Altitude Indications ..... CHECK

**NOTE: -** An alternative procedure using QFE may also be used.
**-** The maximum difference between altimeters indication should not exceed 23 m (75 ft).

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It has been observed that, during normal operation when flying with the autopilot using ADC 1 as source of information and transponder 2 is selected for transmitting altitude information to ATC or vice versa, the altitude difference between the two ADC's, however small it is, is seen by ATC as discrepancy between the assigned altitude and the actual altitude, adding to the altitude overall error. For this reason, when the autopilot uses ADC 1 as source of information, transponder 1 should be used to report altitude because during normal operation it is connected to ADC 1. The same logic applies when using ADC 2 as source of information, that is, transponder 2 should be used.

## CRUISE

Be sure that all required equipment are in proper operating condition.

Ensure that the airplane is flown at the cleared flight level and that ATC clearances are fully understood and followed. Do not depart from cleared flight level without a positive clearance from ATC except for a contingency or emergency situation.

While changing flight levels, do not overshoot or undershoot the cleared flight level by more than 45 m (150 ft).

The autopilot should be operative and engaged during level cruise, except for circumstances such as the need to re-trim the airplane or when it must be disengaged due to turbulence.

## AFTER LANDING

In case of failure or malfunction, the following information should be recorded when appropriate:

a) Primary and standby altimeter readings;
b) Altitude selector setting;
c) Subscale setting on altimeter;
d) Flight Director used with the Autopilot to control the airplane and any differences when the other Flight Director was coupled;
e) Use of air data computer selector for fault diagnosis procedure;
f) The transponder selected to provide altitude information to ATC and any difference noted when an alternative transponder was selected.

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# ENHANCED/GROUND PROXIMITY WARNING

Aural Warning: WHOOP-WHOOP PULL UP or PULL UP (for EGPWS), SINK RATE, TERRAIN TERRAIN or TERRAIN TERRAIN PULL UP (for EGPWS), CAUTION TERRAIN (for EGPWS), OBSTACLE OBSTACLE PULL UP (for EGPWS), CAUTION OBSTACLE (for EGPWS), DON`T SINK DON`T SINK, TOO LOW TERRAIN, TOO LOW GEAR, TOO LOW FLAPS, GLIDE SLOPE and BANK ANGLE voice messages may be generated, but are not associated with GPWS/EGPWS EICAS message.

When an EGPWS/GPWS alert occurs, use the flight controls and thrust as necessary to correct the airplane attitude, flight path and configuration according to the voice message presented to provide terrain clearance.

**CAUTION:** FOR EGPWS, THE TERRAIN DISPLAY IS INTENDED TO BE USED AS A SITUATIONAL TOOL ONLY AND MAY NOT PROVIDE THE ACCURACY AND/OR FIDELITY ON WHICH TO SOLELY BASE TERRAIN AVOIDANCE MANEUVERING DECISIONS.

# WINDSHEAR PREVENTION/RECOVERY

Aural Warning: WINDSHEAR voice message is generated if WDSHEAR red indication is presented (GPWS warning may also be activated).

| | |
|---|---|
| Thrust Levers | MAX |
| Go-around Buttons | PRESS |

Rotate the airplane smoothly to minimize altitude loss. Flight guidance on EADI must be followed.

**NOTE:** Pitch attitude may be well above normal angles.

Maintain airplane configuration. Do not change gear and flap position until terrain clearance is assured and above 1500 ft AGL or after WDSHEAR label is removed from PFD.

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# TRAFFIC AND COLLISION AVOIDANCE

Aural Warning: According to the Traffic Advisory (TA) and Resolution Advisory (RA) associated.

The pilot must not initiate evasive maneuvers using information from the traffic display or the voice message only, without visually sighting the traffic. The traffic display and advisories are intended for assistance in visually locating the traffic.

Compliance with TCAS resolution advisory is required unless the pilot considers it unsafe to do so. Maneuvers which are in the opposite direction of the RA are extremely hazardous, especially RAs involving altitude crossing, and are prohibited unless it is visually determined to be the only means to assure safe separation.

# TRANSPONDER

In compliance with FAA Airworthiness Directive 2006-19-04, during all flight phases, after completion of any 4096 ATC Code change (also referred to as Mode A Code), check the status of the transponder. If the transponder indicates that it is in standby mode, re-select the desired mode (i.e., the transponder should be in the active mode).

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# RNP APPROACH

## INTRODUCTION

The material contain herein is a guidance to perform RNP APCH operations.

According to AC 90-105, airplanes conducting GPS approaches under AC 90-94 meet the airworthiness requirements of RNP Approach Operations.

**NOTE:** Compliance with the above regulations does not constitute operational approvals.

In addition to the guidance of this section, the operator must continue to ensure they comply with the general operating requirements; checking Notices to Airmen (NOTAMs), availability of Navigational Aids (NAVAIDs) for overlay approaches, airworthiness of airplane systems, and aircrew qualification. Pilots should assess their capability to navigate (potentially to an alternate destination) in case of GPS outages or predicted unavailability. In these situations, pilots should rely on other equipment, delay departure, or discontinue IFR operations.

Any required alternate airport should have an approved instrument approach procedure other than GPS which is anticipated to be operational at the estimated time of arrival.

## NAVIGATION DATA VALIDATION

The navigation database must be obtained by a supplier complying with AC 20-153 or equivalent and is expected to be current for the duration of the flight.

**NOTE:** If the AIRAC cycle will change during the flight, the locations of the waypoints used to define procedures must be verified with current navigational charts.

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## GENERAL GUIDANCE

While performing RNP APCH operations, pilots are required to use the Flight Director and/or Autopilot in lateral navigation mode.

RNP APCH operations require flight crew monitoring of lateral track deviations on the PFD to ensure the airplane remains within the bounds defined by the procedure. The lateral scale and CDI are automatically changed according the current phase of flight as presented in the following table:

| DEVIATION | ENROUTE (nm) | TERMINAL (nm) | APPROACH (nm) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 1 dot | 2.5 | 0.5 | 0.15 |
| 2 dots | 5.0 | 1.0 | 0.30 |

**NOTE:** In the PFD display, the phases of flight are identified as follows:
- Terminal phase is presented as TERM.
- Approach phase is presented as APP.
- Enroute is recognized in case neither of these two denominations is presented.

All pilots are expected to maintain centerlines, as depicted by onboard lateral deviation indicators and/or flight guidance. For normal operations, cross-track error/deviation (the difference between the RNAV system computed path and the airplane position relative to the path) should be limited to half the navigation accuracy associated with the procedure (i.e., 0.15 nm for RNP APCH operations).

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## PRIOR TO FLIGHT

Airplane Minimum Configuration ..... CHECK

Check the airplane configuration complies with the applicable list below:

For RNP APCH Operation:

- 1 FMS.
- 1 GPS.
- 1 DME (*).
- 1 VOR/LOC (*).
- 1 ADF(*).
- 4 Display units.
- 1 Flight Director.
- 1 CDU.

(*) Since the Flight crew should ensure sufficient means are available to navigate and land at the destination or at an alternate aerodrome in the case of loss of RNP APCH airborne, this equipment may be required to comply with this condition. This equipment may also be required to comply with the missed approach procedure if it is based on conventional navaids.

NAV Database ..... VERIFY CURRENCY

Verify that the Navigation Data Base (NDB) is current for the duration of the flight.

Predictive RAIM ..... CONFIRM AVAILABLE

The performance capability may be checked from an offline station, or with the airplane own capability. If using the airplane capability, insert the appropriate GPS NOTAMs to allow for an accurate predictive RAIM.

NOTAM NAVAIDS ..... DESELECT

Deselect manually the appropriate NAVAIDs in accordance with NOTAMs.

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## APPROACH BRIEFING

Procedure ..... CONFIRM

The flight crew must retrieve the approach procedure by procedure name from the FMS and confirm that the correct approach and missed approach procedures have been selected by comparing the FMS waypoints and distances with the aeronautical charts.

Display Control Panel ..... SET

Select the FMS as the source for the PFD and Bearing Pointer.

**NOTE: -** The manual entry or creation of new waypoints, by manual entry of latitude and longitude or position/bearing/distance values is not permitted.

**-** Slight differences between the navigation information portrayed in the chart and CDI (magenta) may occur. Differences of 3° or less are considered acceptable.

LNAV Mode ..... AS REQUIRED

GPS is in use by the FMS ..... CONFIRM

**NOTE:** If the ETA is more than 15 minutes from the pre-flight ETA, a new RAIM availability check should be performed.

## APPROACH

Track deviation ..... MONITOR

The deviation can be monitored through the lateral scales and CDI on PFD. Lateral deviation should not exceed 0.15 nm except briefly during and immediately after turns. If the deviation exceeds this limit perform a missed approach.

At the IAF:

Altimeters..... SET

2 NM before the FAF:

APP Annunciation..... CHECK

The annunciation indicates that the FMS is in the flight approach phase and the lateral deviation scaling has been set to approach scale factor.

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## ABNORMAL PROCEDURES

In case of loss of GPS based navigation capability, alternate non-GPS procedures at the destination airport must be available.

### LOSS OF SIGNAL IN SPACE

During a RNP APCH operation, if at any time GPS signal is lost the APP annunciation is removed, the DGR (or DR) PFD annunciation is displayed, and the deviations remain displayed and valid.

In any case, if not visual, perfom a missed approach using alternate sources (VOR, NDB or visual references).

### DEGRADED NAVIGATION

The navigation will be degraded whenever the FMS cannot guarantee that the accuracy of the system meets the requirements for the current phase of flight (DGRAD annunciator) or if the sensors being used for navigation are not approved for the current phase of flight.

Select the non-affected FMS. For single FMS installations, if not visual, perform missed approach.

For airplanes equipped with FMZ 2010 FMS, in case one FMS (single FMS) or both FMS (dual FMS) are affected, use the procedures from the following table.

| OPERATION | REQUIRED ACTION |
|---|---|
| Non-RNP Terminal or Enroute | Crosscheck FMS data with raw data from VOR, DME, and NDB. De-select error causing sensor, if detectable. Otherwise, contact ATC and revert to an alternative means of navigation (VOR, DME, or NDB). |
| RNAV/RNP | Contact ATC, advise of any loss of the RNAV/RNP capability or inability to continue RNAV/RNP. |

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**FMS FAILURE**

Select the cross side FMS. For single FMS installation, if not visual, perform missed approach.

**FLIGHT DIRECTOR FAILURE**

If flight director is lost, if not visual, perform missed approach.

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# PERFORMANCE BASED NAVIGATION (PBN)

## INTRODUCTION

The material contain herein is a guidance to perform PBN operation. It does not consider AC-90-105 or AMC-20-27 which deal with RNP APCH operation. For RNP APCH operation, refer to 1-02-80 RNP Approach.

In addition to the guidance of this section, the operator must continue to ensure compliance with the general operating requirements; checking Notices to Airmen (NOTAMS), availability of Navigational Aids (NAVAID), airworthiness of airplane systems, and flight crew qualification.

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## NAVIGATION DATA VALIDATION

The navigation database must be obtained by a supplier complying with AC 20-153 or equivalent and is expected to be current for the duration of the flight.

**NOTE:** If the AIRAC cycle will change during the flight, the locations of the waypoints used to define procedures must be verified with current navigational charts.

## GENERAL GUIDANCE

While performing PBN operations, pilots are encouraged to use the Flight Director and/or Autopilot in lateral navigation mode.

The following table presents the EMBRAER ERJ-145 capabilities in terms of the navigation specifications related to PBN. The information provided is based on AFM statements and, when there is no AFM statement, on analysis of the respective guidance material.

It is important to note that some guidance material that are listed on the table may either refer to other documentation for purposes of alternative compliance or may have been superseded by subsequent guidance material.

The ERJ-145 capabilities listed in this publication do not imply operational approval. Appropriate approval from the appropriate local authorities must be granted for each intended operation(s).



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The airplane is compliant with AC 90-100A (RNAV 1 and RNAV 2) and with TGL-10 (P-RNAV and B-RNAV).

| RNAV SPECIFICATIONS | | | |
|---|---|---|---|
| **Operation** | **Sensors that may be used** | **Guidance FAA** | **Guidance EASA** |
| RNAV 10 (RNP 10) (1) | 2 GNSS (2)<br>2 IRS+2 GPS<br>2 IRS (3) | Order 8400.12A | Order 8400.12A |
| RNAV 5 | GNSS<br>DME/DME<br>VOR/DME | AC 90-96A (5a) | AMC 20-4 (5b) |
| RNAV 2 | All permitted sensors (4)<br>GNSS (2)<br>DME/DME<br>DME/DME/IRU (4) | AC 90-100A (6) | - |
| RNAV 1 | All permitted sensors (4)<br>GNSS (2)<br>DME/DME<br>DME/DME/IRU (4) | AC 90-100A (6) | TGL 10 (P-RNAV) |

For P-RNAV operations, VOR/DME may be used as a sensor for positioning.

(1) Dual FMS is required.

(2) Off Line RAIM prediction is required.

(3) This operation is permitted up to 6.2 hours after the system is placed in the navigation mode.

(4) Only applicable for airplane with dual IRS installation (FMS HNL).

**NOTE:** For airplanes equipped with two AHRS and one additional IRS dedicated to HGS, only navigation based on GPS is allowable.

(5a) According to AC 90-96A, the airplane should be considered eligible for B-RNAV/RNAV 5 operations if the AFM shows the appropriate instrument flight rules (IFR) navigation system installation has received airworthiness approval in accordance with the current edition of AC 20-130. According to AFM, the EMB-145 RNAV system installation is compliant with AC 20-130A.

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(5b) AMC 20-4 defines that installations in accordance with AC 20-130() is an acceptable means of compliance for Basic RNAV systems, with no further substantiation. According to AFM, the EMB-145 RNAV system installation is compliant with AC 20-130A.

(6) NO AFM STATMENT - The AC 90-100A compliance table lists that the EMB-145 complies with AC-90-100A, therefore it is capable of RNAV 1 operation. Approval using DME/DME/IRU may be obtained only by those airplanes equipped with dual IRS. The airplanes with AHRS may obtain such approval using GPS.

## LIMITATIONS

- For RNAV operations in terminal airspace, obstacle clearance protection, up to the Final Approach FIX (FAF), will assume that airplane comply with the required RNAV accuracy requirements;
- Obstacle clearance altitude is based upon the infrastructure giving the poorest precision;
- The minimum flight crew are 2 Pilots;
- The system must display essential information in the Pilot's primary field of view such as:
  - Lateral deviation;
  - TO/FROM waypoints;
  - Failure flag (failure of RNAV system);
- Where DME/DME/IRS is used, the flight crew must ensure initialization on the runway either by means of a manual runway threshold or intersection update, as applicable. This is to preclude any inappropriate or inadvertent position shift after takeoff;
- Where GNSS is used, the signal must be acquired before the takeoff roll commences and GNSS position may be used instead of runway update;
- Where reliance is placed on the use of radar to assist contingency procedures, its performance has been shown to be adequate for that purpose, and the requirement for a radar service is identified in the AIP;
- RNAV operations must use FMS to control all lateral navigation functions. For FMS limitations, refer to Section 1-01-60 (Limitations, System: FMS) of AOM;

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- The airplane RNAV system must display the following information to the flight crew:
  - The active (TO) waypoint and distance/bearing to this point;
  - Ground speed or time to the active (TO) waypoint;
  - For P-RNAV, automatic tuning of VOR and DME used for position updating together with the capability to inhibit individual NAVAIDs;
  - RNAV system failures; alternate means of displaying navigation information, that is sufficient to perform cross-checks.

# NORMAL PROCEDURES

## PRE-FLIGHT PLANNING

NOTAM NAVAIDS ..... VERIFY

Verify the availability of the intended RNAV procedure. Verify also if any NAVAID identified in the AIP and on the relevant charts as critical for a specific RNAV procedure is not available.

Airplane Minimum Configuration ..... CHECK

Check if the airplane configuration complies with the applicable list below:

For all but RNAV 10 operations:

– 1 GPS (*) ;
– 1 VOR (*);
– 1 DME (*);
– 1 IRS (*);
– 1 FMS;
– 1 CDU;
– 4 Display units;
– 1 Flight Director.

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For RNAV 10 operations:

– 2 GPS (*);
– 2 IRS (*);
– 2 FMS;
– 2 CDU;
– 4 Display units;
– 1 Flight Director.

(*) Verify required positioning sensors for the intended operation, acording to RNAV Specifications table.

Navigation Infrastructure ..... CHECK AVAILABILITY

Check minimum equipment required acording to local regulation.

Navigation Database..... CHECK

The navigation database must be appropriate for the region of the intended operation and must include the NAVAIDS, waypoints, and coded terminal airspace procedures for the departure, arrival and alternate airfields. In this case, affected procedures must be prohibited by an operator's notice to the flight crew.

RNAV System (if required)..... CONFIRM AVAILABILITY

When dual RNAV system is required on the AIP.

RAIM (if applicable)..... CONFIRM AVAILABILITY

– Confirmation is necessary if a stand-alone GPS is to be used for RNAV 1 and RNAV 2 operations.
– Confirmation is necessary if dual GPS is to be used for RNP 10 operations.

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## DEPARTURE (RNAV 1/P-RNAV/RNAV 2)

NAV Database (both pilots) ..... VERIFY CURRENCY

Airplane Position Entry ..... CHECK

Desired Path (PNF) ..... VERIFY

Airplane Position relative to the Path..... CHECK

Flight Plan ..... CHECK

Compare the navigation charts with the MAP display and the MCDU.

**NOTE: -** A procedure shall not be used if doubt exists as to the validity of the procedure in the navigation database;
- The creation of new waypoints by manual entry into the RNAV system by the flight crew is not permitted;
- Route modifications in the terminal area may take form of radar headings or direct to clearances.

Airplane Minimum Configuration ..... VERIFY AVAILABILITY

Also, where applicable, verify if the correct airport and runway data have been loaded.

Flight Progress..... MONITOR

During the procedure and where feasible, monitor navigation reasonableness by cross-check with conventional NAVAIDs using the primary displays with the MCDU.

**NOTE:** When automatic update for departure is not available, the procedure should be flown by conventional navigation means. A transition to the RNAV structure should be made at the point where the airplane has entered DME/DME coverage and has had sufficient time to achieve an adequate input. If a procedure is designed to be started conventionally, then the latest point of transition to the RNAV structure will be marked on the charts. If a Pilot elects to start a RNAV procedure using conventional methods, there may not be any indication on the charts of the transition point to the RNAV structure.

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## CONTINENTAL ENROUTE (B-RNAV/RNAV 5/RNAV 1/RNAV 2)

Cleard Flight Plan ..... CHECK

Flight crew should cross-check the cleared flight plan by comparing charts or other applicable resources with the navigation system textual display and the airplane map display, if applicable. If required, the exclusion of specific NAVAIDs should be confirmed.

Flight Progress ..... MONITOR

During the flight, and where feasible, monitore navigational reasonableness by cross-check with conventional NAVAIDs using the primary displays in conjunction with the RNAV control and display unit (CDU).

## REMOTE ENROUTE (RNAV 10)

Dual FMS and GPS ..... CHECK AVAILABILITY

At least two FMS and two GPS must be operational at the oceanic entry point. If this is not the case, then the pilot should consider an alternate route which does not require that particular equipment or regard to make a diversion for repairs.

Before entering oceanic airspace:

Airplane Position ..... CHECK

The position of the airplane must be checked as accurately as possible by using external NAVAIDs. This may require DME/DME and/or VOR checks to determine navigation system errors through displayed and actual positions.

**NOTE:** Operator in-flight operating drills must include mandatory cross-checking procedures to identify navigation errors in sufficient time to prevent airplane from inadvertent deviation from ATC-cleared routes.

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## ARRIVAL (RNAV 1/P-RNAV AND RNAV 2)

RNAV arrival operation may only be performed down to the FAF, and shall not be used on Final Approach, i.e. from FAF to RWY or during Missed Approach.

Active Flight Plan ..... CHECK

Prior to the arrival phase, verify that the correct terminal procedure has been loaded. Then, compare the charts with the MAP display and the MCDU. This includes confirmation of the waypoint sequence, reasonableness of track angles and distances, any altitude or speed constraints, and, where possible, which waypoints are fly-by and which are fly-over.

**NOTE:** If required by procedure, a check will need to be made to confirm that updating will exclude a particular NAVAID. A procedure shall not be used in case of doubt regarding the procedure in the navigation database.

Flight Progress..... MONITOR

During the procedure and where feasible, monitor navigation reasonableness by cross-checks with the conventional NAVAIDs using the primary displays with the MCDU.

**NOTE: -** When the contingency plan is to revert to a conventional arrival procedure the flight crew must make the necessary preparation.

- For VOR/DME RNAV procedure (P-RNAV only), the reference VOR/DME used for the construction of the procedure must be displayed and checked by the flight crew. Incase there is no GNSS updating, a check for navigation reasonableness is required during the descent phase before reaching the Initial Approach FIX (IAF). For GNSS-based RNAV systems, the absence of an integrity alarm is considered sufficient. If the check fails, a conventional procedure must be flown.
- Route modifications in the terminal area may take the form of radar headings or “direct to” clearances and the flight crew must be capable of reacting in a timely manner. This may include the insertion of tactical waypoints loaded from the database. Manual entry or modification by the flight crew of a loaded procedure, using temporary waypoints or fixes not provided in the database is not permitted.

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Altitude/Speed Constraints ..... CHECK

Flight crew must be aware of any published altitude or speed constraints in the procedure.

## CONTINGENCY PROCEDURES

ATC ..... NOTIFY

Notify any problem with the RNAV system that results in the loss of required navigation capability, together with the proposed course of action.

### COMMUNICATION FAILURE

Continue with the RNAV procedure in accordance with the published lost communication procedure.

### RNAV CABABILITY LOSS

Navigate using an alternative means of navigation. The alternate means does not need to be based on RNAV system.

### NAVIGATION SENSORS FAILURE

Discontinue the RNAV procedure following the approved missed approach procedure or if feasible revert to a conventional or IRS procedure and inform ATC.

### MULTIPLE SYSTEM FAILURES

If multiple system failures occur such as those affecting GNSS, Flight Director, and any other used for RNAV procedure, perform a missed approach and inform ATC.

If the Autopilot fails, continue the approach using manually, and in case the flight path cannot be followed, perform a missed approach procedure and inform ATC.

If the DGRAD annunciation is displayed:

Select the non-affected FMS. For single FMS installations, use the procedures from the following tables:

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| Operation | Required Action |
|---|---|
| Non-RNP Terminal or En-route (including B-RNAV) | Crosscheck FMS data with raw data from VOR, DME and NDB. De-select sensor causing error, if detectable. |
| P-RNAV | Contact ATC, advise inability to continue P-RNAV. |
| Non-RNP (excluding GPS required) Approach | Use alternate sourse (VOR, NDB or visual references) if available. If not, declare Missed Approach. |
| Non-RNP Remote | Crosscheck FMS data with raw data from GPS or IRS. De-select error causing sensor, if detectable. |

**FMS 1(2) FAILURE**

Select the cross-side FMS.

In case both FMS are unavailable, use the procedures from the following table:

| Operation | Required Action |
|---|---|
| Non-RNP Terminal or En-route | Use alternate sourse (VOR, NDB, DME). |
| B-RNAV, P-RNAV | Contact ATC, advise inability to continue B-RNAV or P-RNAV operations. |
| Non-RNP (excluding GPS required) Approach | Use alternate sourse, if available (VOR, NDB or visual references) if available. If not, declare Missed Approach. |
| Remote Operations | Contact ATC and declare loss of long range navigation capability. |

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## INCIDENT REPORTING

Significant incidents associated with the operation of the airplane which affect or could affect the safety of RNAV operations, need to be reported on the appropriate report manifest.
Specific examples may include:

- Airplane system malfunctions during RNAV operations which lead to:
  - Navigations errors not associated with transitions between different navigation modes;
  - Significant navigation errors attributed to incorrect data or a navigation database coding error;
  - Unexpected deviations in lateral or vertical flight path not cause by Pilot input;
  - Significant misleading information without a failure warning;
  - Total loss or multiple navigation equipment failure.
- Problems with ground navigational facilities leading to significant navigational errors not associated with transitions between different navigation modes.

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# UNS-1K FLIGHT MANAGEMENT SYSTEM

The information contained herein supplements the information of the basic AOM Normal Procedures.

## HOLDING

If a Holding Pattern entering is necessary:

FMS ..... AS REQUIRED

The pilot must check the entry type and turn direction of holding pattern before entering it. For entry types other than the direct one, the pilot must activate the procedure holding pattern as soon as the approach procedure is retrieved from the Navigation Data Base.

**NOTE:** The FMS normal operating procedures are contained in the Universal UNS1 Operator's Manual.

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**FMS SOURCE SELECTION**

Flight Plan ..... SELECT OR CREATE

FMS Source ..... SELECT

The FMS can be selected as the navigation source through the FMS Selector Button located on the Display Control Panel.

FMS Label..... CHECK

The FMS label appears on the associated PFD and MFD.
On PFD:

For airplanes equipped with dual FMS:
If the FMS is the navigation source to the respective side the label will be magenta, otherwise it will be amber.

For airplanes equipped with single FMS:

- For airplanes Pre-Mod. SB 145-22-0001 or Post-Mod. SB 145-31-0009 or equipped with an equivalent modification factory-incorporated, if the FMS is the navigation source for only one side the color will be magenta, otherwise it will be amber.
- For airplanes Post-Mod. SB 145-22-0001 or with an equivalent modification factory incorporated, the FMS label will be always magenta.

On MFD the label will be always magenta.

For FMS coupling to the Autopilot/Flight Director:

NAV Mode (Flight Guidance Controller) ..... SELECT

The FMS will be coupled to the Autopilot/Flight Director when it is selected and valid at the on side EHSI and crew selects the NAV mode on the associated Flight Guidance Controller. Once coupled, the autopilot will follow the preselected flight plan on the FMS.

## APPROACH

**NOTE: -** ILS approaches can be retrieved from the navigation data base and linked to the flight plan, but cannot be armed or activated as FMS approaches. The FMS can be used to provide navigation up to the final approach course at the point that the PFD must be changed to display raw ILS data.

**-** GPS will remain selected for GPS and GPS-overlay approved approaches from the navigation database, as well as pilot-defined VFR approaches. Refer to Universal Operator's Manual approaches procedures.

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The FMS LOC, B/C, GPS, NDB, RNAV, VOR, VOR/DME and VFR approaches may be linked into the flight plan and laterally coupled to the autopilot/Flight Director as follows:

**APPROACH TRANSITION**

When a entire approach transition (e.g., procedure turn, DME arc, etc.) is to be flown, the FMS will automatically enter in the ARM APPR mode at 30 nm from the runway with the lateral deviation scaling of 1 nm (full scale), then:

NAV Mode (Flight Guidance Controller) ..... SELECT

The approach will be automatically activated prior to the FAF and the lateral deviation scaling will change to 0.3 nm full scale.
The VNAV scale will appear on the PFD.

VS or Pitch Hold Mode ..... SELECT AS REQUIRED

Use VS or pitch hold mode mode as required to fly the VNAV flight path.

**HEADING VECTORS**

If the airplane is given heading vectors by ATC to the final approach course, proceed as follows to manually activate the FMS approach:

HDG Mode (Flight Controller Panel)..... SELECT

If frequency is not already tuned:

TUNE APPR (FMS Control Panel) ..... PRESS

Navigation Frequency..... SELECT

ACT APPR (FMS Control Panel)..... PRESS

The MFD will display the final approach course data. The lateral deviation scaling of 0.3 nm (full scale) displayed on PFD.

When established on an intercept heading and cleared for the approach by the ATC:

NAV Mode (Flight Guidance Controller)..... SELECT

**NOTE:** Guidance is provided to the runway threshold or missed approach point. It is the pilot's responsibility to level out at the Minimum Descent Altitude if the runway environment is not in sight.

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## TRANSITION FROM FMS TO AUTOPILOT ILS APPROACH

ILS Frequency..... SELECT AS REQUIRED

Radio Altitude..... SELECT AS REQUIRED

HDG Mode (Flight Guidance Controller)..... SELECT

Before selection, set the desired interception course on heading bug.

Navigation Source..... SELECT

Select the NAV source on the Display Control Panel (LOC course selected on the PFD).

Autopilot/Flight Director..... AS REQUIRED

APR Mode (Flight Guidance Controller) ..... SELECT

## ARC DME APPROACH USING FMS

Pilot Not-flying..... CHECK DME

During Arc DME approach using FMS the pilot not-flying must check DME Raw Data.

## MISSED APPROACH

Go-Around Button ..... PRESS

Thrust Levers ..... MAX

Verify that airplane rotates to 10° nose up (Pitch Mode) and changes to Speed Hold Mode after 20 seconds.

Flaps ..... 9°

With a positive rate of climb:

Landing Gear ..... UP

Airspeed..... APPROACH CLIMB SPEED OR ABOVE

**NOTE:** During the GO-AROUND procedure, the DON'T SINK aural warning may sound. In this case monitor the sink rate and follow the GO-AROUND guidance.

NAV Mode (Flight Guidance Controller) ..... SELECT

Reselecting the NAV mode the airplane will regain the lateral guidance from the FMS to fly the missed approach legs to the missed holding point and to enter holding, as required.

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# RVSM OPERATION

The RVSM operation reduces the EMB-145 minimum vertical separation from 2000 ft to 1000 ft between FL 290 and FL 370.

Airworthiness approval alone does not authorize flight into airspace for which an RVSM operational approval is required by an ICAO Regional Navigation Agreement.

## LIMITATIONS

### MINIMUM EQUIPMENT REQUIRED

During RVSM operation it is necessary that the following equipment and instruments be in proper operating condition:

- 2 Primary Altitude Measurement Systems;
- 1 Autopilot with Altitude Hold Mode operative;
- 1 Altitude Alerter;
- 1 Transponder.

**NOTE: -** An operating transponder may not be required for entry into all designated RVSM airspace. The operator should determine the requirement for an operational transponder in each RVSM area where operations are intended. The operator should also determine the transponder requirements for transition areas next to RVSM airspace.

**-** Should any of the required equipment fail prior to the airplane entering RVSM airspace, the pilot should request a new clearance to avoid entering this airspace.

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# EMERGENCY AND ABNORMAL PROCEDURES

The procedures presented in the basic AOM Emergency/Abnormal Procedures remain unchanged, except as amended herein.

- In case of emergency or abnormal situation or contingencies (equipment failures, weather, etc.) which affect the ability to maintain the cleared flight level, notify ATC and co-ordinate an action plan that is appropriate to the airspace concerned;
- Notify ATC when encountering greater than moderate turbulence;
- If unable to notify ATC and obtain an ATC clearance prior to deviating from the cleared flight level, follow any established contingency procedures and obtain ATC clearance as soon as possible.

# NORMAL PROCEDURES

The procedures presented in the basic AOM Normal Procedures remain unchanged, except as amended herein.

### EXTERNAL SAFETY INSPECTION - NOSE SECTION

Sensors, Pitot Tubes and Static Ports .....CONDITION, NO OBSTRUCTION

Particular attention should be paid to the condition of static sources and to the marked area on the fuselage skin near each primary static source.

### BEFORE TAKEOFF

Altimeters .....SET TO THE AIRFIELD QNH

Altitude Indications .....CHECK

**NOTE: -** An alternative procedure using QFE may also be used.
**-** The maximum difference between altimeters indication should not exceed 23 m (75 ft).

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It has been observed that, during normal operation when flying with the autopilot using ADC 1 as source of information and transponder 2 is selected for transmitting altitude information to ATC or vice versa, the altitude difference between the two ADC's, however small it is, is seen by ATC as discrepancy between the assigned altitude and the actual altitude, adding to the altitude overall error. For this reason, when the autopilot uses ADC 1 as source of information, transponder 1 should be used to report altitude because during normal operation it is connected to ADC 1. The same logic applies when using ADC 2 as source of information, that is, transponder 2 should be used.

**CRUISE**

Be sure that all required equipment are in proper operating condition.

Ensure that the airplane is flown at the cleared flight level and that ATC clearances are fully understood and followed. Do not depart from cleared flight level without a positive clearance from ATC except for a contingency or emergency situation.

While changing flight levels, do not overshoot or undershoot the cleared flight level by more than 45 m (150 ft).

The autopilot should be operative and engaged during level cruise, except for circumstances such as the need to re-trim the airplane or when it must be disengaged due to turbulence.

**AFTER LANDING**

In case of failure or malfunction, the following information should be recorded when appropriate:

a) Primary and standby altimeter readings;
b) Altitude selector setting;
c) Subscale setting on altimeter;
d) Flight Director used with the Autopilot to control the airplane and any differences when the other Flight Director was coupled;
e) Use of air data computer selector for fault diagnosis procedure;
f) The transponder selected to provide altitude information to ATC and any difference noted when an alternative transponder was selected.

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# ENHANCED/GROUND PROXIMITY WARNING

Aural Warning: WHOOP-WHOOP PULL UP or PULL UP (for EGPWS), SINK RATE, TERRAIN TERRAIN or TERRAIN TERRAIN PULL UP (for EGPWS), CAUTION TERRAIN (for EGPWS), OBSTACLE OBSTACLE PULL UP (for EGPWS), CAUTION OBSTACLE (for EGPWS), DON`T SINK DON`T SINK, TOO LOW TERRAIN, TOO LOW GEAR, TOO LOW FLAPS, GLIDE SLOPE and BANK ANGLE voice messages may be generated, but are not associated with GPWS/EGPWS EICAS message.

When an EGPWS/GPWS alert occurs, use the flight controls and thrust as necessary to correct the airplane attitude, flight path and configuration according to the voice message presented to provide terrain clearance.

**CAUTION:** FOR EGPWS, THE TERRAIN DISPLAY IS INTENDED TO BE USED AS A SITUATIONAL TOOL ONLY AND MAY NOT PROVIDE THE ACCURACY AND/OR FIDELITY ON WHICH TO SOLELY BASE TERRAIN AVOIDANCE MANEUVERING DECISIONS.

# WINDSHEAR PREVENTION/RECOVERY

Aural Warning: WINDSHEAR voice message is generated if WDSHEAR red indication is presented (GPWS warning may also be activated).

| | |
|---|---|
| Thrust Levers | MAX |
| Go-around Buttons | PRESS |

Rotate the airplane smoothly to minimize altitude loss. Flight guidance on EADI must be followed.

**NOTE:** Pitch attitude may be well above normal angles.

Maintain airplane configuration. Do not change gear and flap position until terrain clearance is assured and above 1500 ft AGL or after WDSHEAR label is removed from PFD.

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# TRAFFIC AND COLLISION AVOIDANCE

Aural Warning: According to the Traffic Advisory (TA) and Resolution Advisory (RA) associated.

The pilot must not initiate evasive maneuvers using information from the traffic display or the voice message only, without visually sighting the traffic. The traffic display and advisories are intended for assistance in visually locating the traffic.

Compliance with TCAS resolution advisory is required unless the pilot considers it unsafe to do so. Maneuvers which are in the opposite direction of the RA are extremely hazardous, especially RAs involving altitude crossing, and are prohibited unless it is visually determined to be the only means to assure safe separation.

# TRANSPONDER

In compliance with FAA Airworthiness Directive 2006-19-04, during all flight phases, after completion of any 4096 ATC Code change (also referred to as Mode A Code), check the status of the transponder. If the transponder indicates that it is in standby mode, re-select the desired mode (i.e., the transponder should be in the active mode).

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# RNP APPROACH

## INTRODUCTION

The material contain herein is a guidance to perform RNP APCH operations.

According to AC 90-105, airplanes conducting GPS approaches under AC 90-94 meet the airworthiness requirements of RNP Approach Operations.

**NOTE:** Compliance with the above regulations does not constitute operational approvals.

In addition to the guidance of this section, the operator must continue to ensure they comply with the general operating requirements; checking Notices to Airmen (NOTAMs), availability of Navigational Aids (NAVAIDs) for overlay approaches, airworthiness of airplane systems, and aircrew qualification. Pilots should assess their capability to navigate (potentially to an alternate destination) in case of GPS outages or predicted unavailability. In these situations, pilots should rely on other equipment, delay departure, or discontinue IFR operations.

Any required alternate airport should have an approved instrument approach procedure other than GPS which is anticipated to be operational at the estimated time of arrival.

## NAVIGATION DATA VALIDATION

The navigation database must be obtained by a supplier complying with AC 20-153 or equivalent and is expected to be current for the duration of the flight.

**NOTE:** If the AIRAC cycle will change during the flight, the locations of the waypoints used to define procedures must be verified with current navigational charts.

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## GENERAL GUIDANCE

While performing RNP APCH operations, pilots are required to use the Flight Director and/or Autopilot in lateral navigation mode.

RNP APCH operations require flight crew monitoring of lateral track deviations on the PFD to ensure the airplane remains within the bounds defined by the procedure. The lateral scale and CDI are automatically changed according the current phase of flight as presented in the following table:

| DEVIATION | ENROUTE (nm) | TERMINAL (nm) | APPROACH (nm) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 1 dot | 2.5 | 0.5 | 0.15 |
| 2 dots | 5.0 | 1.0 | 0.30 |

**NOTE:** In the PFD display, the phases of flight are identified as follows:
- Terminal phase is presented as TERM.
- Approach phase is presented as APP.
- Enroute phase is recognized in case neither of these two denominations is presented.

All pilots are expected to maintain centerlines, as depicted by onboard lateral deviation indicators and/or flight guidance. For normal operations, cross-track error/deviation (the difference between the RNAV system computed path and the airplane position relative to the path) should be limited to half the navigation accuracy associated with the procedure (i.e., 0.15 nm for RNP APCH operations).

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## PRIOR TO FLIGHT

Airplane Minimum Configuration..... CHECK

Check the airplane configuration complies with the applicable list below:

For RNP APCH Operation:

- 1 FMS.
- 1 GPS.
- 1 DME (*).
- 1 VOR/LOC (*).
- 1 ADF(*).
- 4 Display units.
- 1 Flight Director.
- 1 CDU.

(*) Since the Flight crew should ensure sufficient means are available to navigate and land at the destination or at an alternate aerodrome in the case of loss of RNP AR airborne, this equipment may be required to comply with this condition. This equipment may also be required to comply with the missed approach procedure if it is based on conventional navaids.

NAV Database ..... VERIFY CURRENCY

Verify that the Navigation Data Base (NDB) is current for the duration of the flight.

Predictive RAIM ..... CONFIRM AVAILABLE

The performance capability may be checked from an offline station, or with the airplane own capability. If using the airplane capability, insert the appropriate GPS NOTAMs to allow for an accurate predictive RAIM.

NOTAM NAVAIDS ..... DESELECT

NAVAIDs are continuosly monitored for reasonableness and are automaticaly de-selected with a notification to the pilot when out of bounds. NAVAIDs, except VORs, cannot be manually inhibited from automatic selection process.

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## APPROACH BRIEFING

Procedure ..... CONFIRM

The flight crew must retrieve the approach procedure by procedure name from the FMS and confirm that the correct approach and missed approach procedures have been selected by comparing the FMS waypoints and distances with the aeronautical charts.

Display Control Panel ..... SET

Select the FMS as the source for the PFD and Bearing Pointer.

**NOTE: -** The manual entry or creation of new waypoints, by manual entry of latitude and longitude or position/bearing/distance values is not permitted.

**-** Slight differences between the navigation information portrayed in the chart and CDI (magenta) may occur. Differences of 3° or less are considered acceptable.

LNAV Mode ..... AS REQUIRED

GPS is in use by the FMS..... CONFIRM

**NOTE:** If the ETA is more than 15 minutes from the pre-flight ETA, a new RAIM availability check should be performed.

## APPROACH

Track deviation ..... MONITOR

The deviation can be monitored through the lateral scales and CDI on PFD. Lateral deviation should not exceed 0.15 nm except briefly during and immediately after turns. If the deviation exceeds this limit perform a missed approach.

At the IAF:

Altimeters..... SET

2 NM before the FAF:

APP Annunciation..... CHECK

The annunciation indicates that the FMS is in the flight approach phase and the lateral deviation scaling has been set to approach scale factor.

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# ABNORMAL PROCEDURES

In case of loss of GPS based navigation capability, alternate non-GPS procedures at the destination airport must be available.

## LOSS OF SIGNAL IN SPACE

During a RNP APCH operations, if at any time GPS signal is lost a red X is displayed over the Course Deviation Scale and the INTEG annunciation may be displayed. The APP annunciation is not automatically removed from the PFD.

If any of these situations happens, if not visual, declare missed approach.

## DEGRADED NAVIGATION

The navigation will be degraded whenever the FMS cannot guarantee that the accuracy of the system meets the requirements for the current phase of flight or if the sensors being used for navigation are not approved for the current phase of flight.

Select the non-affected FMS. For single FMS installations, if not visual, declare missed approach.

## FMS FAILURE

Select the cross side FMS. For single FMS installation, if not visual, declare missed approach.

## FLIGHT DIRECTOR FAILURE

If flight director is lost, If not visual, declare missed approach.

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# PERFORMANCE BASED NAVIGATION (PBN)

## INTRODUCTION

The material contain herein is a guidance to perform PBN operation. It does not consider AC-90-105 or AMC-20-27 which deal with RNP APCH operation. For RNP APCH operation, refer to 1-02-80 RNP Approach.
In addition to the guidance of this section, the operator must continue to ensure compliance with the general operating requirements; checking Notices to Airmen (NOTAMS), availability of Navigational Aids (NAVAID), airworthiness of airplane systems, and flight crew qualification.

## NAVIGATION DATA VALIDATION

The navigation database must be obtained by a supplier complying with AC 20-153 or equivalent and is expected to be current for the duration of the flight.

**NOTE:** If the AIRAC cycle will change during the flight, the locations of the waypoints used to define procedures must be verified with current navigational charts.

## GENERAL GUIDANCE

While performing PBN operations, pilots are encouraged to use the Flight Director and/or Autopilot in lateral navigation mode.

The following table presents the EMBRAER ERJ-145 capabilities in terms of the navigation specifications related to PBN. The information provided is based on AFM statements and, when there is no AFM statement, on analysis of the respective guidance material.

It is important to note that some guidance material that are listed on the table may either refer to other documentation for purposes of alternative compliance or may have been superseded by subsequent guidance material.

The ERJ-145 capabilities listed in this publication do not imply operational approval. Appropriate approval from the appropriate local authorities must be granted for each intended operation(s).

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The airplane is compliant with AC 90-100A (RNAV 1 and RNAV 2) and with TGL-10 (P-RNAV and B-RNAV).

| RNAV SPECIFICATIONS | | | |
|---|---|---|---|
| **Operation** | **Sensors that may be used** | **Guidance FAA** | **Guidance EASA** |
| RNAV 10 (RNP 10) (1) | 2 GNSS (2) | Order 8400.12A | Order 8400.12A |
| RNAV 5 | GNSS<br>DME/DME<br>VOR/DME | AC 90-96A (3a) | AMC 20-4 (3b) |
| RNAV 2 | GNSS (2) | AC 90-100A | - |
| RNAV 1 | GNSS (2) | AC 90-100A | TGL 10 (P-RNAV) |

(1) Dual FMS is required.

(2) Off Line RAIM prediction is required.

(3a) According to AC 90-96A, the airplane should be considered eligible for B-RNAV/RNAV 5 operations if the AFM shows the appropriate instrument flight rules (IFR) navigation system installation has received airworthiness approval in accordance with the current edition of AC 20-130. According to AFM, the EMB-145 RNAV system installation is compliant with AC 20-130A.

(3b) AMC 20-4 defines that installations in accordance with AC 20-130() is an acceptable means of compliance for Basic RNAV systems, with no further substantiation. According to AFM, the EMB-145 RNAV system installation is compliant with AC 20-130A.

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## LIMITATIONS

- For RNAV operations in terminal airspace, obstacle clearance protection, up to the Final Approach FIX (FAF), will assume that airplane comply with the required RNAV accuracy requirements;
- Obstacle clearance altitude is based upon the infrastructure giving the poorest precision;
- The minimum flight crew are 2 Pilots;
- The system must display essential information in the Pilot's primary field of view such as:
  - Lateral deviation;
  - TO/FROM waypoints;
  - Failure flag (failure of RNAV system);
- Where GNSS is used, the signal must be acquired before the takeoff roll commences and GNSS position may be used instead of runway update;
- Where reliance is placed on the use of radar to assist contingency procedures, its performance has been shown to be adequate for that purpose, and the requirement for a radar service is identified in the AIP;
- RNAV operations must use FMS to control all lateral navigation functions. For FMS limitations, refer to Section 1-01-60 (Limitations, System: FMS) of AOM;
- The airplane RNAV system must display the following information to the flight crew:
  - The active (TO) waypoint and distance/bearing to this point;
  - Ground speed or time to the active (TO) waypoint;
  - RNAV system failure;
  - Alternate means of displaying navigation information, that is sufficient to perform cross-checks.

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# NORMAL PROCEDURES

## PRE-FLIGHT PLANNING

NOTAM NAVAIDS ..... VERIFY

Verify the availability of the intended RNAV procedure. Verify also if any NAVAID identified in the AIP and on the relevant charts as critical for a specific RNAV procedure is not available.

**NOTE:** If it is requested to inhibit an individual NAVAID, do not perform an operation that uses VOR/DME for positioning.

Airplane Minimum Configuration..... CHECK

Check if the airplane configuration complies with the applicable list below:

For all but RNAV 10 operations:

– 1 GPS;
– 1 FMS;
– 1 CDU;
– 4 Display units;
– 1 Flight Director.

For RNAV 10 operations:

– 2 GPS;
– 2 FMS;
– 2 CDU;
– 4 Display units;
– 1 Flight Director.

Navigation Infrastructure ..... CHECK AVAILABILITY

Check minimum equipment required acording to local regulation.

Navigation Database..... CHECK

The navigation database must be appropriate for the region of the intended operation and must include the NAVAIDS, waypoints, and coded terminal airspace procedures for the departure, arrival and alternate airfields. In this case, affected procedures must be prohibited by an operator's notice to the flight crew.

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RNAV System (if required) ..... CONFIRM AVAILABILITY

When dual RNAV system is required on the AIP.

RAIM (if applicable) ..... CONFIRM AVAILABILITY

- Confirmation is necessary if a stand-alone GPS is to be used for RNAV 1 and RNAV 2 operations.
- Confirmation is necessary if dual GPS is to be used for RNP 10 operations.

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## DEPARTURE (RNAV 1/P-RNAV / RNAV 2)

NAV Database (both pilots) ..... VERIFY CURRENCY

Airplane Position Entry..... CHECK

Desired Path (PNF)..... VERIFY

Airplane Position relative to the Path..... CHECK

Flight Plan ..... CHECK

Compare the navigation charts with the MAP display and the MCDU.

**NOTE: -** A procedure shall not be used if doubt exists as to the validity of the procedure in the navigation database;
- The creation of new waypoints by manual entry into the RNAV system by the flight crew is not permitted;
- Route modifications in the terminal area may take form of radar headings or direct to clearances.

Airplane Minimum Configuration..... VERIFY AVAILABILITY

Also, where applicable, verify if the correct airport and runway data have been loaded.

**NOTE:** Where GNSS is used, the signal must be acquired before the takeoff roll commences and GNSS position may be used instead of runway update.

Flight Progress..... MONITOR

During the procedure and where feasible, monitor navigation reasonableness by cross-check with conventional NAVAIDs using the primary displays with the MCDU.

**NOTE:** When automatic update for departure is not available, the procedure should be flown by conventional navigation means. If a procedure is designed to be started conventionally, then the latest point of transition to the RNAV structure will be marked on the charts. If a Pilot elects to start a RNAV procedure using conventional methods, there may not be any indication on the charts of the transition point to the RNAV structure.

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## CONTINENTAL ENROUTE (B-RNAV/RNAV 5/RNAV 1/RNAV 2)

Cleard Flight Plan ..... CHECK

Flight crew should cross-check the cleared flight plan by comparing charts or other applicable resources with the navigation system textual display and the airplane map display, if applicable. If required, the exclusion of specific NAVAIDs should be confirmed.

Flight Progress..... MONITOR

During the flight, and where feasible, monitore navigational reasonableness by cross-check with conventional NAVAIDs using the primary displays in conjunction with the RNAV control and display unit (CDU).

## REMOTE ENROUTE (RNAV 10)

Dual FMS and GPS ..... CHECK AVAILABILITY

At least two FMS and two GPS must be operational at the oceanic entry point. If this is not the case, then the pilot should consider an alternate route which does not require that particular equipment or regard to make a diversion for repairs.

Before entering oceanic airspace:

Airplane Position ..... CHECK

The position of the airplane must be checked as accurately as possible by using external NAVAIDs. This may require DME/DME and/or VOR checks to determine navigation system errors through displayed and actual positions.

**NOTE:** Operator in-flight operating drills must include mandatory cross-checking procedures to identify navigation errors in sufficient time to prevent airplane from inadvertent deviation from ATC-cleared routes.

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## ARRIVAL (RNAV 1/P-RNAV AND RNAV 2)

RNAV arrival operation may only be performed down to the FAF, and shall not be used on Final Approach, i.e. from FAF to RWY or during Missed Approach.

Active Flight Plan ..... CHECK

Prior to the arrival phase, verify that the correct terminal procedure has been loaded. Then, compare the charts with the MAP display and the MCDU. This includes confirmation of the waypoint sequence, reasonableness of track angles and distances, any altitude or speed constraints, and, where possible, which waypoints are fly-by and which are fly-over.

**NOTE:** If required by procedure, a check will need to be made to confirm that updating will exclude a particular NAVAID. A procedure shall not be used in case of doubt regarding the procedure in the navigation database.

Flight Progress ..... MONITOR

During the procedure and where feasible, monitor navigation reasonableness by cross-checks with the conventional NAVAIDs using the primary displays with the MCDU.

**NOTE: -** When the contingency plan is to revert to a conventional arrival procedure the flight crew must make the necessary preparation.

**-** For GNSS-based RNAV systems, the absence of an integrity alarm is considered sufficient. If the check fails, a conventional procedure must be flown.

**-** Route modifications in the terminal area may take the form of radar headings or “direct to” clearances and the flight crew must be capable of reacting in a timely manner. This may include the insertion of tactical waypoints loaded from the database. Manual entry or modification by the flight crew of a loaded procedure, using temporary waypoints or fixes not provided in the database is not permitted.

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Altitude/Speed Constraints ..... CHECK

Flight crew must be aware of any published altitude or speed constraints in the procedure.

## CONTINGENCY PROCEDURES

ATC..... NOTIFY

Notify any problem with the RNAV system that results in the loss of required navigation capability, together with the proposed course of action.

### COMMUNICATION FAILURE

Continue with the RNAV procedure in accordance with the published lost communication procedure.

### RNAV CABABILITY LOSS

Navigate using an alternative means of navigation. The alternate means does not need to be based on RNAV system.

### NAVIGATION SENSORS FAILURE

Discontinue the RNAV procedure following the approved missed approach procedure or if feasible revert to a conventional or IRS procedure and inform ATC.

### MULTIPLE SYSTEM FAILURES

If multiple system failures occur such as those affecting GNSS, Flight Director, and any other used for RNAV procedure, perform a missed approach and inform ATC.

If the Autopilot fails, continue the approach using manually, and in case the flight path cannot be followed, perform a missed approach procedure and inform ATC.

If the DGRAD annunciation is displayed:

Select the non-affected FMS. For single FMS installations, use the procedures from the following tables:

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| Operation | Required Action |
|---|---|
| Non-RNP Terminal or En-route (including B-RNAV) | Crosscheck FMS data with raw data from VOR, DME and NDB. De-select sensor causing error, if detectable. |
| P-RNAV | Contact ATC, advise inability to continue P-RNAV. |
| Non-RNP (excluding GPS required) Approach | Use alternate sourse (VOR, NDB or visual references) if available. If not, declare Missed Approach. |
| Non-RNP Remote | Crosscheck FMS data with raw data from GPS or IRS. De-select error causing sensor, if detectable. |

**FMS 1(2) FAILURE**

Select the cross-side FMS.

In case both FMS are unavailable, use the procedures from the following table:

| Operation | Required Action |
|---|---|
| Non-RNP Terminal or En-route | Use alternate sourse (VOR, NDB, DME). |
| B-RNAV, P-RNAV | Contact ATC, advise inability to continue B-RNAV or P-RNAV operations. |
| Non-RNP (excluding GPS required) Approach | Use alternate sourse, if available (VOR, NDB or visual references) if available. If not, declare Missed Approach. |
| Remote Operations | Contact ATC and declare loss of long range navigation capability. |

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## INCIDENT REPORTING

Significant incidents associated with the operation of the airplane which affect or could affect the safety of RNAV operations, need to be reported on the appropriate report manifest.
Specific examples may include:

- Airplane system malfunctions during RNAV operations which lead to:
  - Navigations errors not associated with transitions between different navigation modes;
  - Significant navigation errors attributed to incorrect data or a navigation database coding error;
  - Unexpected deviations in lateral or vertical flight path not cause by Pilot input;
  - Significant misleading information without a failure warning;
  - Total loss or multiple navigation equipment failure.
- Problems with ground navigational facilities leading to significant navigational errors not associated with transitions between different navigation modes.

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# ENGINE START WITH AIRPLANE BATTERIES AND LOW PRESSURE UNIT (LPU)

This procedure may be used when operating without APU or GPU but with the batteries and a Low Pressure Unit (LPU) available for engine start.

**NOTE:** - Before attempting to start the engines using the batteries ensure that minimum batteries voltage is 24.0 VDC.

- Accomplish a BEFORE START - FIRST FLIGHT procedure as soon as the electrical source is established.
- The Captain may elect to start the remaining engine using the LPU or to perform a crossbleed start.
- The engines pneumatic start does not affect the electrical system or the individual loads connected to it. The voltage of the buses fed by the batteries remain steady during engine starts, with no power transients. After the first engine start and with generators on line, the normal electrical system voltage will be between 24 V and 28.5 V.
- It is recommended that audio communication with the ground crew be used instead of signaling.

## BEFORE START

Internal and External Safety Inspections ..... ACCOMPLISH
Parking Brake ..... ON
Batteries 1 & 2 ..... AUTO
Avionics Masters ..... ON
Batteries Voltage ..... CHECK
Avionics Masters ..... OFF
Emergency Lights ..... ARM
Fire Detection System ..... CHECK
Crossbleed ..... AUTO or OPEN
Packs ..... OFF
Engine Bleeds ..... CLOSE

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## CLEARED TO START

Doors and Windows ..... CLOSED
Red Beacon ..... ON
Fuel Pump (associated engine) ..... ON
Start Pressure ..... AVAILABLE

## START

Start/Stop Selector (associated engine)..... START, THEN RUN

Turn the start selector to RUN for 2 seconds, then turn the switch to the START position momentarily (signals the initiate start sequence to the FADEC) and then to RUN, and start the stopwatch.

Engine Indication..... MONITOR

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# ENGINE START ASSISTED BY THE OPPOSITE ENGINE (CROSS START)

This procedure may be used to start the second engine using the operating engine bleed as the pneumatic source.

APU Bleed ..... CLOSE
Crossbleed..... AUTO or OPEN
Engine Bleed (non-operating engine) ..... CLOSE
Engine Bleed (operating engine) ..... OPEN

N2 of the operating engine must be accelerated to above 80%.

Start/Stop Selector..... START,THEN RUN

Turn the start selector to RUN for 2 seconds, then turn the switch to the START position momentarily (signals the initiate start sequence to the FADEC) and then to RUN, and start the stopwatch.

Engine Indication ..... MONITOR

**NOTE:** After the start is completed, reduce operating engine power to idle.

# ENGINE START ASSISTED BY THE APU

This procedure may be used to start the engine using the APU bleed as the pneumatic source.

APU bleed..... OPEN
Crossbleed ..... OPEN or AUTO
Engine Bleeds..... CLOSED

Start/Stop Selector..... START,THEN RUN

Turn the start selector to RUN for 2 seconds, then turn the switch to the START position momentarily (signals the initiate start sequence to the FADEC) and then to RUN, and start the stopwatch.

Engine Indication ..... MONITOR

**NOTE:** With the APU Bleed Valve open and the Crossbleed Valve in AUTO position, the Engine 1 will always be started assisted by the APU, even when the Engine 2 is running with associated Engine Bleed Valve open.

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# SINGLE ENGINE TAXI

The procedures below are provided to allow operators to perform a single engine taxi. This procedure can be adopted at crowded airports, where the taxi time may be too long, leading to unnecessary fuel waste and air pollution.

For single engine taxi, change or complement the normal procedures according to the following.

## BEFORE START

Evaluate which engine will be started based on fuel distribution on tanks, passenger boarding and baggage loading. If the airplane is operating under MEL with one engine driven generator inoperative, choose the engine which has both generators operating.

**NOTE:** Batteries charge may be preserved by using all available generators.

## AFTER START

FADEC Control Knob ..... RESET, THEN ALTN

Electric Hydraulic Pumps ..... AUTO

Check on MFD Hydraulic Page that both hydraulic systems pressure are within green range.

Air Conditioning and Pneumatic System ..... AS REQUIRED

If both air conditioning packs are required, select Crossbleed to OPEN.

Shed Buses ..... OVRD

Check all DC Buses energized and operating generators load. If required, turn off equipment not essential (galley, coffee maker, etc.). In such case, inform flight attendant that those equipment shall be off until second engine start.

## TAXI

Monitor both fuel quantities to avoid excessive fuel imbalance.

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## BEFORE TAKEOFF

Non Operating Engine ..... START
Crossfeed ..... OFF
Shed Buses..... AUTO
Electric Hydraulic Pumps ..... AUTO
Air Conditioning and Pneumatic System..... AS REQUIRED

## AFTER LANDING

Shed Buses..... OVRD
Electric Hydraulic Pumps ..... AUTO
Air Conditioning and Pneumatic System..... AS REQUIRED
Selected Engine ..... SHUTDOWN

## ABNORMAL PROCEDURES

If the operating engine fails, stop the airplane as soon as possible, apply Parking Brakes and turn off both hydraulic pumps and any unnecessary equipment. APU may be used to start remaining engine and return to gate.

**NOTE:** Batteries will be discharging until APU or remaining generators are turned on.

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# ALTIMETER MISCOMPARE TOLERANCES

This Section provides information regarding maximum allowed tolerances between PFD altitude indications and standby altimeter.

For the EMB-145, ERJ-140 and EMB-135 models, there are two pitot probes, four static probes and one pitot static probe. Pitot probes 1 and 2 and the static ports send information to ADCs 1 and 2. The third (auxiliary) pitot probe sends information directly to the standby indicators.

The standby altimeter system is a back-up navigation source to be used in the event of a total loss of the primary source (ADC).

The differences between the readings of ADC 1 and 2 altimeters and between these and the standby system altimeter, with the airplane on ground or in flight, can occur due to a number of reasons and may vary with altitude, airspeed and airplane configuration. In addition, the static port for the standby system and the static port for the primary system are located in different positions.

This criterion considers additional parameters, as follows: measurement errors, installation deviations, internal and skin waviness distortions and airplane sideslip condition that bear an influence on data variations when comparing the two systems. The new range of values is applicable to both the Integrated Standby Instrument System and the Conventional Standby System.

For all EMB-145, ERJ-140 and EMB-135 models, the maximum acceptable difference between both ADC altimeter indications and between the ADC altimeters and the Standby System are shown in the table on the next page.

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To verify if altimeter difference is within tolerance, the flight crew should proceed as follows:

Altitude.....STABILIZE

Maintain variation within +/- 50 ft.

Air Speed.....STABILIZE

Maintain variation within +/- 5 kt.

Wait a minimum of 15 seconds in straight and leveled flight, preferably with Autopilot engaged, to compare the difference between altitudes using the following table:

| ALTITUDE (ft) | MAXIMUM DIFFERENCE BETWEEN PILOT AND COPILOT'S ALTIMETERS (ft) | MAXIMUM DIFFERENCE BETWEEN PILOT OR COPILOT'S ALTIMETERS AND STANDBY ALTIMETER (ft) |
|---|---|---|
| 0 | 50 | 150 |
| 5000 | 60 | 200 |
| 10000 | 60 | 280 |
| 15000 | 70 | 320 |
| 20000 | 70 | 500 |
| 25000 | 100 | 600 |
| 30000 | 120 | 750 |
| 35000 | 150 | 750 |
| 37000 | 160 | 750 |
| 39000 | 180 | 800 |

Differences greater than the values in the table must be verified by maintenance checks.

In flight, if a discrepancy is reported between the values shown in the table, a double check must be performed using the previous and the next referenced altitude level.

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# CAT II OPERATION

The information contained herein supplements the information of the the basic AOM Normal Procedures.

## AUTOPILOT COUPLED CAT II APPROACH

### BEFORE INTERCEPTING LOCALIZER COURSE

- Perform the Descent/Approach/Before Landing checklists, as appropriate.
- Perform the Radio Altimeter test.
- Set the CAT II Decision Height on both Display Control Panels.
- Check radio altimeter information on both PFD.
- Select the same ILS frequency on both RMU.

**NOTE: -** After test, if Radio Altimeter is checked not functioning properly the CAT II approach must discontinued.

- A minimum distance of 4 NM to the Outer Marker is recommended for interception and stabilization along the approach course.

### BEFORE INTERCEPTING THE GLIDE SLOPE

- Monitor radio altimeter information.
- Lower landing gear (one dot below GS interception) and set flaps to 22°.
- Set the Approach Speed ($V_{APP}$) for flaps 22° on AP bug (green bug).

**NOTE:** The $V_{APP}$ is determined by adjusting the $V_{APP}$ for head wind component and gust according to the following equation:
$V_{APP} = V_{REF}$ + WIND CORRECTION, where:
WIND CORRECTION = ½ head wind component + full gust, limited to 20 kt.

- Stabilize and maintain the Approach Speed ($V_{APP}$) for flaps 22°.
- Set approach climb speed on SPD reference speed bug (cyan bug).
- Be sure that Marker Beacon audio is on.

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**AFTER PASSING THE OUTER MARKER INBOUND**

- The pilot flying should maintain the Approach Speed ($V_{APP}$) for flaps 22°.
- Both pilots must monitor the progress of the approach on their displays down to approximately 200 ft above the decision height. At this point the pilot not flying looks out for external visual references while the pilot flying continues to monitor his displays down to the decision height.
- At 80 ft above the decision height setting the GPWS will call out "APPROACHING MINIMUM".
- At the decision height setting the GPWS will call out "MINIMUM", and the pilot not flying will call out "LANDING" or "GO AROUND", as appropriate.
- If visual contact is not made upon reaching the decision height or if any malfunction could not be promptly identified during approach, a missed approach shall be immediately initiated.

## FLIGHT DIRECTOR CAT II APPROACH (ONLY APPLICABLE TO EMB-135 AND EMB-145XR MODELS)

The procedures for Flight Director CAT II Approach are the same as those for Autopilot Coupled CAT II Approach except that the approach is performed manually following the Flight Director indications.

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## MISSED APPROACH

GO-AROUND Procedure..... ACCOMPLISH

## LANDING

Reaching the Decision Height with runway in sight:

Autopilot..... DISENGAGE
Speed ..... $V_{REF\ 22°}$
Landing..... PERFORM

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# HGS OPERATION

The information presented in this Supplement enables the establishment of the conditions required to accomplish the HGS operation.

The Flight Dynamics Model 3300 Head-Up Guidance System (HGS) is approved for use throughout the full flight regime as a supplemental display.

The CAT IIIa operation is predicated upon the use of an ILS facility with performance and integrity equivalent to, or between, an ICAO Annex 1 Facility Performance CAT III ILS, an US Type II or Type III ILS, or equivalent.

This AOM Supplement does not constitute approval to conduct takeoff operations or CAT II or CAT IIIa approach and landing operations below established operational minima. Approval must be obtained from the appropriate regulatory authority prior to conducting these operations.

For limitations, procedures and performance information not contained in this Supplement, refer to the basic AOM.

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## LOW VISIBILITY TAKEOFF - CONDITIONS OF OPERATION

The low visibility takeoff display and Ground Roll Guidance Cue are automatically provided to the pilot once the following conditions have been established:

- Primary mode selected;
- IRS in NAV mode;
- All NAV receivers tuned to same ILS frequency;
- Runway length set between 6000 ft (1829 m) to 13500 ft (4114 m);
- Selected heading bug set to runway heading;
- Selected course set to runway heading or approach course.

**NOTE:** Misleading/removal of the guidance is not annunciated. Safe operation in this condition was demonstrated and is predicated on the pilot's ability to see outside visual references.

## AIII MODE - APPROACH AND LANDING - CONDITIONS OF OPERATION

The system conditions that must be met in order to achieve AIII capability include:

- IRS in NAV mode;
- AHRS 2 in Full Performance mode;
  **NOTE:** AHRS is not applicable in case of dual IRS configuration.
- All reversion selections in NORMAL position;
- All NAV receivers tuned to same ILS frequency;
- Basic attitude (pitch, roll, heading) data from dual sources within defined limits;
- All sensors/input data valid and no HGS BIT faults present;
- Radio altitude greater than 500 ft;
- Glideslope set between -2.50° and -3.00°.

AIII becomes available for selection as the active mode when the above conditions are satisfied and the Approach On Course (AOC) logic is met. Approach On Course is dependent on the following criteria:

- Flight Director Lateral Capture Mode indicates LOC and FD Vertical Capture mode indicates GS;
- No Localizer and Glideslope deviation for a period of 5 seconds;
- Difference between IRS Magnetic Track and the Selected Course 1 less than 15°.

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## USE OF HGS IN MODES OTHER THAN LOW VISIBILITY TAKEOFF AND AIII

The use of HGS in all modes other than for Low Visibility Takeoff and AIII must be in accordance with the limitations, emergency and abnormal procedures, normal procedures and performance data contained in the basic AOM. When using PRI or IMC modes to monitor autopilot-coupled approaches, refer to the CAT II limitations, emergency and abnormal procedures, in the basic AOM.

## CAT II OPERATIONS USING AIII MODE

For CAT II operations using AIII mode, the limitations, emergency and abnormal procedures and normal procedures data contained in this Supplement must replace or complement the information contained in the CAT II limitations, emergency and abnormal procedures and performance, in the basic AOM.

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## NORMAL PROCEDURES

The procedures below must replace or complement the Normal Procedures contained in the basic AOM.

### BEFORE START

| | |
|---|---|
| IRS | SET TO NAV |
| HGS Combiner | SET |
| HGS Control Panel: | |
| HGS Mode | PRI |
| RUNWAY LENGTH | SET |
| RUNWAY ELEVATION | SET |
| GLIDESLOPE | SET |
| Display Control Panel 1 | SET TO NAV 1 |
| Display Control Panel 2 | SET TO NAV 2 |
| ALL 3 NAV Receivers | SET TO ILS |
| Course Selector 1 | SET TO RUNWAY HEADING |
| Course Selector 2 | SET TO RUNWAY HEADING |

**NOTE: -** The Low Visibility Takeoff must only be performed in PRI mode.

- Although it is recommended to perform the Low Visibility Take Off, a normal takeoff can also be performed using the IMC or VMC modes.

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**BEFORE TAKEOFF**

Low Visibility Takeoff Briefing ..... PERFORM
Aircraft Reference Symbol ..... SET TO RUNWAY CENTERLINE
Course Selector 1 ..... READJUST WITH RUNWAY CENTERLINE
Course Selector 2 ..... READJUST WITH RUNWAY CENTERLINE
Heading Bug ..... SET TO RUNWAY CENTERLINE
Ground Roll Guidance Cue ..... CHECK
Display Intensity ..... ADJUST

**CAUTION:** RUNWAY REMAINING IS A SUPPLEMENTAL SITUATION AWARENESS DISPLAY DECREASING IN 500 FT INCREMENTS AVAILABLE IN LOW VISIBILITY TAKEOFF. THE DATA DISPLAYED IS NOT INTENDED TO BE USED FOR PERFORMANCE MONITORING PURPOSES.

**CLIMB/CRUISE**

HGS Mode ..... AS REQUIRED
HGS Display ..... MONITOR

**NOTE:** Although it is recommended to perform CLIMB/CRUISE in PRI mode, the IMC or VMC can also be used.

**DESCENT**

HGS Combiner ..... SET
HGS Control Panel:
HGS ..... SET AND X CHECK
HGS Mode ..... AS REQUIRED
AIII Approach Briefing ..... PERFORM AS REQUIRED

**NOTE:** Although it is recommended to perform DESCENT in PRI mode, the IMC or VMC can also be used.

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## APPROACH

### AIII MODE APPROACH

**NOTE:** The approach must be initiated with the airplane in final configuration and stabilized.

Display Control Panel 1 ..... SET TO NAV 1
Display Control Panel 2 ..... SET TO NAV 2
ALL 3 NAV Receivers ..... SET TO ILS
Course Selector 1 ..... SET TO RUNWAY HEADING
Course Selector 2 ..... SET TO RUNWAY HEADING
Decision Height (DH) 1 ..... SET
Decision Height (DH) 2 ..... SET
HGS Control Panel:
- HGS Mode ..... AIII
- RUNWAY LENGTH ..... CHECK
- RUNWAY ELEVATION ..... CHECK
- GLIDESLOPE ..... CHECK

Flaps ..... 22°
Speed ..... SET AIII $V_{APP}$

**NOTE:** The AIII $V_{APP}$ is determined by adjusting the $V_{APP}$ for head wind component and gust according to the following equation:
AIII $V_{APP}$ = $V_{REF}$ + WIND CORRECTION, where:
WIND CORRECTION = ½ head wind component + full gust, limited to 20 kt.

Autopilot and Yaw Damper ..... DISENGAGE ABOVE 500 FT

**NOTE:** During approach, the reference for selected airspeed will change from Speed Bug to $V_{APP}$ (MFD Green Bug) when the following conditions are met: RA below 1300 ft; Landing Gear is down; aircraft in air; the Flight Director mode TO, WSHR or GA not engaged. This transition will be indicated by the replacing of “SPD” symbol by “VAP” symbol flashing initially for 5 seconds on the Combiner.

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**CAUTION:**
- IF VISUAL CONTACT IS NOT MADE UPON REACHING THE DECISION HEIGHT OR IF ANY MALFUNCTION COULD NOT BE PROMPTLY IDENTIFIED DURING APPROACH, A MISSED APPROACH MUST BE IMMEDIATELY INITIATED;
- RUNWAY REMAINING IS A SUPPLEMENTAL SITUATION AWARENESS DISPLAY DECREASING IN 500 FT INCREMENTS AVAILABLE AFTER TOUCHDOWN IN AIII MODE. THE DATA DISPLAYED IS NOT INTENDED TO BE USED FOR PERFORMANCE MONITORING PURPOSES.

**PRIMARY, IMC OR VMC APPROACH**

Course Selector 1 ..... SET TO RUNWAY HEADING
Course Selector 2 ..... SET TO RUNWAY HEADING
HGS Control Panel:
HGS Mode ..... AS REQUIRED
RUNWAY LENGTH ..... SET
RUNWAY ELEVATION..... SET
GLIDESLOPE ..... SET

**NOTE:** In IMC or VMC modes, if the “ALIGN HUD” annunciation is displayed on the Combiner, it should be repositioned to eliminate the annunciation prior to use.

**CAUTION:** THE FLARE GUIDANCE IS ADVISORY INFORMATION ONLY. THE CREW MUST PERFORM A VISUAL LANDING.

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## WINDSHEAR PREVENTION/RECOVERY

The HGS will display a “WDSHEAR” message when the GPWS/EGPWS detects a windshear.

In the event of a windshear, the HGS will display a “WDSHEAR” on the combiner and on the PFD. A voice message will be presented in case of a red “WDSHEAR” indication on the PFD.

When the go around mode is selected after a windshear warning, the primary mode is selected and a windshear guidance cue is provided.

## TRAFFIC AND COLLISION AVOIDANCE

The HGS will display TCAS Resolution Advisories (RA) to alert the crew to traffic conflicts. Preventive and Corrective Resolution Advisories provided are similar to MFD indications.

Preventive Advisories do not require that action be taken by the crew to alter the flight path of the airplane, but indicate an unsafe zone.

Corrective Advisories displayed on the HGS require a vertical evasive maneuver.

Preventive and corrective resolution advisory use angled lines to guide the fly path to box or preventive bracket to indicate the unsafe or no-fly zone.

In this case, the lines out of the box bottom will flash until the flight path is positioned within the safe zone.

Preventive RA procedure:

- Ensure the airplane flight path remains clear of unsafe zones.

Corrective RA procedure:

- Fly the airplane to box and outside of the unsafe zone indicated by the lines off the fly-to box.
- Maintain action as required by TCAS RA.

**NOTE:** In case the operating Transponder fails, the “TCAS FAIL” flag will not be displayed on the Combiner.

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# HIGH ALTITUDE OPERATION

The information presented herein is only applicable to airplanes properly equipped for takeoff and landing operation above 8000 ft.
Airplanes properly equipped accomplished any of the following Service Bulletins or have an equivalent modification factory incorporated:
- SB 145-00-0031
- SB 145-00-0033
- SB 145-21-0050.

**NOTE:** During high altitude operations, at least one pilot is required to use oxygen continuously, until the cabin altitude has reached 8000 ft.

## BEFORE START

Pressurization ..... 8000 FT
If flying from an airport above 8000 ft:
High Altitude Mode ..... ON
Check that HI ALT LDG-T/O advisory message is displayed on the EICAS.
Crew Oxygen Mask ..... DON

## CLIMB

When cabin altitude is below 9700 ft:

High Altitude Mode ..... OFF
Check that HI ALT LDG-T/O advisory message is no longer displayed the EICAS.

## DESCENT

Pressurization ..... SET
Set the destination airport altitude.
If flying in an airport above 8000 ft:
High Altitude Mode ..... ON
Check that HI ALT LDG-T/O advisory message is displayed on the EICAS.
Crew Oxygen Mask ..... DON

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# OPERATION IN AIRPORTS UP TO 8500 FT

The actions listed in the procedure below must complement the equivalent procedure contained in the basic AOM. The remaining Normal Procedures section remains unchanged.

## BEFORE START

Pressurization ..... 8000 ft

**NOTE:** In airports with pressure altitude between 8000 ft and 8500 ft, the cabin altitude displayed in EICAS may be amber.

## DESCENT

Pressurization ..... SET
Set the destination airport altitude.

**NOTE:** When flying to an airport with pressure altitude between 8000 ft and 8500 ft, the cabin altitude displayed in EICAS may become amber during approach.

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# BOUNCED LANDING RECOVERY

The key factor for a successful landing is a stabilized approach and proper thrust/flare coordination. Do not extend the flare at idle thrust as it will significantly increase landing distance. Reducing to idle before the flare will also require an increase in pitch. Flaring high and quickly reducing thrust to idle can cause the plane to settle abruptly. Do not apply stabilizer trim during the flare.

When a light bounce occurs, maintain or re-establish a normal landing attitude. Increasing pitch can lead to a tail strike. Beware of the increased landing distance and use power as required to soften the second touchdown. When a more severe bounce occurs, initiate a go-around – do not attempt to land. Press the go-around button and advance thrust levers to MAX. Hold the flare attitude until the engines spool up, then reset stabilizer trim while completing normal go-around procedures.

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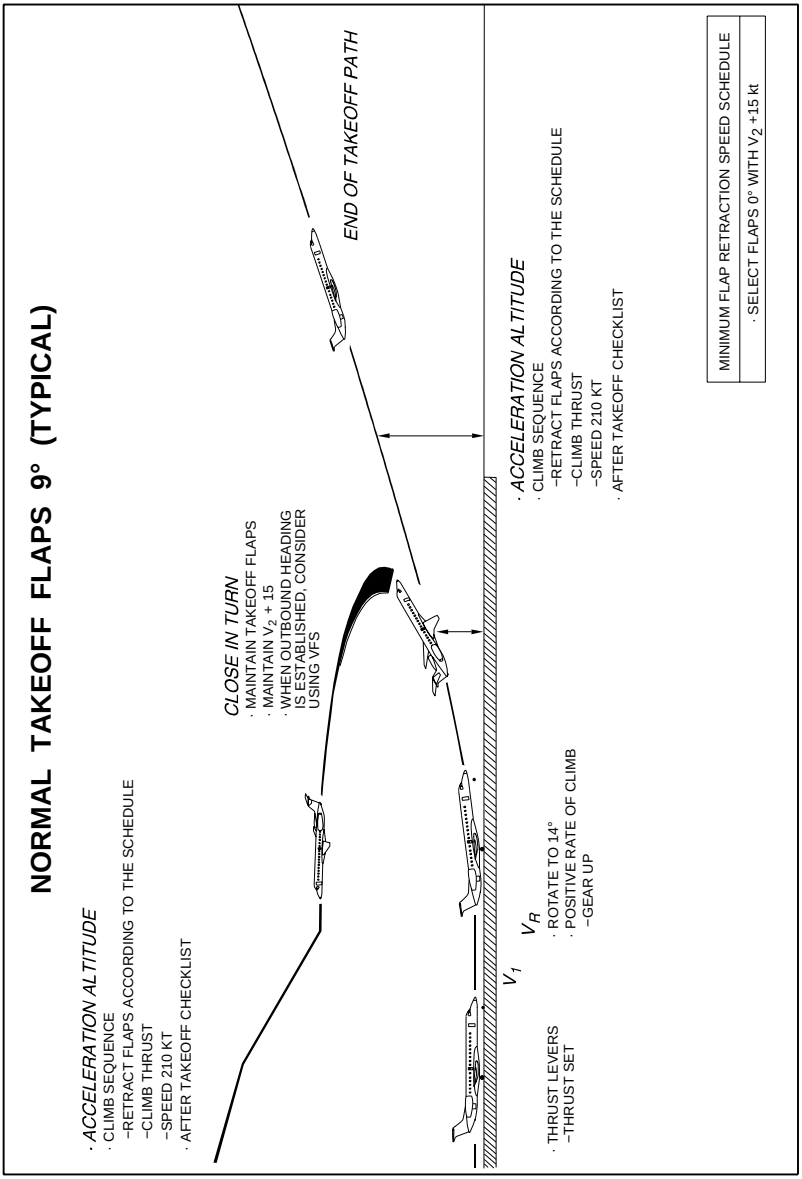
# PROFILES

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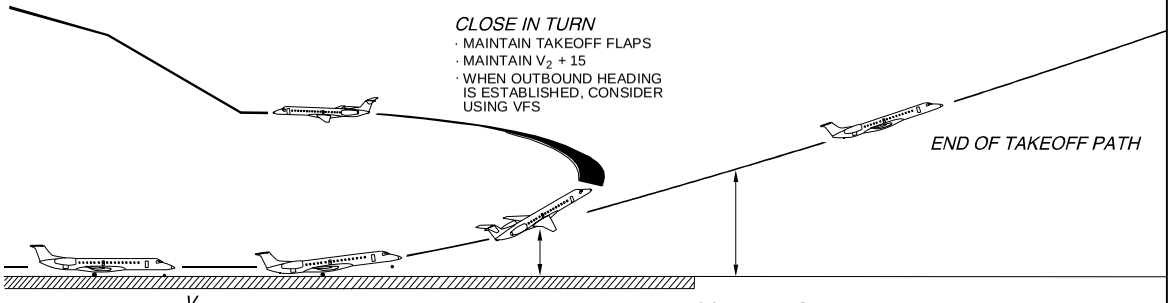
# NORMAL TAKEOFF FLAPS 18° (TYPICAL)

· *ACCELERATION ALTITUDE*
· CLIMB SEQUENCE
  −RETRACT FLAPS ACCORDING TO THE SCHEDULE
  −CLIMB THRUST
  −SPEED 210 KT
· AFTER TAKEOFF CHECKLIST




· THRUST LEVERS
  −THRUST SET

· ROTATE TO 13°
· POSITIVE RATE OF CLIMB
  −GEAR UP

· *ACCELERATION ALTITUDE*
· CLIMB SEQUENCE
  −RETRACT FLAPS ACCORDING TO THE SCHEDULE
  −CLIMB THRUST
  −SPEED 210 KT
· AFTER TAKEOFF CHECKLIST

| MINIMUM FLAP RETRACTION SPEED SCHEDULE |
|---|
| · SELECT FLAPS 9° WITH $V_2$ +10 kt |
| · SELECT FLAPS 0° WITH $V_2$ +30 kt |

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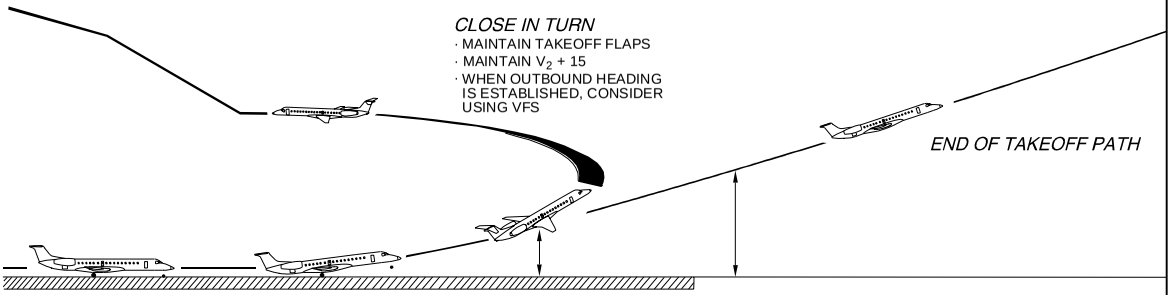
# NORMAL TAKEOFF FLAPS 22° (TYPICAL)

· *ACCELERATION ALTITUDE*
· CLIMB SEQUENCE
  −RETRACT FLAPS ACCORDING TO THE SCHEDULE
  −CLIMB THRUST
  −SPEED 210 KT
· AFTER TAKEOFF CHECKLIST




· THRUST LEVERS
  −THRUST SET

· ROTATE TO 12°
· POSITIVE RATE OF CLIMB
  −GEAR UP

· *ACCELERATION ALTITUDE*
· CLIMB SEQUENCE
  −RETRACT FLAPS ACCORDING TO THE SCHEDULE
  −CLIMB THRUST
  −SPEED 210 KT
· AFTER TAKEOFF CHECKLIST

| MINIMUM FLAP RETRACTION SPEED SCHEDULE | |
|---|---|
| · ALL ENGINES EXCEPT AE3007A1P | · AE3007A1P ENGINES |
| · SELECT FLAPS 9° WITH $V_2$ +5 kt | · SELECT FLAPS 9° WITH $V_2$ +10 kt |
| · SELECT FLAPS 0° WITH $V_2$ +25 kt | · SELECT FLAPS 0° WITH $V_2$ +30 kt |

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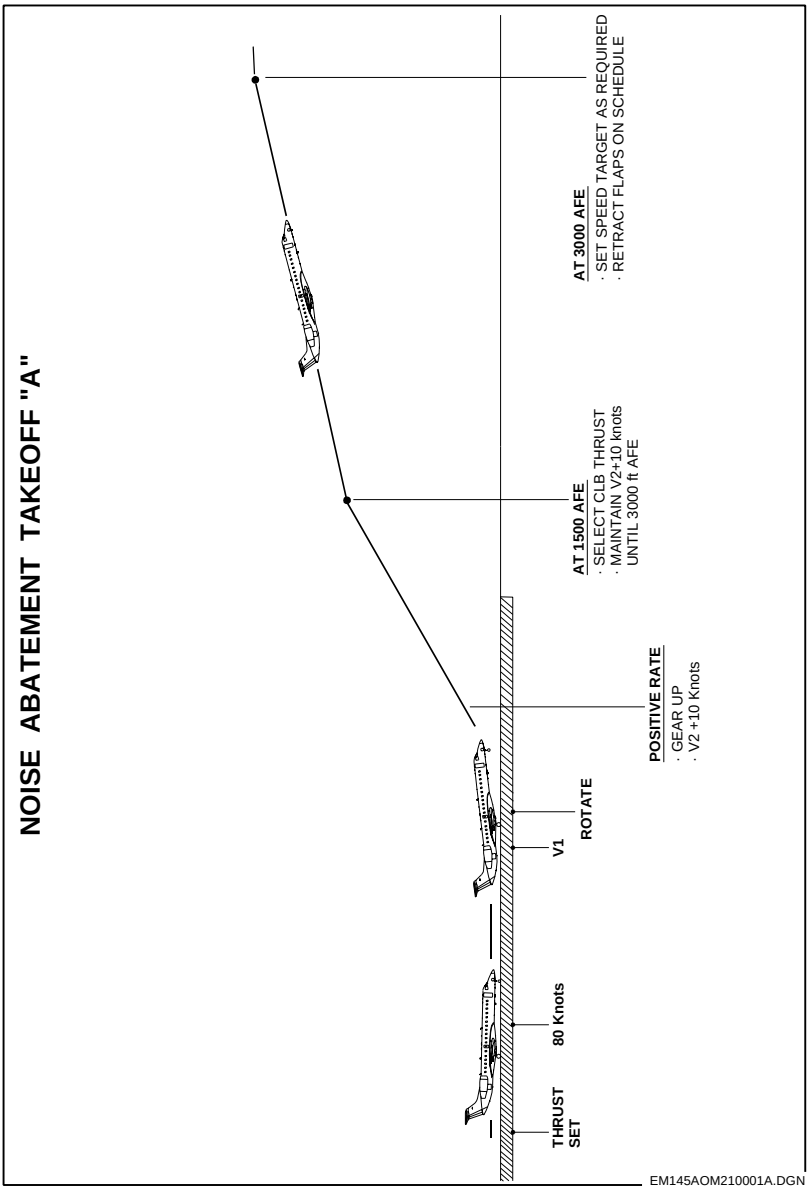
## NOISE ABATEMENT TAKEOFF "A"



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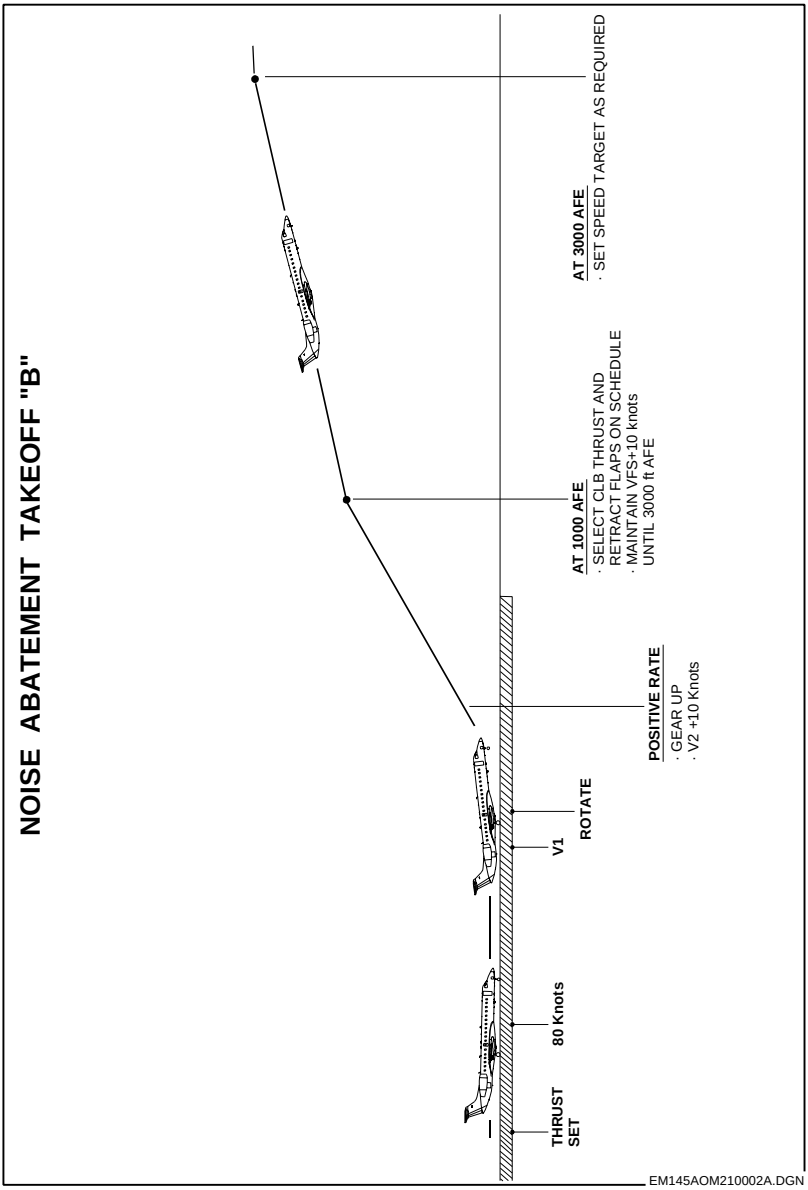


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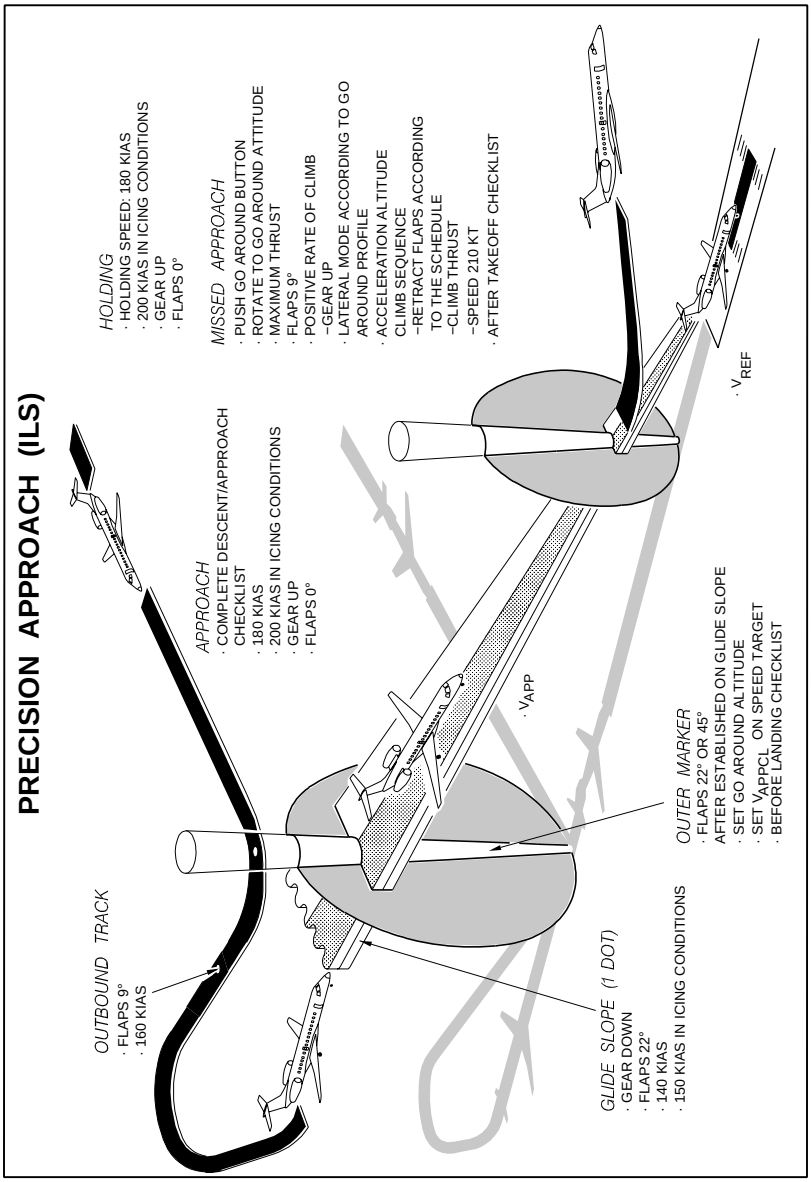


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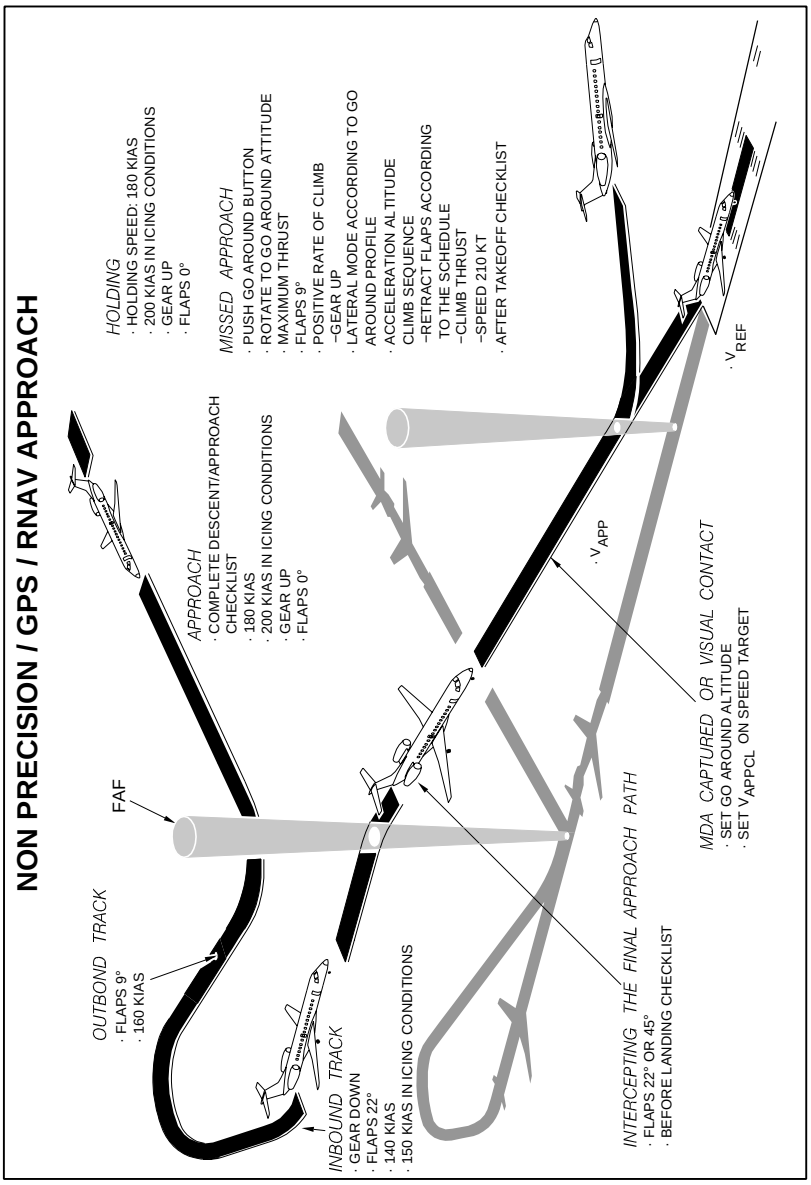


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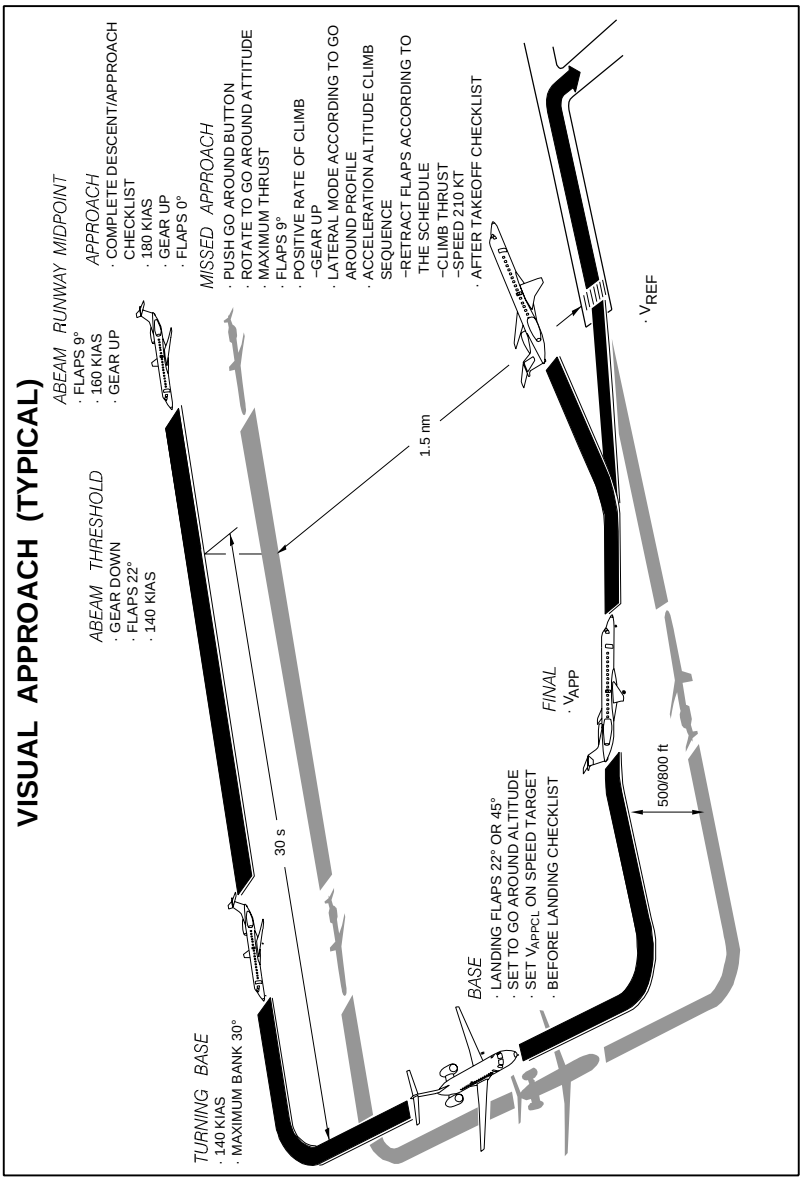
## VISUAL APPROACH (TYPICAL)

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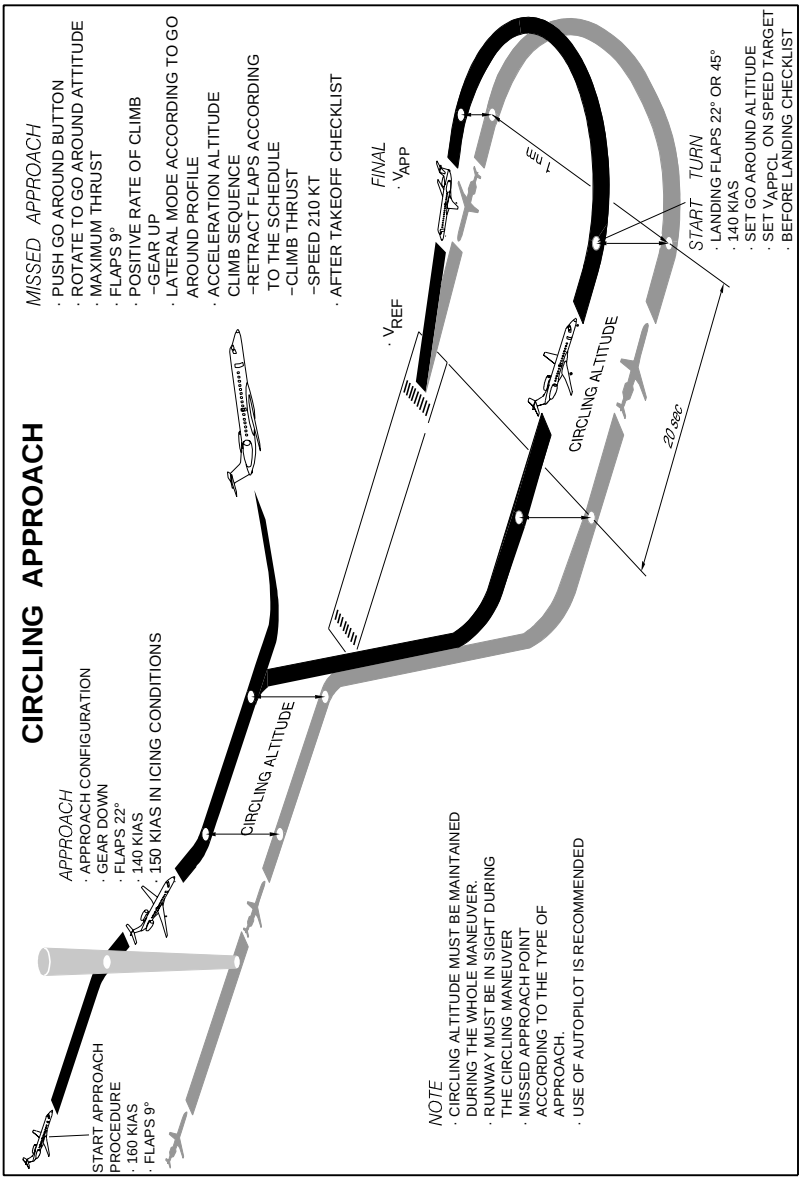


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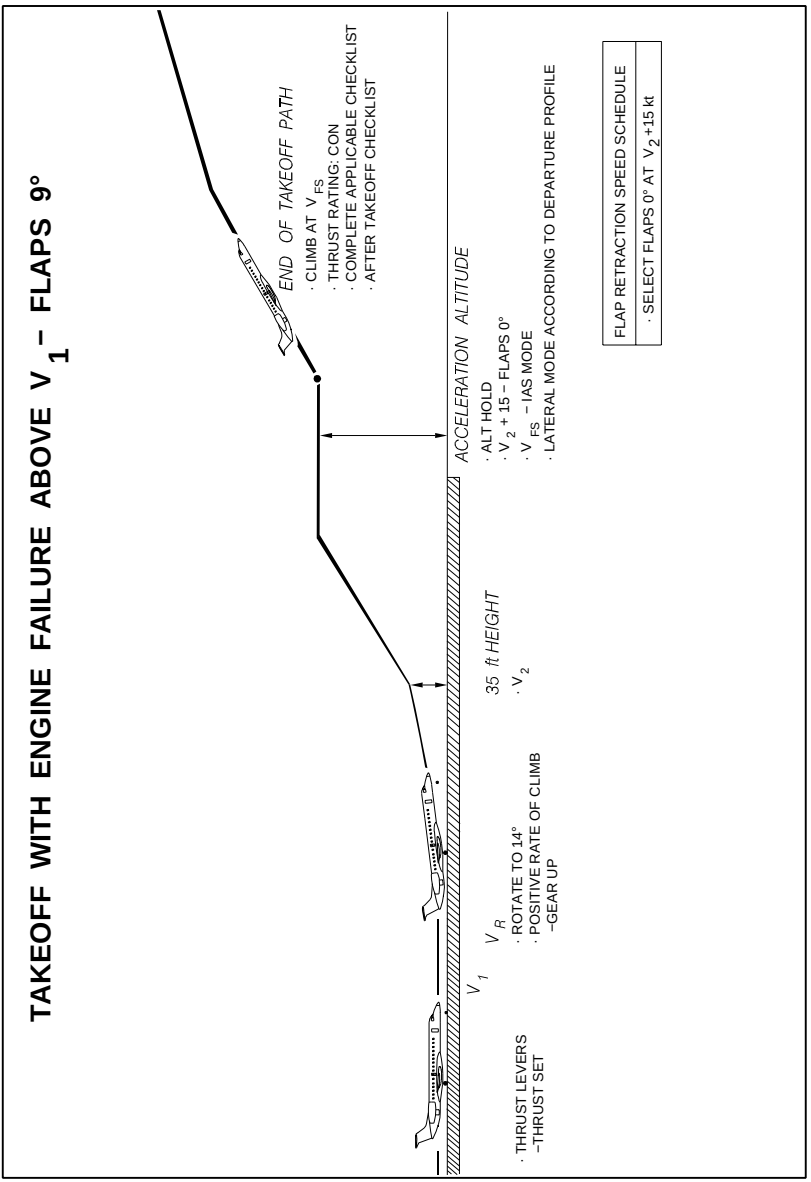
## TAKEOFF WITH ENGINE FAILURE ABOVE $V_1$ – FLAPS 9°

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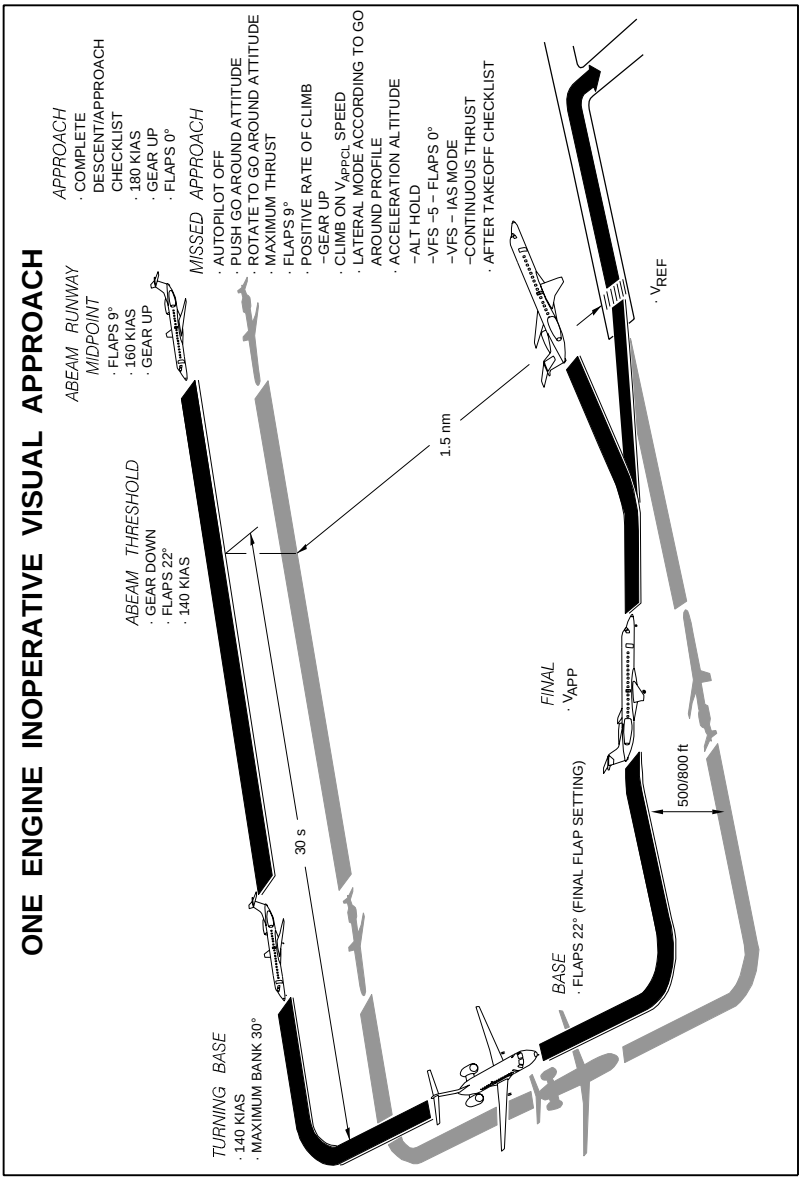


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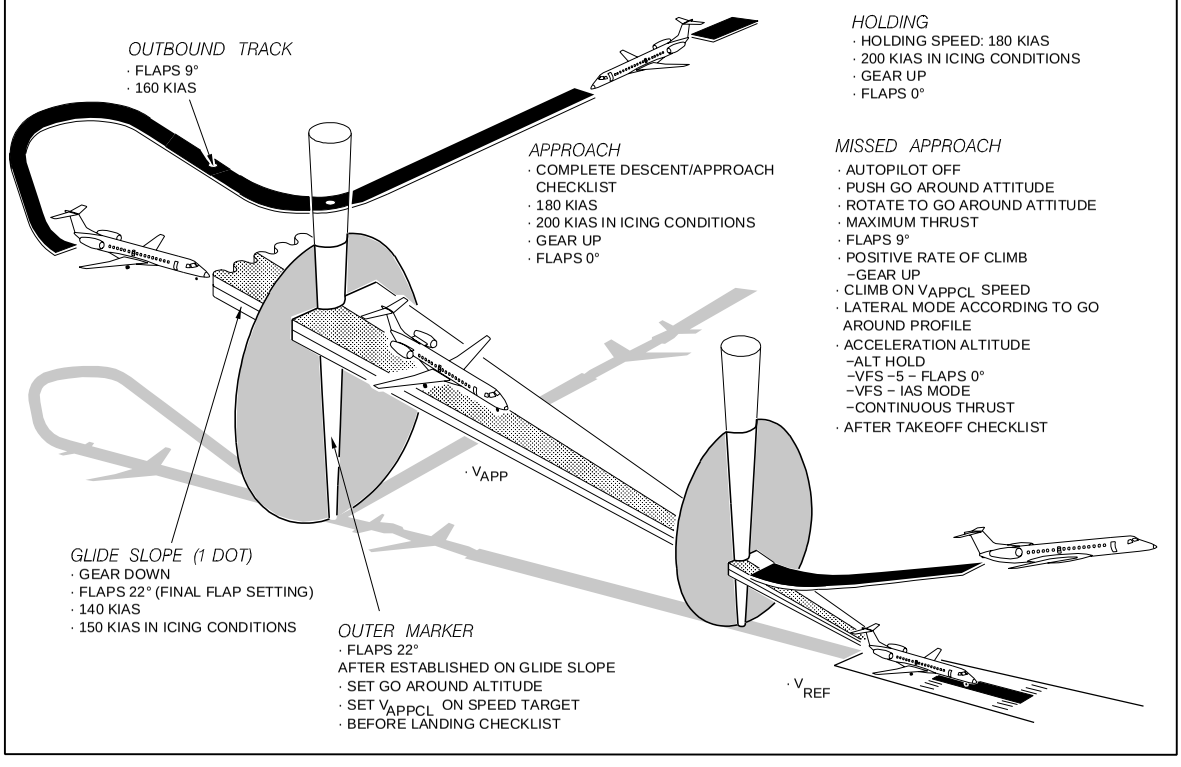
# ONE ENGINE INOPERATIVE PRECISION APPROACH (ILS)



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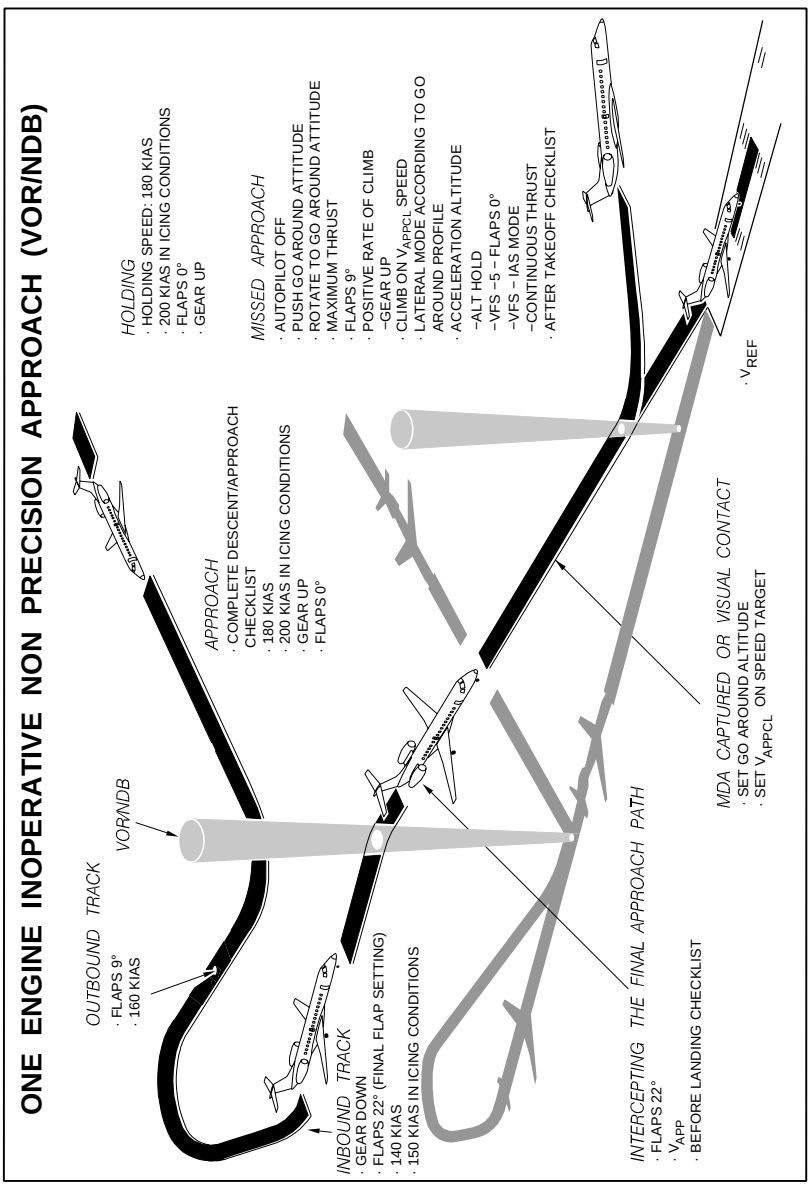


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# ONE ENGINE INOPERATIVE CIRCLING APPROACH

START APPROACH PROCEDURE
· 160 KIAS
· FLAPS 9°

· APPROACH CONFIGURATION
· GEAR DOWN
· FLAPS 22° (FINAL FLAP SETTING)
· 140 KIAS
· 150 KIAS IN ICING CONDITIONS

CIRCLING ALTITUDE

*MISSED APPROACH*
· AUTOPILOT OFF
· PUSH GO AROUND ATTITUDE
· ROTATE TO GO AROUND ATTITUDE
· MAXIMUM THRUST
· FLAPS 9°
· POSITIVE RATE OF CLIMB
  −GEAR UP
· CLIMB ON $V_{APPCL}$ SPEED
· LATERAL MODE ACCORDING TO GO AROUND PROFILE
· ACCELERATION ALTITUDE
  −ALT HOLD
  −VFS −5 − FLAPS 0°
  −VFS − IAS MODE
  −CONTINUOUS THRUST
· AFTER TAKEOFF CHECKLIST

· $V_{REF}$

*FINAL*
· $V_{APP}$

1 nm

CIRCLING ALTITUDE

20 sec

*START TURN*
· 140 KIAS
· SET GO AROUND ALTITUDE
· SET $V_{APPCL}$ ON SPEED TARGET
· BEFORE LANDING CHECKLIST

*NOTE*
· CIRCLING ALTITUDE MUST BE MAINTAINED DURING THE WHOLE MANEUVER.
· RUNWAY MUST BE IN SIGHT DURING THE CIRCLING MANEUVER
· MISSED APPROACH POINT ACCORDING TO THE TYPE OF APPROACH.

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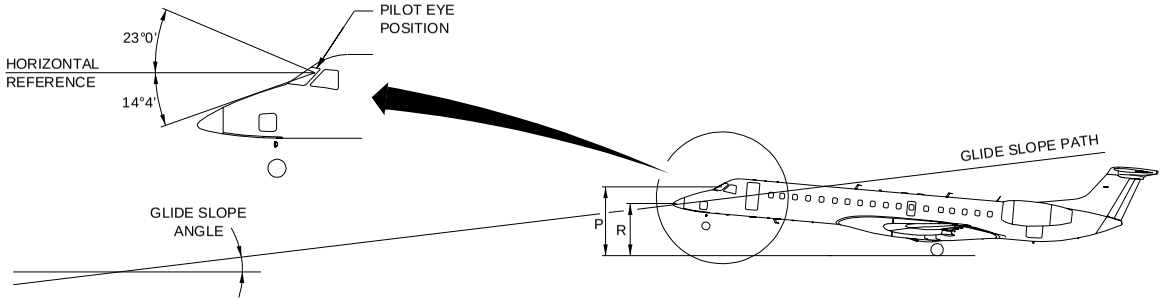
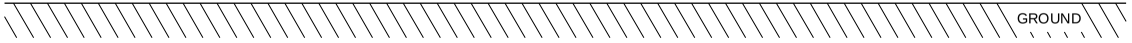
**EMB−145**

# CAT II OR AIII MODE APPROACH GEOMETRY AT DECISION HEIGHT

**JAA FLAPS 22°**




P − HEIGHT OF THE PILOT'S EYE ABOVE THE WHEELS
R − HEIGHT OF GLIDE RECEIVER ANTENNA ABOVE THE WHEELS




| GLIDE SLOPE ANGLE (DEGREES) | AIRPLANE ATTITUDE (DEGREES) | P (FEET) | R (FEET) |
|---|---|---|---|
| 2,5 | 4,9 | 14,9 | 11,4 |
| 3,0 | 4,4 | 14,6 | 11,0 |

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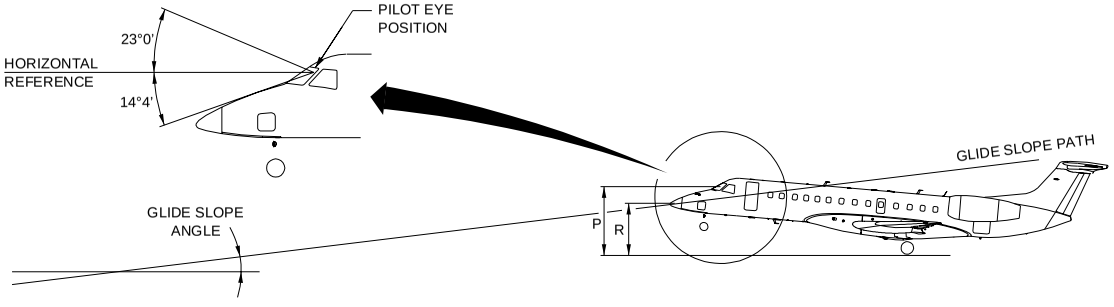
**EMB−135**

# CAT II APPROACH GEOMETRY AT DECISION HEIGHT

**JAA FLAPS 22°**




P − HEIGHT OF THE PILOT'S EYE ABOVE THE WHEELS
R − HEIGHT OF GLIDE RECEIVER ANTENNA ABOVE THE WHEELS

| GLIDE SLOPE ANGLE (DEGREES) | AIRPLANE ATTITUDE (DEGREES) | P (FEET) | R (FEET) |
|---|---|---|---|
| 2,5 | 4,3 | 14,1 | 10,4 |
| 3,0 | 3,8 | 13,7 | 10,0 |

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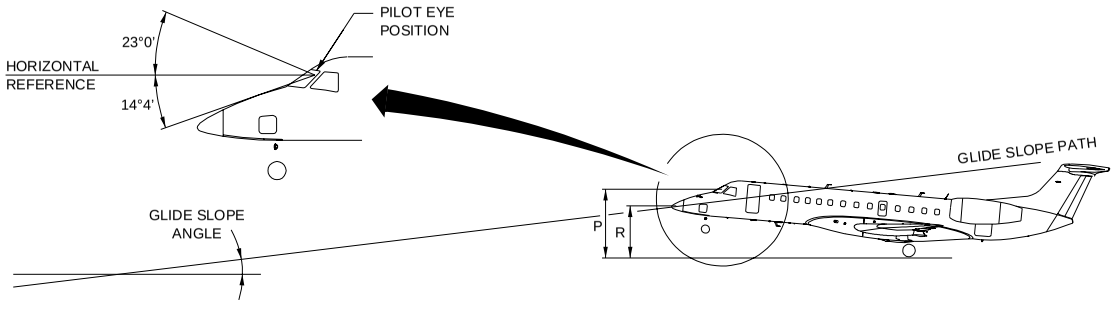
**EMB−135**

# CAT II APPROACH GEOMETRY AT DECISION HEIGHT

**JAA FLAPS 22°**




P − HEIGHT OF THE PILOT'S EYE ABOVE THE WHEELS
R − HEIGHT OF GLIDE RECEIVER ANTENNA ABOVE THE WHEELS

| GLIDE SLOPE ANGLE (DEGREES) | AIRPLANE ATTITUDE (DEGREES) | P (FEET) | R (FEET) |
|---|---|---|---|
| 2,5 | 4,3 | 14,1 | 10,4 |
| 3,0 | 3,8 | 13,7 | 10,0 |

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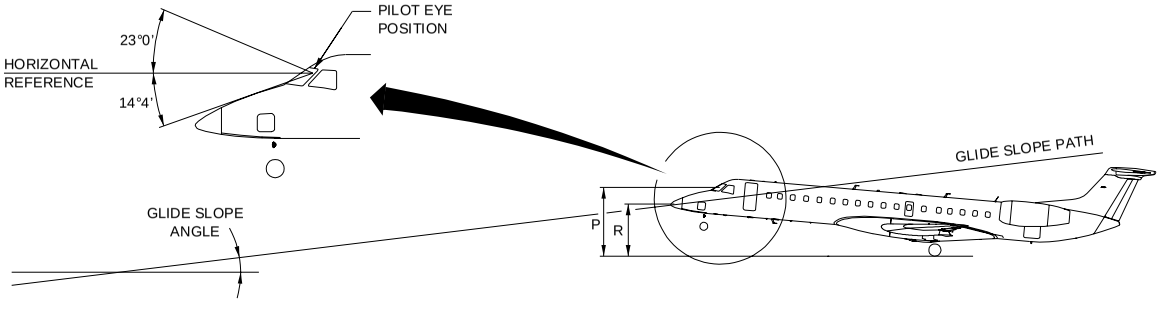
**EMB−145**

# CAT II APPROACH GEOMETRY AT DECISION HEIGHT

**FAA/CTA FLAPS 22°**




P − HEIGHT OF THE PILOT'S EYE ABOVE THE WHEELS
R − HEIGHT OF GLIDE RECEIVER ANTENNA ABOVE THE WHEELS

EM145AOM021010A.DGN

| GLIDE SLOPE ANGLE (DEGREES) | AIRPLANE ATTITUDE (DEGREES) | P (FEET) | R (FEET) |
|---|---|---|---|
| 2,5 | 5,8 | 15,6 | 12,2 |
| 3,0 | 5,3 | 15,2 | 11,8 |

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## PITCH, N1 AND SPEED TABLE

| WEIGHT (kg) | GEAR | PITCH | N1 | FLAPS | SPEED (kt) |
|---|---|---|---|---|---|
| 20000 | UP | 2.7 | 61.5 | 0 | 250 |
| 20000 | UP | 4.8 | 55.3 | 0 | 200 |
| 20000 | UP | 6.3 | 53.6 | 0 | 180 |
| 20000 | UP | 6.3 | 53.6 | 0 | 180 |
| 20000 | UP | 6.4 | 55.3 | 9 | 160 |
| 20000 | UP | 6.6 | 57.2 | 18 | 150 |
| 20000 | UP | 6.8 | 59.8 | 22 | 140 |
| 19000 | DN | 3.7 | 66.9 | 9 | 180 |
| 19000 | DN | 5.1 | 65.4 | 18 | 160 |
| 19000 | DN | 6.4 | 64.2 | 22 | 140 |
| 19000 | DN | 4.9 | 72.5 | 45 | 130 |
| 19000 | DN | 1.2 | 61.9 | 45 | 130 |
| 18000 | UP | 2.3 | 60.3 | 0 | 250 |
| 18000 | UP | 4.3 | 53.4 | 0 | 200 |
| 18000 | UP | 5.5 | 51.7 | 0 | 180 |
| 18000 | UP | 5.3 | 52.7 | 9 | 160 |
| 18000 | UP | 5.4 | 55.3 | 18 | 150 |
| 18000 | UP | 5.5 | 56.8 | 22 | 140 |

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# SECTION 1-03

# EMERGENCY AND ABNORMAL PROCEDURES

TABLE OF CONTENTS

Page Block

Introduction ..... 1-03-00

Emergency Procedures

- Doors ..... 1-03-01
- Crew Awareness ..... 1-03-02
- Electrical ..... 1-03-03
- Fire Protection ..... 1-03-05
- Fuel ..... 1-03-07
- APU ..... 1-03-09
- Powerplant ..... 1-03-11
- Landing Gear ..... 1-03-14
- Flight Controls ..... 1-03-20
- Air Conditioning/Pressurization/Ice Protection ..... 1-03-24
- Autopilot ..... 1-03-26
- Forced Landing ..... 1-03-30

Abnormal Procedures

- Equipment & Furnishings ..... 1-03-35
- Crew Awareness ..... 1-03-36
- Electrical ..... 1-03-37
- Lighting ..... 1-03-38
- Fire Protection ..... 1-03-39

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Fuel ..... 1-03-40
APU ..... 1-03-41
Powerplant ..... 1-03-45
Hydraulic ..... 1-03-48
Landing Gear ..... 1-03-50
Flight Controls ..... 1-03-53
Air Conditioning, Pneumatics and Pressurization ..... 1-03-56
Ice Protection ..... 1-03-57
Oxygen ..... 1-03-58
Navigation ..... 1-03-59
Autopilot ..... 1-03-60
CAT II Operation ..... 1-03-65
HGS Operation (*) ..... 1-03-66
Steep Approach Operation (*) ..... 1-03-67
Miscellaneous ..... 1-03-70
Runway Awareness and Advisory System (*) ..... 1-03-75
Emergency Profiles ..... 1-03-95
Abnormal Profiles ..... 1-03-97

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**NOTE:** Items marked with an asterisk (*) may not be present in this manual.

# INTRODUCTION

The source document for all procedures contained herein is the approved Airplane Flight Manual (AFM). In the event that any procedure disagrees with the AFM, the AFM will prevail. In the event that any of the procedures are missing or unusable, operations may be continued provided the approved AFM is available for use.

This Section provides the emergency and abnormal procedures to be performed in case of a system malfunction or failure, in order to protect passengers and/or crew from serious harm and to maintain the airworthiness of the airplane.

Some procedures require a landing at the nearest suitable airport. Such information is provided with the intent of establishing that the flight should be terminated at the pilot's discretion. It is the pilot's responsibility to use good judgement concerning the time and place to land, as well as to evaluate factors such as airplane condition, weather, etc.

The decision to reject takeoff should be considered if any undesirable event occurs.

However, it is emphasized that for fire or smoke that cannot be positively located and extinguished, an immediate descent, landing and passenger evacuation should be performed.

The procedures are presented as follows:

- The actions contained in a box are vital actions. They must be performed expeditiously and from memory to minimize hazards. The other actions should be performed as soon as the condition permits.
- All the actions must be performed in the order given.

Procedures contained herein assume that:

- It is normal crew action to confirm the message by the following procedures:
  1. Calling associated system page on MFD and checking system parameters.
  2. If the MFD is not available, checking the messages for both sides of the failed system, when applicable.
- Airplane systems are operating normally prior to the failure.
- Normal procedures have been properly accomplished.

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- System controls are in normal condition prior to initiation of the associated procedure.
- Aural warnings are silenced as applicable. Master Warning/Caution lights are reset as soon as the failure is recognized.
- Oxygen masks and smoke goggles are donned when cabin altitude is excessive or ambient air is contaminated.
- Crew communication is established when required.
- Circuit breakers are checked.

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# EMERGENCY PROCEDURES

## MAIN OR SERVICE DOOR OPEN

EICAS WARNING: MAIN DOOR OPN or SERVICE DOOR OPN
LIGHT: Master Warning
INDICATION: Associated door pictorial indication and a DOOR OPEN inscription on MFD are displayed in red.

Fasten Seat Belts..... ON

Check doors pictorial indication on MFD Takeoff Page. If message is confirmed or if MFD is not available:

Door Internal Lock Indicators (red marks)..... CHECK

If the door is confirmed locked:

Monitor cabin pressure.

If the door internal lock indicators are not aligned or it is not possible to maintain the pressurization, proceed:

Altitude..... MEA OR 10000 ft, WHICHEVER IS HIGHER
Cabin ..... DEPRESSURIZE
Land at the nearest suitable airport.

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# STALL PROTECTION INOPERATIVE

EICAS WARNING: SPS 1 (2) INOP
LIGHT: Master Warning

Associated Stall Protection System ..... OFF
Avoid skidding the airplane.

Add 5 KIAS to go-around speeds.

**NOTE:** The remaining stick shaker is available.

Approach and landing configuration:

Landing Gear ..... DOWN

Flaps ..... 45°

Airspeed ..... $V_{REF\ 45}$ + 5 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.10.

# STICK PUSHER FAILURE

EICAS WARNING: SPS 1-2 INOP
EICAS CAUTION: STICK PUSHER FAIL
LIGHT: Master Warning and Master Caution

Control Column ..... PUSH FORWARD TO NEUTRAL

Stall Protection is not available.

Airspeed ..... 1.2 $V_{SR}$ MINIMUM

# TAKEOFF CONFIGURATION WARNING

EICAS WARNING: NO TAKEOFF CONFIG
LIGHT: Master Warning
or
AURAL WARNING: Voice Messages TAKEOFF-BRAKES, TAKEOFF-FLAPS, TAKEOFF-SPOILERS or TAKEOFF-TRIM

Do not takeoff.

Airplane configuration ..... CORRECT



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# ENHANCED/GROUND PROXIMITY WARNING

EICAS WARNING: GPWS
LIGHT: Master Warning
Voice Messages: WHOOP-WHOOP PULL UP or PULL UP (for EGPWS), SINK RATE, TERRAIN TERRAIN or TERRAIN TERRAIN PULL UP (for EGPWS), CAUTION TERRAIN (for EGPWS), OBSTACLE OBSTACLE PULL UP (for EGPWS), CAUTION OBSTACLE (for EGPWS), DON`T SINK DON`T SINK, TOO LOW TERRAIN, TOO LOW GEAR, TOO LOW FLAPS, GLIDE SLOPE and BANK ANGLE voice messages may be generated, but are not associated with GPWS/EGPWS EICAS message.

## EGPWS/GPWS CAUTION

If an EGPWS/GPWS CAUTION occurs, adjust the airplane flight path until the CAUTION alert ceases.

## EGPWS/GPWS WARNING

If an EGPWS/GPWS WARNING occurs and unless operating in visual meteorological condition (VMC) and/or the pilot determines, based on all available information, that a turning in addition to the procedures established below is the safest course of action, proceed:

Disconnect the autopilot and set thrust levers to MAX position.
Rotate the airplane to increase pitch attitude to the highest possible value.
When stick shaker is encountered, reduce pitch rate/angle of attack to keep the shaker speed as minimum.
Do not retract flaps or landing gear until safe climb-out is assured.
Once warning ceases, resume the normal level flight attitude.

**CAUTION:** FOR EGPWS, THE TERRAIN DISPLAY IS INTENDED TO BE USED AS A SITUATIONAL TOOL ONLY AND MAY NOT PROVIDE THE ACCURACY AND/OR FIDELITY ON WHICH TO SOLELY BASE TERRAIN AVOIDANCE MANEUVERING DECISIONS.

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# WINDSHEAR PREVENTION/RECOVERY

INDICATION: WDSHEAR on PFD (red or amber)

AURAL WARNING: WINDSHEAR voice message is generated if WDSHEAR red indication is presented and CAUTION WINDSHEAR voice message is generated if WDSHEAR amber indication is presented (GPWS warning may also be activated).

CONDITION: Airplane loses altitude after windshear is encountered and threat of ground contact exists.

| | |
|---|---|
| Thrust Levers | MAX |
| Go-around Buttons | PRESS |

Rotate the airplane smoothly to minimize altitude loss. Flight guidance on EADI must be followed.

**NOTE:** Pitch attitude may be well above normal angles.

Maintain airplane configuration.

**CAUTION:** DO NOT CHANGE GEAR AND FLAP POSITION UNTIL TERRAIN CLEARANCE IS ASSURED AND ABOVE 1500 FT AGL OR AFTER WDSHEAR LABEL IS REMOVED FROM PFD.

# TRAFFIC AND COLLISION AVOIDANCE

AURAL WARNING: According to the Traffic Advisory (TA) and Resolution Advisory (RA) associated.

The pilot must not initiate evasive maneuvers using information from the traffic display or the voice message only, without visually sighting the traffic. The traffic display and advisories are intended for assistance in visually locating the traffic.

Compliance with TCAS resolution advisory is required unless the pilot considers it unsafe to do so. Maneuvers which are in the opposite direction of the RA are extremely hazardous, especially RAs involving altitude crossing, and are prohibited unless it is visually determined to be the only means to assure safe separation.

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# AIRPLANE OVERSPEED

AURAL WARNING: Voice Message HIGHSPEED

LIGHT: Master Warning

INDICATION: Airspeed and Mach indications on PFD enter the red range.

| | |
|---|---|
| Airspeed ..... | BELOW $V_{MO}/M_{MO}$ |

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# BATTERY OVERTEMPERATURE

EICAS WARNING: BATT 1 (2) OVTEMP
LIGHT: Master Warning
INDICATION: Associated battery temperature indication on MFD becomes red.

| Associated Battery ..... OFF |
|---|

Check that the associated BATT OFF BUS message is on.

If the associated BATT OFF BUS message is not on, land at the nearest suitable airport.

# ELECTRIC ESSENTIAL TRANSFER FAILURE

EICAS WARNING: ELEC ESS XFR FAIL
LIGHT: Master Warning

If no generator is available:
LOSS OF ALL GENERATORS
Procedure ..... ACCOMPLISH
If the message remains:
Bus Ties ..... OFF
If the message still remains:
Shed Buses ..... OFF
Turn off equipment not essential for the flight. Begin with the equipment connected to DC Buses 1 and 2 (Circuit Breaker Panel rows D, E, F, G, H).
Land at the nearest suitable airport.

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# LOSS OF ALL GENERATORS

EICAS CAUTION: GEN 1, 2, 3, 4 OFF BUS and APU GEN OFF BUS
LIGHT: Master Caution

Airspeed ..... MAXIMUM 250 KIAS
Altitude ..... MEA OR 10000 ft, WHICHEVER IS HIGHER
Essential Power ..... ON
Crew Oxygen ..... AS REQUIRED
Passenger Oxygen ..... AS REQUIRED
Emergency Lights ..... OFF

If required, turn on Emergency Lights before landing.

Land at the nearest suitable airport.

Landing Gear ..... DOWN

| FLAPS POSITION | MINIMUM AIRSPEED |
|---|---|
| 0° TO 8° | $V_{REF\ 45}$ + 30 KIAS |
| 9° TO 21° | $V_{REF\ 45}$ + 10 KIAS |
| 22° TO 44° | $V_{REF\ 45}$ + 5 KIAS |
| 45° | $V_{REF\ 45}$ |

**CAUTION:**
- MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.95.
- BATTERY DURATION IS 40 MINUTES. THIS DURATION IS VALID WITH UP TO THREE APU START ATTEMPTS IN FLIGHT.

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**NOTE: -** For EMB-145XR airplanes, ISIS battery duration is 4 hours.
- The nose landing gear doors will open if DC Bus 2 is off, therefore the pilot should expect noise increase.
- The following warning messages will be presented: SPS 1-2 INOP and ICE COND-A/I INOP.
- The following caution messages will be presented: STICK PUSHER FAIL, SPS ADVANCED, GPWS INOP, WINDSHEAR INOP, CHECK PFD 1, IC BUS FAIL, APU GEN OFF BUS, GEN 1-2-3-4 OFF BUS, DC BUS 1-2 OFF, SHED BUS 1-2 OFF, 115 VAC BUS OFF, EMERG LT NOT ARMD, E1-2 CTL A-B FAIL, ENG 1-2 REV FAIL, LG AIR/GND FAIL, FLAP FAIL, SPOILER FAIL, PITOT 1-2 INOP, W/S 1-2 HEAT FAIL, TAT 1-2 HEAT INOP, STAB A/ICE FAIL, A/ICE SW OFF, WG 1-2 A/ICE FAIL, E1-2 A/ICE FAIL, AOA 1-2 HEAT INOP, ICE DET 1-2 FAIL and ICE DETECTORS FAIL.

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# SMOKE EVACUATION

CONDITION: Smoke or odor inside the cabin and/or cockpit requiring smoke removal.

| | |
|---|---|
| Crew Oxygen Masks | DON, 100% |
| Smoke Goggles | DON |
| Crew Communication | ESTABLISH |

LAND AT THE NEAREST SUITABLE AIRPORT.

Cockpit Door ..... CLOSE
Reinforced Cockpit Door Louver Vent (if applicable) ... CLOSE
Recirculation Fan ..... OFF
Gasper Fan ..... OFF
Pressurization Manual Controller ..... 1 O'CLOCK
Wait 15 seconds.
Pressurization Mode Selector ..... MAN
Pressurization Manual Controller ..... AS REQUIRED
Passenger Oxygen ..... AS REQUIRED
To evacuate the smoke faster:
- Pressurization Manual Controller ..... UP
- Packs 1 and 2 ..... OFF
- Bleeds (engine or APU) ..... OPEN
- Emergency Descent ..... AS REQUIRED
- Altitude ..... MEA OR 10000 ft, WHICHEVER IS HIGHER

Recover cabin pressure as soon as smoke has been cleared.

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# SMOKE FIRE OR FUMES

CONDITION: Smoke fire or fumes visually confirmed or identified by odor without an EICAS warning.

| | |
|---|---|
| Crew Oxygen Masks | DON, 100% |
| Smoke Goggles | DON |
| Crew Communication | ESTABLISH |

LAND AT THE NEAREST SUITABLE AIRPORT.

Recirculation Fans ..... OFF
Gasper Fan ..... OFF

If smoke origin is identified, remove the affected source.

If applicable, perform the SMOKE EVACUATION procedure.

If smoke origin is not identified:

Emergency Descent procedure ..... ACCOMPLISH
Smoke Evacuation procedure ..... ACCOMPLISH
Packs 1 and 2 ..... OFF
Shed Buses ..... OFF
Bus Ties ..... OFF
Ventral Pump Selector Button
(if applicable) ..... SET TO A
Fuel Pump 1 ..... 1A OR 1C
Fuel Pump 2 ..... 2B
Battery 2 ..... OFF
Generators 2 and 4 ..... OFF

Shed Buses, Central DC Bus, DC Bus 2 and Essential Bus 2 deenergized.

If able to land soon or if smoke stops or decreases:

**NOTE:** Landing gear lever can not be moved up.

Icing Conditions ..... EXIT/AVOID
Airspeed ..... MAX 250 KIAS
On Reversionary Panel 2:
SG ..... PRESS

**NOTE:** PFD or MFD information is available in Display Unit 4.

COM 1 on Digital Audio Panel 1 ..... PUSH IN

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Do not set Thrust Lever 2 below idle in flight.
Anticipate flap actuation.
Monitor fuel quantity indication 2 through FMS.

Landing configuration:

If landing gear has not been selected down:
Abnormal Landing Gear Extension ..... ACCOMPLISH
Flaps ..... 45°
Airspeed ..... $V_{REF\ 45}$ + 5 KIAS

**CAUTION:** MULTIPLY THE FLAPS 45° UNFACTORED LANDING DISTANCE BY 1.95.

Do not actuate Thrust Reverser 2.
Brake effectiveness will be reduced.

If smoke persists and unable to land soon:

Generators 2 and 4 ..... ON
Battery 2 ..... AUTO
Fuel Pump 1 ..... 1B
Fuel Pump 2 ..... 2A OR 2C
Ventral Pump Selector Button
(if applicable) ..... SET TO B
Battery 1 ..... OFF
Generators 1 and 3 ..... OFF
Shed Buses, Central DC Bus, DC Bus 1 and Essential Bus 1 deenergized.
Emergency lights ..... OFF

If smoke stops or decreases:

**NOTE:** Landing gear lever can only be moved up using downlock release button (DN Lock Rel).

Icing Conditions ..... EXIT/AVOID
On Reversionary Panel 1:
SG ..... PRESS

**NOTE:** PFD or MFD information is available in Display Unit 2.

COM 2 on Digital Audio Panel 2 .....PUSH IN
Do not set Thrust Lever 1 below idle in flight.

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***CONTINUES FROM PREVIOUS PAGE***

Anticipate flap actuation.
Monitor fuel quantity indication 1 through FMS.

Landing configuration:

Emergency lights..... ON
Flaps..... 45°
Airspeed ..... $V_{REF\ 45}$ + 5 KIAS

**CAUTION:** MULTIPLY THE FLAPS 45° UNFACTORED LANDING DISTANCE BY 1.95.

Do not actuate Thrust Reverser 1.
Brake effectiveness will be reduced.

If smoke persists:

Generators 1 and 3 ..... ON
Battery 1 ..... AUTO
Backup Battery ..... OFF

**WARNING: CONSIDER AN IMMEDIATE LANDING.**

Landing configuration:

Emergency lights..... ON
Flaps..... 45°
Airspeed ..... $V_{REF\ 45}$

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# LAVATORY SMOKE

EICAS WARNING: LAV SMOKE (may be presented)
LIGHT: Master Warning

Lavatory Flush/Lavatory Light CB's (E11 and E12) ..... PULL

Establish contact with the cabin crew.

If necessary, consider a diversion and accomplish the Smoke Evacuation Procedure.

# BAGGAGE COMPARTMENT SMOKE

EICAS WARNING: BAGG SMOKE
LIGHT: Master Warning

| Baggage Fire Extinguishing Button (if installed)..... PRESS |
|---|

LAND AT THE NEAREST SUITABLE AIRPORT.

Shed Buses ..... OFF
Diversion..... CONSIDER
Altitude..... MAINTAIN
Delay the descent as long as possible.

**NOTE: -** The extinguishing agent duration is approximately 50 minutes.
- Advise ground crew of possible presence of Halon vapors and smoke trapped in the compartment.

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# FUEL LEAK

CONDITION:
- FMS Fuel Remaining quantity is above the MFD or EICAS total fuel indication.
- Excessive Fuel flow from one of the engines.
- Fuel imbalance develops.
- Fuel quantity of a tank decreases at an abnormal rate.

Land at the nearest suitable airport.

Crossfeed Selector ..... OFF

Affected Fuel Tank..... IDENTIFY

Asymmetric Thrust..... AS REQUIRED

If the leak is on the right side tank:

APU ..... OFF

Right tank supplies fuel to the APU.

The pilot may consider to shutdown the engine if fuel leakage continues and is severe:

Associated Thrust Lever ..... IDLE

Start/Stop Selector ..... STOP

**NOTE:** Engine will not shutdown with the Start/Stop Selector unless associated Thrust Lever is first moved to IDLE. If STOP is selected before Thrust Lever is retarded to IDLE, momentarily cycle START/STOP Selector to RUN and back to STOP.

Fire Extinguishing Handle ..... PULL (DO NOT ROTATE)

Thrust Rating..... CONTINUOUS

TCAS..... TA ONLY

Altitude ..... MAX 25000 FT, MIN MEA

**WARNING: IF IN ICING CONDITIONS, REFER TO SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS PROCEDURES.**

ONE ENGINE INOPERATIVE APPROACH AND LANDING Procedure ..... ACCOMPLISH

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# FUEL LOW LEVEL

EICAS WARNING: FUEL 1 (2) LO LEVEL

LIGHT: Master Warning

INDICATION: Fuel quantity indication enters in red range.

Thrust Levers ..... REDUCE TO LONG RANGE SET

Level the airplane and check both fuel quantities.

If fuel quantity is sufficient, complete the flight normally.

If fuel quantity is not sufficient, avoid pitch attitudes in excess of 10° nose down or 12° nose up attitude, uncoordinated maneuvers and negative g's.

CROSSFEED OPERATION

Procedure ..... AS REQUIRED

Land at the nearest suitable airport.

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# APU FIRE

EICAS WARNING: APU FIRE
LIGHT: Master Warning
AURAL WARNING: BELL

APU Fuel Shutoff Valve ..... CLOSE
APU Master Knob ..... OFF
APU FUEL SOV CLSD message
on EICAS ..... CONFIRM
If the valve is not confirmed closed and the fire message remains:
Right Electric Fuel Pumps ..... OFF
Crossfeed ..... OFF
Initiate a descent to 25000 ft or MEA, whichever is higher.
After 30 seconds, if the APU FIRE message remains displayed or if the APU FIREDET FAIL message is displayed:
APU Fire Extinguishing Button ..... PRESS
Land at the nearest suitable airport.

**WARNING: DO NOT ATTEMPT TO RESTART APU.**

# APU OVERTEMPERATURE

EICAS Indication: EGT enters amber or red range.

APU Bleed ..... CLOSE

Wait 10 seconds.
If EGT still in red or yellow range:
APU Fuel Shutoff Valve ..... CLOSE
APU Master Knob ..... OFF

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# ENGINE FIRE, SEVERE DAMAGE OR SEPARATION

EICAS WARNING: ENG 1 (2) FIRE (may be presented)
LIGHT: Engine Fire Handle (may be illuminated)
AURAL WARNING: BELL (in case of fire) (may sound)

| | |
|---|---|
| Associated Thrust Lever | IDLE |
| Associated Start/Stop Selector | STOP |
| Associated Fire Extinguishing Handle | PULL (DO NOT ROTATE) |

Land at the nearest suitable airport.

If E1 (2) FUELSOV CLSD advisory message is displayed on the EICAS:

After 30 seconds from pulling the Fire Handle:
Fire Extinguishing Handle (1st shot)..... ROTATE
If the fire message remains displayed on EICAS after 30 seconds from 1st shot:
Fire Extinguishing Handle (2nd shot)..... ROTATE

If E1 (2) FUELSOV CLSD advisory message is not displayed on the EICAS:

Crossfeed Selector Knob..... OFF
Associated Fuel Pumps..... OFF

After 30 seconds from selecting the fuel pumps to off:
Fire Extinguishing Handle (1st shot)..... ROTATE
If the fire message remains displayed on EICAS after 30 seconds from 1st shot:
Fire Extinguishing Handle (2nd shot)..... ROTATE

If the E1 (2) FIREDET FAIL message is displayed:
Fire Extinguishing Handle (one shot, if available) ... ROTATE
In flight:
TCAS ..... TA ONLY
Affected Engine Bleed ..... CLOSE
Remaining Engine Thrust Rating ..... CON
APU ..... START
APU Bleed ..... AS REQUIRED
Crossbleed..... AS REQUIRED

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EMERGENCY EVACUATION Procedure..... AS REQUIRED

**WARNING:**
- **DO NOT ATTEMPT TO RESTART ENGINE.**
- **IF IN ICING CONDITIONS, REFER TO SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS PROCEDURE.**

**NOTE: -** If in flight below 9700 ft, the air conditioning pack valves may close automatically. The APU may be used as pneumatic source by closing the remaining engine bleed valve.

- Engine will not shutdown with the START/STOP Selector unless associated Thrust Lever is first moved to IDLE. If STOP is selected before Thrust Lever is retarded to IDLE, momentarily cycle START/STOP Selector to RUN and back to STOP.

# ENGINE LOW N1

EICAS WARNING: E1 (2) LOW N1
LIGHT: Master Warning

Do not takeoff.

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# ENGINE ATTCS NO MARGIN

EICAS WARNING: E1 (2) ATTCS NO MRGN
LIGHT: Master Warning

Consider not taking off.

For airplanes equipped with A, A1/1, A1 or A3 engines:

Perform a Thrust Assurance Check before the next takeoff, as follows:

Thrust Levers ..... MAX
Check engine parameters.

If engine parameters are within normal range, another takeoff may be attempted. Alternate Takeoff modes are prohibited.

**CAUTION:**
- BRAKES TEMPERATURE MUST BE CHECKED AFTER REJECTED TAKEOFFS.
- CHECK THE AREA AROUND THE AIRPLANE FOR F.O.D. OR LOOSE OBJECTS PRIOR TO THE RUN-UP CHECK.

For airplanes equipped with A1P, A1/3 or A1E engines:

Another takeoff is not permitted.

# ATTCS FAILURE

EICAS WARNING: ATTCS FAIL
LIGHT: Master Warning

| |
|---|
| Thrust Levers ..... MAX |

Another takeoff is not permitted.

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# DUAL ENGINE FAILURE

EICAS WARNING: ENG 1-2 OUT
LIGHT: Master Warning

| | |
|---|---|
| Airspeed | MINIMUM 260 KIAS |
| Oxygen Mask (if required) | DON |

Altitude ..... MAX 25000 ft

ENGINE AIRSTART Procedure ..... ACCOMPLISH

**CAUTION:** IF APU HAS BEEN USED TO START THE ENGINES, DO NOT ALTERNATE THE FADECS AFTER START.

**NOTE:** If APU is not available, only equipment supplied by the Essential DC Bus 1 and 2 will be available. Engine windmilling should drive engine driven pumps and supply hydraulic pressure.

If neither engine can be restarted:

FORCED LANDING Procedure ..... ACCOMPLISH

# ENGINE OIL LOW PRESSURE

EICAS WARNING: E1 (2) OIL LOW PRESS (may be presented)
LIGHT: Master Warning
INDICATION: Oil pressure indication may be red.

Oil Pressure Indication ..... CHECK
If flight conditions permit, reduce N2 below 88% and monitor oil temperature and oil quantity indication.

Monitor oil pressure for the remainder of the flight. If oil pressure is in the red range:

Associated Thrust Lever ..... IDLE
If oil pressure is still in the red range:
PRECAUTIONARY ENGINE
SHUTDOWN Procedure ..... ACCOMPLISH

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# ENGINE REVERSER FAILURE/DISAGREE

EICAS CAUTION: ENG1 (2) REV FAIL or
ENG1 (2) REV DISAGREE

LIGHT: Master Caution

Do not takeoff.

During landing:

Affected Thrust Lever ..... IDLE

In flight:

N1 ..... CHECK

If N1 is decreasing:

Associated Thrust Lever..... IDLE

Airspeed ..... MAXIMUM 200 KIAS

PRECAUTIONARY ENGINE SHUTDOWN Procedure..... ACCOMPLISH

Land at the nearest suitable airport.

# REJECTED TAKEOFF (AT OR BELOW $V_1$)

CONDITION: In the event of engine failure, engine fire, or any condition affecting safety of flight, occuring prior to V1.

| | |
|---|---|
| Thrust Levers | IDLE OR MAX REVERSE |
| Brakes | APPLY MAXIMUM |
| Directional Control | MAINTAIN |

Immediately after stopping:

Precautionary Engine Shutdown or
ENGINE FIRE, SEVERE DAMAGE OR SEPARATION Procedure ..... AS REQUIRED

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# TAKEOFF WITH ENGINE FAILURE ABOVE $V_1$

## (APPLICABLE TO ALL MODELS EXCEPT EMB-145 XR)

Maximum Takeoff Thrust ..... CHECK
At $V_R$ rotate the airplane to 14° (flaps 9°), 13° (flaps 18°) or 12° (flaps 22°).
With positive rate of climb:
Landing Gear ..... UP
Airspeed ..... $V_2$

Maintain $V_2$ up to the level off altitude. If maneuvering is required, maintain a maximum bank of 15°.

During takeoff with flaps 9°, when reaching the level off height:

At $V_2$ + 15 KIAS:
Flaps ..... UP
Airspeed ..... ACCELERATE TO FINAL SEGMENT SPEED

During takeoff with flaps 18° or 22°, when reaching the level off height:

For airplanes equipped with AE3007A, or AE3007A1 or AE3007A1/1 engines:

At $V_2$ + 5 KIAS:
Flaps ..... 9°

At $V_2$ + 25 KIAS:
Flaps ..... UP
Airspeed ..... ACCELERATE TO FINAL SEGMENT SPEED

For airplanes equipped with AE3007A1P or AE3007A1/3 engines:

At $V_2$ + 10 KIAS:
Flaps ..... 9°

At $V_2$ + 30 KIAS:
Flaps ..... UP
Airspeed ..... ACCELERATE TO FINAL SEGMENT SPEED

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After flaps are retracted:
PRECAUTIONARY ENGINE SHUTDOWN or
ENGINE FIRE, SEVERE DAMAGE OR
SEPARATION Procedure..... AS REQUIRED
After a maximum of 5 minutes at Takeoff Thrust:
Thrust Rating ..... AS REQUIRED

# TAKEOFF WITH ENGINE FAILURE ABOVE $V_1$

## (APPLICABLE TO EMB-145XR MODEL)

Maximum Takeoff Thrust..... CHECK
At $V_R$ rotate the airplane to 13° (flaps 9°) or 12° (flaps 18°).
With positive rate of climb:
Landing Gear..... UP
Airspeed..... $V_2$

Maintain $V_2$ up to the level off altitude. If maneuvering is required, maintain a maximum bank of 15°.

During takeoff with flaps 9°, when reaching the level off height:

At $V_2$ + 15 KIAS:
Flaps..... UP
Airspeed ..... ACCELERATE TO FINAL SEGMENT SPEED

During takeoff with flaps 18°, when reaching the level off height:

At $V_2$ + 10 KIAS:
Flaps..... 9°
At $V_2$ + 30 KIAS:
Flaps..... UP
Airspeed..... ACCELERATE TO FINAL SEGMENT SPEED

After flaps are retracted:
PRECAUTIONARY ENGINE SHUTDOWN or
ENGINE FIRE, SEVERE DAMAGE OR
SEPARATION Procedure..... AS REQUIRED
After a maximum of 5 minutes at Takeoff Thrust:
Thrust Rating ..... AS REQUIRED

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# LANDING GEAR/LEVER DISAGREE

EICAS WARNING: LG/LEVER DISAGREE
LIGHT: Master Warning.
EICAS Indication: Landing gear indication may be present one or more boxes cross-hatched or red.

Airspeed ..... MAXIMUM 200 KIAS
Landing Gear ..... CYCLE
If the message persists:
- In a retraction:
  - Landing Gear ..... DOWN
  - Airspeed ..... MAXIMUM 250 KIAS
  - Land at the nearest suitable airport. Leave and avoid icing conditions.
- In an extension:
  - ABNORMAL LANDING GEAR EXTENSION Procedure ..... ACCOMPLISH

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# PITCH TRIM RUNAWAY

EICAS WARNING: AUTOPILOT FAIL (may be presented)
EICAS CAUTION: AUTO TRIM FAIL (may be presented)
LIGHT: Master Warning light illuminates if AUTOPILOT FAIL message is presented. Message Caution light illuminates if AUTO TRIM FAIL message is presented.
CONDITION: Uncommanded pitch and respective trim pictorial indication changes

Quick Disconnect Button ..... PRESS AND HOLD

**NOTE:** Do not change flap setting.

At safe altitude:
Pitch Trim Main System..... OFF
Pitch Trim Back Up System..... OFF
Quick Disconnect Button ..... RELEASE

**WARNING: DO NOT OPEN THE SPEED BRAKE.**

If control column forces are excessive, try to recover airplane control by turning one system on and trimming the airplane as necessary. Initiate with the Backup System. Leave the failed system off.

Autopilot..... AS REQUIRED

If neither Main nor Back Pitch Trim system is operative:
PITCH TRIM INOPERATIVE Procedure..... ACCOMPLISH

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# PITCH TRIM INOPERATIVE
## (APPLICABLE TO EMB-135 AND EMB-145 AIRPLANES)

EICAS WARNING: PIT TRIM 1(2) INOP or
PTRIM MAIN INOP, PTRIM BACKUP INOP
(may be presented)

EICAS CAUTION: AUTO TRIM FAIL (may be presented)

If at least one message is presented without pressing any Pitch Trim Switch:

Affected Pitch Trim System ..... OFF

Use the remaining Pitch Trim System.

If both Pitch Trim Systems become inoperative:

Pitch Trim Main System..... OFF

Pitch Trim Back Up System ..... OFF

Consider landing at the nearest suitable airport.

If no message is presented or is only presented when pressing any Pitch Trim Switch:

Airspeed..... REDUCE

Airspeed reduction alleviates control column forces and may permit Pitch Trim command to be recovered.

If Pitch Trim command is reestablished continue using the remaining Pitch Trim System.

**NOTE: -** For the EMB-145 XR model, if the PTRIM BACKUP INOP message is displayed the maximum airspeed allowed is Mach 0.78.

**-** Do not engage the Autopilot if the Main Pitch Trim System is inoperative.

**-** If only one segment of the Pitch Trim Switch is pressed, the TRIM aural warning message will be generated.

**WARNING: IF PITCH TRIM COMMAND IS NOT REESTABLISHED, DO NOT OPEN SPEEDBRAKE.**

If pitch trim command is not reestablished and the airplane presents a NOSE UP tendency:

Airspeed..... REDUCE

If it is necessary to reduce airspeed below 180 KIAS (or 200 KIAS in icing conditions), extend flaps to 9° (at 20000 ft maximum).

***CONTINUES ON THE NEXT PAGE***

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

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If it is necessary to reduce airspeed below 160 KIAS, extend flaps to 22°.

**NOTE:** Turning the airplane and extending the landing gear helps to maintain minimum airspeed with unwanted pitch up tendency.

Pitch Trim Command..... CHECK ALL SWITCHES

If pitch trim is recovered, re-trim the airplane and proceed with flight normally.

If pitch trim is not recovered:

Consider landing at the nearest suitable airport.

Approach and landing configuration:

Landing Gear ..... DOWN

Flaps..... 22°

Airspeed ..... $V_{REF\ 45}$ + 10 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.45.

If pitch trim command is not reestablished and the airplane presents a NOSE DOWN tendency:

Airspeed ..... REDUCE

Below 250 KIAS:

Flaps (at 20000 ft maximum) ..... 9°

Below 200 KIAS:

Flaps..... 22°

Approach and landing configuration:

Landing Gear..... DOWN

**NOTE:** Gear extension should be delayed as long as possible.

Flaps..... 22°

Airspeed ..... $V_{REF\ 45}$ + 25 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.75.

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# PITCH TRIM INOPERATIVE
## (APPLICABLE TO ERJ-140 AIRPLANES)

EICAS WARNING: PIT TRIM 1(2) INOP or
PTRIM MAIN INOP, PTRIM BACKUP INOP
EICAS CAUTION: AUTO TRIM FAIL

If at least one message is presented without pressing any Pitch Trim Switch:

Affected Pitch Trim System ..... OFF
Use the remaining Pitch Trim System.
If both Pitch Trim Systems are inoperative:
Pitch Trim Main System ..... OFF
Pitch Trim Back Up System ..... OFF
Consider landing at the nearest suitable airport.

If message is presented when pressing any Pitch Trim Switch:

Airspeed ..... REDUCE
Airspeed reduction alleviates control column forces and may permit Pitch Trim command to be recovered.

If Pitch Trim command is reestablished continue using the remaining Pitch Trim System.

**NOTE: -** Do not engage the Autopilot if the Main Pitch Trim System is inoperative.
**-** If only one segment of the Pitch Trim Switch is pressed, the TRIM aural warning message will be generated.

**WARNING: IF PITCH TRIM COMMAND IS NOT REESTABLISHED, DO NOT OPEN SPEEDBRAKE.**

If pitch trim command is not reestablished and the airplane presents a NOSE UP tendency:

Airspeed ..... REDUCE
If it is necessary to reduce airspeed below 180 KIAS (or 200 KIAS in icing conditions), extend flaps to 9° (at 20000 ft maximum).

If it is necessary to reduce airspeed below 160 KIAS, extend flaps to 22°.

**NOTE:** Turning the airplane and extending the landing gear helps to maintain minimum airspeed with unwanted pitch up tendency.

Pitch Trim Command ..... CHECK ALL SWITCHES

**CAUTION:** IF PITCH TRIM IS RECOVERED, RETRIM THE AIRPLANE AND PROCEED WITH FLIGHT NORMALLY.

***CONTINUES ON THE NEXT PAGE***



User: fhherna0f - Printed By myTechCare - Nov 21/24 - 00:45:44

***CONTINUED FROM PREVIOUS PAGE***

If pitch trim is not recovered:

Consider landing at the nearest suitable airport.

Approach and landing configuration:

Landing Gear ..... DOWN

Flaps..... 22°

Airspeed ..... $V_{REF\ 45}$ + 10 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.45.

If pitch trim command is not reestablished and the airplane presents a NOSE DOWN tendency:

Airspeed..... REDUCE

Below 250 KIAS:

Flaps (at 20000 ft maximum)..... 9°

Below 200 KIAS:

Flaps..... 22°

Approach and landing configuration:

Landing Gear..... DOWN

**NOTE:** Gear extension should be delayed as long as possible.

Flaps..... 22°

Airspeed ..... $V_{REF\ 45}$ + 25 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.75.

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# JAMMED ELEVATOR

EICAS WARNING: SPS 1-2 INOP (may be presented)
EICAS CAUTION: STICK PUSHER FAIL (may be presented)
LIGHT: Master Warning and Master Caution lights illuminate if STICK PUSHER FAIL and SPS 1-2 INOP messages are presented.
CONDITION: Both control columns can not be moved either forward or backward.

| | |
|---|---|
| Elevator Disconnect | PULL |

Autopilot ..... OFF
Airspeed ..... MAXIMUM 200 KIAS
Pitch Trim ..... AS REQUIRED
Avoid landing at airports with anticipated turbulence or crosswind.

Approach and landing configuration:
Landing Gear ..... DOWN
Flaps ..... 22°
Airspeed ..... $V_{REF\ 45}$ + 10 KIAS

If both elevators are jammed, pitch trim may be used to land the airplane.
If left elevator is jammed, Stick Pusher will not be available.
Depending on the jammed elevator position, the remaining elevator power to flare the airplane will be reduced.
Do not reengage autopilot.

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.45.

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# AILERON/ROLL TRIM RUNAWAY

CONDITION: Uncommanded roll noticed by pilots.
INDICATION: Trim pictorial indication if caused by roll trim runway.

| | |
|---|---|
| Quick Disconnect Button | PRESS AND HOLD |
| Aileron System 1 and 2 | OFF |

Roll Trim Circuit Breaker (F23) ..... PULL
Quick Disconnect Button ..... RELEASE
Airspeed ..... MAXIMUM 250 KIAS

If necessary, turn on one aileron hydraulic system at a time to identify the failed system. Prepare to overcome the roll generated by the failed aileron system. If the failure is confirmed in one aileron system, the roll trim system may be used as required.

If the message AIL SYS 1-2 INOP is displayed on EICAS:

Aileron is operating under mechanical reversion mode. Expect greater aileron control force. If required, both pilots should act together to control airplane. Avoid landing at airports with anticipated turbulence or crosswind. Perform a long final approach.

Approach and landing configuration:

Landing Gear ..... DOWN
Flaps ..... 22°
Airspeed ..... $V_{REF\ 45}$ + 30 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.85.

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# JAMMED AILERON

CONDITION: Both control columns can not be moved to either side.

| | |
|---|---|
| Aileron Disconnect | PULL |

Autopilot ..... OFF
Airspeed ..... MAXIMUM
200 KIAS

**NOTE:** Roll rate with aileron disconnected is lower than with full system.

After control is regained:

If the copilot's aileron is operative, roll trim and artificial feel are available.

If the pilot's aileron is operative, roll trim and artificial feel are not available. Do not make sudden and large aileron inputs. Do not increase bank angle above 20°.

Airspeed ..... MAXIMUM
200 KIAS

In either case, autopilot must not be reengaged.

If both ailerons are jammed, use rudder to control the airplane.

Avoid landing at airports with anticipated turbulence or crosswind.

Approach and landing configuration:

Landing Gear ..... DOWN
Flaps ..... 45°
Airspeed ..... $V_{REF\ 45}$ + 5 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.10.

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# JAMMED RUDDER

CONDITION: Pedals can not be moved.

Command rudder through yaw trim. If not possible:
Rudder System 2 ..... OFF

If still jammed:
Rudder System 2 ..... ON
Rudder System 1 ..... OFF

If rudder control through pedals is not restored:
Airspeed ..... MAXIMUM 200 KIAS

Avoid landing at airports with anticipated turbulence or crosswind.

Approach and landing configuration:
Landing Gear ..... DOWN
Flaps ..... 22°
Airspeed ..... $V_{REF\ 45}$ + 5 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.62.

If required, use asymmetric thrust to trim the airplane directionally, and maintain the engine thrust until nose gear contact in order to avoid lateral and directional miscontrol.

During final approach, the pilot not flying must keep the Steering Disengage Button pressed to avoid inadvertent nose wheel deflection once on ground.

When the airplane is firmly on ground, use the Steering Handle to control the airplane still keeping the Steering Disengage Button pressed and then reduce the engine thrust to IDLE. The message STEER INOP may appear while not using the Steering Handle.

If necessary, use differential braking to steer the airplane.

**NOTE:** The Steering Handle is effective even with the Steering Disengage Button pressed.

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# INADVERTENT SPOILER OPENING IN FLIGHT

EICAS CAUTION: SPOILER FAIL (may be presented)

LIGHT: Master Caution

CONDITION: Sudden airspeed or altitude loss, buffeting or roll tendency.

INDICATION: SPLRS OPN

| | |
|---|---|
| Speed Brake | CLOSE |

Speed Brake Circuit Breaker (F13) ..... PULL

Ground Spoiler Outboard
Circuit Breaker (F14) ..... PULL

Ground Spoiler Inboard
Circuit Breaker (F21) ..... PULL

If any panel is jammed closed, open or is floating:

Approach and landing configuration:

Landing Gear ..... DOWN
Flaps ..... 22°
Airspeed ..... $V_{REF\ 45}$ + 10 KIAS

Do not reduce engine thrust during flare to avoid abrupt lateral and directional corrections before touchdown.

**CAUTION:**

- IN CASE OF PANEL JAMMED CLOSED OR FLOATING, TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.50.
- IN CASE OF PANEL JAMMED OPEN, TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.45.

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# BLEED LEAK

EICAS WARNING: BLD 1 (2) LEAK or BLD APU LEAK
LIGHT: Master Warning and leak inscription in the associated bleed button illuminated.

Crossbleed ..... CLOSE
Confirm the failed side and proceed.

Associated Bleed and APU Bleed ..... CLOSE
Check on EICAS the following messages: CROSS BLD SW OFF and associated BLD VLV CLSD. Check APU bleed button not illuminated.

Altitude ..... MAX 25000 ft
MINIMUM MEA

Icing Conditions ..... EXIT/AVOID

Wait 3 minutes.

If the message remains on, but the associated advisory message on EICAS (BLD 1 or 2 VLV CLSD) indicates the valve is closed:

Opposite Bleed ..... CLOSE
Associated Bleed ..... OPEN
Wait 3 minutes.

If the message still remains:

Associated Bleed ..... CLOSE
Altitude ..... MEA OR 10000 ft WHICHEVER IS HIGHER

If the message remains on and is associated with a failed engine bleed valve (BLD 1 or 2 VLV FAIL caution message):

Associated Thrust Lever ..... IDLE
Wait 3 minutes.

If the message still remains:

Associated Engine (or APU) ..... SHUTDOWN

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# BLEED OVERTEMPERATURE

EICAS WARNING: BLD 1 (2) OVTEMP
LIGHT: Master Warning
INDICATION: Pointer on MFD may be out of view and indication may be red.

| | |
|---|---|
| Crossbleed | OPEN |
| Cross-side Bleed | OPEN |
| Associated Bleed | CLOSE |
| Altitude | MAX 25000 ft<br>MINIMUM MEA |

**WARNING: IF IN ICING CONDITIONS, REFER TO SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS PROCEDURE.**

# RAPID CABIN DEPRESSURIZATION

AURAL WARNING: CABIN
CONDITION: Cabin altitude indication has exceeded 10000 ft and becomes red.

| | |
|---|---|
| Crew Oxygen Masks | DON |
| Crew Communication | ESTABLISH |
| Emergency Descent | AS REQUIRED |

| | |
|---|---|
| Passenger Oxygen | AS REQUIRED |
| Altitude | MEA OR<br>10000 ft,<br>WHICHEVER<br>IS HIGHER |

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# ANTI-ICING INOPERATIVE IN ICING CONDITIONS

EICAS WARNING: ICE COND-A/I INOP with any or all Anti-icing System EICAS CAUTION
LIGHT: Master Warning and Master Caution.

On the ground, whenever the message is displayed, do not takeoff and perform the test below:

Thrust Levers..... IDLE
Ice Detection Override Knob..... AUTO
Ice Detection Test Knob ..... 1, THEN 2

Test knob must be held for 5 seconds in each test position.

For each side separately, check that OPEN inscriptions in the anti-icing buttons are flashing and that ICE DET 1 (or 2) FAIL caution message and ICE CONDITION advisory message are displayed on the EICAS.

If any OPEN inscription does not flash do not takeoff.

If the message ICE COND-A/I INOP persists do not takeoff.

If the message ICE COND-A/I INOP disappears within 60 seconds:
TAKEOFF ..... ACCOMPLISH

In flight:

Ice Detection Override Knob..... ALL
If necessary, refer to the specific anti-icing system failure.
If the message persists, exit and avoid icing conditions.

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# AUTOPILOT FAILURE

EICAS WARNING: AUTOPILOT FAIL
LIGHT: Master Warning
AURAL WARNING: AUTOPILOT (only below 2500 ft radio altitude, when autopilot is disconnected)

Autopilot ..... DISENGAGE

Trim the airplane as required.

**NOTE:** If associated with autopilot hardover a sudden deviation from the expected flight path may occur.

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# EMERGENCY DESCENT

| | |
|---|---|
| Cabin Crew | NOTIFY |
| Fasten Belts | ON |
| Thrust Levers | IDLE |
| Speed Brakes | OPEN |
| Airspeed | 250 KIAS |
| Landing Gear | DOWN |
| Altitude | MEA OR 10000 FT WHICHEVER IS HIGHER |

Transponder ..... 7700
ATC ..... NOTIFY

**CAUTION:** THIS PROCEDURE ASSUMES THAT THE INTEGRITY OF THE STRUCTURE IS NOT AFFECTED. IF STRUCTURAL DAMAGE IS SUSPECTED, USE THE FLIGHT CONTROLS WITH CAUTION AVOIDING HIGH MANEUVERING LOADS AND REDUCING AIRSPEED AS APPROPRIATE.

**NOTE: -** It is recommended that descent be initiated by a turn with a bank angle of 30°.

**-** Anti-Icing System failure messages may be presented if icing conditions are encountered during the descent. In this case, emergency descent must be completed before performing the associated failure procedure.

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# FORCED LANDING

This procedure is recommended for landings, with engines operative or not, including places other than a runway.

ATC and Cabin Crew ..... NOTIFY
Transponder ..... 7700
ELT ..... ON
Emergency Lights ..... ON
Passenger ..... PREPARE FOR FORCED LANDING
Cabin (below 10000 ft) ..... DEPRESSURIZE
When committed to land:

Landing Gear ..... AS REQUIRED
Flaps ..... 45°

If it is not possible to achieve the selected flap position, maintain airspeed according to the following:

| FLAPS POSITION | MINIMUM AIRSPEED |
|---|---|
| 0° to 8° | $V_{REF\ 45}$ + 30 KIAS |
| 9° to 21° | $V_{REF\ 45}$ + 10 KIAS |
| 22° to 44° | $V_{REF\ 45}$ + 5 KIAS |
| 45° | $V_{REF\ 45}$ |

If necessary, inhibit EGPWS/GPWS (CB J7 or CB J8) and Aural Warning System (CBs B4 and E30) by pulling their circuit breakers.

If crash is unavoidable, just before touchdown:

Cabin ..... ANNOUNCE IMPACT
Fire Extinguishing Handles ..... PULL
APU Fuel Shutoff Valve ..... CLOSE
Ventral Tank Transfer Knob (EMB-145XR only) ..... OFF

When the airplane comes to a complete stop:

EMERGENCY EVACUATION Procedure ..... ACCOMPLISH

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# DITCHING

**WARNING: THE EMB-145 WAS NOT TESTED FOR DITCHING. BELOW ARE THE RECOMMENDED PROCEDURES, WHICH HAVE BEEN DEVELOPED BASED ON PREVIOUS EXPERIENCE.**

ATC/Cabin Crew ..... NOTIFY
Transponder ..... 7700
ELT ..... ON
Emergency Lights ..... ON
Passengers ..... PREPARE FOR DITCHING
Cabin (below 10000 ft) ..... DEPRESSURIZE

If necessary, inhibit EGPWS/GPWS (CB J7 or CB J8) and Aural Warning System (CBs B4 and E30) by pulling their circuit breakers.

When reaching 1000 ft:

Ventral Tank Transfer Knob (EMB-145XR only) ..... OFF
Air Conditioning 1 and 2 ..... OFF
Engine Bleeds ..... CLOSE

Approach configuration:

Landing Gear ..... UP
Flaps ..... 45°

If it is not possible to achieve the selected flap position, maintain airspeed according to the following:

| FLAPS POSITION | MINIMUM AIRSPEED |
|---|---|
| 0° to 8° | $V_{REF\ 45}$ + 30 KIAS |
| 9° to 21° | $V_{REF\ 45}$ + 10 KIAS |
| 22° to 44° | $V_{REF\ 45}$ + 5 KIAS |
| 45° | $V_{REF\ 45}$ |

The final path should be made with airplane straight and level. Yaw angles should be limited to one ball of sideslip. If possible, ditching should be made parallel to the line of the wave crests.

Before touchdown:

Cabin ..... ANNOUNCE IMPACT
Rate of Descent ..... LESS THAN 180 ft/MIN
Attitude ..... 4° NOSE UP

***CONTINUES ON NEXT PAGE***



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*CONTINUED FROM PREVIOUS PAGE*

Upon water contact:

Start/Stop Selectors ..... STOP

EMERGENCY EVACUATION Procedure ..... ACCOMPLISH

**WARNING:** **AIRPLANE EVACUATION MUST BE DONE THROUGH THE OVERWING EMERGENCY EXITS ONLY. DO NOT OPEN REMAINING DOORS.**

# EMERGENCY EVACUATION

Parking Brake (if necessary) ..... APPLY
Cabin ..... DEPRESSURIZE
Fire Extinguishing Handles ..... PULL
APU Fuel Shutoff Valve ..... CLOSE
APU and Engine Fire Extinguishing
Bottles (if necessary) ..... DISCHARGE
Ventral Tank Transfer Knob (if applicable) ..... OFF
Electric Fuel Pumps ..... OFF
Electric Hydraulic Pumps ..... OFF
Cabin Crew ..... NOTIFY
Emergency Lights ..... ON
Evacuation ..... INITIATE

**NOTE:** Cockpit door blow-out panels may be broken to be used as an alternative way to leave cockpit.

ATC ..... NOTIFY
Before leaving the airplane:
Batteries ..... OFF

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# ABNORMAL PROCEDURES

# EQUIPMENT AND FURNISHINGS

## EMERGENCY EXIT OPEN

EICAS CAUTION: EMERG EXIT OPEN
LIGHT: Master Caution

Fasten Belts ..... ON
Verify door handle pushed in and remove passengers from the seats near the associated emergency exit.
If emergency exit is not confirmed locked or it is not possible to maintain the pressurization:

| | |
|---|---|
| Altitude ..... | MEA OR 10000 ft, WHICHEVER IS HIGHER |
| Cabin Pressure ..... | DEPRESSURIZE |

## BAGGAGE/ACCESS DOOR OPEN

EICAS CAUTION: BAGGAGE DOOR OPN or ACCESS DOORS OPN
LIGHT: Master Caution

Avoid rapid maneuvers.
If it is not possible to maintain the pressurization, proceed:

| | |
|---|---|
| Altitude ..... | MEA OR 10000 ft, WHICHEVER IS HIGHER |
| Pressurization ..... | MONITOR |

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## MAIN DOOR BLOCKED

LIGHT: Door Blocked Closed (Attendant's panel)

To open the door on ground:

Check that the door opening area is free of both people and ground equipment.

Hydraulic System 1 ..... OFF

Main Door Alternative Opening Valve ..... ACTUATE DURING 2 MINUTES

Unlock the door and open it.

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# CREW AWARENESS

## ERRONEOUS STALL PROTECTION ACTUATION

Immediately and simultaneously:
Quick Disconnect Button ..... PRESS
Both Stall Protection Systems ..... CUTOUT

Avoid skidding the airplane.

Add 5 KIAS to approach, landing and go-around speeds.

Landing configuration:
Flaps..... 45°
Airspeed ..... $V_{REF\ 45}$ + 5 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.10.

## ADVANCED STALL PROTECTION

EICAS CAUTION: SPS ADVANCED
LIGHT: Master Caution

If altitude is above 25000 ft:

Airspeed..... ABOVE 150 KIAS

Add 5 KIAS to go-around speed to prevent stall protection from being actuated.

Approach and landing configuration:
Landing Gear..... DOWN
Flaps..... 45°
Airspeed ..... $V_{REF\ 45}$ + 5 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.10.

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## STICK PUSHER JAMMING

EICAS CAUTION: STICK PUSHER FAIL
LIGHT: Master Caution

Elevator Disconnection Handle..... PULL
Copilot must fly the airplane.

Avoid landings at airports with anticipated turbulence or crosswinds.

## GPWS INOPERATIVE

EICAS CAUTION: GPWS INOP or TERR INOP (for EGPWS)
LIGHT: Master Caution

Monitor any trend toward terrain contact, excessive sink rate, marginal flight path and airplane configuration.

Do not perform CAT II or CAT III approaches.

## AURAL WARNING FAILURE

EICAS CAUTION: AURAL WARN FAIL
LIGHT: Master Caution

Monitor airplane instruments.

Do not perform CAT II or CAT III approaches.

## WINDSHEAR DETECTION INOPERATIVE

EICAS CAUTION: WINDSHEAR INOP
LIGHT: Master Caution

Avoid windshear.

## STALL PROTECTION SYSTEM UNTESTED

LIGHT: Stall Protection Test Button is illuminated.

Stall Protection Test Button (on ground)..... PRESS

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# ELECTRICAL

## APU CONTACTOR CLOSED

EICAS CAUTION: APU CNTOR CLOSED
LIGHT: Master Caution

Bus Ties ..... OFF
Battery 2 ..... OFF

## BACKUP BATTERY OFF BUS

EICAS CAUTION: BKUP BATT OFF BUS

Backup Battery ..... VERIFY ON

## BATTERY OFF BUS

EICAS CAUTION: BATT 1 (2) OFF BUS
LIGHT: Master Caution

Affected Battery ..... AUTO

## DC BUS OFF

EICAS CAUTION: DC BUS 1 (2) OFF
LIGHT: Master Caution

Bus Ties ..... OVERRIDE
If associated bus is still off:
  Bus Ties ..... AUTO
Remaining Buses ..... CHECK
If DC Bus 2 is off:
  Airspeed ..... MAXIMUM 250 KIAS

**NOTE:** The nose landing doors will open, therefore the pilot should expect noise increase.

Icing Conditions ..... EXIT/AVOID

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# ELECTRICAL EMERGENCY ABNORMAL TRANSFER

EICAS CAUTION: ELEC EMERG ABNORM
LIGHT: Master Caution

Essential Power ..... CHECK
PUSHED OUT

If message persists:

Land at the nearest suitable airport.
Bus Ties ..... OFF
Batteries 1 and 2 ..... OFF

If message persists:

Bus Ties ..... AUTO
Batteries 1 and 2 ..... AUTO
APU Generator (if serviceable) ..... ON
Altitude ..... MEA OR
10000 ft,
WHICHEVER
IS HIGHER

At 10000 ft:

Packs 1 and 2 ..... OFF
Pressurization Mode Selector ..... MAN
Pressurization Manual Controller ..... FULL UP

**CAUTION:** IF APU GENERATOR IS NOT AVAILABLE OR THE MESSAGE REMAINS, BATTERY DURATION WILL BE 40 MINUTES.

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## ESSENTIAL BUS 1 OFF

EICAS CAUTION: ESS BUS 1 OFF
LIGHT: Master Caution
MFD Indication: ESS BUS may be amber.

On Reversionary Panel 1:
SG ..... PUSH IN
Fuel Pump 1 ..... 1B OR 1C
Fuel Pump 2 ..... 2A OR 2C
Altitude ..... MAX 25000 FT, MINIMUM MEA

**WARNING:** **IF IN ICING CONDITIONS, REFER TO SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS PROCEDURE.**

COM 2 on Digital Audio Panel 2 ..... PUSH IN
Monitor fuel quantity indication 1 through FMS.
Brake effectiveness will be reduced.

If the EICAS is not energized:
DAU 1 on EICAS Rev ..... PUSH IN
At pilot's discretion, on Reversionary Panel 1:
MFD Knob ..... EICAS

Landing configuration:
Landing Gear ..... DOWN
Flaps ..... 45°
Airspeed ..... $V_{REF\ 45}$

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.45.

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## ESSENTIAL BUS 2 OFF

EICAS CAUTION: ESS BUS 2 OFF
LIGHT: Master Caution
MFD Indication: ESS BUS may be amber.

Fuel Pump 1 ..... 1A OR 1C
Fuel Pump 2 ..... 2B OR 2C
Icing Conditions ..... EXIT/AVOID
Altitude ..... MAX 25000 FT, MINIMUM MEA

Monitor fuel quantity indication 2 through FMS.

Brake effectiveness will be reduced.

When necessary to extend landing gear:
ABNORMAL LANDING GEAR EXTENSION ..... ACCOMPLISH

Landing configuration:
Landing Gear ..... DOWN
Flaps ..... 45°
Airspeed ..... $V_{REF\ 45}$

**CAUTION:**
- DO NOT USE CROSSFEED.
- TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.45.

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## ESSENTIAL BUS 1-2 OFF

EICAS CAUTION: ESS BUS 1-2 OFF

Bus Ties ..... OFF
MFD Electrical Page ..... CHECK
If both DC buses are energized:
  Batteries 1 and 2 ..... OFF
  Check if the essential buses remain off.
  Associated ESS BUS OFF Procedure ..... ACCOMPLISH
If only DC BUS 1 is energized:
  Battery 1 ..... OFF
  Check which essential bus is off.
  Associated ESS BUS OFF Procedure ..... ACCOMPLISH
If only DC BUS 2 is energized:
  Battery 2 ..... OFF
  Check which essential bus is off.
  Associated ESS BUS OFF Procedure ..... ACCOMPLISH

## GENERATOR BEARING FAILURE

EICAS ADVISORY: GEN 1 (2, 3, 4) BRG FAIL

Crew awareness.

## GENERATOR OFF BUS

EICAS CAUTION: GEN 1 (2, 3, 4) OFF BUS or APU GEN OFF BUS
LIGHT: Master Caution

Affected Generator ..... OFF, THEN ON
If the generator does not reset:
  APU Generator ..... AS REQUIRED

**CAUTION:**
- IF ALL GENERATORS ARE OFF BUS, CABIN WILL DEPRESSURIZE. REFER TO LOSS OF ALL GENERATORS PROCEDURE.
- BATTERY DURATION IS 40 MINUTES.

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## GENERATOR OVERLOAD

EICAS CAUTION: GEN 1 (2, 3, 4) OVLD or APU GEN OVLD
LIGHT: Master Caution

Shed Buses ..... OFF
If the message remains:
Electrical Load (on affected generator) ..... REDUCE
If APU generator is not affected and any generator is overloaded:

APU Generator ..... ON

## SHED BUS OFF

EICAS CAUTION: SHED BUS 1 (2) OFF
LIGHT: Master Caution

If message is confirmed and shed buses are off, monitor the system for the remainder of the flight.

## 115 V AC BUS OFF

EICAS CAUTION: 115 VAC BUS OFF
LIGHT: Master Caution

AC Power ..... OFF, THEN ON
If unsuccessful:
AC Power ..... OFF

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# LIGHTING

## EMERGENCY LIGHTS NOT ARMED

EICAS CAUTION: EMERG LT NOT ARMD
LIGHT: Master Caution

Emergency Lighting Selector ..... ARM
If unsuccessful, check that Attendant Emergency Light Control Button is set to NORM.

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# FIRE PROTECTION

## ENGINE TAILPIPE FIRE

CONDITION: Tailpipe fire was detected visually by crew or ground personnel. No EICAS message displayed.

Affected engine:
- Thrust Lever ..... IDLE
- Start/Stop Selector ..... STOP
- Ignition ..... OFF
- Fuel Pump ..... OFF
- XFeed Selector Knob ..... OFF
- Start/Stop Selector ..... START, THEN RUN

ITT ..... MONITOR

ATC ..... NOTIFY

Wait 90 seconds.

Associated Start/Stop Selector ..... STOP

Associated Fire Extinguishing Handle ..... PULL (DO NOT ROTATE)

**NOTE:** If fire is not extinguished while the engine is motored, ground personnel support must be requested.

## FIRE DETECTION FAILURE

EICAS CAUTION: E1 (2) FIREDET FAIL or APU FIREDET FAIL
LIGHT: Master Caution

Engine or APU ..... MONITOR

If engine fire or overheat is suspected or if E1 (2) FIREDET FAIL message appears simultaneously with engine failure:

ENGINE FIRE, SEVERE DAMAGE OR SEPARATION Procedure ..... ACCOMPLISH

If APU fire or overheat is suspected or if APU FIREDET FAIL message appears simultaneously with APU failure:

APU FIRE Procedure ..... ACCOMPLISH

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## FIRE EXTINGUISHING INOPERATIVE

EICAS CAUTION: E1 (2) EXTBTLA INOP, E1 (2) EXTBTLB INOP, APU EXTBTL INOP or BAGG EXTBL INOP (if installed)

LIGHT: Master Caution

CONDITION: Associated bottle has not been discharged intentionally.

On Engines:

Only one discharge will be available from the remaining bottle, to protect both engines against fire.

On APU:

Consider shutting APU down (or not starting it) if bleed extraction or electrical generation is not essential.

On Baggage Compartment:

In flight:

If associated with the BAGG SMOKE message, land at the nearest suitable airport.

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# FUEL

## FUEL LOW PRESSURE

EICAS CAUTION: E1 (2) FUEL LO PRESS
LIGHT: Master Caution
CONDITION: One or more associated tank electric fuel pump may be inoperative.

Select another electric fuel pump on the associated tank.
If all pumps in one tank are inoperative:

Altitude ..... MAX 25000 ft
MINIMUM MEA

**NOTE:** If required, Crossfeed may be open above 25000 ft.

Avoid rapid thrust lever movements and set minimum required thrust.

## FUEL LOW TEMPERATURE

EICAS CAUTION: FUEL TANK LO TEMP or E1 (2) FUEL LO TEMP
LIGHT: Master Caution
CONDITION: Fuel temperature in amber range.

**WARNING: IF FUEL TANK LO TEMP MESSAGE IS PRESENTED, IN ANY CASE, OR E1 (2) FUEL LO TEMP IS PRESENTED WITHOUT ICING INHIBITOR, ENGINE FLAMEOUT MAY OCCUR.**

On ground:

Low temperature in the engine (E1 or E2 FUEL LO TEMP):

Before takeoff, check that fuel icing inhibitor has been added to the fuel.

Low temperature in the tank (FUEL TANK LO TEMP):

Check tank temperature. If message is confirmed or if MFD is not available, do not takeoff.

In flight:

Descend to lower altitude and monitor engine indications as long as the message remains.

If the low temperature is in the tank (FUEL TANK LO TEMP) and MFD is available, tank temperature may be checked on the MFD Fuel Page, before descending.

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## FUEL CROSSFEED FAILURE

EICAS CAUTION: FUEL XFEED FAIL
LIGHT: Master Caution

Fuel Imbalance..... MONITOR
Asymmetric Thrust..... AS REQUIRED

## FUEL IMBALANCE

EICAS CAUTION: FUEL IMBALANCE
LIGHT: Master Caution

If fuel imbalance is confirmed:
CROSSFEED OPERATION
Procedure ..... ACCOMPLISH

## REFUELING COMPARTMENT DOOR OPEN

EICAS CAUTION: FUELING DOOR OPN
LIGHT: Master Caution

On ground:
Check the door for positive locking before takeoff. If the message remains, repair is required before takeoff.

## ENGINE FUEL SHUTOFF VALVE FAILURE

EICAS CAUTION: E1 (2) FUEL SOV INOP
LIGHT: Master Caution

Confirm the failed valve.
Engine Fuel Indications..... MONITOR
If the message has been presented during a fire procedure:
Crossfeed..... OFF
Associated Fuel Pumps ..... OFF
If valve is confirmed closed during normal operation (fuel flow decreasing to zero):
Fire Extinguishing Handle ..... CHECK IN
If valve remains closed and it is not possible to restart the affected engine, land at the nearest suitable airport.
PRECAUTIONARY ENGINE
SHUTDOWN Procedure..... ACCOMPLISH
If engine is running normally, disregard the message.

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## ENGINE FUEL SHUTOFF VALVE CLOSED

EICAS ADVISORY: E1 (2) FUEL SOV CLSD

Fire Extinguishing Handle ..... CHECK IN
If valve is open and engine is running normally, disregard the message.
If valve remains closed and it is not possible to restart the affected engine:
PRECAUTIONARY ENGINE SHUTDOWN Procedure ..... ACCOMPLISH
Land at the nearest suitable airport.

## APU FUEL SHUTOFF VALVE FAILED

EICAS CAUTION: APU FUEL SOV INOP

LIGHT: Master Caution

Check that APU Fuel Shutoff Button is not pressed.
If valve remains closed and it is not possible to restart the APU:
APU Master Knob ..... OFF
If APU is running normally, disregard the message.

## APU FUEL SHUTOFF VALVE CLOSED

EICAS ADVISORY: APU FUEL SOV CLSD

If valve is open and APU is running normally, disregard the message.

## APU FUEL LOW PRESSURE

EICAS CAUTION: APU FUEL LO PRESS
LIGHT: Master Caution

Select another right electric fuel pump on the associated tank.
If message remains, repeat the procedure. If MFD is available check pumps operation on MFD Fuel Page.

## FUEL CROSSFEED OPEN

EICAS ADVISORY: FUEL XFEED OPEN

If not required, close crossfeed.

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## CROSSFEED OPERATION

**NOTE:** Crossfeed must be OFF during takeoff and landing.

If fuel imbalance is verified:

Attitude ..... WINGS LEVELED

If left wing presents lower level:

Crossfeed Selector ..... LOW1

If right wing presents lower level:

Crossfeed Selector ..... LOW2

Avoid rapid thrust levers movement.

Monitor fuel imbalance. When the desired balance is achieved:

Crossfeed Selector ..... OFF

## FUEL CROSSFEED MISCOMMAND

EICAS CAUTION: FUEL EQ XFEED OPN

Crossfeed Selector Knob ..... OFF
Fuel Imbalance..... CHECK
Crossfeed Selector Knob ..... AS REQUIRED
Check Crossfeed Selector Knob properly positioned to correct wing fuel imbalance.

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# AUXILIARY POWER UNIT

## APU OIL LOW PRESSURE/OIL HIGH TEMPERATURE

EICAS CAUTION: APU OIL LO PRESS, APU OIL HI TEMP
LIGHT: Master Caution

If the APU is not essential for the flight:
APU ..... SHUTDOWN

If APU is essential, monitor APU EGT and RPM.
If the APU EGT enters the red or amber range, apply the APU OVERTEMPERATURE Procedure.

If RPM enters red range:
APU ..... SHUTDOWN

## APU AUTOMATIC SHUTDOWN

EICAS CAUTION: APU FAIL
LIGHT: Master Caution

If shutdown occurs with APU running:
Do not try to restart the APU.

If shutdown occurs during APU start cycle and provided there is no obvious safety hazard:
APU Start Procedure ..... AS REQUIRED
If APU fails to restart, two more APU start attempts may be accomplished.

**NOTE:** Refer to APU STARTER LIMITS in AOM Limitations section between start attempts.

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# POWER PLANT

## ENGINE FAILURE

Remaining Engine Thrust Rating..... CON
Altitude..... MAX 25000 ft
MINIMUM MEA
ENGINE AIRSTART Procedure ..... AS REQUIRED
TCAS ..... TA ONLY

**WARNING: IF IN ICING CONDITIONS, REFER TO SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS PROCEDURE.**

In flight, the air conditioning pack valves will close automatically when:

- For AE3007A or AE3007A1/1 engines Pre-Mod. SB 145-73-0010: below 15000 ft, TAT above -18°C and the remaining engine at T/O-1 or CON mode.
- For AE3007A1 engines and AE3007A or AE3007A1/1 engines Post-Mod. SB 145-73-0010: below 9700 ft, TAT above 19°C at sea level, decreasing linearly to -5°C at 9700 ft and the remaining engine is at T/O-1 mode.
- For AE3007A1P or AE3007A1/3 engines: below 9700 ft, TAT above 19°C at sea level, decreasing linearly to -5°C at 9700 ft and the remaining engine is at T/O or T/O RSV mode.

If APU bleed is being used, the packs are not shut down.

## ONE ENGINE INOPERATIVE APPROACH AND LANDING

Inoperative Engine Thrust Lever ..... IDLE
Landing Gear..... DOWN
Thrust Rating ..... TAKEOFF
MODE

When landing is assured:
Flaps..... 22°
Airspeed..... $V_{REF45}$ + 10
KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.48.

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## ONE ENGINE INOPERATIVE GO-AROUND

Quick Disconnect Button..... PRESS
Go Around Button ..... PRESS
Operative Engine Thrust Lever ..... MAX

**NOTE:** If during approach an engine fails and a go around is initiated, advance both thrust levers to MAX.

Rotate to go-around attitude (10° nose up).
Flaps ..... 9°
With positive rate of climb:
Landing Gear ..... UP
Minimum Airspeed ..... APPROACH CLIMB SPEED
At level off height, proceed as for TAKEOFF WITH ENGINE FAILURE Procedure.

**NOTE: -** Limiting bank angle to 5° towards operative engine improves climb performance.
**-** During GO-AROUND procedure, the DON'T SINK aural warning may sound. In this case monitor the sink rate and follow the GO-AROUND guidance.

## ENGINE ROTOR BURST

CONDITION: Depending on the burst direction, one of the following conditions may be verified: E1 (or E2) FIREDET FAIL message displayed simultaneously with engine failure, or a sudden cabin depressurization, or impact noise, or hydraulic system failure.

ENGINE FIRE, SEVERE DAMAGE
OR SEPARATION Procedure..... APPLY

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## ABNORMAL ENGINE START

Abort engine start immediately when:

- Only on ground, no light-up in 10 seconds after the first fuel flow indication.

**NOTE:** The start should not be aborted if fuel flow drops to zero pph immediately after light-up.

- ITT approaches start limit.
- N2 remains steady or decreases for more than 30 seconds after light off.
- N2 indicates no rotation up to 10 seconds after the start command.
- Any unusual noise or vibration occurs.
- Engine instruments indicate abnormal conditions.
- Visible burning on the exhaust pipe.
- Oil pressure does not reach at least 34 psi after the engine reaches stabilized idle.

To abort start:
Associated Thrust Lever..... IDLE
Start/Stop Selector ..... STOP

If fire occurs or engine does not shutdown:
Fire Extinguishing Handle..... PULL
ENGINE DRY MOTORING Procedure..... ACCOMPLISH

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## ENGINE DRY MOTORING

Dry motor the engine for a minimum of 30 seconds to clear it of unburned fuel prior to attempting another start.

FADEC Control Knob..... ALTN

Check alternation of FADEC-in-control indication on the EICAS.

**CAUTION:** IF FADEC DOES NOT ALTERNATE, DO NOT PROCEED WITH THE ENGINE DRY MOTORING.

Ignition..... OFF

Check IGN OFF indication on EICAS display.

Start/Stop Selector..... START, THEN RUN

**NOTE:** If N2 indicates no rotation after 10 seconds, abort dry motoring attempt immediately.

After 30 seconds:

Start/Stop Selector..... STOP

Ignition Selector..... AUTO

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## PRECAUTIONARY ENGINE SHUTDOWN

CONDITION: Engine malfunction that is likely to result in an engine damage.

Associated Thrust Lever ..... IDLE
Associated Start/Stop Selector ..... STOP

**NOTE: -** In the event of a thrust lever inoperative above Flight Idle, engine may be shutdown using associated engine fire handle.

**-** Engine will not shutdown with the Start/Stop Selector unless associated Thrust Lever is first moved to IDLE. If STOP is selected before Thrust Lever is retarded to IDLE, momentarily cycle START/STOP Selector to RUN and back to STOP.

If engine shutdown does not occur:

Fire Extinguishing Handle ..... PULL (DO NOT ROTATE)
Remaining Engine Thrust Rating ..... CON
Verify N2 and ITT decreasing below IDLE values.
APU ..... START
APU Bleed ..... AS REQUIRED
Crossbleed ..... AS REQUIRED
Land at the nearest suitable airport.
TCAS ..... TA ONLY

**WARNING: IF IN ICING CONDITIONS, REFER TO SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS PROCEDURE.**

In flight, the air conditioning pack valves will close automatically when:

- For AE3007A or AE3007A1/1 engines Pre-Mod. SB 145-73-0010: below 15000 ft, TAT above -18°C and the remaining engine at T/O-1 or CON mode.
- For AE3007A1 engines and AE3007A or AE3007A1/1 engines Post-Mod. SB 145-73-0010: below 9700 ft, TAT above 19°C at sea level, decreasing linearly to -5°C at 9700 ft and the remaining engine is at T/O-1 mode.
- For AE3007A1P or AE3007A1/3 engines: below 9700 ft, TAT above 19°C at sea level, decreasing linearly to -5°C at 9700 ft and the remaining engine is at T/O or T/O RSV mode.

If APU bleed is being used, the packs are not shut down.

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## ENGINE AIRSTART

Affected engine:

One Electric Fuel Pump (A or B) ..... ON
Ignition ..... AUTO
Start/Stop Selector ..... STOP
Engine Bleed ..... CLOSE
Thrust Lever ..... IDLE
Airspeed and Altitude..... REFER TO AIRSTART ENVELOPE

Perform an assisted start or windmilling, as required:

**CAUTION:** IN ICING CONDITIONS DO NOT USE APU BLEED START, TO AVOID LOSS OF ANTI-ICE SYSTEM PERFORMANCE.

Assisted start:

Crossbleed start:

N2 (operating engine)..... ABOVE 80%
Crossbleed ..... AUTO OR OPEN
Engine Bleed (operating engine)..... OPEN
Start/Stop Selector ..... START, THEN RUN
Engine Indication..... MONITOR

Check ignition. Check N2 rising. Observe limits. Abort start immediately if an Abnormal Engine Start is detected.

APU bleed start:

APU ..... START
APU Bleed..... OPEN
Crossbleed ..... AUTO OR OPEN
Engine Bleed (operating engine)..... CLOSE

If only the APU Generator is operative:

Windshield Heating ..... OFF
Electric Hydraulic Pump (inoperative engine)..... OFF

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Start/Stop Selector..... START, THEN RUN
Engine Indication ..... MONITOR
Check ignition. Check N2 rising. Observe limits. Abort start immediately if an Abnormal Engine Start is detected.

If Windshield Heating and Electric Hydraulic Pump were turned off before engine start:
Windshield Heating..... ON
Electric Hydraulic Pump ..... AUTO

Windmilling start:
Airspeed..... ABOVE 260 KIAS
Minimum N2..... 10%
Start/Stop Selector..... START, THEN RUN
ITT and N2..... MONITOR
Observe limits. Abort start immediately if an Abnormal Engine Start is detected.

**NOTE: -** Windmilling start will be slower than an assisted start.
- Windmilling start with N2 above 30% and increasing, the loss of altitude may be minimized, by reducing airspeed.
- Initiate windmilling start with N2 as high as possible. Windmilling starts are not possible with N2 below 10%. Once N2 is below 10%, it may not be recovered.

After start:

Affected Engine Bleed ..... AS REQUIRED
Crossbleed..... AUTO
APU Bleed ..... AS REQUIRED

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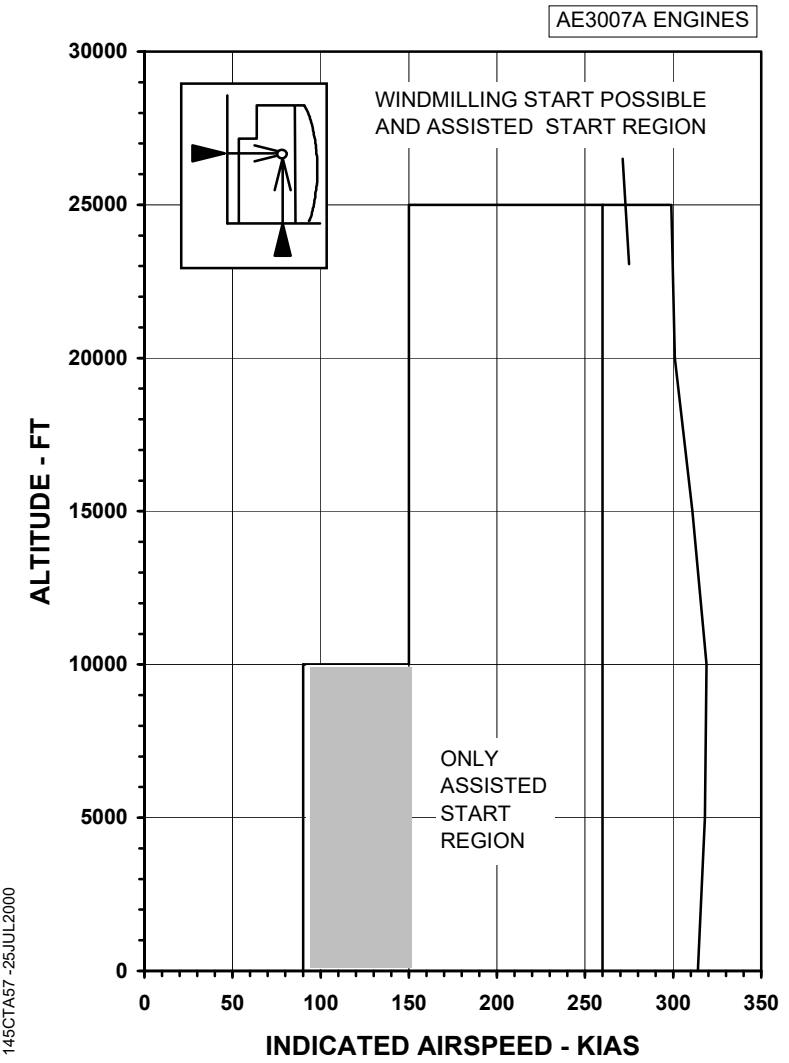
## ENGINE AIRSTART ENVELOPE




**NOTE:** Shaded area may be below 1. 23 $V_{SR}$



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## ENGINE HIGH OIL PRESSURE

Oil Pressure, Oil Temperature,
Oil Level, Engine Vibration ..... MONITOR
If oil temperature, and/or oil level, and/or engine vibration, exceeds normal operation range:
Associated Procedure..... ACCOMPLISH

## ENGINE HIGH OIL TEMPERATURE

EICAS Indication: Oil temperature pointers and digits become red.

Associated Thrust Lever ..... REDUCE
Reduce thrust lever and maintain the temperature within limits.
If oil temperature remains high, above 25000 ft:

Altitude ..... MAX 25000 ft
MINIMUM MEA

Monitor oil temperature for the remainder of the flight.
If limits cannot be maintained, perform a precautionary engine shutdown to prevent engine damage.

## ENGINE OIL LOW PRESSURE

EICAS Indication: Oil pressure pointers and digits become amber (below 49 psi).

When conditions permit, reduce N2 below 88%, and monitor oil temperature.

## ENGINE LOW OIL LEVEL

MFD Indication: Oil level digits become amber.

Monitor oil pressure for the remainder of the flight.
Consider performing a precautionary engine shutdown in order to preserve oil quantity so that engine may be restarted prior to landing.

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## ENGINE ATS SHUTOFF VALVE OPEN

EICAS CAUTION: E1 (2) ATS SOV OPN
LIGHT: Master Caution

Associated Bleed (including APU bleed)..... CLOSE
Crossbleed..... CLOSE

On ground:
- Associated Thrust Lever..... IDLE
- Associated Start/Stop..... STOP
- If engine shutdown dows not occur:
  - Fire Extinguishing Handle..... PULL (DO NOT ROTATE)

In flight:
- Altitude..... MAX 25000 ft
- Exit and avoid icing conditions.

## ENGINE REFERENCE ANTI-ICE DISAGREE

EICAS CAUTION: ENG REF A/I DISAG
LIGHT: Master Caution

Check ice protection system selection against takeoff data entered.

## ENGINE OVERTEMPERATURE

EICAS Indication: ITT pointer and digits become red and flash.

Confirm the affected side.
Associated Thrust Lever..... REDUCE

If the condition remains:
- Associated Bleed..... CLOSE
- Check the associated BLD VLV CLSD message on EICAS:
- Altitude..... MAX 25000 ft MINIMUM MEA
- TCAS..... TA ONLY

If the conditions remains:
- PRECAUTIONARY ENGINE SHUTDOWN or ENGINE FIRE, SEVERE DAMAGE OR SEPARATION Procedure..... ACCOMPLISH

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## ENGINE CONTROL FAILURE

EICAS CAUTION: E1 (2) CTL FAIL (may be presented)
LIGHT: Master Caution

**CAUTION:** DO NOT MANUALLY ALTERNATE ASSOCIATED FADECS.

Verify the associated FADEC in control.
Associated FADEC ..... RESET
If FADEC alternates automatically:
Avoid quick movements of the associated Thrust Lever.

**NOTE:** Thrust Lever movements may cause surge or an uncommanded engine shutdown.

If the associated engine thrust is no longer controllable:
PRECAUTIONARY ENGINE
SHUTDOWN procedure ..... AS REQUIRED

If FADEC does not alternate automatically:
Engine control is recovered.

## ENGINE NO TAKEOFF DATA

EICAS CAUTION: ENG NO TO DATA
LIGHT: Master Caution

Enter takeoff data before takeoff.

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## THRUST LEVER FAILURE

EICAS CAUTION: ENG1 (2) TLA FAIL
LIGHT: Master Caution

Associated FADEC ..... RESET

If Thrust Lever command is not available:
Associated FADEC ..... ALTN
Check on EICAS that FADEC in control has changed.

If thrust lever still does not respond thrust can be partially controlled through the Thrust Rating Buttons.

PRECAUTIONARY ENGINE
SHUTDOWN Procedure ..... AS REQUIRED

## ENGINE NOT DISPATCHABLE

EICAS CAUTION: E1 (2) NO DISP
LIGHT: Master Caution

Crew awareness.

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## ENGINE OUT

EICAS CAUTION: ENG1 (2) OUT
LIGHT: Master Caution

If during takeoff, above $V_1$ and associated with an engine flameout:

TAKEOFF WITH ENGINE
FAILURE Procedure ..... ACCOMPLISH

If in flight:

PRECAUTIONARY ENGINE
SHUTDOWN Procedure ..... ACCOMPLISH
ENGINE AIRSTART Procedure ..... AS REQUIRED
TCAS ..... TA ONLY

## FADEC NOT DISPATCHABLE

EICAS CAUTION: FADEC ID NO DISP
LIGHT: Master Caution

Crew awareness.

## ADC DATA FAIL

EICAS ADVISORY: E1 (2) ADC DATA FAIL

Confirm the failed side.
Associated FADEC ..... RESET
If the message remains on:
Associated FADEC ..... ALTN
Check on EICAS that the associated FADEC in control has changed.
If the message remains on:
Avoid unnecessary rapid thrust levers movement.

## THRUST LEVER STOP FAILURE

EICAS ADVISORY: E1 (2) IDL STP FAIL

Be careful when reducing engines near IDLE.

NEVER SET THRUST LEVERS BELOW IDLE IN FLIGHT.

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## ENGINE ABNORMAL VIBRATION

EICAS Indication: Vibration in the amber range below 2.5 IPS for more than 5 minutes during the takeoff or go-around phases or for more than 10 seconds during the remainder flight phases or equal or above 2.5 IPS.

Associated Thrust Lever ..... REDUCE TO KEEP VIBRATION WITHIN LIMITS

**CAUTION:** CONTINUOUS VIBRATION ABOVE LIMITS MAY DAMAGE THE ENGINE.

TCAS ..... TA ONLY

If vibration indication remains out of limits:
PRECAUTIONARY ENGINE SHUTDOWN Procedure..... ACCOMPLISH

## ENGINE FUEL FILTER IMPENDING BYPASS

EICAS ADVISORY: E1 (2) FUEL IMP BYP

If both engine fuel filters are affected:
Land at the nearest suitable airport.

## ENGINE OIL FILTER IMPENDING BYPASS

EICAS ADVISORY: E1 (2) OIL IMP BYP

Crew awareness.

## ENGINE FADEC DEGRADED

EICAS ADVISORY: E1 (2) CTL A (B) DEGRAD

Crew awareness.

## ENGINE SHORT DISPATCHABLE

EICAS ADVISORY: E1 (2) SHORT DISP

Crew awareness.

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## CHECK ENGINE PERFORMANCE

EICAS ADVISORY: CHECK A (A1, A1E, A1P, A3, A1/3) PERF

Associated Engine Performance..... CHECK

## LOSS OF ENGINE INDICATIONS

CONDITION: Loss of Thrust Mode, ITT, N1 and N2 indications.

If engine is operative but the indications are lost, proceed:

Associated FADEC ..... RESET

If engine indications are still not available:

Associated FADEC ..... ALTN

If engine indications are still not available:

Monitor the remaining engine indications.

PRECAUTIONARY ENGINE
SHUTDOWN Procedure..... AS REQUIRED

## ENGINE LIMITS EXCEEDANCE

EICAS CAUTION: E1 (2) EXCEEDANCE

Do not takeoff:

## ENGINE FPMU NOT DISPATCHABLE

EICAS CAUTION: E1 (2) FPMU NO DISP

Do not takeoff.

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# HYDRAULIC POWER

## BOTH HYDRAULIC SYSTEMS FAILURE

EICAS CAUTION: HYD SYS 1-2 FAIL, RUDDER SYS 1-2 INOP, AIL SYS 1-2 INOP

EICAS ADVISORY: E1-2 HYD PUMP FAIL

LIGHT: Master Caution

INDICATION: Hydraulic pressure indication on MFD may be amber.

Airspeed..... MAXIMUM 250 KIAS

Check hydraulic systems fluid quantity:

If any hydraulic system fluid quantity is in green range:

Associated Electric Hydraulic Pump..... ON

If any hydraulic system fluid quantity is in amber range:

Associated Electric Hydraulic Pump..... OFF

**CAUTION:** DO NOT OPEN THE SPEED BRAKE.

If one system can be recovered, complete the appropriate procedure for one hydraulic system failure.

If both systems remain inoperative:

Quick Disconnect Button ..... PRESS

Both Electric Hydraulic Pumps ..... OFF

**NOTE:** The nose landing gear doors will open, therefore the pilot should expect noise increase.

ABNORMAL LANDING GEAR EXTENSION Procedure ..... ACCOMPLISH

Rudder and aileron are operating under mechanical reversion mode. Expect greater rudder pedals and control wheels control forces. Both pilots should act together to control the airplane, if required. Consider the use of aileron and asymmetric thrust to help in yaw control.

Land at the nearest suitable airport. Avoid landings at airports with anticipated crosswind or turbulence. Perform a long final approach.

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Approach and landing configuration:
- Landing Gear ..... DOWN
- Flaps ..... 22°
- Airspeed ..... $V_{REF\ 45}$ + 30 KIAS

Use rudder for directional control on the ground.

EMERGENCY BRAKE
- TECHNIQUE Procedure ..... ACCOMPLISH

Do not attempt to taxi.

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 3.45.

## HYDRAULIC SYSTEM 1 FAILURE

EICAS CAUTION: HYD SYS 1 FAIL, RUDDER SYS 1 INOP, AIL SYS 1 INOP

EICAS ADVISORY: E1 HYD PUMP FAIL

LIGHT: Master Caution

INDICATION: Hydraulic pressure indication on MFD may be amber.

Check hydraulic systems fluid quantity:
- If hydraulic system fluid quantity is in green range:
  - Electric Hydraulic Pump 1 ..... ON
- If hydraulic system fluid quantity is in amber range:
  - Electric Hydraulic Pump 1 ..... OFF

If hydraulic power is not recovered:
- Airspeed ..... MAXIMUM 250 KIAS
- Electric Hydraulic Pump 1 ..... OFF

**NOTE:** As the nose landing gear doors will open, the pilot should expect a noise increasing during flight.

For landing gear extension:
- ABNORMAL LANDING GEAR EXTENSION Procedure ..... ACCOMPLISH

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Do not actuate left Thrust Reverser.
Use rudder and differential braking technique for directional control on ground.

Approach and landing configuration:
- Landing Gear..... DOWN
- Flaps..... 45°
- Airspeed ..... $V_{REF\ 45}$

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.60.

**NOTE:** The following systems will be inoperative: Inboard Spoiler, Outboard Brakes, LH Thrust Reverser, Landing Gear Extension, Steering and Nose Landing Gear Doors Retraction.

## HYDRAULIC SYSTEM 2 FAILURE

EICAS CAUTION: HYD SYS 2 FAIL, RUDDER SYS 2 INOP, AIL SYS 2 INOP

EICAS ADVISORY: E2 HYD PUMP FAIL

LIGHT: Master Caution

INDICATION: Hydraulic pressure indication on MFD may be amber.

Check hydraulic systems fluid quantity:
- If hydraulic system fluid quantity is in green range:
  - Electric Hydraulic Pump 2 ..... ON
- If hydraulic system fluid quantity is in amber range:
  - Electric Hydraulic Pump 2 ..... OFF

If hydraulic power is not recovered:
- Airspeed..... MAXIMUM 250 KIAS
- Electric Hydraulic Pump 2 ..... OFF
- Do not actuate right Thrust Reverser.

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Approach and landing configuration:
Landing Gear ..... DOWN
Flaps ..... 45°
Airspeed ..... $V_{REF\ 45}$

**CAUTION:** • DO NOT OPEN THE SPEED BRAKE.

• TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.53.

**NOTE: -** The following systems will be inoperative: Outboard Spoiler, Inboard Brakes, RH Thrust Reverser, and Emergency/Parking Brake.

**-** The Emergency/Parking Brake will be available only with the accumulator charge.

## HYDRAULIC SYSTEM OVERHEAT

EICAS CAUTION: HYD SYS 1 (2) OVHT
LIGHT: Master Caution

Associated Engine Hydraulic Pump ..... SHUTOFF
Associated Electric Hydraulic Pump ..... OFF
Airspeed ..... MAXIMUM 250 KIAS

For the remainder of flight, if required:
Affected Hydraulic system ..... 15 MINUTES OFF, 1 MINUTE ON

During approach and landing or when required:
Affected Hydraulic system ..... ON

After reaching taxi speed or when the system is no longer required:
Affected Hydraulic system ..... OFF

**NOTE:** To turn the hydraulic system on, first turn the electric pump to AUTO. As soon as the system pressure is recovered, release the engine pump shutoff button.

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## HYDRAULIC SYSTEM LOW QUANTITY

EICAS ADVISORY: HYD1 (2) LO QTY
MFD INDICATION: Hydraulic fluid quantity may be amber.

Monitor associated hydraulic system.

**NOTE:** If hydraulic system 2 is affected, do not open the Speed Brakes.

If HYD SYS 1 FAIL message is presented:

HYDRAULIC SYSTEM 1 FAILURE Procedure ..... ACCOMPLISH

If HYD SYS 2 FAIL message is presented:

HYDRAULIC SYSTEM 2 FAILURE Procedure ..... ACCOMPLISH

## HYDRAULIC ENGINE PUMP FAILURE

EICAS ADVISORY: E1 (2) HYD PUMP FAIL

Monitor associated hydraulic system.

If HYD SYS 1 FAIL message is presented:

HYDRAULIC SYSTEM 1 FAILURE Procedure ..... ACCOMPLISH

If HYD SYS 2 FAIL message is presented:

HYDRAULIC SYSTEM 2 FAILURE Procedure ..... ACCOMPLISH

## HYDRAULIC PUMP SELECTED OFF

EICAS ADVISORY: HYD PUMP SELEC OFF
Electric Hydraulic Pumps..... AUTO

## HYDRAULIC SHUTOFF VALVE CLOSED

EICAS ADVISORY: E1 (2) HYDSOV CLSD
If valve is not intentionally closed:
Engine Pump Shutoff Button ..... CHECK NOT PRESSED

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# LANDING GEAR AND BRAKES

## GEAR LEVER CANNOT BE MOVED TO UP AFTER TAKEOFF

CONDITION: Landing gear cannot be moved to up position after takeoff in the normal manner.

Wait 10 seconds to verify if the LG AIR/GND FAIL message is displayed.

If the message is presented, do not move Landing Gear Lever.

If the message is not presented:

Downlock Release Button ..... PRESS
Landing Gear Lever..... UP

Landing gear lever will be released, permitting gear retraction.

## ABNORMAL LANDING GEAR EXTENSION

CONDITION: Landing gear has not extended by normal means.

Landing Gear Lever..... DOWN

Continue accomplishing this procedure even if Landing Gear Lever cannot be moved DOWN.

Gear Electrical Override ..... DOORS

Wait 3 seconds:

Gear Electrical Override ..... GEAR
Landing Gear Indication ..... CHECK

If any of the gear is not locked down:

Landing Gear Lever..... UP
Gear Electrical Override ..... NORMAL
Wait 10 seconds.
Free Fall Lever ..... ACTUATE

Actuate the free fall lever up to full uplock position.

Landing Gear Lever..... DOWN
Landing Gear Indication ..... CHECK

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*CONTINUED FROM PREVIOUS PAGE*

If the failure persists:

Free Fall Lever ..... CYCLE

Cycle the free fall lever as long as necessary, but limited to 10 times, to lower the landing gear. Wait 20 seconds, with the lever in the uplock position, between each cycle. Verify lever at full uplock position after cycling.

If the failure still persists:

PARTIAL OR GEAR UP

LANDING Procedure ..... ACCOMPLISH

## PARTIAL OR GEAR UP LANDING

EICAS WARNING: LG/LEVER DISAGREE

LIGHT: Master Warning

CONDITION: Airplane committed to land with gear up or in transit.

EICAS Indication: Landing gear indication may present one or more boxes cross-hatched.

Burn fuel to reduce touchdown speed.

Passengers/crew ..... PREPARE FOR EMERGENCY LANDING AND EVACUATION PROCEDURE

Prior to approach:

Inhibit GPWS and landing gear warning by pulling their circuit breakers:

GPWS Circuit Breaker ..... J7 or J8

Aural Warning Circuit Breakers ..... B4 AND E30

Emergency Lights ..... ON

Electric Hydraulic Pumps ..... OFF

Engine Bleeds ..... OFF

Pressurization Dump Button ..... PRESS

Flaps ..... 45°

Landing Gear ..... AS REQUIRED

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**NOTE: -** The decision to land with all gear up or with any gear extended is left to pilots. The choice of configuration is made with basis on the number of gears available, airplane load distribution, controllability, and conditions of the landing field.

**-** In case one main gear leg is not down and locked, it is recommended that a gear up landing should be considered.

Landing Briefing ..... PERFORM

Just before touchdown:

Cabin ..... ANNOUNCE IMPACT

Apply thrust reversers (if available) at touchdown. Ground spoilers, thrust reversers, steering and normal brakes will not operate if any main gear is up.

Rudder is available to maintain runway centerline during initial landing phase.

Maintain wings level as long as possible and use brakes and steering (if available) for directional control.

After the airplane comes to a complete stop:

Start/Stop Selector ..... STOP
Electric Fuel Pumps ..... OFF
Fire Extinguishing Handles ..... PULL AND ROTATE

EMERGENCY EVACUATION

Procedure ..... ACCOMPLISH

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## LANDING GEAR AIR/GROUND SYSTEM FAILURE

EICAS CAUTION: LG AIR/GND FAIL
LIGHT: Master Caution

If not in icing conditions:
Icing Conditions ..... AVOID

If in icing conditions:
Anti-icing system ..... MONITOR

If any anti-ice valve does not open or anti-ice failure messages appear, exit and avoid icing conditions.

After exiting icing conditions, proceed as follows:
Maximum Bank Angle ..... 30°
Minimum Airspeed for
Flaps up or 9° ..... 190 KIAS

Approach and Landing Configuration:
Landing Gear ..... DOWN
Flaps ..... 45°
Airspeed ..... $V_{REF\ 45}$

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.70.

**NOTE: -** Thrust Reversers, and Ground Spoiler may not be available. Depending on the failed condition, Ground Idle may not be selectable. Refer to the associated abnormal procedures.

**-** If message is presented on ground, one pair of brakes (below 10 kt ground speed) and Steering may not be available. Refer to the associated abnormal procedures.

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## BRAKE OVERHEAT

EICAS CAUTION: BRAKE OVERHEAT
LIGHT: Master Caution

If during landing and runway length is enough:
- Brake Pressure ..... REDUCE
- Use of full reverse thrust is recommended.

If after takeoff:
- Lower landing gear for cooling as soon as possible.
- Airspeed ..... BELOW 200 KIAS
- Retract gear when brakes temperature is in the green range.
- If MFD is not available, retract gear after message is removed.
- Airspeed ..... AS REQUIRED

When on ground, park the airplane as soon as possible.

Before next takeoff:
- Brakes Temperature ..... CHECK IN GREEN RANGE

If Brakes Temperature Monitoring System is not available:
- Quick Turn Around Chart ..... CHECK
- Wheel Thermal Plugs ..... CHECK

**NOTE: -** Brake effectiveness may be reduced.
**-** A positive way to check Wheel Thermal Plugs is to verify that none of the tires are flat.

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## BRAKES INOPERATIVE

EICAS CAUTION: BRK OUTBD (INBD) INOP
LIGHT: Master Caution

If one pair of brakes is inoperative, apply brakes normally through the pedals.

If both pair of brakes are inoperative:

EMERGENCY BRAKING
TECHNIQUE Procedure. ..... ACCOMPLISH

In any case:

Landing configuration:
Flaps ..... 45°
Airspeed ..... $V_{REF\ 45}$
During landing run:
Thrust Levers ..... REVERSE

**CAUTION:** IN BOTH CASES, TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1. 45.

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## BRAKES DEGRADED

EICAS CAUTION: BRAKE DEGRADED
LIGHT: Master Caution

Apply brakes normally.
Brake effectiveness may be reduced and braking asymmetry may be felt.

During landing run:
Thrust Levers (if available) ..... REVERSE

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.24.

## EMERGENCY BRAKING TECHNIQUE

Pull the emergency brake handle carefully and continuously until the first airplane reaction. Use the parking brake light as a reference for brake application. Modulate brake application until the airplane achieves the desired deceleration.
In case of airplane skidding, release the handle and pull it again as required.

**NOTE:** Anti-skid protection is not available for emergency/parking brake.

## EMERGENCY/PARKING BRAKE LOW PRESSURE

EICAS CAUTION: EMRG BRK LO PRES
LIGHT: Master Caution

If necessary to use the emergency/parking brake, apply it in advance (brake response may be delayed).
When parking the airplane, use wheel blocks.

## EMERGENCY/PARKING BRAKE HANDLE DISAGREE

INDICATION: BRAKE ON light illuminated with Emergency/Parking Brake handle not actuated.

Park the airplane as soon as possible.
Do not takeoff.

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## STEERING SYSTEM INOPERATIVE OR UNCOMMANDED SWERVING ON GROUND

EICAS CAUTION: STEER INOP (may be presented)
LIGHT: Master Caution

| | |
|---|---|
| Steering Handwheel | DO NOT USE |
| Steering Disengagement Button | PRESS |

Control the airplane using differential brakes and rudder.
Consider the use of differential thrust reverser if serviceable.

**NOTE:** Do not actuate the steering handwheel since it will reengage the steering system and will disable the 7° maximum nose wheel deflection protection. This may cause the nose wheel to be steered up to its limit and may exacerbate the swerving effect.

## NOSE LANDING GEAR DOOR OPEN

CONDITION: Noise increase due to nose landing gear doors open.

| | |
|---|---|
| Airspeed | MAX 250 KIAS |
| Icing Conditions | AVOID/EXIT |
| Fuel Consumption | MONITOR |
| ABNORMAL LANDING GEAR EXTENSION Procedure | AS REQUIRED |

## TIRE BURST

CONDITION: Abnormal noise from any landing gear, visual cues or report of tire burst.

If failure has occurred during takeoff, do not retract gear. Allow a reasonable time for wheels spin down and tires cooling.

## PARKING BRAKE RESIDUAL PRESSURE

CONDITION: BRAKE light remained illuminated with Parking Brake Handle released.

Do not attempt to taxi or takeoff.
If required, taxi the minimum distance necessary to clear the area.

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# FLIGHT CONTROLS

## RUDDER/YAW TRIM RUNAWAY

| | |
|---|---|
| Quick Disconnect Button | PRESS AND HOLD |
| Rudder Systems 1 and 2 | OFF |

Yaw Trim Circuit Breaker (F12) ..... PULL
Quick Disconnect Button ..... RELEASE

Strongly push pedal opposite to the side of the uncommanded yaw, while applying ailerons to control roll.

If necessary, turn on one rudder system at a time to identify the failed system. Prepare to overcome the yaw generated by the failed system.

If both systems remains inoperative:

Expect greater rudder pedals force. Both pilots should act together to control the airplane, if required. Consider the use of aileron to help in yaw control, and asymmetric thrust to trim the airplane.

Do not use yaw trim system for the remainder of the flight.

Avoid landing at airports with anticipated turbulence or crosswind.

Land at the nearest suitable airport.

**CAUTION:** DO NOT TRY TO RESET THE RUDDER SYSTEMS.

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## AILERON SYSTEM INOPERATIVE

EICAS CAUTION: AIL SYS 1 (2) INOP
LIGHT: Master Caution

Associated Aileron System ..... OFF
Airspeed ..... MAXIMUM 250 KIAS

If the remaining system fails:
- Remaining Aileron System ..... OFF
- Quick Disconnect Button ..... PRESS

Aileron is operating under mechanical reversion mode. Expect greater aileron control force. If required, both pilots should act together to control airplane. Avoid landing at airports with anticipated turbulence or crosswind. Perform a long final approach.

Approach and landing configuration:
- Landing Gear ..... DOWN
- Flaps ..... 22°
- Airspeed ..... $V_{REF\ 45}$ + 30 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.85.

## RUDDER OVERBOOST

EICAS CAUTION: RUDDER OVERBOOST
LIGHT: Master Caution

Rudder System 2 ..... OFF

Check that only RUDDER 2 SYS INOP message is presented on EICAS.

If the message disappears:
- Continue flight with rudder system 2 off.
- Below 135 KIAS:
  - Rudder System 2 ..... ON

If message remains:
- Rudder System 2 ..... ON
- Rudder System 1 ..... OFF
- Check that only RUDDER 1 SYS INOP message is presented on EICAS.
- Continue flight with the rudder system 1 off.
- Below 135 KIAS:
  - Rudder System 1 ..... ON

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## RUDDER HARDOVER PROTECTION FAILURE

EICAS CAUTION: RUD HDOV PROTFAIL
LIGHT: Master Caution

On ground:
Do not takeoff.

In flight:
Hardover protection is not available.

## RUDDER SYSTEM INOPERATIVE

EICAS CAUTION: RUDDER SYS 1(2) INOP or RUDDER SYS 1-2 INOP
LIGHT: Master Caution

If only one rudder system is affected:
Affected Rudder System..... OFF

If RUDDER SYS 1-2 INOP message is displayed:
Rudder System 2..... OFF

If RUDDER SYS 1-2 INOP message is still displayed:
Rudder System 1..... OFF

**CAUTION:** IF THE MESSAGE IS PRESENTED FOLLOWING A RUDDER RUNAWAY, DO NOT TURN ON THE SYSTEMS.

Both Rudder Systems ..... ON

If RUDDER SYS 1-2 INOP message is still displayed:
Expect greater rudder pedal force. If required, both pilots should act together to control the airplane. Consider the use of aileron to help in yaw control, and asymmetric thrust to control the airplane.

Avoid landing at airports with anticipated turbulence, gusts or crosswind.

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# FLAP SYSTEM FAILURE
# (APPLICABLE TO ALL MODELS EXCEPT EMB-145 XR)

EICAS CAUTION: FLAP FAIL
LIGHT: Master Caution
CONDITION: Flap operation is not possible. Flap position indication may be amber.

Flaps may be at intermediate positions. Maintain airspeed according to the following:

| FLAPS POSITION | MAXIMUM AIRSPEED |
|---|---|
| 1° to 9° | 250 KIAS |
| 10° to 22° | 200 KIAS |
| 23° to 45° | 145 KIAS |

When landing maintain airspeed according to the following:

| FLAPS POSITION | MINIMUM AIRSPEED |
|---|---|
| 0 to 8° | $V_{REF\ 45}$ + 30 KIAS |
| 9° to 21° | $V_{REF\ 45}$ + 10 KIAS |
| 22° to 44° | $V_{REF\ 45}$ + 5 KIAS |
| 45° | $V_{REF\ 45}$ |

**CAUTION:**
- TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.65 WHEN LANDING WITH FLAPS BETWEEN ZERO AND 8°.
- TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.40 WHEN LANDING WITH FLAPS BETWEEN 9° AND 21°.
- TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.40 WHEN LANDING WITH FLAPS BETWEEN 22° AND 44°.

**NOTE:**
- Depending on the flap position, EGPWS/GPWS warnings may sound. If necessary, inhibit EGPWS/GPWS by pulling its circuit breaker (J7 or J8).
- If flap indication on EICAS is not available, use flap position marks on the wing.

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# FLAP SYSTEM FAILURE (APPLICABLE TO EMB-145XR MODEL)

EICAS CAUTION: FLAP FAIL
LIGHT: Master Caution
CONDITION: Flap operation is not possible. Flap position indication may be amber.

Flaps may be at intermediate positions. Maintain airspeed according to the following:

| FLAPS POSITION | MAXIMUM AIRSPEED | ABOVE 10000 ft AND Y/D DISENGAGED |
|---|---|---|
| 1° to 9° | 250 KIAS | 250 KIAS |
| 10° to 22° | 200 KIAS | 180 KIAS |
| 23° to 45° | 160 KIAS | 145 KIAS |

When landing maintain airspeed according to the following:

| FLAPS POSITION | MINIMUM AIRSPEED |
|---|---|
| 0 to 8° | $V_{REF\ 45}$ + 30 KIAS |
| 9° to 21° | $V_{REF\ 45}$ + 10 KIAS |
| 22° to 44° | $V_{REF\ 45}$ + 5 KIAS |
| 45° | $V_{REF\ 45}$ |

**CAUTION:**
- TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.65 WHEN LANDING WITH FLAPS BETWEEN ZERO AND 8°.
- TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.40 WHEN LANDING WITH FLAPS BETWEEN 9° AND 21°.
- TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.40 WHEN LANDING WITH FLAPS BETWEEN 22° AND 44°.

**NOTE:**
- Depending on the flap position, EGPWS/GPWS warnings may sound. If necessary, inhibit EGPWS/GPWS by pulling its circuit breaker (J7 or J8).
- If flap indication on EICAS is not available, use flap position marks on the wing.

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## SPEED BRAKE LEVER DISAGREE

EICAS CAUTION: SPBK LVR DISAGREE
LIGHT: Master Caution

Speed Brake Lever ..... CLOSE

## FLAP LOW ACTUATION SPEED

EICAS ADVISORY: FLAP LOW SPEED

Anticipate flap actuation.

## LOSS OF PITCH OR ROLL COMMAND

CONDITION: Pitch or roll commands are not effective.

If loss of command by one pilot is total or partial, command will be taken over by the other pilot.

If a subsequent jamming occurs:

Affected Surface Disconnection Handle ..... PULL

If the failure persists, control the airplane using rudder, trims, aileron and asymmetric thrust, as required.

Avoid landing at airports with anticipated turbulence or crosswind.

## UNCOMMANDED ELEVATOR OR AILERON DISCONNECTION

LIGHT: Amber ELEV DISC or AIL DISC on Control Stand.
CONDITION: One control column or control wheel moves independently of the other.

Affected Surface Disconnection Handle ..... PULL

Avoid landing at airport with anticipated turbulence or crosswind.

**NOTE:** Since aileron artificial feel unit is installed in the copilot's side, avoid use of pilot's control wheel, when aileron is disconnected.

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## AILERON ARTIFICIAL FEEL INOPERATIVE

CONDITION: Control Wheel inputs become light and do not center by itself.

Airspeed ..... BELOW 200 KIAS

Do not make sudden and large aileron inputs.

## RUDDER ARTIFICIAL FEEL INOPERATIVE

CONDITION: Rudder pedals become extremely light and do not center by themselves. Yaw trim does not operate properly, although its pictorial indicates normal condition.

Rudder System 2 ..... OFF

If the failure persists:

Rudder System 1 ..... OFF

RUDDER MECHANICAL REVERSION MODE Procedure ..... APPLY

## ASYMMETRIC RUDDER OPERATION

CONDITION: Rudder pedals require more effort to be moved to one side than the other. Also, the rudder and yaw trim commands provide different results for both sides.

Rudder System 2 ..... OFF

If the failure persists:

Rudder System 2 ..... ON

Land at the nearest suitable airport.

The remainder of the flight should be made with both rudder systems operational, which provides better rudder performance than in mechanical reversion mode.

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## GUST LOCK FAILURE

LIGHT: GUST LOCK (amber)

On ground:

Do not takeoff.

In flight:

Do not push control column full Nose Down.
Avoid flying in turbulence conditions.
Consider diversion.
Avoid landing at airports with anticipated turbulence or crosswind.

**NOTE:** This procedure is applicable only to airplanes equipped with electromechanical gust lock system.

## PITCH TRIM SWITCH INOPERATIVE

EICAS CAUTION: PTRIM CPT SW FAIL, PTRIM F/O SW FAIL,
PTRIM BKP SW FAIL

On ground:

Deenergize the airplane and energize it again.

In flight:

Use another serviceable switch.

## STIFFENED ELEVATOR

EICAS WARNING: AUTOPILOT FAIL (may be presented),
SPS 1-2 INOP (may be presented)
EICAS CAUTION: STICK PUSHER FAIL (may be presented)
CONDITION: Elevator control columns movement is stiffened.

Autopilot ..... DISENGAGE
Pitch Trim ..... AS REQUIRED

Avoid abrupt and large elevator inputs.

Consider descent to a warmer altitude.

Freezing conditions may lead to de/anti-icing fluids residues to stiffen the elevator.

If the elevator control columns movement is not recovered:

JAMMED ELEVATOR Procedure ..... ACCOMPLISH

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# AIR CONDITIONING, PNEUMATICS AND PRESSURIZATION

## BLEED LOW TEMPERATURE

EICAS Caution: BLD 1 (2) LOW TEMP
LIGHT: Master Caution
INDICATION: Pointer on MFD may be out of view or indication may be amber.

If temperature indication on MFD (ECS and Pneumatic Page) is in the green range or the pointer is out of view, disregard the message.
Monitor the bleed temperature.

If the pointer on MFD indicates low temperature (white range):

Associated Thrust Lever ..... ADVANCE

Adjust associated Thrust Lever until the message disappears or until the pointer of the failed side reaches the green range or the remaining pointer.

Advancing Thrust Lever until 86% N2 represents normal system condition.

If the message persists or if the MFD is not available:

Associated Bleed ..... CLOSE
Altitude ..... MAX 25000 ft
MINIMUM MEA

**WARNING: IF IN ICING CONDITIONS, REFER TO SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS PROCEDURE.**

If the message persists, avoid or exit icing conditions.

**NOTE:** Ice Detection Override Knob must be set to ALL at least 2 minutes after exiting icing conditions or after ICE CONDITION advisory message has disappeared.

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## HIGH STAGE VALVE FAILURE

EICAS Caution: HS VLV 1 (2) FAIL
LIGHT: Master Caution

Monitor bleed temperature.
If the bleed temperature is too high:
BLEED OVERTEMPERATURE
Procedure ..... AS REQUIRED

If the bleed temperature is too low:
BLEED LOW TEMPERATURE
Procedure ..... AS REQUIRED

**WARNING: IF IN ICING CONDITIONS, REFER TO SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS PROCEDURE.**

## BLEED VALVE FAILURE

EICAS Caution: BLD 1 (2) VLV FAIL
LIGHT: Master Caution

If BLD 2 VLV CLSD message is also displayed on the EICAS:
Crossbleed ..... OPEN
Altitude ..... MAX 25000 ft
MINIMUM MEA

If BLD 1 VLV CLSD message is also displayed on the EICAS:
If APU is not serviceable:
Crossbleed ..... OPEN
Altitude ..... MAX 25000 ft
MINIMUM MEA

If APU is serviceable:
Crossbleed ..... CLOSE
APU ..... START
APU Bleed ..... OPEN

**WARNING: IF IN ICING CONDITIONS, REFER TO SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS PROCEDURE.**

If BLD 1(2) VLV CLSD message is not displayed on the EICAS:
Monitor the system for the remainder of the flight.

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## BLEED VALVE CLOSED

EICAS ADVISORY: BLD 1 (2) VLV CLSD

If required and the situation permits:
- Associated Pack ..... OFF THEN ON
- Associated Bleed ..... OPEN

If it is not possible to open bleed valve:
- BLEED VALVE FAILURE Procedure ..... ACCOMPLISH

## APU BLEED VALVE FAIL

EICAS Caution: APU BLD VLV FAIL
LIGHT: Master Caution

If valve failed closed:
- Engine Bleed ..... AS REQUIRED

If valve failed open and a duct leak exists (OPEN annunciation in the APU Bleed Button and BLD APU LEAK message displayed):
- APU ..... SHUTDOWN

## CROSSBLEED FAILURE

EICAS Caution: CROSS BLD FAIL
LIGHT: Master Caution

If the valve has failed open, associated to a duct leakage or engine overtemperature:
- Both Engine Bleeds ..... CLOSE
- APU Bleed ..... CLOSE
- Altitude ..... MEA OR 10000ft, WHICHEVER IS HIGHER
- Icing Conditions ..... EXIT/AVOID

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## CROSSBLEED SELECTED OFF

EICAS Caution: CROSS BLD SW OFF
LIGHT: Master Caution

Crossbleed Knob ..... AUTO

## CROSSBLEED OPEN

EICAS ADVISORY: CROSS BLD OPEN

Crew awareness.

## RAM AIR VALVE FAILURE

EICAS Caution: RAM AIR VLV FAIL
LIGHT: Master Caution

Air Conditioning System..... MONITOR

If the PACK 1 (2) OVLD or PACK 1 (2) OVHT caution message appears:

- Associated Pack ..... OFF
- Altitude ..... MAX 25000 ft
  MINIMUM MEA

If both packs have been shutoff:

- Altitude ..... MEA OR
  10000 ft,
  WHICHEVER
  IS HIGHER
- Pressurization Mode Selector..... MAN
- Pressurization Manual Controller..... AS REQUIRED
- If necessary:
  - Pressurization Manual Controller ..... FULL UP
  - At least one bleed source, engines or APU, must be kept open.

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## PACK OVERLOAD

EICAS Caution: PACK 1 (2) OVLD
LIGHT: Master Caution

Recirculation Fan ..... ON

Associated Temperature & Mode Selector ..... AUTO/
12 O'CLOCK
Associated Pack ..... OFF
Wait 3 minutes.
Associated Pack ..... ON

**NOTE:** In case the message remains displayed after reset, report to the maintenance personnel.

If the message remains on:
- Associated Temperature & Mode Selector ..... MANUAL/ 12 O´CLOCK
- Associated Pack ..... OFF
- Wait 3 minutes.
- Associated Pack ..... ON

If the message still remains on:
- Associated Pack ..... OFF
- Altitude ..... MAX 25000 ft MINIMUM MEA
- Associated Engine Bleed ..... OPEN

If both packs have been shutoff:
- Altitude ..... MEA OR 10000 ft, WHICHEVER IS HIGHER
- Pressurization Mode Selector ..... MAN
- Pressurization Manual Controller ..... AS REQUIRED
- If required:
  - Pressurization Manual Controller ..... FULL UP

**NOTE:** At least one bleed source, engines or APU, must be kept open.

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# PACK OVERHEAT

EICAS Caution: PACK 1 (2) OVHT
LIGHT: Master Caution

Associated Temperature & Mode Selector ..... AUTO/FULL COLD
Associated Pack ..... OFF
Wait 3 minutes.
Associated Pack ..... ON
If message remains:
- Associated Temperature & Mode Selector ..... MANUAL/FULL COLD
- Associated Pack ..... OFF
- Wait 3 minutes.
- Associated Pack ..... ON

If the message still remains:
- Associated Pack ..... OFF
- Altitude ..... MAX 25000 ft MINIMUM MEA

If both packs have been shutoff:
- Altitude ..... MEA OR 10000 ft, WHICHEVER IS HIGHER
- Pressurization Mode Selector ..... MAN
- Pressurization Manual Controller ..... AS REQUIRED
- If required:
  - Pressurization Manual Controller ..... FULL UP

**NOTE:** At least one bleed source, engines or APU, must be kept open.

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## PACK VALVE FAILURE

EICAS Caution: PACK 1 (2) VLV FAIL
LIGHT: Master Caution
If valve failed closed (pack valve closed advisory message is on):
Altitude ..... MAX 25000 ft
MINIMUM MEA

If valve failed open and it is necessary to turn off associated air conditioning system:
Crossbleed ..... CLOSE
Associated Bleed ..... CLOSE
APU Bleed (if left pack failed) ..... CLOSE
Altitude ..... MAX 25000 ft
MINIMUM MEA

**WARNING: IF IN ICING CONDITIONS, REFER TO SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS PROCEDURE.**

If both packs have been shutoff:
Altitude ..... MEA OR 10000 ft, WHICHEVER IS HIGHER
Pressurization Mode Selector ..... MAN
Pressurization Manual Controller ..... AS REQUIRED
If required:
Pressurization Manual Controller ..... FULL UP

**NOTE:** At least one bleed source, engines or APU, must be kept open.

## PACK VALVE CLOSED

EICAS ADVISORY: PACK 1 (2) VLV CLSD
If required and situation permitting:
Associated Pack ..... OFF THEN ON
If it is not possible to open pack valve:
Altitude ..... MAX 25000 ft
MINIMUM MEA

If both packs are closed:
Altitude ..... MEA OR 10000 ft WHICHEVER IS HIGHER

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# PRESSURIZATION AUTOMATIC SYSTEM FAILURE/ CABIN DEPRESSURIZATION/ CABIN RATE ABNORMAL FLUCTUATIONS

EICAS Caution: PRESN AUTO FAIL (may be presented)
LIGHT: Master Caution
EICAS INDICATION: Abnormal cabin altitude (amber or red) may be presented.
Erratic cabin rate fluctuations may be presented.

Pressurization Manual Controller ..... 11 O'CLOCK POSITION

**NOTE:** At least one bleed, engines or APU, must be open.

Pressurization Mode Selector ..... MAN
Wait 20 seconds due to the time response of pressurization system in manual mode.

Pressurization Manual Controller ..... AS REQUIRED
If unsuccessful:
Altitude ..... MEA OR 10000 ft, WHICHEVER IS HIGHER
Pressurization Manual Controller ..... FULL DOWN
Pressurization Mode Selector ..... AUTO
Pressurization Dump Button ..... PRESS

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## LOSS OF PRESSURIZATION INDICATION

INDICATION: One or more of the pressurization system indications is not being presented.

Use the remaining indications to maintain cabin altitude below 10000 ft, according to the table below:

| AIRPLANE ALTITUDE (ft) | CABIN ALTITUDE (ft) | DIFFERENTIAL PRESSURE (psi) |
|---|---|---|
| 10000 | 300 | 4.4 |
| 11000 | 500 | 4.7 |
| 12000 | 700 | 5.0 |
| 13000 | 900 | 5.2 |
| 14000 | 1100 | 5.5 |
| 15000 | 1300 | 5.7 |
| 16000 | 1500 | 5.9 |
| 17000 | 1700 | 6.1 |
| 18000 | 1900 | 6.3 |
| 19000 | 2200 | 6.5 |
| 20000 | 2400 | 6.7 |
| 21000 | 2700 | 6.8 |
| 22000 | 2900 | 7.0 |
| 23000 | 3200 | 7.1 |
| 24000 | 3400 | 7.2 |
| 25000 | 3800 | 7.3 |
| 26000 | 4100 | 7.4 |
| 27000 | 4400 | 7.5 |
| 28000 | 4700 | 7.6 |
| 29000 | 5000 | 7.6 |
| 30000 | 5400 | 7.7 |
| 31000 | 5700 | 7.7 |
| 32000 | 6100 | 7.7 |
| 33000 | 6500 | 7.7 |
| 34000 | 6800 | 7.8 |
| 35000 | 7200 | 7.8 |
| 36000 | 7600 | 7.8 |
| 37000 | 8000 | 7.8 |

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# ELECTRONIC BAY OVERTEMPERATURE

EICAS Caution: ELEKBAY OVTEMP
LIGHT: Master Caution

Turn off systems and equipment that are redundant or unessential for the current phase of flight.

The following equipment is installed in the forward electronic compartment:

- Air Data Computer (ADC);
- Transponder Mode S;
- Integrated Communication Unit (ICU);
- Aural Warning Computer (AWC);
- Flight Management System (FMS);
- Attitude and Heading Reference System (AHRS);
- Passenger Address;
- Integrated Navigation Unit (INU);
- Inverters;
- Dimmers;
- Backup Battery.

It is recommended to turn off the systems that are unessential, using the table below to assess which system could be turned off. Turn off only systems that are unessential to the present phase of flight.

| SYSTEM | POWER OFF CONTROL |
|---|---|
| Passenger Address | PA CB.....PULL |
| Dimmers | Panel lights knob (pilot, pedestal and copilot) at left and right side of the glare shield panel .....OFF<br>OR<br>PUSH BUTTONS CB.....PULL |
| Integrated Navigation Unit | For INU 1:<br>ADF 1 CB, DME 1 CB and VOR/ILS 1 CB.....PULL<br>OR<br>For INU 2:<br>ADF 2 CB, DME 2 CB and VOR/ILS 2 CB.....PULL |

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| SYSTEM | POWER OFF CONTROL |
|---|---|
| Inverters | Push out AC PWR Push Button on overhead Electrical System panel.<br>**NOTE:** TCAS and GPWS/Windshear may use 115V AC. |

If the message persists, it is recommended to turn off the redundant system and unessential equipment, using the table below to assess which system or equipment could be turned off. Turn off only systems and equipment that are unessential to the present phase of flight.

| SYSTEM | POWER OFF CONTROL |
|---|---|
| FMS | - For Honeywell FMS:<br>  - For FMS 1: CMPTR 1 CB.<br>  - For FMS 2: CMPTR 2 CB.<br>- For Universal FMS:<br>  - FMS 1 CB.<br>  - FMS 2 CB.<br>**NOTE:** Some airplanes may not be equipped with dual FMS. |
| Aural Warning Computer | AWS CB. |
| Transponder Mode S | - For Transponder 1: XPDR 1 CB.<br>- For Transponder 2: XPDR 2 CB. |
| Integrated Communication Unit | - For ICU 1: XPDR 1 CB and VHF 1 CB.<br>- For ICU 2: XPDR 2 CB and VHF 2 CB. |
| Attitude and Reference System | - AHRS 1 CB.<br>- AHRS 2 CB. |
| Air Data Computer | - ADC 1 CB.<br>- ADC 2 CB. |
| Backup Battery | Backup Power Push Button on overhead Electrical System panel. |

If the message remains, maintain a cross-check between main and standby instruments. In case a disagreement arises, assume the main instruments indication is unreliable and land at the nearest suitable airport.

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# ICE PROTECTION SYSTEM

## WING ANTI-ICING FAILURE

EICAS WARNING: ICE COND-A/I INOP
EICAS CAUTION: WG 1 (2) A/ICE FAIL or WG A/ICE FAIL
LIGHT: Master Warning and Master Caution

Ice Detection Override Knob ..... ALL
Thrust Levers ..... ADVANCE

If failure persists:
Wing Anti-Icing Button ..... CYCLE

If failure persists:
Wing Anti-Icing Button ..... OFF
Avoid or exit icing conditions.

After exiting icing conditions:

Ice Detection Override Knob ..... AUTO

Maximum Bank Angle ..... 30°
Minimum Airspeed for
Flaps up or 9° ..... 190 KIAS

If in icing conditions or if there is any uncertainty as to whether the wing surfaces are clear of ice prior to approach and landing, proceed:

Landing configuration:
Flaps ..... 22°
Airspeed ..... $V_{REF\ 45}$ + 30 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.85.

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## STABILIZER ANTI-ICING FAILURE

EICAS WARNING: ICE COND-A/I INOP
EICAS CAUTION: STAB A/ICE FAIL
LIGHT: Master Warning and Master Caution

Ice Detection Override Knob ..... ALL
Thrust Levers ..... ADVANCE

If failure persists:
Stabilizer Anti-Icing Button ..... CYCLE

If failure persists:
Stabilizer Anti-Icing Button ..... OFF
Avoid or exit icing conditions.

After exiting icing conditions:

Ice Detection Override Knob ..... AUTO
Maximum Bank Angle ..... 30°
Minimum Airspeed for
Flaps up or 9° ..... 190 KIAS
Landing configuration:
Flaps ..... 22°
Airspeed ..... $V_{REF\ 45}$ + 15 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.55.

If associated with Wing Anti-icing System failure and if in icing conditions or if there is any uncertainty as to whether the wing surfaces are clear of ice prior to approach and landing, proceed:

Landing configuration:
Flaps ..... 22°
Airspeed ..... $V_{REF\ 45}$ + 30 KIAS

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FORFLAPS 45° BY 1.85.

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## ENGINE ANTI-ICING FAILURE

EICAS WARNING: ICE COND-A/I INOP
EICAS CAUTION: E1 (2) A/ICE FAIL
LIGHT: Master Warning and Master Caution

Thrust Levers ..... ADVANCE
If the message persists:
Ice Detection Override Knob ..... ALL
If the message still persists:
Engine Air Inlet Anti-Icing Button ..... CYCLE
If the message still persists:
Icing Conditions ..... AVOID/EXIT
Two minutes after exiting icing conditions:
Ice Detection Override Knob ..... AUTO

**NOTE:** Ice Detection Override Knob must be set to ALL for at least 2 minutes after exiting icing conditions or after ICE CONDITION advisory message has disappeared. In such condition, caution message NO ICE-A/I ON may be presented, and must be disregarded.

Engine Vibration ..... MONITOR
If vibration increases, advance thrust levers, one at a time, to obtain 60% N1 minimum for 5 seconds, and then return to the former setting.
If vibration increases to unacceptable values or engine parameters indicate abnormal values, exit icing conditions.

## SINGLE ENGINE OR SINGLE BLEED OPERATION IN ICING CONDITIONS

Crossbleed ..... OPEN
Altitude ..... MEA OR BELOW 15000 ft, WHICHEVER IS HIGHER

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Above 15000 ft:

Anti-icing system performance decreases.

If it is not possible to descend below 15000 ft, failure messages may be presented. In this case, exit icing conditions and refer to the appropriate approach and landing procedure.

Below 15000 ft:

If an anti-icing system failure message is presented, refer to the Associated System Anti-Icing Procedure.

In flight, the air conditioning pack valves will close automatically when:

- For AE3007A or AE3007A1/1 engines Pre-Mod. SB 145-73-0010: below 15000 ft, TAT above -18°C and the remaining engine at T/O-1 or CON mode.
- For AE3007A1 engines and AE3007A or AE3007A1/1 engines Post-Mod. SB 145-73-0010: below 9700 ft, TAT above 19°C at sea level, decreasing linearly to -5°C at 9700 ft and the remaining engine is at T/O-1 mode.
- For AE3007A1P or AE3007A1/3 engines: below 9700 ft, TAT above 19°C at sea level, decreasing linearly to -5°C at 9700 ft and the remaining engine is at T/O or T/O RSV mode.

## ANTI-ICING LOW CAPACITY

EICAS WARNING: ICE COND-A/I INOP
EICAS CAUTION: A/ICE LOW CAPACITY
LIGHT: Master Warning and Master Caution

Thrust Lever ..... ADVANCE

Advance Thrust Lever to at least 55% N1 and wait for 5 seconds.

If Thrust Lever advance required to clear the message exceeds 55% N1, report to the maintenance personnel.

If the message still persists, Wing and/or Stabilizer Anti-Icing Failure messages may be presented, then:

Associated System Anti-Icing Failure Procedure ..... PERFORM

## ENGINE ANTI-ICING OVERPRESSURE

EICAS ADVISORY: ENG A/ICE OVERPRES

Crew awareness.

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## ANTI-ICING ON WITHOUT ICING CONDITIONS

EICAS CAUTION: NO ICE- A/ICE ON
LIGHT: Master Caution

Ice Detection Override Knob..... AUTO
If the message persists, check the overhead panel and turn off all unnecessary anti-ice system.

If the message persists and is associated with Wing or Stabilizer Anti-Icing System:

Altitude..... MAX 25000 ft
MINIMUM MEA
APU ..... START
APU Bleed ..... OPEN
Crossbleed..... OPEN
Engine Bleeds..... CLOSE

## ANTI-ICING SWITCH OFF

EICAS CAUTION: A/ICE SWITCH OFF
LIGHT: Master Caution

Turn on all anti-icing system buttons.

## ICE DETECTOR FAIL

EICAS CAUTION: ICE DET 1 (2) FAIL or ICE DETECTORS FAIL
LIGHT: Master Caution

Use visual cues (ice accretion on windshield and windshield wipers) and temperature criteria to determine whether icing conditions exist.

When flying in icing conditions:
Ice Detection Override Knob..... ALL

After positively exiting icing conditions:
Ice Detection Override Knob..... AUTO

**NOTE: -** Icing conditions may exist in flight when Total Air Temperature (TAT) is 10°C or below and visible moisture in any form is present (such as clouds, fog with visibility of one mile or less, rain, snow, sleet, and ice crystals).

**-** Ice Detection Override Knob must be kept at ALL for at least 2 minutes after exiting icing conditions or after ICE CONDITION advisory message has disappeared. In such condition, caution message NO ICE-A/I ON may be presented, and must be disregarded.

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## CLEAR ICE DETECTED (APPLICABLE TO EMB-145XR MODEL)

EICAS CAUTION: CLR ICE 1 (2)
LIGHT: CLR ICE 1(2)
LIGHT: Master Caution

Do not takeoff.
Airplane de-icing is required.
If there is no clear ice on the wing surface, disregard the message.

## CLEAR ICE DETECTION SYSTEM FAILURE (APPLICABLE TO EMB-145XR MODEL)

EICAS CAUTION: CLR/I INOP 1 (2)
LIGHT: Master Caution

Check physically if wing surface is free of clear ice before each flight.
If clear ice is found, de-ice the airplane.

## WINDSHIELD HEATING FAILURE

EICAS CAUTION: W/S 1 (2) HEAT FAIL
LIGHT: Master Caution

Associated Windshield Heating ..... OFF

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## PITOT SENSORS HEATING FAILURE

EICAS CAUTION: PITOT 1 (2, 3) INOP
LIGHT: Master Caution

Information on the instruments supplied by the affected system may be unreliable. Cross-check and do not use the affected system if a disagreement is found.
If the Pitot 3 is the affected one, standby instruments and pressurization system may be affected.

If necessary:
ADC Button (Reversionary Panel) ..... PRESS

## AOA SENSOR HEATING FAILURE

EICAS CAUTION: AOA 1 (2) HEAT INOP
LIGHT: Master Warning and Master Caution

Maintain airspeed according to the following:

| FLAPS POSITION | MINIMUM AIRSPEED |
|---|---|
| UP | $V_{REF\ 45}$ + 25 KIAS |
| 9° | $V_{REF\ 45}$ + 5 KIAS |
| 18° | $V_{REF\ 45}$ + 5 KIAS |
| 22° | $V_{REF\ 22}$ |
| 45° | $V_{REF\ 45}$ |

## TAT SENSORS HEATING FAILURE

EICAS CAUTION: TAT 1 (2) HEAT INOP
LIGHT: Master Caution

TAS and SAT indication may be unreliable.

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# OXYGEN

## CREW/PASSENGER OXYGEN LOW PRESSURE

EICAS CAUTION: OXYGEN LO PRESS
CREW (PAX) OXY LOW PRESS
LIGHT: Master Caution
INDICATION: Oxygen pressure may become red or amber on MFD.

Check oxygen pressure on the MFD ECS Page. If message is confirmed or if MFD is not available:

Altitude ..... MEA OR 10000 ft, WHICHEVER IS HIGHER

## OXYGEN LEAKAGE

CONDITION: Evidence of oxygen leakage through the crew mask, mask hose, flow indicator (blinker), or oxygen line.

No Smoking ..... ON

If oxygen leakage is verified in the crew mask, mask hose, or flow indicator:

- Stowage Box Doors ..... CLOSE
- Test and Shutoff Sliding Control ..... ACTUATE
- Oxygen Pressure ..... CHECK
- Altitude ..... AS REQUIRED

  If oxygen pressure is below minimum oxygen pressure for dispatch, descend to below 10000 ft or minimum altitude for terrain clearance. The pilot of the affected side should use the crew portable oxygen cylinder, if necessary.

If oxygen leakage is verified in the oxygen line:

- Oxygen Cylinder Shutoff Valve ..... OFF

Altitude ..... MEA OR 10000 ft, WHICHEVER IS HIGHER

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# NAVIGATION

## AHRS ALIGNMENT

EICAS ADVISORY: AHRS 1 (2) ALN

This message is normally presented during alignment phase. No action is required.

## AHRS ALIGNMENT FAULT

EICAS CAUTION: AHRS 1 (2) ALN FAULT
LIGHT: Master Caution

Check and reenter present position. If necessary, reenter present position once again.

## AHRS ATTITUDE MODE

EICAS ADVISORY: AHRS 1 (2) ATT MODE

Associated AHRS Reversionary Button ..... PRESS
If cross-side AHRS is not available:

Maintain wings level and constant airspeed until AHRS 1 (2) ALN message is no longer displayed and attitude is recovered (approximately 20 seconds).

**CAUTION:**
- ATTITUDE OUTPUTS ARE NOT AS ACCURATE AS IN THE NORMAL OPERATIONAL MODE.
- AHRS MAGNETIC HEADING IS NOT AVAILABLE.

**NOTE:** The Autopilot is not available while AHRS 1 (2) ALN is being displayed.

## AHRS BASIC MODE

EICAS ADVISORY: AHRS 1 (2) BASIC MODE

Affected AHRS is reverted to the basic mode due to the TAS signal lost.

## AHRS EXCESSIVE MOTION

EICAS ADVISORY: AHRS 1 (2) EXC MOTION

Make sure the airplane is completely stationary.

The AHRS will restart a full alignment 30 seconds after the motion is stopped.

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## AHRS FAIL

EICAS CAUTION: AHRS 1 (2) FAIL
LIGHT: Master Caution

Associated AHRS Reversionary Button..... PRESS

**NOTE:** The Autopilot is not available.

## AHRS NO MAGNETIC HEADING

EICAS ADVISORY: AHRS 1 (2) NO MAG HDG

Enter Magnetic Heading.

## AHRS NO PRESENT POSITION

EICAS ADVISORY: AHRS 1 (2) NO PPOS

Enter Present Position.

## AHRS ON BATTERY

EICAS ADVISORY: AHRS 1 (2) ON BATT

Associated AHRS will operate for 40 minutes.

## AHRS OVERHEAT

EICAS CAUTION: AHRS 1 (2) OVERHEAT
LIGHT: Master Caution

AHRS data is valid for 30 minutes after failure. Use standby indicators for reference.

## CDU DATA BUS FAIL FMS ANNUNCIATION (UNS-1K)

CONDITION: Affected FMS is not updating CDU.
CDU DATA BUS FAIL message presented on FMS.

Affected FMS ..... OFF, then ON

If CDU DATA BUS FAIL message persists:

Affected FMS ..... OFF

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## CENTRAL MAINTENANCE COMPUTER FAILURE

EICAS ADVISORY: CMC FAIL
Crew awareness.

## CHECK IC SOFTWARE

EICAS CAUTION: CHECK IC 1 (2) SW
LIGHT: Master Caution
Do not takeoff.

## CHECK TRANSPONDER

EICAS CAUTION: CHECK XPDR
LIGHT: Master Caution
Crew awareness.

## CHECKLIST MISMATCH

EICAS ADVISORY: CHECKLIST MISMATCH
Do not use Checklist Display.

## DAU AIRPLANE ID MISCOMPARE

EICAS CAUTION: DAU AC ID MISCMP
Do not takeoff.

## DAU FAILURE

EICAS CAUTION: DAU 1 (2) A FAIL with Master Caution Light or
EICAS ADVISORY: DAU 1 (2) B FAIL
If on ground, do not takeoff.
Confirm the failed side and channel.

For DAU 1 A FAIL caution message proceed:
DAU 1 Reversion..... ON
Check DAU 1 REVERSION message on EICAS.

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**NOTE:** The following indications and messages will not be available:

- Indications: Engine 1 oil (temperature and pressure), Battery 1 and 2 temperature, fuel tank temperature, roll trim position, cockpit temperature, Bleed 1 temperature.
- Messages: BLD 1 OVTEMP, E1 FUEL LO TEMP, FUEL TANK LO TEMP.

- BLD 1 LOW TEMP message will appear.

For DAU 2 A FAIL caution message proceed:
DAU 2 Reversion ..... ON
Check DAU 2 REVERSION message on EICAS.

**NOTE:** The following indications and messages will not be available:

- Indications: Engine 2 oil (temperature and pressure), Hydraulic quantity 1 and 2, yaw trim position, cabin temperature, Bleed 2 temperature.
- Messages: BLD 2 OVTEMP, E2 FUEL LO TEMP, HYD 1 LO QTY, HYD 2 LO QTY.

- BLD 2 LOW TEMP and APU OIL HI TEMP messages will appear.

If both channels of one DAU have failed:
Exit or avoid icing conditions.
Land at the nearest suitable airport.

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**NOTE: -** If both channels of DAU 1 have failed, the messages and indications associated with the following systems will not be available:

- All messages and indications: Oxygen, Steering, Pressurization, Landing Gear, Roll Trim, and the message EMERG LIGHT NOT ARMED.
- Some messages and indications: Doors, Stall Protection, Electrical, Fire Protection, Fuel, APU, Power Plant, Thrust Reverser, Flap, Spoiler, Brakes, Air Conditioning, Ice And Rain Protection, Hydraulic.

- If both channels of DAU 2 have failed, the messages and indications associated with the following systems will not be available:
  - All messages and indications: Smoke, Hydraulic, Rudder, Yaw Trim.
  - Some messages and indications: Doors, Stall Protection, Electrical, Fire Protection, Fuel, APU, Power Plant, Thrust Reverser, Flap, Spoiler, Brakes, Air Conditioning, Ice And Rain Protection.

## DAU MISCOMPARE

EICAS CAUTION: DAU 1 (2) ENG MISCOMP or DAU 1 (2) SYS MISCOMP or DAU 1 (2) WRN MISCOMP

LIGHT: Master Caution

Associated DAU Reversion ..... ON
Check associated DAU REVERSION message on EICAS.

Analyze the situation before and after the reversion, and take the appropriate corrective action.

**NOTE:** For each miscompare message and each side, check the following parameters before and after the reversion:

- Engine: N1, N2, ITT.
- System: Battery voltage and temperature, takeoff temperature, hydraulic pressure, oxygen pressure.
- Warning: all warning messages, if any.

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## DAU REVERSION

EICAS ADVISORY: DAU 1 (2) REVERSION

If the reversionary condition is not required, press the associated DAU Reversionary Button to remove it.

## DISPLAY FAILURE

EICAS CAUTION: CHECK PFD 1 (2) message is presented if PFD is the failed display.

LIGHT: Master Caution

Confirm the failed display.

If PFD failed:

Associated MFD Selector Knob ..... PFD

If EICAS failed:

MFD Selector Knob (as required) ..... EICAS

If all main panel displays failed:

Exit or avoid icing conditions.

RMU ..... AS REQUIRED

Use RMU to access power plant or navigation data.

Land at the nearest suitable airport.

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## DISPLAY FAN FAILURE

EICAS ADVISORY: DU 1 (2, 3, 4, 5) FAN FAIL

An overheat condition may arise in the associated display. In this case, it will be shut down automatically. Use reversionary capabilities.

## DISPLAY OVERHEAT

EICAS ADVISORY: DU 1 (2, 3, 4, 5) OVHT

An overheat condition may arise in the associated display. In this case, it will be shut down automatically. Use reversionary capabilities.

## FDAU FAIL

EICAS ADVISORY: FDAU FAIL

Crew awareness.

## FLIGHT DATA RECORDER FAILURE

EICAS CAUTION: DFDR FAIL
LIGHT: Master Caution

Crew awareness.

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# FMS NAVIGATION PERFORMANCE DEGRADED / FMS IN DEAD RECKONING MODE

Verify airplane position by using VOR/DME information (enroute and terminal operations) or other sources as appropriate (oceanic).

If conducting an instrument approach, discontinue use of FMS for approach guidance and select an alternate source of navigation, if available.

In case of one FMS (single FMS) or both FMS (dual FMS) entering in Dead Reckoning Mode and EGPWS is installed:

EGPWS TERRAIN SYS OVRD Button..... PRESS

The Terrain Awareness Alerting and Display functions on MFD will be inhibited. This will not affect the basic GPWS functions (modes 1 to 7).

If the FMS is restored after a period of inadequacy:

EGPWS TERRAIN SYS OVRD Button ..... PRESS

The Terrain Awareness will be enabled.

**NOTE:** For the FMZ 2000 FMS and the FMZ 2010 FMS, the DGRAD annunciator indicates that the FMS cannot guarantee that the accuracy of the system meets the requirements for the current phase of flight.

- Except in the case of conducting an instrument approach procedure, the FMS may still be accurate and may be used for navigation, provided the crew can confirm the position through other means, such as cross checking the VOR/DME raw data.
- For the FMZ 2010 FMS, the best estimate of the airplane position will be provided by the FMS based on airspeed and heading inputs, but it cannot guarantee the required accuracy for any of the flight phases. The pilot should cross check position with other navaids, station overfly, or visually.

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## LPV UNAVAILABLE (AIRPLANES POST-MOD. SB145-34-0125)

If on approach:

MISSED APPROACH Procedure ..... ACCOMPLISH

Consider the possibility of continuing and performing the landing if under visual conditions and the airplane position and attitude assure a safe landing.

Perform an approach with non-LPV minima.

## GPS FAILED

In case of GPS fail (GPS FAILED Scratchpad Message for single GPS or GPS 1 FAILED and GPS 2 FAILED Scratchpad Messages for dual GPS) associated with FMS Navigation Performance Degraded:

FMS NAVIGATION PERFORMANCE DEGRADED /
FMS IN DEAD RECKONING MODE
Abnormal Procedure ..... Accomplish

In case of GPS fail (GPS FAILED Scratchpad Message for single GPS or GPS 1 FAILED and GPS 2 FAILED Scratchpad Messages for dual GPS) and EGPWS is installed:

EGPWS TERRAIN SYS OVRD Button ..... PRESS

The Terrain Awareness Alerting and Display functions on MFD will be inhibited. This will not affect the basic GPWS functions (modes 1 to 7).

## IC AIR/GROUND CONDITION SIGNAL INOPERATIVE

EICAS CAUTION: IC 1 (2) WOW INOP
LIGHT: Master Caution
Do not take off.

## IC CONFIGURATION FAILURE

EICAS ADVISORY: IC 1 (2) CONFIG FAIL

Crew awareness.

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## IC FAILURE/IC BUS FAILURE

EICAS CAUTION: IC BUS FAIL may be presented
LIGHT: Master Caution if IC BUS FAIL message is presented
CONDITION: Associated Display Units blank and with a red X drawn over them.

The following features will be inoperative:

- EICAS messages miscompare monitoring,
- Takeoff speeds synchronization,
- Check List Display synchronization, and
- Flight Director mode synchronization.

If IC 1 failed (loss of PFD 1, MFD 1 and EICAS):
SG 1 Button ..... PRESS

**NOTE:** - In case of IC 1 failure, the PTRIM MAIN (BACKUP) INOP or PIT TRIM 1 (2) INOP messages may not be available, and
- The autopilot is not available.

If IC 2 failed (loss of MFD 2 and PFD 2):
SG 2 Button ..... PRESS

## IC FAN FAILURE

EICAS ADVISORY: IC 1 (2) FAN FAIL

An overheat condition may arise in the associated IC. In this case, turn the IC off by pulling its respective circuit breaker (C3 or D31 or D32).

## IC OVERHEAT

EICAS CAUTION: IC 1(2) OVERHEAT

If there is smoke associated to IC 1 OVERHEAT message:
IC 1 Circuit Breaker (C3) ..... PULL
Backup Battery..... OFF
SG 1 Button ..... PRESS
If smoke persists:
ELECTRICAL SYSTEM
FAILURE OR SMOKE Procedure..... ACCOMPLISH

If there is smoke associated to IC 2 OVERHEAT message:

IC 2 Circuit Breaker (D31 or D32) ..... PULL

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SG 2 Button ..... PRESS

If smoke persists:

ELECTRICAL SYSTEM

FAILURE OR SMOKE Procedure ..... ACCOMPLISH

## IC'S CONFIGURATION MISMATCH

EICAS CAUTION: CHK IC CONFIG with Master Caution Light or
EICAS ADVISORY: CONFIG MISMATCH

Do not take off.

## INTEG ANNUNCIATOR ON (UNS-1K)

Discontinue the use of FMS whenever using the GPS source solely. If possible and feasible, select an alternate source of navigation for approach guidance.

## IRS ALIGNMENT

EICAS ADVISORY: IRS 1 (2) ALN

IRU Mode Select Switch ..... CHECK NAV

This message is only presented during alignment phase or while the IRU mode select switch is set at ALIGN position.

## IRS ALIGNMENT FAULT

EICAS CAUTION: IRS 1 (2) ALN FAULT

Check and reenter present position. If necessary, reenter present position once again.

## IRS ATTITUDE MODE

EICAS ADVISORY: IRS 1 (2) ATT MODE

On ground:

IRU Mode Select Switch ..... OFF

Wait until POWER-OFF phase is finished (MSU annunciator lights extinguished).

IRU Mode Select Switch ..... NAV

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## IRS EXCESSIVE MOTION

EICAS ADVISORY: IRS 1 (2) EXC MOTION

Make sure the airplane is completely stationary.

The IRU will restart a full alignment 30 seconds after the motion is stopped.

## IRS FAIL

EICAS CAUTION: IRS 1 (2) FAIL

During power on or alignment phases:

IRU Mode Select Switch ..... OFF
Wait until POWER-OFF phase is finished (MSU annunciator lights extinguished).

IRU Mode Select Switch ..... NAV

In flight:

Reversionary Panel IRS Button ..... PRESS

If cross-side IRU is not available:

IRU Mode Select Switch ..... ATT
Maintain wings level and constant airspeed until attitude display recovers (approximately 20 seconds).

Magnetic Heading ..... ENTER

**CAUTION:** FOR IRS IN ATTITUDE MODE, NAVIGATION AND ATTITUDE OUTPUTS ARE NOT AS ACCURATE AS IN THE NAV MODE. MAGNETIC HEADING MUST BE ENTERED AND UPDATED PERIODICALLY FROM THE BEST AVAILABLE ALTERNATIVE SOURCE, THROUGH THE FMS CDU.

**NOTE:** Autopilot is available if the IRS 1(2) ATT MODE message is displayed and the IRS 1(2) ALN message is extinguished.

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## IRS ON BATTERY

EICAS ADVISORY: IRS 1 (2) ON BATT

Associated IRU will operate for 40 minutes.

## IRS OVERHEAT

EICAS CAUTION: IRS 1 (2) OVERHEAT

Operate affected IRU until completion of the flight.

If MSU FAULT annunciator is lighted, IRS 1 (2) FAIL message is presented or inertial data ceases to be transmitted by IRU:

Associated IRS Reversionary Button ..... PRESS
Affected IRU Mode Select Switch ..... OFF

**NOTE:** The Autopilot is not available.

If IRU is OFF, the airplane is near the end of the flight and additional attitude reference is necessary:

IRU Mode Select Switch..... ATT

**CAUTION:** FOR IRS IN ATTITUDE MODE, NAVIGATION AND ATTITUDE OUTPUTS ARE NOT AS ACCURATE AS IN THE NAV MODE. MAGNETIC HEADING MUST BE ENTERED AND UPDATED PERIODICALLY FROM THE BEST AVAILABLE ALTERNATIVE SOURCE, THROUGH THE FMS CDU.

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# IRS/MSU FAILURE ANNUNCIATION

| LIGHT | OPERATION PHASE | | |
|---|---|---|---|
| | POWER ON | ALIGNMENT | IN FLIGHT |
| ALIGN | – No light:<br>– Check IRS CB's.<br>– Set mode select switch to ALIGN or NAV.<br>– Press MSU Test switch. Annunciator bulb must be replaced if the other MSU annunciators do light. | – Flashes immediately after entry:<br>– Check and reenter latitude or longitude.<br>– Reenter same latitude or longitude.<br>– Flashes at the end of alignment:<br>– Enter latitude.<br>– Check and reenter latitude.<br>– Allow additional time for alignment. | – Flashes:<br>– Select the remaining IRU by pressing the IRS Button on the associated reversionary panel.<br>– If necessary set mode select switch to ATT. |
| FAULT | – Set mode select switch to OFF for at least 3 sec. Then set mode select switch back to ALIGN or NAV. | – Associated with ALIGN annunciation:<br>– Recheck coordinates and reenter latitude.<br>– Allow additional time for alignment.<br>– Try new alignment. Set mode select switch to OFF for at least 3 sec, then to ALIGN, and enter present position. | – Select the remaining IRU by pressing the IRS Button on the associated reversionary panel.<br>– If necessary set mode select switch to ATT. |

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## IRS/MSU FAILURE ANNUNCIATION (Continued)

| LIGHT | OPERATION PHASE | | |
|---|---|---|---|
| | POWER ON | ALIGNMENT | IN FLIGHT |
| ON BATT | –Check IRS CB's.<br>–If the annunciator remains lighted, do not takeoff. | ******* | – The IRU operates on backup DC power and will operate for 30 minutes. |
| BATT FAIL | – Do not takeoff. | ******* | ******* |
| NO AIR | –Do not takeoff. | ******* | – Operate IRU until completion of flight.<br>– If fault annunciator is ON or inertial data ceases to be transmitted by IRU, select the remaining IRU and set mode select switch for affected IRU to OFF. If IRU is OFF, the airplane is near the end of the flight and additional attitude reference is needed, set mode select switch to ATT. |

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## MESSAGE MISCOMPARISON

INDICATION: CAS MSG indication on PFD.

Pilot's MFD Selector Knob ..... EICAS
Copilot's MFD Selector Knob ..... EICAS

Compare the messages displayed on the copilot's MFD with the messages presented on the pilot's MFD to check which is the discrepant message. Analyze the situation to check whether the discrepant message is spurious or not, and take the appropriate corrective action.

## NAV/FLIGHT INSTRUMENTS FAILURE

**CAUTION:** IN THE EVENT OF TOTAL LOSS OF DISPLAY INFORMATION, EXIT OR AVOID ICING CONDITIONS.

**NOTE:** For EMB-145 XR model if one ADC fails, indicated by a "X" (red) over the IAS and altitude tapes and a VS (red) annunciation displayed in the PFD, the maximum airspeed allowed is Mach 0.78.

| ANNUNCIATOR /FAILURE | LOCATION | ACTION |
|---|---|---|
| ATT FAIL (red) | PFD | Use cross-side attitude by pressing the AHRS (IRS) button on associated reversionary panel or use standby attitude indicator. |
| "X" (red) over IAS tape | | Use cross-side airspeed by pressing the ADC button on associated reversionary panel or use standby airspeed indicator. |
| "X" (red) over altitude tape | | Use cross-side altitude by pressing the ADC button on associated reversionary panel or use standby altimeter. |
| "X" (red) over course scale | | Select another sensor. |

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## NAV/FLIGHT INSTRUMENTS FAILURE (Continued)

| ANNUNCIATOR /FAILURE | LOCATION | ACTION |
|---|---|---|
| VS (red) | PFD | Use cross-side vertical speed by pressing the ADC button on associated reversionary panel. |
| ROL, PIT, ATT, IAS or ALT (amber) | | Compare data with Standby Indicator. For altitude compare the PFD altimeters setting also. If required, use cross-side data by pressing the appropriate button on associated reversionary panel. |
| PFD or EICAS Blank or "X" (red) | | Use the MFD Knob to present the required information on MFD. |
| RA (amber) | | Compare both Radio Altimeter indications. If required, consider only the lower altitude indication. Otherwise, disregard Radio Altitude. If RA displayed in the center, the RA is failed. |
| RA1 (2) (amber) | PFD MFD | Radio altimeter automatic reversion has occurred. No action is required. |
| HDG FAIL (red) | | Use cross-side heading by pressing the AHRS (IRS) button on associated reversionary panel or use RMU or standby attitude indicator. |
| HDG (amber) | | Compare data with the Magnetic Compass. After identifying the failed side, use cross-side data by pressing the AHRS (IRS) button on associated reversionary panel. |

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## NAV/FLIGHT INSTRUMENTS FAILURE (Continued)

| ANNUNCIATOR /FAILURE | LOCATION | ACTION |
|---|---|---|
| MENU INOP (amber) | MFD | Crew awareness. |
| ATT:CAGE (amber) | ISIS | Press the CAGE push button in order to recover attitude indication. Caging the ISIS in flight will result in loss of attitude indication for up to 10 seconds and the amber message ATT 10s will be presented during this time. Until attitude indication is available again use the primary indication source. |
| ATT, ALT, SPD, M, HDG (red) | | Use the primary indication source. |
| Errors in attitude indication | Standby Attitude Instrument | Maintain a straight and leveled flight using the primary indication source. Wait 3 minutes. If error persists, cage the instrument and monitor for 5 min after uncaging. |

## RADIO ALTIMETER FAIL

EICAS ADVISORY: RAD ALT 1 (2) FAIL or RAD ALT FAIL

If one Radio altimeter is lost (RAD ALT 1 (2) FAIL is presented):

Automatic reversion ..... CONFIRM

Automatic reversion may be confirmed through the RA1 (2) amber annunciator presented on both PFDs. In this case the CAT II logic is assured.

If both Radio Altimeters are lost (RAD ALT FAIL is presented):

Do not perform CAT II approaches.

If already performing a CAT II approach procedure:

MISSED APPROACH Procedure ..... PERFORM

Perform a normal MISSED APPROACH Procedure, unless the approach is continued under visual conditions and the airplane position and attitude assure a safe landing.

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# AUTOPILOT

## AUTOPILOT TRIM FAILED

EICAS CAUTION: AUTO TRIM FAIL
LIGHT: Master Caution

Control Column ..... HOLD FIRMLY
Quick Disconnect Button..... PRESS
Pitch Trim ..... AS REQUIRED
Trim the airplane.
Autopilot ..... AS REQUIRED

## STABILIZER OUT OF TRIM

EICAS CAUTION: AP ELEV MISTRIM
LIGHT: Master Caution
CONDITION: Autopilot is engaged and pitch servo is holding force.

Control Column ..... HOLD FIRMLY
Quick Disconnect Button..... PRESS
Pitch Trim ..... AS REQUIRED
Trim the airplane.
Autopilot ..... AS REQUIRED

## FD LATERAL MODE FAILURE

EICAS CAUTION: LATERAL MODE OFF
LIGHT: Master Caution

The Flight Director has been reverted to the basic roll mode.
At crew discretion, re-select the Flight Director affected mode or select another mode.

**NOTE: -** 5 seconds after pressing the Master Caution, the message will be removed. If the lost mode or any other mode is not selected again, the Flight Director will continue in the basic mode.

**-** For some EICAS versions this message will be presented if the crew turns the Flight Director off. In this case the message must be disregarded.

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## FD VERTICAL MODE FAILURE

EICAS CAUTION: VERTICAL MODE OFF
LIGHT: Master Caution

The Flight Director has been reverted to the basic pitch mode.
At crew discretion, re-select the Flight Director affected mode or select another mode.

**NOTE: -** 5 seconds after pressing the Master Caution, the message will be removed. If the lost mode or any other mode is not selected again, the Flight Director will continue in the basic mode.

**-** For some EICAS versions this message will be presented if the crew turns the Flight Director off. In this case the message must be disregarded.

## AILERON OUT OF TRIM

EICAS CAUTION: AP AIL MISTRIM
LIGHT: Master Caution

CONDITION: Autopilot is engaged and aileron servo is holding force.
If the message is displayed more than 10 seconds, proceed:
Control Wheel.....HOLD FIRMLY
Quick Disconnect Button.....PRESS
Roll Trim.....AS REQUIRED
Return the airplane to an in-trim condition, by trimming in the direction as requested by the EICAS indication.
Autopilot.....AS REQUIRED

## YAW DAMPER FAILURE

EICAS CAUTION: YAW DAMPER FAIL
LIGHT: Master Caution

Yaw Damper.....DISENGAGE
Autopilot may be reengaged at pilot's discretion. If after reengagement the failure persists, continue the flight with autopilot disengaged.

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# CAT II OPERATION

## HARDOVER

If any unusual acceleration or motion is noticed on the airplane flight path the approach must be discontinued, and:

Autopilot ..... DISENGAGE
MISSED APPROACH Procedure ..... PERFORM AS REQUIRED

- Consider the possibility of continuing and performing the landing if adequate visual reference has been established to assure the airplane position and approach path.
- For EMB-135 and EMB-145XR models, consider the possibility of continuing the approach using the Flight Director for guidance.

## SLOWOVER

The Slowover consists in a smooth and slow airplane attitude change due to an autopilot system malfunction. It may be recognized if one of the following symptoms occurs during approach:

- Unusual glide slope small deviation.
- Change in the rate of descent (small or large).
- Excessive glide slope deviation and the GS indications becoming amber.
- Flight Director command bar diverging from the airplane symbol.
- Autopilot self disconnection.

If a Slowover tendency is confirmed:

Autopilot ..... DISENGAGE
MISSED APPROACH Procedure ..... PERFORM AS REQUIRED

- Consider the possibility of continuing and performing the landing if adequate visual reference has been established to assure the airplane position and approach path.
- For EMB-135 and EMB-145XR models, consider the possibility of continuing the approach using the Flight Director for guidance.

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# ENGINE FAILURE ON FINAL APPROACH OR DURING GO-AROUND

ONE ENGINE INOPERATIVE
GO-AROUND Procedure.....APPLY

# AUTOPILOT MALFUNCTION

## BEFORE REACHING OUTER MARKER

If the autopilot disengages or has to be disengaged, transfer autopilot and reengage it. The pilot on-side of the engaged autopilot may continue the approach. Check no failure light illuminated on the PFD and no EICAS message related to the autopilot system.
If the autopilot disengages again:

MISSED APPROACH Procedure.....PERFORM AS REQUIRED

- Consider the possibility of continuing and performing the landing if under visual conditions and the airplane position and attitude assure a safe landing.
- For EMB-135 and EMB-145XR models, consider the possibility of continuing the approach using the Flight Director for guidance.

## AFTER REACHING OUTER MARKER

If the autopilot disengages or has to be disengaged, do not reengage the autopilot.

MISSED APPROACH Procedure.....PERFORM AS REQUIRED

- Consider the possibility of continuing and performing the landing if under visual conditions and the airplane position and attitude assure a safe landing.
- For EMB-135 and EMB-145XR models, consider the possibility of continuing the approach using the Flight Director for guidance.

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## DISPLAY WARNINGS DURING FINAL APPROACH

Discontinue the approach if any of the following warnings occur:
- CAT 2 (not displayed or amber)
- AURAL WARN FAIL (amber)
- RAD ALT FAIL (cyan) (for airplanes Post-Mod. SB 145-31-0020 or with an equivalent modification factory incorporated)
- RA (amber)
- GS (red or amber)
- LOC (red or amber)
- ILS (amber)
- ATT FAIL (red)
- ATT (amber)
- PIT (amber)
- ROL (amber)
- HDG FAIL (red)
- HDG (amber)
- FD (red)

Perform a normal MISSED APPROACH Procedure, unless the approach is continued under visual conditions and the airplane position and attitude assure a safe landing.

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**EXCESSIVE DEVIATION WARNING**

If warning occurs above 200 ft Radio Altitude:
Monitor the ILS deviation to ensure that the airplane returns to the center beam. If not recovered up to 200 ft radio altitude:
Discontinue the approach.

If warning occurs below 200 ft Radio Altitude:
Discontinue the approach.

On both cases, perform a normal MISSED APPROACH Procedure, unless the approach is continued under visual conditions and the airplane position and attitude assure a safe landing.

## ABNORMALITIES

The following abnormalities are deviation from CAT II normal range and must be called out:

- Excessive LOC or GS deviations.
- Airspeed 10 kt higher or 5 kt lower than the Landing Reference Speed ($V_{REF\ 22}$).
- Roll angle in excess of 15°.
- Pitch angle below - 5° or above 5°.

Rate of descent in excess of 1200 ft/min.

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# HGS OPERATION

For AIII mode operations, the approach must be discontinued in the event of engine failure above DH. A new approach may be attempted with one engine inoperative. In this case, the normal procedure AIII approach contained in HGS Operation must be used.

## APPROACH WARNING

COMBINER Message: APCH WARN

MISSED APPROACH Procedure ..... PERFORM

A MISSED APPROACH procedure must be performed, unless the approach is continued under visual conditions and the airplane position and attitude assure a safe landing. In this case, the AIII guidance must not be followed.

## HGS FAIL

EICAS CAUTION: HGS FAIL

Do not use HGS system.

## AIII NOT AVAILABLE

EICAS ADVISORY: AIII NOT AVAIL

Do not perform AIII mode approaches.

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# MISCELLANEOUS

## IMPAIRED OR CRACKED WINDSHIELD

Associated Windshield Heating ..... OFF

If only the outer layer (glass) is cracked, no action is required.
If not, proceed as follows:

Cockpit Door ..... CLOSE
Altitude ..... MEA OR BELOW 10000 ft, WHICHEVER IS HIGHER
Cabin $\Delta P$ = 1 psi ..... SET

**NOTE:** Pressurization Manual Controller must be used to reach and maintain cabin altitude steady while descending.

Airspeed ..... MAXIMUM 250 KIAS
Smoke Goggle ..... DON

In case both windshields are impaired:

Cabin (below 10000 ft) ..... DEPRESSURIZE
Airspeed ..... MAX 140 KIAS MINIMUM $V_{REF}$
Make sure there are no loose objects in the cockpit.
Direct Vision Window ..... REMOVE
Landing must be made by looking through Direct Vision Window.

**NOTE:** Intercommunication will be impossible with window removed.

## LIGHTNING STRIKE REPORT

In case of lightning strike, report the incident to the maintenance personnel, by filling the LIGHTNING STRIKE INCIDENT REPORT form, part I (see model on the next page).

The part II of the LIGHTNING STRIKE INCIDENT REPORT form is reserved to the ground personnel, and is presented in the Aircraft Maintenance Manual.

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# EMB-145 LIGHTNING STRIKE INCIDENT REPORT

Part I (to be completed by flight crew)

Conditions at time of strike:

- Operator: _____ Date of incident: _____
- ACFT S/N: _____ Flight no.: _____
- Route: From _____ To: _____
- Altitude: _____ ft Airspeed: _____ kt
- Flight phase: Approach ☐ Climb ☐ Level Flight ☐
  Other: _____
- Weather: Cloud type % Cover Ceiling (ft) Top at (ft) OAT (°C)
  _____ _____ _____ _____ _____
  Rain ☐ Sleet ☐ Hail ☐ Snow ☐ None ☐
- Was St. Elmo's fire visible before strike? Yes ☐ No ☐
- Any effects on:

DC power system: _____

Flight controls: _____

Engine: _____

Avionics: _____

Other (describe): _____

- Any effects on personnel, such as: Flash blindness: _____
  Electrical shock: _____

Part I completed by: _____

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## BIRD IMPACT

Against windshield:

CRACKED WINDSHIELD Procedure..... APPLY

Against leading edge (wing or tail) or fuselage:

Maneuverability may be reduced. Refer to the associated leading edge deicer failure procedure, if necessary.

At a safe altitude, perform a controllability check step by step up to the landing configuration. Define a safe configuration and $V_{REF}$ for approach and landing.

The use of a greater $V_{REF}$ will cause the landing distance to increase.

Against engine:

PRECAUTIONARY ENGINE SHUTDOWN Procedure (if necessary)..... APPLY

Land at the nearest suitable airport.

## STRUCTURAL DAMAGE

On evidence of structural damage:

Airspeed under turbulence ..... BELOW 200 KIAS

Load Factor ..... BELOW 2.0

Refer to Buffet Onset Envelope to obtain altitude and airspeed for the desired load factor.

Aileron and Rudder Deflection ..... BELOW 30%

If fuselage is damaged:

Altitude..... MEA OR BELOW 10000 ft, WHICHEVER IS HIGHER

Cabin ..... DEPRESSURIZE

When landing:

Rate of descent ..... LESS THAN 300 ft/MIN

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## LANDING BELOW -40°C

Before touchdown:

Rate of descent..... LESS THAN 300 ft/MIN

## OVERWEIGHT LANDING

Before touchdown:

Rate of Descent ..... MAXIMUM 300 FT/MIN

Touch smoothly the runway surface. Reduce the engine thrust only after the touchdown.

**CAUTION:** TO DETERMINE THE MINIMUM SUITABLE LANDING DISTANCE, MULTIPLY THE UNFACTORED LANDING DISTANCE FOR FLAPS 45° BY 1.10.

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## UNRELIABLE AIRSPEED

CONDITION: Airspeed indications are erroneous or unreliable.

Autopilot/Yaw Damper ..... DISENGAGE
Both Flight Directors ..... OFF
If speed indication on both PFD is below 135 kt:
    Rudder Shutoff Sys 1 ..... PUSH OUT
Avoid using the speed brake.
Attitude/Thrust ..... ADJUST
    Maintain airplane control. Refer to Unreliable Airspeed tables. Altitude and/or Vertical Speed indications may also be unreliable.
Ground Speed indication is available in the FMS for reference.

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A3 | Anti-Ice: OFF |
|---|---|---|

**CLB THRUST MODE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 |
| 0 (240 KIAS) | Pitch (deg) | 11 | 10 | 9 | 8 |
| | V/S (ft/min) | 4100 | 3400 | 2900 | 2400 |
| 10000 (240 KIAS) | Pitch (deg) | 8 | 7 | 6 | 6 |
| | V/S (ft/min) | 3100 | 2500 | 2100 | 1700 |
| 20000 (0.56 M) | Pitch (deg) | 5 | 5 | 5 | 4 |
| | V/S (ft/min) | 2600 | 2000 | 1600 | 1200 |
| 30000 (0.56 M) | Pitch (deg) | 6 | 5 | 5 | 5 |
| | V/S (ft/min) | 2000 | 1400 | 1100 | 700 |
| 34000 (0.56 M) | Pitch (deg) | 6 | 6 | 6 | 6 |
| | V/S (ft/min) | 1700 | 1200 | 900 | 400 |

**CRUISE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 69.5 | 70.8 | 72.1 | 73.5 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 73.4 | 74.7 | 75.9 | 77.2 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 76.9 | 78.1 | 79.5 | 80.9 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 |
| | N1 (%) | 78.6 | 80.1 | 81.3 | 82.7 |
| 37000 (0.63 M) | Pitch (deg) | 2 | 3 | 4 | 4 |
| | N1 (%) | 79.6 | 81.6 | 84.1 | 86.4 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A3 | Anti-Ice: OFF |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 |
| | V/S (ft/min) | -1800 | -1700 | -1600 | -1600 |
| 10000 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 |
| | V/S (ft/min) | -2200 | -2000 | -1900 | -1800 |
| 20000 (240 KIAS) | Pitch (deg) | -3 | -2 | -1 | -1 |
| | V/S (ft/min) | -2300 | -2200 | -2100 | -2000 |
| 30000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | 0 |
| | V/S (ft/min) | -2600 | -2400 | -2300 | -2200 |
| 37000 (240 KIAS) | Pitch (deg) | -2 | -1 | 0 | 0 |
| | V/S (ft/min) | -2500 | -2300 | -2200 | -2100 |

| HOLDING | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 |
| | N1 (%) | 54.2 | 56.2 | 58.2 | 60.5 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 |
| | N1 (%) | 58.0 | 60.1 | 62.2 | 64.1 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A3 | Anti-Ice: OFF |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 7 |
| | N1 (%) | 48.5 | 52.3 | 55.8 | 59.1 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 8 | 8 | 8 |
| | N1 (%) | 51.0 | 54.9 | 58.5 | 61.6 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 4 | 4 |
| | N1 (%) | 47.1 | 50.3 | 53.1 | 55.8 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | 0 | 0 | 0 | 0 |
| | N1 (%) | 59.7 | 63.3 | 66.4 | 69.2 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A3 | Anti-Ice: ON |
|---|---|---|

| CLB THRUST MODE | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 (240 KIAS) | Pitch (deg) | 11 | 10 | 9 | 8 |
| | V/S (ft/min) | 4000 | 3300 | 2800 | 2300 |
| 10000 (240 KIAS) | Pitch (deg) | 7 | 6 | 6 | 5 |
| | V/S (ft/min) | 2600 | 2100 | 1700 | 1300 |
| 20000 (0.56 M) | Pitch (deg) | 4 | 3 | 3 | 3 |
| | V/S (ft/min) | 1600 | 1100 | 800 | 600 |
| 30000 (0.56 M) | Pitch (deg) | 4 | 4 | 4 | 4 |
| | V/S (ft/min) | 900 | 500 | 300 | 100 |
| 34000 (0.56 M) | Pitch (deg) | 4 | 4 | 5 | - |
| | V/S (ft/min) | 800 | 400 | 200 | - |

| CRUISE | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 69.5 | 70.8 | 72.1 | 73.4 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 73.4 | 74.7 | 75.9 | 77.1 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 76.9 | 78.1 | 79.5 | 80.8 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 |
| | N1 (%) | 78.4 | 79.9 | 81.2 | 82.5 |
| 37000 (0.63 M) | Pitch (deg) | 3 | 3 | 4 | 4 |
| | N1 (%) | 79.5 | 81.7 | 84.1 | 86.4 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A3 | Anti-Ice: ON |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | V/S (ft/min) | -1000 | -1000 | -1000 | -1000 |
| 10000 (240 KIAS) | Pitch (deg) | -1 | -1 | 0 | 0 |
| | V/S (ft/min) | -1300 | -1200 | -1200 | -1200 |
| 20000 (240 KIAS) | Pitch (deg) | -1 | -1 | 0 | 0 |
| | V/S (ft/min) | -1400 | -1400 | -1400 | -1400 |
| 30000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -1600 | -1600 | -1500 | -1500 |
| 37000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -1800 | -1706 | -1700 | -1700 |

| HOLDING | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 6 |
| | N1 (%) | 54.3 | 56.2 | 58.2 | 62.4 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 6 |
| | N1 (%) | 58.0 | 60.1 | 62.2 | 65.7 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A3 | Anti-Ice: ON |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 7 |
| | N1 (%) | 48.6 | 52.3 | 55.7 | 61.9 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 8 | 8 | 8 |
| | N1 (%) | 51.7 | 54.9 | 58.5 | 64.1 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 4 | 4 |
| | N1 (%) | 48.6 | 52.3 | 55.7 | 61.9 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | 0 | 0 | 0 | 0 |
| | N1 (%) | 59.7 | 63.2 | 66.4 | 71.4 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A1/3 | Anti-Ice: OFF |
|---|---|---|

| CLB THRUST MODE | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 (240 KIAS) | Pitch (deg) | 13 | 11 | 10 | 9 |
| | V/S (ft/min) | 4800 | 4000 | 3400 | 2900 |
| 10000 (240 KIAS) | Pitch (deg) | 9 | 8 | 8 | 7 |
| | V/S (ft/min) | 3800 | 3100 | 2700 | 2200 |
| 20000 (0.56 M) | Pitch (deg) | 7 | 6 | 6 | 5 |
| | V/S (ft/min) | 3500 | 2800 | 2300 | 1800 |
| 30000 (0.56 M) | Pitch (deg) | 7 | 6 | 6 | 6 |
| | V/S (ft/min) | 2700 | 2000 | 1600 | 1200 |
| 37000 (0.56 M) | Pitch (deg) | 7 | 7 | 7 | 7 |
| | V/S (ft/min) | 1800 | 1300 | 900 | 400 |

| CRUISE | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 68.9 | 70.0 | 71.2 | 72.5 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 72.1 | 73.5 | 74.9 | 76.5 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 76.3 | 77.8 | 79.4 | 80.9 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 |
| | N1 (%) | 78.5 | 80.0 | 81.2 | 82.5 |
| 37000 (0.63 M) | Pitch (deg) | 2 | 3 | 4 | 4 |
| | N1 (%) | 79.8 | 81.7 | 83.8 | 86.2 |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A1/3 | Anti-Ice: OFF |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 |
| | V/S (ft/min) | -1800 | -1700 | -1600 | -1600 |
| 10000 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 |
| | V/S (ft/min) | -2100 | -1900 | -1800 | -1800 |
| 20000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | -1 |
| | V/S (ft/min) | -2200 | -2100 | -2000 | -1900 |
| 30000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | 0 |
| | V/S (ft/min) | -2500 | -2400 | -2200 | -2100 |
| 37000 (240 KIAS) | Pitch (deg) | -2 | -1 | 0 | 0 |
| | V/S (ft/min) | -2400 | -2200 | -2100 | -2100 |

| HOLDING | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 |
| | N1 (%) | 54.1 | 55.9 | 57.9 | 59.9 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 |
| | N1 (%) | 57.6 | 59.6 | 61.8 | 63.9 |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A1/3 | Anti-Ice: OFF |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 7 |
| | N1 (%) | 48.9 | 52.5 | 55.7 | 58.8 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 8 | 8 | 8 |
| | N1 (%) | 51.4 | 55.1 | 58.2 | 61.3 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 4 | 4 |
| | N1 (%) | 47.5 | 50.8 | 53.5 | 56.0 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | 0 | 0 | 0 | 0 |
| | N1 (%) | 59.5 | 63.4 | 66.7 | 69.6 |

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*CONTINUES ON NEXT PAGE*



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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A1/3 | Anti-Ice: ON |
|---|---|---|

| CLB THRUST MODE | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 (240 KIAS) | Pitch (deg) | 12 | 11 | 10 | 9 |
| | V/S (ft/min) | 4700 | 3900 | 3400 | 2800 |
| 10000 (240 KIAS) | Pitch (deg) | 8 | 8 | 7 | 7 |
| | V/S (ft/min) | 3500 | 2800 | 2400 | 1900 |
| 20000 (0.56 M) | Pitch (deg) | 6 | 5 | 5 | 5 |
| | V/S (ft/min) | 3000 | 2300 | 1900 | 1500 |
| 30000 (0.56 M) | Pitch (deg) | 6 | 5 | 5 | 5 |
| | V/S (ft/min) | 2000 | 1400 | 1100 | 700 |
| 37000 (0.56 M) | Pitch (deg) | 6 | 6 | 6 | 6 |
| | V/S (ft/min) | 1200 | 700 | 400 | 0 |

| CRUISE | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 68.9 | 70.0 | 71.2 | 72.4 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 72.2 | 73.5 | 74.9 | 76.5 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 |
| | N1 (%) | 76.2 | 77.8 | 79.4 | 80.9 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 |
| | N1 (%) | 78.4 | 79.9 | 81.2 | 82.5 |
| 37000 (0.63 M) | Pitch (deg) | 3 | 3 | 4 | 4 |
| | N1 (%) | 79.8 | 81.7 | 83.8 | 86.3 |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A1/3 | Anti-Ice: ON |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | V/S (ft/min) | -900 | -900 | -900 | -900 |
| 10000 (240 KIAS) | Pitch (deg) | -1 | -1 | 0 | 0 |
| | V/S (ft/min) | -1200 | -1200 | -1200 | -1200 |
| 20000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | V/S (ft/min) | -1300 | -1300 | -1300 | -1300 |
| 30000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -1400 | -1400 | -1400 | -1400 |
| 37000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -1700 | -1600 | -1600 | -1500 |

| HOLDING | | | | | |
|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 6 |
| | N1 (%) | 54.1 | 55.9 | 57.8 | 61.8 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 6 |
| | N1 (%) | 57.5 | 59.6 | 61.8 | 65.8 |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-135 | Engine: AE3007A1/3 | Anti-Ice: ON |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 7 |
| | N1 (%) | 48.9 | 52.5 | 55.7 | 61.3 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 8 | 8 | 8 |
| | N1 (%) | 51.5 | 55.1 | 58.3 | 63.9 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 4 | 4 |
| | N1 (%) | 47.6 | 50.7 | 53.5 | 58.0 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | 0 | 0 | 0 | 0 |
| | N1 (%) | 59.5 | 63.4 | 66.7 | 72.0 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-140 | Engine: AE3007A1/3 | Anti-Ice: OFF |
|---|---|---|

| CLB THRUST MODE | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | 13 | 11 | 10 | 10 | 9 |
| | V/S (ft/min) | 4800 | 4000 | 3400 | 2900 | 2500 |
| 10000 (240 KIAS) | Pitch (deg) | 9 | 8 | 8 | 7 | 7 |
| | V/S (ft/min) | 3800 | 3200 | 2700 | 2200 | 1900 |
| 20000 (0.56 M) | Pitch (deg) | 7 | 6 | 6 | 5 | 5 |
| | V/S (ft/min) | 3500 | 2800 | 2300 | 1800 | 1500 |
| 30000 (0.56 M) | Pitch (deg) | 7 | 7 | 7 | 7 | 7 |
| | V/S (ft/min) | 2700 | 2000 | 1600 | 1200 | 900 |
| 37000 (0.56 M) | Pitch (deg) | 7 | 7 | 7 | 8 | 8 |
| | V/S (ft/min) | 1800 | 1300 | 900 | 400 | 100 |

| CRUISE | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 68.5 | 69.7 | 70.9 | 72.2 | 73.6 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 71.8 | 73.2 | 74.6 | 76.2 | 77.8 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 75.9 | 77.4 | 79.1 | 80.6 | 81.7 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 78.5 | 80.0 | 81.2 | 82.5 | 83.9 |
| 37000 (0.63 M) | Pitch (deg) | 3 | 3 | 4 | 4 | 5 |
| | N1 (%) | 79.8 | 81.7 | 83.8 | 86.4 | 90.0 |

*CONTINUES ON NEXT PAGE*



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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-140 | Engine: AE3007A1/3 | Anti-Ice: OFF |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | -3 | -2 | -1 | -1 | -1 |
| | V/S (ft/min) | -1800 | -1700 | -1600 | -1500 | -1500 |
| 10000 (240 KIAS) | Pitch (deg) | -3 | -2 | -1 | -1 | 0 |
| | V/S (ft/min) | -2000 | -1900 | -1800 | -1700 | -1700 |
| 20000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | -1 | 0 |
| | V/S (ft/min) | -2200 | -2000 | -2000 | -1900 | -1900 |
| 30000 (240 KIAS) | Pitch (deg) | -2 | -1 | -1 | 0 | 0 |
| | V/S (ft/min) | -2500 | -2300 | -2200 | -2100 | -2100 |
| 37000 (240 KIAS) | Pitch (deg) | -1 | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -2300 | -2200 | -2100 | -2000 | -2000 |

| HOLDING | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 4 | 4 | 5 | 5 |
| | N1 (%) | 53.8 | 55.8 | 57.7 | 59.9 | 62.1 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 4 | 5 | - | - |
| | N1 (%) | 59.1 | 61.4 | 63.6 | - | - |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-140 | Engine: AE3007A1/3 | Anti-Ice: OFF |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| **Flap position ($V_{REF}$ + INCREMENT)** | | **WEIGHT (lb)** | | | |
| | | **30000** | **35000** | **40000** | **45000** |
| 0 | Pitch (deg) | 7 | 7 | 7 | 8 |
| ($V_{REF45}$ + 30) | N1 (%) | 48.9 | 52.5 | 55.7 | 58.8 |
| 9 | Pitch (deg) | 7 | 7 | 7 | 8 |
| ($V_{REF45}$ + 15) | N1 (%) | 51.5 | 55.2 | 58.4 | 61.6 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| **Flap position ($V_{REF}$ + INCREMENT)** | | **WEIGHT (lb)** | | | |
| | | **30000** | **35000** | **40000** | **45000** |
| 22 | Pitch (deg) | 3 | 3 | 3 | 3 |
| ($V_{REF22}$ + 10) | N1 (%) | 47.6 | 50.9 | 53.6 | 56.2 |
| 45 | Pitch (deg) | -1 | -1 | 0 | 0 |
| ($V_{REF45}$ + 10) | N1 (%) | 59.7 | 63.5 | 66.7 | 69.5 |

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*CONTINUES ON NEXT PAGE*



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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-140 | Engine: AE3007A1/3 | Anti-Ice: ON |
|---|---|---|

### CLB THRUST MODE

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | 13 | 11 | 10 | 10 | 9 |
| | V/S (ft/min) | 4700 | 3900 | 3400 | 2900 | 2500 |
| 10000 (240 KIAS) | Pitch (deg) | 8 | 8 | 7 | 7 | 7 |
| | V/S (ft/min) | 3500 | 2800 | 2400 | 1900 | 1600 |
| 20000 (0.56 M) | Pitch (deg) | 6 | 5 | 5 | 5 | 5 |
| | V/S (ft/min) | 3000 | 2300 | 1900 | 1500 | 1200 |
| 30000 (0.56 M) | Pitch (deg) | 6 | 6 | 6 | 6 | 6 |
| | V/S (ft/min) | 2000 | 1400 | 1100 | 700 | 400 |
| 37000 (0.56 M) | Pitch (deg) | 6 | 6 | 7 | 7 | - |
| | V/S (ft/min) | 1200 | 700 | 400 | 40 | - |

### CRUISE

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 2 |
| | N1 (%) | 68.5 | 69.6 | 70.9 | 72.2 | 73.6 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 71.8 | 73.1 | 74.6 | 76.2 | 77.8 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 75.9 | 77.4 | 79.1 | 80.6 | 81.7 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 78.4 | 79.9 | 81.2 | 82.5 | 83.9 |
| 37000 (0.63 M) | Pitch (deg) | 3 | 3 | 4 | 4 | 5 |
| | N1 (%) | 79.8 | 81.7 | 83.8 | 86.5 | 90.1 |

*CONTINUES ON NEXT PAGE*

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-140 | Engine: AE3007A1/3 | Anti-Ice: ON |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 | 1 |
| | V/S (ft/min) | -900 | -900 | -900 | -900 | -900 |
| 10000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 | 1 |
| | V/S (ft/min) | -1100 | -1100 | -1100 | -1100 | -1200 |
| 20000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 | 1 |
| | V/S (ft/min) | -1300 | -1300 | -1300 | -1300 | -1300 |
| 30000 (240 KIAS) | Pitch (deg) | 0 | 0 | 0 | 1 | 1 |
| | V/S (ft/min) | -1400 | -1400 | -1300 | -1300 | -1400 |
| 37000 (240 KIAS) | Pitch (deg) | 0 | 0 | 1 | 1 | 1 |
| | V/S (ft/min) | -1600 | -1600 | -1500 | -1500 | -1500 |

| HOLDING | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 4 | 4 | 5 | 5 |
| | N1 (%) | 53.8 | 55.8 | 57.7 | 59.9 | 63.7 |
| 10000 (200 KIAS) | Pitch (deg) | 4 | 4 | 5 | 5 | - |
| | N1 (%) | 59.1 | 61.4 | 63.6 | 67.7 | - |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-140 | Engine: AE3007A1/3 | Anti-Ice: ON |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 7 |
| | N1 (%) | 48.9 | 52.5 | 55.7 | 61.3 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 8 | 8 | 8 |
| | N1 (%) | 52.1 | 55.2 | 58.4 | 64.2 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 3 | 3 |
| | N1 (%) | 48.9 | 52.5 | 55.7 | 61.3 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | N1 (%) | 59.7 | 63.5 | 66.7 | 71.9 |

*CONTINUES ON NEXT PAGE*

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A | Anti-Ice: OFF |
|---|---|---|

| CLB THRUST MODE | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | 10 | 9 | 8 | 8 | 8 |
| | V/S (ft/min) | 3800 | 3100 | 2700 | 2200 | 1900 |
| 10000 (240 KIAS) | Pitch (deg) | 8 | 7 | 7 | 6 | 6 |
| | V/S (ft/min) | 3100 | 2500 | 2100 | 1700 | 1400 |
| 20000 (0.56 M) | Pitch (deg) | 6 | 5 | 5 | 5 | 5 |
| | V/S (ft/min) | 2900 | 2300 | 1800 | 1400 | 1100 |
| 30000 (0.56 M) | Pitch (deg) | 6 | 6 | 6 | 6 | 6 |
| | V/S (ft/min) | 2200 | 1600 | 1200 | 800 | 500 |
| 37000 (0.56 M) | Pitch (deg) | 7 | 7 | 7 | 7 | - |
| | V/S (ft/min) | 1400 | 900 | 600 | 200 | - |

| CRUISE | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 69.2 | 70.7 | 71.9 | 73.2 | 74.6 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 72.9 | 74.3 | 75.9 | 77.1 | 78.4 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 76.8 | 78.0 | 79.4 | 80.8 | 82.0 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 78.5 | 80.1 | 81.4 | 82.9 | 84.5 |
| 37000 (0.63 M) | Pitch (deg) | 3 | 3 | 4 | 4 | - |
| | N1 (%) | 79.9 | 82.0 | 84.3 | 86.8 | - |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A | Anti-Ice: OFF |
|---|---|---|

**FLIGHT IDLE DESCENT**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 | -1 |
| | V/S (ft/min) | -1800 | -1700 | -1600 | -1500 | -1500 |
| 10000 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 | -1 |
| | V/S (ft/min) | -2100 | -2000 | -1900 | -1800 | -1800 |
| 20000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | -1 | 0 |
| | V/S (ft/min) | -2300 | -2200 | -2100 | -2000 | -2000 |
| 30000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | -1 | 0 |
| | V/S (ft/min) | -2600 | -2400 | -2300 | -2200 | -2100 |
| 37000 (240 KIAS) | Pitch (deg) | -1 | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -2400 | -2300 | -2200 | -2100 | -2000 |

**HOLDING**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 5 |
| | N1 (%) | 54.0 | 56.2 | 58.5 | 60.4 | 62.4 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 4 | 5 | 5 | - |
| | N1 (%) | 59.8 | 61.8 | 64.0 | 65.9 | - |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A | Anti-Ice: OFF |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 7 |
| | N1 (%) | 48.2 | 52.2 | 56.0 | 59.0 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 51.2 | 55.2 | 58.7 | 61.7 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 3 | 3 |
| | N1 (%) | 46.9 | 50.5 | 53.6 | 56.5 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | N1 (%) | 58.5 | 62.2 | 65.3 | 68.1 |

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*CONTINUES ON NEXT PAGE*



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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A | Anti-Ice: ON |
|---|---|---|

| CLB THRUST MODE | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | 10 | 9 | 9 | 8 | 8 |
| | V/S (ft/min) | 3800 | 3100 | 2700 | 2200 | 1900 |
| 10000 (240 KIAS) | Pitch (deg) | 7 | 7 | 6 | 6 | 6 |
| | V/S (ft/min) | 2800 | 2300 | 1900 | 1500 | 1200 |
| 20000 (0.56 M) | Pitch (deg) | 4 | 3 | 3 | 3 | 3 |
| | V/S (ft/min) | 1600 | 1100 | 800 | 600 | 300 |
| 30000 (0.56 M) | Pitch (deg) | 4 | 4 | 4 | - | - |
| | V/S (ft/min) | 700 | 300 | 100 | - | - |
| 37000 (0.56 M) | Pitch (deg) | 5 | 5 | - | - | - |
| | V/S (ft/min) | 400 | 0 | - | - | - |

| CRUISE | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 69.2 | 70.6 | 71.9 | 73.2 | 74.6 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 72.9 | 74.3 | 75.9 | 77.1 | 78.4 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | - | - |
| | N1 (%) | 76.8 | 78.0 | 79.4 | - | - |
| 30000 (0.63 M) | Pitch (deg) | - | - | - | - | - |
| | N1 (%) | - | - | - | - | - |
| 37000 (0.63 M) | Pitch (deg) | - | - | - | - | - |
| | N1 (%) | - | - | - | - | - |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A | Anti-Ice: ON |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 | -1 |
| | V/S (ft/min) | -1800 | -1700 | -1600 | -1500 | -1500 |
| 10000 (240 KIAS) | Pitch (deg) | -1 | -1 | 0 | 0 | 0 |
| | V/S (ft/min) | -1300 | -1300 | -1200 | -1200 | -1200 |
| 20000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 | 1 |
| | V/S (ft/min) | -1400 | -1400 | -1400 | -1400 | -1400 |
| 30000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 1 | 1 |
| | V/S (ft/min) | -1600 | -1600 | -1600 | -1500 | -1500 |
| 37000 (240 KIAS) | Pitch (deg) | 0 | 0 | 1 | 1 | 1 |
| | V/S (ft/min) | -1600 | -1600 | -1500 | -1500 | -1500 |

| HOLDING | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 6 |
| | N1 (%) | 54.0 | 56.2 | 58.5 | 60.4 | 63.8 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 4 | 5 | 6 | - |
| | N1 (%) | 59.8 | 61.8 | 64.0 | 67.5 | - |

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*CONTINUES ON NEXT PAGE*



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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A | Anti-Ice: ON |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 48.2 | 52.2 | 56.0 | 61.5 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 51.9 | 55.1 | 58.7 | 64.1 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 3 | 3 |
| | N1 (%) | 48.2 | 52.2 | 56.0 | 61.5 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | N1 (%) | 58.5 | 62.1 | 65.3 | 70.4 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1/1 | Anti-Ice: OFF |
|---|---|---|

| CLB THRUST MODE | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | 12 | 11 | 10 | 9 | 9 |
| | V/S (ft/min) | 4600 | 3800 | 3300 | 2700 | 2400 |
| 10000 (240 KIAS) | Pitch (deg) | 9 | 8 | 7 | 7 | 7 |
| | V/S (ft/min) | 3500 | 2800 | 2400 | 1900 | 1600 |
| 20000 (0.56 M) | Pitch (deg) | 6 | 5 | 5 | 5 | 5 |
| | V/S (ft/min) | 3000 | 2400 | 2000 | 1500 | 1200 |
| 30000 (0.56 M) | Pitch (deg) | 6 | 6 | 6 | 6 | 6 |
| | V/S (ft/min) | 2300 | 1700 | 1300 | 900 | 600 |
| 37000 (0.56 M) | Pitch (deg) | 7 | 7 | 7 | 7 | - |
| | V/S (ft/min) | 1500 | 1000 | 700 | 300 | - |

| CRUISE | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 68.7 | 70.0 | 71.4 | 72.8 | 74.2 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 72.6 | 74.0 | 75.3 | 76.7 | 78.1 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 76.4 | 77.7 | 79.1 | 80.4 | 81.5 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 78.2 | 79.6 | 80.8 | 82.2 | 83.8 |
| 37000 (0.63 M) | Pitch (deg) | 3 | 3 | 4 | 4 | 5 |
| | N1 (%) | 79.0 | 81.1 | 83.5 | 85.9 | 88.3 |

*CONTINUES ON NEXT PAGE*



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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1/1 | Anti-Ice: OFF |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 | -1 |
| | V/S (ft/min) | -1800 | -1700 | -1600 | -1500 | -1500 |
| 10000 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 | -1 |
| | V/S (ft/min) | -2100 | -2000 | -1900 | -1800 | -1800 |
| 20000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | -1 | 0 |
| | V/S (ft/min) | -2300 | -2100 | -2000 | -2000 | -1900 |
| 30000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | 0 | 0 |
| | V/S (ft/min) | -2500 | -2400 | -2300 | -2200 | -2100 |
| 37000 (240 KIAS) | Pitch (deg) | -2 | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -2400 | -2200 | -2100 | -2100 | -2000 |

| HOLDING | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 5 |
| | N1 (%) | 53.5 | 55.6 | 57.7 | 59.9 | 62.1 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 4 | 5 | 5 | - |
| | N1 (%) | 59.3 | 61.5 | 63.5 | 65.6 | - |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1/1 | Anti-Ice: OFF |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 | Pitch (deg) | 7 | 7 | 7 | 7 |
| ($V_{REF45}$ + 30) | N1 (%) | 48.0 | 51.8 | 55.4 | 58.7 |
| 9 | Pitch (deg) | 7 | 7 | 7 | 8 |
| ($V_{REF45}$ + 15) | N1 (%) | 50.9 | 55.0 | 58.4 | 61.6 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 | Pitch (deg) | 3 | 3 | 3 | 3 |
| ($V_{REF22}$ + 10) | N1 (%) | 46.8 | 50.3 | 53.4 | 56.3 |
| 45 | Pitch (deg) | -1 | 0 | 0 | 0 |
| ($V_{REF45}$ + 10) | N1 (%) | 58.6 | 62.2 | 65.3 | 68.0 |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1/1 | Anti-Ice: ON |
|---|---|---|

**CLB THRUST MODE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | 12 | 11 | 10 | 9 | 9 |
| | V/S (ft/min) | 4600 | 3800 | 3300 | 2700 | 2400 |
| 10000 (240 KIAS) | Pitch (deg) | 8 | 7 | 7 | 6 | 6 |
| | V/S (ft/min) | 3200 | 2600 | 2200 | 1800 | 1500 |
| 20000 (0.56 M) | Pitch (deg) | 4 | 4 | 3 | 3 | 3 |
| | V/S (ft/min) | 1700 | 1200 | 900 | 700 | 400 |
| 30000 (0.56 M) | Pitch (deg) | 4 | 4 | 4 | 4 | - |
| | V/S (ft/min) | 2000 | 1400 | 1100 | 700 | - |
| 37000 (0.56 M) | Pitch (deg) | 5 | 5 | - | - | - |
| | V/S (ft/min) | 500 | 100 | - | - | - |

**CRUISE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 68.7 | 70.0 | 71.4 | 72.8 | 74.2 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 72.6 | 74.0 | 75.3 | 76.7 | 78.1 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 76.4 | 77.7 | 79.1 | 80.4 | 81.5 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 78.2 | 79.6 | 80.8 | 82.2 | 83.8 |
| 37000 (0.63 M) | Pitch (deg) | 3 | 3 | 4 | 4 | 5 |
| | N1 (%) | 79.0 | 81.1 | 83.5 | 85.9 | 88.3 |

*CONTINUES ON NEXT PAGE*

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1/1 | Anti-Ice: ON |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 0 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 | -1 |
| | V/S (ft/min) | -1800 | -1700 | -1600 | -1500 | -1500 |
| 10000 (240 KIAS) | Pitch (deg) | -1 | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -1200 | -1200 | -1200 | -1200 | -1200 |
| 20000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 | 1 |
| | V/S (ft/min) | -1400 | -1400 | -1400 | -1400 | -1400 |
| 30000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 1 | 1 |
| | V/S (ft/min) | -1600 | -1600 | -1500 | -1500 | -1500 |
| 37000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 1 | 1 |
| | V/S (ft/min) | -1800 | -1700 | -1700 | -1700 | -1600 |

| HOLDING | | | | | | |
|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 6 |
| | N1 (%) | 53.5 | 55.6 | 57.7 | 59.9 | 63.6 |
| 10000 (200 KIAS) | Pitch (deg) | 4 | 4 | 5 | 6 | - |
| | N1 (%) | 59.3 | 61.5 | 63.5 | 67.3 | - |

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*CONTINUES ON NEXT PAGE*



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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1/1 | Anti-Ice: ON |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 48.0 | 51.8 | 55.4 | 61.5 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 51.6 | 55.0 | 58.4 | 64.2 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 3 | 3 |
| | N1 (%) | 48.0 | 51.8 | 55.4 | 61.5 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | N1 (%) | 58.6 | 62.2 | 65.3 | 70.2 |

*CONTINUES ON NEXT PAGE*

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1&A1P | Anti-Ice: OFF |
|---|---|---|

**CLB THRUST MODE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 0 | Pitch (deg) | 13 | 12 | 11 | 10 | 10 | 9 |
| (240 KIAS) | V/S (ft/min) | 4800 | 4000 | 3400 | 2900 | 2500 | 2200 |
| 10000 | Pitch (deg) | 10 | 9 | 8 | 8 | 8 | 7 |
| (240 KIAS) | V/S (ft/min) | 3800 | 3100 | 2700 | 2200 | 1900 | 1600 |
| 20000 | Pitch (deg) | 7 | 6 | 6 | 5 | 5 | 5 |
| (0.56 M) | V/S (ft/min) | 3500 | 2800 | 2300 | 1800 | 1500 | 1200 |
| 30000 | Pitch (deg) | 7 | 7 | 7 | 8 | 7 | 7 |
| (0.56 M) | V/S (ft/min) | 2700 | 2000 | 1600 | 1200 | 900 | 600 |
| 37000 | Pitch (deg) | 7 | 7 | 8 | 8 | 8 | - |
| (0.56 M) | V/S (ft/min) | 1800 | 1300 | 900 | 400 | 100 | - |

**CRUISE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 15000 | Pitch (deg) | 1 | 1 | 2 | 2 | 2 | 3 |
| (250 KIAS) | N1 (%) | 68.7 | 69.9 | 71.1 | 72.4 | 73.8 | 75.3 |
| 20000 | Pitch (deg) | 1 | 1 | 2 | 2 | 2 | 3 |
| (250 KIAS) | N1 (%) | 72.0 | 73.3 | 74.8 | 76.4 | 78.0 | 79.6 |
| 25000 | Pitch (deg) | 1 | 1 | 2 | 2 | 2 | 3 |
| (250 KIAS) | N1 (%) | 76.1 | 77.6 | 79.3 | 80.7 | 81.9 | 83.1 |
| 30000 | Pitch (deg) | 1 | 1 | 2 | 2 | 2 | 3 |
| (0.63 M) | N1 (%) | 78.5 | 80.0 | 81.2 | 82.5 | 84.0 | 85.5 |
| 37000 | Pitch (deg) | 2 | 2 | 2 | 3 | 3 | 4 |
| (0.63 M) | N1 (%) | 79.8 | 81.7 | 83.8 | 86.4 | 89.8 | 92.8 |

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*CONTINUED FROM PREVIOUS PAGE*

## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1&A1P | Anti-Ice: OFF |
|---|---|---|

**FLIGHT IDLE DESCENT**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 0 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 | -1 | 0 |
| | V/S (ft/min) | -1800 | -1700 | -1600 | -1500 | -1500 | -1500 |
| 10000 (240 KIAS) | Pitch (deg) | -3 | -2 | -1 | -1 | 0 | 0 |
| | V/S (ft/min) | -2000 | -1900 | -1800 | -1800 | -1700 | -1700 |
| 20000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | -1 | 0 | 0 |
| | V/S (ft/min) | -2200 | -2100 | -2000 | -1900 | -1900 | -1900 |
| 30000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -2500 | -2400 | -2200 | -2100 | -2100 | -2000 |
| 37000 (240 KIAS) | Pitch (deg) | -1 | -1 | 0 | 0 | 1 | 1 |
| | V/S (ft/min) | -2400 | -2200 | -2100 | -2100 | -2000 | -2000 |

**HOLDING**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 5 | 6 |
| | N1 (%) | 54.0 | 55.9 | 57.8 | 59.9 | 62.2 | 64.4 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 5 | 6 |
| | N1 (%) | 57.5 | 59.5 | 61.8 | 63.9 | 66.2 | 68.4 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1&A1P | Anti-Ice: OFF |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 48.9 | 52.5 | 55.7 | 58.8 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 51.6 | 55.3 | 58.6 | 61.7 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 3 | 3 |
| | N1 (%) | 47.7 | 51.1 | 53.9 | 56.6 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | N1 (%) | 58.6 | 62.4 | 65.7 | 68.6 |

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*CONTINUES ON NEXT PAGE*



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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1&A1P | Anti-Ice: ON |
|---|---|---|

**CLB THRUST MODE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 0 (240 KIAS) | Pitch (deg) | 13 | 11 | 10 | 10 | 9 | 9 |
| | V/S (ft/min) | 4700 | 3900 | 3400 | 2900 | 2500 | 2200 |
| 10000 (240 KIAS) | Pitch (deg) | 8 | 8 | 7 | 7 | 7 | 6 |
| | V/S (ft/min) | 3500 | 2800 | 2400 | 1900 | 1600 | 1400 |
| 20000 (0.56 M) | Pitch (deg) | 6 | 5 | 5 | 5 | 5 | 5 |
| | V/S (ft/min) | 3000 | 2300 | 1900 | 1500 | 1200 | 900 |
| 30000 (0.56 M) | Pitch (deg) | 6 | 6 | 6 | 6 | 6 | 6 |
| | V/S (ft/min) | 2000 | 1400 | 1100 | 700 | 400 | 200 |
| 37000 (0.56 M) | Pitch (deg) | 6 | 6 | 7 | 7 | - | - |
| | V/S (ft/min) | 1200 | 700 | 400 | 0 | - | - |

**CRUISE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 68.7 | 69.9 | 71.1 | 72.4 | 73.8 | 75.3 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 72.0 | 73.4 | 74.8 | 76.4 | 78.0 | 79.6 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 76.1 | 77.6 | 79.3 | 80.7 | 81.9 | 83.1 |
| 30000 (0.63 M) | Pitch (deg) | 1 | 1 | 2 | 2 | 2 | 3 |
| | N1 (%) | 78.5 | 79.9 | 81.2 | 82.5 | 84.0 | 85.5 |
| 37000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 | 3 | 4 |
| | N1 (%) | 79.8 | 81.7 | 83.8 | 86.4 | 89.8 | 92.8 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1&A1P | Anti-Ice: ON |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | | | |
|---|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 0 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 | 1 | 1 |
| | V/S (ft/min) | -900 | -900 | -900 | -900 | -900 | -1000 |
| 10000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 | 1 | 1 |
| | V/S (ft/min) | -1200 | -1200 | -1200 | -1200 | -1200 | -1200 |
| 20000 (240 KIAS) | Pitch (deg) | -1 | 0 | 0 | 0 | 1 | 1 |
| | V/S (ft/min) | -1300 | -1300 | -1300 | -1300 | -1300 | -1400 |
| 30000 (240 KIAS) | Pitch (deg) | 0 | 0 | 0 | 1 | 1 | 2 |
| | V/S (ft/min) | -1400 | -1400 | -1400 | -1400 | -1400 | -1400 |
| 37000 (240 KIAS) | Pitch (deg) | 0 | 0 | 0 | 1 | 1 | 2 |
| | V/S (ft/min) | -1700 | -1600 | -1600 | -1500 | -1500 | -1500 |

| HOLDING | | | | | | | |
|---|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 5 | 6 |
| | N1 (%) | 54.0 | 55.9 | 57.8 | 59.9 | 62.2 | 65.7 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 5 | 6 |
| | N1 (%) | 57.5 | 59.5 | 61.8 | 65.7 | 66.2 | 69.7 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145 | Engine: AE3007A1&A1P | Anti-Ice: ON |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 48.9 | 52.5 | 55.7 | 61.3 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 52.3 | 55.3 | 58.6 | 64.3 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 3 | 3 |
| | N1 (%) | 48.9 | 52.5 | 55.7 | 61.3 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | N1 (%) | 58.6 | 62.4 | 65.7 | 70.9 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145XR | Engine: AE3007A1E | Anti-Ice: OFF |
|---|---|---|

**CLB THRUST MODE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 0 (240 KIAS) | Pitch (deg) | 11 | 10 | 9 | 9 | 9 | 8 |
| | V/S (ft/min) | 4000 | 3400 | 3000 | 2600 | 2300 | 2000 |
| 10000 (240 KIAS) | Pitch (deg) | 8 | 7 | 7 | 7 | 7 | 7 |
| | V/S (ft/min) | 3200 | 2700 | 2400 | 2000 | 1700 | 1500 |
| 20000 (0.56 M) | Pitch (deg) | 4 | 4 | 4 | 4 | 4 | 4 |
| | V/S (ft/min) | 1800 | 1400 | 1200 | 1100 | 900 | 800 |
| 30000 (0.56 M) | Pitch (deg) | 6 | 6 | 6 | 6 | 6 | 6 |
| | V/S (ft/min) | 1900 | 1400 | 1200 | 900 | 600 | 300 |
| 37000 (0.56 M) | Pitch (deg) | 6 | 7 | 7 | 7 | - | - |
| | V/S (ft/min) | 1400 | 900 | 500 | 100 | - | - |

**CRUISE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 79.1 | 79.2 | 79.5 | 79.9 | 80.4 | 81.0 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 82.7 | 82.8 | 83.1 | 83.5 | 84.0 | 84.6 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 86.0 | 86.2 | 86.5 | 86.9 | 87.5 | 88.2 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 | 3 | - |
| | N1 (%) | 86.6 | 86.9 | 87.5 | 88.4 | 89.8 | - |
| 37000 (0.63 M) | Pitch (deg) | 3 | 3 | 4 | 4 | - | - |
| | N1 (%) | 85.7 | 87.4 | 89.9 | 92.0 | - | - |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145XR | Engine: AE3007A1E | Anti-Ice: OFF |
|---|---|---|

**FLIGHT IDLE DESCENT**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 0 (240 KIAS) | Pitch (deg) | -6 | -5 | -4 | -3 | -2 | -1 |
| | V/S (ft/min) | -3000 | -2800 | -2500 | -2300 | -2100 | -2000 |
| 10000 (240 KIAS) | Pitch (deg) | -5 | -4 | -3 | -2 | -2 | -1 |
| | V/S (ft/min) | -3000 | -3000 | -2800 | -2500 | -2300 | -2100 |
| 20000 (240 KIAS) | Pitch (deg) | -4 | -3 | -3 | -2 | -1 | -1 |
| | V/S (ft/min) | -3000 | -3000 | -2900 | -2700 | -2500 | -2400 |
| 30000 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 | -1 | 0 |
| | V/S (ft/min) | -3000 | -3000 | -3000 | -2900 | -2700 | -2600 |
| 37000 (240 KIAS) | Pitch (deg) | -2 | -2 | -1 | -1 | 0 | 1 |
| | V/S (ft/min) | -3000 | -3000 | -3000 | -2800 | -2600 | -2400 |

**HOLDING**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 5 | 6 |
| | N1 (%) | 61.4 | 62.2 | 63.3 | 64.6 | 66.0 | 67.5 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 5 | 6 |
| | N1 (%) | 65.1 | 66.0 | 67.0 | 68.2 | 69.6 | 71.1 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145XR | Engine: AE3007A1E | Anti-Ice: OFF |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 51.4 | 54.8 | 57.9 | 60.9 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 7 | 8 | 8 |
| | N1 (%) | 49.3 | 52.8 | 56.0 | 58.8 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 3 | 3 |
| | N1 (%) | 43.9 | 46.9 | 49.6 | 52.0 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | N1 (%) | 57.1 | 60.8 | 63.9 | 66.7 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145XR | Engine: AE3007A1E | Anti-Ice: ON |
|---|---|---|

**CLB THRUST MODE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 0 (240 KIAS) | Pitch (deg) | 10 | 10 | 9 | 9 | 8 | 8 |
| | V/S (ft/min) | 3800 | 3300 | 2900 | 2500 | 2200 | 1900 |
| 10000 (240 KIAS) | Pitch (deg) | 7 | 7 | 6 | 6 | 6 | 6 |
| | V/S (ft/min) | 2700 | 2200 | 2000 | 1700 | 1400 | 1200 |
| 20000 (0.56 M) | Pitch (deg) | 3 | 3 | 3 | 3 | 3 | 4 |
| | V/S (ft/min) | 900 | 800 | 700 | 600 | 400 | 300 |
| 30000 (0.56 M) | Pitch (deg) | 4 | 4 | 5 | 5 | 5 | 0 |
| | V/S (ft/min) | 900 | 700 | 500 | 300 | 0 | 0 |
| 37000 (0.56 M) | Pitch (deg) | 5 | 5 | 0 | 0 | - | - |
| | V/S (ft/min) | 500 | 100 | 0 | 0 | - | - |

**CRUISE**

| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 15000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 79.1 | 79.2 | 79.5 | 79.9 | 80.4 | 81.0 |
| 20000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 82.7 | 82.8 | 83.1 | 83.5 | 84.0 | 84.6 |
| 25000 (250 KIAS) | Pitch (deg) | 1 | 2 | 2 | 2 | 3 | 3 |
| | N1 (%) | 86.0 | 86.2 | 86.5 | 86.9 | 87.5 | 88.2 |
| 30000 (0.63 M) | Pitch (deg) | 2 | 2 | 2 | 3 | 3 | - |
| | N1 (%) | 86.6 | 86.9 | 87.5 | 88.4 | 89.8 | - |
| 37000 (0.63 M) | Pitch (deg) | 3 | 3 | 4 | 4 | - | - |
| | N1 (%) | 85.7 | 87.5 | 89.9 | 92.0 | - | - |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145XR | Engine: AE3007A1E | Anti-Ice: ON |
|---|---|---|

| FLIGHT IDLE DESCENT | | | | | | | |
|---|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 0 (240 KIAS) | Pitch (deg) | -4 | -3 | -2 | -1 | -1 | 0 |
| | V/S (ft/min) | -2400 | -2000 | -1800 | -1700 | -1600 | -1500 |
| 10000 (240 KIAS) | Pitch (deg) | -4 | -3 | -2 | -1 | -1 | 0 |
| | V/S (ft/min) | -2700 | -2300 | -2100 | -1900 | -1800 | -1700 |
| 20000 (240 KIAS) | Pitch (deg) | -3 | -2 | -2 | -1 | 0 | 0 |
| | V/S (ft/min) | -2900 | -2500 | -2200 | -2100 | -2000 | -1900 |
| 30000 (240 KIAS) | Pitch (deg) | -3 | -2 | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -2900 | -2500 | -2300 | -2100 | -2000 | -2000 |
| 37000 (240 KIAS) | Pitch (deg) | -2 | -1 | -1 | 0 | 0 | 1 |
| | V/S (ft/min) | -3100 | -2700 | -2500 | -2400 | -2200 | -2100 |

| HOLDING | | | | | | | |
|---|---|---|---|---|---|---|---|
| PRESSURE ALTITUDE (ft) | | WEIGHT (lb) | | | | | |
| | | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 |
| 5000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 5 | 6 |
| | N1 (%) | 61.4 | 62.2 | 63.3 | 64.6 | 66.0 | 68.4 |
| 10000 (200 KIAS) | Pitch (deg) | 3 | 3 | 4 | 5 | 5 | 6 |
| | N1 (%) | 65.1 | 66.0 | 67.0 | 69.1 | 69.6 | 71.9 |

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## UNRELIABLE AIRSPEED TABLES

| Airplane: EMB-145XR | Engine: AE3007A1E | Anti-Ice: ON |
|---|---|---|

| Terminal Area (5000 ft) - %N1 for Level Flight | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 0 ($V_{REF45}$ + 30) | Pitch (deg) | 7 | 7 | 7 | 8 |
| | N1 (%) | 51.4 | 54.8 | 57.9 | 63.4 |
| 9 ($V_{REF45}$ + 15) | Pitch (deg) | 7 | 7 | 8 | 8 |
| | N1 (%) | 49.9 | 52.8 | 56.0 | 61.2 |

| Final Approach (1500 ft) - %N1 for 3° Glideslope | | | | | |
|---|---|---|---|---|---|
| Flap position ($V_{REF}$ + INCREMENT) | | WEIGHT (lb) | | | |
| | | 30000 | 35000 | 40000 | 45000 |
| 22 ($V_{REF22}$ + 10) | Pitch (deg) | 3 | 3 | 3 | 4 |
| | N1 (%) | 51.4 | 54.8 | 57.9 | 63.4 |
| 45 ($V_{REF45}$ + 10) | Pitch (deg) | -1 | 0 | 0 | 0 |
| | N1 (%) | 57.1 | 60.8 | 63.9 | 69.0 |

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## TRANSPONDER FAIL

CONDITION: The transponder mode annunciation replaced with dashes on the RMU Radio page or by ATC notification.

Transponder..... SELECT
ANOTHER

## ADS-B OUT FAIL OR DEGRADED

CONDITION: ADS-B FAIL or ADS-B DGR annunciation displayed on the RMU Radio page or by ATC notification.

Transponder..... SELECT
ANOTHER

**NOTE:** Only applicable to airplanes Post-Mod. SB 145-34-0118 or equipped with an equivalent modification factory incorporated.

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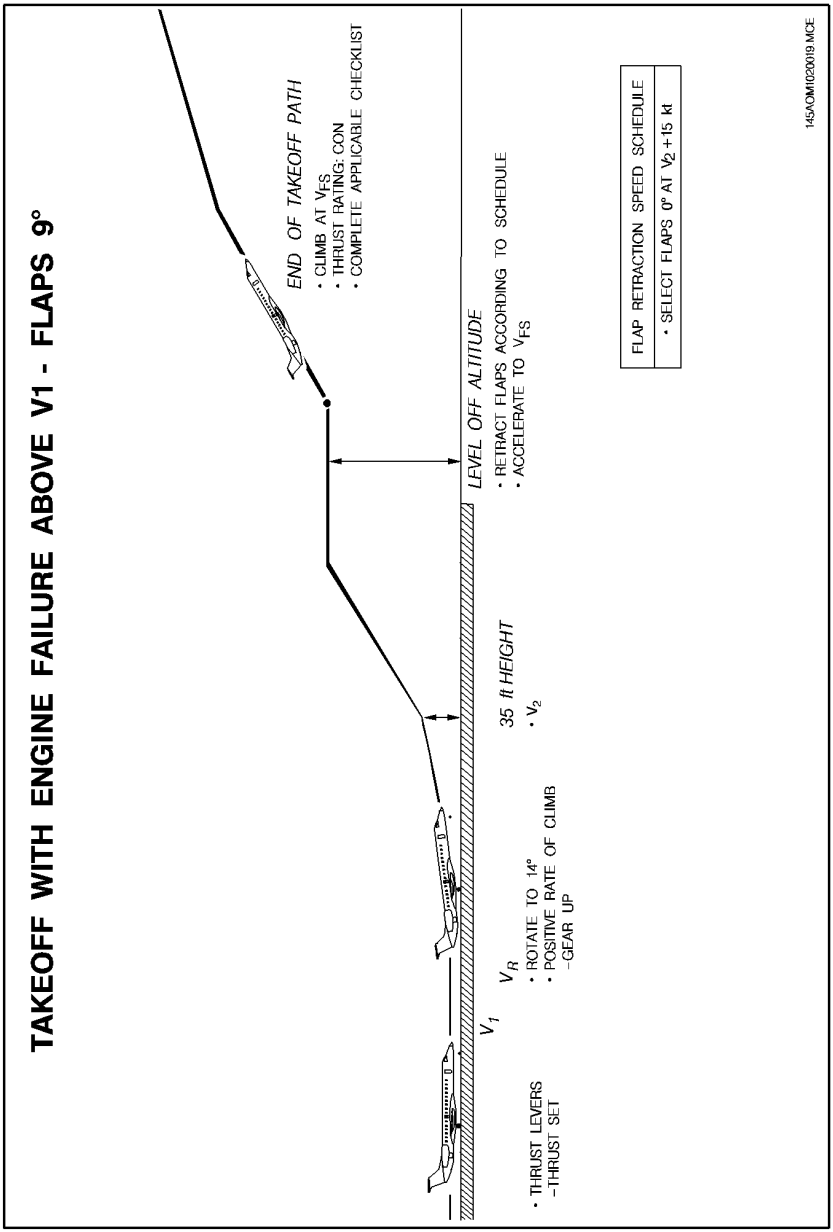
# EMERGENCY PROFILES



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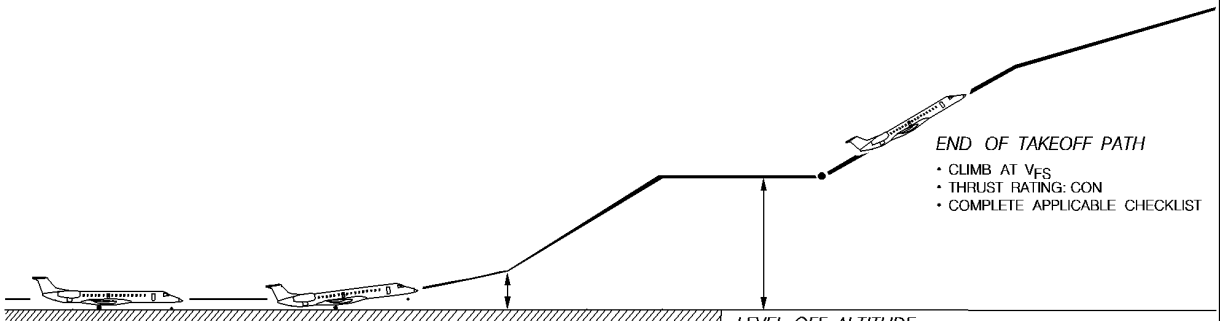
# TAKEOFF WITH ENGINE FAILURE ABOVE V1 - FLAPS 18°




| FLAP RETRACTION SPEED SCHEDULE |
|---|
| • SELECT FLAPS 9° AT $V_2$+10 kt |
| • SELECT FLAPS 0° AT $V_2$+30 kt |

145AOM1020018.MCE

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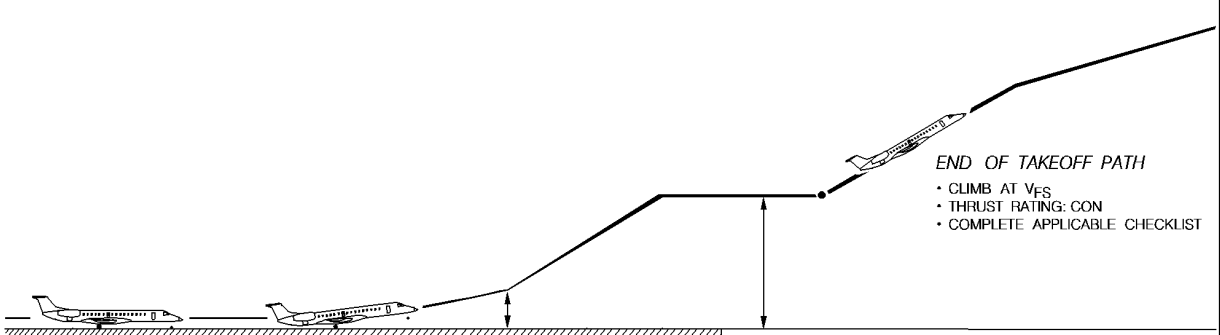
# TAKEOFF WITH ENGINE FAILURE ABOVE V1 - FLAPS 22°




| FLAP RETRACTION SPEED SCHEDULE | |
|---|---|
| ALL ENGINES EXCEPT AE3007A1P | AE3007A1P ENGINES |
| • SELECT FLAPS 9° AT $V_2$ + 5 kt | • SELECT FLAPS 9° AT $V_2$ + 10 kt |
| • SELECT FLAPS 0° AT $V_2$ + 25 kt | • SELECT FLAPS 0° AT $V_2$ + 30 kt |

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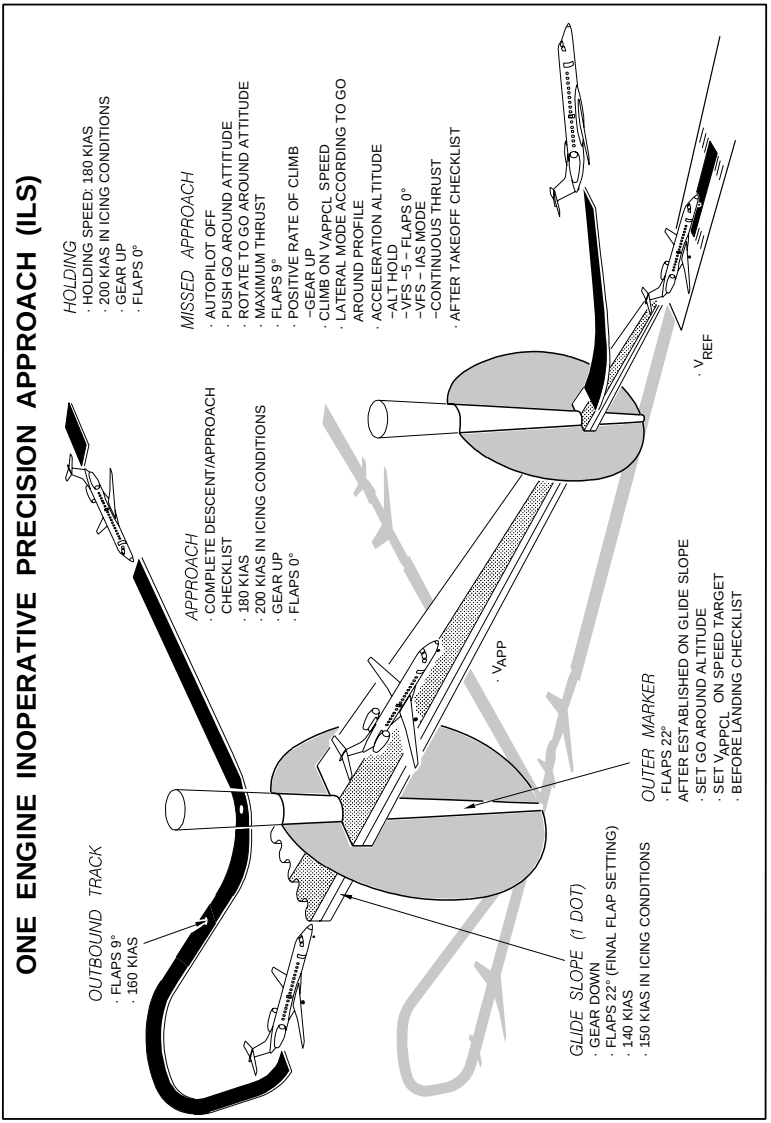
# ABNORMAL PROFILES

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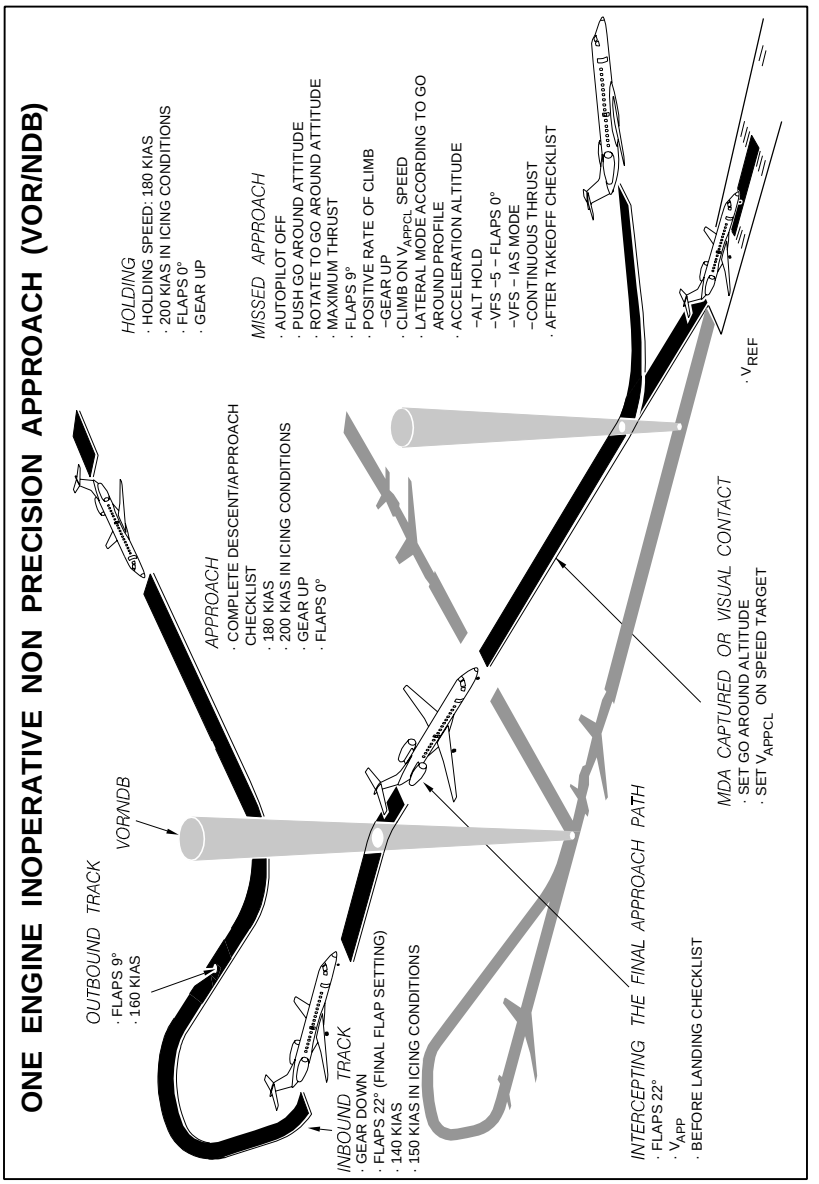
## ONE ENGINE INOPERATIVE NON PRECISION APPROACH (VOR/NDB)

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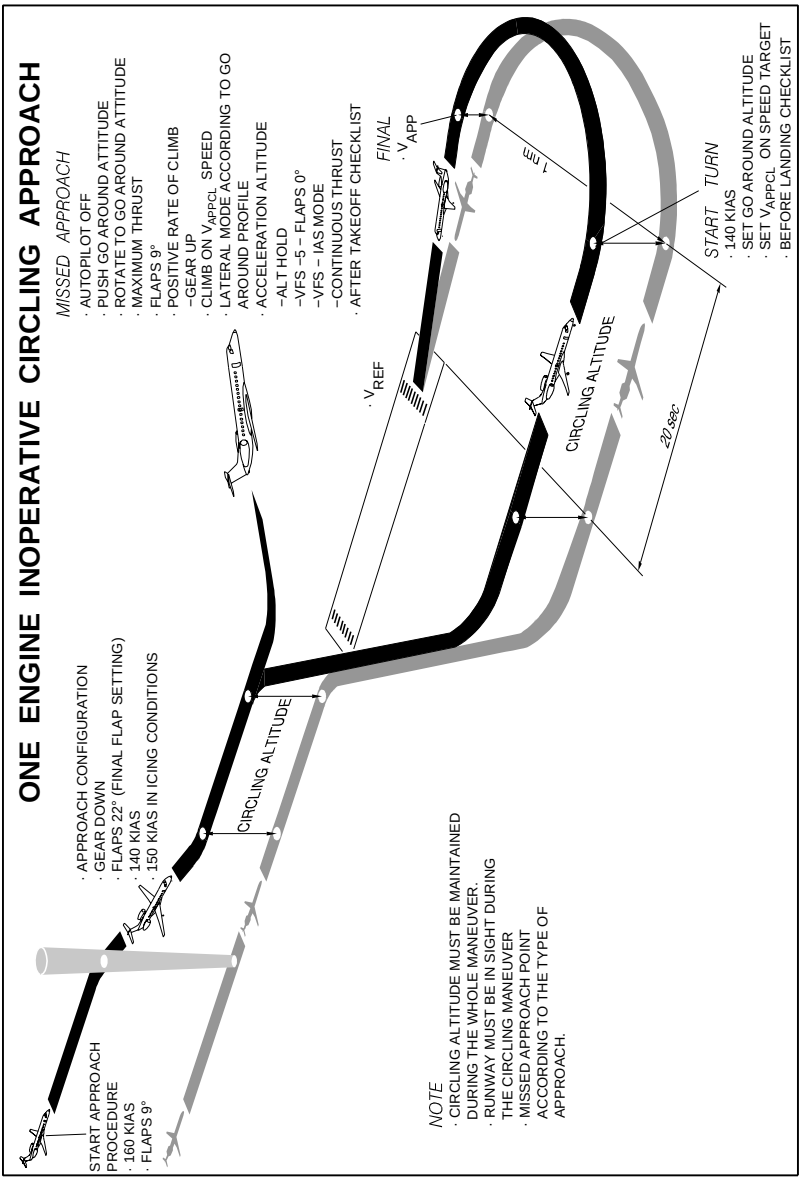


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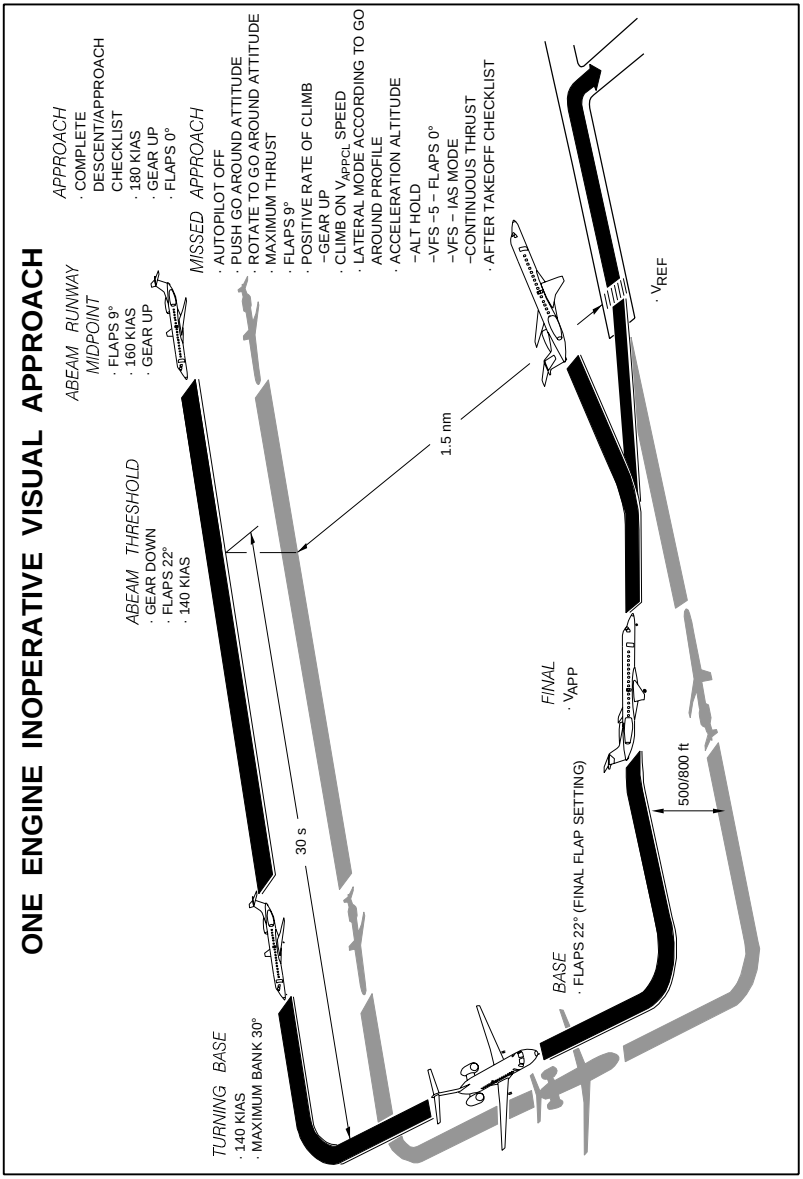
## ONE ENGINE INOPERATIVE VISUAL APPROACH

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# SECTION 1-04
# PERFORMANCE

TABLE OF CONTENTS

Page Block

Introduction ..... 1-04-00
Noise Levels ..... 1-04-03
Wind and Altitude Conversion ..... 1-04-05
Thrust Setting Tables ..... 1-04-10
Takeoff ..... 1-04-15
Supplementary Takeoff Information ..... 1-04-20
Approach ..... 1-04-25
Landing ..... 1-04-30
Landing Information for Stockholm-Bromma (ESSB) Airport (*) ..... 1-04-35

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**NOTE:** Items marked with an asterisk (*) may not be present in this manual.

# INTRODUCTION

This section presents takeoff, approach and landing performance information.
For determination of the takeoff and landing limiting weights, the performance data as presented in the approved Airplane Flight Manual (AFM) or Runway Analysis Software must be used.

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# NOISE LEVELS

The following Effective Perceived Noise Levels comply with RBHA 36, 14 CFR Part 36, and ICAO Annex 16 Volume I, Chapter 3.

The values below are stated for reference conditions of standard atmosphere pressure at sea level, 25°C ambient temperature, 70% relative humidity, and zero wind.

Takeoff and sideline noise levels were established for the EMB-145 equipped with two Rolls-Royce AE3007A, AE3007A1, AE3007A1/1, AE3007A1P or AE3007A1E engines or EMB-135 equipped with two Rolls-Royce AE3007A3 or AE3007A1/3 engines, at the MTOW (Maximum Takeoff Weight) related to each model, $V_2$ climb speed, flaps 9°, and all engines with maximum takeoff power setting. The takeoff power cutback procedure was used.

Approach noise levels were established from a 3° glide slope at the MLW (Maximum Landing Weight) associated to each airplane model, $V_{REF45}$, and flaps 45°.

No determination has been made by the Airworthiness Authority that the noise levels in this manual are or should be acceptable or unacceptable for operation at, into, or out of any airport.

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| NOISE LEVEL IN EPNdB | | | | |
|---|---|---|---|---|
| Airplane | Noise Level | CONDITION | | |
| | | Sideline | Takeoff | Approach |
| All | Maximum Allowable | 94.0 | 89.0 | 98.0 |
| EMB-145 EP model | Actual | 85.0 | 80.1 | 92.6 |
| EMB-145 ER model | Actual | 85.1 | 79.8 | 92.6 |
| EMB-145 EU model | Actual | 85.1 | 79.2 | 92.6 |
| EMB-145 MK model | Actual | 85.1 | 79.2 | 92.5 |
| EMB-145 LU model | Actual | 84.9 (5)(6) | 81.0 | 92.5 |
| EMB-145 LR model (1) | Actual | 84.9 (2)(5)(6) | 81.0 (2) (3) | 92.5 |
| EMB-145 MP model | Actual | 85.0 | 80.1 | 92.5 |
| EMB-145 XR model | Actual | 86.9 | 81.2 | 91.6 |
| ERJ-140 ER (EMB-135 KE model) | Actual | 84.3 | 79.7 | 92.4 |
| ERJ-140 LR (EMB-135 KL model) | Actual | 84.2 | 80.4 | 92.4 |
| EMB-135 ER model | Actual | 84.4 (4) | 78.6 (4) | 92.3 |
| EMB-135 LR model | Actual | 84.3 | 79.4 | 92.3 |

**NOTE: 1)** Noise levels applicable to airplanes with MTOW of 22000 kg.

**2)** For airplanes with MTOW of 21450 kg, the actual noise level for takeoff condition is 80.5 EPNdB and for sideline condition is 85.0 EPNdB.

**3)** For airplanes with MTOW of 22600 kg the actual noise level for takeoff condition is 81.6 EPNdB.

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**4)** For airplanes Post-Mod. SB 145-00-0028 or equipped with an equivalent modification factory incorporated, the actual noise level for Sideline condition is 84.3 EPNdB, and for Takeoff is 79.1 EPNdB.

**5)** For airplanes Post-Mod. SB 145-53-0065 or equipped with an equivalent modification factory incorporated, the actual noise level for Sideline condition is 85.0 EPNdB and for Takeoff condition is 80.5 EPNdB.

**6)** For airplanes Post-Mod. SB 145-53-0066 or equipped with an equivalent modification factory incorporated, the actual noise level for Sideline condition is 84.9 EPNdB.

The following table contains the noise levels in dBA for the same takeoff and approach conditions described above and should be used as general guidance.

| NOISE LEVEL IN dBA | | |
|---|---|---|
| Airplane | CONDITION | |
| | Takeoff | Approach |
| EMB-145 EP model | 68.8 | 82.9 |
| EMB-145 ER model | 68.4 | 82.9 |
| EMB-145 EU model | 67.6 | 82.9 |
| EMB-145 MK model | 67.6 | 82.6 |
| EMB-145 LU model | 70.1 (4) | 82.6 |
| EMB-145 LR model (1) | 70.1 (2) (3) (4) | 82.6 |
| EMB-145 MP model | 68.8 | 82.6 |
| EMB-145 XR model | 70.2 | 81.3 |
| ERJ-140 ER (EMB-135 KE model) | 67.9 | 82.4 |
| ERJ-140 LR (EMB-135 KL model) | 69.0 | 82.4 |

(Continued)

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(Continued)

| NOISE LEVEL IN dBA | | |
|---|---|---|
| Airplane | CONDITION | |
| | Takeoff | Approach |
| EMB-135 ER model | 66.5 | 82.2 |
| EMB-135 LR model | 67.7 | 82.2 |

**NOTE: 1)** Noise levels applicable to airplanes with MTOW of 22000 kg.

**2)** For airplanes with MTOW of 21450 kg, the actual noise level for takeoff condition is 69.4 dBA.

**3)** For airplanes with MTOW of 22600 kg the actual noise level for takeoff condition is 70.9 dBA.

**4)** For airplanes Post-Mod. SB 145-53-0065 or equipped with an equivalent modification factory incorporated, the actual noise level takeoff condition is 69.4 dBA.

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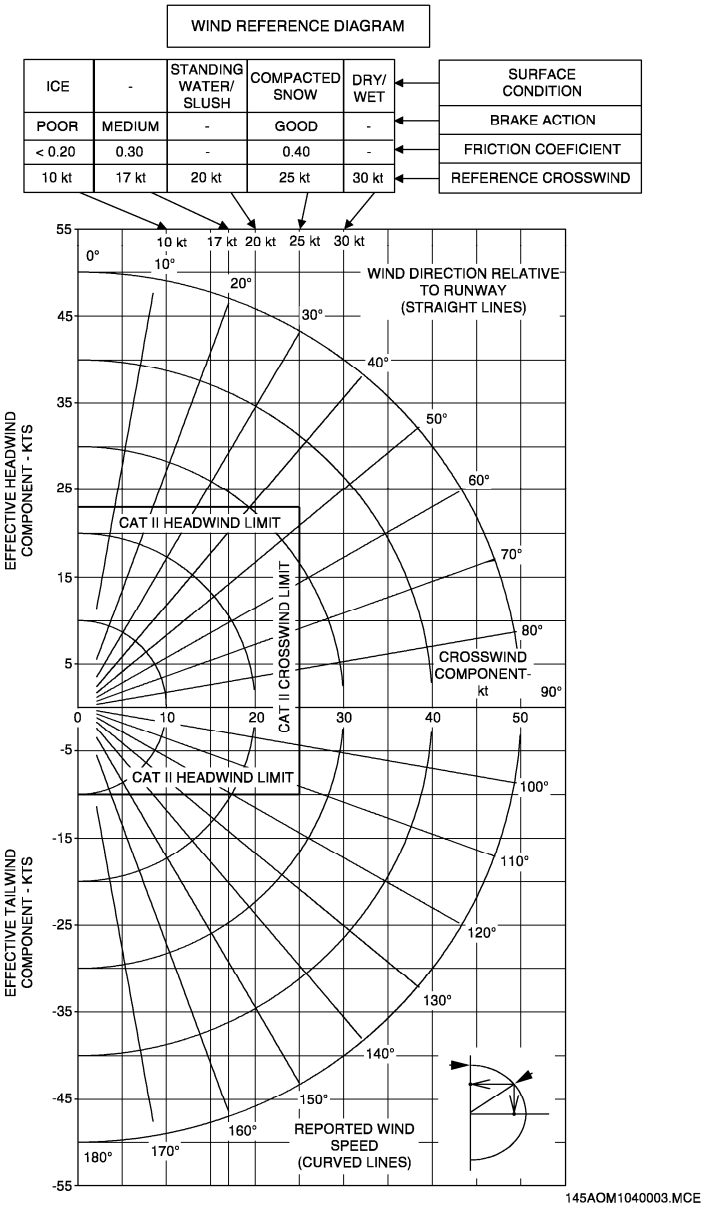
# WIND AND ALTITUDE CONVERSION

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## USE

Enter the chart with the reported wind velocity and the relative angle to the runway, to read the wind component parallel to the runway and the crosswind.

## EXAMPLE

Given:

Wind velocity ..... 20 kt
Wind direction ..... 60°

Determine:

Wind component parallel to the runway ..... 10 kt
Crosswind ..... 17.5 kt

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# ALTIMETER SETTING TO STATION PRESSURE

## QNH TO PRESSURE ALTITUDE

| QNH | | CORRECTION TO ELEVATION FOR PRES. ALT. (FT) |
|---|---|---|
| in Hg | hPa | |
| 28.81 to 28.91 | 976 to 979 | 1000 |
| 28.92 to 29.02 | 980 to 983 | 900 |
| 29.03 to 29.12 | 984 to 986 | 800 |
| 29.13 to 29.23 | 987 to 990 | 700 |
| 29.24 to 29.34 | 991 to 994 | 600 |
| 29.35 to 29.44 | 995 to 997 | 500 |
| 29.45 to 29.55 | 998 to 1001 | 400 |
| 29.56 to 29.66 | 1002 to 1004 | 300 |
| 29.67 to 29.76 | 1005 to 1008 | 200 |
| 29.77 to 29.87 | 1009 to 1012 | 100 |
| 29.88 to 29.97 | 1013 to 1015 | 0 |
| 29.98 to 30.08 | 1016 to 1019 | -100 |
| 30.09 to 30.19 | 1020 to 1022 | -200 |
| 30.20 to 30.30 | 1023 to 1026 | -300 |
| 30.31 to 30.41 | 1027 to 1030 | -400 |
| 30.42 to 30.52 | 1031 to 1034 | -500 |
| 30.53 to 30.63 | 1035 to 1037 | -600 |
| 30.64 to 30.74 | 1038 to 1041 | -700 |
| 30.75 to 30.85 | 1042 to 1045 | -800 |
| 30.86 to 30.96 | 1046 to 1048 | -900 |
| 30.97 to 31.07 | 1049 to 1052 | -1000 |

Example: Elevation = 2000 ft
QNH = 29.60 in Hg
Correction = 300 ft
Pressure Altitude = 2300 ft

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# QFE TO STATION PRESSURE

| QFE | | PRESSURE ALTITUDE (ft) |
|---|---|---|
| in Hg | hPa | |
| 31.01 | 1050 | -989 |
| 30.86 | 1045 | -856 |
| 30.71 | 1040 | -723 |
| 30.57 | 1035 | -589 |
| 30.42 | 1030 | -454 |
| 30.27 | 1025 | -319 |
| 30.12 | 1020 | -184 |
| 29.98 | 1015 | -48 |
| 29.83 | 1010 | 89 |
| 29.68 | 1005 | 227 |
| 29.53 | 1000 | 364 |
| 29.38 | 995 | 503 |
| 29.23 | 990 | 641 |
| 29.09 | 985 | 781 |
| 28.94 | 980 | 921 |
| 28.79 | 975 | 1062 |
| 28.64 | 970 | 1202 |
| 28.50 | 965 | 1344 |
| 28.35 | 960 | 1486 |
| 28.20 | 955 | 1630 |
| 28.05 | 950 | 1773 |
| 27.91 | 945 | 1918 |
| 27.76 | 940 | 2062 |
| 27.61 | 935 | 2208 |
| 27.46 | 930 | 2353 |
| 27.32 | 925 | 2500 |
| 27.17 | 920 | 2647 |
| 27.02 | 915 | 2796 |
| 26.87 | 910 | 2944 |
| 26.73 | 905 | 3094 |
| 26.58 | 900 | 3243 |
| 26.43 | 895 | 3394 |
| 26.28 | 890 | 3545 |
| 26.14 | 885 | 3698 |
| 25.99 | 880 | 3850 |
| 25.84 | 875 | 4004 |
| 25.69 | 870 | 4157 |

| QFE | | PRESSURE ALTITUDE (ft) |
|---|---|---|
| in Hg | hPa | |
| 25.55 | 865 | 4313 |
| 25.40 | 860 | 4468 |
| 25.25 | 855 | 4625 |
| 25.10 | 850 | 4781 |
| 24.96 | 845 | 4939 |
| 24.81 | 840 | 5097 |
| 24.66 | 835 | 5257 |
| 24.51 | 830 | 5417 |
| 24.36 | 825 | 5579 |
| 24.21 | 820 | 5740 |
| 24.07 | 815 | 5903 |
| 23.92 | 810 | 6065 |
| 23.77 | 805 | 6230 |
| 23.62 | 800 | 6394 |
| 23.48 | 795 | 6561 |
| 23.33 | 790 | 6727 |
| 23.18 | 785 | 6895 |
| 23.03 | 780 | 7063 |
| 22.89 | 775 | 7233 |
| 22.74 | 770 | 7402 |
| 22.59 | 765 | 7574 |
| 22.44 | 760 | 7745 |
| 22.30 | 755 | 7920 |
| 22.15 | 750 | 8095 |
| 22.00 | 745 | 8269 |
| 21.85 | 740 | 8442 |
| 21.71 | 735 | 8619 |
| 21.56 | 730 | 8796 |
| 21.41 | 725 | 8975 |
| 21.26 | 720 | 9154 |
| 21.12 | 715 | 9335 |
| 20.97 | 710 | 9516 |
| 20.82 | 705 | 9699 |
| 20.67 | 700 | 9882 |
| 20.53 | 695 | 10068 |
| 20.38 | 690 | 10253 |
| 20.19 | 685 | 10439 |

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# GEOMETRIC HEIGHT TO PRESSURE HEIGHT

Pressure altimeters are calibrated to indicate true altitude under International Standard Atmosphere (ISA) conditions. Any deviation from ISA will therefore result in an erroneous reading on the altimeter. In the case when the temperature is higher than ISA the true altitude will be higher than the figure indicated by the altimeter, and the true altitude will be lower when the temperature is lower than ISA. The altimeter error may be significant under conditions of extremely cold temperature (ICAO PANS-OPS Vol I 3.5.4.5.2).

| AERODROME TEMP. (°C) | HEIGHT ABOVE THE ELEVATION OF THE ALTIMETER SETTING SOURCE (feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| (ft) | 200 | 300 | 400 | 500 | 600 | 700 | 800 |
| 0 | 0 | 20 | 20 | 20 | 20 | 20 | 40 |
| -10 | 20 | 20 | 40 | 40 | 40 | 60 | 60 |
| -20 | 20 | 40 | 40 | 60 | 80 | 80 | 100 |
| -30 | 40 | 60 | 60 | 80 | 100 | 120 | 140 |
| -40 | 40 | 60 | 80 | 100 | 140 | 160 | 180 |
| -50 | 60 | 80 | 100 | 140 | 160 | 200 | 220 |

| AERODROME TEMP. (°C) | HEIGHT ABOVE THE ELEVATION OF THE ALTIMETER SETTING SOURCE (feet) | | | | | | |
|---|---|---|---|---|---|---|---|
| (ft) | 900 | 1000 | 1500 | 2000 | 3000 | 4000 | 5000 |
| 0 | 40 | 40 | 60 | 80 | 120 | 160 | 200 |
| -10 | 80 | 80 | 120 | 160 | 240 | 320 | 400 |
| -20 | 100 | 120 | 180 | 240 | 360 | 500 | 620 |
| -30 | 160 | 160 | 260 | 340 | 500 | 680 | 860 |
| -40 | 200 | 220 | 320 | 440 | 660 | 880 | 1100 |
| -50 | 240 | 280 | 400 | 540 | 820 | 1100 | 1380 |

**NOTE:** The tables above are based on aerodrome elevation of 2000 ft; however, they can be used operationally for any aerodrome at or above sea level.

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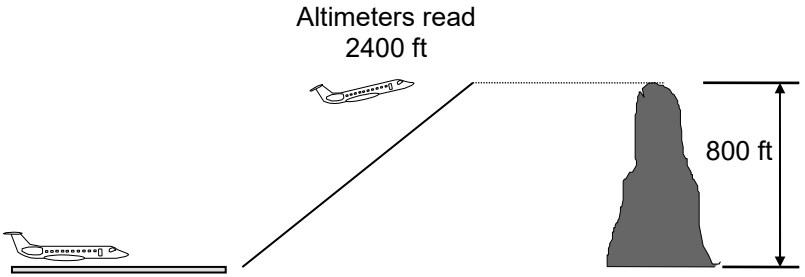
Example:

Airport elevation: ..... 1500 ft
Airport Temperature..... -20ºC
Obstacle Height above airport elevation..... 800 ft
Altimeter adjusted to airport QNH (on ground altimeter reads 1500 ft).

Enter table with 800 ft and -20ºC and read 100 ft.
So, when the airplane reaches the obstacle geometric height, the altimeter will read 1500 + 800 + 100 = 2400 ft




Elevation = 1500 ft
T = -20ºC
Altimeters reads 1500 ft

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# THRUST SETTING TABLES

Thrust settings tables are presented for various pressure altitudes and static air temperatures, with engine bleed closed or open, and anti-ice on or off.
The tables present the following data:

- N1 for T/O-1 mode.
- N1 for ALT T/O-1 mode.
- N1 for go-around (T/O-1 mode).
- N1 for maximum continuous thrust (CON mode).

**T/O-1:** It is the maximum permissible thrust at takeoff for existing conditions of temperature and pressure altitude. This rating is time limited to a 5 minutes.

**ALT T/O-1:** It is an engine rating lower than the takeoff thrust, intended for engine life extension (due to lower turbine temperatures). It is also time limited to 5 minutes. In case of engine failure the FADEC will command the operating engine to T/O-1 mode.

**GO AROUND (T/O-1):** It is the maximum permissible thrust during go around. The amount of thrust is the same as for the takeoff case, but the N1 are different because the effect of the airplane's airspeed during go around is taken into consideration.
Go-around thrust is also time-limited to 5 minutes.

**MAXIMUM CONTINUOUS THRUST (CON):** It is the maximum permissible thrust for continuous use.
Maximum Continuous Thrust is to be used whenever pilot judgment indicates it is necessary for safety reasons (1 engine inoperative, severe icing, etc).

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## N1 FOR T/O-1 MODE

## ANTI-ICE OFF

## AIRSPEED: 0 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -54 | -50 | -45 | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 |
| -1000 | 74.8 | 75.5 | 76.4 | 77.2 | 78.0 | 78.8 | 79.6 | 80.4 | 81.2 | 82.0 | 82.8 |
| 0 | 75.5 | 76.1 | 77.0 | 77.8 | 78.7 | 79.5 | 80.3 | 81.1 | 81.9 | 82.7 | 83.5 |
| 1000 | 76.5 | 77.2 | 78.0 | 78.9 | 79.7 | 80.6 | 81.4 | 82.2 | 83.0 | 83.8 | 84.6 |
| 2000 | 77.5 | 78.2 | 79.1 | 80.0 | 80.8 | 81.7 | 82.5 | 83.3 | 84.1 | 84.9 | 85.7 |
| 3000 | 78.5 | 79.2 | 80.1 | 81.0 | 81.8 | 82.7 | 83.5 | 84.4 | 85.2 | 86.0 | 86.8 |
| 4000 | 79.5 | 80.2 | 81.1 | 82.0 | 82.8 | 83.7 | 84.6 | 85.4 | 86.2 | 87.1 | 87.9 |
| 5000 | 80.4 | 81.1 | 82.0 | 82.9 | 83.8 | 84.7 | 85.6 | 86.4 | 87.3 | 88.1 | 88.9 |
| 6000 | 80.9 | 81.7 | 82.6 | 83.5 | 84.4 | 85.2 | 86.1 | 87.0 | 87.8 | 88.7 | 89.5 |
| 7000 | 81.4 | 82.2 | 83.1 | 84.0 | 84.9 | 85.8 | 86.7 | 87.5 | 88.4 | 89.2 | 90.1 |
| 8000 | 82.0 | 82.7 | 83.6 | 84.6 | 85.5 | 86.3 | 87.2 | 88.1 | 89.0 | 89.8 | 90.7 |
| 9000 | 82.5 | 83.3 | 84.2 | 85.1 | 86.0 | 86.9 | 87.8 | 88.7 | 89.6 | 90.4 | 91.3 |
| 10000 | 83.1 | 83.9 | 84.8 | 85.7 | 86.6 | 87.5 | 88.4 | 89.3 | 90.2 | 91.1 | 91.9 |
| 11000 | 83.2 | 83.9 | 84.9 | 85.8 | 86.7 | 87.6 | 88.5 | 89.4 | 90.3 | 91.1 | 92.0 |
| 12000 | 83.3 | 84.0 | 84.9 | 85.9 | 86.8 | 87.7 | 88.6 | 89.5 | 90.4 | 91.2 | 92.1 |
| 13000 | 83.5 | 84.3 | 85.2 | 86.2 | 87.1 | 88.0 | 88.9 | 89.8 | 90.7 | 91.5 | 92.4 |
| 14000 | 84.0 | 84.8 | 85.8 | 86.7 | 87.6 | 88.5 | 89.4 | 90.3 | 91.2 | 92.1 | 93.0 |
| 15000 | 84.6 | 85.3 | 86.3 | 87.2 | 88.2 | 89.1 | 90.0 | 90.9 | 91.8 | 92.7 | 93.5 |
| 16000 | 84.6 | 85.3 | 86.3 | 87.2 | 88.2 | 89.1 | 90.0 | 90.9 | 91.8 | 92.7 | 93.5 |

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## N1 FOR T/O-1 MODE

## ANTI-ICE OFF

## AIRSPEED: 0 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| -1000 | 83.6 | 84.3 | 85.1 | 85.8 | 86.6 | 87.3 | 88.0 | 88.8 | 89.5 | 90.2 | 90.3 |
| 0 | 84.2 | 85.0 | 85.8 | 86.5 | 87.3 | 88.0 | 88.8 | 89.5 | 90.2 | 90.9 | 90.8 |
| 1000 | 85.4 | 86.2 | 86.9 | 87.7 | 88.5 | 89.2 | 90.0 | 90.7 | 91.4 | 91.4 | 90.1 |
| 2000 | 86.5 | 87.3 | 88.1 | 88.9 | 89.7 | 90.4 | 91.2 | 91.9 | 92.0 | 91.0 | 90.2 |
| 3000 | 87.7 | 88.5 | 89.2 | 90.0 | 90.8 | 91.6 | 92.3 | 92.7 | 91.8 | 91.0 | 90.4 |
| 4000 | 88.7 | 89.5 | 90.3 | 91.1 | 91.9 | 92.7 | 93.2 | 93.1 | 91.8 | 91.0 | 90.7 |
| 5000 | 89.8 | 90.6 | 91.4 | 92.2 | 93.0 | 93.8 | 93.7 | 92.7 | 91.9 | 91.0 | - |
| 6000 | 90.3 | 91.2 | 92.0 | 92.8 | 93.6 | 94.0 | 93.3 | 92.6 | 91.7 | 91.2 | - |
| 7000 | 90.9 | 91.7 | 92.6 | 93.4 | 94.2 | 94.3 | 93.2 | 92.4 | 91.6 | 91.4 | - |
| 8000 | 91.5 | 92.4 | 93.2 | 94.0 | 94.5 | 94.4 | 93.1 | 92.3 | 91.6 | - | - |
| 9000 | 92.2 | 93.0 | 93.8 | 94.6 | 94.9 | 93.7 | 92.9 | 92.2 | 91.8 | - | - |
| 10000 | 92.8 | 93.6 | 94.5 | 94.5 | 93.2 | 92.2 | 91.5 | 90.9 | - | - | - |
| 11000 | 92.9 | 93.7 | 94.5 | 94.5 | 93.0 | 92.1 | 91.4 | 91.0 | - | - | - |
| 12000 | 92.9 | 93.8 | 94.6 | 94.6 | 92.8 | 92.0 | 91.3 | 91.2 | - | - | - |
| 13000 | 93.3 | 94.1 | 94.7 | 94.5 | 92.6 | 91.9 | 91.3 | - | - | - | - |
| 14000 | 93.8 | 94.7 | 94.9 | 93.4 | 92.5 | 91.7 | 91.4 | - | - | - | - |
| 15000 | 94.4 | 95.2 | 95.1 | 93.2 | 92.4 | 91.5 | - | - | - | - | - |
| 16000 | 94.1 | 94.1 | 92.7 | 91.7 | 90.9 | 90.3 | - | - | - | - | - |

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## N1 FOR ALT T/O-1 MODE

## ANTI-ICE OFF

## AIRSPEED: 0 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -54 | -50 | -45 | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 |
| -1000 | 72.3 | 72.9 | 73.7 | 74.6 | 75.3 | 76.1 | 76.9 | 77.7 | 78.4 | 79.2 | 79.9 |
| 0 | 72.9 | 73.5 | 74.3 | 75.1 | 75.9 | 76.7 | 77.5 | 78.3 | 79.1 | 79.8 | 80.6 |
| 1000 | 73.7 | 74.4 | 75.2 | 76.1 | 76.9 | 77.7 | 78.5 | 79.2 | 80.0 | 80.8 | 81.6 |
| 2000 | 74.6 | 75.3 | 76.1 | 77.0 | 77.8 | 78.6 | 79.4 | 80.2 | 81.0 | 81.8 | 82.5 |
| 3000 | 75.6 | 76.2 | 77.1 | 77.9 | 78.8 | 79.6 | 80.4 | 81.2 | 82.0 | 82.8 | 83.6 |
| 4000 | 76.6 | 77.2 | 78.1 | 79.0 | 79.8 | 80.6 | 81.5 | 82.3 | 83.1 | 83.9 | 84.7 |
| 5000 | 77.5 | 78.3 | 79.1 | 80.0 | 80.8 | 81.7 | 82.5 | 83.4 | 84.2 | 85.0 | 85.8 |
| 6000 | 78.0 | 78.7 | 79.6 | 80.5 | 81.3 | 82.2 | 83.0 | 83.9 | 84.7 | 85.5 | 86.3 |
| 7000 | 78.5 | 79.2 | 80.1 | 81.0 | 81.8 | 82.7 | 83.5 | 84.4 | 85.2 | 86.0 | 86.8 |
| 8000 | 78.9 | 79.6 | 80.5 | 81.4 | 82.2 | 83.1 | 84.0 | 84.8 | 85.6 | 86.5 | 87.3 |
| 9000 | 79.3 | 80.1 | 80.9 | 81.8 | 82.7 | 83.6 | 84.4 | 85.3 | 86.1 | 86.9 | 87.8 |
| 10000 | 79.7 | 80.5 | 81.4 | 82.2 | 83.1 | 84.0 | 84.8 | 85.7 | 86.5 | 87.4 | 88.2 |
| 11000 | 80.1 | 80.8 | 81.7 | 82.6 | 83.5 | 84.4 | 85.3 | 86.1 | 87.0 | 87.8 | 88.6 |
| 12000 | 80.5 | 81.2 | 82.1 | 83.0 | 83.9 | 84.8 | 85.7 | 86.5 | 87.4 | 88.2 | 89.0 |
| 13000 | 80.9 | 81.7 | 82.6 | 83.5 | 84.4 | 85.2 | 86.1 | 87.0 | 87.8 | 88.7 | 89.5 |
| 14000 | 81.4 | 82.1 | 83.1 | 84.0 | 84.9 | 85.7 | 86.6 | 87.5 | 88.3 | 89.2 | 90.0 |
| 15000 | 81.9 | 82.6 | 83.6 | 84.5 | 85.4 | 86.3 | 87.1 | 88.0 | 88.9 | 89.7 | 90.6 |
| 16000 | 82.6 | 83.3 | 84.3 | 85.2 | 86.1 | 87.0 | 87.9 | 88.8 | 89.6 | 90.5 | 91.4 |

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## N1 FOR ALT T/O-1 MODE

## ANTI-ICE OFF

## AIRSPEED: 0 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| -1000 | 80.7 | 81.4 | 82.2 | 82.9 | 83.6 | 84.3 | 85.0 | 85.7 | 86.4 | 87.1 | 87.3 |
| 0 | 81.3 | 82.1 | 82.8 | 83.5 | 84.3 | 85.0 | 85.7 | 86.4 | 87.1 | 87.7 | 87.5 |
| 1000 | 82.3 | 83.1 | 83.8 | 84.5 | 85.3 | 86.0 | 86.7 | 87.4 | 88.1 | 88.1 | 86.9 |
| 2000 | 83.3 | 84.1 | 84.8 | 85.6 | 86.3 | 87.0 | 87.8 | 88.5 | 88.6 | 87.7 | 87.1 |
| 3000 | 84.3 | 85.1 | 85.9 | 86.6 | 87.4 | 88.1 | 88.9 | 89.2 | 88.4 | 87.8 | 87.3 |
| 4000 | 85.5 | 86.2 | 87.0 | 87.8 | 88.5 | 89.3 | 89.8 | 89.1 | 88.5 | 87.8 | 87.6 |
| 5000 | 86.6 | 87.4 | 88.2 | 88.9 | 89.7 | 90.3 | 90.2 | 89.1 | 88.5 | 87.9 | - |
| 6000 | 87.1 | 87.9 | 88.7 | 89.5 | 90.2 | 90.6 | 89.7 | 89.1 | 88.5 | 88.0 | - |
| 7000 | 87.6 | 88.4 | 89.2 | 90.0 | 90.8 | 90.8 | 89.7 | 89.0 | 88.3 | 88.2 | - |
| 8000 | 88.1 | 88.9 | 89.7 | 90.5 | 91.0 | 90.3 | 89.6 | 88.9 | 88.3 | - | - |
| 9000 | 88.6 | 89.4 | 90.2 | 91.0 | 91.2 | 90.2 | 89.5 | 88.8 | 88.5 | - | - |
| 10000 | 89.0 | 89.8 | 90.6 | 91.4 | 91.3 | 90.1 | 89.4 | 88.6 | - | - | - |
| 11000 | 89.4 | 90.3 | 91.1 | 91.5 | 90.6 | 90.0 | 89.3 | 88.8 | - | - | - |
| 12000 | 89.9 | 90.7 | 91.5 | 91.5 | 90.5 | 89.9 | 89.2 | 89.0 | - | - | - |
| 13000 | 90.4 | 91.2 | 91.8 | 91.1 | 90.5 | 89.8 | 89.1 | - | - | - | - |
| 14000 | 90.9 | 91.7 | 92.0 | 91.1 | 90.4 | 89.7 | 89.3 | - | - | - | - |
| 15000 | 91.4 | 92.2 | 92.1 | 91.0 | 90.3 | 89.5 | - | - | - | - | - |
| 16000 | 92.2 | 92.5 | 91.5 | 90.8 | 90.1 | 89.6 | - | - | - | - | - |

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## N1 FOR GO-AROUND

## ANTI-ICE OFF

## AIRSPEED: 100 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -54 | -50 | -45 | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 |
| -1000 | 74.9 | 75.6 | 76.4 | 77.2 | 78.1 | 78.9 | 79.7 | 80.5 | 81.3 | 82.1 | 82.8 |
| 0 | 75.5 | 76.2 | 77.1 | 77.9 | 78.7 | 79.5 | 80.4 | 81.2 | 82.0 | 82.8 | 83.5 |
| 1000 | 76.5 | 77.2 | 78.1 | 78.9 | 79.7 | 80.6 | 81.4 | 82.2 | 83.0 | 83.8 | 84.6 |
| 2000 | 77.5 | 78.2 | 79.1 | 79.9 | 80.8 | 81.6 | 82.5 | 83.3 | 84.1 | 84.9 | 85.7 |
| 3000 | 78.4 | 79.2 | 80.0 | 80.9 | 81.8 | 82.6 | 83.5 | 84.3 | 85.1 | 86.0 | 86.8 |
| 4000 | 79.4 | 80.1 | 81.0 | 81.9 | 82.8 | 83.6 | 84.5 | 85.3 | 86.2 | 87.0 | 87.8 |
| 5000 | 80.4 | 81.1 | 82.0 | 82.9 | 83.8 | 84.6 | 85.5 | 86.4 | 87.2 | 88.0 | 88.9 |
| 6000 | 80.8 | 81.5 | 82.5 | 83.4 | 84.2 | 85.1 | 86.0 | 86.9 | 87.7 | 88.6 | 89.4 |
| 7000 | 81.3 | 82.0 | 82.9 | 83.8 | 84.7 | 85.6 | 86.5 | 87.4 | 88.2 | 89.1 | 89.9 |
| 8000 | 81.8 | 82.5 | 83.4 | 84.4 | 85.3 | 86.1 | 87.0 | 87.9 | 88.8 | 89.6 | 90.5 |
| 9000 | 82.3 | 83.1 | 84.0 | 84.9 | 85.8 | 86.7 | 87.6 | 88.5 | 89.4 | 90.2 | 91.1 |
| 10000 | 82.9 | 83.6 | 84.6 | 85.5 | 86.4 | 87.3 | 88.2 | 89.1 | 90.0 | 90.8 | 91.7 |
| 11000 | 83.0 | 83.8 | 84.7 | 85.6 | 86.5 | 87.4 | 88.3 | 89.2 | 90.1 | 91.0 | 91.8 |
| 12000 | 83.1 | 83.9 | 84.8 | 85.8 | 86.7 | 87.6 | 88.5 | 89.4 | 90.2 | 91.1 | 92.0 |
| 13000 | 83.5 | 84.2 | 85.2 | 86.1 | 87.0 | 87.9 | 88.8 | 89.7 | 90.6 | 91.5 | 92.3 |
| 14000 | 84.0 | 84.8 | 85.8 | 86.7 | 87.6 | 88.5 | 89.4 | 90.3 | 91.2 | 92.1 | 93.0 |
| 15000 | 84.6 | 85.4 | 86.3 | 87.3 | 88.2 | 89.1 | 90.0 | 90.9 | 91.8 | 92.7 | 93.6 |
| 16000 | 84.6 | 85.4 | 86.3 | 87.3 | 88.2 | 89.1 | 90.0 | 90.9 | 91.8 | 92.7 | 93.6 |

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## N1 FOR GO-AROUND

## ANTI-ICE OFF

## AIRSPEED: 100 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| -1000 | 83.6 | 84.4 | 85.1 | 85.9 | 86.6 | 87.3 | 88.1 | 88.8 | 89.5 | 90.2 | 90.5 |
| 0 | 84.3 | 85.1 | 85.8 | 86.6 | 87.3 | 88.1 | 88.8 | 89.5 | 90.3 | 90.9 | 90.7 |
| 1000 | 85.4 | 86.2 | 87.0 | 87.7 | 88.5 | 89.2 | 90.0 | 90.7 | 91.4 | 91.5 | 89.9 |
| 2000 | 86.5 | 87.3 | 88.1 | 88.8 | 89.6 | 90.4 | 91.1 | 91.9 | 92.0 | 90.9 | 90.0 |
| 3000 | 87.6 | 88.4 | 89.2 | 90.0 | 90.7 | 91.5 | 92.3 | 92.6 | 91.7 | 90.9 | 90.3 |
| 4000 | 88.6 | 89.5 | 90.3 | 91.0 | 91.8 | 92.6 | 93.1 | 93.0 | 91.8 | 91.0 | 90.6 |
| 5000 | 89.7 | 90.5 | 91.3 | 92.1 | 92.9 | 93.7 | 93.6 | 92.6 | 91.8 | 91.0 | - |
| 6000 | 90.2 | 91.0 | 91.9 | 92.7 | 93.5 | 93.9 | 93.2 | 92.5 | 91.7 | 91.2 | - |
| 7000 | 90.7 | 91.6 | 92.4 | 93.2 | 94.0 | 94.1 | 93.2 | 92.4 | 91.6 | 91.4 | - |
| 8000 | 91.3 | 92.1 | 93.0 | 93.8 | 94.4 | 94.2 | 93.1 | 92.3 | 91.6 | - | - |
| 9000 | 91.9 | 92.8 | 93.6 | 94.4 | 94.6 | 93.6 | 92.9 | 92.1 | 91.8 | - | - |
| 10000 | 92.5 | 93.4 | 94.2 | 94.2 | 93.1 | 92.2 | 91.5 | 90.8 | - | - | - |
| 11000 | 92.7 | 93.5 | 94.4 | 94.4 | 92.9 | 92.0 | 91.4 | 90.9 | - | - | - |
| 12000 | 92.8 | 93.7 | 94.5 | 94.5 | 92.6 | 91.9 | 91.3 | 91.1 | - | - | - |
| 13000 | 93.2 | 94.1 | 94.6 | 94.4 | 92.4 | 91.8 | 91.2 | - | - | - | - |
| 14000 | 93.8 | 94.7 | 94.9 | 93.3 | 92.4 | 91.7 | 91.4 | - | - | - | - |
| 15000 | 94.4 | 95.3 | 95.1 | 93.0 | 92.3 | 91.5 | - | - | - | - | - |
| 16000 | 94.3 | 94.2 | 92.6 | 91.6 | 90.9 | 90.4 | - | - | - | - | - |

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## N1 FOR GO-AROUND

## ANTI-ICE OFF

## AIRSPEED: 150 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -54 | -50 | -45 | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 |
| -1000 | 74.8 | 75.5 | 76.3 | 77.2 | 78.0 | 78.8 | 79.6 | 80.4 | 81.2 | 82.0 | 82.8 |
| 0 | 75.4 | 76.1 | 77.0 | 77.8 | 78.7 | 79.5 | 80.3 | 81.1 | 81.9 | 82.7 | 83.5 |
| 1000 | 76.4 | 77.1 | 78.0 | 78.8 | 79.7 | 80.5 | 81.3 | 82.1 | 82.9 | 83.7 | 84.5 |
| 2000 | 77.4 | 78.1 | 79.0 | 79.8 | 80.7 | 81.5 | 82.4 | 83.2 | 84.0 | 84.8 | 85.6 |
| 3000 | 78.4 | 79.1 | 80.0 | 80.8 | 81.7 | 82.6 | 83.4 | 84.2 | 85.1 | 85.9 | 86.7 |
| 4000 | 79.3 | 80.1 | 81.0 | 81.8 | 82.7 | 83.6 | 84.4 | 85.3 | 86.1 | 87.0 | 87.8 |
| 5000 | 80.3 | 81.1 | 82.0 | 82.9 | 83.7 | 84.6 | 85.5 | 86.3 | 87.2 | 88.0 | 88.9 |
| 6000 | 80.7 | 81.5 | 82.4 | 83.3 | 84.2 | 85.1 | 85.9 | 86.8 | 87.6 | 88.5 | 89.3 |
| 7000 | 81.2 | 81.9 | 82.8 | 83.7 | 84.6 | 85.5 | 86.4 | 87.2 | 88.1 | 88.9 | 89.8 |
| 8000 | 81.6 | 82.4 | 83.3 | 84.2 | 85.1 | 86.0 | 86.9 | 87.7 | 88.6 | 89.4 | 90.3 |
| 9000 | 82.1 | 82.9 | 83.8 | 84.7 | 85.6 | 86.5 | 87.4 | 88.2 | 89.1 | 90.0 | 90.8 |
| 10000 | 82.6 | 83.4 | 84.3 | 85.2 | 86.1 | 87.0 | 87.9 | 88.8 | 89.7 | 90.5 | 91.4 |
| 11000 | 82.7 | 83.5 | 84.4 | 85.3 | 86.2 | 87.1 | 88.0 | 88.9 | 89.8 | 90.6 | 91.5 |
| 12000 | 82.8 | 83.6 | 84.5 | 85.4 | 86.3 | 87.2 | 88.1 | 89.0 | 89.9 | 90.7 | 91.6 |
| 13000 | 83.1 | 83.9 | 84.8 | 85.7 | 86.7 | 87.6 | 88.5 | 89.3 | 90.2 | 91.1 | 92.0 |
| 14000 | 83.7 | 84.5 | 85.4 | 86.3 | 87.3 | 88.2 | 89.1 | 90.0 | 90.9 | 91.7 | 92.6 |
| 15000 | 84.3 | 85.1 | 86.0 | 86.9 | 87.9 | 88.8 | 89.7 | 90.6 | 91.5 | 92.4 | 93.2 |
| 16000 | 84.3 | 85.0 | 86.0 | 86.9 | 87.8 | 88.8 | 89.7 | 90.6 | 91.5 | 92.3 | 93.2 |

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## N1 FOR GO-AROUND

## ANTI-ICE OFF

## AIRSPEED: 150 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| -1000 | 83.5 | 84.3 | 85.1 | 85.8 | 86.5 | 87.3 | 88.0 | 88.7 | 89.4 | 90.2 | 90.4 |
| 0 | 84.2 | 85.0 | 85.8 | 86.5 | 87.3 | 88.0 | 88.7 | 89.5 | 90.2 | 90.8 | 90.6 |
| 1000 | 85.3 | 86.1 | 86.9 | 87.6 | 88.4 | 89.1 | 89.9 | 90.6 | 91.4 | 91.3 | 89.7 |
| 2000 | 86.4 | 87.2 | 88.0 | 88.8 | 89.5 | 90.3 | 91.0 | 91.8 | 91.9 | 90.7 | 89.8 |
| 3000 | 87.5 | 88.3 | 89.1 | 89.9 | 90.7 | 91.4 | 92.2 | 92.5 | 91.6 | 90.8 | 90.1 |
| 4000 | 88.6 | 89.4 | 90.2 | 91.0 | 91.8 | 92.6 | 93.1 | 93.0 | 91.7 | 90.8 | 90.5 |
| 5000 | 89.7 | 90.5 | 91.3 | 92.1 | 92.9 | 93.7 | 93.6 | 92.5 | 91.7 | 90.9 | - |
| 6000 | 90.1 | 91.0 | 91.8 | 92.6 | 93.4 | 93.8 | 93.1 | 92.4 | 91.6 | 91.1 | - |
| 7000 | 90.6 | 91.4 | 92.3 | 93.1 | 93.9 | 94.0 | 93.0 | 92.3 | 91.5 | 91.3 | - |
| 8000 | 91.1 | 92.0 | 92.8 | 93.6 | 94.2 | 94.1 | 93.0 | 92.2 | 91.5 | - | - |
| 9000 | 91.7 | 92.5 | 93.3 | 94.2 | 94.4 | 93.5 | 92.8 | 92.0 | 91.7 | - | - |
| 10000 | 92.2 | 93.1 | 93.9 | 94.0 | 92.9 | 92.2 | 91.5 | 90.7 | - | - | - |
| 11000 | 92.3 | 93.2 | 94.0 | 94.1 | 92.8 | 92.0 | 91.3 | 90.8 | - | - | - |
| 12000 | 92.4 | 93.3 | 94.1 | 94.1 | 92.5 | 91.8 | 91.1 | 91.0 | - | - | - |
| 13000 | 92.8 | 93.7 | 94.2 | 94.0 | 92.3 | 91.7 | 91.1 | - | - | - | - |
| 14000 | 93.5 | 94.3 | 94.5 | 93.0 | 92.2 | 91.6 | 91.3 | - | - | - | - |
| 15000 | 94.1 | 94.9 | 94.8 | 92.7 | 92.1 | 91.4 | - | - | - | - | - |
| 16000 | 94.0 | 94.0 | 92.4 | 91.4 | 90.8 | 90.4 | - | - | - | - | - |

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## N1 FOR GO-AROUND

## ANTI-ICE OFF

## AIRSPEED: 200 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -54 | -50 | -45 | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 |
| -1000 | 74.6 | 75.2 | 76.1 | 76.9 | 77.7 | 78.5 | 79.3 | 80.1 | 80.9 | 81.7 | 82.5 |
| 0 | 75.2 | 75.9 | 76.7 | 77.6 | 78.4 | 79.2 | 80.0 | 80.8 | 81.6 | 82.4 | 83.2 |
| 1000 | 76.2 | 76.9 | 77.8 | 78.6 | 79.5 | 80.3 | 81.1 | 81.9 | 82.7 | 83.5 | 84.3 |
| 2000 | 77.3 | 78.0 | 78.9 | 79.7 | 80.6 | 81.4 | 82.2 | 83.1 | 83.9 | 84.7 | 85.5 |
| 3000 | 78.3 | 79.0 | 79.9 | 80.8 | 81.6 | 82.5 | 83.3 | 84.2 | 85.0 | 85.8 | 86.6 |
| 4000 | 79.3 | 80.0 | 80.9 | 81.8 | 82.7 | 83.6 | 84.4 | 85.3 | 86.1 | 86.9 | 87.8 |
| 5000 | 80.4 | 81.1 | 82.0 | 82.9 | 83.8 | 84.6 | 85.5 | 86.3 | 87.2 | 88.0 | 88.9 |
| 6000 | 80.7 | 81.5 | 82.4 | 83.3 | 84.2 | 85.0 | 85.9 | 86.8 | 87.6 | 88.5 | 89.3 |
| 7000 | 81.1 | 81.8 | 82.8 | 83.7 | 84.5 | 85.4 | 86.3 | 87.2 | 88.0 | 88.9 | 89.7 |
| 8000 | 81.5 | 82.3 | 83.2 | 84.1 | 85.0 | 85.9 | 86.7 | 87.6 | 88.5 | 89.3 | 90.2 |
| 9000 | 82.0 | 82.7 | 83.6 | 84.5 | 85.4 | 86.3 | 87.2 | 88.1 | 89.0 | 89.8 | 90.7 |
| 10000 | 82.4 | 83.1 | 84.1 | 85.0 | 85.9 | 86.8 | 87.7 | 88.5 | 89.4 | 90.3 | 91.1 |
| 11000 | 82.4 | 83.2 | 84.1 | 85.0 | 85.9 | 86.8 | 87.7 | 88.6 | 89.5 | 90.3 | 91.2 |
| 12000 | 82.5 | 83.2 | 84.2 | 85.1 | 86.0 | 86.9 | 87.8 | 88.6 | 89.5 | 90.4 | 91.2 |
| 13000 | 82.8 | 83.5 | 84.4 | 85.4 | 86.3 | 87.2 | 88.1 | 88.9 | 89.8 | 90.7 | 91.5 |
| 14000 | 83.3 | 84.1 | 85.0 | 85.9 | 86.8 | 87.7 | 88.6 | 89.5 | 90.4 | 91.3 | 92.1 |
| 15000 | 83.8 | 84.6 | 85.5 | 86.5 | 87.4 | 88.3 | 89.2 | 90.1 | 91.0 | 91.9 | 92.7 |
| 16000 | 83.7 | 84.5 | 85.4 | 86.4 | 87.3 | 88.2 | 89.1 | 90.0 | 90.9 | 91.7 | 92.6 |

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## N1 FOR GO-AROUND

## ANTI-ICE OFF

## AIRSPEED: 200 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| -1000 | 83.2 | 84.0 | 84.7 | 85.5 | 86.2 | 87.0 | 87.7 | 88.4 | 89.1 | 89.8 | 89.8 |
| 0 | 83.9 | 84.7 | 85.5 | 86.2 | 87.0 | 87.7 | 88.4 | 89.2 | 89.9 | 90.6 | 90.3 |
| 1000 | 85.1 | 85.9 | 86.7 | 87.4 | 88.2 | 88.9 | 89.7 | 90.4 | 91.1 | 91.1 | 89.3 |
| 2000 | 86.3 | 87.1 | 87.8 | 88.6 | 89.4 | 90.1 | 90.9 | 91.6 | 91.8 | 90.5 | 89.4 |
| 3000 | 87.4 | 88.2 | 89.0 | 89.8 | 90.6 | 91.3 | 92.1 | 92.5 | 91.5 | 90.5 | 89.7 |
| 4000 | 88.6 | 89.4 | 90.2 | 91.0 | 91.7 | 92.5 | 93.1 | 92.9 | 91.5 | 90.6 | 90.2 |
| 5000 | 89.7 | 90.5 | 91.3 | 92.1 | 92.9 | 93.7 | 93.6 | 92.4 | 91.6 | 90.7 | - |
| 6000 | 90.1 | 91.0 | 91.7 | 92.6 | 93.4 | 93.8 | 93.0 | 92.3 | 91.5 | 91.0 | - |
| 7000 | 90.5 | 91.4 | 92.2 | 93.0 | 93.8 | 93.9 | 93.0 | 92.3 | 91.5 | 91.3 | - |
| 8000 | 91.0 | 91.8 | 92.7 | 93.5 | 94.1 | 94.0 | 92.9 | 92.2 | 91.5 | - | - |
| 9000 | 91.5 | 92.3 | 93.2 | 94.0 | 94.2 | 93.5 | 92.8 | 92.0 | 91.7 | - | - |
| 10000 | 92.0 | 92.8 | 93.7 | 93.8 | 92.8 | 92.2 | 91.5 | 90.7 | - | - | - |
| 11000 | 92.0 | 92.9 | 93.7 | 93.7 | 92.7 | 92.0 | 91.2 | 90.7 | - | - | - |
| 12000 | 92.1 | 92.9 | 93.7 | 93.8 | 92.4 | 91.7 | 91.0 | 90.9 | - | - | - |
| 13000 | 92.4 | 93.2 | 93.8 | 93.7 | 92.2 | 91.6 | 91.0 | - | - | - | - |
| 14000 | 93.0 | 93.8 | 94.1 | 92.8 | 92.1 | 91.4 | 91.1 | - | - | - | - |
| 15000 | 93.6 | 94.4 | 94.3 | 92.5 | 91.9 | 91.3 | - | - | - | - | - |
| 16000 | 93.5 | 93.5 | 92.1 | 91.3 | 90.6 | 90.2 | - | - | - | - | - |

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## N1 FOR MAXIMUM CONTINUOUS MODE

## ANTI-ICE OFF

## AIRSPEED: 100 KCAS

**ROLLS ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -65 | -60 | -54 | -50 | -45 | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 |
| 0 | 71.2 | 72.1 | 73.1 | 73.7 | 74.6 | 75.4 | 76.2 | 77.0 | 77.8 | 78.5 | 79.3 | 80.1 | 80.8 |
| 2000 | 72.9 | 73.8 | 74.9 | 75.5 | 76.4 | 77.2 | 78.0 | 78.8 | 79.6 | 80.4 | 81.2 | 82.0 | 82.8 |
| 4000 | 74.8 | 75.7 | 76.8 | 77.5 | 78.4 | 79.2 | 80.1 | 80.9 | 81.7 | 82.5 | 83.4 | 84.2 | 85.0 |
| 6000 | 76.3 | 77.2 | 78.3 | 79.0 | 79.9 | 80.7 | 81.6 | 82.4 | 83.3 | 84.1 | 84.9 | 85.8 | 86.6 |
| 8000 | 77.1 | 78.0 | 79.1 | 79.9 | 80.8 | 81.6 | 82.5 | 83.4 | 84.2 | 85.1 | 85.9 | 86.7 | 87.6 |
| 10000 | 77.9 | 78.9 | 80.0 | 80.7 | 81.6 | 82.5 | 83.4 | 84.2 | 85.1 | 85.9 | 86.8 | 87.6 | 88.4 |
| 12000 | 78.7 | 79.7 | 80.8 | 81.5 | 82.4 | 83.3 | 84.2 | 85.1 | 86.0 | 86.8 | 87.7 | 88.5 | 89.4 |
| 14000 | 79.6 | 80.6 | 81.7 | 82.5 | 83.4 | 84.3 | 85.2 | 86.1 | 86.9 | 87.8 | 88.7 | 89.6 | 90.4 |
| 16000 | 80.6 | 81.5 | 82.7 | 83.4 | 84.4 | 85.3 | 86.2 | 87.1 | 88.0 | 88.9 | 89.7 | 90.6 | 91.5 |
| 18000 | 81.7 | 82.7 | 83.8 | 84.6 | 85.6 | 86.5 | 87.4 | 88.3 | 89.2 | 90.1 | 91.0 | 91.9 | 92.7 |
| 20000 | 83.5 | 84.5 | 85.7 | 86.4 | 87.4 | 88.4 | 89.3 | 90.2 | 91.2 | 92.1 | 93.0 | 93.9 | 94.3 |
| 22000 | 84.2 | 85.2 | 86.4 | 87.2 | 88.2 | 89.1 | 90.1 | 91.0 | 92.0 | 92.9 | 93.8 | 94.2 | 93.2 |
| 24000 | 85.0 | 86.0 | 87.2 | 88.0 | 89.0 | 89.9 | 90.9 | 91.9 | 92.8 | 93.7 | 94.3 | 93.4 | 92.6 |
| 26000 | 85.8 | 86.8 | 88.0 | 88.8 | 89.8 | 90.8 | 91.7 | 92.7 | 93.7 | 94.3 | 94.1 | 92.8 | 92.0 |
| 28000 | 86.6 | 87.6 | 88.8 | 89.7 | 90.7 | 91.6 | 92.6 | 93.6 | 94.3 | 94.2 | 93.0 | 92.2 | 91.5 |
| 30000 | 87.4 | 88.5 | 89.7 | 90.5 | 91.5 | 92.5 | 93.5 | 94.3 | 94.2 | 93.1 | 92.4 | 91.7 | 90.9 |
| 32000 | 88.3 | 89.3 | 90.6 | 91.4 | 92.4 | 93.4 | 94.2 | 94.1 | 93.2 | 92.6 | 91.9 | 91.0 | 90.7 |
| 34000 | 89.2 | 90.3 | 91.5 | 92.3 | 93.4 | 94.1 | 94.1 | 93.3 | 92.8 | 92.0 | 91.2 | 90.7 | - |
| 36000 | 90.1 | 91.2 | 92.5 | 93.3 | 94.0 | 93.8 | 93.4 | 92.9 | 92.2 | 91.3 | 90.6 | - | - |
| 37000 | 90.1 | 91.2 | 92.5 | 93.3 | 94.2 | 94.0 | 94.0 | 93.2 | 92.5 | 91.5 | 90.8 | - | - |

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## N1 FOR MAXIMUM CONTINUOUS MODE

### ANTI-ICE OFF

### AIRSPEED: 100 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| 0 | 81.6 | 82.3 | 83.1 | 83.8 | 84.5 | 85.2 | 85.9 | 86.6 | 87.3 | 88.0 | 87.8 |
| 2000 | 83.6 | 84.3 | 85.1 | 85.8 | 86.6 | 87.3 | 88.0 | 88.8 | 88.9 | 88.0 | 87.2 |
| 4000 | 85.7 | 86.5 | 87.3 | 88.1 | 88.8 | 89.6 | 90.1 | 89.4 | 88.8 | 88.1 | 87.9 |
| 6000 | 87.4 | 88.2 | 89.0 | 89.7 | 90.5 | 90.8 | 90.0 | 89.4 | 88.8 | 88.3 | - |
| 8000 | 88.4 | 89.2 | 90.0 | 90.8 | 91.3 | 90.6 | 90.0 | 89.3 | 88.7 | - | - |
| 10000 | 89.3 | 90.1 | 90.9 | 91.6 | 91.5 | 90.4 | 89.7 | 89.0 | - | - | - |
| 12000 | 90.2 | 91.0 | 91.8 | 91.9 | 90.9 | 90.2 | 89.5 | 89.3 | - | - | - |
| 14000 | 91.2 | 92.1 | 92.3 | 91.4 | 90.8 | 90.0 | 89.7 | - | - | - | - |
| 16000 | 92.3 | 92.7 | 91.9 | 91.2 | 90.5 | 90.0 | - | - | - | - | - |
| 18000 | 93.3 | 93.1 | 91.5 | 90.9 | 90.3 | - | - | - | - | - | - |
| 20000 | 93.0 | 92.0 | 91.4 | 90.8 | - | - | - | - | - | - | - |
| 22000 | 92.3 | 91.6 | 91.0 | 90.8 | - | - | - | - | - | - | - |
| 24000 | 91.8 | 91.1 | 90.8 | - | - | - | - | - | - | - | - |
| 26000 | 91.3 | 90.8 | - | - | - | - | - | - | - | - | - |
| 28000 | 90.8 | - | - | - | - | - | - | - | - | - | - |
| 30000 | - | - | - | - | - | - | - | - | - | - | - |
| 32000 | - | - | - | - | - | - | - | - | - | - | - |
| 34000 | - | - | - | - | - | - | - | - | - | - | - |
| 36000 | - | - | - | - | - | - | - | - | - | - | - |
| 37000 | - | - | - | - | - | - | - | - | - | - | - |

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## N1 FOR MAXIMUM CONTINUOUS MODE

## ANTI-ICE OFF

## AIRSPEED: 150 KCAS

**ROLLS ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -65 | -60 | -54 | -50 | -45 | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 |
| 0 | 71.2 | 72.1 | 73.1 | 73.8 | 74.6 | 75.4 | 76.2 | 77.0 | 77.8 | 78.6 | 79.3 | 80.1 | 80.9 |
| 2000 | 73.0 | 73.9 | 74.9 | 75.6 | 76.4 | 77.3 | 78.1 | 78.9 | 79.7 | 80.5 | 81.3 | 82.1 | 82.9 |
| 4000 | 74.9 | 75.8 | 76.9 | 77.6 | 78.5 | 79.3 | 80.2 | 81.0 | 81.8 | 82.6 | 83.5 | 84.3 | 85.1 |
| 6000 | 76.3 | 77.3 | 78.3 | 79.0 | 79.9 | 80.8 | 81.7 | 82.5 | 83.4 | 84.2 | 85.0 | 85.8 | 86.6 |
| 8000 | 77.2 | 78.1 | 79.2 | 79.9 | 80.8 | 81.7 | 82.6 | 83.4 | 84.3 | 85.1 | 86.0 | 86.8 | 87.6 |
| 10000 | 78.0 | 78.9 | 80.0 | 80.8 | 81.7 | 82.6 | 83.4 | 84.3 | 85.2 | 86.0 | 86.9 | 87.7 | 88.5 |
| 12000 | 78.8 | 79.7 | 80.8 | 81.6 | 82.5 | 83.4 | 84.3 | 85.1 | 86.0 | 86.9 | 87.7 | 88.6 | 89.4 |
| 14000 | 79.6 | 80.6 | 81.7 | 82.4 | 83.3 | 84.2 | 85.1 | 86.0 | 86.9 | 87.8 | 88.6 | 89.5 | 90.3 |
| 16000 | 80.4 | 81.3 | 82.5 | 83.2 | 84.2 | 85.1 | 86.0 | 86.9 | 87.8 | 88.6 | 89.5 | 90.4 | 91.2 |
| 18000 | 81.3 | 82.3 | 83.5 | 84.2 | 85.2 | 86.1 | 87.0 | 87.9 | 88.8 | 89.7 | 90.6 | 91.5 | 92.3 |
| 20000 | 83.1 | 84.1 | 85.2 | 86.0 | 87.0 | 87.9 | 88.9 | 89.8 | 90.7 | 91.6 | 92.5 | 93.4 | 93.9 |
| 22000 | 83.9 | 84.9 | 86.1 | 86.9 | 87.9 | 88.8 | 89.8 | 90.7 | 91.7 | 92.6 | 93.5 | 94.1 | 94.0 |
| 24000 | 84.8 | 85.8 | 87.0 | 87.8 | 88.8 | 89.8 | 90.7 | 91.7 | 92.6 | 93.5 | 94.2 | 94.1 | 92.6 |
| 26000 | 85.7 | 86.7 | 87.9 | 88.7 | 89.7 | 90.7 | 91.7 | 92.6 | 93.6 | 94.2 | 94.1 | 92.8 | 92.0 |
| 28000 | 86.6 | 87.7 | 88.9 | 89.7 | 90.7 | 91.7 | 92.7 | 93.6 | 94.2 | 93.7 | 93.0 | 92.3 | 91.4 |
| 30000 | 87.7 | 88.7 | 89.9 | 90.8 | 91.8 | 92.8 | 93.8 | 94.3 | 93.7 | 93.1 | 92.4 | 91.6 | 90.7 |
| 32000 | 88.7 | 89.8 | 91.1 | 91.9 | 92.9 | 93.9 | 94.3 | 93.8 | 93.2 | 92.6 | 91.7 | 90.7 | 90.4 |
| 34000 | 89.9 | 91.0 | 92.3 | 93.1 | 94.1 | 94.2 | 93.7 | 93.3 | 92.7 | 91.9 | 90.8 | 90.3 | - |
| 36000 | 91.2 | 92.3 | 93.6 | 94.0 | 93.9 | 93.8 | 93.4 | 92.9 | 92.1 | 91.0 | 90.1 | - | - |
| 37000 | 90.8 | 91.9 | 93.2 | 94.0 | 94.1 | 94.1 | 93.7 | 93.2 | 92.4 | 91.2 | 90.3 | - | - |

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## N1 FOR MAXIMUM CONTINUOUS MODE

## ANTI-ICE OFF

## AIRSPEED: 150 KCAS

**ROLLS ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| -1000 | 81.0 | 81.7 | 82.4 | 83.1 | 83.9 | 84.6 | 85.3 | 86.0 | 86.7 | 87.3 | 87.6 |
| 0 | 81.6 | 82.4 | 83.1 | 83.8 | 84.5 | 85.3 | 86.0 | 86.7 | 87.4 | 88.0 | 87.8 |
| 1000 | 82.6 | 83.4 | 84.1 | 84.9 | 85.6 | 86.3 | 87.0 | 87.8 | 88.5 | 88.4 | 86.8 |
| 2000 | 83.6 | 84.4 | 85.2 | 85.9 | 86.7 | 87.4 | 88.1 | 88.8 | 89.0 | 87.9 | 87.0 |
| 3000 | 84.7 | 85.5 | 86.3 | 87.0 | 87.8 | 88.5 | 89.3 | 89.7 | 88.8 | 88.0 | 87.3 |
| 4000 | 85.8 | 86.6 | 87.4 | 88.2 | 88.9 | 89.7 | 90.2 | 89.5 | 88.8 | 88.1 | 87.7 |
| 5000 | 87.0 | 87.7 | 88.5 | 89.3 | 90.1 | 90.7 | 90.6 | 89.6 | 88.9 | 88.2 | - |
| 6000 | 87.4 | 88.2 | 89.0 | 89.8 | 90.6 | 90.9 | 90.1 | 89.5 | 88.9 | 88.4 | - |
| 8000 | 88.4 | 89.2 | 90.0 | 90.8 | 91.3 | 90.6 | 90.1 | 89.4 | 88.8 | - | - |
| 10000 | 89.4 | 90.2 | 91.0 | 91.7 | 91.6 | 90.6 | 89.9 | 89.1 | - | - | - |
| 12000 | 90.2 | 91.1 | 91.9 | 91.9 | 91.0 | 90.3 | 89.6 | 89.4 | - | - | - |
| 14000 | 91.2 | 92.0 | 92.2 | 91.4 | 90.8 | 90.1 | 89.8 | - | - | - | - |
| 16000 | 92.1 | 92.6 | 91.9 | 91.3 | 90.6 | 90.1 | - | - | - | - | - |
| 18000 | 93.2 | 93.1 | 91.6 | 91.0 | 90.4 | - | - | - | - | - | - |
| 20000 | 93.7 | 92.0 | 91.4 | 90.8 | - | - | - | - | - | - | - |
| 22000 | 92.3 | 91.6 | 91.0 | 90.8 | - | - | - | - | - | - | - |
| 24000 | 91.8 | 91.2 | 90.8 | - | - | - | - | - | - | - | - |
| 26000 | 91.3 | 90.8 | - | - | - | - | - | - | - | - | - |
| 28000 | 90.7 | - | - | - | - | - | - | - | - | - | - |
| 30000 | - | - | - | - | - | - | - | - | - | - | - |
| 32000 | - | - | - | - | - | - | - | - | - | - | - |
| 34000 | - | - | - | - | - | - | - | - | - | - | - |
| 36000 | - | - | - | - | - | - | - | - | - | - | - |
| 37000 | - | - | - | - | - | - | - | - | - | - | - |

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## N1 FOR MAXIMUM CONTINUOUS MODE

## ANTI-ICE OFF

## AIRSPEED: 200 KCAS

**ROLLS ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -65 | -60 | -54 | -50 | -45 | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 |
| 0 | 71.1 | 72.0 | 73.0 | 73.6 | 74.5 | 75.3 | 76.1 | 76.9 | 77.7 | 78.4 | 79.2 | 80.0 | 80.7 |
| 2000 | 73.1 | 74.0 | 75.0 | 75.7 | 76.5 | 77.4 | 78.2 | 79.0 | 79.8 | 80.6 | 81.4 | 82.2 | 83.0 |
| 4000 | 75.0 | 75.9 | 77.0 | 77.7 | 78.6 | 79.4 | 80.3 | 81.1 | 81.9 | 82.8 | 83.6 | 84.4 | 85.2 |
| 6000 | 76.4 | 77.3 | 78.4 | 79.1 | 80.0 | 80.9 | 81.8 | 82.6 | 83.5 | 84.3 | 85.1 | 85.9 | 86.8 |
| 8000 | 77.3 | 78.2 | 79.3 | 80.0 | 80.9 | 81.8 | 82.7 | 83.5 | 84.4 | 85.2 | 86.1 | 86.9 | 87.7 |
| 10000 | 78.1 | 79.1 | 80.2 | 80.9 | 81.8 | 82.7 | 83.6 | 84.4 | 85.3 | 86.2 | 87.0 | 87.8 | 88.7 |
| 12000 | 78.8 | 79.8 | 80.9 | 81.6 | 82.5 | 83.4 | 84.3 | 85.2 | 86.1 | 86.9 | 87.8 | 88.6 | 89.5 |
| 14000 | 79.6 | 80.5 | 81.7 | 82.4 | 83.3 | 84.2 | 85.1 | 86.0 | 86.9 | 87.8 | 88.6 | 89.5 | 90.3 |
| 16000 | 80.2 | 81.2 | 82.3 | 83.1 | 84.0 | 84.9 | 85.8 | 86.7 | 87.6 | 88.5 | 89.3 | 90.2 | 91.1 |
| 18000 | 80.9 | 81.9 | 83.0 | 83.8 | 84.7 | 85.7 | 86.6 | 87.5 | 88.4 | 89.3 | 90.1 | 91.0 | 91.8 |
| 20000 | 82.3 | 83.3 | 84.4 | 85.2 | 86.2 | 87.1 | 88.0 | 89.0 | 89.9 | 90.8 | 91.7 | 92.5 | 93.4 |
| 22000 | 83.3 | 84.3 | 85.5 | 86.2 | 87.2 | 88.1 | 89.1 | 90.0 | 90.9 | 91.8 | 92.8 | 93.6 | 93.5 |
| 24000 | 84.3 | 85.3 | 86.5 | 87.3 | 88.3 | 89.3 | 90.2 | 91.2 | 92.1 | 93.0 | 93.8 | 93.7 | 92.5 |
| 26000 | 85.5 | 86.5 | 87.7 | 88.5 | 89.5 | 90.5 | 91.4 | 92.4 | 93.3 | 93.9 | 93.8 | 92.7 | 92.0 |
| 28000 | 86.5 | 87.5 | 88.7 | 89.5 | 90.5 | 91.5 | 92.5 | 93.5 | 94.0 | 93.4 | 92.8 | 92.2 | 91.3 |
| 30000 | 87.7 | 88.7 | 90.0 | 90.8 | 91.8 | 92.8 | 93.8 | 94.2 | 93.5 | 92.9 | 92.3 | 91.4 | 90.4 |
| 32000 | 89.1 | 90.2 | 91.4 | 92.3 | 93.3 | 94.3 | 94.3 | 93.5 | 92.9 | 92.3 | 91.4 | 90.4 | 90.1 |
| 34000 | 89.6 | 90.6 | 91.9 | 92.7 | 93.8 | 94.1 | 93.5 | 93.0 | 92.3 | 91.5 | 90.5 | 89.9 | - |
| 36000 | 90.0 | 91.1 | 92.3 | 93.2 | 93.8 | 93.4 | 92.9 | 92.3 | 91.5 | 90.5 | 89.7 | - | - |
| 37000 | 90.0 | 91.1 | 92.3 | 93.2 | 94.1 | 94.0 | 93.1 | 92.4 | 91.6 | 90.6 | 89.9 | - | - |

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## N1 FOR MAXIMUM CONTINUOUS MODE

### ANTI-ICE OFF

### AIRSPEED: 200 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| 0 | 81.5 | 82.2 | 83.0 | 83.7 | 84.4 | 85.1 | 85.8 | 86.5 | 87.2 | 87.8 | 87.6 |
| 2000 | 83.7 | 84.5 | 85.2 | 86.0 | 86.7 | 87.5 | 88.2 | 88.9 | 89.1 | 87.8 | 86.6 |
| 4000 | 86.0 | 86.7 | 87.5 | 88.3 | 89.0 | 89.8 | 90.2 | 89.6 | 88.9 | 88.0 | 87.6 |
| 6000 | 87.6 | 88.4 | 89.1 | 89.9 | 90.7 | 91.0 | 90.2 | 89.7 | 88.9 | 88.5 | - |
| 8000 | 88.5 | 89.4 | 90.1 | 90.9 | 91.4 | 90.7 | 90.2 | 89.6 | 89.1 | - | - |
| 10000 | 89.5 | 90.3 | 91.1 | 91.8 | 91.7 | 90.7 | 90.1 | 89.4 | - | - | - |
| 12000 | 90.3 | 91.1 | 91.9 | 92.0 | 91.1 | 90.5 | 89.8 | 89.6 | - | - | - |
| 14000 | 91.2 | 92.0 | 92.2 | 91.5 | 90.9 | 90.2 | 89.9 | - | - | - | - |
| 16000 | 91.9 | 92.5 | 91.9 | 91.3 | 90.6 | 90.2 | - | - | - | - | - |
| 18000 | 92.7 | 92.8 | 91.6 | 91.0 | 90.4 | - | - | - | - | - | - |
| 20000 | 93.4 | 92.0 | 91.4 | 90.8 | - | - | - | - | - | - | - |
| 22000 | 92.3 | 91.6 | 90.9 | 90.7 | - | - | - | - | - | - | - |
| 24000 | 91.8 | 91.1 | 90.7 | - | - | - | - | - | - | - | - |
| 26000 | 91.2 | 90.6 | - | - | - | - | - | - | - | - | - |
| 28000 | 90.4 | - | - | - | - | - | - | - | - | - | - |
| 30000 | - | - | - | - | - | - | - | - | - | - | - |
| 32000 | - | - | - | - | - | - | - | - | - | - | - |
| 34000 | - | - | - | - | - | - | - | - | - | - | - |
| 36000 | - | - | - | - | - | - | - | - | - | - | - |
| 37000 | - | - | - | - | - | - | - | - | - | - | - |

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## N1 FOR T/O-1 MODE

## ANTI-ICE ON

## AIRSPEED: 0 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 | 0 | 5 | 10 |
| -1000 | 78.3 | 79.2 | 80.0 | 80.8 | 81.6 | 82.4 | 83.2 | 84.0 | 83.6 | 84.3 | 85.1 |
| 0 | 79.0 | 79.8 | 80.6 | 81.5 | 82.3 | 83.1 | 83.9 | 84.7 | 84.2 | 85.0 | 85.8 |
| 1000 | 80.0 | 80.9 | 81.7 | 82.6 | 83.4 | 84.2 | 85.0 | 85.8 | 85.4 | 86.2 | 86.9 |
| 2000 | 81.1 | 82.0 | 82.8 | 83.7 | 84.5 | 85.3 | 86.2 | 87.0 | 86.5 | 87.3 | 88.1 |
| 3000 | 82.1 | 83.0 | 83.9 | 84.7 | 85.6 | 86.4 | 87.2 | 88.1 | 87.6 | 88.4 | 89.2 |
| 4000 | 83.1 | 84.0 | 84.9 | 85.7 | 86.6 | 87.4 | 88.3 | 89.1 | 88.7 | 89.5 | 89.5 |
| 5000 | 84.1 | 85.0 | 85.9 | 86.7 | 87.6 | 88.5 | 89.3 | 90.2 | 89.8 | 90.5 | 89.5 |
| 6000 | 84.6 | 85.5 | 86.4 | 87.3 | 88.2 | 89.0 | 89.9 | 90.7 | 90.3 | 90.1 | 89.1 |
| 7000 | 85.1 | 86.0 | 86.9 | 87.8 | 88.7 | 89.6 | 90.4 | 91.3 | 90.6 | 89.8 | 88.8 |
| 8000 | 85.7 | 86.6 | 87.5 | 88.4 | 89.3 | 90.2 | 91.0 | 91.8 | 90.0 | 89.3 | 88.4 |
| 9000 | 86.3 | 87.2 | 88.1 | 89.0 | 89.9 | 90.8 | 91.6 | 91.1 | 89.3 | 88.7 | 88.0 |
| 10000 | 86.9 | 87.8 | 88.7 | 89.6 | 90.5 | 91.4 | 90.9 | 89.1 | 87.5 | 87.1 | 86.7 |
| 11000 | 86.9 | 87.9 | 88.8 | 89.7 | 90.6 | 90.9 | 90.4 | 88.8 | 87.3 | 87.0 | 86.6 |
| 12000 | 87.0 | 87.9 | 88.9 | 89.8 | 90.7 | 90.5 | 88.8 | 88.6 | 87.1 | 86.9 | 86.6 |
| 13000 | 87.3 | 88.2 | 89.2 | 90.1 | 90.5 | 90.1 | 88.6 | 88.4 | 87.0 | 86.8 | 86.5 |
| 14000 | 87.8 | 88.8 | 89.7 | 90.5 | 90.2 | 88.6 | 88.4 | 88.3 | 87.0 | 86.8 | 86.2 |
| 15000 | 88.4 | 89.3 | 90.2 | 90.2 | 89.9 | 88.4 | 88.3 | 88.3 | 87.0 | 86.9 | 85.9 |
| 16000 | 88.4 | 89.3 | 90.1 | 89.7 | 88.1 | 87.7 | 87.5 | 87.3 | 85.8 | 85.2 | 84.1 |

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## N1 FOR ALT T/O-1 MODE

## ANTI-ICE ON

## AIRSPEED: 0 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 | 0 | 5 | 10 |
| -1000 | 75.7 | 76.5 | 77.3 | 78.1 | 78.9 | 79.6 | 80.4 | 81.2 | 80.7 | 81.4 | 82.2 |
| 0 | 76.3 | 77.1 | 77.9 | 78.7 | 79.5 | 80.3 | 81.0 | 81.8 | 81.3 | 82.1 | 82.8 |
| 1000 | 77.2 | 78.0 | 78.8 | 79.6 | 80.4 | 81.2 | 82.0 | 82.8 | 82.3 | 83.1 | 83.8 |
| 2000 | 78.1 | 78.9 | 79.7 | 80.6 | 81.4 | 82.2 | 83.0 | 83.8 | 83.3 | 84.1 | 84.8 |
| 3000 | 79.1 | 79.9 | 80.7 | 81.6 | 82.4 | 83.2 | 84.0 | 84.8 | 84.3 | 85.1 | 85.9 |
| 4000 | 80.1 | 80.9 | 81.8 | 82.6 | 83.5 | 84.3 | 85.1 | 85.9 | 85.5 | 86.2 | 87.0 |
| 5000 | 81.1 | 82.0 | 82.9 | 83.7 | 84.5 | 85.4 | 86.2 | 87.0 | 86.6 | 87.4 | 88.1 |
| 6000 | 81.6 | 82.5 | 83.3 | 84.2 | 85.0 | 85.9 | 86.7 | 87.5 | 87.1 | 87.9 | 88.7 |
| 7000 | 82.1 | 83.0 | 83.8 | 84.7 | 85.5 | 86.4 | 87.2 | 88.0 | 87.6 | 88.4 | 89.2 |
| 8000 | 82.5 | 83.4 | 84.3 | 85.2 | 86.0 | 86.9 | 87.7 | 88.5 | 88.1 | 88.9 | 89.4 |
| 9000 | 83.0 | 83.8 | 84.7 | 85.6 | 86.5 | 87.3 | 88.1 | 89.0 | 88.6 | 89.4 | 89.3 |
| 10000 | 83.4 | 84.3 | 85.2 | 86.0 | 86.9 | 87.7 | 88.6 | 89.4 | 89.0 | 89.8 | 89.2 |
| 11000 | 83.8 | 84.7 | 85.6 | 86.4 | 87.3 | 88.2 | 89.0 | 89.8 | 89.4 | 89.7 | 88.8 |
| 12000 | 84.2 | 85.1 | 86.0 | 86.8 | 87.7 | 88.6 | 89.4 | 90.3 | 89.9 | 89.3 | 88.5 |
| 13000 | 84.6 | 85.5 | 86.4 | 87.3 | 88.2 | 89.0 | 89.9 | 90.7 | 89.8 | 89.0 | 88.3 |
| 14000 | 85.1 | 86.0 | 86.9 | 87.8 | 88.7 | 89.6 | 90.4 | 91.3 | 89.6 | 88.9 | 88.2 |
| 15000 | 85.6 | 86.5 | 87.4 | 88.3 | 89.2 | 90.1 | 90.9 | 91.3 | 89.4 | 88.7 | 88.1 |
| 16000 | 86.3 | 87.3 | 88.2 | 89.1 | 90.0 | 90.8 | 91.7 | 91.3 | 89.4 | 88.7 | 88.0 |

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## N1 FOR GO-AROUND

## ANTI-ICE ON

## AIRSPEED: 100 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 | 0 | 5 | 10 |
| -1000 | 78.4 | 79.2 | 80.0 | 80.9 | 81.7 | 82.5 | 83.3 | 84.1 | 83.6 | 84.4 | 85.1 |
| 0 | 79.0 | 79.9 | 80.7 | 81.5 | 82.4 | 83.2 | 84.0 | 84.8 | 84.3 | 85.1 | 85.8 |
| 1000 | 80.0 | 80.9 | 81.7 | 82.6 | 83.4 | 84.2 | 85.0 | 85.8 | 85.4 | 86.2 | 87.0 |
| 2000 | 81.1 | 81.9 | 82.8 | 83.6 | 84.5 | 85.3 | 86.1 | 86.9 | 86.5 | 87.3 | 88.1 |
| 3000 | 82.1 | 82.9 | 83.8 | 84.7 | 85.5 | 86.3 | 87.2 | 88.0 | 87.6 | 88.4 | 89.2 |
| 4000 | 83.0 | 83.9 | 84.8 | 85.7 | 86.5 | 87.4 | 88.2 | 89.0 | 88.6 | 89.5 | 89.8 |
| 5000 | 84.0 | 84.9 | 85.8 | 86.7 | 87.5 | 88.4 | 89.3 | 90.1 | 89.7 | 90.5 | 89.8 |
| 6000 | 84.5 | 85.4 | 86.3 | 87.2 | 88.1 | 88.9 | 89.8 | 90.6 | 90.2 | 90.5 | 89.5 |
| 7000 | 85.0 | 85.9 | 86.8 | 87.7 | 88.5 | 89.4 | 90.3 | 91.1 | 90.7 | 90.2 | 89.2 |
| 8000 | 85.5 | 86.4 | 87.3 | 88.2 | 89.1 | 90.0 | 90.8 | 91.7 | 90.6 | 89.7 | 88.8 |
| 9000 | 86.1 | 87.0 | 87.9 | 88.8 | 89.7 | 90.6 | 91.4 | 91.6 | 89.8 | 89.1 | 88.4 |
| 10000 | 86.6 | 87.6 | 88.5 | 89.4 | 90.3 | 91.2 | 91.5 | 89.7 | 88.0 | 87.5 | 86.9 |
| 11000 | 86.8 | 87.7 | 88.6 | 89.5 | 90.4 | 91.3 | 91.0 | 89.3 | 87.7 | 87.3 | 86.9 |
| 12000 | 86.9 | 87.8 | 88.7 | 89.7 | 90.6 | 91.1 | 89.4 | 89.0 | 87.5 | 87.2 | 86.9 |
| 13000 | 87.3 | 88.2 | 89.1 | 90.0 | 90.9 | 90.6 | 89.0 | 88.9 | 87.4 | 87.2 | 86.8 |
| 14000 | 87.8 | 88.8 | 89.7 | 90.6 | 90.6 | 89.1 | 88.9 | 88.8 | 87.4 | 87.3 | 86.5 |
| 15000 | 88.4 | 89.3 | 90.3 | 90.5 | 90.3 | 88.7 | 88.7 | 88.7 | 87.4 | 87.4 | 86.2 |
| 16000 | 88.4 | 89.3 | 90.3 | 90.3 | 88.6 | 88.3 | 88.1 | 87.8 | 86.3 | 85.8 | 84.5 |

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## N1 FOR GO-AROUND

## ANTI-ICE ON

## AIRSPEED: 150 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -45 | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 | 0 | 5 | 10 |
| -1000 | 77.5 | 78.3 | 79.2 | 80.0 | 80.8 | 81.6 | 82.4 | 83.2 | 84.0 | 83.5 | 84.3 | 85.1 |
| 0 | 78.1 | 79.0 | 79.8 | 80.6 | 81.5 | 82.3 | 83.1 | 83.9 | 84.7 | 84.2 | 85.0 | 85.8 |
| 1000 | 79.1 | 80.0 | 80.8 | 81.7 | 82.5 | 83.3 | 84.1 | 85.0 | 85.8 | 85.3 | 86.1 | 86.9 |
| 2000 | 80.1 | 81.0 | 81.8 | 82.7 | 83.5 | 84.4 | 85.2 | 86.0 | 86.8 | 86.4 | 87.2 | 88.0 |
| 3000 | 81.1 | 82.0 | 82.9 | 83.7 | 84.6 | 85.4 | 86.3 | 87.1 | 87.9 | 87.5 | 88.3 | 89.1 |
| 4000 | 82.1 | 83.0 | 83.9 | 84.8 | 85.6 | 86.5 | 87.3 | 88.2 | 89.0 | 88.6 | 89.4 | 89.8 |
| 5000 | 83.1 | 84.0 | 84.9 | 85.8 | 86.7 | 87.5 | 88.4 | 89.2 | 90.1 | 89.7 | 90.5 | 89.9 |
| 6000 | 83.5 | 84.4 | 85.3 | 86.2 | 87.1 | 88.0 | 88.8 | 89.7 | 90.5 | 90.2 | 90.6 | 89.6 |
| 7000 | 83.9 | 84.9 | 85.8 | 86.7 | 87.5 | 88.4 | 89.3 | 90.2 | 91.0 | 90.6 | 90.3 | 89.3 |
| 8000 | 84.4 | 85.3 | 86.2 | 87.1 | 88.0 | 88.9 | 89.8 | 90.7 | 91.5 | 90.8 | 89.8 | 88.9 |
| 9000 | 84.9 | 85.9 | 86.8 | 87.7 | 88.6 | 89.5 | 90.3 | 91.2 | 91.9 | 90.0 | 89.2 | 88.4 |
| 10000 | 85.4 | 86.4 | 87.3 | 88.2 | 89.1 | 90.0 | 90.9 | 91.7 | 90.0 | 88.2 | 87.6 | 86.9 |
| 11000 | 85.5 | 86.5 | 87.4 | 88.3 | 89.2 | 90.1 | 91.0 | 91.4 | 89.6 | 87.9 | 87.3 | 86.8 |
| 12000 | 85.6 | 86.6 | 87.5 | 88.4 | 89.3 | 90.2 | 91.1 | 89.8 | 89.3 | 87.6 | 87.2 | 86.7 |
| 13000 | 86.0 | 86.9 | 87.8 | 88.7 | 89.6 | 90.5 | 91.1 | 89.4 | 89.1 | 87.5 | 87.1 | 86.6 |
| 14000 | 86.5 | 87.5 | 88.4 | 89.3 | 90.3 | 91.1 | 89.4 | 89.1 | 88.9 | 87.4 | 87.1 | 86.4 |
| 15000 | 87.1 | 88.1 | 89.0 | 90.0 | 90.9 | 90.7 | 89.1 | 88.9 | 88.8 | 87.4 | 87.2 | 86.1 |
| 16000 | 87.1 | 88.1 | 89.0 | 89.9 | 90.6 | 88.9 | 88.5 | 88.2 | 87.9 | 86.3 | 85.7 | 84.5 |

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## N1 FOR GO-AROUND

## ANTI-ICE ON

## AIRSPEED: 200 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 | 0 | 5 | 10 |
| -1000 | 78.1 | 78.9 | 79.7 | 80.5 | 81.3 | 82.1 | 82.9 | 83.7 | 83.2 | 84.0 | 84.7 |
| 0 | 78.7 | 79.5 | 80.4 | 81.2 | 82.0 | 82.8 | 83.6 | 84.4 | 83.9 | 84.7 | 85.5 |
| 1000 | 79.8 | 80.6 | 81.5 | 82.3 | 83.1 | 83.9 | 84.8 | 85.6 | 85.1 | 85.9 | 86.7 |
| 2000 | 80.9 | 81.7 | 82.6 | 83.4 | 84.3 | 85.1 | 85.9 | 86.7 | 86.3 | 87.1 | 87.8 |
| 3000 | 81.9 | 82.8 | 83.7 | 84.5 | 85.4 | 86.2 | 87.0 | 87.9 | 87.4 | 88.2 | 89.0 |
| 4000 | 83.0 | 83.9 | 84.7 | 85.6 | 86.5 | 87.3 | 88.1 | 89.0 | 88.6 | 89.4 | 89.8 |
| 5000 | 84.0 | 84.9 | 85.8 | 86.7 | 87.6 | 88.4 | 89.3 | 90.1 | 89.7 | 90.5 | 89.9 |
| 6000 | 84.4 | 85.3 | 86.2 | 87.1 | 88.0 | 88.8 | 89.7 | 90.5 | 90.1 | 90.7 | 89.7 |
| 7000 | 84.8 | 85.7 | 86.6 | 87.5 | 88.4 | 89.2 | 90.1 | 91.0 | 90.5 | 90.5 | 89.5 |
| 8000 | 85.2 | 86.1 | 87.0 | 87.9 | 88.8 | 89.7 | 90.6 | 91.4 | 91.0 | 90.1 | 89.0 |
| 9000 | 85.7 | 86.6 | 87.5 | 88.4 | 89.3 | 90.2 | 91.0 | 91.9 | 90.3 | 89.4 | 88.5 |
| 10000 | 86.1 | 87.1 | 88.0 | 88.9 | 89.8 | 90.6 | 91.5 | 90.4 | 88.5 | 87.7 | 87.0 |
| 11000 | 86.2 | 87.1 | 88.0 | 88.9 | 89.8 | 90.7 | 91.6 | 89.9 | 88.1 | 87.4 | 86.7 |
| 12000 | 86.2 | 87.1 | 88.1 | 89.0 | 89.8 | 90.7 | 90.2 | 89.6 | 87.8 | 87.2 | 86.6 |
| 13000 | 86.5 | 87.4 | 88.4 | 89.3 | 90.2 | 91.0 | 89.7 | 89.3 | 87.5 | 87.0 | 86.4 |
| 14000 | 87.1 | 88.0 | 88.9 | 89.8 | 90.7 | 89.9 | 89.4 | 89.0 | 87.4 | 86.9 | 86.2 |
| 15000 | 87.6 | 88.6 | 89.5 | 90.4 | 91.3 | 89.5 | 89.2 | 88.9 | 87.3 | 86.9 | 85.9 |
| 16000 | 87.5 | 88.5 | 89.4 | 90.3 | 89.2 | 88.7 | 88.2 | 87.8 | 86.1 | 85.4 | 84.4 |

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## N1 FOR MAXIMUM CONTINUOUS MODE

## ANTI-ICE ON

## AIRSPEED: 100 KCAS

**ROLLS-ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 | 0 | 5 | 10 |
| 0 | 76.5 | 77.3 | 78.1 | 78.9 | 79.7 | 80.5 | 81.3 | 82.1 | 81.6 | 82.3 | 83.1 |
| 2000 | 78.3 | 79.2 | 80.0 | 80.8 | 81.6 | 82.4 | 83.2 | 84.0 | 83.6 | 84.3 | 85.1 |
| 4000 | 80.4 | 81.2 | 82.0 | 82.9 | 83.7 | 84.6 | 85.4 | 86.2 | 85.7 | 86.5 | 85.8 |
| 6000 | 81.9 | 82.7 | 83.6 | 84.5 | 85.3 | 86.1 | 87.0 | 87.8 | 87.1 | 86.4 | 85.6 |
| 8000 | 82.8 | 83.7 | 84.5 | 85.4 | 86.3 | 87.1 | 88.0 | 88.8 | 86.9 | 86.2 | 85.4 |
| 10000 | 83.6 | 84.5 | 85.4 | 86.3 | 87.1 | 88.0 | 88.8 | 89.0 | 86.9 | 86.0 | 85.0 |
| 12000 | 84.5 | 85.4 | 86.3 | 87.2 | 88.0 | 88.9 | 88.8 | 88.0 | 86.0 | 85.2 | 84.4 |
| 14000 | 85.4 | 86.3 | 87.3 | 88.1 | 89.0 | 88.8 | 88.1 | 87.5 | 85.5 | 84.8 | 83.9 |
| 16000 | 86.4 | 87.3 | 88.3 | 89.2 | 89.1 | 88.5 | 87.9 | 87.2 | 85.3 | 84.4 | 83.1 |
| 18000 | 87.6 | 88.6 | 89.5 | 89.9 | 89.3 | 88.5 | 87.7 | 86.9 | 84.7 | 83.4 | 82.1 |
| 20000 | 89.5 | 90.5 | 91.2 | 90.4 | 89.1 | 87.7 | 86.3 | 84.8 | 83.1 | 82.7 | 81.7 |
| 22000 | 90.3 | 90.8 | 90.1 | 89.1 | 87.8 | 86.5 | 85.2 | 84.5 | 82.8 | 82.1 | 81.3 |
| 24000 | 90.4 | 89.8 | 89.0 | 87.9 | 86.7 | 85.5 | 84.7 | 84.1 | 82.3 | 81.7 | 81.4 |
| 26000 | 89.5 | 88.8 | 87.9 | 87.0 | 86.0 | 85.0 | 84.3 | 83.7 | 82.0 | 81.6 | - |
| 28000 | 88.6 | 87.9 | 87.1 | 86.3 | 85.5 | 84.6 | 83.7 | 83.4 | 81.9 | - | - |
| 30000 | 87.7 | 87.1 | 86.4 | 85.8 | 84.9 | 84.1 | 83.5 | 82.9 | - | - | - |
| 32000 | 87.0 | 86.5 | 86.0 | 85.3 | 84.5 | 83.6 | 82.8 | 82.5 | - | - | - |
| 34000 | 86.4 | 86.0 | 85.4 | 84.7 | 83.9 | 82.9 | 82.4 | - | - | - | - |
| 36000 | 85.9 | 85.5 | 84.9 | 84.1 | 83.1 | 82.3 | - | - | - | - | - |
| 37000 | 85.7 | 85.2 | 84.5 | 83.6 | 82.6 | 81.9 | - | - | - | - | - |

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## N1 FOR MAXIMUM CONTINUOUS MODE

## ANTI-ICE ON

## AIRSPEED: 150 KCAS

**ROLLS ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 | 0 | 5 | 10 |
| 0 | 76.5 | 77.4 | 78.2 | 79.0 | 79.8 | 80.5 | 81.3 | 82.1 | 81.6 | 82.4 | 83.1 |
| 2000 | 78.4 | 79.3 | 80.1 | 80.9 | 81.7 | 82.5 | 83.3 | 84.1 | 83.7 | 84.4 | 85.2 |
| 4000 | 80.4 | 81.3 | 82.1 | 83.0 | 83.8 | 84.7 | 85.5 | 86.3 | 85.8 | 86.6 | 86.1 |
| 6000 | 81.9 | 82.8 | 83.7 | 84.5 | 85.4 | 86.2 | 87.1 | 87.9 | 87.3 | 86.6 | 85.9 |
| 8000 | 82.8 | 83.7 | 84.6 | 85.5 | 86.3 | 87.2 | 88.0 | 88.8 | 87.2 | 86.4 | 85.6 |
| 10000 | 83.7 | 84.6 | 85.5 | 86.4 | 87.2 | 88.1 | 88.9 | 89.6 | 87.4 | 86.4 | 85.4 |
| 12000 | 84.5 | 85.4 | 86.3 | 87.2 | 88.1 | 88.9 | 89.4 | 88.6 | 86.5 | 85.6 | 84.6 |
| 14000 | 85.4 | 86.3 | 87.2 | 88.1 | 89.0 | 89.2 | 88.5 | 87.8 | 85.7 | 84.9 | 84.0 |
| 16000 | 86.2 | 87.1 | 88.1 | 89.0 | 89.3 | 88.7 | 88.0 | 87.4 | 85.4 | 84.5 | 83.2 |
| 18000 | 87.2 | 88.2 | 89.1 | 90.0 | 89.4 | 88.6 | 87.8 | 87.0 | 84.8 | 83.5 | 82.2 |
| 20000 | 89.1 | 90.0 | 91.0 | 90.5 | 89.2 | 87.9 | 86.5 | 85.1 | 83.3 | 82.8 | 81.7 |
| 22000 | 90.0 | 90.9 | 90.2 | 89.2 | 88.0 | 86.7 | 85.4 | 84.7 | 82.9 | 82.1 | 81.2 |
| 24000 | 90.5 | 89.9 | 89.1 | 88.0 | 86.8 | 85.5 | 84.7 | 84.3 | 82.5 | 81.7 | 81.4 |
| 26000 | 89.6 | 88.9 | 88.0 | 87.0 | 86.0 | 85.1 | 84.4 | 83.8 | 82.0 | 81.6 | - |
| 28000 | 88.7 | 87.9 | 87.2 | 86.3 | 85.5 | 84.6 | 83.8 | 83.5 | 82.0 | - | - |
| 30000 | 87.8 | 87.2 | 86.5 | 85.8 | 85.0 | 84.2 | 83.6 | 83.0 | - | - | - |
| 32000 | 87.1 | 86.6 | 86.1 | 85.3 | 84.5 | 83.7 | 82.9 | 82.6 | - | - | - |
| 34000 | 86.5 | 86.1 | 85.5 | 84.8 | 83.9 | 82.9 | 82.4 | - | - | - | - |
| 36000 | 86.1 | 85.7 | 85.0 | 84.2 | 83.0 | 82.1 | - | - | - | - | - |
| 37000 | 85.9 | 85.4 | 84.7 | 83.7 | 82.6 | 81.8 | - | - | - | - | - |

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## N1 FOR MAXIMUM CONTINUOUS MODE

## ANTI-ICE ON

## AIRSPEED: 200 KCAS

**ROLLS ROYCE AE3007A1 ENGINES**

| Pressure Altitude (ft) | Static Air Temperature - °C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -40 | -35 | -30 | -25 | -20 | -15 | -10 | -5 | 0 | 5 | 10 |
| 0 | 76.4 | 77.2 | 78.0 | 78.8 | 79.6 | 80.4 | 81.2 | 82.0 | 81.5 | 82.2 | 82.9 |
| 2000 | 78.5 | 79.3 | 80.2 | 81.0 | 81.8 | 82.6 | 83.4 | 84.2 | 83.7 | 84.5 | 85.2 |
| 4000 | 80.6 | 81.4 | 82.3 | 83.1 | 83.9 | 84.8 | 85.6 | 86.4 | 86.0 | 86.7 | 86.4 |
| 6000 | 82.0 | 82.9 | 83.8 | 84.6 | 85.5 | 86.3 | 87.2 | 88.0 | 87.6 | 86.9 | 86.2 |
| 8000 | 83.0 | 83.8 | 84.7 | 85.6 | 86.4 | 87.3 | 88.1 | 89.0 | 87.4 | 86.7 | 85.9 |
| 10000 | 83.8 | 84.7 | 85.6 | 86.5 | 87.4 | 88.2 | 89.1 | 89.9 | 87.8 | 86.8 | 85.7 |
| 12000 | 84.6 | 85.5 | 86.4 | 87.3 | 88.1 | 89.0 | 89.9 | 89.1 | 86.9 | 85.9 | 84.9 |
| 14000 | 85.4 | 86.3 | 87.2 | 88.1 | 89.0 | 89.6 | 88.8 | 88.0 | 86.0 | 85.1 | 84.1 |
| 16000 | 86.1 | 87.0 | 87.9 | 88.8 | 89.4 | 88.8 | 88.1 | 87.4 | 85.5 | 84.5 | 83.3 |
| 18000 | 86.8 | 87.7 | 88.7 | 89.6 | 89.3 | 88.5 | 87.8 | 87.0 | 84.8 | 83.6 | 82.3 |
| 20000 | 88.3 | 89.2 | 90.1 | 90.3 | 89.1 | 87.9 | 86.7 | 85.4 | 83.4 | 82.5 | 81.5 |
| 22000 | 89.3 | 90.3 | 90.1 | 89.1 | 87.9 | 86.7 | 85.5 | 84.7 | 82.8 | 81.9 | 81.0 |
| 24000 | 90.4 | 89.9 | 89.0 | 87.9 | 86.7 | 85.5 | 84.7 | 84.2 | 82.3 | 81.5 | 81.1 |
| 26000 | 89.5 | 88.9 | 87.9 | 86.9 | 85.9 | 85.0 | 84.4 | 83.8 | 81.9 | 81.5 | - |
| 28000 | 88.7 | 87.9 | 87.1 | 86.2 | 85.3 | 84.6 | 83.9 | 83.5 | 81.9 | - | - |
| 30000 | 87.9 | 87.2 | 86.4 | 85.6 | 84.9 | 84.1 | 83.5 | 82.8 | - | - | - |
| 32000 | 87.2 | 86.6 | 85.9 | 85.2 | 84.4 | 83.6 | 82.7 | 82.4 | - | - | - |
| 34000 | 86.6 | 86.0 | 85.4 | 84.6 | 83.8 | 82.8 | 82.2 | - | - | - | - |
| 36000 | 86.1 | 85.5 | 84.7 | 83.9 | 82.8 | 82.0 | - | - | - | - | - |
| 37000 | 85.8 | 85.2 | 84.3 | 83.5 | 82.4 | 81.6 | - | - | - | - | - |

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# TAKEOFF

## TAKEOFF SPEEDS

Takeoff performance in the FAA approved EMB-145 AFM and ETOASG (First Principles) software is presented in two formats for airplanes equipped with A1 engines:

a) Balanced Field Length (fixed V1/VR ratio):
   - Flaps 9°, ALT T/O-1 thrust - AFM.
   - Flaps 9°, T/O-1 thrust - AFM.
   - Flaps 22°, T/O-1 thrust - AFM.

b) Unbalanced Field Length (variable V1/VR ratio):
   - Flaps 9°, ALT T/O-1 thrust - ETOASG (First Principles).
   - Flaps 9°, T/O-1 thrust - ETOASG (First Principles).
   - Flaps 22°, T/O-1 thrust - ETOASG (First Principles).

## TAKEOFF SPEEDS FOR BALANCED PERFORMANCE

Takeoff speeds V1, VR and V2 for Balanced Performance are read from the tables using the procedure below:

a) Enter the appropriate table with Airport Pressure Altitude and move right as far as the appropriate Static Air Temperature Range.
b) Enter the table with Airplane Brake Release Gross Weight and move right as far as the appropriate temperature column. Read V1, VR and V2. If necessary, interpolate between two weights to obtain the corrected speed.

## TAKEOFF SPEEDS FOR UNBALANCED PERFORMANCE

Takeoff speeds V1, VR and V2 for Unbalanced Performance are read from the tables using the procedure below:

a) Enter the appropriate table with Airport Pressure Altitude and move right as far as the appropriate Static Air Temperature Range.
b) Enter the table with Airplane Brake Release Gross Weight and move right as far as the appropriate temperature column. Read VR and V2. If necessary, interpolate between two weights to obtain the corrected speed.
c) For determining V1, enter the appropriate takeoff analysis with the Static Air Temperature and wind and read V1 for the Maximum Takeoff Weight. Use the lower between this V1 and VR obtained in step b as the V1 for the actual Takeoff Weight.

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## V1/VR/V2 SPEEDS
## EMB-145 - AE3007A1 ENGINES - FAA CERTIFICATION
## T/O-1 MODE - NORMAL V2 - FLAPS 9°
## ANTI-ICE ON OR OFF

| PRESSURE ALTITUDE (ft) | STATIC AIR TEMPERATURE (°C) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL → | -40 to 44 | | | 45 to 49 | | | 50 to 50 | | | - | | |
| 1000 → | -40 to 41 | | | 42 to 47 | | | 48 to 48 | | | - | | |
| 2000 → | -40 to 37 | | | 38 to 43 | | | 44 to 46 | | | - | | |
| 3000 → | -40 to 33 | | | 34 to 40 | | | 41 to 44 | | | - | | |
| 4000 → | -40 to 29 | | | 30 to 36 | | | 37 to 41 | | | 42 to 42 | | |
| 5000 → | -40 to 24 | | | 25 to 31 | | | 32 to 37 | | | 38 to 40 | | |
| 6000 → | -40 to 15 | | | 16 to 26 | | | 27 to 33 | | | 34 to 38 | | |
| 7000 → | - | | | -40 to 22 | | | 23 to 28 | | | 29 to 36 | | |
| 8000 → | - | | | -40 to 18 | | | 19 to 23 | | | 24 to 34 | | |
| 8500 → | - | | | - | | | -40 to 20 | | | 21 to 33 | | |
| | ↓ | | | ↓ | | | ↓ | | | ↓ | | |
| **WEIGHT (lb)** | **V1** | **VR** | **V2** | **V1** | **VR** | **V2** | **V1** | **VR** | **V2** | **V1** | **VR** | **V2** |
| 28000 | 102 | 106 | 122 | 98 | 101 | 117 | 96 | 99 | 114 | 94 | 95 | 110 |
| 29000 | 102 | 105 | 122 | 98 | 101 | 117 | 97 | 100 | 114 | 96 | 98 | 111 |
| 30000 | 102 | 105 | 121 | 98 | 102 | 116 | 97 | 100 | 115 | 99 | 100 | 113 |
| 31000 | 101 | 105 | 121 | 99 | 102 | 117 | 99 | 102 | 116 | 101 | 103 | 115 |
| 32000 | 101 | 105 | 120 | 101 | 103 | 117 | 102 | 104 | 117 | 104 | 105 | 117 |
| 33000 | 103 | 106 | 121 | 103 | 105 | 119 | 104 | 106 | 119 | 106 | 107 | 119 |
| 34000 | 105 | 107 | 122 | 106 | 108 | 121 | 107 | 108 | 121 | 109 | 109 | 121 |
| 35000 | 107 | 109 | 123 | 108 | 110 | 122 | 109 | 110 | 122 | 111 | 112 | 122 |
| 36000 | 109 | 111 | 124 | 111 | 112 | 124 | 112 | 113 | 124 | 113 | 114 | 124 |
| 37000 | 111 | 113 | 126 | 113 | 114 | 126 | 114 | 115 | 126 | 115 | 116 | 126 |
| 38000 | 114 | 115 | 128 | 115 | 116 | 128 | 116 | 117 | 128 | 118 | 118 | 128 |
| 39000 | 116 | 117 | 129 | 117 | 118 | 129 | 118 | 119 | 129 | 120 | 120 | 129 |
| 40000 | 118 | 119 | 131 | 120 | 120 | 131 | 120 | 121 | 131 | 122 | 122 | 131 |
| 41000 | 121 | 121 | 132 | 122 | 122 | 132 | 122 | 123 | 132 | 123 | 124 | 132 |
| 42000 | 123 | 123 | 134 | 124 | 124 | 134 | 124 | 124 | 134 | 125 | 125 | 134 |
| 43000 | 125 | 125 | 135 | 126 | 126 | 136 | 126 | 126 | 136 | 127 | 127 | 136 |
| 44000 | 127 | 127 | 137 | 128 | 128 | 137 | 128 | 128 | 137 | 129 | 129 | 137 |
| 45000 | 128 | 128 | 138 | 129 | 129 | 139 | 130 | 130 | 139 | 131 | 131 | 139 |
| 46000 | 130 | 130 | 140 | 131 | 131 | 140 | 132 | 132 | 140 | 133 | 133 | 140 |
| 47000 | 132 | 132 | 141 | 133 | 133 | 141 | 133 | 133 | 141 | 134 | 134 | 142 |
| 48000 | 134 | 134 | 143 | 135 | 135 | 143 | 135 | 135 | 143 | 136 | 136 | 143 |
| 49000 | 135 | 135 | 144 | 136 | 136 | 144 | 137 | 137 | 144 | 138 | 138 | 144 |
| 50000 | 137 | 137 | 146 | 137 | 137 | 146 | 138 | 138 | 146 | 139 | 139 | 146 |

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# V1/VR/V2 SPEEDS
## EMB-145 - AE3007A1 ENGINES - FAA CERTIFICATION
## T/O-1 MODE - NORMAL V2 - FLAPS 22°
## ANTI-ICE ON OR OFF

| PRESSURE ALTITUDE (ft) | STATIC AIR TEMPERATURE (°C) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL → | -40 to 42 | | | 43 to 47 | | | 48 to 50 | | | - | | |
| 1000 → | -40 to 42 | | | 43 to 45 | | | 46 to 48 | | | - | | |
| 2000 → | -40 to 38 | | | 39 to 42 | | | 43 to 46 | | | - | | |
| 3000 → | -40 to 34 | | | 35 to 38 | | | 39 to 44 | | | - | | |
| 4000 → | - | | | -40 to 34 | | | 35 to 41 | | | 42 to 42 | | |
| 5000 → | - | | | -40 to 29 | | | 30 to 37 | | | 38 to 40 | | |
| 6000 → | - | | | -40 to 24 | | | 25 to 32 | | | 33 to 38 | | |
| 7000 → | - | | | -40 to 20 | | | 21 to 27 | | | 28 to 36 | | |
| 8000 → | - | | | - | | | -40 to 23 | | | 24 to 34 | | |
| 8500 → | - | | | - | | | -40 to 20 | | | 21 to 33 | | |
| | ↓ | | | ↓ | | | ↓ | | | ↓ | | |
| **WEIGHT (lb)** | **V1** | **VR** | **V2** | **V1** | **VR** | **V2** | **V1** | **VR** | **V2** | **V1** | **VR** | **V2** |
| 28000 | 95 | 109 | 119 | 93 | 106 | 115 | 91 | 102 | 111 | 89 | 98 | 106 |
| 29000 | 95 | 108 | 118 | 93 | 106 | 115 | 91 | 102 | 111 | 90 | 99 | 107 |
| 30000 | 95 | 108 | 117 | 94 | 105 | 115 | 92 | 102 | 110 | 90 | 99 | 107 |
| 31000 | 96 | 108 | 117 | 94 | 105 | 114 | 93 | 102 | 110 | 92 | 100 | 107 |
| 32000 | 96 | 108 | 116 | 95 | 105 | 114 | 93 | 102 | 110 | 94 | 100 | 108 |
| 33000 | 97 | 107 | 116 | 96 | 105 | 113 | 95 | 103 | 110 | 96 | 102 | 109 |
| 34000 | 98 | 107 | 116 | 97 | 105 | 113 | 97 | 104 | 111 | 99 | 103 | 110 |
| 35000 | 99 | 107 | 116 | 98 | 105 | 114 | 98 | 105 | 112 | 102 | 105 | 111 |
| 36000 | 100 | 107 | 116 | 100 | 106 | 114 | 100 | 106 | 113 | 104 | 106 | 113 |
| 37000 | 101 | 108 | 116 | 101 | 107 | 115 | 103 | 107 | 114 | 107 | 108 | 114 |
| 38000 | 102 | 109 | 117 | 103 | 108 | 116 | 106 | 108 | 116 | 109 | 109 | 116 |
| 39000 | 104 | 110 | 118 | 105 | 110 | 117 | 108 | 110 | 117 | 111 | 111 | 117 |
| 40000 | 106 | 111 | 118 | 108 | 111 | 118 | 110 | 112 | 118 | 112 | 112 | 118 |
| 41000 | 108 | 112 | 120 | 110 | 113 | 120 | 112 | 113 | 120 | 114 | 114 | 120 |
| 42000 | 111 | 114 | 121 | 113 | 114 | 121 | 114 | 115 | 121 | 115 | 115 | 121 |
| 43000 | 114 | 115 | 122 | 115 | 115 | 122 | 116 | 116 | 122 | 117 | 117 | 122 |
| 44000 | 116 | 116 | 123 | 117 | 117 | 123 | 117 | 117 | 123 | 118 | 118 | 123 |
| 45000 | 117 | 118 | 124 | 118 | 118 | 124 | 119 | 119 | 124 | 119 | 119 | 124 |
| 46000 | 119 | 119 | 125 | 119 | 119 | 125 | 120 | 120 | 125 | 121 | 121 | 125 |
| 47000 | 120 | 120 | 126 | 121 | 121 | 126 | 121 | 121 | 126 | 122 | 122 | 126 |
| 48000 | 122 | 122 | 127 | 122 | 122 | 127 | 123 | 123 | 127 | 123 | 123 | 127 |
| 49000 | 123 | 123 | 128 | 123 | 123 | 128 | 124 | 124 | 128 | 124 | 124 | 128 |
| 50000 | 124 | 124 | 130 | 125 | 125 | 130 | 125 | 125 | 130 | 126 | 126 | 130 |

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# V1/VR/V2 SPEEDS
## EMB-145 - AE3007A1 ENGINES - FAA CERTIFICATION
## ALT T/O-1 MODE - NORMAL V2 - FLAPS 9°
## ANTI-ICE ON OR OFF

| PRESSURE ALTITUDE (ft) | STATIC AIR TEMPERATURE (°C) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL → | -40 to 43 | | | 44 to 48 | | | 49 to 50 | | | - | | |
| 1000 → | -40 to 43 | | | 44 to 45 | | | 46 to 48 | | | - | | |
| 2000 → | -40 to 40 | | | 41 to 42 | | | 43 to 46 | | | - | | |
| 3000 → | -40 to 36 | | | 37 to 38 | | | 39 to 44 | | | - | | |
| 4000 → | -40 to 31 | | | 32 to 33 | | | 34 to 40 | | | 41 to 42 | | |
| 5000 → | -40 to 27 | | | 28 to 29 | | | 30 to 36 | | | 37 to 40 | | |
| 6000 → | - | | | -40 to 25 | | | 26 to 31 | | | 32 to 38 | | |
| 7000 → | - | | | - | | | -40 to 27 | | | 28 to 36 | | |
| 8000 → | - | | | - | | | -40 to 23 | | | 24 to 34 | | |
| 8500 → | - | | | - | | | -40 to 19 | | | 20 to 33 | | |
| | ↓ | | | ↓ | | | ↓ | | | ↓ | | |
| **WEIGHT (lb)** | **V1** | **VR** | **V2** | **V1** | **VR** | **V2** | **V1** | **VR** | **V2** | **V1** | **VR** | **V2** |
| 28000 | 101 | 105 | 122 | 100 | 103 | 120 | 97 | 100 | 116 | 94 | 97 | 111 |
| 29000 | 101 | 105 | 121 | 100 | 103 | 119 | 97 | 100 | 116 | 96 | 98 | 112 |
| 30000 | 101 | 104 | 120 | 100 | 103 | 119 | 97 | 101 | 115 | 98 | 100 | 113 |
| 31000 | 101 | 104 | 120 | 100 | 103 | 118 | 99 | 102 | 116 | 100 | 102 | 115 |
| 32000 | 101 | 104 | 119 | 100 | 103 | 118 | 101 | 103 | 117 | 103 | 104 | 117 |
| 33000 | 103 | 106 | 121 | 103 | 105 | 119 | 104 | 105 | 119 | 105 | 107 | 119 |
| 34000 | 105 | 107 | 122 | 105 | 107 | 121 | 106 | 108 | 121 | 108 | 109 | 121 |
| 35000 | 107 | 109 | 123 | 108 | 109 | 123 | 109 | 110 | 122 | 110 | 111 | 122 |
| 36000 | 109 | 111 | 124 | 110 | 111 | 124 | 111 | 112 | 124 | 112 | 113 | 124 |
| 37000 | 112 | 113 | 126 | 112 | 113 | 126 | 113 | 114 | 126 | 115 | 115 | 126 |
| 38000 | 114 | 115 | 127 | 115 | 115 | 128 | 116 | 116 | 128 | 117 | 117 | 128 |
| 39000 | 116 | 117 | 129 | 117 | 117 | 129 | 118 | 118 | 129 | 119 | 119 | 129 |
| 40000 | 118 | 119 | 131 | 119 | 119 | 131 | 120 | 120 | 131 | 121 | 121 | 131 |
| 41000 | 121 | 121 | 132 | 121 | 121 | 132 | 122 | 122 | 132 | 123 | 123 | 132 |
| 42000 | 123 | 123 | 134 | 123 | 123 | 134 | 124 | 124 | 134 | 125 | 125 | 134 |
| 43000 | 124 | 125 | 135 | 125 | 125 | 135 | 126 | 126 | 136 | 127 | 127 | 136 |
| 44000 | 126 | 126 | 137 | 127 | 127 | 137 | 128 | 128 | 137 | 129 | 129 | 137 |
| 45000 | 128 | 128 | 138 | 129 | 129 | 139 | 129 | 129 | 139 | 130 | 130 | 139 |
| 46000 | 130 | 130 | 140 | 130 | 130 | 140 | 131 | 131 | 140 | 132 | 132 | 140 |
| 47000 | 132 | 132 | 141 | 132 | 132 | 141 | 133 | 133 | 141 | 134 | 134 | 142 |
| 48000 | 133 | 133 | 143 | 134 | 134 | 143 | 135 | 135 | 143 | 135 | 135 | 143 |
| 49000 | 135 | 135 | 144 | 135 | 135 | 144 | 136 | 136 | 144 | 137 | 137 | 144 |
| 50000 | 137 | 137 | 146 | 138 | 138 | 146 | 138 | 138 | 146 | 139 | 139 | 146 |

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## FLAPS RETRACTION SCHEDULE

Takeoff with flaps 9°:
Flaps 9° to UP ..... $V_2$ + 15 KIAS

Takeoff with flaps 22°:
Flaps 22° to 9° ..... $V_2$ + 5 KIAS
Flaps 9° to UP ..... $V_2$ + 25 KIAS

## FINAL SEGMENT SPEED

| WEIGHT (lb) | $V_{FS}$ (KIAS) |
|---|---|
| 28000 | 136 |
| 29000 | 139 |
| 30000 | 141 |
| 31000 | 142 |
| 32000 | 145 |
| 33000 | 147 |
| 34000 | 150 |
| 35000 | 152 |
| 36000 | 154 |
| 37000 | 156 |
| 38000 | 158 |
| 39000 | 160 |
| 40000 | 162 |
| 41000 | 164 |
| 42000 | 165 |
| 43000 | 167 |
| 44000 | 169 |
| 45000 | 171 |
| 46000 | 172 |
| 47000 | 173 |
| 48000 | 175 |
| 49000 | 177 |
| 50000 | 179 |

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## PITCH TRIM SETTING FOR TAKEOFF

| CG POSITION (%) | LESS THAN OR EQUAL TO 27.5 | 27.6 UP TO 32.5 | 32.6 UP TO 36.5 | 36.6 UP TO 41.5 | ABOVE OR EQUAL TO 41.6 |
|---|---|---|---|---|---|
| PITCH TRIM UNITS | 8 | 7 | 6 | 5 | 4 |

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## CLIMB GRADIENT

The climb gradient tables show the climb gradients for several weights, temperatures and altitudes. These tables are published in the following configurations:

### GRADIENTS FOR TAKEOFF THRUST AND FLAPS 9

The gradients were obtained for a speed equal to $V_2$ + 10 KIAS and $V_2/V_S$ ratio equal to 1.2. The thrust rating was T/O-1 with Anti-Ice OFF. Corrections in the climb gradient for Anti-Ice ON and Flaps 22 are also provided below each table.

### GRADIENTS FOR TAKEOFF THRUST AND FLAPS UP

The gradients were obtained for a speed equal to 200 KIAS. The thrust rating was T/O-1 with Anti-Ice OFF. Below each table are provided corrections in the climb gradients for Anti-Ice ON and corrections for climb speed equal to $V_{FS}$.

### GRADIENTS FOR CLIMB THRUST AND FLAPS UP

The gradients were obtained for the following climb schedule:

- 240 KIAS up to 10000 ft, increasing linearly to 300 KIAS at 12000 ft, maintaining this speed up to 20000 ft.
- The thrust rating was CLB with Anti-Ice OFF. Corrections in the climb gradient for Anti-Ice ON are provided after the tables.

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# CLIMB GRADIENT - ALL ENGINES OPERATING

# TAKEOFF RATING - FLAPS 9

**AE3007A1 ENGINES**

ANTI ICE: OFF
LANDING GEAR UP
T/O-1 MODE
AIRSPEED: V2 + 10 KIAS
WINGS LEVELED

## ALTITUDE: 0 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 34.06 | 31.23 | 28.67 | 26.33 | 24.20 | 22.31 | 20.61 | 19.08 | 17.70 | 16.45 | 15.30 | 14.26 |
| -20 | 34.07 | 31.24 | 28.68 | 26.34 | 24.21 | 22.32 | 20.62 | 19.10 | 17.71 | 16.46 | 15.32 | 14.27 |
| -10 | 34.02 | 31.19 | 28.63 | 26.29 | 24.17 | 22.28 | 20.58 | 19.06 | 17.68 | 16.43 | 15.28 | 14.24 |
| 0 | 33.90 | 31.08 | 28.53 | 26.18 | 24.07 | 22.18 | 20.50 | 18.98 | 17.60 | 16.35 | 15.21 | 14.17 |
| 10 | 33.76 | 30.95 | 28.40 | 26.07 | 23.96 | 22.08 | 20.40 | 18.88 | 17.51 | 16.26 | 15.13 | 14.09 |
| 20 | 33.64 | 30.84 | 28.30 | 25.97 | 23.86 | 21.99 | 20.31 | 18.80 | 17.43 | 16.19 | 15.06 | 14.02 |
| 30 | 32.23 | 29.51 | 27.04 | 24.77 | 22.74 | 20.93 | 19.31 | 17.85 | 16.53 | 15.33 | 14.24 | 13.25 |

## ALTITUDE : 2000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 33.88 | 31.06 | 28.50 | 26.15 | 24.04 | 22.17 | 20.48 | 18.97 | 17.60 | 16.35 | 15.22 | 14.20 |
| -20 | 33.88 | 31.06 | 28.51 | 26.16 | 24.05 | 22.17 | 20.49 | 18.98 | 17.60 | 16.36 | 15.23 | 14.20 |
| -10 | 33.83 | 31.01 | 28.46 | 26.12 | 24.01 | 22.13 | 20.45 | 18.94 | 17.57 | 16.32 | 15.20 | 14.17 |
| 0 | 33.73 | 30.92 | 28.37 | 26.03 | 23.93 | 22.05 | 20.38 | 18.87 | 17.50 | 16.26 | 15.13 | 14.11 |
| 10 | 33.62 | 30.82 | 28.28 | 25.94 | 23.85 | 21.98 | 20.30 | 18.80 | 17.43 | 16.20 | 15.07 | 14.05 |
| 20 | 33.44 | 30.65 | 28.11 | 25.79 | 23.70 | 21.84 | 20.17 | 18.67 | 17.32 | 16.08 | 14.97 | 13.95 |
| 30 | 30.81 | 28.13 | 25.69 | 23.46 | 21.51 | 19.77 | 18.21 | 16.81 | 15.54 | 14.39 | 13.35 | 12.40 |

## ALTITUDE: 4000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 33.49 | 30.68 | 28.14 | 25.80 | 23.71 | 21.85 | 20.19 | 18.69 | 17.33 | 16.10 | 14.99 | 13.98 |
| -20 | 33.50 | 30.69 | 28.15 | 25.81 | 23.72 | 21.87 | 20.20 | 18.70 | 17.34 | 16.11 | 15.00 | 13.99 |
| -10 | 33.45 | 30.64 | 28.10 | 25.76 | 23.68 | 21.82 | 20.16 | 18.67 | 17.31 | 16.08 | 14.97 | 13.96 |
| 0 | 33.36 | 30.56 | 28.02 | 25.69 | 23.61 | 21.76 | 20.10 | 18.61 | 17.26 | 16.03 | 14.92 | 13.91 |
| 10 | 33.25 | 30.46 | 27.93 | 25.60 | 23.53 | 21.68 | 20.02 | 18.54 | 17.19 | 15.96 | 14.86 | 13.85 |
| 20 | 32.74 | 29.97 | 27.46 | 25.16 | 23.11 | 21.29 | 19.66 | 18.19 | 16.86 | 15.65 | 14.56 | 13.57 |
| 30 | 29.35 | 26.71 | 24.30 | 22.16 | 20.28 | 18.62 | 17.12 | 15.78 | 14.56 | 13.46 | 12.46 | 11.56 |

FOR ANTI-ICE ON, REDUCE THE CLIMB GRADIENT BY 3.62%.

FOR FLAPS 22, REDUCE THE CLIMB GRADIENT BY 1.94%.

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# CLIMB GRADIENT - ALL ENGINES OPERATING

## TAKEOFF RATING - FLAPS 9

**AE3007A1 ENGINES**

ANTI ICE: OFF
LANDING GEAR UP
T/O-1 MODE
AIRSPEED: V2 + 10 KIAS
WINGS LEVELED

### ALTITUDE: 6000 FT

| ISA+ºC | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 32.62 | 29.84 | 27.32 | 25.00 | 22.97 | 21.15 | 19.53 | 18.06 | 16.74 | 15.54 | 14.45 | 13.46 |
| -20 | 32.65 | 29.87 | 27.35 | 25.03 | 22.99 | 21.17 | 19.55 | 18.08 | 16.76 | 15.55 | 14.47 | 13.48 |
| -10 | 32.62 | 29.84 | 27.32 | 25.00 | 22.96 | 21.15 | 19.52 | 18.06 | 16.74 | 15.53 | 14.45 | 13.46 |
| 0 | 32.52 | 29.74 | 27.23 | 24.92 | 22.88 | 21.08 | 19.45 | 17.99 | 16.67 | 15.47 | 14.39 | 13.40 |
| 10 | 32.40 | 29.64 | 27.13 | 24.82 | 22.79 | 20.99 | 19.37 | 17.92 | 16.60 | 15.40 | 14.32 | 13.34 |
| 20 | 30.93 | 28.26 | 25.83 | 23.60 | 21.65 | 19.91 | 18.35 | 16.94 | 15.67 | 14.52 | 13.48 | 12.53 |
| 30 | 27.69 | 25.08 | 22.76 | 20.72 | 18.93 | 17.34 | 15.92 | 14.64 | 13.48 | 12.43 | 11.48 | 10.62 |

### ALTITUDE: 8000 FT

| ISA+ºC | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 30.78 | 28.05 | 25.56 | 23.35 | 21.40 | 19.68 | 18.13 | 16.74 | 15.48 | 14.33 | 13.30 | 12.36 |
| -20 | 30.79 | 28.06 | 25.57 | 23.36 | 21.42 | 19.70 | 18.15 | 16.76 | 15.50 | 14.36 | 13.33 | 12.39 |
| -10 | 30.79 | 28.06 | 25.57 | 23.35 | 21.41 | 19.69 | 18.14 | 16.75 | 15.49 | 14.35 | 13.31 | 12.38 |
| 0 | 30.71 | 27.98 | 25.50 | 23.29 | 21.35 | 19.63 | 18.08 | 16.70 | 15.44 | 14.30 | 13.27 | 12.33 |
| 10 | 30.61 | 27.89 | 25.41 | 23.20 | 21.27 | 19.55 | 18.01 | 16.63 | 15.37 | 14.23 | 13.21 | 12.27 |
| 20 | 29.23 | 26.60 | 24.19 | 22.05 | 20.18 | 18.52 | 17.03 | 15.69 | 14.47 | 13.37 | 12.38 | 11.48 |
| 30 | 25.82 | 23.30 | 21.10 | 19.16 | 17.47 | 15.97 | 14.62 | 13.41 | 12.32 | 11.32 | 10.43 | 9.62 |

### ALTITUDE: 10000 FT

| ISA+ºC | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 28.94 | 26.25 | 23.85 | 21.74 | 19.89 | 18.25 | 16.78 | 15.46 | 14.26 | 13.18 | 12.20 | 11.31 |
| -20 | 28.97 | 26.28 | 23.88 | 21.77 | 19.92 | 18.28 | 16.81 | 15.48 | 14.29 | 13.20 | 12.22 | 11.33 |
| -10 | 28.95 | 26.25 | 23.86 | 21.75 | 19.90 | 18.26 | 16.79 | 15.47 | 14.27 | 13.19 | 12.21 | 11.32 |
| 0 | 28.87 | 26.18 | 23.78 | 21.68 | 19.84 | 18.20 | 16.74 | 15.42 | 14.22 | 13.14 | 12.16 | 11.28 |
| 10 | 28.79 | 26.10 | 23.71 | 21.62 | 19.78 | 18.15 | 16.69 | 15.37 | 14.18 | 13.10 | 12.13 | 11.24 |
| 20 | 27.55 | 24.90 | 22.59 | 20.55 | 18.77 | 17.19 | 15.77 | 14.50 | 13.35 | 12.30 | 11.36 | 10.50 |
| 30 | 23.78 | 21.41 | 19.34 | 17.53 | 15.94 | 14.53 | 13.27 | 12.13 | 11.10 | 10.17 | 9.34 | 8.58 |

FOR ANTI-ICE ON, REDUCE THE CLIMB GRADIENT BY 3.62%.

FOR FLAPS 22, REDUCE THE CLIMB GRADIENT BY 1.94%.

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# CLIMB GRADIENT - ALL ENGINES OPERATING

## TAKEOFF RATING - FLAPS 9

**AE3007A1 ENGINES**

ANTI ICE: OFF
LANDING GEAR UP
T/O-1 MODE
AIRSPEED: V2 + 10 KIAS
WINGS LEVELED

### ALTITUDE: 12000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 26.15 | 23.60 | 21.38 | 19.42 | 17.72 | 16.20 | 14.84 | 13.62 | 12.51 | 11.51 | 10.61 | 9.79 |
| -20 | 26.16 | 23.61 | 21.39 | 19.44 | 17.73 | 16.21 | 14.85 | 13.63 | 12.52 | 11.52 | 10.62 | 9.80 |
| -10 | 26.15 | 23.61 | 21.38 | 19.43 | 17.72 | 16.21 | 14.85 | 13.63 | 12.52 | 11.52 | 10.61 | 9.79 |
| 0 | 26.08 | 23.54 | 21.32 | 19.37 | 17.67 | 16.15 | 14.80 | 13.58 | 12.47 | 11.47 | 10.57 | 9.75 |
| 10 | 25.98 | 23.44 | 21.23 | 19.28 | 17.58 | 16.07 | 14.72 | 13.50 | 12.40 | 11.40 | 10.50 | 9.69 |
| 20 | 25.53 | 23.03 | 20.84 | 18.92 | 17.25 | 15.76 | 14.42 | 13.22 | 12.13 | 11.15 | 10.26 | 9.45 |
| 30 | 22.01 | 19.75 | 17.78 | 16.06 | 14.55 | 13.21 | 12.01 | 10.93 | 9.96 | 9.08 | - | - |

### ALTITUDE: 13500 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 24.51 | 22.09 | 19.97 | 18.11 | 16.49 | 15.05 | 13.76 | 12.59 | 11.54 | 10.59 | 9.73 | 8.95 |
| -20 | 24.52 | 22.09 | 19.98 | 18.12 | 16.50 | 15.05 | 13.76 | 12.60 | 11.55 | 10.59 | 9.73 | 8.95 |
| -10 | 24.50 | 22.08 | 19.97 | 18.11 | 16.49 | 15.04 | 13.75 | 12.59 | 11.54 | 10.58 | 9.73 | 8.95 |
| 0 | 24.44 | 22.02 | 19.91 | 18.06 | 16.44 | 15.00 | 13.71 | 12.55 | 11.50 | 10.55 | 9.69 | 8.91 |
| 10 | 24.36 | 21.95 | 19.84 | 17.99 | 16.37 | 14.94 | 13.65 | 12.49 | 11.45 | 10.50 | 9.64 | 8.87 |
| 20 | 24.02 | 21.63 | 19.55 | 17.71 | 16.11 | 14.69 | 13.42 | 12.27 | 11.24 | 10.30 | 9.45 | 8.68 |
| 30 | 20.77 | 18.60 | 16.71 | 15.05 | 13.60 | 12.32 | 11.17 | 10.13 | 9.20 | - | - | - |

FOR ANTI-ICE ON, REDUCE THE CLIMB GRADIENT BY 3.62%.

FOR FLAPS 22, REDUCE THE CLIMB GRADIENT BY 1.94%.

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# CLIMB GRADIENT - ALL ENGINES OPERATING

# TAKEOFF RATING - FLAPS UP

**AE3007A1 ENGINES**

ANTI ICE: OFF
LANDING GEAR UP
T/O-1 MODE
AIRSPEED: 200 KIAS
WINGS LEVELED

## ALTITUDE: 0 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 29.37 | 27.14 | 25.17 | 23.42 | 21.86 | 20.44 | 19.15 | 17.97 | 16.89 | 15.89 | 14.96 | 14.10 |
| -20 | 29.38 | 27.15 | 25.19 | 23.44 | 21.87 | 20.45 | 19.16 | 17.98 | 16.90 | 15.90 | 14.97 | 14.11 |
| -10 | 29.30 | 27.08 | 25.12 | 23.37 | 21.80 | 20.39 | 19.10 | 17.93 | 16.85 | 15.85 | 14.92 | 14.06 |
| 0 | 29.17 | 26.96 | 25.00 | 23.26 | 21.70 | 20.29 | 19.01 | 17.84 | 16.76 | 15.77 | 14.85 | 13.99 |
| 10 | 29.03 | 26.82 | 24.87 | 23.14 | 21.59 | 20.18 | 18.91 | 17.74 | 16.67 | 15.68 | 14.76 | 13.91 |
| 20 | 28.91 | 26.71 | 24.77 | 23.05 | 21.50 | 20.10 | 18.83 | 17.67 | 16.60 | 15.61 | 14.69 | 13.84 |
| 30 | 27.75 | 25.63 | 23.75 | 22.09 | 20.59 | 19.24 | 18.01 | 16.89 | 15.86 | 14.90 | 14.02 | 13.19 |

## ALTITUDE: 2000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 29.52 | 27.28 | 25.31 | 23.55 | 21.97 | 20.55 | 19.26 | 18.07 | 16.99 | 15.98 | 15.05 | 14.18 |
| -20 | 29.52 | 27.28 | 25.30 | 23.54 | 21.97 | 20.55 | 19.25 | 18.07 | 16.98 | 15.98 | 15.05 | 14.18 |
| -10 | 29.47 | 27.23 | 25.26 | 23.51 | 21.93 | 20.51 | 19.22 | 18.04 | 16.95 | 15.95 | 15.02 | 14.15 |
| 0 | 29.36 | 27.13 | 25.16 | 23.41 | 21.84 | 20.43 | 19.14 | 17.96 | 16.88 | 15.88 | 14.95 | 14.09 |
| 10 | 29.25 | 27.03 | 25.07 | 23.33 | 21.76 | 20.35 | 19.07 | 17.89 | 16.82 | 15.82 | 14.89 | 14.03 |
| 20 | 29.08 | 26.87 | 24.92 | 23.19 | 21.63 | 20.23 | 18.95 | 17.78 | 16.71 | 15.72 | 14.80 | 13.94 |
| 30 | 26.39 | 24.36 | 22.57 | 20.97 | 19.54 | 18.24 | 17.06 | 15.99 | 14.99 | 14.08 | 13.22 | 12.43 |

## ALTITUDE: 4000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 29.29 | 27.06 | 25.10 | 23.36 | 21.79 | 20.38 | 19.09 | 17.92 | 16.84 | 15.84 | 14.91 | 14.05 |
| -20 | 29.28 | 27.06 | 25.10 | 23.35 | 21.79 | 20.37 | 19.09 | 17.91 | 16.83 | 15.83 | 14.91 | 14.05 |
| -10 | 29.23 | 27.01 | 25.05 | 23.31 | 21.75 | 20.33 | 19.05 | 17.88 | 16.80 | 15.80 | 14.88 | 14.02 |
| 0 | 29.15 | 26.94 | 24.98 | 23.24 | 21.68 | 20.28 | 19.00 | 17.83 | 16.75 | 15.76 | 14.83 | 13.98 |
| 10 | 29.05 | 26.84 | 24.89 | 23.16 | 21.61 | 20.20 | 18.92 | 17.76 | 16.68 | 15.69 | 14.77 | 13.92 |
| 20 | 28.57 | 26.39 | 24.47 | 22.77 | 21.23 | 19.85 | 18.59 | 17.44 | 16.38 | 15.40 | 14.50 | 13.65 |
| 30 | 25.02 | 23.08 | 21.37 | 19.84 | 18.47 | 17.23 | 16.10 | 15.07 | 14.12 | 13.24 | 12.42 | 11.66 |

FOR ANTI-ICE ON, REDUCE THE CLIMB GRADIENT BY 3.66%.

CLIMBING IN VFS, INCREASE THE CLIMB GRADIENT BY 0.51%.

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# CLIMB GRADIENT - ALL ENGINES OPERATING

# TAKEOFF RATING - FLAPS UP

**AE3007A1 ENGINES**

ANTI ICE: OFF
LANDING GEAR UP
T/O-1 MODE
AIRSPEED: 200 KIAS
WINGS LEVELED

## ALTITUDE: 6000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 28.34 | 26.18 | 24.27 | 22.57 | 21.05 | 19.68 | 18.43 | 17.28 | 16.23 | 15.26 | 14.36 | 13.52 |
| -20 | 28.33 | 26.17 | 24.26 | 22.56 | 21.04 | 19.67 | 18.42 | 17.28 | 16.22 | 15.25 | 14.35 | 13.51 |
| -10 | 28.29 | 26.13 | 24.23 | 22.53 | 21.01 | 19.64 | 18.39 | 17.25 | 16.20 | 15.23 | 14.33 | 13.49 |
| 0 | 28.19 | 26.04 | 24.14 | 22.45 | 20.94 | 19.57 | 18.33 | 17.19 | 16.14 | 15.17 | 14.28 | 13.44 |
| 10 | 28.07 | 25.93 | 24.04 | 22.36 | 20.85 | 19.48 | 18.24 | 17.11 | 16.07 | 15.10 | 14.21 | 13.37 |
| 20 | 26.76 | 24.71 | 22.89 | 21.28 | 19.83 | 18.52 | 17.33 | 16.23 | 15.23 | 14.30 | 13.44 | 12.64 |
| 30 | 23.48 | 21.65 | 20.02 | 18.58 | 17.28 | 16.10 | 15.03 | 14.05 | 13.14 | 12.31 | 11.53 | 10.80 |

## ALTITUDE: 8000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 26.43 | 24.39 | 22.60 | 21.00 | 19.57 | 18.27 | 17.09 | 16.01 | 15.02 | 14.10 | 13.25 | 12.45 |
| -20 | 26.48 | 24.44 | 22.64 | 21.04 | 19.60 | 18.31 | 17.12 | 16.04 | 15.05 | 14.13 | 13.27 | 12.48 |
| -10 | 26.44 | 24.41 | 22.61 | 21.01 | 19.58 | 18.28 | 17.10 | 16.02 | 15.03 | 14.11 | 13.25 | 12.46 |
| 0 | 26.35 | 24.32 | 22.53 | 20.94 | 19.50 | 18.21 | 17.03 | 15.96 | 14.97 | 14.05 | 13.20 | 12.41 |
| 10 | 26.22 | 24.20 | 22.41 | 20.83 | 19.40 | 18.11 | 16.94 | 15.87 | 14.88 | 13.97 | 13.12 | 12.33 |
| 20 | 24.79 | 22.87 | 21.17 | 19.66 | 18.30 | 17.07 | 15.95 | 14.92 | 13.98 | 13.10 | 12.29 | 11.54 |
| 30 | 21.82 | 20.09 | 18.56 | 17.20 | 15.98 | 14.87 | 13.86 | 12.94 | 12.08 | 11.29 | 10.56 | 9.87 |

## ALTITUDE: 10000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 24.60 | 22.69 | 21.00 | 19.50 | 18.15 | 16.92 | 15.81 | 14.79 | 13.86 | 12.99 | 12.18 | 11.43 |
| -20 | 24.64 | 22.73 | 21.04 | 19.53 | 18.18 | 16.95 | 15.84 | 14.82 | 13.88 | 13.01 | 12.21 | 11.45 |
| -10 | 24.59 | 22.68 | 20.99 | 19.49 | 18.14 | 16.92 | 15.81 | 14.79 | 13.85 | 12.98 | 12.18 | 11.42 |
| 0 | 24.52 | 22.61 | 20.93 | 19.43 | 18.08 | 16.86 | 15.75 | 14.74 | 13.80 | 12.94 | 12.13 | 11.38 |
| 10 | 24.44 | 22.54 | 20.86 | 19.36 | 18.02 | 16.80 | 15.70 | 14.68 | 13.75 | 12.89 | 12.09 | 11.34 |
| 20 | 23.08 | 21.27 | 19.67 | 18.24 | 16.96 | 15.80 | 14.74 | 13.78 | 12.88 | 12.06 | 11.29 | 10.58 |
| 30 | 20.10 | 18.49 | 17.06 | 15.79 | 14.64 | 13.61 | 12.66 | 11.79 | 10.99 | 10.25 | 9.56 | 8.91 |

FOR ANTI-ICE ON, REDUCE THE CLIMB GRADIENT BY 3.66%.

CLIMBING IN VFS, INCREASE THE CLIMB GRADIENT BY 0.51%.

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# CLIMB GRADIENT - ALL ENGINES OPERATING

## TAKEOFF RATING - FLAPS UP

**AE3007A1 ENGINES**

ANTI ICE: OFF
LANDING GEAR UP
T/O-1 MODE
AIRSPEED: 200 KIAS
WINGS LEVELED

### ALTITUDE: 12000 FT

| ISA+ºC | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 21.93 | 20.20 | 18.66 | 17.30 | 16.07 | 14.95 | 13.94 | 13.01 | 12.15 | 11.36 | 10.62 | 9.93 |
| -20 | 21.94 | 20.20 | 18.67 | 17.30 | 16.07 | 14.96 | 13.95 | 13.02 | 12.16 | 11.36 | 10.63 | 9.94 |
| -10 | 21.93 | 20.20 | 18.67 | 17.30 | 16.07 | 14.96 | 13.94 | 13.01 | 12.16 | 11.36 | 10.62 | 9.93 |
| 0 | 21.84 | 20.11 | 18.58 | 17.22 | 16.00 | 14.89 | 13.88 | 12.95 | 12.10 | 11.31 | 10.57 | 9.88 |
| 10 | 21.76 | 20.04 | 18.52 | 17.16 | 15.94 | 14.83 | 13.82 | 12.90 | 12.05 | 11.26 | 10.53 | 9.84 |
| 20 | 21.33 | 19.63 | 18.13 | 16.80 | 15.60 | 14.51 | 13.52 | 12.61 | 11.77 | 10.99 | 10.27 | 9.59 |
| 30 | 18.27 | 16.78 | 15.46 | 14.28 | 13.22 | 12.26 | 11.38 | 10.57 | 9.82 | 9.13 | 8.49 | 7.88 |

### ALTITUDE: 13500 FT

| ISA+ºC | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 20.52 | 18.88 | 17.43 | 16.13 | 14.97 | 13.91 | 12.95 | 12.07 | 11.25 | 10.50 | 9.80 | 9.14 |
| -20 | 20.52 | 18.88 | 17.43 | 16.13 | 14.97 | 13.91 | 12.95 | 12.07 | 11.25 | 10.50 | 9.80 | 9.14 |
| -10 | 20.52 | 18.88 | 17.43 | 16.14 | 14.97 | 13.92 | 12.95 | 12.07 | 11.26 | 10.50 | 9.80 | 9.14 |
| 0 | 20.45 | 18.81 | 17.37 | 16.07 | 14.91 | 13.86 | 12.90 | 12.02 | 11.21 | 10.46 | 9.76 | 9.10 |
| 10 | 20.36 | 18.73 | 17.29 | 16.00 | 14.85 | 13.80 | 12.84 | 11.96 | 11.16 | 10.41 | 9.71 | 9.05 |
| 20 | 20.03 | 18.42 | 17.00 | 15.73 | 14.59 | 13.55 | 12.61 | 11.74 | 10.94 | 10.20 | 9.51 | 8.87 |
| 30 | 17.09 | 15.67 | 14.42 | 13.31 | 12.30 | 11.38 | 10.55 | 9.78 | 9.07 | 8.41 | 7.80 | 7.22 |

FOR ANTI-ICE ON, REDUCE THE CLIMB GRADIENT BY 3.66%.

CLIMBING IN VFS, INCREASE THE CLIMB GRADIENT BY 0.51%.

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# CLIMB GRADIENT - ALL ENGINES OPERATING

## CLIMB RATING - FLAPS UP

**AE3007A1 ENGINES**

ANTI ICE: OFF
LANDING GEAR UP
CLB MODE
WINGS LEVELED
SPEED SCHEDULE: 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 300 KIAS AT 12000 FT, MAINTAINING 300 KIAS UP TO 20000 FT.

### ALTITUDE: 0 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 21.01 | 19.41 | 18.00 | 16.75 | 15.62 | 14.61 | 13.68 | 12.84 | 12.07 | 11.36 | 10.70 | 9.94 |
| -20 | 21.01 | 19.41 | 18.00 | 16.74 | 15.62 | 14.60 | 13.68 | 12.84 | 12.07 | 11.36 | 10.69 | 9.94 |
| -10 | 20.97 | 19.37 | 17.96 | 16.71 | 15.58 | 14.57 | 13.65 | 12.81 | 12.04 | 11.33 | 10.67 | 9.91 |
| 0 | 20.87 | 19.28 | 17.88 | 16.63 | 15.51 | 14.50 | 13.59 | 12.75 | 11.98 | 11.27 | 10.61 | 9.86 |
| 10 | 20.57 | 18.99 | 17.61 | 16.38 | 15.27 | 14.28 | 13.37 | 12.54 | 11.79 | 11.08 | 10.44 | 9.70 |
| 20 | 17.27 | 15.92 | 14.72 | 13.66 | 12.71 | 11.85 | 11.06 | 10.35 | 9.69 | 9.08 | 8.51 | 7.86 |
| 30 | 14.26 | 13.11 | 12.09 | 11.19 | 10.37 | 9.63 | 8.96 | 8.34 | 7.77 | 7.25 | 6.76 | 6.18 |

### ALTITUDE: 2000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 19.62 | 18.11 | 16.78 | 15.60 | 14.53 | 13.58 | 12.71 | 11.91 | 11.18 | 10.50 | 9.88 | 9.16 |
| -20 | 19.63 | 18.12 | 16.79 | 15.61 | 14.55 | 13.59 | 12.72 | 11.92 | 11.19 | 10.51 | 9.89 | 9.17 |
| -10 | 19.60 | 18.09 | 16.76 | 15.58 | 14.52 | 13.56 | 12.69 | 11.89 | 11.16 | 10.49 | 9.87 | 9.15 |
| 0 | 19.51 | 18.01 | 16.68 | 15.50 | 14.45 | 13.49 | 12.63 | 11.84 | 11.11 | 10.44 | 9.81 | 9.10 |
| 10 | 19.12 | 17.64 | 16.34 | 15.18 | 14.15 | 13.21 | 12.36 | 11.58 | 10.86 | 10.20 | 9.59 | 8.88 |
| 20 | 16.08 | 14.80 | 13.68 | 12.68 | 11.78 | 10.97 | 10.23 | 9.55 | 8.93 | 8.35 | 7.81 | 7.19 |
| 30 | 13.22 | 12.14 | 11.18 | 10.33 | 9.56 | 8.86 | 8.23 | 7.65 | 7.11 | 6.61 | 6.15 | 5.60 |

### ALTITUDE: 4000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 18.25 | 16.83 | 15.58 | 14.46 | 13.46 | 12.56 | 11.74 | 10.99 | 10.30 | 9.67 | 9.08 | 8.39 |
| -20 | 18.27 | 16.85 | 15.59 | 14.48 | 13.48 | 12.58 | 11.76 | 11.01 | 10.32 | 9.68 | 9.09 | 8.41 |
| -10 | 18.24 | 16.83 | 15.57 | 14.46 | 13.46 | 12.56 | 11.74 | 10.99 | 10.30 | 9.67 | 9.07 | 8.39 |
| 0 | 18.17 | 16.76 | 15.51 | 14.40 | 13.41 | 12.51 | 11.69 | 10.94 | 10.26 | 9.62 | 9.03 | 8.35 |
| 10 | 17.78 | 16.40 | 15.17 | 14.08 | 13.10 | 12.22 | 11.42 | 10.68 | 10.01 | 9.39 | 8.81 | 8.14 |
| 20 | 14.87 | 13.67 | 12.62 | 11.68 | 10.83 | 10.07 | 9.38 | 8.74 | 8.15 | 7.61 | 7.10 | 6.51 |
| 30 | 12.15 | 11.14 | 10.25 | 9.45 | 8.73 | 8.07 | 7.48 | 6.93 | 6.43 | 5.96 | 5.52 | 5.00 |

FOR ANTI-ICE ON, REDUCE THE CLIMB GRADIENT BY 3.73%.

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# CLIMB GRADIENT - ALL ENGINES OPERATING

# CLIMB RATING - FLAPS UP

**AE3007A1 ENGINES**

ANTI ICE: OFF
LANDING GEAR UP
CLB MODE
WINGS LEVELED
SPEED SCHEDULE: 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 300 KIAS AT 12000 FT, MAINTAINING 300 KIAS UP TO 20000 FT.

## ALTITUDE: 6000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 16.91 | 15.58 | 14.41 | 13.36 | 12.42 | 11.58 | 10.80 | 10.10 | 9.45 | 8.85 | 8.29 | 7.66 |
| -20 | 16.93 | 15.60 | 14.42 | 13.37 | 12.44 | 11.59 | 10.82 | 10.11 | 9.46 | 8.86 | 8.30 | 7.67 |
| -10 | 16.92 | 15.59 | 14.42 | 13.37 | 12.43 | 11.59 | 10.81 | 10.11 | 9.46 | 8.86 | 8.30 | 7.67 |
| 0 | 16.87 | 15.54 | 14.37 | 13.32 | 12.39 | 11.54 | 10.77 | 10.07 | 9.42 | 8.82 | 8.27 | 7.64 |
| 10 | 16.48 | 15.18 | 14.03 | 13.01 | 12.09 | 11.26 | 10.50 | 9.81 | 9.18 | 8.59 | 8.04 | 7.42 |
| 20 | 13.65 | 12.54 | 11.55 | 10.68 | 9.89 | 9.17 | 8.52 | 7.93 | 7.38 | 6.87 | 6.39 | 5.84 |
| 30 | 11.08 | 10.14 | 9.31 | 8.56 | 7.89 | 7.28 | 6.73 | 6.22 | 5.74 | 5.30 | 4.90 | 4.41 |

## ALTITUDE: 8000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 15.68 | 14.43 | 13.33 | 12.35 | 11.47 | 10.67 | 9.94 | 9.28 | 8.67 | 8.10 | 7.57 | 6.97 |
| -20 | 15.72 | 14.47 | 13.36 | 12.38 | 11.49 | 10.69 | 9.97 | 9.30 | 8.69 | 8.12 | 7.59 | 6.99 |
| -10 | 15.71 | 14.46 | 13.36 | 12.37 | 11.49 | 10.69 | 9.96 | 9.30 | 8.69 | 8.12 | 7.59 | 6.99 |
| 0 | 15.65 | 14.40 | 13.30 | 12.32 | 11.44 | 10.64 | 9.92 | 9.26 | 8.65 | 8.08 | 7.56 | 6.96 |
| 10 | 15.32 | 14.10 | 13.01 | 12.05 | 11.18 | 10.40 | 9.69 | 9.04 | 8.44 | 7.88 | 7.36 | 6.77 |
| 20 | 12.52 | 11.48 | 10.57 | 9.75 | 9.01 | 8.34 | 7.73 | 7.17 | 6.66 | 6.18 | 5.73 | 5.21 |
| 30 | 10.08 | 9.21 | 8.43 | 7.74 | 7.11 | 6.54 | 6.02 | 5.55 | 5.10 | 4.69 | 4.31 | 3.85 |

## ALTITUDE: 10000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 14.50 | 13.32 | 12.29 | 11.37 | 10.54 | 9.79 | 9.11 | 8.48 | 7.91 | 7.37 | 6.88 | 6.31 |
| -20 | 14.52 | 13.35 | 12.31 | 11.39 | 10.56 | 9.81 | 9.13 | 8.50 | 7.92 | 7.39 | 6.89 | 6.32 |
| -10 | 14.52 | 13.35 | 12.31 | 11.39 | 10.56 | 9.81 | 9.12 | 8.50 | 7.92 | 7.39 | 6.89 | 6.32 |
| 0 | 14.47 | 13.30 | 12.27 | 11.35 | 10.52 | 9.77 | 9.09 | 8.47 | 7.89 | 7.36 | 6.86 | 6.29 |
| 10 | 14.22 | 13.07 | 12.05 | 11.14 | 10.33 | 9.59 | 8.92 | 8.30 | 7.73 | 7.21 | 6.72 | 6.16 |
| 20 | 11.40 | 10.44 | 9.58 | 8.82 | 8.13 | 7.51 | 6.94 | 6.42 | 5.94 | 5.49 | 5.08 | 4.58 |
| 30 | 9.08 | 8.27 | 7.55 | 6.90 | 6.32 | 5.80 | 5.31 | 4.87 | 4.46 | 4.08 | 3.72 | 3.28 |

FOR ANTI-ICE ON, REDUCE THE CLIMB GRADIENT BY 3.73%.

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# CLIMB GRADIENT - ALL ENGINES OPERATING

# CLIMB RATING - FLAPS UP

**AE3007A1 ENGINES**

ANTI ICE: OFF
LANDING GEAR UP
CLB MODE
WINGS LEVELED
SPEED SCHEDULE: 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 300 KIAS AT 12000 FT, MAINTAINING 300 KIAS UP TO 20000 FT.

## ALTITUDE: 12000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 7.74 | 7.06 | 6.45 | 5.92 | 5.44 | 5.00 | 4.61 | 4.24 | 3.91 | 3.60 | 3.32 | 2.83 |
| -20 | 7.76 | 7.08 | 6.47 | 5.94 | 5.45 | 5.02 | 4.62 | 4.26 | 3.93 | 3.62 | 3.33 | 2.84 |
| -10 | 7.77 | 7.08 | 6.48 | 5.94 | 5.46 | 5.02 | 4.63 | 4.26 | 3.93 | 3.62 | 3.34 | 2.85 |
| 0 | 7.73 | 7.04 | 6.44 | 5.91 | 5.43 | 4.99 | 4.60 | 4.23 | 3.90 | 3.60 | 3.31 | 2.82 |
| 10 | 7.36 | 6.70 | 6.12 | 5.60 | 5.14 | 4.72 | 4.34 | 3.99 | 3.67 | 3.37 | 3.10 | 2.62 |
| 20 | 5.03 | 4.53 | 4.08 | 3.69 | 3.33 | 3.01 | 2.71 | 2.44 | 2.19 | 1.96 | 1.74 | 1.32 |
| 30 | 2.98 | 2.62 | 2.29 | 2.00 | 1.74 | 1.50 | 1.28 | 1.07 | 0.88 | 0.71 | 0.54 | 0.18 |

## ALTITUDE: 14000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 6.75 | 6.13 | 5.58 | 5.10 | 4.66 | 4.26 | 3.90 | 3.57 | 3.27 | 2.99 | 2.73 | 2.27 |
| -20 | 6.77 | 6.15 | 5.60 | 5.11 | 4.67 | 4.28 | 3.92 | 3.59 | 3.28 | 3.00 | 2.74 | 2.28 |
| -10 | 6.77 | 6.15 | 5.60 | 5.12 | 4.68 | 4.28 | 3.92 | 3.59 | 3.28 | 3.00 | 2.74 | 2.28 |
| 0 | 6.74 | 6.12 | 5.57 | 5.09 | 4.65 | 4.25 | 3.89 | 3.56 | 3.26 | 2.98 | 2.72 | 2.26 |
| 10 | 6.39 | 5.80 | 5.27 | 4.80 | 4.38 | 4.00 | 3.65 | 3.34 | 3.04 | 2.77 | 2.52 | 2.07 |
| 20 | 4.15 | 3.70 | 3.31 | 2.95 | 2.64 | 2.35 | 2.08 | 1.84 | 1.62 | 1.41 | 1.21 | 0.82 |
| 30 | 2.21 | 1.90 | 1.61 | 1.36 | 1.13 | 0.92 | 0.73 | 0.55 | 0.38 | 0.23 | 0.08 | - |

## ALTITUDE: 16000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 5.93 | 5.36 | 4.86 | 4.41 | 4.01 | 3.65 | 3.32 | 3.01 | 2.73 | 2.48 | 2.23 | 1.80 |
| -20 | 5.95 | 5.38 | 4.88 | 4.43 | 4.03 | 3.66 | 3.33 | 3.03 | 2.75 | 2.49 | 2.25 | 1.82 |
| -10 | 5.94 | 5.37 | 4.87 | 4.42 | 4.02 | 3.66 | 3.33 | 3.02 | 2.74 | 2.48 | 2.24 | 1.81 |
| 0 | 5.92 | 5.35 | 4.85 | 4.41 | 4.00 | 3.64 | 3.31 | 3.01 | 2.73 | 2.47 | 2.23 | 1.80 |
| 10 | 5.58 | 5.04 | 4.55 | 4.13 | 3.74 | 3.39 | 3.07 | 2.78 | 2.51 | 2.26 | 2.03 | 1.61 |
| 20 | 3.35 | 2.96 | 2.61 | 2.29 | 2.01 | 1.75 | 1.51 | 1.30 | 1.10 | 0.91 | 0.73 | 0.37 |
| 30 | 1.50 | 1.23 | 0.98 | 0.76 | 0.57 | 0.38 | 0.22 | 0.06 | - | - | - | - |

FOR ANTI-ICE ON, REDUCE THE CLIMB GRADIENT BY 3.73%.

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# CLIMB GRADIENT - ALL ENGINES OPERATING

# CLIMB RATING - FLAPS UP

**AE3007A1 ENGINES**

ANTI ICE: OFF
LANDING GEAR UP
CLB MODE
WINGS LEVELED
SPEED SCHEDULE: 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 300 KIAS AT 12000 FT, MAINTAINING 300 KIAS UP TO 20000 FT.

## ALTITUDE: 18000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | 5.38 | 4.85 | 4.38 | 3.96 | 3.58 | 3.23 | 2.92 | 2.64 | 2.37 | 2.13 | 1.90 | 1.49 |
| -20 | 5.39 | 4.85 | 4.38 | 3.96 | 3.58 | 3.24 | 2.93 | 2.64 | 2.38 | 2.13 | 1.91 | 1.50 |
| -10 | 5.39 | 4.86 | 4.39 | 3.96 | 3.59 | 3.24 | 2.93 | 2.64 | 2.38 | 2.14 | 1.91 | 1.50 |
| 0 | 5.37 | 4.83 | 4.36 | 3.94 | 3.57 | 3.22 | 2.91 | 2.63 | 2.36 | 2.12 | 1.89 | 1.48 |
| 10 | 4.93 | 4.42 | 3.98 | 3.58 | 3.22 | 2.90 | 2.60 | 2.33 | 2.08 | 1.85 | 1.64 | 1.24 |
| 20 | 2.80 | 2.44 | 2.12 | 1.83 | 1.57 | 1.33 | 1.12 | 0.92 | 0.73 | 0.56 | 0.40 | 0.05 |
| 30 | 0.97 | 0.73 | 0.51 | 0.32 | 0.14 | - | - | - | - | - | - | - |

## ALTITUDE: 20000 FT

| ISA+°C | WEIGHT (LB) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28000 | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 | 50000 |
| -30 | - | - | - | - | - | - | - | - | - | - | - | - |
| -20 | 5.20 | 4.68 | 4.21 | 3.80 | 3.43 | 3.09 | 2.78 | 2.50 | 2.24 | 2.00 | 1.78 | 1.38 |
| -10 | 5.20 | 4.68 | 4.21 | 3.80 | 3.43 | 3.09 | 2.78 | 2.50 | 2.24 | 2.00 | 1.78 | 1.38 |
| 0 | 5.19 | 4.66 | 4.20 | 3.79 | 3.42 | 3.08 | 2.78 | 2.50 | 2.24 | 2.00 | 1.77 | 1.37 |
| 10 | 4.76 | 4.26 | 3.82 | 3.43 | 3.08 | 2.76 | 2.47 | 2.21 | 1.96 | 1.73 | 1.52 | 1.13 |
| 20 | 2.83 | 2.46 | 2.14 | 1.84 | 1.58 | 1.34 | 1.12 | 0.92 | 0.73 | 0.56 | 0.40 | 0.06 |
| 30 | 0.85 | 0.61 | 0.40 | 0.21 | 0.04 | - | - | - | - | - | - | - |

FOR ANTI-ICE ON, REDUCE THE CLIMB GRADIENT BY 3.73%.

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# SUPPLEMENTARY TAKEOFF INFORMATION

## TURN ANALYSIS

The method below presents the criteria for transforming a takeoff flight path with turns in an equivalent straight one to allow the use of the AFM charts or runway analysis software to determine obstacle clearance.

The method to be used herein converts an actual flight path with turns and wind effects to an equivalent straight flight path with still air.

The equivalent straight flight path with still air will be determined in terms of increments on the existing obstacles' height that should be taken into account to ensure obstacle clearance. With the equivalent straight flight path, the performance calculation must be done, as usual, as presented in the AFM.

### OPERATIONAL LIMITATIONS

Maximum bank angle: All Engines Operative: 25° at V2 + 10

One Engine Inoperative: 15° at V2

### EQUIVALENT STRAIGHT FLIGHT PATH DETERMINATION

The equivalent straight flight path (zero wind) to be used in the performance calculation should be determined as follows:

1) OBSTACLE INCREMENT IN A STEADY TURN

During a steady turn the climb gradient deteriorates. To compensate, an increment of the actual obstacle height must be obtained as a function of the gradient loss due to a steady turn and the turning distance flown to the obstacle by the following relation:

$$\Delta H = D_T \times G_L$$

Where:

- $\Delta H$ = height increment
- $D_T$ = distance flown along the turning flight
- $G_L$ = gradient loss (obtained from the gradient loss due to a steady turn chart)

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The equivalent obstacle height to be used in a obstacle clearance calculation is:

$$H_E = H_A + \Delta H_1 + \Delta H_2 + ..... + \Delta H_n$$

where:

$H_E$ = equivalent obstacle height
$H_A$ = actual obstacle height
$\Delta H_{1, 2, n}$ = height increments for each distance portion flown in turn to the obstacle.

2) WIND EFFECT ON THE FLIGHT PATH

a) STRAIGHT FLIGHT PORTIONS
Considering the drift compensation, the straight portions of the flight path may be corrected to still air equivalent distance as follows:

$$SAD = \frac{GD \times TAS}{GS}$$

Where:

SAD = still air equivalent distance
GD = actual ground distance
TAS = airplane true airspeed (obtained from the radius of turns and speed conversion chart)
GS = airplane ground speed

For straight flight:

$GS = TAS + (V_W \times \cos\alpha)$

Where:

$V_W$ = wind speed
$\alpha$ = angle between flight direction and wind direction

Remarks:

$V_W \times \cos\alpha$ is negative for a head wind component
$V_W \times \cos\alpha$ is positive for a tailwind component

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b) TURNING FLIGHT PORTIONS
Two effects must be taken into account:

b1) Trajectory Displacement:

The trajectory is displaced in the wind component direction proportionally to the time.

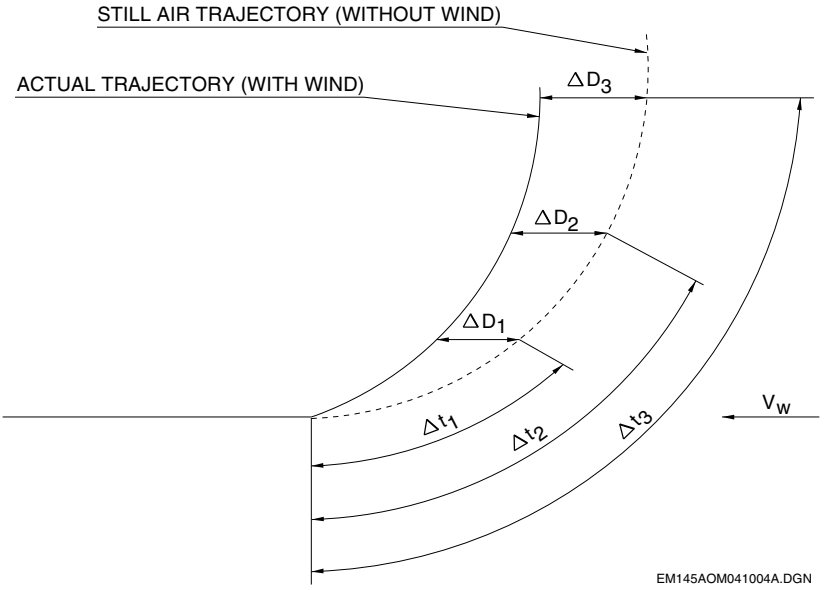
The displacement may be calculated by:

$\Delta D = \Delta t \times V_W$

$\Delta D$ = trajectory displacement in the wind component direction.

$\Delta t$ = elapsed time in turning flight (obtained from the Horizontal Distance and Time to Complete chart)

$V_W$ = wind speed

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b2) Distance Flown Compensation

The wind takes the same effect as mentioned in item 2a.

$$SAD = \frac{GD \times TAS}{GS}$$

For turning flight:

$$GS = \frac{Dm}{\Delta t}$$

Where:

Dm = distance flown along the actual trajectory

$\Delta t$ = elapsed time in turning flight

**PERFORMANCE CHARTS PRESENTATION**

GRADIENT LOSS DUE TO A STEADY TURN

This chart shows the gradient loss due to a steady turn as a function of the bank angle.

RADIUS OF TURN AND SPEED CONVERSION

This chart shows the radius of turn and the true airspeed to be used on the turning flight path calculation as a function of the indicated airspeed ($V_2$), airport pressure altitude, outside air temperature and the bank angle.

HORIZONTAL DISTANCE AND TIME TO COMPLETE

This chart shows the horizontal distance and the elapsed time during a turning flight as a function of the radius of turn, heading change and the bank angle.

**NOTE:** If necessary, the heading change may be divided in segments and the elapsed time of each segment should be added.

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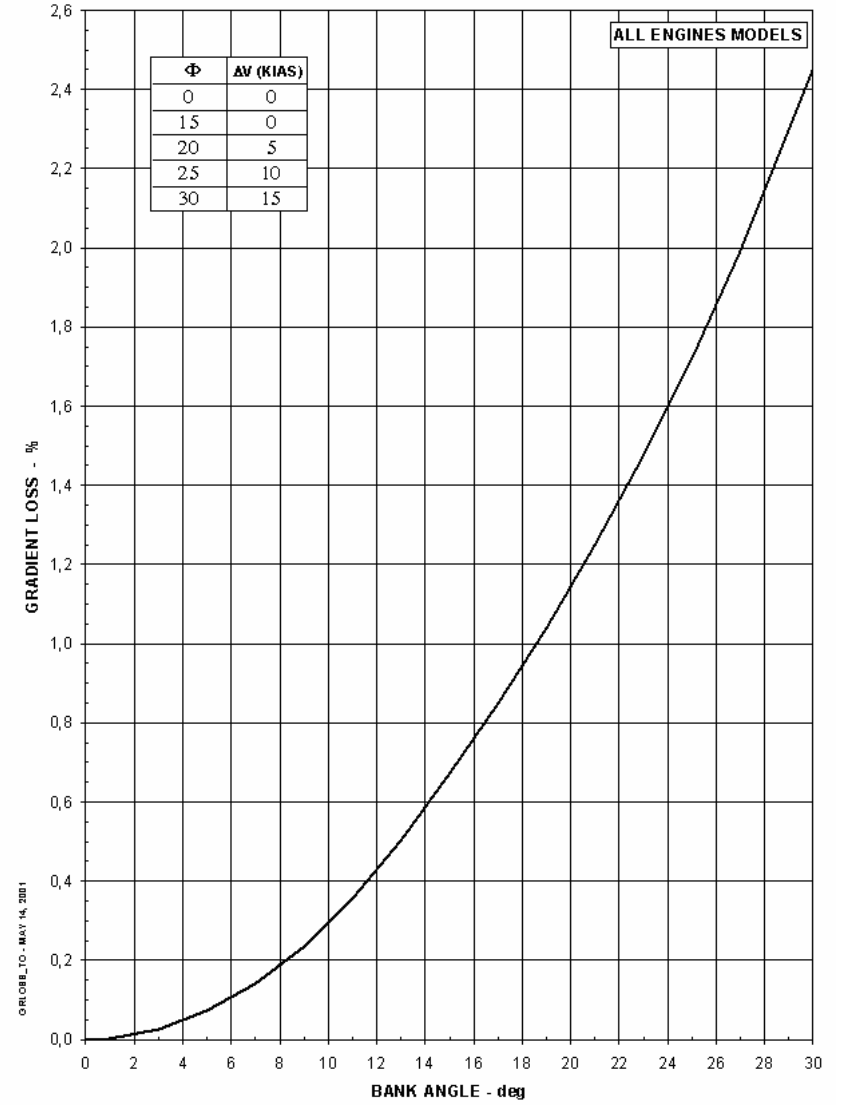
## GRADIENT LOSS DUE TO A STEADY TURN
ONE ENGINE INOPERATIVE
TAKEOFF FLAPS 9°



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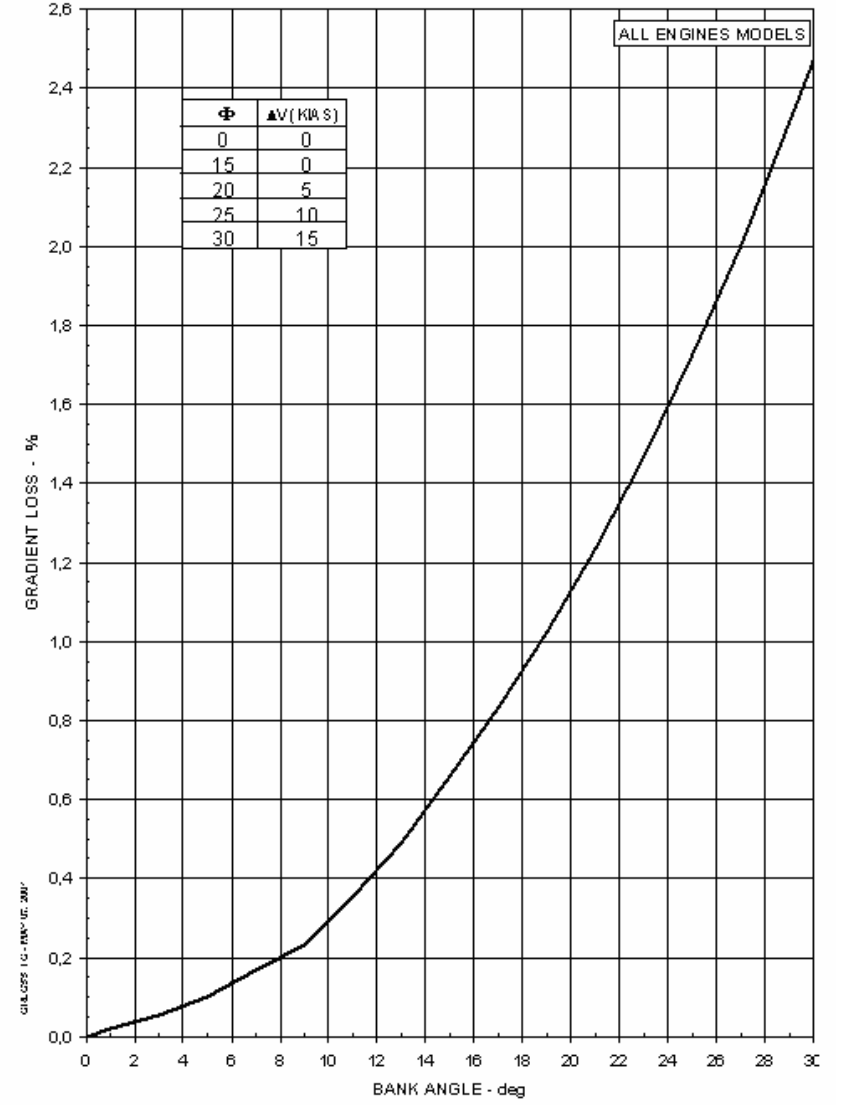
## GRADIENT LOSS DUE TO A STEADY TURN

ONE ENGINE INOPERATIVE

**TAKEOFF FLAPS 18°**



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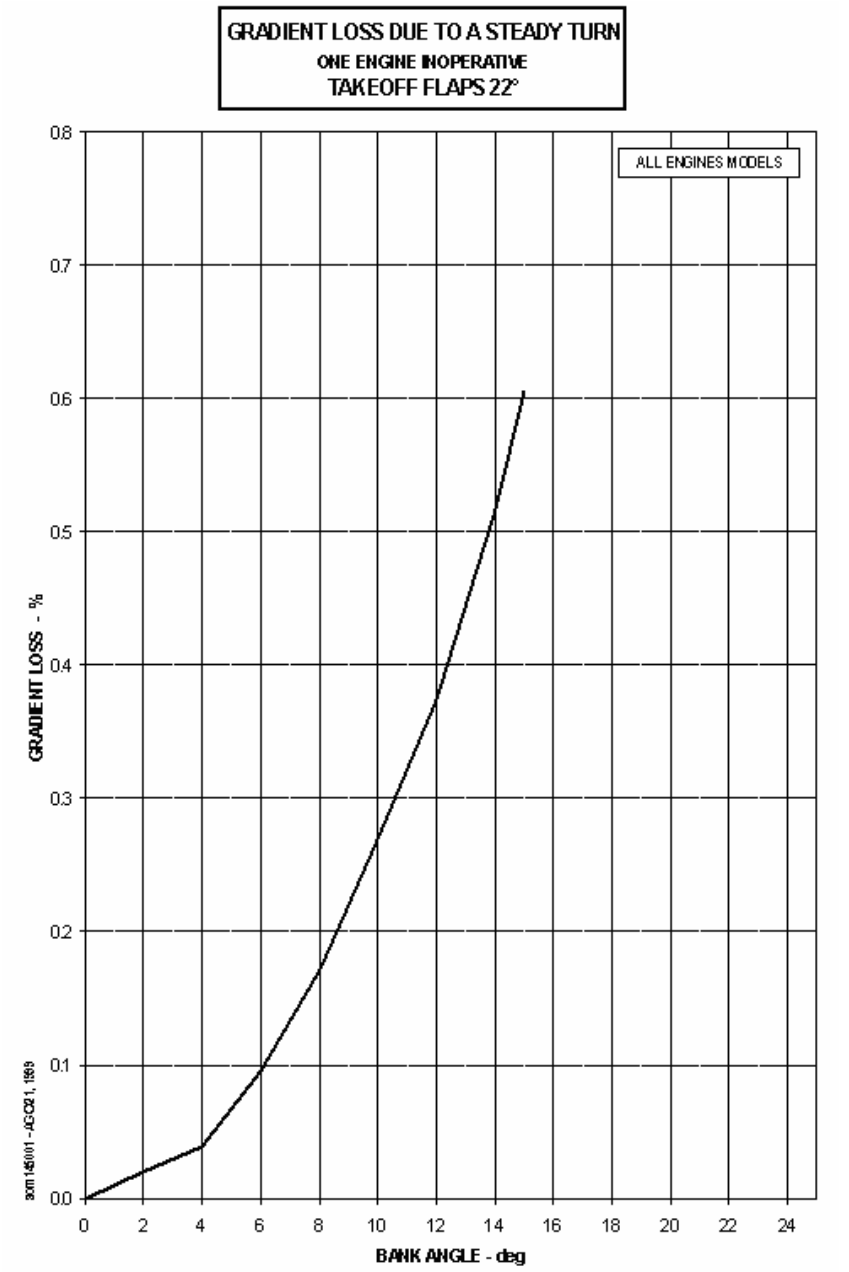


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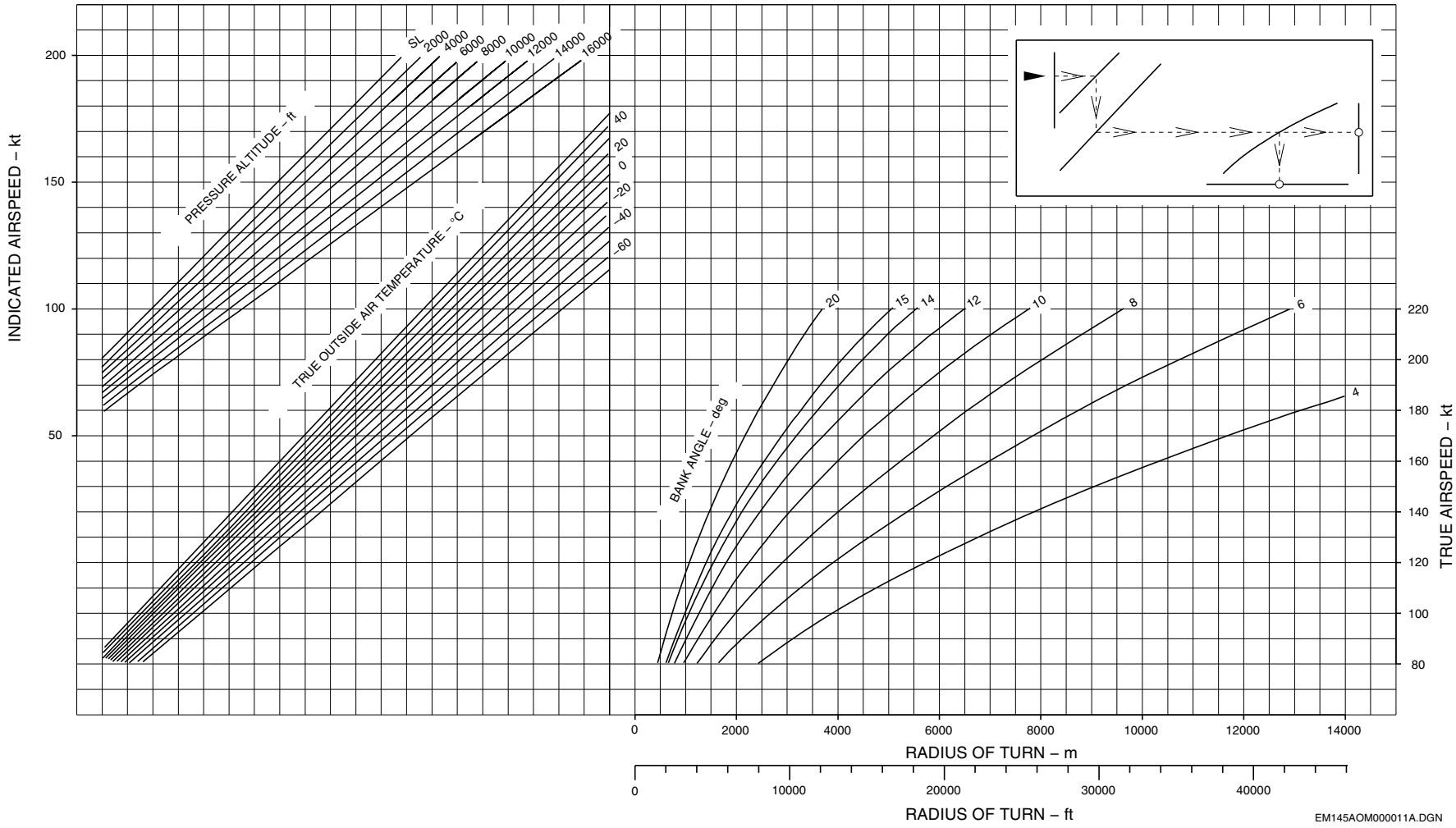
## RADIUS OF TURN AND SPEED CONVERSION



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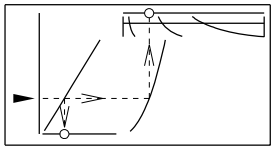
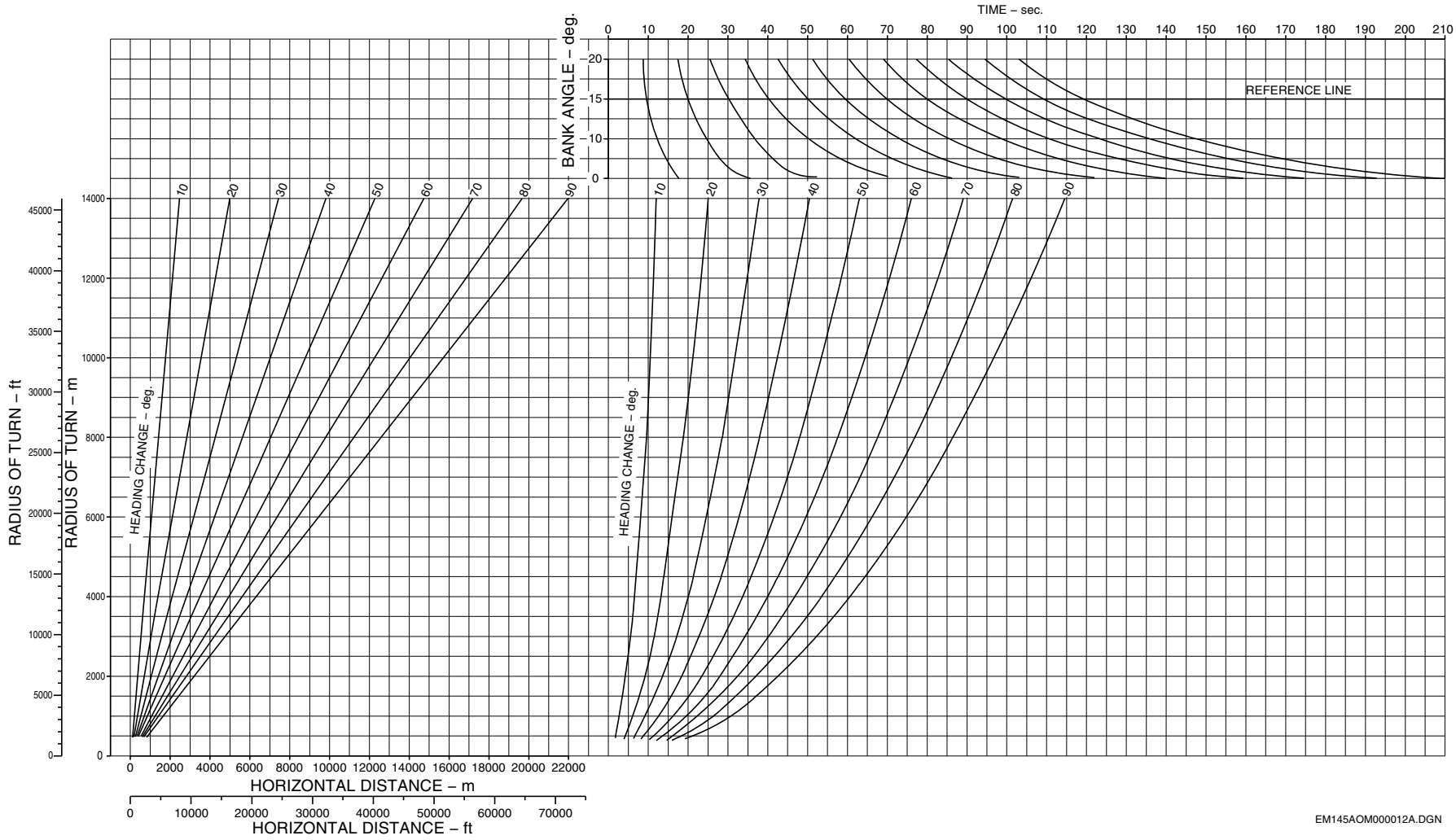
## HORIZONTAL DISTANCE AND TIME TO COMPLETE



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## AIRCRAFT CLASSIFICATION NUMBER - ACN

The Pavement Classification Number (PCN) reported shall indicate that an airplane with ACN equal to or less than the reported PCN can operate on that pavement.

## PCN - PAVEMENT CLASSIFICATION NUMBER

Example: PCN 50 / F / A / X / T

1 2 3 4

1 - Type of pavement:

R = Rigid (concrete) F = Flexible (asphalt)

2 - Pavement sub-grade strength category:

A = High B = Medium,

C = Low D = Ultra-low.

3 - Maximum tire pressure authorized for the pavement:

W = Unlimited, no limit; X = High (up to 254 psi)

Y = Medium (up to 181 psi); Z = Low (up to 73 psi)

4 - Pavement evaluation method:

T = Technical evaluation;

U = By experience of airplane actually using the pavement.

## OVERLOAD OPERATIONS

Individual airport authorities are free to decide on their own criteria for permitting overload operations as long as pavements remain safe for use by airplane. However, a 10% difference in ACN over PCN for flexible pavement and 5% for rigid pavements is generally accepted, provided that overload operations do not exceed 5% of the annual departures and are spread throughout the year.

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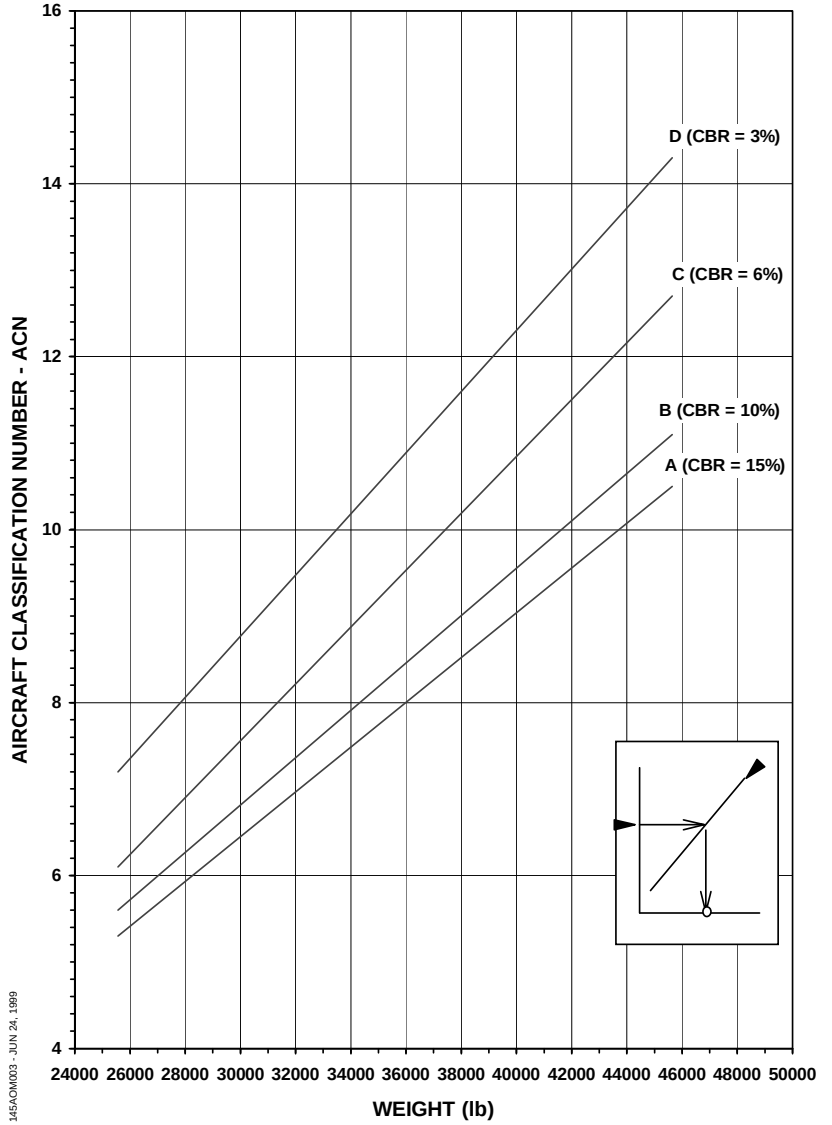
# EMB-145ER - ACN FLEXIBLE PAVEMENT

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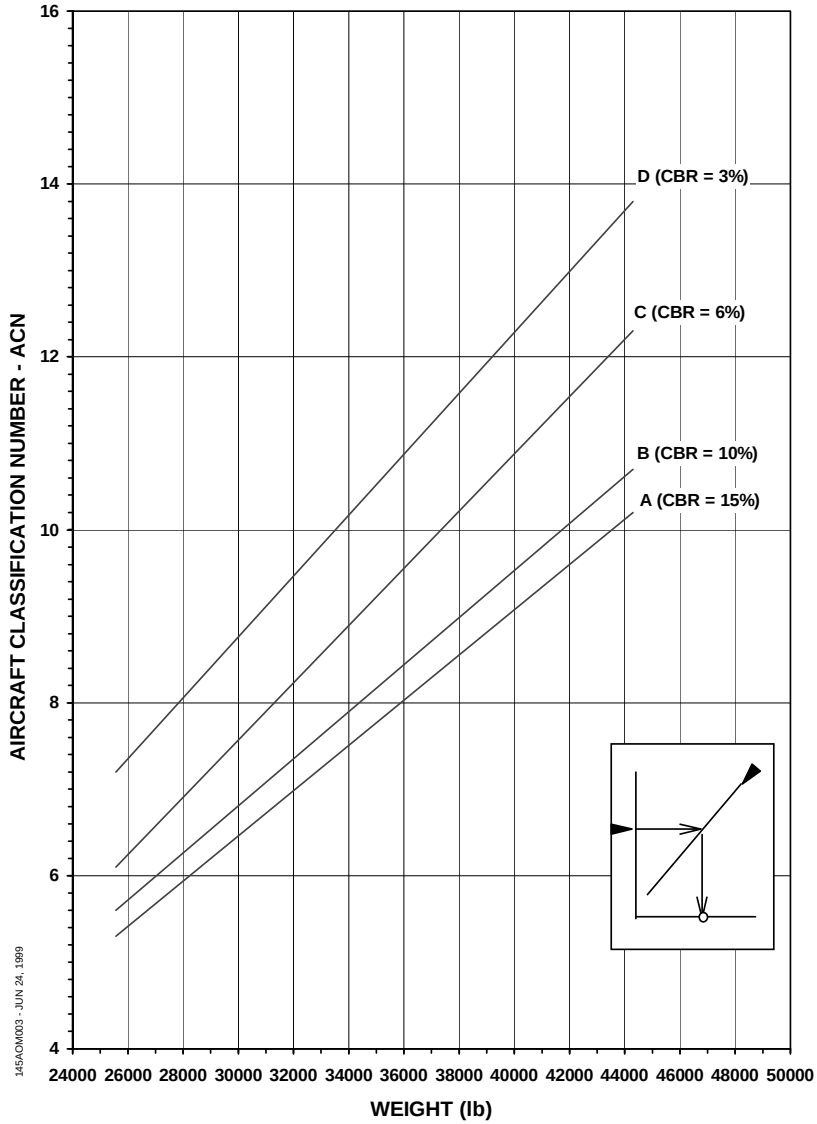
# EMB-145EU - ACN FLEXIBLE PAVEMENT

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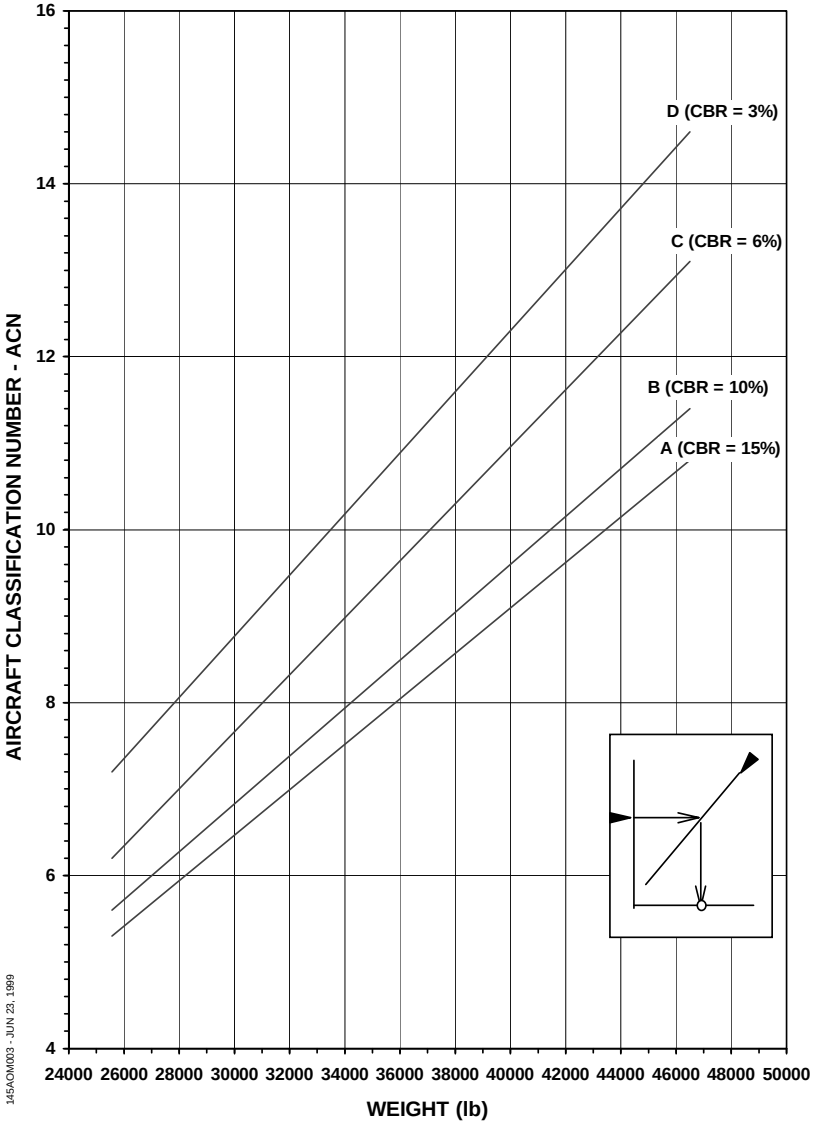
# EMB-145EP/MP - ACN FLEXIBLE PAVEMENT

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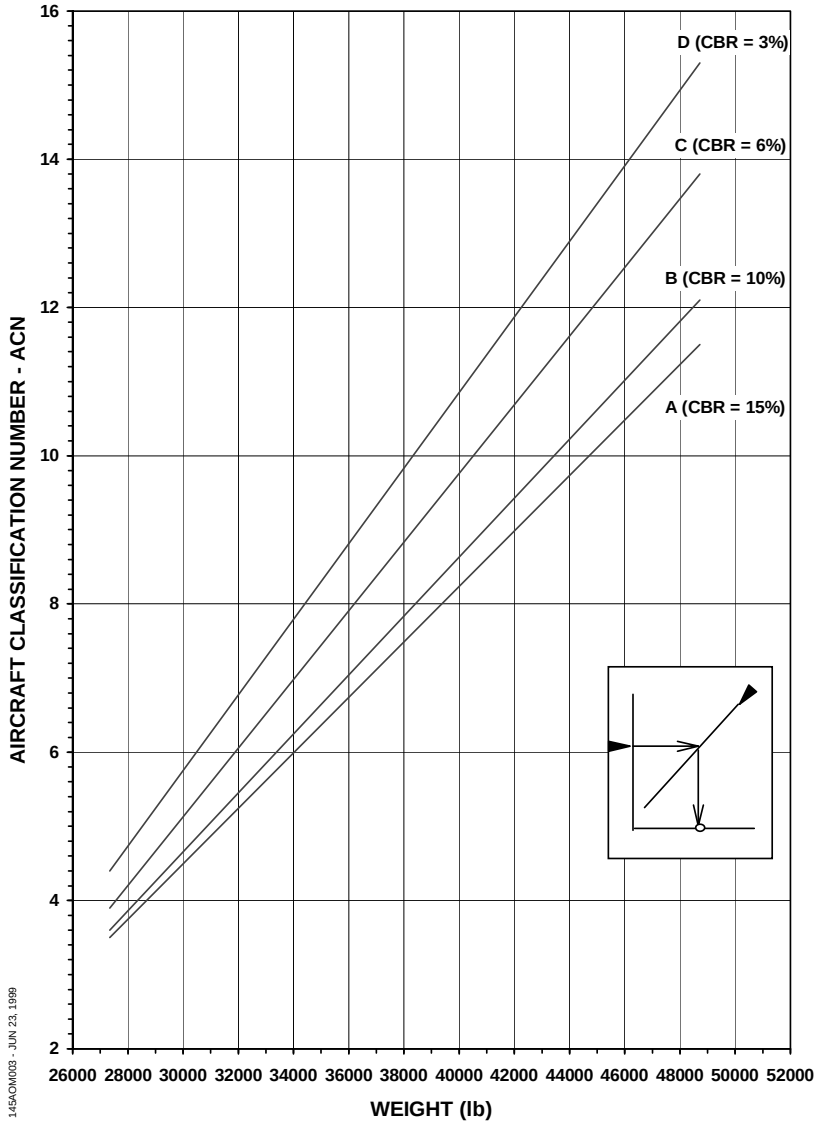
# EMB-145LR/LU - ACN FLEXIBLE PAVEMENT

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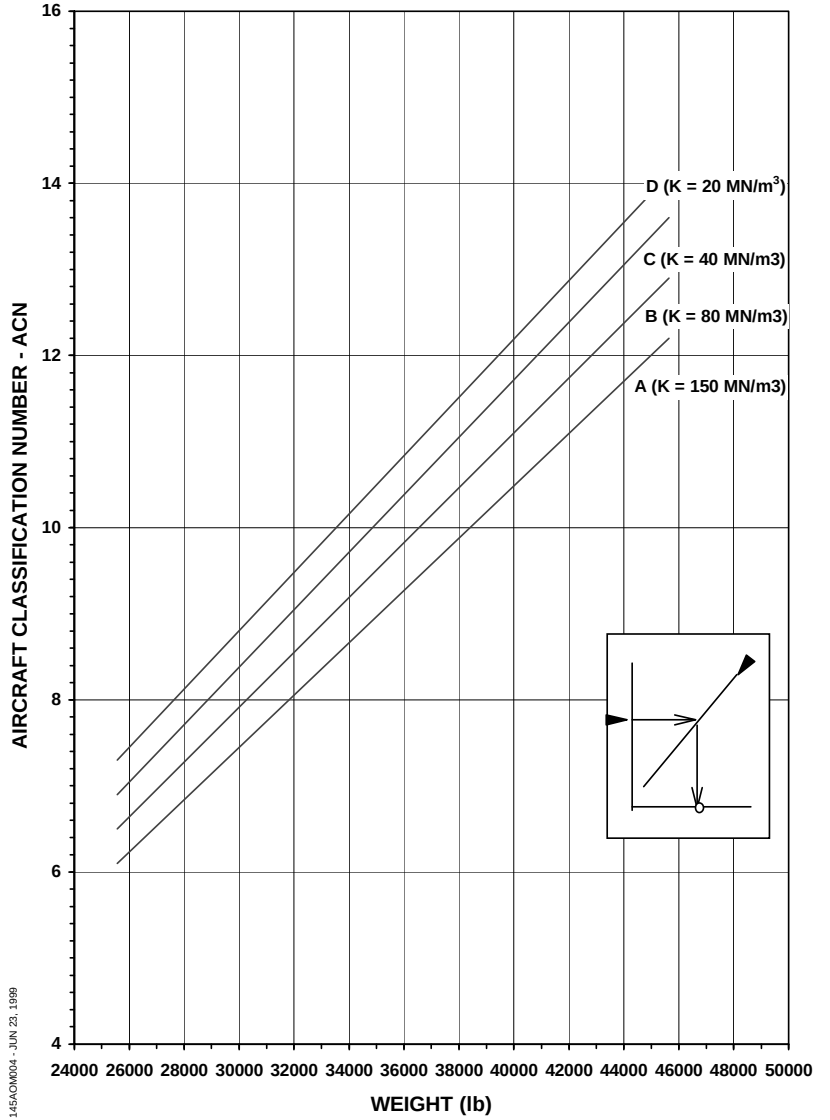
# EMB-145ER - ACN RIGID PAVEMENT

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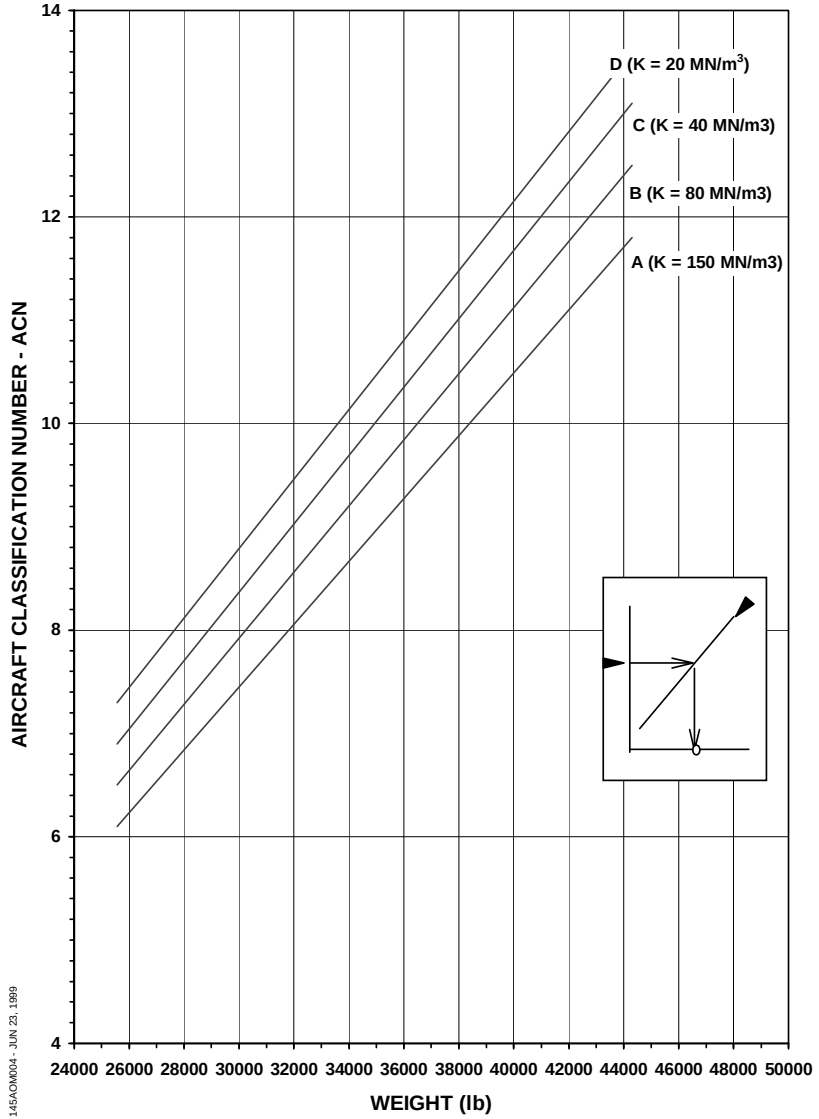
# EMB-145EU - ACN RIGID PAVEMENT

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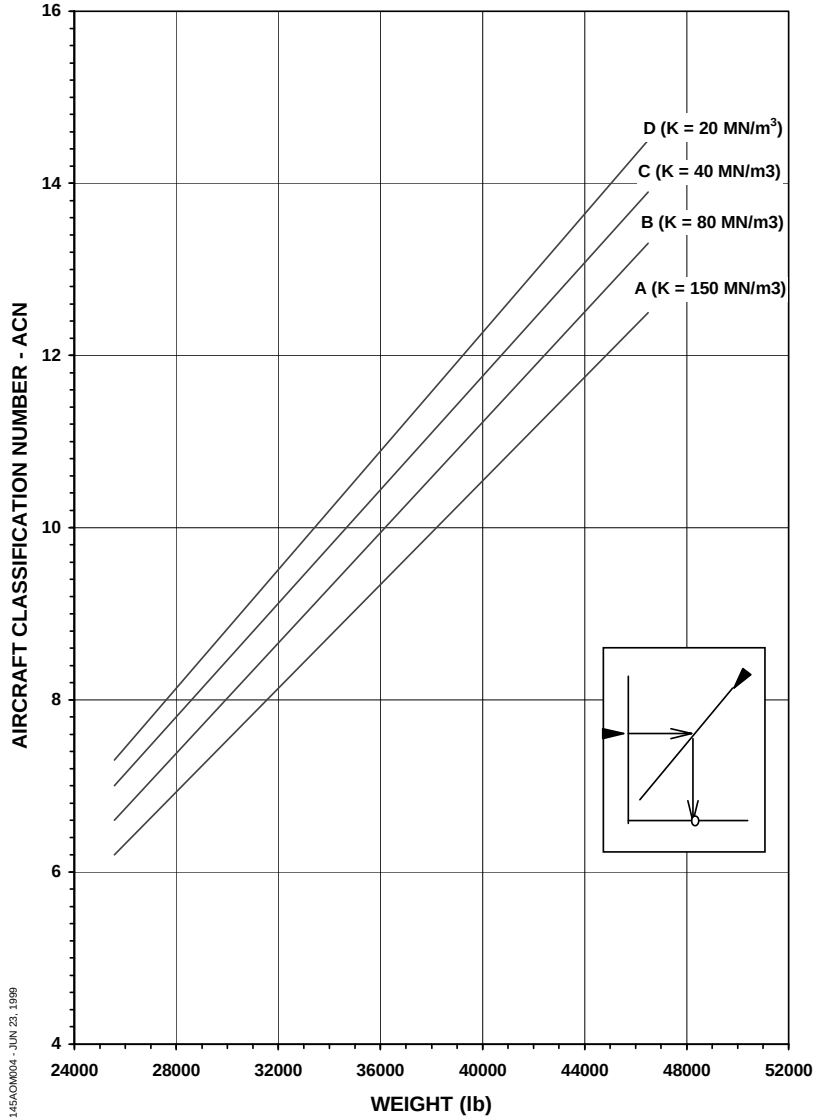
## EMB-145EP/MP - ACN RIGID pavement

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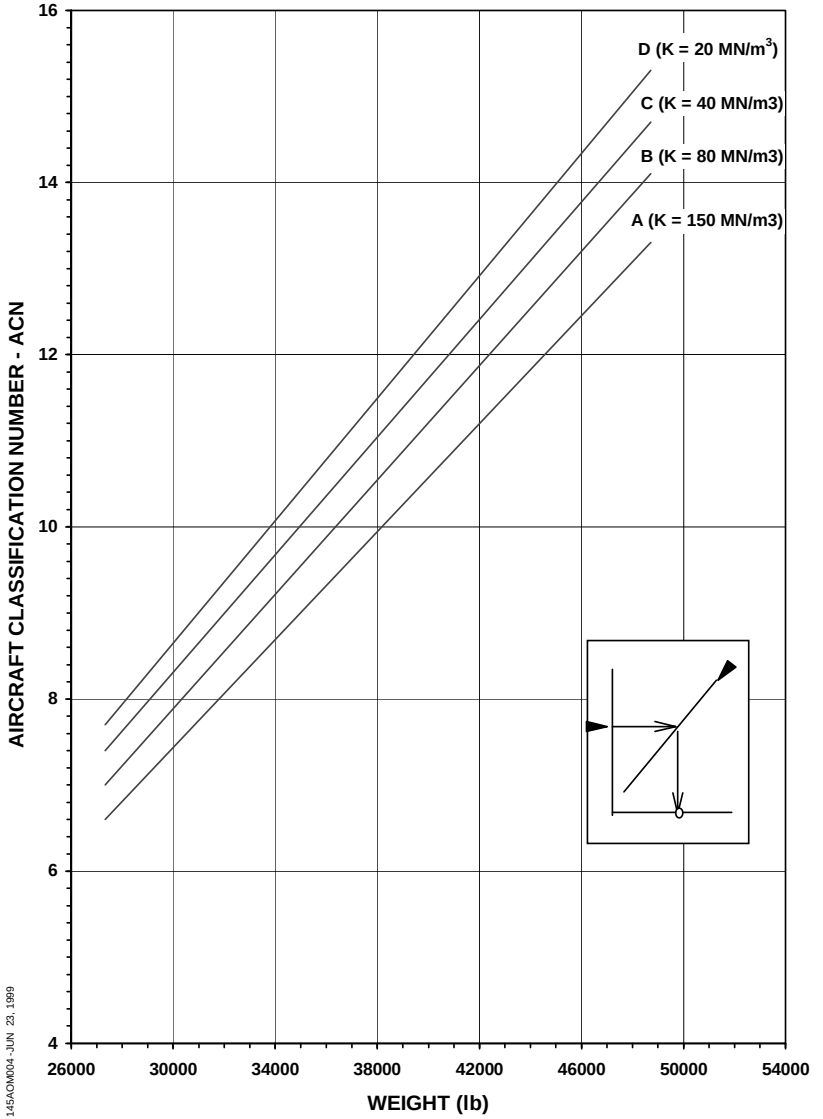
# EMB-145LR/LU - ACN RIGID PAVEMENT

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# TAKEOFF PERFORMANCE

Refer to the Airplane Flight Manual for a complete set of charts for determination of the limiting takeoff weights.

## EMBRAER RUNWAY ANALYSIS SOFTWARE

Although the AFM presents all the required performance data for takeoff, the amount of options and charts presented, makes their use very difficult. In order to help operators, EMBRAER developed a runway analysis software for determination of the limiting weights.

## THE TAKEOFF OUTPUT DATA

The program outputs the N1, weight, $V_1/V_R/V_2$, the level-off altitude and height, and the code assigned to the limitation detected during the calculation process. These data are valid for the wind and temperature associated.

The data are calculated for four reference winds for range of temperatures.

The level-off output depends upon the Minimum Level-off Height entered in the data input. If obstacle clearance requires, a value higher than the one entered will be automatically output.

**NOTE:** Level-off height must be corrected for temperatures below standard.

Limitation codes assigned are a number (1, 2 etc.) for Obstacle limited weight, R for Runway limited weight, W for WAT limited weight (same as Climb or Second Segment), S for Structural limited weight, V for $V1_{min}$, L for Level Off limited weight and B for a Brake Energy limited weight.

If the operation for a specific condition is considered unfeasible or outside the performance tables, the relevant data will be provided with asterisks.

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Wind (in knots)

Level off altitude and height (ft)

**EMB-145 TAKEOFF ANALYSIS, ALLISON AE3007A1 ENGINES, FAA CERTIFICATION**

---

**Airport:** AIRPORT NAME **ICAO:** KLAX **Runway:** 04 **Level Off Height:** 400 ft **FLAP** 9
**Elevation:** 5000 ft
**TORA:** 2000 m
**Clearway:** 0 m
**Stopway:** 0 m
**Slope:** .6 %
**Alignment allowance:** 21 m

---

Thrust: T/O-1
Anti Ice: OFF

DRY RUNWAY

LIMIT WEIGHTS (Lb), V1, VR, V2 (Kt) as function of Temperature and Wind:

| Temp(C)/N1(%) | -10Kt | 0Kt | 10Kt | 20Kt |
|---|---|---|---|---|
| -4 / 89.0 | 39941/118/119/131/R | 42875/124/125/135/R | 43815/126/126/137/R | 44684/128/128/138/R |
| -2 / 89.4 | 39830/118/119/131/R | 42754/124/124/135/R | 43689/126/126/137/R | 44572/128/128/138/R |
| 0 / 89.8 | 39720/118/118/130/R | 42635/124/124/135/R | 43563/126/126/136/R | 44460/127/127/138/R |
| 2 / 90.1 | 39598/118/118/130/R | 42512/124/124/135/R | 43434/126/126/136/R | 44346/127/127/138/R |
| 4 / 90.4 | 39474/117/118/130/R | 42391/124/124/135/R | 43307/125/125/136/R | 44234/127/127/137/R |
| 6 / 90.7 | 39349/117/118/130/R | 42269/123/123/134/R | 43179/125/125/136/R | 44121/127/127/137/R |
| 8 / 91.0 | 39226/117/117/130/R | 42148/123/123/134/R | 43052/125/125/136/R | 43993/127/127/137/R |
| 10 / 91.4 | 39104/116/117/129/R | 42027/123/123/134/R | 42925/125/125/135/R | 43860/126/126/137/R |
| 12 / 91.7 | 38987/116/117/129/R | 41912/123/123/134/R | 42804/124/124/135/R | 43733/126/126/137/R |
| 14 / 92.0 | 38873/116/117/129/R | 41792/122/123/134/R | 42684/124/124/135/R | 43607/126/126/136/R |
| 16 / 92.3 | 38756/116/117/129/R | 41667/122/122/133/R | 42563/124/124/135/R | 43479/126/126/136/R |

Limitation codes: 1,2,.-Obstacle No.; L = Level off; R-Runway; S-Structural; B-Brake Energy; W-WAT

Temperature (in degrees Celsius) and N1 (in percentage)

Weight/$V_1$/$V_R$/$V_2$ and limitation code (weight in pounds, and speeds in knots)

## EXAMPLE 1

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Wind (in knots)

Level off altitude and height (ft)

```
EMB-145 TAKEOFF ANALYSIS, ALLISON AE3007A1 ENGINES, FAA CERTIFICATION
-------------------------------------------------------------------------------------------------------------

Airport: AIRPORT NAME              ICAO: ABCD    Runway: 04     Level Off Height: 400 ft     FLAP  9
Elevation:  5000 ft
TORA:  2000 m
Clearway:  0 m
Stopway:   0 m
Slope:  .6 %
Alignment allowance:  21 m
-------------------------------------------------------------------------------------------------------------

Thrust: T/O-1
Anti Ice: OFF

DRY RUNWAY

-------------------------------------------------------------------------------------------------------------
    LIMIT WEIGHTS (Lb) as function of Temperature and Wind:
-------------------------------------------------------------------------------------------------------------
Temp(C)/N1(%) -10Kt            0Kt             10Kt             20Kt
-------------------------------------------------------------------------------------------------------------

-10  / 88.0  40280/ R         43244/ R         44186/ R         45030/ R
-8   / 88.4  40166/ R         43119/ R         44072/ R         44913/ R
-6   / 88.7  40053/ R         42997/ R         43943/ R         44798/ R
-4   / 89.0  39941/ R         42875/ R         43815/ R         44684/ R
-2   / 89.4  39830/ R         42754/ R         43689/ R         44572/ R
 0   / 89.8  39720/ R         42635/ R         43563/ R         44460/ R
 2   / 90.1  39598/ R         42512/ R         43434/ R         44346/ R
 4   / 90.4  39474/ R         42391/ R         43307/ R         44234/ R
 6   / 90.7  39349/ R         42269/ R         43179/ R         44121/ R
 8   / 91.0  39226/ R         42148/ R         43054/ R         43993/ R
 10  / 91.4  39104/ R         42027/ R         42928/ R         43860/ R
 12  / 91.7  38987/ R         41912/ R         42804/ R         43733/ R
 14  / 92.0  38873/ R         41792/ R         42684/ R         43607/ R
 16  / 92.3  38756/ R         41667/ R         42563/ R         43479/ R
 18  / 92.6  38641/ R         41542/ R         42442/ R         43352/ R
 20  / 93.0  38527/ R         41419/ R         42321/ R         43226/ R
 22  / 93.3  38414/ R         41295/ R         42201/ R         43100/ R
 24  / 93.6  37783/ R         40595/ R         41496/ R         42391/ R
-------------------------------------------------------------------------------------------------------------
Limitation codes: 1,2,... - Obstacle No.; L = Level off;  R - Runway; S - Structural; B - Brake Energy; W - WAT
```

Temperature (in degrees Celsius) and N1 (in percentage)

Weight in pounds and limitation code

```
V1/VR/V2 (Kt) vs. Weight and Temperature:

Temp/Weight  48500        46000        43500        41000        38500        36000        33500
-------------------------------------------------------------------------------------------------------

-10      134/134/144  130/130/140  126/126/136  121/121/132  115/116/128  109/111/124  103/105/120
-6       134/134/144  130/130/140  126/126/136  121/121/132  115/116/128  109/111/124  103/105/120
-2       134/134/144  130/130/140  126/126/136  121/121/132  115/116/128  109/111/124  103/105/120
 2       134/134/144  130/130/140  126/126/136  121/121/132  115/116/128  109/111/124  103/105/120
 6       134/134/144  130/130/140  126/126/136  121/121/132  115/116/128  109/111/124  103/105/120
 10      134/134/144  130/130/140  126/126/136  121/121/132  115/116/128  109/111/124  103/105/120
 14      135/134/144  130/130/140  126/126/136  121/121/132  115/116/128  109/111/124  103/105/120
 18      135/135/144  130/130/140  126/126/136  121/121/132  115/116/128  109/111/124  103/105/120
 22      135/135/144  130/130/140  126/126/136  121/121/132  115/116/128  109/111/124  103/105/120
 26      135/135/144  131/131/140  126/127/136  122/122/132  116/117/128  110/112/124  104/106/120
```

Temperature (in degrees Celsius)

$V_1/V_R/V_2$ in knots

**EXAMPLE 2**

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# APPROACH

## APPROACH CLIMB SPEED - FLAPS 9°

| WEIGHT (lb) | APPROACH CLIMB SPEED (KIAS) |
|---|---|
| 27000 | 125 |
| 28000 | 128 |
| 29000 | 130 |
| 30000 | 132 |
| 31000 | 134 |
| 32000 | 136 |
| 33000 | 138 |
| 34000 | 140 |
| 35000 | 142 |
| 36000 | 144 |
| 37000 | 146 |
| 38000 | 148 |
| 39000 | 150 |
| 40000 | 152 |
| 41000 | 154 |
| 42000 | 156 |
| 43000 | 157 |
| 44000 | 159 |
| 45000 | 161 |
| 46000 | 163 |
| 47000 | 164 |
| 48000 | 166 |
| 49000 | 167 |
| 50000 | 167 |

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# LANDING CLIMB AND REFERENCE SPEEDS

| WEIGHT (lb) | $V_{REF}$ - KIAS | |
|---|---|---|
| | FLAPS 45° | FLAPS 22° |
| 27000 | 104 | 109 |
| 28000 | 106 | 111 |
| 29000 | 108 | 113 |
| 30000 | 109 | 114 |
| 31000 | 111 | 116 |
| 32000 | 113 | 118 |
| 33000 | 115 | 120 |
| 34000 | 117 | 121 |
| 35000 | 118 | 123 |
| 36000 | 120 | 125 |
| 37000 | 121 | 127 |
| 38000 | 123 | 128 |
| 39000 | 124 | 130 |
| 40000 | 126 | 131 |
| 41000 | 127 | 133 |
| 42000 | 128 | 134 |
| 43000 | 130 | 136 |
| 44000 | 131 | 137 |
| 45000 | 132 | 139 |
| 46000 | 134 | 140 |
| 47000 | 135 | 142 |
| 48000 | 136 | 143 |
| 49000 | 137 | 144 |
| 50000 | 137 | 144 |

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## FLAP MANEUVERING SPEED

These speeds allow for an inadvertent 15° overshoot beyond the normal 30° bank over stick shaker actuation.

| | | FLAP MANEUVERING SPEED (KIAS) | | | |
|---|---|---|---|---|---|
| | | BELOW MSLW* | | ABOVE MSLW* | |
| FLAPS | GEAR | NO ICING CONDITIONS | WITH ICING CONDITIONS | NO ICING CONDITIONS | WITH ICING CONDITIONS |
| 0° | UP | 180 | 200 | 180 | 200 |
| 9° | UP/DN | 160 | | | |
| 18°/22° | UP/DN | 140 | 150 | | |
| 45° | DN | 140 | | | |

*Maximum Structural Landing Weight as specified on Limitations Section.

## FINAL APPROACH SPEED

$V_{APP} = V_{REF}$ + wind correction.

Wind correction = ½ steady headwind component + gust increment above steady wind.

For Flaps 45° landing, the minimum wind correction is 5 KIAS and the maximum is 15 KIAS.

For Flaps 22° landing:

- Performing CAT I approaches, the minimum wind correction is 5 KIAS and the maximum is 20 KIAS.
- Performing CAT II or CAT III approaches, the minimum wind correction is 0 KIAS and the maximum is 20 KIAS.

For Emergency and Abnormal procedures using Flaps 0°, 9° and 18°, the minimum wind correction is 0 KIAS and the maximum is 20 KIAS. For Flaps 22°, the minimum wind correction is 0 KIAS and the maximum is 15 KIAS. When there is wind and abnormal operation speed additives, use the sum of both corrections.

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# LANDING

## UNFACTORED LANDING DISTANCES

Unfactored landing distance is the actual distance to land the airplane on a zero slope, ISA temperature, dry runway from a point 50 ft above runway threshold at Vref, using only the brakes and spoilers as deceleration device (i.e., no engine reverse thrust is used).

The required landing distance for dispatch is the unfactored landing distance increased by the 66.7% for dry runway or 91.7% for wet runway.

For obtaining the DRY runway factored distance, multiply unfactored landing distance by 1.667.

For obtaining the WET runway factored distance, multiply unfactored landing distance by 1.917.

**NOTE:** The landing distance correction factors mentioned in some emergency or abnormal procedures must be applied to the flap 45 unfactored landing distance.

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## UNFACTORED LANDING DISTANCE TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22°

| Weight (lb) | ALTITUDE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 ft | | | | 1000 ft | | | |
| | WIND - (kt) | | | | | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 43000 | 4206 | 3638 | 3458 | 3284 | 4304 | 3726 | 3544 | 3366 |
| 41000 | 4047 | 3493 | 3319 | 3148 | 4139 | 3577 | 3399 | 3227 |
| 39000 | 3889 | 3350 | 3180 | 3014 | 3976 | 3429 | 3257 | 3088 |
| 37000 | 3737 | 3213 | 3047 | 2885 | 3819 | 3287 | 3119 | 2955 |
| 35000 | 3587 | 3076 | 2914 | 2757 | 3664 | 3146 | 2982 | 2823 |
| 33000 | 3432 | 2935 | 2777 | 2623 | 3504 | 3000 | 2841 | 2685 |
| 31000 | 3288 | 2802 | 2649 | 2499 | 3356 | 2864 | 2709 | 2557 |
| 29000 | 3147 | 2673 | 2523 | 2377 | 3210 | 2731 | 2579 | 2432 |
| 27000 | 3000 | 2538 | 2392 | 2249 | 3059 | 2592 | 2444 | 2301 |

| Weight (lb) | ALTITUDE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2000 ft | | | | 3000 ft | | | |
| | WIND - (kt) | | | | | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 43000 | 4406 | 3818 | 3632 | 3452 | 4513 | 3914 | 3725 | 3542 |
| 41000 | 4235 | 3664 | 3483 | 3308 | 4336 | 3755 | 3571 | 3393 |
| 39000 | 4066 | 3511 | 3336 | 3165 | 4161 | 3597 | 3419 | 3245 |
| 37000 | 3904 | 3364 | 3194 | 3027 | 3993 | 3445 | 3272 | 3103 |
| 35000 | 3744 | 3219 | 3053 | 2891 | 3828 | 3295 | 3127 | 2962 |
| 33000 | 3579 | 3068 | 2907 | 2749 | 3657 | 3140 | 2976 | 2817 |
| 31000 | 3425 | 2928 | 2771 | 2617 | 3499 | 2995 | 2836 | 2681 |
| 29000 | 3275 | 2791 | 2638 | 2488 | 3344 | 2854 | 2699 | 2547 |
| 27000 | 3120 | 2648 | 2499 | 2353 | 3184 | 2707 | 2556 | 2409 |

| Weight (lb) | ALTITUDE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4000 ft | | | | 5000 ft | | | |
| | WIND - (kt) | | | | | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 43000 | 4625 | 4015 | 3822 | 3635 | 4741 | 4120 | 3925 | 3734 |
| 41000 | 4441 | 3849 | 3663 | 3481 | 4552 | 3949 | 3758 | 3574 |
| 39000 | 4260 | 3686 | 3505 | 3329 | 4364 | 3780 | 3595 | 3416 |
| 37000 | 4086 | 3529 | 3353 | 3182 | 4184 | 3617 | 3439 | 3265 |
| 35000 | 3915 | 3374 | 3203 | 3037 | 4007 | 3457 | 3284 | 3115 |
| 33000 | 3739 | 3214 | 3048 | 2886 | 3825 | 3292 | 3124 | 2960 |
| 31000 | 3575 | 3065 | 2903 | 2746 | 3655 | 3138 | 2974 | 2815 |
| 29000 | 3415 | 2919 | 2762 | 2609 | 3490 | 2988 | 2829 | 2673 |
| 27000 | 3250 | 2768 | 2615 | 2466 | 3320 | 2832 | 2677 | 2527 |

**NOTE:** Landing distance in ft.

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## UNFACTORED LANDING DISTANCE TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22°

| Weight (lb) | ALTITUDE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 6000 ft | | | | 7000 ft | | | |
| | WIND - (kt) | | | | | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 43000 | 4861 | 4230 | 4031 | 3838 | 4986 | 4344 | 4142 | 3945 |
| 41000 | 4665 | 4052 | 3859 | 3671 | 4783 | 4160 | 3963 | 3772 |
| 39000 | 4472 | 3877 | 3689 | 3507 | 4585 | 3978 | 3787 | 3601 |
| 37000 | 4285 | 3709 | 3527 | 3350 | 4391 | 3804 | 3619 | 3439 |
| 35000 | 4102 | 3544 | 3367 | 3195 | 4201 | 3633 | 3454 | 3279 |
| 33000 | 3914 | 3373 | 3202 | 3036 | 4006 | 3457 | 3283 | 3114 |
| 31000 | 3739 | 3214 | 3048 | 2886 | 3825 | 3293 | 3124 | 2960 |
| 29000 | 3568 | 3059 | 2898 | 2740 | 3649 | 3133 | 2969 | 2810 |
| 27000 | 3393 | 2899 | 2742 | 2589 | 3468 | 2967 | 2809 | 2654 |

| Weight (lb) | ALTITUDE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 8000 ft | | | | 9000 ft | | | |
| | WIND - (kt) | | | | | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 43000 | 5117 | 4463 | 4257 | 4057 | 5253 | 4588 | 4378 | 4175 |
| 41000 | 4905 | 4272 | 4072 | 3878 | 5033 | 4389 | 4186 | 3988 |
| 39000 | 4700 | 4083 | 3889 | 3700 | 4820 | 4193 | 3996 | 3804 |
| 37000 | 4501 | 3903 | 3715 | 3531 | 4616 | 4007 | 3814 | 3627 |
| 35000 | 4304 | 3726 | 3544 | 3366 | 4412 | 3823 | 3637 | 3456 |
| 33000 | 4102 | 3544 | 3368 | 3196 | 4203 | 3634 | 3455 | 3281 |
| 31000 | 3915 | 3374 | 3204 | 3037 | 4009 | 3459 | 3286 | 3116 |
| 29000 | 3733 | 3209 | 3043 | 2882 | 3821 | 3289 | 3120 | 2956 |
| 27000 | 3546 | 3038 | 2878 | 2721 | 3627 | 3112 | 2949 | 2791 |

| Weight (lb) | ALTITUDE | | | |
|---|---|---|---|---|
| | 10000 ft | | | |
| | WIND - (kt) | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 44000 | 5396 | 4718 | 4504 | 4297 |
| 42000 | 5167 | 4511 | 4304 | 4103 |
| 40000 | 4946 | 4308 | 4107 | 3912 |
| 38000 | 4734 | 4114 | 3919 | 3729 |
| 36000 | 4524 | 3924 | 3734 | 3550 |
| 34000 | 4307 | 3728 | 3546 | 3368 |
| 32000 | 4106 | 3547 | 3371 | 3199 |
| 30000 | 3912 | 3371 | 3200 | 3034 |
| 28000 | 3711 | 3189 | 3024 | 2863 |

**NOTE:** Landing distance in ft.

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## UNFACTORED LANDING DISTANCE TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45°

| Weight (lb) | ALTITUDE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 ft | | | | 1000 ft | | | |
| | WIND - (kt) | | | | | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 43000 | 3246 | 2781 | 2634 | 2493 | 3317 | 2845 | 2697 | 2553 |
| 41000 | 3139 | 2684 | 2542 | 2409 | 3207 | 2745 | 2600 | 2462 |
| 39000 | 3032 | 2591 | 2455 | 2323 | 3097 | 2647 | 2508 | 2375 |
| 37000 | 2924 | 2500 | 2366 | 2236 | 2989 | 2554 | 2419 | 2288 |
| 35000 | 2823 | 2408 | 2276 | 2148 | 2879 | 2459 | 2326 | 2197 |
| 33000 | 2720 | 2311 | 2181 | 2056 | 2772 | 2360 | 2229 | 2103 |
| 31000 | 2611 | 2209 | 2082 | 1959 | 2661 | 2256 | 2128 | 2003 |
| 29000 | 2501 | 2107 | 1982 | 1861 | 2549 | 2151 | 2025 | 1903 |
| 27000 | 2391 | 2003 | 1881 | 1762 | 2435 | 2045 | 1921 | 1802 |

| Weight (lb) | ALTITUDE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2000 ft | | | | 3000 ft | | | |
| | WIND - (kt) | | | | | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 43000 | 3391 | 2912 | 2762 | 2616 | 3469 | 2983 | 2830 | 2682 |
| 41000 | 3277 | 2809 | 2661 | 2519 | 3351 | 2876 | 2726 | 2581 |
| 39000 | 3165 | 2707 | 2565 | 2429 | 3235 | 2770 | 2625 | 2484 |
| 37000 | 3054 | 2610 | 2473 | 2341 | 3121 | 2669 | 2528 | 2394 |
| 35000 | 2939 | 2513 | 2379 | 2248 | 3006 | 2569 | 2433 | 2302 |
| 33000 | 2827 | 2411 | 2279 | 2151 | 2884 | 2464 | 2331 | 2202 |
| 31000 | 2713 | 2304 | 2175 | 2049 | 2766 | 2355 | 2224 | 2097 |
| 29000 | 2597 | 2196 | 2069 | 1946 | 2648 | 2244 | 2116 | 1992 |
| 27000 | 2481 | 2087 | 1963 | 1842 | 2529 | 2132 | 2007 | 1885 |

| Weight (lb) | ALTITUDE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4000 ft | | | | 5000 ft | | | |
| | WIND - (kt) | | | | | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 43000 | 3550 | 3056 | 2900 | 2750 | 3635 | 3132 | 2974 | 2821 |
| 41000 | 3428 | 2945 | 2794 | 2647 | 3508 | 3018 | 2864 | 2715 |
| 39000 | 3307 | 2836 | 2687 | 2544 | 3382 | 2904 | 2754 | 2608 |
| 37000 | 3189 | 2729 | 2585 | 2448 | 3259 | 2793 | 2646 | 2504 |
| 35000 | 3073 | 2626 | 2488 | 2356 | 3143 | 2687 | 2545 | 2411 |
| 33000 | 2947 | 2519 | 2385 | 2254 | 3015 | 2577 | 2441 | 2310 |
| 31000 | 2822 | 2407 | 2275 | 2147 | 2881 | 2461 | 2328 | 2199 |
| 29000 | 2701 | 2293 | 2164 | 2039 | 2756 | 2345 | 2214 | 2088 |
| 27000 | 2578 | 2179 | 2052 | 1929 | 2630 | 2227 | 2099 | 1976 |

**NOTE:** Landing distance in ft.

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## UNFACTORED LANDING DISTANCE TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45°

| Weight (lb) | ALTITUDE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 6000 ft | | | | 7000 ft | | | |
| | WIND - (kt) | | | | | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 43000 | 3723 | 3211 | 3050 | 2894 | 3812 | 3294 | 3131 | 2973 |
| 41000 | 3592 | 3094 | 2937 | 2785 | 3679 | 3172 | 3012 | 2858 |
| 39000 | 3462 | 2976 | 2823 | 2675 | 3544 | 3051 | 2895 | 2745 |
| 37000 | 3334 | 2860 | 2711 | 2567 | 3411 | 2930 | 2779 | 2632 |
| 35000 | 3211 | 2749 | 2604 | 2466 | 3282 | 2814 | 2666 | 2523 |
| 33000 | 3084 | 2636 | 2497 | 2365 | 3154 | 2698 | 2555 | 2420 |
| 31000 | 2945 | 2518 | 2383 | 2253 | 3014 | 2576 | 2441 | 2309 |
| 29000 | 2813 | 2398 | 2267 | 2139 | 2873 | 2453 | 2320 | 2192 |
| 27000 | 2684 | 2278 | 2149 | 2024 | 2740 | 2330 | 2199 | 2073 |

| Weight (lb) | ALTITUDE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 8000 ft | | | | 9000 ft | | | |
| | WIND - (kt) | | | | | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 43000 | 3905 | 3379 | 3214 | 3053 | 4002 | 3468 | 3300 | 3137 |
| 41000 | 3768 | 3253 | 3091 | 2934 | 3861 | 3338 | 3173 | 3014 |
| 39000 | 3630 | 3128 | 2970 | 2817 | 3719 | 3208 | 3047 | 2891 |
| 37000 | 3492 | 3003 | 2849 | 2700 | 3576 | 3079 | 2923 | 2771 |
| 35000 | 3356 | 2880 | 2730 | 2586 | 3434 | 2951 | 2799 | 2652 |
| 33000 | 3224 | 2761 | 2615 | 2476 | 3297 | 2827 | 2679 | 2536 |
| 31000 | 3084 | 2636 | 2497 | 2364 | 3155 | 2698 | 2556 | 2421 |
| 29000 | 2936 | 2510 | 2376 | 2246 | 3006 | 2569 | 2434 | 2302 |
| 27000 | 2797 | 2383 | 2252 | 2124 | 2857 | 2439 | 2306 | 2177 |

| Weight (lb) | ALTITUDE | | | |
|---|---|---|---|---|
| | 10000 ft | | | |
| | WIND - (kt) | | | |
| | -10 Kt | 0 Kt | 10 Kt | 20 Kt |
| 44000 | 4101 | 3559 | 3388 | 3223 |
| 42000 | 3955 | 3424 | 3257 | 3095 |
| 40000 | 3810 | 3290 | 3127 | 2969 |
| 38000 | 3662 | 3157 | 2998 | 2844 |
| 36000 | 3515 | 3024 | 2870 | 2720 |
| 34000 | 3370 | 2894 | 2743 | 2598 |
| 32000 | 3225 | 2762 | 2616 | 2477 |
| 30000 | 3076 | 2629 | 2491 | 2358 |
| 28000 | 2918 | 2495 | 2361 | 2231 |

**NOTE:** Landing distance in ft.

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# CONTAMINATED RUNWAYS
# UNFACTORED LANDING DISTANCE - ADVISORY INFORMATION

A runway is considered to be contaminated when more than 25% of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by the following:

- Surface water more than 3 mm (0.125 in) deep, or by slush, or dry snow, equivalent to more than 3 mm (0.125 in) of water;
- Snow which has been compressed into a solid mass which resists further compression and will hold together or break into lumps if picked up (compacted snow); or
- Ice, including wet ice.

Contaminants can be classified as being: drag producing, for example by contaminant displacement or impingement; braking friction reducing; or a combination of both. Runways contaminated with compacted snow, ice and wet ice are considered slippery, once there is no impingent drag and the braking friction coefficient reduces. Other contaminants, such as, standing water, slush or dry snow, combine both effects.

The contaminated unfactored landing distance is the actual distance to land the airplane after a stabilized approach, crossing a point at 50 ft above the runway threshold at $V_{REF}$, on a zero slope runway, ISA temperature, using maximum manual braking effort.

The following tables present guidance information for obtaining the airplane landing distance on contaminated runways. The result is the worst value between wet and contaminated landing distance. However, this distance does not consider the 1.15 factor from EU-OPS 1.515 and 1.520. It is the operator's responsibility to evaluate the application of the factor above.

In order to find the contaminated landing distance, enter the table with the current contaminant, flaps configuration and actual landing weight and obtain a reference contaminated unfactored landing distance ($CULD_{REF}$).

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Apply corrections to the reference contaminated unfactored landing distance according to the formula below:

Final altitude correction (%) = Altitude correction from the table x (Current Altitude in ft/1000 ft)

Final tailwind correction (%) = Wind correction from the table x (Current tailwind component in kt/5 kt)

Final overspeed correction (%) = Overspeed correction from the table x (Current overspeed in kt/5 kt)

The unfactored landing distance on contaminated runways (CULD) becomes:

Additional Distance = $CULD_{REF}$ x (Final Altitude Correction + Final Tailwind Correction + Final overspeed Correction)

CULD = $CULD_{REF}$ + Additional distance

Suppose:

| | |
|---|---|
| Airport pressure altitude: | 4000 ft |
| Wind: | 10 kt headwind |
| Overspeed: | $V_{REF}$ + 5 kt |
| $CULD_{REF}$: | 2000 ft |
| Altitude correction: | 3% |
| Wind correction: | 11% |
| Overspeed correction: | 9% |

Calculations:

Final Altitude Correction = 3% x (4000 ft/1000 ft) = 12%

Final Tailwind Correction = 11% x (0 kt/5 kt) = 0%

Final Overspeed Correction = 9% x (5 kt/5 kt) = 9%

Unfactored landing distance on contaminated runway:

Additional Distance = 2000 ft x (12% + 0%+ 9%) = 2000 ft x 21% = 420 ft

CULD = 2000 ft + 420 ft = 2420 ft

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## ADVISORY INFORMATION
## EMB-145 UNFACTORED LANDING DISTANCE TABLE (ft)
## FAA – CONTAMINATED RUNWAYS
## AE3007A1 AND A1P ENGINES
## STANDING WATER 0.125 in/SLUSH 0.15 in
## WET SNOW 0.25 in/DRY SNOW 0.625 in

| WEIGHT (lb) | FLAP 22° | FLAP 45° |
|---|---|---|
| **29000** | 6033 | 4822 |
| **30000** | 6194 | 4946 |
| **31000** | 6357 | 5071 |
| **32000** | 6532 | 5201 |
| **33000** | 6707 | 5330 |
| **34000** | 6883 | 5459 |
| **35000** | 7058 | 5589 |
| **36000** | 7245 | 5721 |
| **37000** | 7436 | 5852 |
| **38000** | 7627 | 5983 |
| **39000** | 7819 | 6114 |
| **40000** | 8010 | 6246 |
| **41000** | 8197 | 6377 |
| **42000** | 8383 | 6508 |
| **43000** | 8570 | 6639 |
| **44000** | 8757 | 6768 |
| **45000** | 8971 | 6914 |
| **46000** | 9188 | 7062 |
| **47000** | 9404 | 7210 |
| **48000** | 9621 | 7357 |

| CORRECTIONS | |
|---|---|
| ALTITUDE | LANDING DISTANCE + 3% per 1000 ft above sea level. |
| WIND | LANDING DISTANCE + 11% per 5 kt tailwind. |
| OVERSPEED | LANDING DISTANCE + 9% per 5 kt above $V_{REF}$. |

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## ADVISORY INFORMATION
## EMB-145 UNFACTORED LANDING DISTANCE TABLE (ft)
## FAA – CONTAMINATED RUNWAYS
## AE3007A1 AND A1P ENGINES
## STANDING WATER 0.25 in/SLUSH 0.29 in
## WET SNOW 0.50 in/DRY SNOW 1.25 in

| WEIGHT (lb) | FLAP 22° | FLAP 45° |
|---|---|---|
| **29000** | 5276 | 4357 |
| **30000** | 5411 | 4464 |
| **31000** | 5546 | 4571 |
| **32000** | 5693 | 4683 |
| **33000** | 5839 | 4794 |
| **34000** | 5986 | 4905 |
| **35000** | 6132 | 5016 |
| **36000** | 6289 | 5129 |
| **37000** | 6448 | 5243 |
| **38000** | 6608 | 5356 |
| **39000** | 6768 | 5470 |
| **40000** | 6928 | 5583 |
| **41000** | 7086 | 5697 |
| **42000** | 7243 | 5810 |
| **43000** | 7401 | 5923 |
| **44000** | 7559 | 6036 |
| **45000** | 7739 | 6163 |
| **46000** | 7922 | 6292 |
| **47000** | 8105 | 6421 |
| **48000** | 8288 | 6549 |

| CORRECTIONS | |
|---|---|
| ALTITUDE | LANDING DISTANCE + 3% per 1000 ft above sea level. |
| WIND | LANDING DISTANCE + 11% per 5 kt tailwind. |
| OVERSPEED | LANDING DISTANCE + 8% per 5 kt above $V_{REF}$. |

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## ADVISORY INFORMATION
## EMB-145 UNFACTORED LANDING DISTANCE TABLE (ft)
## FAA – CONTAMINATED RUNWAYS
## AE3007A1 AND A1P ENGINES
## STANDING WATER 0.50 in/SLUSH 0.59 in
## WET SNOW 1.00 in/DRY SNOW 2.50 in

| WEIGHT (lb) | FLAP 22° | FLAP 45° |
|---|---|---|
| **29000** | 4411 | 3856 |
| **30000** | 4515 | 3943 |
| **31000** | 4619 | 4031 |
| **32000** | 4732 | 4122 |
| **33000** | 4845 | 4213 |
| **34000** | 4957 | 4304 |
| **35000** | 5070 | 4395 |
| **36000** | 5190 | 4488 |
| **37000** | 5313 | 4581 |
| **38000** | 5436 | 4674 |
| **39000** | 5559 | 4766 |
| **40000** | 5682 | 4859 |
| **41000** | 5804 | 4952 |
| **42000** | 5926 | 5044 |
| **43000** | 6048 | 5137 |
| **44000** | 6170 | 5229 |
| **45000** | 6310 | 5332 |
| **46000** | 6451 | 5437 |
| **47000** | 6593 | 5542 |
| **48000** | 6734 | 5647 |

| CORRECTIONS | |
|---|---|
| ALTITUDE | LANDING DISTANCE + 3% per 1000 ft above sea level. |
| WIND | LANDING DISTANCE + 10% per 5 kt tailwind. |
| OVERSPEED | LANDING DISTANCE + 8% per 5 kt above $V_{REF}$. |

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## ADVISORY INFORMATION
## EMB-145 UNFACTORED LANDING DISTANCE TABLE (ft)
## FAA – CONTAMINATED RUNWAYS
## AE3007A1 AND A1P ENGINES
## COMPACTED SNOW

| WEIGHT (lb) | FLAP 22° | FLAP 45° |
|---|---|---|
| **29000** | 3944 | 3645 |
| **30000** | 4036 | 3734 |
| **31000** | 4129 | 3823 |
| **32000** | 4222 | 3909 |
| **33000** | 4315 | 3996 |
| **34000** | 4408 | 4082 |
| **35000** | 4501 | 4169 |
| **36000** | 4593 | 4250 |
| **37000** | 4685 | 4329 |
| **38000** | 4777 | 4409 |
| **39000** | 4868 | 4488 |
| **40000** | 4960 | 4567 |
| **41000** | 5052 | 4646 |
| **42000** | 5143 | 4726 |
| **43000** | 5235 | 4805 |
| **44000** | 5327 | 4884 |
| **45000** | 5417 | 4960 |
| **46000** | 5507 | 5035 |
| **47000** | 5597 | 5111 |
| **48000** | 5688 | 5186 |

| CORRECTIONS | |
|---|---|
| ALTITUDE | LANDING DISTANCE + 3% per 1000 ft above sea level. |
| WIND | LANDING DISTANCE + 11% per 5 kt tailwind. |
| OVERSPEED | LANDING DISTANCE + 7% per 5 kt above $V_{REF}$. |

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## ADVISORY INFORMATION
## EMB-145 UNFACTORED LANDING DISTANCE TABLE (ft)
## FAA – CONTAMINATED RUNWAYS
## AE3007A1 AND A1P ENGINES
## ICE

| WEIGHT (lb) | FLAP 22° | FLAP 45° |
|---|---|---|
| **29000** | 11551 | 9411 |
| **30000** | 11556 | 9406 |
| **31000** | 11572 | 9412 |
| **32000** | 11656 | 9487 |
| **33000** | 11740 | 9561 |
| **34000** | 11824 | 9635 |
| **35000** | 11909 | 9709 |
| **36000** | 12032 | 9810 |
| **37000** | 12170 | 9921 |
| **38000** | 12308 | 10032 |
| **39000** | 12446 | 10143 |
| **40000** | 12584 | 10254 |
| **41000** | 12721 | 10365 |
| **42000** | 12859 | 10476 |
| **43000** | 12997 | 10587 |
| **44000** | 13135 | 10698 |
| **45000** | 13303 | 10826 |
| **46000** | 13473 | 10955 |
| **47000** | 13644 | 11084 |
| **48000** | 13814 | 11213 |

| CORRECTIONS | |
|---|---|
| ALTITUDE | LANDING DISTANCE + 3% per 1000 ft above sea level. |
| WIND | LANDING DISTANCE + 24% per 5 kt tailwind. |
| OVERSPEED | LANDING DISTANCE + 5% per 5 kt above $V_{REF}$. |

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## ADVISORY INFORMATION
## EMB-135 UNFACTORED LANDING DISTANCE TABLE (ft)
## FAA – CONTAMINATED RUNWAYS
## AE3007A1/3 ENGINES
## STANDING WATER 0.125 in/SLUSH 0.15 in
## WET SNOW 0.25 in/DRY SNOW 0.625 in

| WEIGHT (ft) | FLAP 22° | FLAP 45° |
|---|---|---|
| **29000** | 6323 | 4930 |
| **30000** | 6501 | 5059 |
| **31000** | 6682 | 5190 |
| **32000** | 6874 | 5330 |
| **33000** | 7065 | 5469 |
| **34000** | 7257 | 5609 |
| **35000** | 7449 | 5748 |
| **36000** | 7658 | 5890 |
| **37000** | 7873 | 6033 |
| **38000** | 8088 | 6175 |
| **39000** | 8303 | 6318 |
| **40000** | 8517 | 6457 |
| **41000** | 8725 | 6596 |
| **42000** | 8933 | 6735 |
| **43000** | 9141 | 6874 |
| **44000** | 9349 | 7013 |

| CORRECTIONS | |
|---|---|
| ALTITUDE | LANDING DISTANCE + 4% per 1000 ft above sea level. |
| WIND | LANDING DISTANCE + 12% per 5 kt tailwind. |
| OVERSPEED | LANDING DISTANCE + 8% per 5 kt above $V_{REF}$. |

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## ADVISORY INFORMATION
## EMB-135 UNFACTORED LANDING DISTANCE TABLE (ft)
## FAA – CONTAMINATED RUNWAYS
## AE3007A1/3 ENGINES
## STANDING WATER 0.25 in/SLUSH 0.29 in
## WET SNOW 0.50 in/DRY SNOW 1.25 in

| WEIGHT (ft) | FLAP 22° | FLAP 45° |
|---|---|---|
| **29000** | 5630 | 4558 |
| **30000** | 5783 | 4672 |
| **31000** | 5938 | 4788 |
| **32000** | 6103 | 4912 |
| **33000** | 6268 | 5035 |
| **34000** | 6433 | 5159 |
| **35000** | 6598 | 5282 |
| **36000** | 6777 | 5408 |
| **37000** | 6962 | 5534 |
| **38000** | 7147 | 5660 |
| **39000** | 7331 | 5786 |
| **40000** | 7516 | 5911 |
| **41000** | 7697 | 6036 |
| **42000** | 7878 | 6160 |
| **43000** | 8059 | 6285 |
| **44000** | 8241 | 6409 |

| CORRECTIONS | |
|---|---|
| ALTITUDE | LANDING DISTANCE + 4% per 1000 ft above sea level. |
| WIND | LANDING DISTANCE + 12% per 5 kt tailwind. |
| OVERSPEED | LANDING DISTANCE + 8% per 5 kt above $V_{REF}$. |

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## ADVISORY INFORMATION
## EMB-135 UNFACTORED LANDING DISTANCE TABLE (ft)
## FAA – CONTAMINATED RUNWAYS
## AE3007A1/3 ENGINES
## STANDING WATER 0.50 in/SLUSH 0.59 in
## WET SNOW 1.00 in/DRY SNOW 2.50 in

| WEIGHT (ft) | FLAP 22° | FLAP 45° |
|---|---|---|
| **29000** | 4885 | 4062 |
| **30000** | 5010 | 4160 |
| **31000** | 5137 | 4258 |
| **32000** | 5272 | 4363 |
| **33000** | 5407 | 4468 |
| **34000** | 5543 | 4573 |
| **35000** | 5678 | 4678 |
| **36000** | 5824 | 4784 |
| **37000** | 5976 | 4892 |
| **38000** | 6127 | 4999 |
| **39000** | 6278 | 5106 |
| **40000** | 6430 | 5213 |
| **41000** | 6579 | 5319 |
| **42000** | 6729 | 5425 |
| **43000** | 6879 | 5532 |
| **44000** | 7028 | 5638 |

| CORRECTIONS | |
|---|---|
| ALTITUDE | LANDING DISTANCE + 3% per 1000 ft above sea level. |
| WIND | LANDING DISTANCE + 11% per 5 kt tailwind. |
| OVERSPEED | LANDING DISTANCE + 8% per 5 kt above $V_{REF}$. |

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## ADVISORY INFORMATION
## EMB-135 UNFACTORED LANDING DISTANCE TABLE (ft)
## FAA – CONTAMINATED RUNWAYS
## AE3007A1/3 ENGINES
## COMPACTED SNOW

| WEIGHT (ft) | FLAP 22° | FLAP 45° |
|---|---|---|
| **29000** | 4001 | 3650 |
| **30000** | 4095 | 3739 |
| **31000** | 4189 | 3828 |
| **32000** | 4284 | 3915 |
| **33000** | 4378 | 4002 |
| **34000** | 4473 | 4089 |
| **35000** | 4567 | 4176 |
| **36000** | 4662 | 4259 |
| **37000** | 4756 | 4340 |
| **38000** | 4850 | 4421 |
| **39000** | 4944 | 4502 |
| **40000** | 5039 | 4583 |
| **41000** | 5133 | 4664 |
| **42000** | 5227 | 4745 |
| **43000** | 5321 | 4826 |
| **44000** | 5415 | 4907 |

| CORRECTIONS | |
|---|---|
| ALTITUDE | LANDING DISTANCE + 3% per 1000 ft above sea level. |
| WIND | LANDING DISTANCE + 11% per 5 kt tailwind. |
| OVERSPEED | LANDING DISTANCE + 8% per 5 kt above $V_{REF}$. |

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## ADVISORY INFORMATION
## EMB-135 UNFACTORED LANDING DISTANCE TABLE (ft)
## FAA – CONTAMINATED RUNWAYS
## AE3007A1/3 ENGINES
## ICE

| WEIGHT (ft) | FLAP 22° | FLAP 45° |
|---|---|---|
| **29000** | 11684 | 9401 |
| **30000** | 11691 | 9415 |
| **31000** | 11707 | 9436 |
| **32000** | 11775 | 9504 |
| **33000** | 11844 | 9572 |
| **34000** | 11913 | 9640 |
| **35000** | 11982 | 9708 |
| **36000** | 12110 | 9810 |
| **37000** | 12260 | 9924 |
| **38000** | 12410 | 10039 |
| **39000** | 12560 | 10153 |
| **40000** | 12710 | 10268 |
| **41000** | 12860 | 10383 |
| **42000** | 13010 | 10497 |
| **43000** | 13160 | 10612 |
| **44000** | 13310 | 10727 |

| CORRECTIONS | |
|---|---|
| ALTITUDE | LANDING DISTANCE + 3% per 1000 ft above sea level. |
| WIND | LANDING DISTANCE + 24% per 5 kt tailwind. |
| OVERSPEED | LANDING DISTANCE + 6% per 5 kt above $V_{REF}$. |

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## LANDING DISTANCE CORRECTION FACTOR - FAA

| Emerg/Abnormal Procedure | Flaps - Speed | Factor |
|---|---|---|
| Advanced Stall Protection | Flaps 45° - $V_{REF\,45}$ + 5 kt | 1.10 |
| Aileron System Inop | Flaps 22° - $V_{REF\,45}$ + 30 kt | 1.85 |
| Both Hydraulic Systems Failure | Flaps 22° - $V_{REF\,45}$ + 30 kt | 3.45 |
| Brake Degraded | Flaps 45° - $V_{REF\,45}$ | 1.24 |
| Brakes Inoperative | Flaps 45° - $V_{REF\,45}$ | 1.45 |
| Erroneous Stall Protect. Actuation | Flaps 45° - $V_{REF\,45}$ + 5 kt | 1.10 |
| Flap System Failure (1) | Flaps 0°- 8° - $V_{REF\,45}$ +30 kt | 1.65 |
| Flap System Failure (2) | Flaps 9°-21°- $V_{REF\,45}$ +10 kt | 1.40 |
| Flap System Failure (3) | Flaps 22°-44°-$V_{REF\,45}$ + 5 kt | 1.40 |
| Hydraulic System 1 Failure | Flaps 45° - $V_{REF\,45}$ | 1.60 |
| Hydraulic System 2 Failure | Flaps 45° - $V_{REF\,45}$ | 1.53 |
| Inadvertent Spoiler Opening in Flight (spoilers closed or floating) | Flaps 22° - $V_{REF\,45}$ + 10 kt | 1.50 |
| Inadvertent Spoiler Opening in Flight (spoilers open) | Flaps 22° - $V_{REF\,45}$ + 10 kt | 1.45 |
| Jammed Aileron | Flaps 45° - $V_{REF\,45}$ + 5 kt | 1.10 |
| Jammed Elevator | Flaps 22° - $V_{REF\,45}$ + 10 kt | 1.45 |
| Jammed Rudder | Flaps 22° - $V_{REF\,45}$ | 1.62 |
| Landing Gear Air/Ground System Failure | Flaps 45° - $V_{REF\,45}$ | 1.70 |
| Landing Gear Air/Ground System Failure (in icing conditions) | Flaps 22° - $V_{REF\,45}$ + 30 kt | 2.40 |
| Loss of All Generators (1) | Flaps 0°- 8°- $V_{REF\,45}$ + 30 kt | 1.95 |
| Loss of All Generators (2) | Flaps 9°-21°-$V_{REF\,45}$ + 10 kt | 1.95 |
| Loss of All Generators (3) | Flaps 22°-44°-$V_{REF\,45}$ + 5 kt | 1.95 |
| One Engine Inoperative Approach and Landing | Flaps 22° - $V_{REF\,45}$ + 10 kt | 1.48 |
| Pitch Trim Inoperative (Pitch up tendency) | Flaps 22° - $V_{REF\,45}$ + 10 kt | 1.45 |
| Pitch Trim Inoperative (Pitch down tendency) | Flaps 22° - $V_{REF\,45}$ + 25 kt | 1.75 |

*CONTINUES ON NEXT PAGE*



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*CONTINUED FROM PREVIOUS PAGE*

| Emerg/Abnormal Procedure | Flaps - Speed | Factor |
|---|---|---|
| Stabilizer Anti-Icing Failure | Flaps 22° - $V_{REF\,45}$ + 15 kt | 1.55 |
| Stabilizer + Wing Anti-Icing Failure | Flaps 22° - $V_{REF\,45}$ + 30 kt | 1.85 |
| Stall Protection Inoperative | Flaps 45° - $V_{REF\,45}$ + 5 kt | 1.10 |
| Wing Anti-Icing Asymmetry | Flaps 22° - $V_{REF\,45}$ + 30 kt | 1.48 |
| Wing Anti-Icing Failure | Flaps 22° - $V_{REF\,45}$ + 30 kt | 1.85 |

## QUICK TURN AROUND WEIGHT

For normal operation, the brake temperature can be monitored through the brake temperature indication in the MFD.

The Quick Turn Around Weight Table must be used only when the brake temperature indication is not working properly (according to the MMEL). In this case, if the landing weight exceeds the Quick Turn Around Weight, a subsequent takeoff must not be performed before 36 minutes (for LR brakes) or 33 minutes (for ER brakes) after chocks on. At the end of this time interval, check that the wheel thermal plugs have not melted.

**NOTE:** If the tires are not flat after 36 minutes (or 33 minutes) this is a positive indication that the wheel thermal plugs have not melted.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - SEA LEVEL
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 32507 | 32983 | 33496 | 34025 | 34483 | 36366 | 36920 | 37473 | 38059 | 38573 |
| -15 | 32185 | 32655 | 33164 | 33688 | 34141 | 35984 | 36531 | 37079 | 37660 | 38169 |
| -10 | 31872 | 32335 | 32841 | 33361 | 33809 | 35613 | 36152 | 36697 | 37272 | 37776 |
| -5 | 31566 | 32023 | 32526 | 33041 | 33485 | 35251 | 35783 | 36324 | 36894 | 37392 |
| 0 | 31268 | 31719 | 32219 | 32729 | 33169 | 34898 | 35423 | 35960 | 36525 | 37018 |
| 4 | 31036 | 31482 | 31979 | 32487 | 32923 | 34624 | 35142 | 35677 | 36237 | 36726 |
| 8 | 30809 | 31250 | 31746 | 32249 | 32682 | 34355 | 34868 | 35400 | 35957 | 36442 |
| 12 | 30588 | 31025 | 31517 | 32018 | 32447 | 34093 | 34601 | 35130 | 35683 | 36164 |
| 16 | 30372 | 30805 | 31296 | 31793 | 32219 | 33838 | 34341 | 34868 | 35416 | 35894 |
| 20 | 30162 | 30590 | 31079 | 31573 | 31996 | 33589 | 34087 | 34611 | 35156 | 35630 |
| 24 | 29955 | 30379 | 30865 | 31357 | 31777 | 33344 | 33837 | 34358 | 34900 | 35370 |
| 28 | 29754 | 30174 | 30658 | 31147 | 31564 | 33106 | 33595 | 34113 | 34651 | 35118 |
| 32 | 29562 | 29978 | 30460 | 30946 | 31360 | 32879 | 33362 | 33879 | 34413 | 34876 |
| 36 | 29373 | 29786 | 30266 | 30749 | 31160 | 32656 | 33135 | 33649 | 34180 | 34640 |
| 40 | 29189 | 29598 | 30076 | 30556 | 30965 | 32438 | 32912 | 33424 | 33952 | 34409 |
| 44 | 29009 | 29414 | 29890 | 30368 | 30774 | 32224 | 32695 | 33204 | 33729 | 34183 |
| 48 | 28831 | 29232 | 29707 | 30182 | 30585 | 32013 | 32479 | 32987 | 33509 | 33959 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 37743 | 38325 | 38892 | 39498 | 40033 | 39169 | 39780 | 40362 | 40989 | 41546 |
| -15 | 37339 | 37913 | 38476 | 39076 | 39605 | 38741 | 39343 | 39921 | 40542 | 41092 |
| -10 | 36946 | 37512 | 38071 | 38665 | 39189 | 38325 | 38919 | 39492 | 40107 | 40650 |
| -5 | 36563 | 37121 | 37676 | 38265 | 38783 | 37919 | 38504 | 39073 | 39682 | 40220 |
| 0 | 36190 | 36740 | 37291 | 37875 | 38387 | 37523 | 38100 | 38665 | 39268 | 39800 |
| 4 | 35899 | 36443 | 36991 | 37570 | 38078 | 37214 | 37786 | 38347 | 38946 | 39473 |
| 8 | 35614 | 36153 | 36698 | 37273 | 37777 | 36913 | 37478 | 38037 | 38631 | 39153 |
| 12 | 35337 | 35871 | 36413 | 36983 | 37483 | 36619 | 37178 | 37734 | 38323 | 38842 |
| 16 | 35068 | 35595 | 36135 | 36702 | 37197 | 36333 | 36887 | 37439 | 38025 | 38539 |
| 20 | 34804 | 35326 | 35863 | 36426 | 36917 | 36053 | 36601 | 37151 | 37732 | 38242 |
| 24 | 34545 | 35062 | 35596 | 36155 | 36642 | 35779 | 36321 | 36867 | 37445 | 37951 |
| 28 | 34293 | 34805 | 35336 | 35892 | 36376 | 35512 | 36049 | 36592 | 37166 | 37668 |
| 32 | 34052 | 34559 | 35088 | 35640 | 36120 | 35256 | 35788 | 36329 | 36899 | 37397 |
| 36 | 33816 | 34318 | 34845 | 35393 | 35870 | 35006 | 35533 | 36071 | 36637 | 37132 |
| 40 | 33585 | 34083 | 34607 | 35152 | 35625 | 34761 | 35283 | 35819 | 36381 | 36872 |
| 44 | 33359 | 33852 | 34374 | 34916 | 35386 | 34522 | 35039 | 35572 | 36131 | 36619 |
| 48 | 33136 | 33625 | 34144 | 34682 | 35149 | 34285 | 34797 | 35328 | 35884 | 36368 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 1000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 31927 | 32391 | 32898 | 33419 | 33868 | 35679 | 36219 | 36765 | 37341 | 37845 |
| -15 | 31609 | 32067 | 32571 | 33086 | 33531 | 35303 | 35835 | 36377 | 36947 | 37446 |
| -10 | 31300 | 31751 | 32251 | 32763 | 33202 | 34936 | 35461 | 35999 | 36564 | 37058 |
| -5 | 31000 | 31445 | 31943 | 32449 | 32885 | 34581 | 35099 | 35634 | 36193 | 36682 |
| 0 | 30710 | 31149 | 31643 | 32146 | 32577 | 34238 | 34749 | 35279 | 35834 | 36317 |
| 4 | 30483 | 30918 | 31410 | 31909 | 32337 | 33970 | 34475 | 35003 | 35554 | 36033 |
| 8 | 30261 | 30692 | 31181 | 31677 | 32102 | 33707 | 34207 | 34732 | 35279 | 35755 |
| 12 | 30045 | 30471 | 30958 | 31451 | 31872 | 33451 | 33946 | 34468 | 35011 | 35483 |
| 16 | 29833 | 30255 | 30740 | 31230 | 31648 | 33200 | 33690 | 34210 | 34750 | 35218 |
| 20 | 29632 | 30050 | 30533 | 31020 | 31435 | 32962 | 33448 | 33965 | 34501 | 34965 |
| 24 | 29436 | 29850 | 30331 | 30815 | 31227 | 32730 | 33211 | 33726 | 34258 | 34719 |
| 28 | 29244 | 29654 | 30133 | 30614 | 31023 | 32503 | 32979 | 33491 | 34020 | 34478 |
| 32 | 29056 | 29462 | 29939 | 30417 | 30824 | 32280 | 32752 | 33262 | 33788 | 34242 |
| 36 | 28870 | 29273 | 29748 | 30223 | 30627 | 32061 | 32528 | 33036 | 33558 | 34009 |
| 40 | 28688 | 29086 | 29560 | 30032 | 30433 | 31844 | 32307 | 32813 | 33332 | 33780 |
| 44 | 28510 | 28905 | 29376 | 29846 | 30244 | 31633 | 32092 | 32595 | 33111 | 33556 |
| 48 | 28335 | 28727 | 29196 | 29663 | 30059 | 31427 | 31881 | 32382 | 32895 | 33337 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 37016 | 37583 | 38142 | 38738 | 39262 | 38398 | 38994 | 39567 | 40184 | 40728 |
| -15 | 36618 | 37177 | 37732 | 38322 | 38840 | 37976 | 38563 | 39133 | 39742 | 40281 |
| -10 | 36229 | 36781 | 37332 | 37916 | 38429 | 37565 | 38143 | 38709 | 39312 | 39845 |
| -5 | 35854 | 36398 | 36945 | 37524 | 38031 | 37167 | 37737 | 38298 | 38896 | 39423 |
| 0 | 35490 | 36027 | 36570 | 37143 | 37645 | 36781 | 37344 | 37901 | 38493 | 39014 |
| 4 | 35206 | 35737 | 36278 | 36847 | 37344 | 36480 | 37037 | 37591 | 38178 | 38695 |
| 8 | 34929 | 35454 | 35991 | 36556 | 37050 | 36186 | 36736 | 37287 | 37870 | 38382 |
| 12 | 34657 | 35177 | 35712 | 36273 | 36762 | 35898 | 36443 | 36991 | 37570 | 38078 |
| 16 | 34392 | 34907 | 35439 | 35996 | 36481 | 35617 | 36156 | 36701 | 37276 | 37780 |
| 20 | 34141 | 34650 | 35179 | 35732 | 36214 | 35350 | 35884 | 36426 | 36997 | 37497 |
| 24 | 33895 | 34399 | 34926 | 35476 | 35954 | 35090 | 35618 | 36158 | 36725 | 37221 |
| 28 | 33654 | 34153 | 34678 | 35224 | 35698 | 34834 | 35358 | 35894 | 36458 | 36950 |
| 32 | 33418 | 33913 | 34435 | 34977 | 35449 | 34585 | 35103 | 35637 | 36197 | 36685 |
| 36 | 33186 | 33676 | 34195 | 34734 | 35202 | 34338 | 34851 | 35383 | 35939 | 36424 |
| 40 | 32957 | 33442 | 33960 | 34495 | 34960 | 34096 | 34604 | 35133 | 35685 | 36167 |
| 44 | 32734 | 33214 | 33729 | 34262 | 34723 | 33859 | 34362 | 34889 | 35438 | 35915 |
| 48 | 32515 | 32991 | 33504 | 34033 | 34491 | 33627 | 34126 | 34650 | 35195 | 35670 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 2000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 31352 | 31805 | 32305 | 32817 | 33258 | 34998 | 35524 | 36063 | 36629 | 37123 |
| -15 | 31038 | 31485 | 31982 | 32489 | 32925 | 34627 | 35146 | 35680 | 36241 | 36730 |
| -10 | 30735 | 31175 | 31669 | 32172 | 32604 | 34268 | 34779 | 35310 | 35865 | 36349 |
| -5 | 30444 | 30879 | 31370 | 31869 | 32296 | 33924 | 34428 | 34956 | 35506 | 35984 |
| 0 | 30161 | 30589 | 31078 | 31572 | 31995 | 33588 | 34086 | 34610 | 35155 | 35629 |
| 4 | 29939 | 30363 | 30849 | 31340 | 31760 | 33325 | 33818 | 34339 | 34880 | 35350 |
| 8 | 29724 | 30144 | 30627 | 31115 | 31532 | 33071 | 33558 | 34077 | 34614 | 35080 |
| 12 | 29519 | 29934 | 30416 | 30901 | 31314 | 32828 | 33310 | 33826 | 34360 | 34822 |
| 16 | 29318 | 29729 | 30209 | 30691 | 31101 | 32590 | 33068 | 33581 | 34111 | 34570 |
| 20 | 29122 | 29529 | 30007 | 30486 | 30893 | 32358 | 32831 | 33342 | 33869 | 34324 |
| 24 | 28929 | 29333 | 29808 | 30284 | 30689 | 32130 | 32598 | 33107 | 33630 | 34082 |
| 28 | 28740 | 29139 | 29613 | 30086 | 30488 | 31906 | 32369 | 32876 | 33396 | 33845 |
| 32 | 28553 | 28949 | 29421 | 29892 | 30291 | 31685 | 32145 | 32649 | 33166 | 33611 |
| 36 | 28371 | 28764 | 29233 | 29701 | 30098 | 31470 | 31925 | 32427 | 32940 | 33383 |
| 40 | 28193 | 28581 | 29049 | 29515 | 29908 | 31258 | 31709 | 32209 | 32719 | 33158 |
| 44 | 28018 | 28403 | 28869 | 29332 | 29723 | 31051 | 31498 | 31995 | 32503 | 32939 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 36295 | 36848 | 37400 | 37985 | 38498 | 37634 | 38214 | 38780 | 39385 | 39918 |
| -15 | 35902 | 36447 | 36995 | 37574 | 38082 | 37218 | 37789 | 38351 | 38949 | 39477 |
| -10 | 35522 | 36059 | 36603 | 37176 | 37679 | 36815 | 37378 | 37935 | 38528 | 39049 |
| -5 | 35158 | 35688 | 36228 | 36796 | 37293 | 36429 | 36984 | 37538 | 38125 | 38640 |
| 0 | 34803 | 35325 | 35862 | 36425 | 36916 | 36052 | 36600 | 37150 | 37731 | 38241 |
| 4 | 34525 | 35041 | 35575 | 36134 | 36621 | 35757 | 36299 | 36846 | 37423 | 37928 |
| 8 | 34255 | 34767 | 35298 | 35852 | 36336 | 35472 | 36008 | 36551 | 37124 | 37626 |
| 12 | 33998 | 34504 | 35032 | 35583 | 36063 | 35199 | 35730 | 36270 | 36839 | 37336 |
| 16 | 33746 | 34247 | 34773 | 35320 | 35796 | 34932 | 35457 | 35995 | 36560 | 37054 |
| 20 | 33501 | 33997 | 34520 | 35063 | 35536 | 34672 | 35192 | 35727 | 36288 | 36777 |
| 24 | 33259 | 33750 | 34271 | 34811 | 35280 | 34416 | 34931 | 35463 | 36020 | 36506 |
| 28 | 33022 | 33508 | 34026 | 34563 | 35028 | 34164 | 34674 | 35204 | 35757 | 36239 |
| 32 | 32789 | 33270 | 33786 | 34319 | 34781 | 33917 | 34422 | 34949 | 35499 | 35977 |
| 36 | 32561 | 33038 | 33551 | 34081 | 34539 | 33675 | 34175 | 34700 | 35246 | 35721 |
| 40 | 32337 | 32809 | 33320 | 33847 | 34302 | 33438 | 33933 | 34455 | 34998 | 35469 |
| 44 | 32118 | 32586 | 33095 | 33618 | 34070 | 33206 | 33696 | 34216 | 34755 | 35223 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 3000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 30777 | 31218 | 31713 | 32216 | 32648 | 34318 | 34830 | 35362 | 35917 | 36402 |
| -15 | 30473 | 30908 | 31399 | 31898 | 32326 | 33958 | 34463 | 34991 | 35541 | 36020 |
| -10 | 30177 | 30606 | 31095 | 31589 | 32013 | 33608 | 34106 | 34630 | 35175 | 35649 |
| -5 | 29892 | 30315 | 30800 | 31291 | 31710 | 33269 | 33761 | 34281 | 34822 | 35291 |
| 0 | 29620 | 30038 | 30521 | 31007 | 31422 | 32948 | 33433 | 33951 | 34486 | 34950 |
| 4 | 29410 | 29823 | 30303 | 30787 | 31199 | 32699 | 33179 | 33693 | 34225 | 34686 |
| 8 | 29203 | 29612 | 30091 | 30571 | 30980 | 32454 | 32929 | 33441 | 33970 | 34427 |
| 12 | 29002 | 29407 | 29884 | 30361 | 30767 | 32217 | 32687 | 33196 | 33721 | 34174 |
| 16 | 28804 | 29205 | 29679 | 30154 | 30557 | 31982 | 32447 | 32954 | 33476 | 33926 |
| 20 | 28610 | 29007 | 29479 | 29951 | 30351 | 31752 | 32213 | 32718 | 33236 | 33682 |
| 24 | 28420 | 28813 | 29284 | 29752 | 30149 | 31527 | 31984 | 32486 | 33001 | 33444 |
| 28 | 28235 | 28624 | 29092 | 29558 | 29953 | 31308 | 31759 | 32260 | 32771 | 33211 |
| 32 | 28052 | 28438 | 28904 | 29368 | 29760 | 31092 | 31539 | 32037 | 32545 | 32982 |
| 36 | 27874 | 28257 | 28721 | 29182 | 29571 | 30881 | 31324 | 31820 | 32325 | 32759 |
| 40 | 27699 | 28078 | 28541 | 28999 | 29385 | 30674 | 31113 | 31606 | 32108 | 32539 |
| 44 | 27528 | 27903 | 28364 | 28819 | 29203 | 30471 | 30906 | 31397 | 31896 | 32324 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 35575 | 36113 | 36657 | 37232 | 37735 | 36871 | 37435 | 37993 | 38587 | 39109 |
| -15 | 35194 | 35724 | 36265 | 36833 | 37331 | 36467 | 37023 | 37577 | 38164 | 38681 |
| -10 | 34823 | 35346 | 35883 | 36446 | 36938 | 36074 | 36623 | 37172 | 37754 | 38264 |
| -5 | 34465 | 34981 | 35514 | 36072 | 36559 | 35695 | 36235 | 36781 | 37357 | 37862 |
| 0 | 34126 | 34634 | 35164 | 35717 | 36198 | 35334 | 35868 | 36410 | 36980 | 37480 |
| 4 | 33861 | 34365 | 34892 | 35441 | 35918 | 35054 | 35582 | 36121 | 36688 | 37183 |
| 8 | 33603 | 34101 | 34625 | 35170 | 35644 | 34780 | 35302 | 35838 | 36401 | 36892 |
| 12 | 33351 | 33844 | 34366 | 34907 | 35377 | 34513 | 35030 | 35563 | 36122 | 36609 |
| 16 | 33103 | 33591 | 34110 | 34647 | 35114 | 34250 | 34761 | 35292 | 35847 | 36330 |
| 20 | 32860 | 33343 | 33859 | 34393 | 34856 | 33992 | 34498 | 35026 | 35577 | 36057 |
| 24 | 32622 | 33100 | 33614 | 34145 | 34604 | 33740 | 34241 | 34766 | 35314 | 35789 |
| 28 | 32389 | 32863 | 33374 | 33902 | 34357 | 33493 | 33989 | 34512 | 35056 | 35528 |
| 32 | 32161 | 32630 | 33139 | 33663 | 34115 | 33251 | 33742 | 34263 | 34803 | 35271 |
| 36 | 31938 | 32402 | 32909 | 33430 | 33879 | 33015 | 33501 | 34019 | 34556 | 35021 |
| 40 | 31718 | 32178 | 32683 | 33200 | 33646 | 32782 | 33264 | 33779 | 34312 | 34774 |
| 44 | 31503 | 31959 | 32461 | 32976 | 33418 | 32554 | 33031 | 33544 | 34074 | 34533 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 4000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 30213 | 30642 | 31131 | 31626 | 32050 | 33649 | 34148 | 34673 | 35219 | 35693 |
| -15 | 29916 | 30339 | 30825 | 31316 | 31735 | 33298 | 33790 | 34311 | 34851 | 35321 |
| -10 | 29634 | 30051 | 30534 | 31021 | 31436 | 32964 | 33449 | 33966 | 34502 | 34967 |
| -5 | 29361 | 29774 | 30254 | 30736 | 31148 | 32642 | 33120 | 33635 | 34166 | 34625 |
| 0 | 29098 | 29505 | 29982 | 30461 | 30868 | 32330 | 32802 | 33313 | 33839 | 34294 |
| 4 | 28891 | 29294 | 29769 | 30245 | 30649 | 32085 | 32553 | 33061 | 33584 | 34035 |
| 8 | 28687 | 29086 | 29559 | 30032 | 30433 | 31844 | 32306 | 32812 | 33331 | 33779 |
| 12 | 28489 | 28883 | 29354 | 29824 | 30222 | 31609 | 32066 | 32570 | 33085 | 33530 |
| 16 | 28294 | 28685 | 29154 | 29621 | 30016 | 31379 | 31832 | 32333 | 32845 | 33286 |
| 20 | 28104 | 28491 | 28958 | 29422 | 29815 | 31154 | 31602 | 32101 | 32610 | 33048 |
| 24 | 27918 | 28301 | 28766 | 29227 | 29617 | 30933 | 31377 | 31873 | 32379 | 32814 |
| 28 | 27736 | 28115 | 28578 | 29037 | 29424 | 30717 | 31157 | 31651 | 32154 | 32585 |
| 32 | 27557 | 27933 | 28394 | 28850 | 29235 | 30506 | 30941 | 31433 | 31933 | 32361 |
| 36 | 27382 | 27755 | 28214 | 28667 | 29049 | 30299 | 30730 | 31220 | 31716 | 32141 |
| 40 | 27211 | 27580 | 28038 | 28489 | 28868 | 30096 | 30524 | 31011 | 31505 | 31927 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 34867 | 35391 | 35928 | 36492 | 36985 | 36121 | 36670 | 37220 | 37803 | 38314 |
| -15 | 34496 | 35012 | 35545 | 36104 | 36591 | 35727 | 36268 | 36814 | 37391 | 37896 |
| -10 | 34142 | 34651 | 35181 | 35734 | 36216 | 35352 | 35885 | 36428 | 36999 | 37498 |
| -5 | 33801 | 34303 | 34829 | 35378 | 35854 | 34990 | 35517 | 36055 | 36621 | 37115 |
| 0 | 33471 | 33966 | 34489 | 35032 | 35504 | 34640 | 35159 | 35694 | 36255 | 36744 |
| 4 | 33212 | 33702 | 34222 | 34762 | 35230 | 34366 | 34880 | 35412 | 35968 | 36453 |
| 8 | 32956 | 33441 | 33959 | 34494 | 34959 | 34095 | 34603 | 35132 | 35685 | 36166 |
| 12 | 32708 | 33188 | 33702 | 34234 | 34695 | 33831 | 34334 | 34860 | 35409 | 35886 |
| 16 | 32464 | 32939 | 33452 | 33980 | 34437 | 33573 | 34071 | 34594 | 35139 | 35612 |
| 20 | 32226 | 32696 | 33206 | 33731 | 34184 | 33320 | 33813 | 34334 | 34875 | 35345 |
| 24 | 31993 | 32458 | 32965 | 33487 | 33937 | 33073 | 33560 | 34079 | 34616 | 35082 |
| 28 | 31764 | 32225 | 32730 | 33248 | 33695 | 32831 | 33313 | 33829 | 34363 | 34826 |
| 32 | 31540 | 31997 | 32499 | 33014 | 33458 | 32594 | 33071 | 33585 | 34115 | 34574 |
| 36 | 31321 | 31773 | 32274 | 32785 | 33225 | 32361 | 32834 | 33346 | 33873 | 34328 |
| 40 | 31107 | 31555 | 32053 | 32561 | 32998 | 32134 | 32603 | 33112 | 33635 | 34087 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 5000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 29660 | 30078 | 30561 | 31048 | 31464 | 32995 | 33481 | 33999 | 34535 | 35000 |
| -15 | 29377 | 29790 | 30270 | 30753 | 31164 | 32661 | 33140 | 33654 | 34185 | 34645 |
| -10 | 29104 | 29511 | 29988 | 30467 | 30874 | 32337 | 32809 | 33320 | 33847 | 34302 |
| -5 | 28836 | 29237 | 29712 | 30187 | 30590 | 32019 | 32485 | 32993 | 33515 | 33965 |
| 0 | 28575 | 28972 | 29444 | 29915 | 30314 | 31711 | 32171 | 32676 | 33193 | 33639 |
| 4 | 28372 | 28764 | 29234 | 29702 | 30099 | 31470 | 31925 | 32427 | 32941 | 33383 |
| 8 | 28173 | 28561 | 29029 | 29494 | 29888 | 31235 | 31685 | 32185 | 32695 | 33134 |
| 12 | 27978 | 28363 | 28828 | 29291 | 29681 | 31005 | 31450 | 31947 | 32454 | 32890 |
| 16 | 27788 | 28168 | 28632 | 29091 | 29479 | 30779 | 31220 | 31715 | 32218 | 32650 |
| 20 | 27601 | 27978 | 28440 | 28896 | 29281 | 30558 | 30995 | 31487 | 31987 | 32416 |
| 24 | 27418 | 27791 | 28251 | 28705 | 29088 | 30342 | 30774 | 31264 | 31761 | 32187 |
| 28 | 27240 | 27609 | 28067 | 28518 | 28898 | 30130 | 30558 | 31046 | 31540 | 31962 |
| 32 | 27065 | 27431 | 27887 | 28336 | 28713 | 29923 | 30347 | 30833 | 31324 | 31743 |
| 36 | 26894 | 27256 | 27710 | 28156 | 28531 | 29720 | 30140 | 30624 | 31112 | 31528 |
| 40 | 26725 | 27084 | 27537 | 27980 | 28352 | 29521 | 29936 | 30418 | 30903 | 31317 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 34175 | 34685 | 35215 | 35768 | 36251 | 35387 | 35921 | 36464 | 37035 | 37535 |
| -15 | 33821 | 34324 | 34850 | 35398 | 35876 | 35012 | 35538 | 36077 | 36643 | 37138 |
| -10 | 33478 | 33974 | 34497 | 35040 | 35512 | 34648 | 35167 | 35702 | 36263 | 36752 |
| -5 | 33142 | 33631 | 34150 | 34689 | 35156 | 34292 | 34804 | 35335 | 35891 | 36375 |
| 0 | 32816 | 33299 | 33814 | 34348 | 34810 | 33946 | 34451 | 34979 | 35529 | 36008 |
| 4 | 32561 | 33038 | 33552 | 34082 | 34540 | 33676 | 34176 | 34700 | 35247 | 35722 |
| 8 | 32312 | 32784 | 33295 | 33821 | 34276 | 33412 | 33906 | 34428 | 34970 | 35442 |
| 12 | 32068 | 32535 | 33044 | 33566 | 34017 | 33153 | 33642 | 34162 | 34700 | 35168 |
| 16 | 31829 | 32292 | 32797 | 33316 | 33764 | 32900 | 33384 | 33901 | 34435 | 34899 |
| 20 | 31596 | 32053 | 32556 | 33072 | 33516 | 32652 | 33131 | 33645 | 34176 | 34636 |
| 24 | 31367 | 31820 | 32320 | 32833 | 33274 | 32409 | 32883 | 33395 | 33923 | 34379 |
| 28 | 31143 | 31591 | 32090 | 32598 | 33036 | 32172 | 32641 | 33150 | 33674 | 34127 |
| 32 | 30924 | 31368 | 31864 | 32370 | 32804 | 31940 | 32404 | 32911 | 33432 | 33881 |
| 36 | 30709 | 31149 | 31643 | 32145 | 32576 | 31712 | 32172 | 32677 | 33194 | 33640 |
| 40 | 30498 | 30933 | 31425 | 31924 | 32352 | 31488 | 31944 | 32446 | 32960 | 33402 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 6000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 kt | | | | | 0 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 29127 | 29534 | 30012 | 30492 | 30899 | 32365 | 32837 | 33349 | 33876 | 34332 |
| -15 | 28849 | 29251 | 29725 | 30201 | 30604 | 32035 | 32501 | 33010 | 33531 | 33983 |
| -10 | 28578 | 28975 | 29446 | 29918 | 30317 | 31714 | 32174 | 32679 | 33196 | 33642 |
| -5 | 28315 | 28706 | 29175 | 29643 | 30038 | 31402 | 31855 | 32357 | 32870 | 33311 |
| 0 | 28060 | 28447 | 28912 | 29377 | 29768 | 31100 | 31547 | 32046 | 32555 | 32991 |
| 4 | 27862 | 28244 | 28708 | 29169 | 29558 | 30865 | 31307 | 31804 | 32309 | 32742 |
| 8 | 27667 | 28045 | 28507 | 28965 | 29351 | 30634 | 31072 | 31566 | 32067 | 32497 |
| 12 | 27475 | 27850 | 28309 | 28765 | 29148 | 30408 | 30840 | 31332 | 31830 | 32256 |
| 16 | 27289 | 27660 | 28118 | 28570 | 28951 | 30187 | 30615 | 31105 | 31600 | 32023 |
| 20 | 27107 | 27474 | 27930 | 28380 | 28757 | 29971 | 30395 | 30882 | 31374 | 31793 |
| 24 | 26928 | 27292 | 27745 | 28192 | 28568 | 29760 | 30179 | 30664 | 31153 | 31569 |
| 28 | 26752 | 27113 | 27565 | 28009 | 28382 | 29552 | 29968 | 30450 | 30936 | 31349 |
| 32 | 26578 | 26936 | 27386 | 27828 | 28198 | 29347 | 29758 | 30239 | 30721 | 31132 |
| 36 | 26408 | 26762 | 27211 | 27650 | 28018 | 29146 | 29553 | 30031 | 30511 | 30919 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 kt | | | | | 20 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 33508 | 34004 | 34527 | 35072 | 35544 | 34681 | 35200 | 35736 | 36298 | 36787 |
| -15 | 33160 | 33648 | 34168 | 34707 | 35175 | 34312 | 34823 | 35355 | 35912 | 36396 |
| -10 | 32820 | 33302 | 33818 | 34352 | 34814 | 33952 | 34455 | 34984 | 35535 | 36014 |
| -5 | 32489 | 32964 | 33478 | 34006 | 34464 | 33601 | 34098 | 34623 | 35169 | 35642 |
| 0 | 32170 | 32639 | 33149 | 33673 | 34126 | 33262 | 33753 | 34274 | 34814 | 35283 |
| 4 | 31921 | 32385 | 32892 | 33412 | 33862 | 32998 | 33483 | 34002 | 34538 | 35003 |
| 8 | 31677 | 32135 | 32640 | 33157 | 33602 | 32739 | 33219 | 33735 | 34267 | 34728 |
| 12 | 31437 | 31891 | 32393 | 32906 | 33348 | 32484 | 32959 | 33472 | 34001 | 34459 |
| 16 | 31204 | 31653 | 32153 | 32663 | 33101 | 32237 | 32707 | 33218 | 33742 | 34196 |
| 20 | 30975 | 31420 | 31917 | 32424 | 32858 | 31994 | 32460 | 32968 | 33489 | 33939 |
| 24 | 30751 | 31191 | 31686 | 32189 | 32621 | 31757 | 32217 | 32723 | 33240 | 33687 |
| 28 | 30531 | 30967 | 31460 | 31960 | 32388 | 31524 | 31979 | 32483 | 32997 | 33440 |
| 32 | 30314 | 30745 | 31236 | 31732 | 32157 | 31293 | 31744 | 32245 | 32756 | 33196 |
| 36 | 30101 | 30527 | 31016 | 31510 | 31931 | 31067 | 31514 | 32012 | 32520 | 32956 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 7000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 kt | | | | | 0 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 28598 | 28995 | 29467 | 29939 | 30338 | 31738 | 32198 | 32703 | 33221 | 33667 |
| -15 | 28326 | 28717 | 29186 | 29654 | 30049 | 31415 | 31868 | 32370 | 32883 | 33325 |
| -10 | 28059 | 28445 | 28910 | 29375 | 29766 | 31098 | 31545 | 32044 | 32552 | 32989 |
| -5 | 27802 | 28183 | 28646 | 29107 | 29495 | 30795 | 31235 | 31731 | 32235 | 32667 |
| 0 | 27551 | 27927 | 28388 | 28844 | 29228 | 30497 | 30932 | 31425 | 31924 | 32351 |
| 4 | 27356 | 27728 | 28187 | 28640 | 29022 | 30266 | 30696 | 31187 | 31683 | 32106 |
| 8 | 27164 | 27533 | 27989 | 28440 | 28819 | 30040 | 30465 | 30953 | 31446 | 31866 |
| 12 | 26978 | 27343 | 27798 | 28245 | 28621 | 29819 | 30240 | 30726 | 31216 | 31632 |
| 16 | 26796 | 27157 | 27609 | 28054 | 28428 | 29604 | 30020 | 30503 | 30990 | 31404 |
| 20 | 26615 | 26973 | 27423 | 27865 | 28236 | 29390 | 29802 | 30283 | 30766 | 31177 |
| 24 | 26437 | 26792 | 27241 | 27680 | 28048 | 29180 | 29588 | 30067 | 30547 | 30955 |
| 28 | 26260 | 26611 | 27058 | 27495 | 27860 | 28971 | 29375 | 29851 | 30328 | 30733 |
| 32 | 26088 | 26436 | 26881 | 27315 | 27678 | 28767 | 29167 | 29641 | 30116 | 30517 |
| 36 | 25920 | 26264 | 26708 | 27139 | 27500 | 28568 | 28965 | 29436 | 29908 | 30307 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 kt | | | | | 20 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 32845 | 33327 | 33844 | 34378 | 34841 | 33978 | 34482 | 35011 | 35563 | 36042 |
| -15 | 32503 | 32978 | 33492 | 34021 | 34478 | 33615 | 34113 | 34638 | 35184 | 35657 |
| -10 | 32168 | 32637 | 33147 | 33670 | 34123 | 33260 | 33750 | 34271 | 34812 | 35281 |
| -5 | 31846 | 32309 | 32815 | 33334 | 33782 | 32919 | 33402 | 33920 | 34455 | 34919 |
| 0 | 31532 | 31988 | 32491 | 33006 | 33449 | 32585 | 33062 | 33576 | 34106 | 34566 |
| 4 | 31287 | 31738 | 32239 | 32750 | 33190 | 32326 | 32798 | 33309 | 33835 | 34291 |
| 8 | 31048 | 31493 | 31992 | 32499 | 32935 | 32071 | 32538 | 33047 | 33569 | 34021 |
| 12 | 30814 | 31256 | 31752 | 32256 | 32688 | 31824 | 32286 | 32792 | 33311 | 33759 |
| 16 | 30586 | 31022 | 31516 | 32017 | 32445 | 31581 | 32038 | 32542 | 33057 | 33501 |
| 20 | 30359 | 30791 | 31282 | 31780 | 32205 | 31341 | 31793 | 32294 | 32806 | 33246 |
| 24 | 30137 | 30564 | 31054 | 31548 | 31970 | 31106 | 31553 | 32052 | 32560 | 32997 |
| 28 | 29915 | 30338 | 30825 | 31316 | 31734 | 30870 | 31313 | 31809 | 32314 | 32747 |
| 32 | 29700 | 30119 | 30603 | 31091 | 31506 | 30642 | 31080 | 31574 | 32076 | 32505 |
| 36 | 29490 | 29904 | 30386 | 30871 | 31283 | 30419 | 30852 | 31344 | 31842 | 32268 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 8000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 kt | | | | | 0 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 28077 | 28463 | 28929 | 29394 | 29785 | 31120 | 31567 | 32066 | 32575 | 33012 |
| -15 | 27809 | 28191 | 28654 | 29114 | 29502 | 30803 | 31244 | 31740 | 32244 | 32676 |
| -10 | 27547 | 27924 | 28384 | 28840 | 29225 | 30493 | 30928 | 31420 | 31920 | 32347 |
| -5 | 27295 | 27666 | 28123 | 28576 | 28957 | 30194 | 30622 | 31112 | 31607 | 32029 |
| 0 | 27049 | 27415 | 27870 | 28319 | 28696 | 29903 | 30325 | 30812 | 31303 | 31721 |
| 4 | 26857 | 27220 | 27673 | 28119 | 28493 | 29676 | 30094 | 30578 | 31066 | 31481 |
| 8 | 26669 | 27028 | 27479 | 27922 | 28294 | 29454 | 29867 | 30349 | 30833 | 31245 |
| 12 | 26484 | 26840 | 27289 | 27729 | 28098 | 29236 | 29645 | 30124 | 30605 | 31014 |
| 16 | 26302 | 26653 | 27101 | 27538 | 27904 | 29020 | 29425 | 29901 | 30379 | 30785 |
| 20 | 26121 | 26469 | 26915 | 27349 | 27713 | 28806 | 29207 | 29681 | 30156 | 30558 |
| 24 | 25945 | 26290 | 26734 | 27166 | 27527 | 28598 | 28995 | 29467 | 29939 | 30338 |
| 28 | 25774 | 26115 | 26557 | 26986 | 27345 | 28395 | 28788 | 29258 | 29727 | 30123 |
| 32 | - | - | - | - | - | 28196 | 28585 | 29053 | 29519 | 29912 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 kt | | | | | 20 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 32190 | 32660 | 33170 | 33694 | 34147 | 33284 | 33775 | 34296 | 34837 | 35306 |
| -15 | 31855 | 32318 | 32825 | 33344 | 33792 | 32928 | 33412 | 33930 | 34466 | 34930 |
| -10 | 31527 | 31983 | 32486 | 33001 | 33444 | 32580 | 33057 | 33571 | 34101 | 34560 |
| -5 | 31211 | 31660 | 32160 | 32670 | 33108 | 32244 | 32714 | 33225 | 33750 | 34204 |
| 0 | 30903 | 31346 | 31843 | 32348 | 32782 | 31917 | 32381 | 32889 | 33409 | 33858 |
| 4 | 30663 | 31101 | 31595 | 32097 | 32527 | 31663 | 32121 | 32626 | 33143 | 33588 |
| 8 | 30427 | 30860 | 31352 | 31851 | 32277 | 31413 | 31866 | 32369 | 32881 | 33323 |
| 12 | 30196 | 30625 | 31114 | 31609 | 32032 | 31168 | 31616 | 32116 | 32625 | 33063 |
| 16 | 29968 | 30391 | 30878 | 31370 | 31789 | 30926 | 31369 | 31866 | 32372 | 32806 |
| 20 | 29741 | 30160 | 30645 | 31134 | 31549 | 30685 | 31124 | 31619 | 32121 | 32551 |
| 24 | 29521 | 29936 | 30418 | 30904 | 31317 | 30453 | 30886 | 31378 | 31877 | 32304 |
| 28 | 29306 | 29717 | 30197 | 30679 | 31089 | 30224 | 30653 | 31143 | 31639 | 32062 |
| 32 | 29096 | 29502 | 29980 | 30459 | 30865 | 30001 | 30425 | 30913 | 31405 | 31825 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 8500 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 kt | | | | | 0 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 27797 | 28178 | 28641 | 29101 | 29489 | 30788 | 31229 | 31725 | 32228 | 32660 |
| -15 | 27530 | 27906 | 28366 | 28822 | 29206 | 30473 | 30907 | 31399 | 31898 | 32325 |
| -10 | 27271 | 27642 | 28099 | 28551 | 28932 | 30166 | 30594 | 31083 | 31578 | 32000 |
| -5 | 27022 | 27387 | 27842 | 28291 | 28667 | 29871 | 30292 | 30779 | 31269 | 31687 |
| 0 | 26779 | 27140 | 27593 | 28037 | 28410 | 29584 | 30000 | 30483 | 30970 | 31383 |
| 4 | 26591 | 26949 | 27399 | 27841 | 28211 | 29362 | 29774 | 30254 | 30737 | 31147 |
| 8 | 26408 | 26762 | 27211 | 27650 | 28018 | 29146 | 29553 | 30031 | 30511 | 30919 |
| 12 | 26229 | 26580 | 27026 | 27463 | 27828 | 28934 | 29337 | 29813 | 30290 | 30694 |
| 16 | 26056 | 26403 | 26847 | 27281 | 27644 | 28729 | 29128 | 29601 | 30075 | 30477 |
| 20 | 25886 | 26229 | 26672 | 27103 | 27464 | 28528 | 28923 | 29394 | 29865 | 30264 |
| 24 | 25721 | 26061 | 26503 | 26931 | 27289 | 28333 | 28725 | 29194 | 29662 | 30057 |
| 28 | - | - | - | - | - | 28146 | 28534 | 29001 | 29466 | 29859 |
| 32 | - | - | - | - | - | 27963 | 28348 | 28812 | 29275 | 29665 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 kt | | | | | 20 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 31840 | 32302 | 32808 | 33327 | 33775 | 32912 | 33395 | 33913 | 34448 | 34912 |
| -15 | 31506 | 31961 | 32464 | 32978 | 33421 | 32557 | 33034 | 33548 | 34078 | 34536 |
| -10 | 31181 | 31630 | 32130 | 32639 | 33077 | 32213 | 32682 | 33193 | 33717 | 34171 |
| -5 | 30869 | 31311 | 31808 | 32312 | 32745 | 31881 | 32344 | 32851 | 33371 | 33820 |
| 0 | 30565 | 31001 | 31495 | 31995 | 32424 | 31560 | 32016 | 32520 | 33035 | 33478 |
| 4 | 30330 | 30761 | 31252 | 31749 | 32174 | 31310 | 31761 | 32262 | 32773 | 33213 |
| 8 | 30101 | 30527 | 31016 | 31510 | 31931 | 31067 | 31514 | 32012 | 32520 | 32956 |
| 12 | 29877 | 30299 | 30785 | 31276 | 31693 | 30830 | 31271 | 31767 | 32271 | 32704 |
| 16 | 29660 | 30077 | 30561 | 31048 | 31463 | 30599 | 31036 | 31529 | 32030 | 32459 |
| 20 | 29447 | 29860 | 30341 | 30826 | 31237 | 30373 | 30805 | 31297 | 31794 | 32220 |
| 24 | 29241 | 29650 | 30129 | 30610 | 31019 | 30155 | 30582 | 31071 | 31566 | 31988 |
| 28 | 29042 | 29448 | 29925 | 30403 | 30809 | 29945 | 30368 | 30855 | 31346 | 31765 |
| 32 | 28849 | 29250 | 29725 | 30201 | 30604 | 29739 | 30158 | 30643 | 31132 | 31547 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - SEA LEVEL
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 34824 | 35263 | 35733 | 36167 | 36612 | 39023 | 39516 | 40026 | 40511 | 41014 |
| -15 | 34489 | 34924 | 35391 | 35821 | 36261 | 38624 | 39113 | 39619 | 40099 | 40597 |
| -10 | 34165 | 34595 | 35059 | 35485 | 35921 | 38238 | 38721 | 39224 | 39699 | 40191 |
| -5 | 33848 | 34275 | 34736 | 35157 | 35589 | 37861 | 38339 | 38839 | 39309 | 39796 |
| 0 | 33543 | 33965 | 34423 | 34841 | 35269 | 37497 | 37971 | 38467 | 38933 | 39415 |
| 4 | 33303 | 33723 | 34179 | 34593 | 35018 | 37212 | 37682 | 38175 | 38638 | 39116 |
| 8 | 33069 | 33485 | 33939 | 34351 | 34772 | 36933 | 37399 | 37890 | 38349 | 38823 |
| 12 | 32840 | 33253 | 33705 | 34114 | 34532 | 36660 | 37123 | 37611 | 38067 | 38538 |
| 16 | 32616 | 33026 | 33476 | 33882 | 34297 | 36394 | 36853 | 37338 | 37791 | 38258 |
| 20 | 32397 | 32804 | 33252 | 33655 | 34067 | 36133 | 36589 | 37071 | 37521 | 37984 |
| 24 | 32184 | 32589 | 33032 | 33433 | 33841 | 35877 | 36329 | 36810 | 37256 | 37716 |
| 28 | 31981 | 32382 | 32817 | 33215 | 33621 | 35626 | 36076 | 36554 | 36997 | 37453 |
| 32 | 31781 | 32179 | 32606 | 33001 | 33404 | 35380 | 35827 | 36302 | 36742 | 37195 |
| 36 | 31585 | 31981 | 32399 | 32792 | 33192 | 35140 | 35583 | 36056 | 36493 | 36943 |
| 40 | 31395 | 31788 | 32198 | 32589 | 32986 | 34906 | 35346 | 35817 | 36251 | 36697 |
| 44 | 31207 | 31597 | 31999 | 32388 | 32783 | 34675 | 35112 | 35581 | 36012 | 36455 |
| 48 | 31022 | 31410 | 31805 | 32191 | 32583 | 34448 | 34882 | 35348 | 35777 | 36217 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 40510 | 41023 | 41548 | 42051 | 42575 | 42088 | 42622 | 43161 | 43683 | 44229 |
| -15 | 40089 | 40596 | 41117 | 41614 | 42132 | 41644 | 42172 | 42707 | 43224 | 43764 |
| -10 | 39680 | 40182 | 40698 | 41191 | 41703 | 41213 | 41735 | 42266 | 42778 | 43312 |
| -5 | 39281 | 39778 | 40291 | 40779 | 41286 | 40794 | 41310 | 41837 | 42344 | 42872 |
| 0 | 38896 | 39388 | 39897 | 40380 | 40882 | 40388 | 40899 | 41422 | 41924 | 42446 |
| 4 | 38595 | 39083 | 39589 | 40068 | 40566 | 40070 | 40578 | 41098 | 41595 | 42113 |
| 8 | 38299 | 38783 | 39287 | 39762 | 40256 | 39759 | 40262 | 40780 | 41273 | 41787 |
| 12 | 38011 | 38491 | 38992 | 39464 | 39953 | 39455 | 39955 | 40469 | 40959 | 41468 |
| 16 | 37729 | 38205 | 38703 | 39172 | 39658 | 39158 | 39654 | 40165 | 40651 | 41157 |
| 20 | 37452 | 37926 | 38421 | 38886 | 39368 | 38867 | 39359 | 39868 | 40350 | 40852 |
| 24 | 37181 | 37651 | 38144 | 38606 | 39084 | 38582 | 39070 | 39576 | 40055 | 40552 |
| 28 | 36916 | 37383 | 37873 | 38332 | 38806 | 38303 | 38787 | 39290 | 39766 | 40260 |
| 32 | 36656 | 37119 | 37607 | 38062 | 38533 | 38029 | 38509 | 39010 | 39483 | 39972 |
| 36 | 36402 | 36861 | 37346 | 37799 | 38266 | 37761 | 38238 | 38736 | 39205 | 39691 |
| 40 | 36154 | 36610 | 37093 | 37543 | 38006 | 37500 | 37973 | 38469 | 38935 | 39417 |
| 44 | 35909 | 36362 | 36843 | 37290 | 37750 | 37242 | 37712 | 38206 | 38669 | 39147 |
| 48 | 35669 | 36119 | 36598 | 37041 | 37498 | 36989 | 37456 | 37947 | 38407 | 38882 |

**NOTE:** Quick Turn Around Weight in lb.



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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 1000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 34220 | 34651 | 35115 | 35541 | 35978 | 38303 | 38787 | 39290 | 39766 | 40260 |
| -15 | 33891 | 34317 | 34779 | 35201 | 35633 | 37911 | 38390 | 38890 | 39361 | 39849 |
| -10 | 33573 | 33996 | 34454 | 34872 | 35300 | 37533 | 38007 | 38503 | 38970 | 39452 |
| -5 | 33263 | 33682 | 34138 | 34552 | 34976 | 37164 | 37634 | 38126 | 38588 | 39066 |
| 0 | 32963 | 33378 | 33831 | 34241 | 34661 | 36807 | 37272 | 37761 | 38218 | 38691 |
| 4 | 32728 | 33140 | 33590 | 33998 | 34414 | 36527 | 36988 | 37474 | 37929 | 38397 |
| 8 | 32498 | 32907 | 33355 | 33760 | 34173 | 36253 | 36711 | 37194 | 37645 | 38110 |
| 12 | 32273 | 32679 | 33125 | 33527 | 33937 | 35985 | 36440 | 36921 | 37368 | 37830 |
| 16 | 32060 | 32463 | 32901 | 33300 | 33707 | 35724 | 36174 | 36653 | 37098 | 37555 |
| 20 | 31852 | 32252 | 32681 | 33078 | 33482 | 35468 | 35915 | 36392 | 36833 | 37287 |
| 24 | 31648 | 32044 | 32465 | 32859 | 33260 | 35216 | 35661 | 36135 | 36573 | 37023 |
| 28 | 31449 | 31843 | 32255 | 32647 | 33045 | 34972 | 35413 | 35885 | 36320 | 36768 |
| 32 | 31253 | 31644 | 32048 | 32438 | 32833 | 34732 | 35169 | 35639 | 36071 | 36515 |
| 36 | 31061 | 31449 | 31846 | 32232 | 32625 | 34495 | 34930 | 35397 | 35827 | 36267 |
| 40 | 30836 | 31221 | 31608 | 31992 | 32381 | 34264 | 34696 | 35161 | 35587 | 36025 |
| 44 | 30593 | 30974 | 31351 | 31732 | 32117 | 34037 | 34466 | 34929 | 35353 | 35787 |
| 48 | 30354 | 30732 | 31099 | 31477 | 31859 | 33815 | 34241 | 34702 | 35123 | 35554 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 39749 | 40252 | 40769 | 41262 | 41776 | 41286 | 41809 | 42341 | 42853 | 43388 |
| -15 | 39334 | 39832 | 40345 | 40833 | 41341 | 40849 | 41367 | 41894 | 42401 | 42930 |
| -10 | 38934 | 39426 | 39936 | 40419 | 40922 | 40428 | 40940 | 41463 | 41965 | 42488 |
| -5 | 38544 | 39032 | 39537 | 40016 | 40513 | 40017 | 40524 | 41043 | 41540 | 42057 |
| 0 | 38166 | 38648 | 39150 | 39624 | 40116 | 39619 | 40120 | 40636 | 41128 | 41640 |
| 4 | 37869 | 38348 | 38847 | 39318 | 39805 | 39307 | 39804 | 40317 | 40805 | 41312 |
| 8 | 37580 | 38054 | 38551 | 39018 | 39501 | 39001 | 39495 | 40005 | 40489 | 40992 |
| 12 | 37297 | 37768 | 38262 | 38725 | 39205 | 38703 | 39193 | 39700 | 40181 | 40680 |
| 16 | 37020 | 37487 | 37978 | 38439 | 38914 | 38412 | 38897 | 39402 | 39879 | 40374 |
| 20 | 36749 | 37213 | 37702 | 38159 | 38630 | 38126 | 38608 | 39110 | 39584 | 40075 |
| 24 | 36483 | 36943 | 37429 | 37883 | 38351 | 37846 | 38324 | 38823 | 39294 | 39781 |
| 28 | 36224 | 36682 | 37165 | 37616 | 38080 | 37574 | 38049 | 38545 | 39012 | 39496 |
| 32 | 35970 | 36424 | 36905 | 37352 | 37813 | 37306 | 37777 | 38271 | 38734 | 39214 |
| 36 | 35720 | 36170 | 36649 | 37094 | 37551 | 37042 | 37510 | 38002 | 38462 | 38938 |
| 40 | 35475 | 35923 | 36399 | 36840 | 37295 | 36785 | 37249 | 37738 | 38195 | 38668 |
| 44 | 35235 | 35679 | 36153 | 36592 | 37043 | 36532 | 36993 | 37479 | 37934 | 38403 |
| 48 | 35000 | 35441 | 35913 | 36349 | 36796 | 36284 | 36742 | 37226 | 37677 | 38143 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 2000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 33624 | 34047 | 34506 | 34925 | 35353 | 37593 | 38068 | 38565 | 39032 | 39516 |
| -15 | 33301 | 33720 | 34176 | 34591 | 35015 | 37209 | 37679 | 38172 | 38635 | 39113 |
| -10 | 32987 | 33402 | 33855 | 34266 | 34686 | 36835 | 37300 | 37790 | 38248 | 38721 |
| -5 | 32685 | 33096 | 33546 | 33953 | 34369 | 36475 | 36936 | 37422 | 37875 | 38343 |
| 0 | 32391 | 32798 | 33245 | 33649 | 34061 | 36125 | 36581 | 37064 | 37513 | 37977 |
| 4 | 32163 | 32567 | 33009 | 33410 | 33818 | 35850 | 36303 | 36783 | 37229 | 37688 |
| 8 | 31944 | 32345 | 32778 | 33176 | 33581 | 35581 | 36030 | 36508 | 36950 | 37406 |
| 12 | 31731 | 32129 | 32553 | 32948 | 33350 | 35319 | 35764 | 36239 | 36679 | 37131 |
| 16 | 31522 | 31917 | 32332 | 32725 | 33124 | 35062 | 35504 | 35977 | 36413 | 36862 |
| 20 | 31319 | 31711 | 32118 | 32508 | 32904 | 34812 | 35251 | 35722 | 36155 | 36600 |
| 24 | 31119 | 31508 | 31907 | 32294 | 32687 | 34566 | 35002 | 35470 | 35900 | 36342 |
| 28 | 30902 | 31288 | 31678 | 32062 | 32453 | 34326 | 34758 | 35224 | 35651 | 36089 |
| 32 | 30649 | 31030 | 31410 | 31791 | 32178 | 34089 | 34519 | 34982 | 35406 | 35841 |
| 36 | 30400 | 30778 | 31147 | 31526 | 31909 | 33858 | 34284 | 34745 | 35167 | 35599 |
| 40 | 30157 | 30531 | 30890 | 31266 | 31645 | 33631 | 34054 | 34513 | 34932 | 35361 |
| 44 | 29918 | 30289 | 30638 | 31010 | 31386 | 33408 | 33829 | 34286 | 34702 | 35127 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 38998 | 39491 | 40001 | 40486 | 40989 | 40495 | 41008 | 41532 | 42035 | 42559 |
| -15 | 38592 | 39080 | 39586 | 40065 | 40562 | 40067 | 40574 | 41094 | 41592 | 42110 |
| -10 | 38196 | 38679 | 39181 | 39656 | 40148 | 39650 | 40152 | 40668 | 41161 | 41673 |
| -5 | 37815 | 38293 | 38791 | 39261 | 39748 | 39249 | 39746 | 40258 | 40745 | 41252 |
| 0 | 37445 | 37918 | 38413 | 38878 | 39360 | 38859 | 39351 | 39859 | 40342 | 40843 |
| 4 | 37154 | 37623 | 38115 | 38577 | 39055 | 38553 | 39040 | 39546 | 40025 | 40522 |
| 8 | 36869 | 37335 | 37824 | 38283 | 38756 | 38253 | 38736 | 39239 | 39715 | 40207 |
| 12 | 36591 | 37053 | 37540 | 37995 | 38465 | 37960 | 38440 | 38940 | 39412 | 39900 |
| 16 | 36319 | 36778 | 37262 | 37714 | 38180 | 37674 | 38150 | 38647 | 39116 | 39600 |
| 20 | 36055 | 36510 | 36992 | 37441 | 37903 | 37396 | 37868 | 38363 | 38828 | 39309 |
| 24 | 35795 | 36246 | 36726 | 37171 | 37630 | 37121 | 37590 | 38082 | 38544 | 39021 |
| 28 | 35540 | 35988 | 36466 | 36908 | 37363 | 36853 | 37319 | 37808 | 38266 | 38740 |
| 32 | 35290 | 35735 | 36210 | 36649 | 37101 | 36590 | 37052 | 37539 | 37994 | 38463 |
| 36 | 35045 | 35487 | 35959 | 36395 | 36844 | 36332 | 36790 | 37275 | 37727 | 38193 |
| 40 | 34805 | 35244 | 35714 | 36147 | 36592 | 36079 | 36534 | 37016 | 37465 | 37928 |
| 44 | 34569 | 35005 | 35473 | 35903 | 36345 | 35831 | 36283 | 36763 | 37208 | 37668 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 3000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 33029 | 33444 | 33898 | 34309 | 34730 | 36885 | 37351 | 37841 | 38299 | 38773 |
| -15 | 32713 | 33124 | 33575 | 33982 | 34398 | 36509 | 36970 | 37456 | 37910 | 38379 |
| -10 | 32406 | 32814 | 33261 | 33665 | 34077 | 36144 | 36600 | 37083 | 37532 | 37996 |
| -5 | 32114 | 32518 | 32958 | 33358 | 33765 | 35790 | 36242 | 36721 | 37166 | 37625 |
| 0 | 31835 | 32234 | 32662 | 33059 | 33463 | 35446 | 35894 | 36370 | 36811 | 37265 |
| 4 | 31615 | 32011 | 32431 | 32825 | 33225 | 35177 | 35620 | 36094 | 36532 | 36982 |
| 8 | 31402 | 31795 | 32206 | 32597 | 32994 | 34915 | 35355 | 35826 | 36261 | 36707 |
| 12 | 31193 | 31582 | 31984 | 32373 | 32767 | 34657 | 35094 | 35563 | 35994 | 36437 |
| 16 | 30988 | 31375 | 31768 | 32154 | 32546 | 34406 | 34839 | 35305 | 35734 | 36173 |
| 20 | 30724 | 31106 | 31489 | 31871 | 32259 | 34159 | 34589 | 35053 | 35479 | 35915 |
| 24 | 30465 | 30844 | 31215 | 31595 | 31979 | 33918 | 34345 | 34807 | 35229 | 35662 |
| 28 | 30211 | 30586 | 30947 | 31324 | 31704 | 33681 | 34106 | 34565 | 34984 | 35414 |
| 32 | 29962 | 30334 | 30685 | 31058 | 31435 | 33450 | 33871 | 34328 | 34745 | 35171 |
| 36 | 29722 | 30090 | 30431 | 30801 | 31174 | 33226 | 33644 | 34099 | 34513 | 34936 |
| 40 | 29490 | 29854 | 30186 | 30553 | 30923 | 33010 | 33425 | 33878 | 34289 | 34709 |
| 44 | 29262 | 29623 | 29945 | 30310 | 30676 | 32798 | 33210 | 33661 | 34070 | 34487 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 38248 | 38732 | 39235 | 39710 | 40203 | 39706 | 40208 | 40725 | 41218 | 41731 |
| -15 | 37851 | 38329 | 38828 | 39298 | 39785 | 39287 | 39784 | 40296 | 40784 | 41291 |
| -10 | 37464 | 37937 | 38433 | 38898 | 39380 | 38880 | 39371 | 39880 | 40363 | 40865 |
| -5 | 37090 | 37558 | 38050 | 38511 | 38988 | 38486 | 38972 | 39477 | 39955 | 40451 |
| 0 | 36726 | 37190 | 37678 | 38135 | 38607 | 38102 | 38584 | 39085 | 39559 | 40050 |
| 4 | 36441 | 36901 | 37387 | 37840 | 38307 | 37802 | 38280 | 38778 | 39248 | 39734 |
| 8 | 36163 | 36620 | 37103 | 37553 | 38016 | 37510 | 37984 | 38479 | 38946 | 39428 |
| 12 | 35891 | 36344 | 36824 | 37270 | 37731 | 37222 | 37693 | 38186 | 38648 | 39127 |
| 16 | 35625 | 36074 | 36552 | 36995 | 37452 | 36942 | 37409 | 37899 | 38358 | 38833 |
| 20 | 35364 | 35810 | 36285 | 36725 | 37178 | 36667 | 37130 | 37618 | 38074 | 38545 |
| 24 | 35109 | 35551 | 36024 | 36461 | 36910 | 36399 | 36858 | 37343 | 37796 | 38263 |
| 28 | 34859 | 35298 | 35769 | 36202 | 36648 | 36135 | 36591 | 37074 | 37523 | 37987 |
| 32 | 34613 | 35050 | 35518 | 35949 | 36391 | 35877 | 36330 | 36810 | 37256 | 37716 |
| 36 | 34376 | 34809 | 35275 | 35703 | 36142 | 35627 | 36077 | 36555 | 36998 | 37454 |
| 40 | 34148 | 34578 | 35042 | 35467 | 35903 | 35386 | 35833 | 36308 | 36749 | 37202 |
| 44 | 33923 | 34350 | 34812 | 35235 | 35667 | 35150 | 35593 | 36067 | 36504 | 36954 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 4000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 32441 | 32849 | 33297 | 33701 | 34113 | 36185 | 36642 | 37125 | 37575 | 38039 |
| -15 | 32137 | 32540 | 32981 | 33382 | 33790 | 35818 | 36270 | 36750 | 37195 | 37654 |
| -10 | 31846 | 32246 | 32675 | 33071 | 33475 | 35461 | 35908 | 36384 | 36826 | 37280 |
| -5 | 31564 | 31959 | 32376 | 32770 | 33169 | 35114 | 35556 | 36029 | 36466 | 36916 |
| 0 | 31291 | 31682 | 32088 | 32478 | 32874 | 34778 | 35216 | 35686 | 36119 | 36563 |
| 4 | 31076 | 31464 | 31861 | 32248 | 32641 | 34513 | 34948 | 35416 | 35845 | 36286 |
| 8 | 30827 | 31211 | 31598 | 31982 | 32371 | 34255 | 34687 | 35152 | 35578 | 36015 |
| 12 | 30555 | 30936 | 31311 | 31692 | 32077 | 34002 | 34431 | 34893 | 35317 | 35750 |
| 16 | 30291 | 30667 | 31032 | 31409 | 31790 | 33756 | 34181 | 34641 | 35061 | 35492 |
| 20 | 30031 | 30403 | 30757 | 31131 | 31509 | 33513 | 33935 | 34393 | 34811 | 35238 |
| 24 | 29778 | 30147 | 30490 | 30861 | 31235 | 33278 | 33697 | 34153 | 34567 | 34991 |
| 28 | 29537 | 29902 | 30235 | 30603 | 30974 | 33053 | 33469 | 33923 | 34334 | 34755 |
| 32 | 29299 | 29661 | 29985 | 30349 | 30717 | 32832 | 33245 | 33697 | 34106 | 34523 |
| 36 | 29067 | 29426 | 29740 | 30101 | 30465 | 32616 | 33026 | 33476 | 33882 | 34297 |
| 40 | 28841 | 29196 | 29500 | 29859 | 30220 | 32405 | 32813 | 33260 | 33664 | 34075 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 37508 | 37982 | 38478 | 38944 | 39426 | 38926 | 39418 | 39927 | 40411 | 40913 |
| -15 | 37119 | 37588 | 38080 | 38542 | 39019 | 38516 | 39003 | 39509 | 39987 | 40484 |
| -10 | 36741 | 37205 | 37694 | 38151 | 38622 | 38118 | 38600 | 39102 | 39575 | 40066 |
| -5 | 36374 | 36833 | 37318 | 37770 | 38237 | 37731 | 38208 | 38706 | 39175 | 39661 |
| 0 | 36018 | 36473 | 36955 | 37403 | 37864 | 37357 | 37829 | 38323 | 38788 | 39268 |
| 4 | 35739 | 36190 | 36669 | 37113 | 37571 | 37062 | 37531 | 38022 | 38483 | 38959 |
| 8 | 35465 | 35913 | 36389 | 36830 | 37285 | 36774 | 37239 | 37728 | 38185 | 38657 |
| 12 | 35198 | 35642 | 36116 | 36554 | 37004 | 36493 | 36954 | 37440 | 37893 | 38362 |
| 16 | 34937 | 35378 | 35849 | 36284 | 36731 | 36218 | 36675 | 37159 | 37609 | 38074 |
| 20 | 34681 | 35118 | 35587 | 36018 | 36462 | 35948 | 36401 | 36883 | 37330 | 37790 |
| 24 | 34432 | 34866 | 35332 | 35761 | 36201 | 35686 | 36136 | 36615 | 37058 | 37516 |
| 28 | 34194 | 34625 | 35089 | 35515 | 35951 | 35435 | 35882 | 36358 | 36799 | 37253 |
| 32 | 33960 | 34388 | 34850 | 35272 | 35706 | 35189 | 35632 | 36106 | 36544 | 36994 |
| 36 | 33731 | 34156 | 34616 | 35036 | 35466 | 34948 | 35388 | 35860 | 36295 | 36742 |
| 40 | 33508 | 33930 | 34388 | 34805 | 35232 | 34712 | 35150 | 35619 | 36051 | 36495 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 5000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 31873 | 32273 | 32703 | 33100 | 33504 | 35493 | 35941 | 36418 | 36859 | 37314 |
| -15 | 31579 | 31975 | 32393 | 32786 | 33186 | 35132 | 35575 | 36048 | 36486 | 36935 |
| -10 | 31295 | 31686 | 32093 | 32482 | 32878 | 34783 | 35221 | 35691 | 36124 | 36569 |
| -5 | 31018 | 31405 | 31800 | 32186 | 32578 | 34442 | 34876 | 35343 | 35772 | 36212 |
| 0 | 30672 | 31054 | 31435 | 31817 | 32204 | 34111 | 34541 | 35005 | 35429 | 35865 |
| 4 | 30395 | 30773 | 31142 | 31520 | 31903 | 33853 | 34279 | 34740 | 35162 | 35594 |
| 8 | 30123 | 30497 | 30855 | 31230 | 31609 | 33600 | 34023 | 34481 | 34900 | 35328 |
| 12 | 29857 | 30227 | 30574 | 30945 | 31321 | 33352 | 33772 | 34228 | 34643 | 35068 |
| 16 | 29604 | 29970 | 30306 | 30674 | 31046 | 33116 | 33532 | 33986 | 34399 | 34820 |
| 20 | 29357 | 29719 | 30045 | 30411 | 30779 | 32886 | 33299 | 33751 | 34161 | 34579 |
| 24 | 29114 | 29473 | 29789 | 30151 | 30516 | 32659 | 33070 | 33520 | 33927 | 34342 |
| 28 | 28878 | 29233 | 29539 | 29899 | 30260 | 32439 | 32847 | 33295 | 33699 | 34112 |
| 32 | 28652 | 29004 | 29300 | 29657 | 30015 | 32224 | 32629 | 33074 | 33475 | 33884 |
| 36 | 28460 | 28810 | 29098 | 29452 | 29808 | 32018 | 32420 | 32856 | 33255 | 33662 |
| 40 | 28273 | 28619 | 28900 | 29252 | 29605 | 31817 | 32216 | 32643 | 33040 | 33443 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 36776 | 37240 | 37729 | 38186 | 38659 | 38155 | 38637 | 39139 | 39613 | 40104 |
| -15 | 36394 | 36853 | 37338 | 37791 | 38258 | 37752 | 38229 | 38727 | 39196 | 39682 |
| -10 | 36024 | 36479 | 36960 | 37408 | 37870 | 37363 | 37835 | 38329 | 38794 | 39274 |
| -5 | 35664 | 36114 | 36592 | 37036 | 37492 | 36983 | 37450 | 37941 | 38401 | 38876 |
| 0 | 35313 | 35759 | 36234 | 36673 | 37125 | 36614 | 37077 | 37564 | 38019 | 38489 |
| 4 | 35040 | 35482 | 35954 | 36390 | 36838 | 36326 | 36785 | 37269 | 37721 | 38187 |
| 8 | 34772 | 35210 | 35680 | 36113 | 36557 | 36044 | 36499 | 36981 | 37429 | 37891 |
| 12 | 34510 | 34945 | 35412 | 35841 | 36282 | 35768 | 36219 | 36698 | 37143 | 37601 |
| 16 | 34260 | 34691 | 35156 | 35583 | 36020 | 35504 | 35952 | 36429 | 36871 | 37325 |
| 20 | 34016 | 34445 | 34908 | 35331 | 35765 | 35248 | 35693 | 36167 | 36606 | 37057 |
| 24 | 33777 | 34202 | 34663 | 35083 | 35514 | 34996 | 35437 | 35909 | 36345 | 36792 |
| 28 | 33544 | 33967 | 34425 | 34843 | 35270 | 34751 | 35189 | 35659 | 36091 | 36535 |
| 32 | 33315 | 33734 | 34190 | 34605 | 35030 | 34509 | 34944 | 35412 | 35841 | 36282 |
| 36 | 33090 | 33506 | 33960 | 34373 | 34794 | 34272 | 34704 | 35169 | 35596 | 36034 |
| 40 | 32870 | 33283 | 33735 | 34144 | 34563 | 34040 | 34469 | 34932 | 35356 | 35790 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 6000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 kt | | | | | 0 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 31320 | 31712 | 32118 | 32508 | 32905 | 34813 | 35251 | 35722 | 36155 | 36599 |
| -15 | 31032 | 31419 | 31814 | 32201 | 32593 | 34459 | 34892 | 35360 | 35788 | 36228 |
| -10 | 30674 | 31056 | 31436 | 31819 | 32205 | 34113 | 34542 | 35006 | 35430 | 35865 |
| -5 | 30314 | 30691 | 31056 | 31435 | 31816 | 33778 | 34203 | 34664 | 35084 | 35514 |
| 0 | - | - | - | - | - | 33454 | 33875 | 34332 | 34748 | 35174 |
| 4 | - | - | - | - | - | 33205 | 33622 | 34077 | 34490 | 34913 |
| 8 | - | - | - | - | - | 32965 | 33379 | 33831 | 34241 | 34661 |
| 12 | - | - | - | - | - | 32728 | 33140 | 33590 | 33997 | 34413 |
| 16 | - | - | - | - | - | 32499 | 32907 | 33355 | 33759 | 34172 |
| 20 | - | - | - | - | - | 32271 | 32677 | 33122 | 33524 | 33934 |
| 24 | - | - | - | - | - | 32057 | 32459 | 32896 | 33295 | 33702 |
| 28 | - | - | - | - | - | 31847 | 32246 | 32674 | 33071 | 33475 |
| 32 | - | - | - | - | - | 31641 | 32037 | 32457 | 32851 | 33252 |
| 36 | - | - | - | - | - | 31439 | 31833 | 32244 | 32636 | 33033 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 kt | | | | | 20 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 36055 | 36511 | 36993 | 37441 | 37904 | 37396 | 37869 | 38364 | 38828 | 39310 |
| -15 | 35680 | 36131 | 36610 | 37053 | 37510 | 37001 | 37469 | 37961 | 38420 | 38896 |
| -10 | 35315 | 35760 | 36236 | 36675 | 37127 | 36615 | 37079 | 37567 | 38022 | 38492 |
| -5 | 34961 | 35401 | 35874 | 36308 | 36755 | 36242 | 36701 | 37185 | 37635 | 38101 |
| 0 | 34618 | 35053 | 35523 | 35953 | 36395 | 35881 | 36334 | 36815 | 37261 | 37721 |
| 4 | 34355 | 34786 | 35253 | 35680 | 36118 | 35604 | 36053 | 36531 | 36974 | 37430 |
| 8 | 34101 | 34529 | 34993 | 35417 | 35852 | 35336 | 35781 | 36257 | 36696 | 37148 |
| 12 | 33851 | 34276 | 34738 | 35158 | 35590 | 35073 | 35514 | 35988 | 36424 | 36872 |
| 16 | 33608 | 34030 | 34489 | 34907 | 35335 | 34817 | 35255 | 35726 | 36159 | 36603 |
| 20 | 33367 | 33786 | 34243 | 34658 | 35082 | 34563 | 34998 | 35466 | 35896 | 36337 |
| 24 | 33133 | 33549 | 34003 | 34415 | 34837 | 34317 | 34748 | 35214 | 35641 | 36078 |
| 28 | 32903 | 33317 | 33769 | 34178 | 34597 | 34075 | 34503 | 34967 | 35391 | 35825 |
| 32 | 32678 | 33089 | 33539 | 33945 | 34361 | 33838 | 34263 | 34725 | 35145 | 35576 |
| 36 | 32458 | 32866 | 33313 | 33717 | 34130 | 33606 | 34028 | 34487 | 34905 | 35333 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 7000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 kt | | | | | 0 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 30702 | 31084 | 31465 | 31848 | 32235 | 34139 | 34568 | 35033 | 35457 | 35892 |
| -15 | 30328 | 30705 | 31071 | 31449 | 31831 | 33791 | 34216 | 34677 | 35097 | 35527 |
| -10 | - | - | - | - | - | 33452 | 33872 | 34330 | 34746 | 35172 |
| -5 | - | - | - | - | - | 33130 | 33546 | 34001 | 34412 | 34834 |
| 0 | - | - | - | - | - | 32821 | 33233 | 33684 | 34092 | 34510 |
| 4 | - | - | - | - | - | 32578 | 32988 | 33436 | 33841 | 34256 |
| 8 | - | - | - | - | - | 32344 | 32751 | 33197 | 33599 | 34010 |
| 12 | - | - | - | - | - | 32117 | 32520 | 32960 | 33359 | 33767 |
| 16 | - | - | - | - | - | 31896 | 32297 | 32727 | 33124 | 33529 |
| 20 | - | - | - | - | - | 31682 | 32079 | 32501 | 32895 | 33297 |
| 24 | - | - | - | - | - | 31472 | 31866 | 32279 | 32671 | 33069 |
| 28 | - | - | - | - | - | 31264 | 31655 | 32059 | 32449 | 32844 |
| 32 | - | - | - | - | - | 31063 | 31451 | 31846 | 32234 | 32626 |
| 36 | - | - | - | - | - | 30865 | 31250 | 31638 | 32023 | 32412 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 kt | | | | | 20 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 35342 | 35788 | 36264 | 36703 | 37155 | 36644 | 37108 | 37596 | 38052 | 38523 |
| -15 | 34975 | 35415 | 35888 | 36322 | 36769 | 36257 | 36715 | 37200 | 37650 | 38116 |
| -10 | 34616 | 35051 | 35520 | 35951 | 36392 | 35879 | 36332 | 36813 | 37259 | 37719 |
| -5 | 34275 | 34706 | 35172 | 35598 | 36035 | 35520 | 35968 | 36446 | 36887 | 37342 |
| 0 | 33948 | 34375 | 34837 | 35259 | 35692 | 35176 | 35619 | 36093 | 36530 | 36980 |
| 4 | 33692 | 34115 | 34575 | 34994 | 35423 | 34905 | 35345 | 35817 | 36250 | 36696 |
| 8 | 33444 | 33864 | 34322 | 34738 | 35163 | 34645 | 35080 | 35550 | 35980 | 36422 |
| 12 | 33199 | 33616 | 34071 | 34484 | 34906 | 34386 | 34818 | 35285 | 35713 | 36151 |
| 16 | 32958 | 33372 | 33825 | 34234 | 34654 | 34132 | 34561 | 35026 | 35450 | 35885 |
| 20 | 32724 | 33135 | 33585 | 33992 | 34408 | 33886 | 34312 | 34774 | 35195 | 35627 |
| 24 | 32494 | 32903 | 33351 | 33755 | 34168 | 33644 | 34067 | 34526 | 34945 | 35373 |
| 28 | 32267 | 32673 | 33118 | 33520 | 33930 | 33405 | 33824 | 34281 | 34697 | 35122 |
| 32 | 32054 | 32456 | 32893 | 33292 | 33699 | 33172 | 33589 | 34044 | 34456 | 34879 |
| 36 | 31845 | 32244 | 32672 | 33069 | 33473 | 32945 | 33359 | 33811 | 34221 | 34640 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 8000 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 kt | | | | | 0 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | - | - | - | - | - | 33473 | 33894 | 34352 | 34768 | 35194 |
| -15 | - | - | - | - | - | 33136 | 33553 | 34007 | 34419 | 34841 |
| -10 | - | - | - | - | - | 32814 | 33227 | 33678 | 34086 | 34503 |
| -5 | - | - | - | - | - | 32503 | 32912 | 33359 | 33764 | 34177 |
| 0 | - | - | - | - | - | 32200 | 32605 | 33048 | 33448 | 33857 |
| 4 | - | - | - | - | - | 31971 | 32373 | 32806 | 33204 | 33610 |
| 8 | - | - | - | - | - | 31745 | 32143 | 32567 | 32962 | 33364 |
| 12 | - | - | - | - | - | 31526 | 31921 | 32336 | 32729 | 33128 |
| 16 | - | - | - | - | - | 31310 | 31702 | 32108 | 32498 | 32894 |
| 20 | - | - | - | - | - | 31100 | 31489 | 31886 | 32274 | 32667 |
| 24 | - | - | - | - | - | 30892 | 31278 | 31666 | 32052 | 32441 |
| 28 | - | - | - | - | - | 30691 | 31073 | 31453 | 31836 | 32223 |
| 32 | - | - | - | - | - | 30491 | 30870 | 31243 | 31623 | 32007 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 kt | | | | | 20 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 34639 | 35074 | 35544 | 35974 | 36416 | 35903 | 36356 | 36837 | 37284 | 37744 |
| -15 | 34282 | 34713 | 35179 | 35605 | 36042 | 35527 | 35975 | 36453 | 36895 | 37349 |
| -10 | 33942 | 34368 | 34830 | 35252 | 35685 | 35168 | 35611 | 36086 | 36523 | 36973 |
| -5 | 33612 | 34034 | 34494 | 34912 | 35340 | 34822 | 35260 | 35731 | 36164 | 36608 |
| 0 | 33289 | 33708 | 34164 | 34578 | 35001 | 34482 | 34915 | 35383 | 35812 | 36252 |
| 4 | 33040 | 33455 | 33908 | 34319 | 34739 | 34219 | 34648 | 35114 | 35539 | 35975 |
| 8 | 32792 | 33204 | 33655 | 34063 | 34480 | 33958 | 34384 | 34847 | 35269 | 35702 |
| 12 | 32553 | 32963 | 33411 | 33816 | 34230 | 33706 | 34130 | 34590 | 35009 | 35438 |
| 16 | 32317 | 32723 | 33169 | 33571 | 33982 | 33457 | 33878 | 34335 | 34751 | 35177 |
| 20 | 32093 | 32496 | 32935 | 33334 | 33742 | 33215 | 33633 | 34088 | 34501 | 34924 |
| 24 | 31873 | 32273 | 32702 | 33099 | 33503 | 32976 | 33390 | 33843 | 34253 | 34673 |
| 28 | 31660 | 32057 | 32477 | 32871 | 33272 | 32744 | 33155 | 33606 | 34013 | 34429 |
| 32 | 31449 | 31842 | 32254 | 32646 | 33044 | 32514 | 32923 | 33371 | 33775 | 34188 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 8500 FT
## ER BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 kt | | | | | 0 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | - | - | - | - | - | 33152 | 33569 | 34024 | 34436 | 34858 |
| -15 | - | - | - | - | - | 32822 | 33234 | 33686 | 34094 | 34511 |
| -10 | - | - | - | - | - | 32503 | 32911 | 33359 | 33763 | 34176 |
| -5 | - | - | - | - | - | 32195 | 32600 | 33042 | 33443 | 33852 |
| 0 | - | - | - | - | - | 31903 | 32303 | 32734 | 33131 | 33535 |
| 4 | - | - | - | - | - | 31674 | 32071 | 32492 | 32886 | 33288 |
| 8 | - | - | - | - | - | 31452 | 31845 | 32257 | 32649 | 33047 |
| 12 | - | - | - | - | - | 31234 | 31625 | 32028 | 32417 | 32812 |
| 16 | - | - | - | - | - | 31020 | 31407 | 31801 | 32188 | 32580 |
| 20 | - | - | - | - | - | 30811 | 31195 | 31581 | 31965 | 32354 |
| 24 | - | - | - | - | - | 30606 | 30988 | 31364 | 31746 | 32132 |
| 28 | - | - | - | - | - | 30407 | 30785 | 31154 | 31533 | 31916 |
| 32 | - | - | - | - | - | 30210 | 30586 | 30946 | 31323 | 31703 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 kt | | | | | 20 kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 34299 | 34730 | 35196 | 35623 | 36060 | 35545 | 35994 | 36471 | 36913 | 37368 |
| -15 | 33950 | 34376 | 34839 | 35261 | 35693 | 35177 | 35620 | 36094 | 36532 | 36981 |
| -10 | 33612 | 34034 | 34493 | 34911 | 35339 | 34821 | 35259 | 35730 | 36163 | 36608 |
| -5 | 33284 | 33702 | 34158 | 34572 | 34996 | 34476 | 34909 | 35377 | 35806 | 36245 |
| 0 | 32965 | 33379 | 33832 | 34241 | 34661 | 34140 | 34568 | 35033 | 35457 | 35893 |
| 4 | 32715 | 33126 | 33576 | 33983 | 34399 | 33876 | 34302 | 34764 | 35185 | 35617 |
| 8 | 32472 | 32880 | 33327 | 33731 | 34144 | 33620 | 34042 | 34502 | 34920 | 35348 |
| 12 | 32235 | 32640 | 33085 | 33486 | 33895 | 33370 | 33789 | 34246 | 34661 | 35086 |
| 16 | 32008 | 32410 | 32845 | 33244 | 33650 | 33123 | 33540 | 33994 | 34406 | 34827 |
| 20 | 31787 | 32186 | 32612 | 33008 | 33411 | 32883 | 33296 | 33748 | 34157 | 34575 |
| 24 | 31571 | 31966 | 32383 | 32776 | 33176 | 32647 | 33057 | 33507 | 33913 | 34328 |
| 28 | 31360 | 31752 | 32160 | 32551 | 32947 | 32417 | 32825 | 33271 | 33675 | 34087 |
| 32 | 31152 | 31541 | 31940 | 32329 | 32722 | 32193 | 32598 | 33040 | 33441 | 33850 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - SEA LEVEL
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 41842 | 42435 | 43083 | 43769 | 44362 | 46257 | 46907 | 47607 | 48358 | 49006 |
| -15 | 41420 | 42008 | 42651 | 43331 | 43919 | 45765 | 46409 | 47103 | 47847 | 48489 |
| -10 | 41019 | 41602 | 42240 | 42914 | 43497 | 45298 | 45936 | 46624 | 47361 | 47997 |
| -5 | 40628 | 41206 | 41840 | 42507 | 43086 | 44842 | 45474 | 46158 | 46888 | 47518 |
| 0 | 40246 | 40818 | 41448 | 42110 | 42683 | 44397 | 45023 | 45701 | 46425 | 47049 |
| 4 | 39944 | 40513 | 41139 | 41796 | 42366 | 44045 | 44667 | 45341 | 46059 | 46679 |
| 8 | 39647 | 40211 | 40834 | 41487 | 42053 | 43698 | 44315 | 44985 | 45698 | 46314 |
| 12 | 39355 | 39916 | 40536 | 41184 | 41747 | 43359 | 43971 | 44637 | 45346 | 45957 |
| 16 | 39072 | 39629 | 40245 | 40889 | 41448 | 43028 | 43636 | 44299 | 45002 | 45609 |
| 20 | 38794 | 39347 | 39960 | 40600 | 41156 | 42704 | 43308 | 43967 | 44665 | 45269 |
| 24 | 38521 | 39071 | 39681 | 40317 | 40869 | 42386 | 42987 | 43641 | 44335 | 44935 |
| 28 | 38255 | 38801 | 39408 | 40040 | 40589 | 42076 | 42672 | 43323 | 44012 | 44608 |
| 32 | 37995 | 38538 | 39142 | 39770 | 40316 | 41773 | 42366 | 43013 | 43698 | 44290 |
| 36 | 37741 | 38280 | 38881 | 39505 | 40048 | 41477 | 42065 | 42709 | 43389 | 43978 |
| 40 | 37492 | 38028 | 38626 | 39247 | 39786 | 41186 | 41771 | 42412 | 43088 | 43673 |
| 44 | 37248 | 37782 | 38376 | 38994 | 39530 | 40903 | 41484 | 42121 | 42793 | 43374 |
| 48 | 37010 | 37540 | 38132 | 38746 | 39280 | 40625 | 41203 | 41837 | 42504 | 43082 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 47887 | 48559 | 49277 | 50053 | 50721 | 49510 | 50203 | 50941 | 51652 | 52264 |
| -15 | 47372 | 48037 | 48750 | 49518 | 50179 | 48968 | 49654 | 50385 | 51177 | 51858 |
| -10 | 46882 | 47540 | 48248 | 49008 | 49663 | 48453 | 49132 | 49857 | 50641 | 51316 |
| -5 | 46405 | 47057 | 47758 | 48512 | 49161 | 47951 | 48623 | 49343 | 50119 | 50788 |
| 0 | 45937 | 46584 | 47280 | 48026 | 48670 | 47459 | 48125 | 48839 | 49608 | 50271 |
| 4 | 45569 | 46210 | 46902 | 47643 | 48282 | 47071 | 47732 | 48442 | 49205 | 49863 |
| 8 | 45205 | 45842 | 46530 | 47265 | 47900 | 46689 | 47345 | 48050 | 48808 | 49460 |
| 12 | 44849 | 45481 | 46165 | 46895 | 47526 | 46315 | 46966 | 47666 | 48419 | 49067 |
| 16 | 44503 | 45130 | 45810 | 46535 | 47161 | 45950 | 46596 | 47293 | 48039 | 48683 |
| 20 | 44163 | 44786 | 45462 | 46182 | 46804 | 45593 | 46235 | 46927 | 47668 | 48308 |
| 24 | 43830 | 44449 | 45121 | 45836 | 46454 | 45243 | 45880 | 46568 | 47304 | 47939 |
| 28 | 43505 | 44120 | 44788 | 45498 | 46112 | 44901 | 45533 | 46217 | 46948 | 47579 |
| 32 | 43188 | 43798 | 44462 | 45168 | 45778 | 44567 | 45195 | 45875 | 46601 | 47228 |
| 36 | 42877 | 43483 | 44144 | 44845 | 45451 | 44240 | 44864 | 45540 | 46261 | 46884 |
| 40 | 42573 | 43175 | 43832 | 44529 | 45131 | 43920 | 44540 | 45212 | 45929 | 46547 |
| 44 | 42275 | 42874 | 43527 | 44219 | 44818 | 43607 | 44223 | 44892 | 45604 | 46219 |
| 48 | 41984 | 42579 | 43229 | 43917 | 44512 | 43301 | 43913 | 44578 | 45285 | 45897 |

**NOTE:** Quick Turn Around Weight in lb.



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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 1000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 41086 | 41669 | 42309 | 42983 | 43567 | 45376 | 46015 | 46704 | 47443 | 48079 |
| -15 | 40680 | 41258 | 41893 | 42561 | 43140 | 44903 | 45535 | 46220 | 46951 | 47582 |
| -10 | 40283 | 40856 | 41486 | 42149 | 42723 | 44440 | 45067 | 45745 | 46470 | 47095 |
| -5 | 39893 | 40461 | 41087 | 41743 | 42312 | 43985 | 44606 | 45280 | 45997 | 46617 |
| 0 | 39512 | 40075 | 40696 | 41347 | 41911 | 43541 | 44156 | 44824 | 45535 | 46149 |
| 4 | 39213 | 39772 | 40390 | 41036 | 41597 | 43193 | 43803 | 44467 | 45173 | 45783 |
| 8 | 38921 | 39476 | 40090 | 40732 | 41289 | 42852 | 43458 | 44118 | 44819 | 45424 |
| 12 | 38636 | 39188 | 39799 | 40436 | 40990 | 42520 | 43122 | 43779 | 44474 | 45076 |
| 16 | 38358 | 38906 | 39514 | 40148 | 40698 | 42197 | 42794 | 43447 | 44138 | 44735 |
| 20 | 38087 | 38631 | 39236 | 39865 | 40412 | 41880 | 42474 | 43122 | 43809 | 44402 |
| 24 | 37822 | 38362 | 38964 | 39590 | 40133 | 41571 | 42161 | 42806 | 43487 | 44077 |
| 28 | 37562 | 38100 | 38698 | 39320 | 39860 | 41269 | 41854 | 42496 | 43173 | 43759 |
| 32 | 37308 | 37843 | 38438 | 39056 | 39594 | 40973 | 41555 | 42193 | 42866 | 43448 |
| 36 | 37060 | 37591 | 38184 | 38798 | 39332 | 40684 | 41262 | 41897 | 42565 | 43144 |
| 40 | 36817 | 37345 | 37935 | 38546 | 39077 | 40401 | 40975 | 41607 | 42271 | 42846 |
| 44 | 36579 | 37104 | 37691 | 38298 | 38827 | 40123 | 40694 | 41322 | 41982 | 42554 |
| 48 | 36346 | 36868 | 37452 | 38056 | 38581 | 39852 | 40419 | 41044 | 41700 | 42268 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 46964 | 47623 | 48331 | 49093 | 49749 | 48539 | 49219 | 49945 | 50731 | 51406 |
| -15 | 46468 | 47121 | 47823 | 48578 | 49228 | 48017 | 48690 | 49411 | 50188 | 50858 |
| -10 | 45983 | 46630 | 47326 | 48074 | 48718 | 47507 | 48174 | 48888 | 49658 | 50321 |
| -5 | 45506 | 46147 | 46838 | 47578 | 48217 | 47006 | 47666 | 48375 | 49137 | 49794 |
| 0 | 45041 | 45675 | 46361 | 47094 | 47727 | 46516 | 47169 | 47872 | 48628 | 49278 |
| 4 | 44676 | 45305 | 45987 | 46715 | 47343 | 46132 | 46780 | 47479 | 48228 | 48874 |
| 8 | 44318 | 44943 | 45621 | 46343 | 46967 | 45756 | 46400 | 47094 | 47838 | 48479 |
| 12 | 43971 | 44592 | 45265 | 45982 | 46601 | 45391 | 46030 | 46719 | 47458 | 48095 |
| 16 | 43632 | 44248 | 44917 | 45629 | 46244 | 45034 | 45668 | 46354 | 47087 | 47719 |
| 20 | 43300 | 43912 | 44577 | 45284 | 45895 | 44684 | 45314 | 45996 | 46724 | 47352 |
| 24 | 42976 | 43584 | 44245 | 44948 | 45555 | 44344 | 44969 | 45647 | 46370 | 46994 |
| 28 | 42659 | 43263 | 43920 | 44618 | 45221 | 44010 | 44631 | 45305 | 46023 | 46643 |
| 32 | 42349 | 42949 | 43603 | 44296 | 44895 | 43684 | 44301 | 44971 | 45684 | 46300 |
| 36 | 42046 | 42641 | 43292 | 43981 | 44576 | 43365 | 43978 | 44644 | 45353 | 45964 |
| 40 | 41749 | 42341 | 42988 | 43672 | 44264 | 43053 | 43662 | 44324 | 45028 | 45636 |
| 44 | 41458 | 42046 | 42690 | 43370 | 43959 | 42747 | 43352 | 44011 | 44710 | 45315 |
| 48 | 41173 | 41758 | 42398 | 43074 | 43659 | 42448 | 43049 | 43704 | 44399 | 44999 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 2000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 40345 | 40919 | 41550 | 42213 | 42788 | 44513 | 45140 | 45820 | 46545 | 47171 |
| -15 | 39940 | 40508 | 41134 | 41792 | 42361 | 44040 | 44661 | 45335 | 46054 | 46674 |
| -10 | 39542 | 40105 | 40727 | 41378 | 41943 | 43576 | 44191 | 44860 | 45571 | 46186 |
| -5 | 39158 | 39716 | 40333 | 40979 | 41539 | 43128 | 43738 | 44402 | 45106 | 45715 |
| 0 | 38785 | 39338 | 39951 | 40591 | 41147 | 42694 | 43298 | 43956 | 44654 | 45258 |
| 4 | 38492 | 39042 | 39651 | 40287 | 40839 | 42353 | 42952 | 43607 | 44300 | 44899 |
| 8 | 38207 | 38753 | 39359 | 39991 | 40539 | 42021 | 42616 | 43266 | 43955 | 44550 |
| 12 | 37929 | 38472 | 39074 | 39702 | 40247 | 41697 | 42288 | 42935 | 43618 | 44209 |
| 16 | 37658 | 38197 | 38796 | 39420 | 39961 | 41381 | 41968 | 42611 | 43289 | 43877 |
| 20 | 37393 | 37929 | 38525 | 39144 | 39683 | 41072 | 41655 | 42294 | 42968 | 43552 |
| 24 | 37134 | 37666 | 38260 | 38875 | 39410 | 40770 | 41349 | 41985 | 42655 | 43235 |
| 28 | 36881 | 37410 | 38000 | 38612 | 39144 | 40475 | 41051 | 41683 | 42348 | 42924 |
| 32 | 36634 | 37159 | 37747 | 38355 | 38884 | 40187 | 40758 | 41388 | 42048 | 42621 |
| 36 | 36391 | 36914 | 37498 | 38103 | 38629 | 39904 | 40472 | 41098 | 41754 | 42324 |
| 40 | 36154 | 36673 | 37255 | 37856 | 38379 | 39627 | 40191 | 40814 | 41466 | 42032 |
| 44 | 35922 | 36438 | 37017 | 37614 | 38135 | 39357 | 39917 | 40537 | 41185 | 41748 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 46059 | 46707 | 47404 | 48153 | 48798 | 47587 | 48255 | 48970 | 49741 | 50405 |
| -15 | 45563 | 46205 | 46897 | 47638 | 48277 | 47066 | 47727 | 48436 | 49199 | 49857 |
| -10 | 45077 | 45712 | 46398 | 47132 | 47765 | 46554 | 47208 | 47912 | 48668 | 49319 |
| -5 | 44608 | 45237 | 45918 | 46645 | 47272 | 46061 | 46709 | 47406 | 48155 | 48800 |
| 0 | 44153 | 44776 | 45451 | 46171 | 46793 | 45582 | 46223 | 46915 | 47656 | 48296 |
| 4 | 43795 | 44413 | 45085 | 45799 | 46417 | 45206 | 45842 | 46530 | 47266 | 47900 |
| 8 | 43447 | 44061 | 44728 | 45437 | 46050 | 44839 | 45471 | 46155 | 46885 | 47515 |
| 12 | 43107 | 43717 | 44380 | 45084 | 45693 | 44482 | 45110 | 45789 | 46514 | 47139 |
| 16 | 42776 | 43381 | 44041 | 44740 | 45345 | 44134 | 44756 | 45432 | 46151 | 46773 |
| 20 | 42452 | 43053 | 43709 | 44404 | 45004 | 43793 | 44412 | 45083 | 45797 | 46415 |
| 24 | 42136 | 42733 | 43385 | 44075 | 44672 | 43460 | 44074 | 44742 | 45451 | 46065 |
| 28 | 41827 | 42420 | 43068 | 43754 | 44346 | 43135 | 43745 | 44409 | 45113 | 45723 |
| 32 | 41525 | 42114 | 42759 | 43439 | 44029 | 42817 | 43423 | 44083 | 44783 | 45388 |
| 36 | 41228 | 41814 | 42455 | 43131 | 43717 | 42506 | 43107 | 43763 | 44459 | 45060 |
| 40 | 40938 | 41519 | 42157 | 42829 | 43411 | 42200 | 42798 | 43450 | 44141 | 44739 |
| 44 | 40655 | 41232 | 41867 | 42535 | 43113 | 41902 | 42496 | 43145 | 43831 | 44425 |

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 3000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 39595 | 40159 | 40781 | 41433 | 41999 | 43638 | 44254 | 44924 | 45636 | 46251 |
| -15 | 39193 | 39752 | 40370 | 41016 | 41576 | 43170 | 43780 | 44444 | 45149 | 45759 |
| -10 | 38805 | 39359 | 39972 | 40612 | 41168 | 42717 | 43322 | 43980 | 44679 | 45283 |
| -5 | 38428 | 38977 | 39585 | 40220 | 40771 | 42278 | 42877 | 43530 | 44222 | 44821 |
| 0 | 38064 | 38608 | 39212 | 39841 | 40388 | 41853 | 42446 | 43095 | 43780 | 44374 |
| 4 | 37779 | 38319 | 38920 | 39545 | 40088 | 41521 | 42110 | 42755 | 43436 | 44025 |
| 8 | 37501 | 38038 | 38635 | 39256 | 39796 | 41197 | 41782 | 42423 | 43099 | 43684 |
| 12 | 37229 | 37763 | 38357 | 38974 | 39510 | 40881 | 41461 | 42099 | 42770 | 43351 |
| 16 | 36965 | 37495 | 38087 | 38699 | 39233 | 40573 | 41150 | 41783 | 42450 | 43027 |
| 20 | 36707 | 37233 | 37822 | 38431 | 38961 | 40272 | 40844 | 41474 | 42137 | 42710 |
| 24 | 36454 | 36977 | 37562 | 38168 | 38694 | 39977 | 40546 | 41172 | 41830 | 42400 |
| 28 | 36206 | 36726 | 37309 | 37910 | 38434 | 39688 | 40253 | 40877 | 41530 | 42097 |
| 32 | 35965 | 36482 | 37062 | 37660 | 38181 | 39407 | 39969 | 40589 | 41238 | 41801 |
| 36 | 35729 | 36243 | 36820 | 37414 | 37932 | 39132 | 39690 | 40307 | 40952 | 41512 |
| 40 | 35498 | 36009 | 36583 | 37174 | 37689 | 38863 | 39418 | 40031 | 40672 | 41229 |
| 44 | 35273 | 35781 | 36353 | 36940 | 37453 | 38601 | 39152 | 39763 | 40400 | 40953 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 45142 | 45778 | 46465 | 47200 | 47833 | 46623 | 47278 | 47982 | 48739 | 49391 |
| -15 | 44652 | 45281 | 45962 | 46690 | 47318 | 46107 | 46755 | 47453 | 48202 | 48848 |
| -10 | 44177 | 44801 | 45476 | 46197 | 46819 | 45608 | 46250 | 46942 | 47684 | 48323 |
| -5 | 43717 | 44334 | 45004 | 45718 | 46334 | 45123 | 45759 | 46445 | 47180 | 47813 |
| 0 | 43271 | 43883 | 44548 | 45255 | 45866 | 44655 | 45284 | 45965 | 46693 | 47321 |
| 4 | 42924 | 43531 | 44192 | 44893 | 45500 | 44289 | 44914 | 45590 | 46313 | 46936 |
| 8 | 42584 | 43187 | 43844 | 44540 | 45143 | 43932 | 44552 | 45225 | 45941 | 46560 |
| 12 | 42252 | 42851 | 43504 | 44196 | 44794 | 43583 | 44198 | 44867 | 45578 | 46193 |
| 16 | 41930 | 42524 | 43173 | 43860 | 44454 | 43243 | 43854 | 44519 | 45226 | 45836 |
| 20 | 41614 | 42204 | 42850 | 43532 | 44122 | 42911 | 43518 | 44179 | 44880 | 45487 |
| 24 | 41305 | 41891 | 42533 | 43211 | 43797 | 42586 | 43189 | 43846 | 44542 | 45145 |
| 28 | 41002 | 41584 | 42223 | 42896 | 43479 | 42268 | 42866 | 43520 | 44211 | 44810 |
| 32 | 40708 | 41286 | 41921 | 42590 | 43169 | 41958 | 42553 | 43202 | 43890 | 44484 |
| 36 | 40420 | 40994 | 41626 | 42290 | 42866 | 41655 | 42245 | 42892 | 43574 | 44165 |
| 40 | 40138 | 40709 | 41337 | 41997 | 42569 | 41358 | 41945 | 42587 | 43266 | 43853 |
| 44 | 39863 | 40430 | 41055 | 41711 | 42280 | 41069 | 41652 | 42291 | 42965 | 43549 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 4000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 38850 | 39404 | 40017 | 40658 | 41215 | 42769 | 43374 | 44034 | 44733 | 45337 |
| -15 | 38458 | 39007 | 39616 | 40251 | 40803 | 42313 | 42912 | 43566 | 44258 | 44857 |
| -10 | 38079 | 38624 | 39228 | 39858 | 40404 | 41872 | 42465 | 43114 | 43800 | 44393 |
| -5 | 37712 | 38252 | 38852 | 39476 | 40018 | 41444 | 42032 | 42676 | 43355 | 43943 |
| 0 | 37356 | 37891 | 38487 | 39106 | 39644 | 41029 | 41611 | 42250 | 42924 | 43507 |
| 4 | 37078 | 37610 | 38203 | 38817 | 39352 | 40705 | 41283 | 41918 | 42587 | 43166 |
| 8 | 36807 | 37335 | 37925 | 38535 | 39066 | 40389 | 40963 | 41595 | 42259 | 42834 |
| 12 | 36543 | 37067 | 37654 | 38260 | 38788 | 40081 | 40651 | 41279 | 41938 | 42510 |
| 16 | 36284 | 36805 | 37388 | 37991 | 38516 | 39779 | 40345 | 40969 | 41624 | 42192 |
| 20 | 36032 | 36549 | 37130 | 37729 | 38250 | 39485 | 40047 | 40668 | 41319 | 41883 |
| 24 | 35785 | 36300 | 36878 | 37473 | 37991 | 39198 | 39757 | 40374 | 41020 | 41581 |
| 28 | 35545 | 36056 | 36631 | 37223 | 37738 | 38917 | 39472 | 40087 | 40729 | 41286 |
| 32 | 35310 | 35818 | 36390 | 36979 | 37491 | 38644 | 39195 | 39806 | 40444 | 40998 |
| 36 | 35077 | 35583 | 36152 | 36737 | 37247 | 38373 | 38921 | 39529 | 40162 | 40713 |
| 40 | 34847 | 35349 | 35916 | 36497 | 37004 | 38104 | 38649 | 39254 | 39883 | 40431 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 44232 | 44856 | 45532 | 46253 | 46876 | 45665 | 46307 | 47000 | 47743 | 48383 |
| -15 | 43753 | 44371 | 45042 | 45756 | 46372 | 45161 | 45798 | 46485 | 47220 | 47854 |
| -10 | 43291 | 43903 | 44568 | 45275 | 45886 | 44675 | 45305 | 45986 | 46714 | 47342 |
| -5 | 42843 | 43449 | 44109 | 44809 | 45415 | 44203 | 44827 | 45503 | 46224 | 46846 |
| 0 | 42407 | 43008 | 43663 | 44357 | 44957 | 43746 | 44364 | 45034 | 45748 | 46365 |
| 4 | 42068 | 42664 | 43315 | 44004 | 44600 | 43389 | 44002 | 44668 | 45377 | 45989 |
| 8 | 41737 | 42328 | 42976 | 43660 | 44251 | 43040 | 43649 | 44311 | 45015 | 45623 |
| 12 | 41414 | 42001 | 42645 | 43324 | 43912 | 42701 | 43305 | 43963 | 44662 | 45265 |
| 16 | 41097 | 41681 | 42320 | 42995 | 43579 | 42368 | 42967 | 43622 | 44315 | 44915 |
| 20 | 40789 | 41368 | 42005 | 42674 | 43255 | 42043 | 42639 | 43290 | 43978 | 44574 |
| 24 | 40488 | 41064 | 41696 | 42362 | 42938 | 41727 | 42319 | 42966 | 43649 | 44241 |
| 28 | 40194 | 40766 | 41395 | 42056 | 42629 | 41418 | 42005 | 42649 | 43328 | 43916 |
| 32 | 39908 | 40476 | 41101 | 41758 | 42327 | 41116 | 41700 | 42340 | 43014 | 43598 |
| 36 | 39623 | 40188 | 40810 | 41463 | 42028 | 40817 | 41397 | 42033 | 42703 | 43284 |
| 40 | 39342 | 39903 | 40522 | 41170 | 41732 | 40521 | 41097 | 41730 | 42396 | 42973 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 5000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 38115 | 38660 | 39265 | 39895 | 40442 | 41913 | 42507 | 43156 | 43843 | 44437 |
| -15 | 37733 | 38273 | 38873 | 39497 | 40040 | 41468 | 42056 | 42700 | 43380 | 43969 |
| -10 | 37363 | 37898 | 38494 | 39113 | 39651 | 41037 | 41619 | 42258 | 42932 | 43515 |
| -5 | 37004 | 37535 | 38127 | 38740 | 39274 | 40619 | 41196 | 41830 | 42497 | 43075 |
| 0 | 36657 | 37183 | 37771 | 38379 | 38908 | 40214 | 40786 | 41415 | 42076 | 42649 |
| 4 | 36386 | 36908 | 37493 | 38097 | 38623 | 39898 | 40466 | 41092 | 41748 | 42317 |
| 8 | 36121 | 36640 | 37221 | 37822 | 38344 | 39589 | 40153 | 40775 | 41427 | 41992 |
| 12 | 35864 | 36379 | 36958 | 37554 | 38074 | 39289 | 39849 | 40468 | 41115 | 41677 |
| 16 | 35612 | 36124 | 36700 | 37293 | 37809 | 38996 | 39552 | 40167 | 40810 | 41368 |
| 20 | 35367 | 35876 | 36449 | 37038 | 37551 | 38710 | 39262 | 39874 | 40513 | 41068 |
| 24 | 35125 | 35631 | 36201 | 36786 | 37297 | 38428 | 38977 | 39585 | 40220 | 40771 |
| 28 | 34885 | 35387 | 35955 | 36537 | 37044 | 38148 | 38693 | 39299 | 39929 | 40477 |
| 32 | 34649 | 35149 | 35713 | 36292 | 36796 | 37873 | 38415 | 39017 | 39644 | 40188 |
| 36 | 34419 | 34916 | 35478 | 36052 | 36554 | 37605 | 38144 | 38743 | 39365 | 39906 |
| 40 | 34193 | 34687 | 35246 | 35818 | 36317 | 37342 | 37877 | 38473 | 39091 | 39629 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 43334 | 43947 | 44612 | 45320 | 45932 | 44721 | 45351 | 46033 | 46762 | 47390 |
| -15 | 42868 | 43474 | 44134 | 44835 | 45441 | 44230 | 44854 | 45530 | 46251 | 46874 |
| -10 | 42416 | 43016 | 43671 | 44365 | 44965 | 43754 | 44372 | 45043 | 45757 | 46374 |
| -5 | 41977 | 42572 | 43222 | 43910 | 44505 | 43293 | 43905 | 44571 | 45278 | 45889 |
| 0 | 41553 | 42142 | 42787 | 43469 | 44058 | 42847 | 43453 | 44113 | 44814 | 45419 |
| 4 | 41222 | 41807 | 42448 | 43125 | 43710 | 42499 | 43100 | 43757 | 44452 | 45053 |
| 8 | 40898 | 41479 | 42116 | 42788 | 43369 | 42158 | 42755 | 43407 | 44098 | 44695 |
| 12 | 40584 | 41161 | 41794 | 42461 | 43039 | 41828 | 42420 | 43069 | 43754 | 44347 |
| 16 | 40276 | 40849 | 41479 | 42142 | 42715 | 41504 | 42093 | 42737 | 43418 | 44007 |
| 20 | 39977 | 40546 | 41172 | 41830 | 42400 | 41189 | 41774 | 42414 | 43090 | 43675 |
| 24 | 39682 | 40247 | 40870 | 41523 | 42090 | 40878 | 41459 | 42096 | 42767 | 43348 |
| 28 | 39388 | 39949 | 40569 | 41218 | 41781 | 40569 | 41146 | 41780 | 42446 | 43024 |
| 32 | 39100 | 39658 | 40274 | 40919 | 41478 | 40267 | 40839 | 41469 | 42131 | 42705 |
| 36 | 38819 | 39373 | 39986 | 40627 | 41183 | 39971 | 40540 | 41166 | 41824 | 42394 |
| 40 | 38543 | 39094 | 39704 | 40340 | 40892 | 39681 | 40246 | 40869 | 41522 | 42089 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 6000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 37394 | 37929 | 38526 | 39145 | 39683 | 41072 | 41656 | 42295 | 42969 | 43553 |
| -15 | 37020 | 37551 | 38143 | 38757 | 39291 | 40637 | 41215 | 41849 | 42517 | 43095 |
| -10 | 36659 | 37185 | 37773 | 38381 | 38910 | 40216 | 40788 | 41417 | 42079 | 42652 |
| -5 | 36308 | 36830 | 37413 | 38017 | 38542 | 39808 | 40374 | 40999 | 41654 | 42222 |
| 0 | 35970 | 36486 | 37066 | 37664 | 38185 | 39413 | 39974 | 40594 | 41244 | 41807 |
| 4 | 35837 | 36352 | 36930 | 37526 | 38046 | 39258 | 39817 | 40436 | 41083 | 41644 |
| 8 | 35706 | 36219 | 36796 | 37390 | 37908 | 39105 | 39663 | 40279 | 40924 | 41484 |
| 12 | 35449 | 35959 | 36533 | 37123 | 37638 | 38806 | 39360 | 39973 | 40613 | 41169 |
| 16 | 35198 | 35705 | 36276 | 36863 | 37374 | 38514 | 39064 | 39673 | 40309 | 40861 |
| 20 | 34947 | 35451 | 36019 | 36602 | 37110 | 38221 | 38767 | 39374 | 40005 | 40554 |
| 24 | 34702 | 35202 | 35767 | 36346 | 36852 | 37935 | 38477 | 39080 | 39708 | 40253 |
| 28 | 34461 | 34959 | 35521 | 36097 | 36599 | 37655 | 38194 | 38793 | 39416 | 39958 |
| 32 | 34226 | 34720 | 35280 | 35852 | 36351 | 37381 | 37916 | 38512 | 39131 | 39669 |
| 36 | 33992 | 34483 | 35040 | 35609 | 36105 | 37108 | 37640 | 38233 | 38848 | 39383 |
| 40 | 33763 | 34252 | 34806 | 35371 | 35864 | 36841 | 37369 | 37959 | 38570 | 39102 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 42453 | 43054 | 43710 | 44404 | 45005 | 43794 | 44412 | 45083 | 45798 | 46415 |
| -15 | 41997 | 42592 | 43242 | 43930 | 44525 | 43314 | 43926 | 44592 | 45299 | 45911 |
| -10 | 41555 | 42145 | 42790 | 43471 | 44061 | 42849 | 43456 | 44116 | 44816 | 45422 |
| -5 | 41127 | 41711 | 42351 | 43026 | 43610 | 42399 | 42999 | 43654 | 44348 | 44948 |
| 0 | 40713 | 41292 | 41927 | 42596 | 43175 | 41964 | 42558 | 43208 | 43896 | 44490 |
| 4 | 40551 | 41127 | 41761 | 42427 | 43004 | 41793 | 42385 | 43033 | 43718 | 44311 |
| 8 | 40391 | 40966 | 41597 | 42261 | 42836 | 41625 | 42215 | 42861 | 43543 | 44134 |
| 12 | 40077 | 40648 | 41275 | 41935 | 42506 | 41295 | 41881 | 42523 | 43200 | 43787 |
| 16 | 39771 | 40337 | 40962 | 41616 | 42184 | 40973 | 41554 | 42193 | 42865 | 43448 |
| 20 | 39465 | 40027 | 40648 | 41298 | 41862 | 40650 | 41228 | 41862 | 42530 | 43109 |
| 24 | 39165 | 39723 | 40340 | 40986 | 41546 | 40335 | 40908 | 41539 | 42202 | 42776 |
| 28 | 38871 | 39425 | 40039 | 40680 | 41237 | 40025 | 40595 | 41222 | 41881 | 42451 |
| 32 | 38584 | 39134 | 39745 | 40382 | 40935 | 39723 | 40289 | 40912 | 41566 | 42133 |
| 36 | 38298 | 38845 | 39452 | 40085 | 40634 | 39422 | 39984 | 40604 | 41254 | 41817 |
| 40 | 38018 | 38562 | 39165 | 39794 | 40340 | 39128 | 39686 | 40303 | 40948 | 41508 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 7000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 36686 | 37212 | 37800 | 38409 | 38938 | 40247 | 40820 | 41449 | 42111 | 42685 |
| -15 | 36321 | 36842 | 37426 | 38029 | 38555 | 39822 | 40389 | 41013 | 41669 | 42237 |
| -10 | 35968 | 36485 | 37065 | 37663 | 38184 | 39411 | 39972 | 40592 | 41242 | 41805 |
| -5 | 35627 | 36139 | 36715 | 37308 | 37825 | 39013 | 39570 | 40185 | 40828 | 41387 |
| 0 | 35298 | 35806 | 36378 | 36966 | 37478 | 38629 | 39181 | 39792 | 40429 | 40983 |
| 4 | 35168 | 35674 | 36245 | 36831 | 37342 | 38478 | 39027 | 39637 | 40272 | 40824 |
| 8 | 35037 | 35542 | 36111 | 36695 | 37204 | 38326 | 38873 | 39481 | 40114 | 40664 |
| 12 | 34780 | 35282 | 35847 | 36428 | 36934 | 38026 | 38570 | 39174 | 39802 | 40349 |
| 16 | 34529 | 35027 | 35590 | 36166 | 36669 | 37733 | 38273 | 38873 | 39498 | 40040 |
| 20 | 34283 | 34778 | 35338 | 35911 | 36411 | 37447 | 37983 | 38580 | 39200 | 39739 |
| 24 | 34040 | 34532 | 35089 | 35659 | 36156 | 37164 | 37696 | 38290 | 38906 | 39441 |
| 28 | 33801 | 34290 | 34844 | 35410 | 35904 | 36885 | 37414 | 38004 | 38616 | 39148 |
| 32 | 33567 | 34053 | 34605 | 35167 | 35658 | 36613 | 37138 | 37725 | 38333 | 38862 |
| 36 | 33339 | 33822 | 34371 | 34930 | 35418 | 36347 | 36868 | 37453 | 38056 | 38582 |
| 40 | 33116 | 33596 | 34142 | 34698 | 35183 | 36087 | 36605 | 37186 | 37786 | 38308 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 41588 | 42178 | 42823 | 43505 | 44095 | 42884 | 43491 | 44151 | 44852 | 45458 |
| -15 | 41142 | 41726 | 42367 | 43042 | 43626 | 42415 | 43015 | 43670 | 44365 | 44965 |
| -10 | 40711 | 41290 | 41925 | 42594 | 43173 | 41962 | 42556 | 43206 | 43893 | 44488 |
| -5 | 40295 | 40868 | 41498 | 42161 | 42735 | 41523 | 42112 | 42757 | 43438 | 44027 |
| 0 | 39892 | 40460 | 41086 | 41742 | 42312 | 41100 | 41684 | 42323 | 42998 | 43582 |
| 4 | 39734 | 40299 | 40923 | 41577 | 42145 | 40933 | 41514 | 42152 | 42824 | 43406 |
| 8 | 39574 | 40138 | 40760 | 41412 | 41977 | 40765 | 41344 | 41980 | 42650 | 43230 |
| 12 | 39260 | 39820 | 40438 | 41085 | 41647 | 40435 | 41010 | 41642 | 42306 | 42882 |
| 16 | 38953 | 39509 | 40123 | 40766 | 41323 | 40112 | 40682 | 41311 | 41970 | 42542 |
| 20 | 38653 | 39205 | 39816 | 40454 | 41008 | 39796 | 40363 | 40987 | 41643 | 42211 |
| 24 | 38356 | 38904 | 39512 | 40145 | 40696 | 39484 | 40047 | 40667 | 41318 | 41882 |
| 28 | 38064 | 38608 | 39213 | 39842 | 40388 | 39177 | 39735 | 40353 | 40998 | 41559 |
| 32 | 37779 | 38319 | 38920 | 39545 | 40088 | 38877 | 39431 | 40045 | 40686 | 41243 |
| 36 | 37500 | 38036 | 38634 | 39255 | 39795 | 38583 | 39134 | 39744 | 40381 | 40934 |
| 40 | 37227 | 37760 | 38355 | 38972 | 39508 | 38296 | 38843 | 39450 | 40083 | 40633 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 8000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 35989 | 36507 | 37087 | 37685 | 38206 | 39436 | 39998 | 40618 | 41268 | 41831 |
| -15 | 35634 | 36147 | 36723 | 37316 | 37832 | 39022 | 39578 | 40194 | 40837 | 41396 |
| -10 | 35291 | 35800 | 36371 | 36959 | 37472 | 38622 | 39174 | 39784 | 40422 | 40976 |
| -5 | 34953 | 35457 | 36025 | 36608 | 37116 | 38228 | 38774 | 39381 | 40012 | 40561 |
| 0 | 34623 | 35123 | 35687 | 36265 | 36769 | 37844 | 38385 | 38986 | 39612 | 40156 |
| 2 | 34494 | 34992 | 35554 | 36130 | 36633 | 37693 | 38232 | 38832 | 39456 | 39998 |
| 4 | 34366 | 34862 | 35423 | 35998 | 36499 | 37544 | 38081 | 38679 | 39301 | 39841 |
| 8 | 34114 | 34606 | 35165 | 35735 | 36233 | 37250 | 37783 | 38378 | 38995 | 39532 |
| 12 | 33863 | 34353 | 34908 | 35475 | 35970 | 36958 | 37488 | 38079 | 38692 | 39225 |
| 16 | 33620 | 34106 | 34659 | 35222 | 35714 | 36674 | 37200 | 37788 | 38397 | 38926 |
| 20 | 33381 | 33864 | 34414 | 34973 | 35462 | 36396 | 36918 | 37503 | 38107 | 38633 |
| 24 | 33148 | 33628 | 34175 | 34731 | 35217 | 36124 | 36643 | 37225 | 37825 | 38348 |
| 28 | 32920 | 33397 | 33942 | 34494 | 34978 | 35858 | 36374 | 36952 | 37549 | 38068 |
| 32 | 32697 | 33172 | 33713 | 34263 | 34743 | 35599 | 36111 | 36687 | 37279 | 37795 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 40738 | 41316 | 41952 | 42621 | 43201 | 41989 | 42584 | 43234 | 43922 | 44517 |
| -15 | 40304 | 40877 | 41507 | 42170 | 42744 | 41533 | 42122 | 42767 | 43447 | 44037 |
| -10 | 39885 | 40453 | 41078 | 41735 | 42304 | 41092 | 41676 | 42315 | 42990 | 43574 |
| -5 | 39472 | 40034 | 40655 | 41305 | 41869 | 40658 | 41235 | 41870 | 42538 | 43116 |
| 0 | 39069 | 39626 | 40242 | 40886 | 41445 | 40234 | 40806 | 41435 | 42097 | 42670 |
| 2 | 38911 | 39466 | 40080 | 40722 | 41279 | 40068 | 40638 | 41265 | 41924 | 42496 |
| 4 | 38755 | 39308 | 39920 | 40560 | 41115 | 39903 | 40471 | 41097 | 41754 | 42323 |
| 8 | 38446 | 38995 | 39604 | 40239 | 40790 | 39579 | 40142 | 40764 | 41416 | 41981 |
| 12 | 38141 | 38686 | 39291 | 39921 | 40469 | 39257 | 39817 | 40435 | 41082 | 41643 |
| 16 | 37843 | 38384 | 38986 | 39612 | 40156 | 38944 | 39499 | 40114 | 40756 | 41314 |
| 20 | 37551 | 38089 | 38687 | 39308 | 39849 | 38637 | 39189 | 39800 | 40437 | 40991 |
| 24 | 37266 | 37800 | 38395 | 39012 | 39549 | 38338 | 38885 | 39493 | 40126 | 40676 |
| 28 | 36988 | 37518 | 38110 | 38723 | 39256 | 38045 | 38589 | 39193 | 39822 | 40368 |
| 32 | 36716 | 37243 | 37831 | 38440 | 38970 | 37759 | 38299 | 38899 | 39524 | 40067 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 9000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 35306 | 35814 | 36386 | 36975 | 37487 | 38639 | 39191 | 39802 | 40440 | 40993 |
| -15 | 34955 | 35459 | 36027 | 36610 | 37118 | 38230 | 38776 | 39383 | 40014 | 40563 |
| -10 | 34612 | 35111 | 35675 | 36253 | 36757 | 37830 | 38371 | 38973 | 39599 | 40142 |
| -5 | 34279 | 34774 | 35334 | 35907 | 36407 | 37442 | 37978 | 38575 | 39195 | 39734 |
| 0 | 33952 | 34443 | 34999 | 35567 | 36063 | 37061 | 37593 | 38185 | 38799 | 39334 |
| 2 | 33824 | 34313 | 34868 | 35434 | 35928 | 36912 | 37441 | 38032 | 38644 | 39176 |
| 4 | 33697 | 34184 | 34737 | 35302 | 35794 | 36764 | 37291 | 37880 | 38490 | 39020 |
| 8 | 33447 | 33931 | 34482 | 35042 | 35532 | 36473 | 36996 | 37582 | 38188 | 38715 |
| 12 | 33204 | 33685 | 34232 | 34789 | 35276 | 36189 | 36709 | 37291 | 37893 | 38416 |
| 16 | 32965 | 33443 | 33988 | 34541 | 35025 | 35911 | 36428 | 37007 | 37604 | 38124 |
| 20 | 32733 | 33208 | 33751 | 34300 | 34781 | 35641 | 36154 | 36730 | 37323 | 37840 |
| 24 | 32506 | 32978 | 33517 | 34063 | 34542 | 35375 | 35885 | 36458 | 37047 | 37560 |
| 28 | 32283 | 32752 | 33289 | 33832 | 34308 | 35116 | 35622 | 36192 | 36777 | 37287 |
| 32 | 32065 | 32532 | 33066 | 33606 | 34078 | 34862 | 35365 | 35932 | 36513 | 37021 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 39903 | 40471 | 41096 | 41753 | 42322 | 41111 | 41695 | 42334 | 43009 | 43593 |
| -15 | 39474 | 40036 | 40657 | 41307 | 41871 | 40660 | 41238 | 41872 | 42540 | 43119 |
| -10 | 39055 | 39612 | 40228 | 40872 | 41431 | 40219 | 40791 | 41420 | 42082 | 42655 |
| -5 | 38648 | 39200 | 39811 | 40449 | 41003 | 39791 | 40358 | 40982 | 41637 | 42205 |
| 0 | 38249 | 38795 | 39402 | 40034 | 40583 | 39371 | 39932 | 40552 | 41201 | 41763 |
| 2 | 38092 | 38636 | 39241 | 39871 | 40418 | 39206 | 39765 | 40383 | 41029 | 41590 |
| 4 | 37937 | 38479 | 39082 | 39709 | 40254 | 39043 | 39599 | 40215 | 40859 | 41418 |
| 8 | 37632 | 38170 | 38770 | 39393 | 39934 | 38722 | 39275 | 39887 | 40526 | 41081 |
| 12 | 37335 | 37869 | 38465 | 39084 | 39621 | 38409 | 38958 | 39566 | 40201 | 40752 |
| 16 | 37044 | 37574 | 38167 | 38781 | 39315 | 38103 | 38648 | 39252 | 39882 | 40429 |
| 20 | 36760 | 37287 | 37876 | 38486 | 39017 | 37805 | 38346 | 38947 | 39572 | 40116 |
| 24 | 36482 | 37005 | 37591 | 38197 | 38724 | 37512 | 38049 | 38647 | 39268 | 39808 |
| 28 | 36210 | 36730 | 37313 | 37914 | 38438 | 37226 | 37759 | 38354 | 38971 | 39507 |
| 32 | 35944 | 36460 | 37040 | 37638 | 38158 | 36946 | 37476 | 38067 | 38680 | 39213 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 22° - 10000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 34621 | 35120 | 35684 | 36262 | 36766 | 37840 | 38382 | 38983 | 39609 | 40153 |
| -15 | 34275 | 34770 | 35330 | 35903 | 36403 | 37438 | 37974 | 38571 | 39191 | 39730 |
| -10 | 33937 | 34427 | 34983 | 35551 | 36047 | 37043 | 37574 | 38167 | 38781 | 39315 |
| -5 | 33606 | 34093 | 34645 | 35208 | 35699 | 36658 | 37184 | 37772 | 38380 | 38910 |
| 0 | 33286 | 33768 | 34316 | 34874 | 35362 | 36285 | 36806 | 37389 | 37992 | 38517 |
| 2 | 33161 | 33641 | 34188 | 34744 | 35231 | 36139 | 36658 | 37240 | 37841 | 38363 |
| 4 | 33037 | 33516 | 34061 | 34616 | 35100 | 35995 | 36512 | 37092 | 37690 | 38212 |
| 8 | 32794 | 33270 | 33813 | 34363 | 34845 | 35712 | 36225 | 36802 | 37396 | 37914 |
| 12 | 32556 | 33028 | 33568 | 34116 | 34594 | 35434 | 35944 | 36517 | 37108 | 37622 |
| 16 | 32323 | 32793 | 33330 | 33874 | 34350 | 35163 | 35669 | 36240 | 36826 | 37337 |
| 20 | 32096 | 32562 | 33097 | 33637 | 34110 | 34898 | 35401 | 35968 | 36550 | 37058 |
| 24 | 31874 | 32338 | 32870 | 33407 | 33877 | 34639 | 35139 | 35703 | 36281 | 36786 |
| 28 | 31657 | 32118 | 32647 | 33181 | 33649 | 34386 | 34883 | 35444 | 36018 | 36520 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 39065 | 39622 | 40238 | 40883 | 41442 | 40230 | 40802 | 41432 | 42093 | 42667 |
| -15 | 38644 | 39195 | 39806 | 40444 | 40998 | 39787 | 40353 | 40977 | 41632 | 42200 |
| -10 | 38230 | 38776 | 39383 | 40014 | 40563 | 39351 | 39912 | 40531 | 41180 | 41742 |
| -5 | 37826 | 38367 | 38969 | 39595 | 40138 | 38927 | 39482 | 40096 | 40738 | 41296 |
| 0 | 37435 | 37971 | 38568 | 39187 | 39726 | 38515 | 39065 | 39674 | 40310 | 40862 |
| 2 | 37282 | 37816 | 38411 | 39029 | 39566 | 38354 | 38902 | 39510 | 40143 | 40693 |
| 4 | 37131 | 37663 | 38256 | 38872 | 39407 | 38195 | 38741 | 39347 | 39978 | 40526 |
| 8 | 36834 | 37362 | 37952 | 38563 | 39095 | 37883 | 38425 | 39027 | 39654 | 40198 |
| 12 | 36543 | 37067 | 37654 | 38261 | 38788 | 37577 | 38114 | 38713 | 39335 | 39876 |
| 16 | 36259 | 36780 | 37363 | 37965 | 38490 | 37278 | 37812 | 38407 | 39024 | 39561 |
| 20 | 35981 | 36498 | 37078 | 37676 | 38197 | 36985 | 37516 | 38107 | 38720 | 39254 |
| 24 | 35710 | 36224 | 36800 | 37395 | 37912 | 36700 | 37227 | 37815 | 38424 | 38954 |
| 28 | 35445 | 35955 | 36529 | 37119 | 37633 | 36421 | 36944 | 37529 | 38134 | 38661 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - SEA LEVEL
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 44410 | 44988 | 45532 | 46196 | 46713 | 49231 | 49861 | 50461 | 51191 | 51732 |
| -15 | 43974 | 44547 | 45086 | 45744 | 46259 | 48723 | 49347 | 49941 | 50664 | 51203 |
| -10 | 43553 | 44121 | 44655 | 45307 | 45820 | 48232 | 48850 | 49439 | 50155 | 50692 |
| -5 | 43141 | 43706 | 44235 | 44881 | 45392 | 47752 | 48366 | 48949 | 49659 | 50193 |
| 0 | 42742 | 43302 | 43826 | 44467 | 44976 | 47286 | 47895 | 48473 | 49176 | 49708 |
| 4 | 42430 | 42986 | 43507 | 44144 | 44651 | 46923 | 47528 | 48101 | 48799 | 49329 |
| 8 | 42125 | 42678 | 43196 | 43828 | 44334 | 46568 | 47169 | 47738 | 48431 | 48959 |
| 12 | 41827 | 42377 | 42891 | 43520 | 44024 | 46221 | 46818 | 47383 | 48072 | 48598 |
| 16 | 41536 | 42083 | 42594 | 43218 | 43721 | 45881 | 46475 | 47036 | 47720 | 48245 |
| 20 | 41252 | 41796 | 42304 | 42924 | 43426 | 45551 | 46141 | 46698 | 47378 | 47901 |
| 24 | 40973 | 41514 | 42018 | 42634 | 43134 | 45225 | 45811 | 46365 | 47040 | 47561 |
| 28 | 40699 | 41237 | 41738 | 42351 | 42849 | 44906 | 45489 | 46039 | 46709 | 47229 |
| 32 | 40431 | 40966 | 41464 | 42073 | 42570 | 44593 | 45173 | 45719 | 46386 | 46904 |
| 36 | 40168 | 40700 | 41195 | 41800 | 42297 | 44287 | 44864 | 45406 | 46068 | 46585 |
| 40 | 39911 | 40440 | 40932 | 41534 | 42029 | 43987 | 44560 | 45099 | 45757 | 46273 |
| 44 | 39658 | 40185 | 40674 | 41272 | 41766 | 43693 | 44263 | 44799 | 45452 | 45966 |
| 48 | 39411 | 39935 | 40421 | 41016 | 41508 | 43404 | 43972 | 44504 | 45154 | 45666 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 50999 | 51648 | 52269 | 52482 | 52640 | 51520 | 52174 | 52801 | 52837 | 52864 |
| -15 | 50467 | 51110 | 51724 | 52119 | 52411 | 51293 | 51945 | 52569 | 52683 | 52767 |
| -10 | 49952 | 50589 | 51198 | 51767 | 52189 | 51074 | 51724 | 52345 | 52533 | 52672 |
| -5 | 49449 | 50081 | 50684 | 51417 | 51960 | 50860 | 51507 | 52126 | 52387 | 52580 |
| 0 | 48961 | 49588 | 50185 | 50911 | 51451 | 50634 | 51279 | 51895 | 52233 | 52483 |
| 4 | 48580 | 49203 | 49795 | 50517 | 51055 | 50233 | 50874 | 51485 | 51959 | 52310 |
| 8 | 48208 | 48827 | 49415 | 50131 | 50667 | 49842 | 50478 | 51085 | 51692 | 52141 |
| 12 | 47844 | 48459 | 49043 | 49754 | 50288 | 49459 | 50091 | 50694 | 51427 | 51969 |
| 16 | 47489 | 48099 | 48679 | 49385 | 49918 | 49085 | 49713 | 50311 | 51039 | 51580 |
| 20 | 47142 | 47749 | 48325 | 49026 | 49557 | 48720 | 49344 | 49939 | 50662 | 51200 |
| 24 | 46800 | 47404 | 47976 | 48672 | 49202 | 48361 | 48981 | 49571 | 50289 | 50826 |
| 28 | 46466 | 47066 | 47634 | 48326 | 48853 | 48009 | 48626 | 49212 | 49925 | 50460 |
| 32 | 46138 | 46735 | 47299 | 47986 | 48512 | 47665 | 48277 | 48859 | 49568 | 50101 |
| 36 | 45817 | 46410 | 46971 | 47654 | 48178 | 47327 | 47936 | 48514 | 49218 | 49750 |
| 40 | 45503 | 46093 | 46649 | 47328 | 47851 | 46996 | 47602 | 48176 | 48875 | 49405 |
| 44 | 45194 | 45781 | 46334 | 47008 | 47530 | 46671 | 47274 | 47844 | 48539 | 49067 |
| 48 | 44892 | 45475 | 46025 | 46695 | 47215 | 46354 | 46952 | 47519 | 48210 | 48737 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 1000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 43621 | 44190 | 44725 | 45378 | 45891 | 48311 | 48931 | 49520 | 50238 | 50774 |
| -15 | 43193 | 43758 | 44287 | 44934 | 45446 | 47812 | 48427 | 49010 | 49721 | 50255 |
| -10 | 42777 | 43338 | 43863 | 44504 | 45013 | 47328 | 47937 | 48515 | 49219 | 49751 |
| -5 | 42375 | 42931 | 43451 | 44087 | 44594 | 46859 | 47463 | 48036 | 48733 | 49263 |
| 0 | 41984 | 42536 | 43052 | 43682 | 44188 | 46404 | 47003 | 47570 | 48261 | 48789 |
| 4 | 41678 | 42227 | 42739 | 43365 | 43869 | 46047 | 46643 | 47206 | 47892 | 48418 |
| 8 | 41379 | 41925 | 42433 | 43055 | 43558 | 45698 | 46290 | 46849 | 47531 | 48054 |
| 12 | 41088 | 41630 | 42136 | 42754 | 43255 | 45359 | 45947 | 46503 | 47179 | 47701 |
| 16 | 40802 | 41342 | 41844 | 42458 | 42957 | 45026 | 45611 | 46162 | 46834 | 47355 |
| 20 | 40523 | 41059 | 41558 | 42168 | 42666 | 44700 | 45281 | 45829 | 46497 | 47015 |
| 24 | 40249 | 40783 | 41278 | 41885 | 42381 | 44382 | 44959 | 45503 | 46166 | 46683 |
| 28 | 39981 | 40511 | 41004 | 41606 | 42102 | 44069 | 44643 | 45183 | 45842 | 46358 |
| 32 | 39717 | 40245 | 40735 | 41334 | 41828 | 43762 | 44333 | 44869 | 45524 | 46038 |
| 36 | 39460 | 39985 | 40471 | 41067 | 41560 | 43462 | 44030 | 44563 | 45213 | 45726 |
| 40 | 39207 | 39730 | 40213 | 40805 | 41297 | 43167 | 43732 | 44261 | 44908 | 45419 |
| 44 | 38960 | 39479 | 39960 | 40549 | 41039 | 42879 | 43440 | 43967 | 44609 | 45119 |
| 48 | 38718 | 39235 | 39713 | 40298 | 40787 | 42597 | 43156 | 43678 | 44317 | 44826 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 50035 | 50673 | 51283 | 51824 | 52225 | 51110 | 51759 | 52381 | 52557 | 52688 |
| -15 | 49512 | 50145 | 50748 | 51467 | 52000 | 50887 | 51534 | 52154 | 52405 | 52592 |
| -10 | 49005 | 49632 | 50229 | 50956 | 51497 | 50671 | 51316 | 51933 | 52258 | 52499 |
| -5 | 48513 | 49135 | 49727 | 50447 | 50985 | 50163 | 50803 | 51414 | 51911 | 52280 |
| 0 | 48036 | 48653 | 49239 | 49953 | 50488 | 49661 | 50295 | 50900 | 51569 | 52064 |
| 4 | 47662 | 48275 | 48857 | 49566 | 50099 | 49268 | 49898 | 50498 | 51229 | 51770 |
| 8 | 47297 | 47906 | 48483 | 49187 | 49718 | 48883 | 49509 | 50105 | 50830 | 51370 |
| 12 | 46941 | 47546 | 48120 | 48818 | 49348 | 48509 | 49131 | 49723 | 50443 | 50981 |
| 16 | 46592 | 47194 | 47763 | 48457 | 48985 | 48142 | 48760 | 49348 | 50063 | 50599 |
| 20 | 46251 | 46848 | 47414 | 48103 | 48629 | 47783 | 48397 | 48980 | 49690 | 50224 |
| 24 | 45916 | 46511 | 47072 | 47757 | 48281 | 47431 | 48041 | 48621 | 49326 | 49858 |
| 28 | 45588 | 46179 | 46737 | 47417 | 47940 | 47086 | 47693 | 48268 | 48968 | 49499 |
| 32 | 45267 | 45854 | 46408 | 47084 | 47605 | 46748 | 47351 | 47922 | 48618 | 49147 |
| 36 | 44953 | 45536 | 46087 | 46758 | 47278 | 46417 | 47017 | 47584 | 48275 | 48803 |
| 40 | 44644 | 45224 | 45771 | 46438 | 46956 | 46092 | 46688 | 47252 | 47939 | 48464 |
| 44 | 44341 | 44919 | 45462 | 46125 | 46642 | 45774 | 46367 | 46927 | 47609 | 48133 |
| 48 | 44046 | 44620 | 45160 | 45819 | 46334 | 45463 | 46053 | 46609 | 47287 | 47810 |

**NOTE:** Quick Turn Around Weight in lb.



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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 2000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 42840 | 43401 | 43927 | 44569 | 45079 | 47401 | 48011 | 48590 | 49295 | 49827 |
| -15 | 42420 | 42977 | 43497 | 44134 | 44641 | 46912 | 47516 | 48089 | 48788 | 49317 |
| -10 | 42012 | 42565 | 43081 | 43712 | 44217 | 46437 | 47036 | 47604 | 48296 | 48823 |
| -5 | 41619 | 42167 | 42678 | 43304 | 43807 | 45978 | 46573 | 47135 | 47820 | 48345 |
| 0 | 41237 | 41781 | 42288 | 42909 | 43410 | 45533 | 46123 | 46680 | 47360 | 47883 |
| 4 | 40937 | 41478 | 41982 | 42598 | 43098 | 45184 | 45770 | 46323 | 46997 | 47518 |
| 8 | 40644 | 41182 | 41682 | 42294 | 42792 | 44842 | 45424 | 45973 | 46643 | 47163 |
| 12 | 40357 | 40892 | 41389 | 41997 | 42494 | 44508 | 45087 | 45632 | 46297 | 46815 |
| 16 | 40077 | 40609 | 41102 | 41707 | 42202 | 44181 | 44757 | 45298 | 45959 | 46475 |
| 20 | 39802 | 40331 | 40821 | 41422 | 41916 | 43861 | 44433 | 44971 | 45627 | 46142 |
| 24 | 39534 | 40060 | 40547 | 41144 | 41637 | 43548 | 44117 | 44651 | 45303 | 45816 |
| 28 | 39271 | 39794 | 40278 | 40871 | 41363 | 43242 | 43807 | 44337 | 44985 | 45497 |
| 32 | 39013 | 39534 | 40015 | 40604 | 41095 | 42941 | 43504 | 44030 | 44674 | 45184 |
| 36 | 38761 | 39279 | 39757 | 40343 | 40832 | 42648 | 43207 | 43730 | 44370 | 44878 |
| 40 | 38514 | 39029 | 39504 | 40087 | 40575 | 42359 | 42915 | 43436 | 44071 | 44578 |
| 44 | 38271 | 38783 | 39256 | 39835 | 40322 | 42076 | 42629 | 43146 | 43777 | 44283 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 49082 | 49710 | 50308 | 51036 | 51577 | 50704 | 51349 | 51966 | 52280 | 52513 |
| -15 | 48568 | 49191 | 49783 | 50504 | 51042 | 50221 | 50861 | 51473 | 51951 | 52305 |
| -10 | 48070 | 48688 | 49274 | 49988 | 50524 | 49697 | 50332 | 50937 | 51594 | 52079 |
| -5 | 47590 | 48202 | 48783 | 49490 | 50023 | 49191 | 49821 | 50420 | 51150 | 51691 |
| 0 | 47124 | 47731 | 48306 | 49007 | 49538 | 48701 | 49325 | 49919 | 50642 | 51181 |
| 4 | 46757 | 47360 | 47932 | 48628 | 49157 | 48316 | 48935 | 49525 | 50242 | 50779 |
| 8 | 46399 | 46998 | 47565 | 48256 | 48784 | 47939 | 48554 | 49139 | 49852 | 50387 |
| 12 | 46048 | 46644 | 47207 | 47893 | 48419 | 47570 | 48182 | 48763 | 49470 | 50003 |
| 16 | 45706 | 46298 | 46857 | 47539 | 48063 | 47210 | 47818 | 48395 | 49097 | 49628 |
| 20 | 45371 | 45959 | 46514 | 47191 | 47713 | 46857 | 47461 | 48034 | 48731 | 49261 |
| 24 | 45043 | 45628 | 46179 | 46852 | 47372 | 46512 | 47113 | 47681 | 48374 | 48902 |
| 28 | 44722 | 45303 | 45851 | 46519 | 47037 | 46174 | 46771 | 47336 | 48024 | 48550 |
| 32 | 44407 | 44985 | 45529 | 46192 | 46710 | 45843 | 46436 | 46997 | 47681 | 48205 |
| 36 | 44099 | 44674 | 45214 | 45874 | 46389 | 45519 | 46109 | 46666 | 47345 | 47868 |
| 40 | 43797 | 44368 | 44905 | 45561 | 46075 | 45201 | 45788 | 46341 | 47016 | 47537 |
| 44 | 43500 | 44068 | 44601 | 45253 | 45765 | 44889 | 45472 | 46021 | 46692 | 47212 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 3000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 42065 | 42617 | 43134 | 43766 | 44271 | 46497 | 47098 | 47666 | 48358 | 48886 |
| -15 | 41654 | 42202 | 42714 | 43340 | 43844 | 46019 | 46614 | 47177 | 47863 | 48388 |
| -10 | 41255 | 41799 | 42306 | 42927 | 43428 | 45554 | 46144 | 46701 | 47381 | 47904 |
| -5 | 40870 | 41410 | 41912 | 42527 | 43027 | 45105 | 45690 | 46242 | 46915 | 47436 |
| 0 | 40494 | 41030 | 41529 | 42138 | 42636 | 44667 | 45248 | 45795 | 46462 | 46981 |
| 4 | 40200 | 40733 | 41228 | 41834 | 42330 | 44325 | 44902 | 45445 | 46107 | 46624 |
| 8 | 39913 | 40443 | 40934 | 41536 | 42031 | 43990 | 44563 | 45102 | 45760 | 46275 |
| 12 | 39632 | 40158 | 40647 | 41245 | 41738 | 43662 | 44232 | 44767 | 45421 | 45934 |
| 16 | 39357 | 39880 | 40366 | 40960 | 41452 | 43341 | 43908 | 44439 | 45089 | 45601 |
| 20 | 39087 | 39608 | 40090 | 40681 | 41171 | 43027 | 43590 | 44118 | 44763 | 45274 |
| 24 | 38825 | 39343 | 39822 | 40409 | 40899 | 42722 | 43282 | 43806 | 44447 | 44956 |
| 28 | 38567 | 39082 | 39558 | 40142 | 40630 | 42421 | 42978 | 43498 | 44135 | 44642 |
| 32 | 38314 | 38827 | 39300 | 39880 | 40367 | 42126 | 42680 | 43197 | 43830 | 44336 |
| 36 | 38067 | 38577 | 39047 | 39624 | 40110 | 41839 | 42389 | 42903 | 43531 | 44036 |
| 40 | 37824 | 38332 | 38799 | 39372 | 39857 | 41555 | 42103 | 42614 | 43238 | 43741 |
| 44 | 37586 | 38091 | 38556 | 39126 | 39609 | 41278 | 41822 | 42330 | 42951 | 43452 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 48134 | 48752 | 49339 | 50054 | 50590 | 49764 | 50399 | 51006 | 51639 | 52108 |
| -15 | 47633 | 48245 | 48827 | 49535 | 50068 | 49237 | 49866 | 50466 | 51196 | 51738 |
| -10 | 47145 | 47752 | 48328 | 49029 | 49560 | 48724 | 49348 | 49942 | 50665 | 51204 |
| -5 | 46674 | 47277 | 47847 | 48542 | 49070 | 48228 | 48847 | 49436 | 50152 | 50688 |
| 0 | 46216 | 46813 | 47378 | 48067 | 48593 | 47746 | 48360 | 48942 | 49652 | 50186 |
| 4 | 45857 | 46450 | 47011 | 47695 | 48219 | 47368 | 47978 | 48556 | 49261 | 49793 |
| 8 | 45506 | 46095 | 46652 | 47331 | 47854 | 46999 | 47605 | 48179 | 48878 | 49408 |
| 12 | 45162 | 45748 | 46301 | 46975 | 47496 | 46638 | 47239 | 47809 | 48504 | 49032 |
| 16 | 44826 | 45409 | 45957 | 46627 | 47146 | 46284 | 46882 | 47448 | 48138 | 48664 |
| 20 | 44497 | 45076 | 45621 | 46286 | 46804 | 45938 | 46532 | 47094 | 47779 | 48304 |
| 24 | 44177 | 44752 | 45294 | 45954 | 46470 | 45601 | 46192 | 46750 | 47430 | 47953 |
| 28 | 43861 | 44433 | 44971 | 45627 | 46142 | 45269 | 45856 | 46410 | 47086 | 47608 |
| 32 | 43553 | 44121 | 44655 | 45307 | 45820 | 44945 | 45528 | 46078 | 46750 | 47270 |
| 36 | 43251 | 43817 | 44347 | 44995 | 45506 | 44627 | 45207 | 45754 | 46421 | 46939 |
| 40 | 42954 | 43517 | 44044 | 44687 | 45197 | 44315 | 44892 | 45435 | 46097 | 46614 |
| 44 | 42663 | 43223 | 43746 | 44386 | 44895 | 44009 | 44583 | 45122 | 45780 | 46296 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 4000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 41299 | 41843 | 42351 | 42972 | 43474 | 45605 | 46196 | 46754 | 47434 | 47957 |
| -15 | 40899 | 41439 | 41942 | 42558 | 43057 | 45139 | 45724 | 46277 | 46951 | 47472 |
| -10 | 40508 | 41045 | 41543 | 42153 | 42651 | 44684 | 45265 | 45812 | 46479 | 46998 |
| -5 | 40129 | 40661 | 41156 | 41760 | 42256 | 44242 | 44818 | 45360 | 46021 | 46538 |
| 0 | 39761 | 40289 | 40779 | 41379 | 41873 | 43812 | 44384 | 44921 | 45576 | 46091 |
| 4 | 39472 | 39997 | 40484 | 41080 | 41572 | 43476 | 44044 | 44577 | 45228 | 45741 |
| 8 | 39190 | 39712 | 40195 | 40787 | 41279 | 43147 | 43712 | 44241 | 44887 | 45398 |
| 12 | 38915 | 39434 | 39914 | 40502 | 40992 | 42827 | 43388 | 43913 | 44555 | 45065 |
| 16 | 38646 | 39162 | 39639 | 40224 | 40712 | 42513 | 43071 | 43593 | 44231 | 44738 |
| 20 | 38382 | 38896 | 39370 | 39951 | 40438 | 42206 | 42760 | 43279 | 43912 | 44418 |
| 24 | 38124 | 38635 | 39106 | 39683 | 40169 | 41905 | 42456 | 42971 | 43600 | 44105 |
| 28 | 37871 | 38379 | 38847 | 39421 | 39906 | 41610 | 42158 | 42670 | 43295 | 43798 |
| 32 | 37624 | 38129 | 38594 | 39164 | 39648 | 41322 | 41866 | 42375 | 42996 | 43498 |
| 36 | 37381 | 37884 | 38346 | 38913 | 39395 | 41039 | 41581 | 42085 | 42703 | 43203 |
| 40 | 37143 | 37643 | 38102 | 38666 | 39147 | 40761 | 41300 | 41802 | 42415 | 42914 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 47199 | 47807 | 48383 | 49085 | 49616 | 48780 | 49405 | 50000 | 50724 | 51263 |
| -15 | 46710 | 47313 | 47883 | 48579 | 49108 | 48266 | 48885 | 49474 | 50191 | 50727 |
| -10 | 46233 | 46831 | 47396 | 48085 | 48611 | 47764 | 48378 | 48961 | 49671 | 50205 |
| -5 | 45770 | 46363 | 46922 | 47605 | 48129 | 47277 | 47886 | 48463 | 49166 | 49698 |
| 0 | 45320 | 45908 | 46462 | 47138 | 47660 | 46804 | 47407 | 47979 | 48676 | 49205 |
| 4 | 44967 | 45551 | 46102 | 46773 | 47293 | 46433 | 47032 | 47600 | 48292 | 48819 |
| 8 | 44623 | 45203 | 45750 | 46416 | 46935 | 46070 | 46666 | 47229 | 47916 | 48441 |
| 12 | 44287 | 44863 | 45406 | 46068 | 46585 | 45717 | 46309 | 46868 | 47550 | 48073 |
| 16 | 43958 | 44531 | 45070 | 45728 | 46243 | 45371 | 45959 | 46515 | 47192 | 47714 |
| 20 | 43636 | 44206 | 44741 | 45394 | 45907 | 45032 | 45617 | 46168 | 46840 | 47361 |
| 24 | 43321 | 43887 | 44418 | 45067 | 45579 | 44700 | 45281 | 45829 | 46497 | 47015 |
| 28 | 43012 | 43575 | 44102 | 44747 | 45257 | 44375 | 44953 | 45497 | 46160 | 46677 |
| 32 | 42709 | 43269 | 43793 | 44433 | 44942 | 44057 | 44631 | 45171 | 45830 | 46346 |
| 36 | 42413 | 42969 | 43490 | 44126 | 44634 | 43745 | 44316 | 44852 | 45507 | 46021 |
| 40 | 42122 | 42675 | 43193 | 43825 | 44331 | 43439 | 44007 | 44540 | 45190 | 45702 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 5000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 40543 | 41080 | 41579 | 42190 | 42688 | 44725 | 45306 | 45854 | 46522 | 47041 |
| -15 | 40149 | 40681 | 41176 | 41781 | 42277 | 44265 | 44841 | 45384 | 46045 | 46562 |
| -10 | 39766 | 40294 | 40784 | 41384 | 41878 | 43818 | 44390 | 44927 | 45583 | 46097 |
| -5 | 39394 | 39918 | 40404 | 40999 | 41491 | 43385 | 43952 | 44484 | 45134 | 45646 |
| 0 | 39032 | 39553 | 40034 | 40624 | 41115 | 42964 | 43526 | 44053 | 44697 | 45207 |
| 4 | 38751 | 39269 | 39747 | 40333 | 40822 | 42636 | 43195 | 43718 | 44358 | 44866 |
| 8 | 38475 | 38990 | 39465 | 40047 | 40534 | 42314 | 42870 | 43389 | 44024 | 44531 |
| 12 | 38205 | 38716 | 39188 | 39767 | 40253 | 41999 | 42551 | 43067 | 43698 | 44203 |
| 16 | 37941 | 38450 | 38919 | 39494 | 39979 | 41692 | 42241 | 42753 | 43380 | 43883 |
| 20 | 37682 | 38188 | 38654 | 39225 | 39709 | 41390 | 41936 | 42445 | 43067 | 43569 |
| 24 | 37429 | 37932 | 38395 | 38963 | 39445 | 41095 | 41637 | 42143 | 42761 | 43262 |
| 28 | 37181 | 37681 | 38141 | 38706 | 39187 | 40806 | 41345 | 41847 | 42461 | 42961 |
| 32 | 36938 | 37436 | 37893 | 38454 | 38934 | 40523 | 41059 | 41558 | 42168 | 42666 |
| 36 | 36700 | 37196 | 37650 | 38208 | 38687 | 40246 | 40779 | 41275 | 41881 | 42378 |
| 40 | 36468 | 36961 | 37413 | 37967 | 38445 | 39975 | 40506 | 40998 | 41601 | 42096 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 46276 | 46874 | 47440 | 48129 | 48656 | 47809 | 48424 | 49007 | 49718 | 50252 |
| -15 | 45794 | 46387 | 46947 | 47630 | 48154 | 47303 | 47911 | 48489 | 49193 | 49724 |
| -10 | 45326 | 45914 | 46468 | 47145 | 47667 | 46810 | 47414 | 47986 | 48682 | 49212 |
| -5 | 44872 | 45455 | 46004 | 46674 | 47194 | 46332 | 46931 | 47497 | 48187 | 48714 |
| 0 | 44430 | 45008 | 45553 | 46217 | 46734 | 45868 | 46461 | 47022 | 47706 | 48231 |
| 4 | 44087 | 44661 | 45201 | 45861 | 46376 | 45506 | 46096 | 46653 | 47332 | 47854 |
| 8 | 43750 | 44320 | 44857 | 45511 | 46025 | 45152 | 45738 | 46290 | 46964 | 47485 |
| 12 | 43419 | 43987 | 44519 | 45169 | 45682 | 44804 | 45386 | 45935 | 46604 | 47123 |
| 16 | 43097 | 43661 | 44190 | 44836 | 45346 | 44465 | 45044 | 45589 | 46253 | 46771 |
| 20 | 42781 | 43341 | 43866 | 44508 | 45017 | 44133 | 44708 | 45248 | 45908 | 46424 |
| 24 | 42472 | 43029 | 43550 | 44187 | 44695 | 43807 | 44379 | 44916 | 45571 | 46085 |
| 28 | 42168 | 42722 | 43240 | 43873 | 44379 | 43488 | 44056 | 44590 | 45241 | 45753 |
| 32 | 41872 | 42423 | 42937 | 43566 | 44070 | 43176 | 43741 | 44271 | 44917 | 45429 |
| 36 | 41581 | 42129 | 42640 | 43265 | 43768 | 42871 | 43432 | 43958 | 44601 | 45111 |
| 40 | 41298 | 41842 | 42350 | 42971 | 43473 | 42572 | 43131 | 43653 | 44292 | 44800 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 6000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 39797 | 40325 | 40816 | 41416 | 41910 | 43854 | 44427 | 44964 | 45620 | 46135 |
| -15 | 39409 | 39934 | 40420 | 41014 | 41507 | 43403 | 43970 | 44502 | 45152 | 45664 |
| -10 | 39033 | 39553 | 40035 | 40624 | 41115 | 42964 | 43526 | 44054 | 44697 | 45208 |
| -5 | 38669 | 39186 | 39663 | 40248 | 40736 | 42540 | 43098 | 43621 | 44259 | 44767 |
| 0 | 38315 | 38827 | 39300 | 39880 | 40367 | 42127 | 42680 | 43198 | 43830 | 44336 |
| 2 | 38176 | 38687 | 39158 | 39736 | 40223 | 41965 | 42517 | 43032 | 43663 | 44168 |
| 4 | 38038 | 38548 | 39018 | 39594 | 40080 | 41805 | 42355 | 42869 | 43497 | 44001 |
| 8 | 37768 | 38275 | 38742 | 39314 | 39798 | 41490 | 42037 | 42547 | 43170 | 43673 |
| 12 | 37503 | 38008 | 38471 | 39040 | 39523 | 41182 | 41725 | 42231 | 42851 | 43352 |
| 16 | 37244 | 37746 | 38206 | 38771 | 39253 | 40880 | 41420 | 41923 | 42538 | 43038 |
| 20 | 36991 | 37490 | 37948 | 38509 | 38990 | 40585 | 41122 | 41621 | 42232 | 42731 |
| 24 | 36743 | 37239 | 37693 | 38252 | 38731 | 40295 | 40829 | 41325 | 41932 | 42429 |
| 28 | 36501 | 36994 | 37446 | 38001 | 38479 | 40013 | 40544 | 41037 | 41640 | 42135 |
| 32 | 36263 | 36753 | 37203 | 37754 | 38231 | 39735 | 40263 | 40753 | 41352 | 41846 |
| 36 | 36030 | 36518 | 36965 | 37513 | 37989 | 39464 | 39989 | 40476 | 41071 | 41564 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 45364 | 45952 | 46507 | 47184 | 47706 | 46850 | 47454 | 48026 | 48724 | 49253 |
| -15 | 44891 | 45474 | 46023 | 46694 | 47213 | 46352 | 46951 | 47517 | 48208 | 48735 |
| -10 | 44431 | 45009 | 45553 | 46217 | 46734 | 45868 | 46462 | 47023 | 47706 | 48231 |
| -5 | 43987 | 44560 | 45099 | 45757 | 46272 | 45401 | 45990 | 46545 | 47222 | 47745 |
| 0 | 43553 | 44122 | 44656 | 45308 | 45821 | 44945 | 45529 | 46079 | 46750 | 47270 |
| 2 | 43384 | 43951 | 44483 | 45132 | 45645 | 44767 | 45349 | 45897 | 46565 | 47084 |
| 4 | 43216 | 43781 | 44311 | 44958 | 45470 | 44590 | 45170 | 45716 | 46382 | 46901 |
| 8 | 42886 | 43447 | 43973 | 44616 | 45126 | 44243 | 44819 | 45361 | 46022 | 46539 |
| 12 | 42562 | 43121 | 43643 | 44281 | 44790 | 43903 | 44475 | 45013 | 45670 | 46185 |
| 16 | 42246 | 42801 | 43320 | 43954 | 44460 | 43570 | 44139 | 44673 | 45325 | 45838 |
| 20 | 41937 | 42488 | 43003 | 43633 | 44138 | 43245 | 43810 | 44341 | 44988 | 45500 |
| 24 | 41633 | 42181 | 42693 | 43319 | 43822 | 42925 | 43487 | 44014 | 44657 | 45167 |
| 28 | 41337 | 41882 | 42391 | 43012 | 43514 | 42614 | 43173 | 43696 | 44335 | 44843 |
| 32 | 41047 | 41589 | 42093 | 42711 | 43211 | 42308 | 42864 | 43383 | 44018 | 44525 |
| 36 | 40762 | 41301 | 41803 | 42416 | 42915 | 42009 | 42561 | 43077 | 43708 | 44213 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 7000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 39059 | 39580 | 40061 | 40652 | 41142 | 42995 | 43557 | 44085 | 44729 | 45239 |
| -15 | 38680 | 39197 | 39674 | 40259 | 40748 | 42553 | 43111 | 43634 | 44272 | 44780 |
| -10 | 38311 | 38824 | 39297 | 39877 | 40364 | 42123 | 42677 | 43194 | 43826 | 44332 |
| -5 | 37954 | 38463 | 38932 | 39507 | 39992 | 41707 | 42256 | 42769 | 43395 | 43899 |
| 0 | 37607 | 38112 | 38577 | 39147 | 39630 | 41302 | 41847 | 42354 | 42975 | 43477 |
| 2 | 37470 | 37974 | 38437 | 39006 | 39488 | 41143 | 41686 | 42192 | 42811 | 43312 |
| 4 | 37335 | 37838 | 38299 | 38866 | 39348 | 40986 | 41527 | 42031 | 42648 | 43148 |
| 8 | 37071 | 37570 | 38029 | 38591 | 39072 | 40677 | 41215 | 41716 | 42328 | 42827 |
| 12 | 36811 | 37308 | 37764 | 38323 | 38802 | 40375 | 40910 | 41407 | 42015 | 42512 |
| 16 | 36558 | 37052 | 37505 | 38060 | 38539 | 40080 | 40612 | 41105 | 41709 | 42205 |
| 20 | 36310 | 36801 | 37251 | 37803 | 38280 | 39791 | 40319 | 40809 | 41410 | 41904 |
| 24 | 36067 | 36556 | 37003 | 37552 | 38027 | 39508 | 40033 | 40520 | 41116 | 41609 |
| 28 | 35829 | 36315 | 36759 | 37305 | 37779 | 39230 | 39752 | 40236 | 40829 | 41320 |
| 32 | 35595 | 36079 | 36520 | 37063 | 37536 | 38958 | 39477 | 39958 | 40547 | 41037 |
| 36 | 35367 | 35848 | 36287 | 36826 | 37298 | 38691 | 39208 | 39686 | 40271 | 40759 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 44463 | 45041 | 45586 | 46250 | 46768 | 45902 | 46496 | 47057 | 47741 | 48266 |
| -15 | 44000 | 44574 | 45113 | 45771 | 46286 | 45415 | 46004 | 46560 | 47237 | 47760 |
| -10 | 43549 | 44118 | 44652 | 45304 | 45817 | 44941 | 45525 | 46075 | 46746 | 47266 |
| -5 | 43113 | 43677 | 44206 | 44852 | 45363 | 44482 | 45061 | 45606 | 46270 | 46788 |
| 0 | 42688 | 43248 | 43772 | 44412 | 44921 | 44035 | 44609 | 45149 | 45808 | 46323 |
| 2 | 42522 | 43080 | 43602 | 44240 | 44747 | 43860 | 44432 | 44970 | 45626 | 46141 |
| 4 | 42357 | 42913 | 43433 | 44069 | 44576 | 43687 | 44257 | 44793 | 45446 | 45960 |
| 8 | 42034 | 42586 | 43103 | 43734 | 44239 | 43347 | 43913 | 44445 | 45094 | 45606 |
| 12 | 41717 | 42266 | 42779 | 43406 | 43909 | 43014 | 43577 | 44104 | 44749 | 45259 |
| 16 | 41408 | 41954 | 42463 | 43085 | 43587 | 42688 | 43248 | 43772 | 44412 | 44920 |
| 20 | 41105 | 41647 | 42153 | 42771 | 43272 | 42369 | 42925 | 43445 | 44081 | 44588 |
| 24 | 40808 | 41347 | 41849 | 42463 | 42963 | 42057 | 42610 | 43126 | 43758 | 44263 |
| 28 | 40517 | 41053 | 41552 | 42162 | 42660 | 41751 | 42300 | 42813 | 43440 | 43944 |
| 32 | 40231 | 40765 | 41260 | 41866 | 42363 | 41451 | 41997 | 42506 | 43130 | 43632 |
| 36 | 39952 | 40483 | 40975 | 41577 | 42072 | 41157 | 41700 | 42206 | 42825 | 43326 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 8000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 38333 | 38845 | 39319 | 39899 | 40386 | 42148 | 42702 | 43219 | 43852 | 44358 |
| -15 | 37960 | 38469 | 38938 | 39513 | 39998 | 41714 | 42263 | 42776 | 43403 | 43906 |
| -10 | 37599 | 38104 | 38568 | 39138 | 39622 | 41292 | 41837 | 42345 | 42966 | 43467 |
| -5 | 37248 | 37749 | 38210 | 38775 | 39257 | 40884 | 41424 | 41927 | 42542 | 43042 |
| 0 | 36908 | 37405 | 37862 | 38423 | 38903 | 40487 | 41023 | 41522 | 42131 | 42629 |
| 2 | 36774 | 37270 | 37725 | 38284 | 38763 | 40331 | 40866 | 41362 | 41970 | 42467 |
| 4 | 36643 | 37137 | 37591 | 38148 | 38627 | 40178 | 40711 | 41206 | 41811 | 42307 |
| 8 | 36383 | 36875 | 37326 | 37879 | 38356 | 39876 | 40405 | 40896 | 41498 | 41993 |
| 12 | 36129 | 36618 | 37066 | 37616 | 38092 | 39580 | 40106 | 40594 | 41191 | 41684 |
| 16 | 35880 | 36367 | 36812 | 37358 | 37833 | 39290 | 39813 | 40297 | 40891 | 41382 |
| 20 | 35637 | 36121 | 36563 | 37106 | 37579 | 39006 | 39526 | 40007 | 40597 | 41087 |
| 24 | 35399 | 35880 | 36319 | 36859 | 37331 | 38728 | 39246 | 39723 | 40309 | 40798 |
| 28 | 35165 | 35644 | 36080 | 36617 | 37088 | 38456 | 38970 | 39445 | 40027 | 40515 |
| 32 | 34937 | 35413 | 35847 | 36380 | 36851 | 38190 | 38702 | 39173 | 39751 | 40238 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 43575 | 44144 | 44679 | 45331 | 45844 | 44968 | 45552 | 46103 | 46774 | 47294 |
| -15 | 43121 | 43685 | 44214 | 44860 | 45371 | 44490 | 45069 | 45614 | 46279 | 46796 |
| -10 | 42679 | 43238 | 43762 | 44402 | 44911 | 44025 | 44599 | 45138 | 45797 | 46312 |
| -5 | 42250 | 42805 | 43324 | 43958 | 44465 | 43575 | 44144 | 44678 | 45330 | 45843 |
| 0 | 41835 | 42385 | 42899 | 43527 | 44032 | 43137 | 43702 | 44231 | 44877 | 45388 |
| 2 | 41671 | 42220 | 42732 | 43358 | 43862 | 42965 | 43528 | 44055 | 44699 | 45209 |
| 4 | 41511 | 42058 | 42568 | 43192 | 43695 | 42797 | 43357 | 43882 | 44524 | 45033 |
| 8 | 41194 | 41737 | 42244 | 42863 | 43365 | 42463 | 43020 | 43541 | 44178 | 44686 |
| 12 | 40883 | 41424 | 41926 | 42542 | 43041 | 42136 | 42690 | 43208 | 43840 | 44346 |
| 16 | 40579 | 41116 | 41616 | 42227 | 42725 | 41817 | 42367 | 42881 | 43509 | 44013 |
| 20 | 40282 | 40816 | 41312 | 41919 | 42416 | 41504 | 42051 | 42561 | 43185 | 43688 |
| 24 | 39991 | 40522 | 41014 | 41617 | 42113 | 41198 | 41741 | 42248 | 42867 | 43369 |
| 28 | 39706 | 40233 | 40723 | 41322 | 41815 | 40898 | 41438 | 41941 | 42557 | 43056 |
| 32 | 39427 | 39952 | 40437 | 41033 | 41525 | 40604 | 41142 | 41641 | 42253 | 42751 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 9000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 37613 | 38118 | 38583 | 39153 | 39637 | 41309 | 41854 | 42362 | 42983 | 43485 |
| -15 | 37248 | 37749 | 38210 | 38775 | 39257 | 40884 | 41424 | 41927 | 42542 | 43042 |
| -10 | 36894 | 37392 | 37848 | 38409 | 38889 | 40472 | 41008 | 41506 | 42115 | 42613 |
| -5 | 36552 | 37046 | 37498 | 38054 | 38532 | 40072 | 40604 | 41097 | 41702 | 42197 |
| 0 | 36218 | 36708 | 37157 | 37708 | 38184 | 39683 | 40211 | 40700 | 41298 | 41792 |
| 2 | 36087 | 36576 | 37023 | 37572 | 38048 | 39531 | 40057 | 40544 | 41141 | 41634 |
| 4 | 35958 | 36445 | 36891 | 37438 | 37913 | 39380 | 39904 | 40390 | 40984 | 41476 |
| 8 | 35703 | 36188 | 36630 | 37174 | 37648 | 39083 | 39604 | 40086 | 40677 | 41167 |
| 12 | 35454 | 35937 | 36376 | 36917 | 37390 | 38794 | 39311 | 39790 | 40377 | 40866 |
| 16 | 35211 | 35690 | 36127 | 36664 | 37136 | 38509 | 39024 | 39500 | 40082 | 40570 |
| 20 | 34972 | 35449 | 35883 | 36417 | 36887 | 38231 | 38743 | 39215 | 39794 | 40281 |
| 24 | 34739 | 35213 | 35645 | 36176 | 36645 | 37960 | 38469 | 38938 | 39513 | 39998 |
| 28 | 34511 | 34983 | 35412 | 35940 | 36408 | 37694 | 38200 | 38666 | 39237 | 39721 |
| 32 | 34287 | 34757 | 35183 | 35707 | 36174 | 37433 | 37936 | 38399 | 38967 | 39450 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 42696 | 43256 | 43780 | 44420 | 44929 | 44043 | 44617 | 45157 | 45816 | 46331 |
| -15 | 42251 | 42805 | 43324 | 43958 | 44465 | 43575 | 44144 | 44678 | 45330 | 45843 |
| -10 | 41818 | 42369 | 42882 | 43511 | 44015 | 43120 | 43684 | 44213 | 44859 | 45370 |
| -5 | 41400 | 41946 | 42454 | 43077 | 43579 | 42680 | 43239 | 43763 | 44403 | 44912 |
| 0 | 40992 | 41533 | 42037 | 42654 | 43154 | 42251 | 42805 | 43324 | 43958 | 44465 |
| 2 | 40832 | 41372 | 41874 | 42489 | 42988 | 42083 | 42636 | 43153 | 43784 | 44290 |
| 4 | 40674 | 41212 | 41713 | 42325 | 42824 | 41916 | 42468 | 42983 | 43612 | 44117 |
| 8 | 40363 | 40897 | 41394 | 42002 | 42500 | 41589 | 42137 | 42648 | 43273 | 43776 |
| 12 | 40059 | 40591 | 41084 | 41688 | 42184 | 41270 | 41814 | 42321 | 42942 | 43444 |
| 16 | 39762 | 40290 | 40780 | 41379 | 41874 | 40956 | 41497 | 42001 | 42617 | 43118 |
| 20 | 39470 | 39995 | 40482 | 41077 | 41570 | 40650 | 41187 | 41688 | 42300 | 42798 |
| 24 | 39185 | 39707 | 40191 | 40782 | 41274 | 40350 | 40885 | 41381 | 41989 | 42486 |
| 28 | 38907 | 39426 | 39906 | 40494 | 40984 | 40057 | 40589 | 41082 | 41686 | 42182 |
| 32 | 38633 | 39150 | 39626 | 40211 | 40699 | 39770 | 40298 | 40788 | 41388 | 41882 |

**NOTE:** Quick Turn Around Weight in lb.

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## QUICK TURN AROUND WEIGHT TABLE
## ALL ENGINE TYPES - FAA - FLAPS 45° - 10000 FT
## LR BRAKES

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | -10 Kt | | | | | 0 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 36902 | 37399 | 37856 | 38416 | 38896 | 40480 | 41016 | 41515 | 42124 | 42622 |
| -15 | 36547 | 37040 | 37493 | 38048 | 38527 | 40066 | 40598 | 41091 | 41695 | 42191 |
| -10 | 36201 | 36691 | 37139 | 37690 | 38166 | 39663 | 40190 | 40679 | 41278 | 41771 |
| -5 | 35864 | 36351 | 36795 | 37341 | 37816 | 39271 | 39794 | 40278 | 40871 | 41363 |
| 0 | 35537 | 36020 | 36461 | 37002 | 37476 | 38890 | 39409 | 39888 | 40476 | 40966 |
| 2 | 35409 | 35891 | 36330 | 36870 | 37342 | 38741 | 39258 | 39736 | 40322 | 40811 |
| 4 | 35282 | 35763 | 36200 | 36739 | 37210 | 38593 | 39109 | 39585 | 40169 | 40657 |
| 8 | 35033 | 35511 | 35945 | 36480 | 36951 | 38302 | 38815 | 39288 | 39867 | 40354 |
| 12 | 34789 | 35264 | 35696 | 36227 | 36696 | 38018 | 38527 | 38997 | 39573 | 40058 |
| 16 | 34551 | 35023 | 35453 | 35981 | 36449 | 37740 | 38247 | 38713 | 39285 | 39770 |
| 20 | 34316 | 34786 | 35213 | 35738 | 36205 | 37467 | 37971 | 38434 | 39002 | 39485 |
| 24 | 34088 | 34556 | 34980 | 35501 | 35967 | 37201 | 37702 | 38162 | 38727 | 39208 |
| 28 | 33864 | 34329 | 34750 | 35269 | 35734 | 36940 | 37438 | 37895 | 38456 | 38936 |

| Temp. (°C) | WIND | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 Kt | | | | | 20 Kt | | | | |
| | SLOPE | | | | | | | | | |
| | -2% | -1% | 0 | 1% | 2% | -2% | -1% | 0 | 1% | 2% |
| -20 | 41827 | 42378 | 42892 | 43520 | 44024 | 43130 | 43694 | 44223 | 44869 | 45380 |
| -15 | 41393 | 41939 | 42448 | 43070 | 43573 | 42673 | 43232 | 43756 | 44396 | 44905 |
| -10 | 40971 | 41512 | 42016 | 42633 | 43133 | 42229 | 42783 | 43302 | 43936 | 44442 |
| -5 | 40560 | 41096 | 41596 | 42206 | 42705 | 41796 | 42346 | 42860 | 43487 | 43992 |
| 0 | 40160 | 40693 | 41187 | 41793 | 42289 | 41376 | 41921 | 42430 | 43052 | 43554 |
| 2 | 40004 | 40535 | 41027 | 41631 | 42126 | 41211 | 41755 | 42262 | 42882 | 43383 |
| 4 | 39849 | 40378 | 40869 | 41470 | 41965 | 41048 | 41590 | 42095 | 42713 | 43213 |
| 8 | 39544 | 40070 | 40558 | 41154 | 41648 | 40728 | 41266 | 41768 | 42381 | 42880 |
| 12 | 39246 | 39769 | 40253 | 40845 | 41337 | 40414 | 40949 | 41447 | 42056 | 42553 |
| 16 | 38956 | 39475 | 39956 | 40544 | 41035 | 40108 | 40640 | 41134 | 41739 | 42235 |
| 20 | 38669 | 39186 | 39663 | 40248 | 40736 | 39807 | 40336 | 40826 | 41427 | 41921 |
| 24 | 38390 | 38904 | 39378 | 39959 | 40446 | 39514 | 40040 | 40527 | 41123 | 41616 |
| 28 | 38117 | 38627 | 39098 | 39675 | 40161 | 39226 | 39748 | 40232 | 40824 | 41316 |

**NOTE:** Quick Turn Around Weight in lb.

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# LANDING PERFORMANCE

Refer to the Airplane Flight Manual for a complete set of charts for determination of the landing limiting weights.

## EMBRAER RUNWAYS ANALYSIS SOFTWARE

Although the AFM presents all the required performance data for takeoff, the amount of options and charts presented, makes its use very difficult. In order to help operators, EMBRAER developed a runway analysis software for determination of the limiting weights.

## THE LANDING OUTPUT DATA

The program outputs the limit weight, the code for the limitation detected, the approach climb speed, the reference speed and the quick turn around weight. This data is provided for several combinations of wind and temperature.

The data is calculated for four reference winds and for a range of temperatures.

Limitation codes assigned are an A for approach climb limited weight, R for runway limited weight, L for landing climb limited weight, and S for structural limited weight.

If the operation for a specific condition is considered unfeasible or outside the performance tables, the relevant data will be provided with asterisks.

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Wind (in knots)

EMB-145 LANDING ANALYSIS, ALLISON AE3007A1 ENGINES, FAA CERTIFICATION

---

Airport: AIRPORT NAME ICAO: ABCD Runway: 04 FLAP 45
Elevation: 1500 ft
LDA: 1900 ft
Slope: 0 %

Factoring: NORMAL

---

Ice Accretion: NO
A/Ice: OFF

DRY RUNWAY

---

LIMIT WEIGHT (Lb)/ Code/ V.Approach Climb(Kt)/ V.Ref(Kt)/ Quick T.Around Wt(Lb) versus Temperature and Wind:

| Temp(C) | -10Kt | 0Kt | 10Kt | 20Kt |
|---|---|---|---|---|
| 0 | 42549/S/156/129/33539 | 42549/S/156/129/37414 | 42549/S/156/129/38782 | 42549/S/156/129/40247 |
| 5 | 42549/S/156/129/33243 | 42549/S/156/129/37061 | 42549/S/156/129/38409 | 42549/S/156/129/39854 |
| 10 | 42549/S/156/129/32952 | 42549/S/156/129/36715 | 42549/S/156/129/38044 | 42549/S/156/129/39469 |
| 15 | 42549/S/156/129/32672 | 42549/S/156/129/36382 | 42549/S/156/129/37691 | 42549/S/156/129/39098 |
| 20 | 42549/S/156/129/32399 | 42549/S/156/129/36057 | 42549/S/156/129/37347 | 42549/S/156/129/38736 |
| 25 | 42549/S/156/129/32134 | 42549/S/156/129/35740 | 42549/S/156/129/37013 | 42549/S/156/129/38384 |
| 30 | 42549/S/156/129/31874 | 42549/S/156/129/35432 | 42549/S/156/129/36686 | 42549/S/156/129/38041 |

Limitation codes: A-Approach climb; L-Landing Climb; R-Runway; S-Structural

Date: 23/06/99

Temperature (in degrees Celsius)

Limit weight (in pounds), limiting factor, approach climb speed (in knots), reference speed (in knots), and quick turn around weight (in pounds)

**EXAMPLE**

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# SECTION 1-05
# FLIGHT PLANNING

TABLE OF CONTENTS

Page Block

Introduction ..... 1-05-00
Simplified Flight Planning ..... 1-05-05
APU and Engine Fuel Consumption ..... 1-05-07
Climb ..... 1-05-10
Cruise ..... 1-05-15
Descent ..... 1-05-20
Holding ..... 1-05-25
One Engine Inoperative Performance ..... 1-05-30
Flight with Landing Gear Down (*) ..... 1-05-35
Flight with Flaps Locked at 9° (*) ..... 1-05-40
Inflight Diversion (*) ..... 1-05-45
Flight with Engine Anti Ice Valve Locked Open (*) ..... 1-05-50

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**NOTE:** Items marked with an asterisk (∗) may not be present in this manual.

# INTRODUCTION

This section presents climb, cruise, descent and holding performance data.

In addition, simplified flight planning and one engine inoperative are included.

**NOTE:** Airplanes equipped with Rolls Royce AE3007A1P engines should use the same simplified flight planning, climb, cruise, descent, holding, one engine inoperative performance, flight with landing gear down, flight with flaps locked at 9° and inflight diversion data applicable to airplanes equipped with Rolls Royce AE3007A1 engines.

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# SIMPLIFIED FLIGHT PLANNING

Simplified flight planning charts allow quick determination of estimated trip fuel and time from brake release to landing. The following phases are included: takeoff, climb, cruise, descent, approach and landing.

Charts are provided for Long Range Cruise (LRC) and Maximum Speed Cruise (MSC) at constant altitude.

Alternate fuel, holding, reserve fuel and other allowances (APU usage and taxi) should be added to the trip fuel in order to obtain the total fuel required.

To determine trip fuel enter trip ground distance, correct for wind condition and estimated landing weight, move as far as the line indicating cruise pressure altitude, and read the trip fuel.

To determine trip time, enter trip ground distance, correct for wind condition, move as far as the referring cruise pressure altitude, and read the trip time.

For winds greater than those shown, enter in the chart, directly, corrected ground distance, ignore wind correction reference line, to obtain the corrected ground distance, apply the following equation.

$$CGD = GD \times \left( \frac{TAS}{TAS + WIND} \right)$$

Where:

CGD: Corrected ground distance;
GD: Ground distance;
Head wind is negative;
Tail wind is positive.

The alternate fuel is determined by entering the LRC Simplified Flight Planning chart with the alternate distance and wind.

The holding fuel is determined from the holding table in this section. Depending upon national regulations, the holding fuel is normally calculated so that the aircraft can hold for 30 min., at 1500 ft above the alternate airport.

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The reserve fuel is also dependant on national regulations and normally is the fuel required for flying 10% of the trip time (based on the latest fuel flow) or is equivalent to 5% of the trip fuel.

The allowances below may be used:

| PHASE OF FLIGHT | FUEL CONSUMPTION (lb/min) |
|---|---|
| TAXI | 15.40 |
| APU | 2.73 |

**EXAMPLE:**

Given:

DESTINATION AIRPORT

| | |
|---|---|
| Trip Distance | 400 NM |
| Flight Level | FL 350 |
| Cruise Speed | LRC |
| Wind | 30 knots (head wind) |
| Estimated landing weight | 35000 lb |

ALTERNATE AIRPORT

| | |
|---|---|
| Distance | 200 NM |
| Flight Level | FL 200 |
| Speed to alternate airport | LRC |
| Wind | 0 |
| Estimated landing weight at alternate | 33000 lb |

| | |
|---|---|
| RESERVE FUEL | 5% of trip fuel |

HOLDING

| | |
|---|---|
| Time | 30 min |
| Altitude | 1500 ft |
| Estimated airplane weight at holding | 33000 lb |

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**RESULTS**

From Simplified Flight Planning Chart - Long Range Cruise:
Trip Fuel ..... 2900 lb

From Simplified Flight Planning Chart - Long Range Cruise:
Fuel to Alternate ..... 1600 lb
Reserve Fuel ..... 145 lb (5% of Trip Fuel)

From Holding Tables:
Fuel consumption at 1500 ft ..... 1563 lb/h
For 30 min of holding, fuel ..... 782 lb

To determine the TOTAL FUEL ON TAKEOFF, let's consider 5 minutes for taxi and an APU consumption equal to 110 lb.

TOTAL FUEL ON TAKEOFF = TRIP FUEL + FUEL TO ALTERNATE + RESERVE FUEL + HOLDING + APU + TAXI
TOTAL FUEL ON TAKEOFF = 2900 + 1600 + 145 + 782 + 110 + 77
TOTAL FUEL ON TAKEOFF = 5614 lb

From Flight Time Chart - Long Range Cruise:
TRIP TIME ..... 73 minutes

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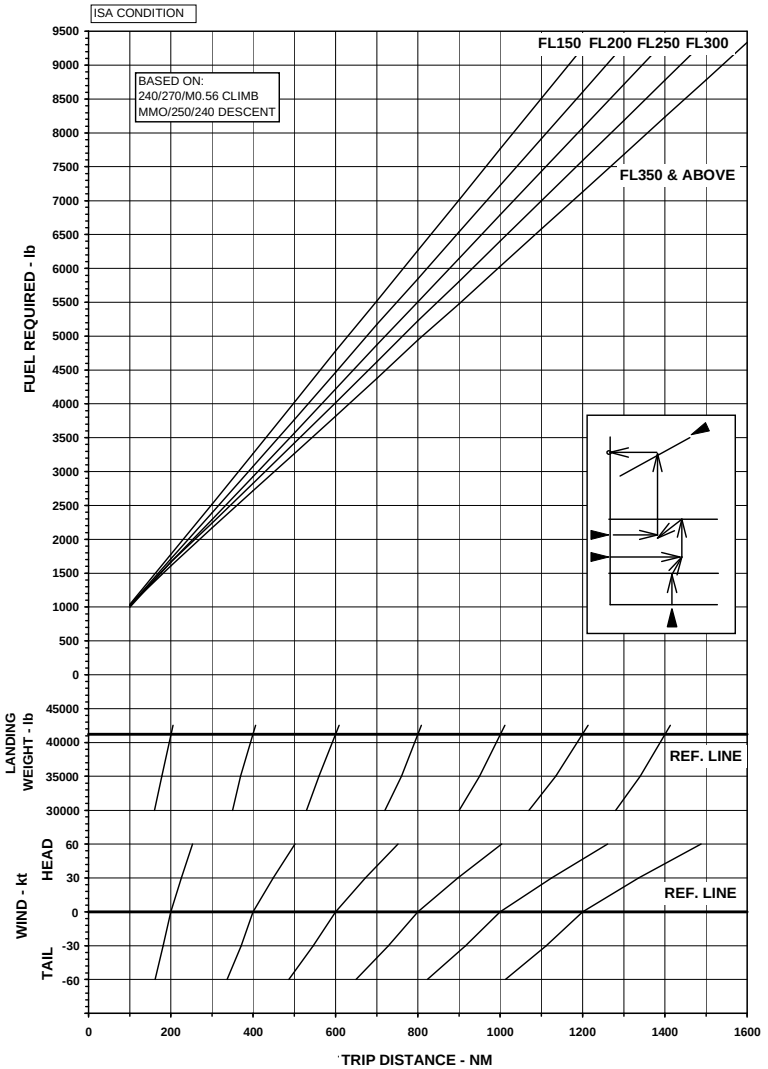
## EMB-145 SIMPLIFIED FLIGHT PLANNING
## AE3007A1 AND AE3007A1P ENGINES
## LONG RANGE CRUISE




145AOMFAA001 - 09OCT2002

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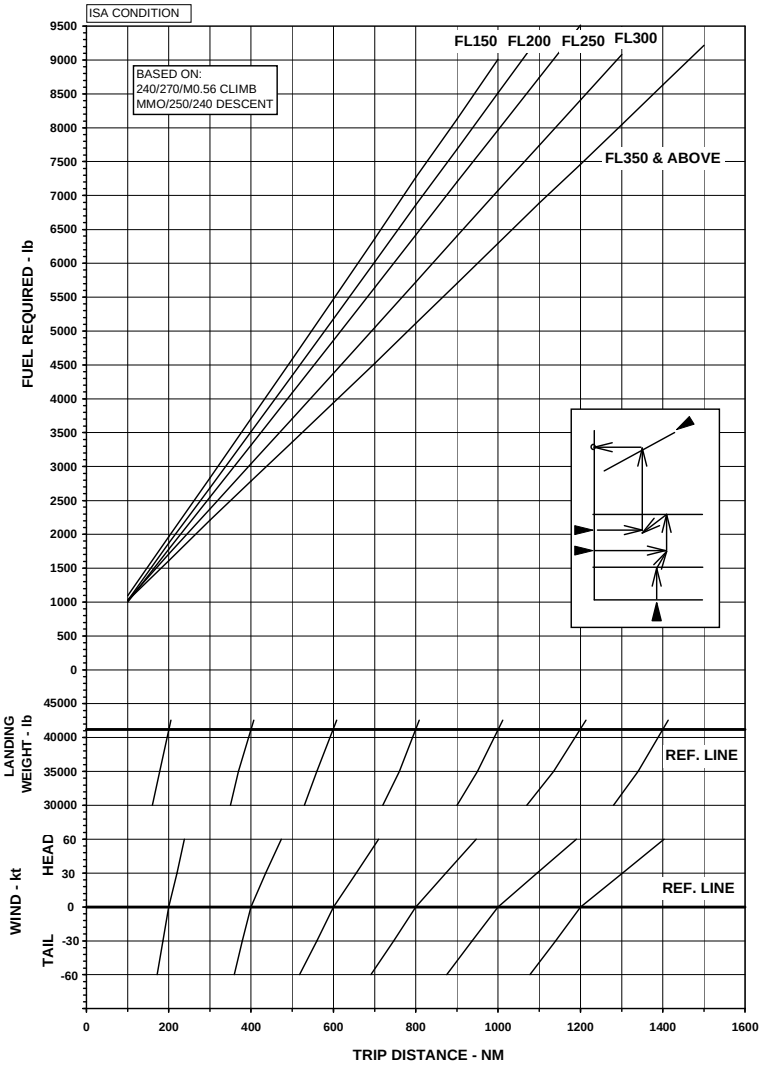
## EMB-145 SIMPLIFIED FLIGHT PLANNING
## AE3007A1 AND AE3007A1P ENGINES
## MAXIMUM SPEED CRUISE




145AOMFAA002 - 09OCT2002

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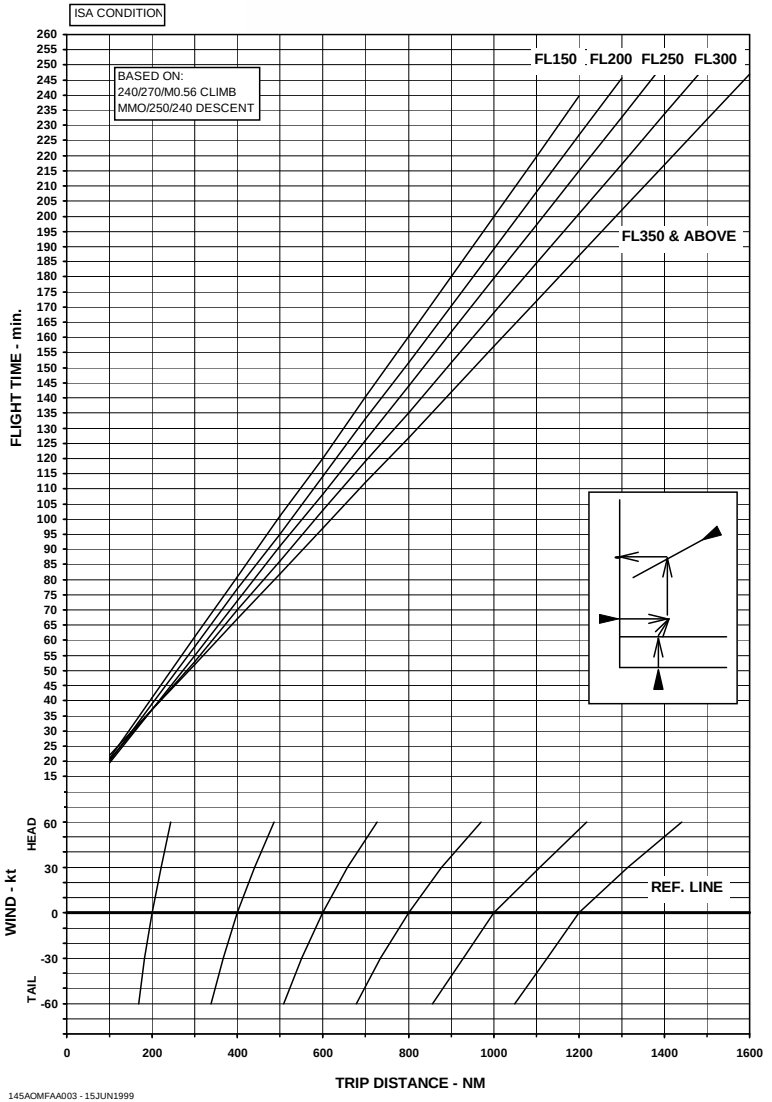
# EMB-145 FLIGHT TIME
## AE3007A1 AND AE3007A1P ENGINES
## LONG RANGE CRUISE




145AOMFAA003 - 15JUN1999

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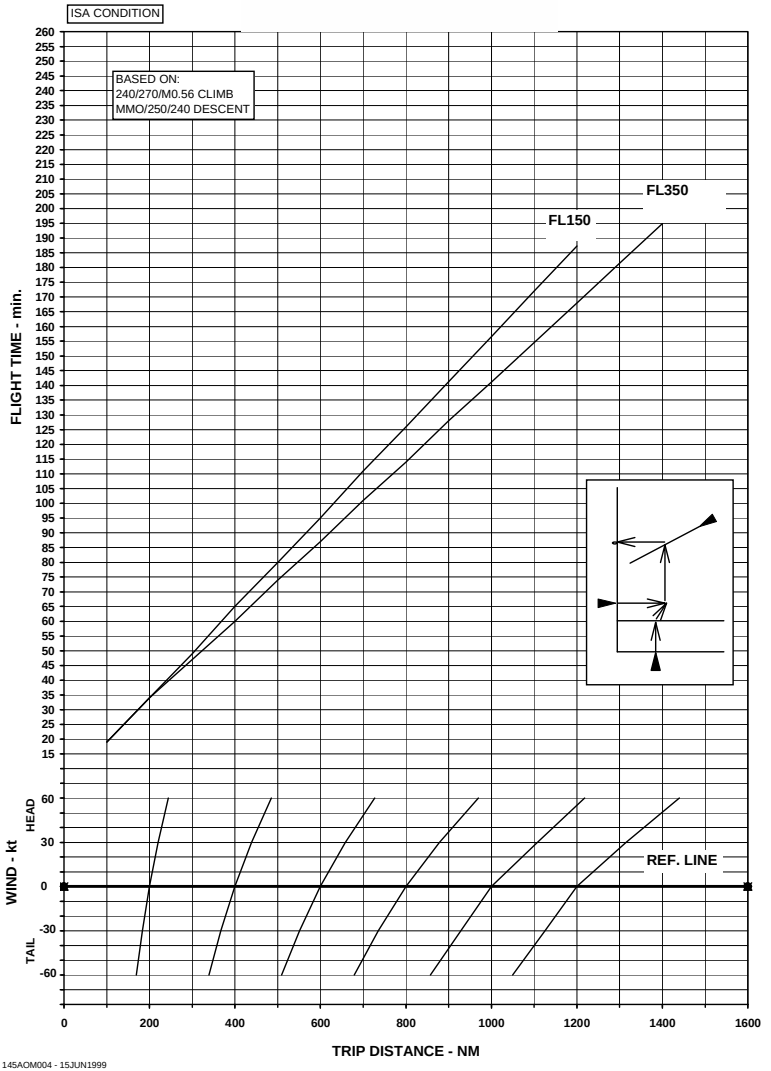
# EMB-145 FLIGHT TIME
## AE3007A1 AND AE3007A1P ENGINES
## MAXIMUM SPEED CRUISE

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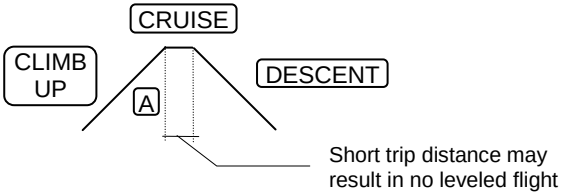
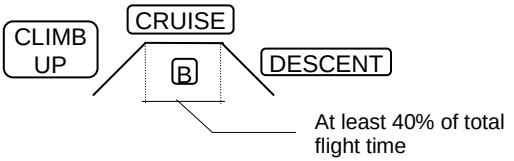
## CRUISE - FLIGHT LEVEL TABLE

The table below permits quick determination of the cruise flight level for minimum fuel consumption, based on the trip distance and takeoff weight. For each takeoff weight two different flight levels are calculated (A or B) based on the following assumptions:

– Condition (A): The flight level was calculated based only on minimum fuel consumption. It may result on reduced time in leveled flight for short trip distances.




– Condition (B): The flight level was calculated based on a combination of minimum fuel consumption and at least 40% of the total flight time in cruise.

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The table data are presented for ISA condition, all engine operating and Maximum Speed Cruise schedule.

## FLIGHT LEVEL - ALL ENGINES OPERATING

### AE3007A1 AND AE3007A1P ENGINES

### MAX SPEED CRUISE AND ISA CONDITIONS

| | | TRIP DISTANCE (NM) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TOW (LB) | | 50 | 75 | 100 | 150 | 200 | 250 | 300 | 400 |
| 48501 (1) | - | - | - | - | - | - | - | - | - |
| 46000 (2) | - | - | - | - | - | - | - | - | - |
| 44000 (3) | A | - | - | - | - | 360 | 370 | 370 | 370 |
| | B | - | - | - | - | 200 | 240 | 280 | 370 |
| 42000 | A | 80 | 170 | 220 | 280 | 360 | 370 | 370 | 370 |
| | B | 60 | 110 | 120 | 160 | 200 | 250 | 290 | 370 |
| 40000 | A | 80 | 180 | 230 | 320 | 370 | 370 | 370 | 370 |
| | B | 60 | 110 | 130 | 160 | 210 | 250 | 300 | 370 |
| 38000 | A | 70 | 170 | 240 | 330 | 370 | 370 | 370 | 370 |
| | B | 80 | 100 | 120 | 170 | 220 | 260 | 330 | 370 |
| 36000 | A | 140 | 190 | 250 | 340 | 370 | 370 | 370 | 370 |
| | B | 80 | 100 | 120 | 170 | 220 | 270 | 350 | 370 |

(1) Due to MLW restrictions, it is only possible to takeoff with 48501 lb TOW if the trip distance is greater than 700 NM (for airplanes with 42549 lb MLW).

(2) Due to MLW restrictions, it is only possible to takeoff with 46000 lb TOW if the trip distance is greater than 500 NM (for airplanes with 42549 lb MLW).

(3) Due to MLW restrictions, it is only possible to takeoff with 44000 lb TOW if the trip distance is greater than 150 NM (for airplanes with 42549 lb MLW) or 300 NM (for airplanes with 41226 lb MLW).

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# CRUISE - ALTITUDE CAPABILITY TABLE

The table below permits quick determination of the altitude capability, based on the initial cruise weight. The table data are presented for various ISA conditions, all engines operating and Maximum Speed Cruise schedule.

The estabilished associated conditions are:

- Flaps ..... UP
- Gears ..... UP
- Bleeds ..... OPEN

## CRUISE ALTITUDE CAPABILITY
## ALL ENGINES OPERATING

### AE3007A1 AND AE3007A1P ENGINES

### MAX SPEED CRUISE, CRUISE THRUST LIMITED

| | ISA + ºC | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Weight (lb)** | **-10** | **-5** | **0** | **5** | **10** | **15** | **20** | **25** | **30** | **35** |
| 50000 | 370 | 370 | 370 | 370 | 370 | 360 | 340 | 320 | 290 | 280 |
| 48000 | 370 | 370 | 370 | 370 | 370 | 370 | 360 | 340 | 310 | 290 |
| 46000 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 360 | 340 | 300 |
| 44000 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 360 | 330 |
| 42000 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 360 |
| 40000 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 360 |
| 38000 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 |
| 36000 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 |
| 34000 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 |
| 32000 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 |
| 30000 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 |
| 28000 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 |

**NOTE:** The weight values refers to the initial cruise weight.

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# CRUISE - WIND ALTITUDE TRADE

The following tables allow the determination of the break-even wind in order to maintain the same ground specific range at another altitude than the one planned initially. Long Range Cruise or Maximum Speed Cruise tables are provided.

These tables are based on the comparison between ground specific range at the new and actual altitudes. They do not consider climb/descent time, fuel and distances. The tables may be used in-flight, where the wind information is available and more accurate.

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**Evaluation Method**

1. Check the wind factors for actual and new altitudes.
2. Calculate the difference between new and actual wind factors. This number may be negative or positive.
3. The BREAK-EVEN WIND at the new altitude is the wind component at actual altitude plus the difference calculated on step (2).

**Example:**

40000 lb of actual cruise weight, LRC:

Actual Flight Level: FL 280, -10 kt (headwind)
New Flight Level: FL 350, -20 kt (headwind)

1. Wind factor FL 280 = 52, Wind factor FL 350 = 12
2. Difference = 12 (new FL) - 52 (actual FL) = -40
3. Break Even Wind = -10 (Wind actual FL) + (-40) (difference) = -50 kt Wind on FL 350.
   (20 kt headwind) is more favorable than Break-Even Wind (50 kt headwind). Therefore, climb to FL 350.



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# CRUISE WIND ALTITUDE TRADE
# LONG RANGE CRUISE SPEED

## AE3007A1 AND AE3007A1P ENGINES, ALL ENGINES OPERATING

| WEIGHT (LB) | PRESSURE ALTITUDE (x 1000 FT) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 |
| **26000** | 0 | 6 | 11 | 16 | 22 | 27 | 33 | 38 | 44 | 50 | 56 |
| **28000** | 0 | 6 | 12 | 18 | 23 | 28 | 33 | 39 | 45 | 50 | 56 |
| **30000** | 0 | 6 | 12 | 18 | 24 | 29 | 34 | 40 | 45 | 50 | 56 |
| **32000** | 0 | 6 | 12 | 18 | 24 | 30 | 35 | 40 | 45 | 51 | 56 |
| **34000** | 0 | 6 | 12 | 18 | 24 | 30 | 36 | 41 | 46 | 51 | 57 |
| **36000** | 0 | 6 | 12 | 17 | 23 | 29 | 35 | 41 | 47 | 52 | 57 |
| **38000** | 0 | 6 | 12 | 17 | 23 | 29 | 35 | 41 | 47 | 53 | 58 |
| **40000** | 0 | 6 | 12 | 17 | 23 | 29 | 35 | 40 | 46 | 52 | 58 |
| **42000** | 0 | 6 | 12 | 17 | 23 | 29 | 34 | 40 | 46 | 52 | 58 |
| **44000** | 0 | 6 | 12 | 17 | 23 | 29 | 34 | 40 | 46 | 51 | 57 |
| **46000** | 0 | 6 | 12 | 17 | 23 | 29 | 34 | 40 | 46 | 51 | 57 |
| **48000** | 0 | 7 | 13 | 19 | 24 | 30 | 35 | 41 | 47 | 52 | 58 |
| **49000** | 0 | 9 | 15 | 21 | 27 | 32 | 38 | 43 | 49 | 54 | 60 |

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# CRUISE WIND ALTITUDE TRADE MAXIMUM SPEED CRUISE

## AE3007A1 AND AE3007A1P ENGINES, ALL ENGINES OPERATING

| WEIGHT (LB) | PRESSURE ALTITUDE (x 1000 FT) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 |
| 26000 | 0 | 19 | 33 | 49 | 67 | 85 | 104 | 124 | 145 | 168 | 191 |
| 28000 | 0 | 18 | 37 | 54 | 71 | 89 | 108 | 127 | 148 | 170 | 193 |
| 30000 | 0 | 17 | 36 | 55 | 76 | 92 | 111 | 130 | 150 | 172 | 194 |
| 32000 | 0 | 17 | 34 | 53 | 73 | 95 | 113 | 132 | 152 | 173 | 195 |
| 34000 | 0 | 16 | 33 | 51 | 70 | 91 | 113 | 133 | 153 | 173 | 194 |
| 36000 | 0 | 15 | 31 | 49 | 67 | 87 | 108 | 131 | 155 | 173 | 194 |
| 38000 | 0 | 14 | 30 | 46 | 64 | 83 | 104 | 125 | 149 | 169 | 189 |
| 40000 | 0 | 13 | 28 | 44 | 61 | 79 | 99 | 119 | 138 | 158 | 180 |
| 42000 | 0 | 13 | 26 | 42 | 58 | 75 | 94 | 110 | 129 | 148 | 168 |
| 44000 | 0 | 12 | 25 | 39 | 54 | 71 | 86 | 100 | 119 | 138 | 157 |
| 46000 | 0 | 11 | 23 | 36 | 51 | 65 | 77 | 90 | 108 | 126 | 144 |
| 48000 | 0 | 11 | 23 | 35 | 47 | 58 | 70 | 83 | 99 | 117 | 134 |
| 49000 | 0 | 12 | 23 | 33 | 44 | 54 | 66 | 79 | 95 | 113 | 130 |

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# FLIGHT PLANNING – FUEL TANKERING

Fuel price variations at different airports may require carrying more fuel than the minimum required on a flight leg. The procedure of loading this extra amount of fuel (or surplus fuel) in order to minimize fuel costs is known as Fuel Tankering.

Since the surplus fuel tankered results in additional fuel burnoff (due to the weight increase) it is important to analyze the costs of the extra fuel transportation operation.

The following tables are designed to determine the break-even fuel price on departure airport and it may be used whenever there is difference on fuel price comparing to destination. Tables are provided for LRC and MSC cruise schedule.

Enter the trip distance on the table and read the fuel surplus ratio according to cruise altitude. The break-even fuel price is the price at departure multiplied by the fuel surplus ratio. If break-even fuel price is lower than destination price, it is economically feasible to execute fuel tankering.

The additional maintenance costs involved with increased weight operations (additional brakes and tires wearing) are not considered. It is important to remind that whenever fuel tankering is considered, the estimated landing weight at destination should be lower than the Maximum Landing Weight.

### Example

Analyze the possibility to proceed with fuel tankering between two airports distant 600 NM from each other, using LRC speed schedule cruising on FL350. Consider the following fuel prices:

Departure Airport: 1.80 US$/Gal.
Destination Airport: 2.00 US$/Gal.

- Enter the LONG RANGE CRUISE table for 600 NM trip distance and FL350, the FUEL SURPLUS RATIO is 1.06.
- The BREAK-EVEN PRICE is 1.80 (price at departure) multiplied by 1.06 = 1.908 US$/Gal.

Since fuel price on destination airport (2.00 US$/Gal) is greater than break-even fuel price (1.908 US$/Gal), it is economically feasible the fuel tankering operation between these two airports.

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## FUEL TANKERING
## LONG RANGE CRUISE SPEED

**AE3007A1 AND AE3007A1P ENGINES, ALL ENGINES OPERATING**

| | FUEL SURPLUS RATIO | |
|---|---|---|
| TRIP DISTANCE (NM) | 32000 FT AND BELOW | 33000 FT AND ABOVE |
| 200 | 1.02 | 1.02 |
| 400 | 1.04 | 1.04 |
| 600 | 1.06 | 1.06 |
| 800 | 1.08 | 1.08 |
| 1000 | 1.10 | 1.10 |
| 1200 | 1.12 | 1.12 |
| 1400 | 1.14 | 1.13 |
| 1600 | 1.16 | 1.16 |
| 1800 | 1.19 | 1.18 |
| 2000 | - | 1.20 |

## FUEL TANKERING
## MAXIMUM SPEED CRUISE

**AE3007A1 AND AE3007A1P ENGINES, ALL ENGINES OPERATING**

| | FUEL SURPLUS RATIO | |
|---|---|---|
| TRIP DISTANCE (NM) | 32000 FT AND BELOW | 33000 FT AND ABOVE |
| 200 | 1.01 | 1.02 |
| 400 | 1.02 | 1.03 |
| 600 | 1.03 | 1.03 |
| 800 | 1.04 | 1.04 |
| 1000 | 1.05 | 1.05 |
| 1200 | 1.05 | 1.06 |
| 1400 | 1.06 | 1.07 |
| 1600 | 1.07 | 1.08 |
| 1800 | - | 1.09 |
| 2000 | - | 1.11 |

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# APU AND ENGINE FUEL CONSUMPTION

## APU FUEL CONSUMPTION

The table below shows the APU fuel consumption on the ground and during level flight at 5000 ft, 25000 ft and 37000 ft altitudes. The data is calculated for different airspeeds, APU air bleeds, and electrical loads.

### APU FUEL CONSUMPTION

**Applicable to Sundstrand APU T-62T-40C11 or T-62T-40C14 (500R)**

| ALTITUDE (ft) | AIRSPEED (KIAS) | APU AIR BLEED | APU GEN. LOAD | APU FUEL FLOW (lb/min) |
|---|---|---|---|---|
| 0 | 0 | No Load | No Load | 1.59 |
| | | | Max Load | 1.70 |
| | | 2 Packs | No Load | 2.49 |
| | | | Max Load | 2.73 |
| 5000 | 140 | No Load | No Load | 1.82 |
| | | | Max Load | 1.94 |
| | | 2 Packs | No Load | 2.59 |
| | | | Max Load | 2.85 |
| | 220 | No Load | No Load | 1.82 |
| | | | Max Load | 1.94 |
| | | 2 Packs | No Load | 2.59 |
| | | | Max Load | 2.85 |
| 25000 | 140 | No Load | No Load | 1.04 |
| | | | Max Load | 1.17 |
| | | 2 Packs | No Load | 1.29 |
| | | | Max Load | 1.55 |
| | 220 | No Load | No Load | 1.04 |
| | | | Max Load | 1.17 |
| | | 2 Packs | No Load | 1.29 |
| | | | Max Load | 1.55 |
| 37000 | 140 | No Load | No Load | 0.55 |
| | | | Max Load | 0.74 |
| | | 2 Packs | Max Load | 0.96 |
| | 220 | No Load | No Load | 0.55 |
| | | | Max Load | 0.69 |
| | | 2 Packs | Max Load | 0.93 |

**NOTE:** Fuel density may range from 6.550 to 6.770 lb/US Gal. The values above have been determined for an adopted fuel density of 6.767 lb/US Gal.

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## ENGINE FUEL CONSUMPTION

The following values established for taxi, take-off, approach and go around fuel consumption should be considered when calculating detailed flight plans.

### FUEL CONSUMPTION

| ENGINE | PHASE OF FLIGHT | FUEL CONSUMPTION lb/min |
|---|---|---|
| **AE3007A** | TAXI | 14.6 |
| | TAKE-OFF | 93.9 |
| | APPROACH AND LANDING | 36.5 |
| | GO AROUND | 93.9 |
| **AE3007A1/1 A1, A3, A1/3, A1P, A1E** | TAXI | 15.4 |
| | TAKE-OFF | 99.2 |
| | APPROACH AND LANDING | 38.6 |
| | GO AROUND | 100.2 |

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# CLIMB

## CLIMB SPEEDS

### MAXIMUM ANGLE SPEED

This speed is recommended for obstacle clearance in order to reach an altitude on minimum ground distance. The recommended maximum angle speed is related to flaps up, all engines operating and is approximately VFS for all gross weights and altitudes (see Final Segment Speed table on section 1-04-15).

### MAXIMUM RATE OF CLIMB SPEED

This speed is recommended when maximum rate of climb is desired in order to reach an altitude on minimum climb time. The recommended maximum rate of climb speed is related to flaps up, all engines operating and is function of gross weights and altitudes as shown in the table below:

| ALT (ft) | WEIGHT (lb) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30000 | 32000 | 34000 | 36000 | 38000 | 40000 | 42000 | 44000 | 46000 | 48000 |
| **5000** | 213 | 214 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 |
| **10000** | 204 | 204 | 205 | 206 | 207 | 208 | 209 | 211 | 212 | 213 |
| **15000** | 199 | 200 | 201 | 202 | 203 | 204 | 204 | 207 | 208 | 208 |
| **20000** | 194 | 195 | 196 | 197 | 198 | 200 | 201 | 203 | 204 | 206 |
| **25000** | 187 | 188 | 189 | 191 | 192 | 194 | 196 | 198 | 200 | 202 |

**NOTE:** Speeds presented in KIAS.

Maintain the speeds above until intercepting Mach 0.56. Then fly with this Mach number until level off.

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## CLIMB TABLES

The climb planning tables show fuel consumption, distance, and time considering the airplane in climb configuration from the Sea Level up to the top of climb. Data are shown for various takeoff weights, ISA deviations and cruise altitudes.

The takeoff fuel consumption is not considered in the following tables.

Tables presents the scheduled climb speed according to the autopilot climb mode, i.e.:

- 240 KIAS for altitudes up to 10000 ft, increasing linearly to 270 KIAS from 10000 to 12000 ft, maintaining 270 KIAS from 12000 to 17400 ft and 0.56 Mach above 17400 ft.

The associated conditions are:

- Thrust Mode ..... CLB
- Flaps..... UP
- Gear..... UP
- Bleeds..... OPEN
- Anti-Ice ..... OFF

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## EXAMPLE:

Given:

Departure Airport Elevation ..... 2100 ft
Takeoff weight ..... 40000 lb
ISA Condition
Cruise Altitude ..... 33000 ft

## RESULTS

Data for 3600 ft (2100 ft + 1500 ft above departure airport) obtained from interpolation from the Sea Level to 5000 ft climb table:

Fuel: 93.6 lb
Distance: 4.3 NM
Time: 1.4 min

Data provided from the Sea Level to 33000 ft (Top of Climb) table:

Fuel: 967 lb
Distance: 79 NM
Time: 15 min

The fuel, distance and time spent during the climb phase (from 3600 ft to 33000 ft) are:

Fuel: 967 - 93.6 = 873.4 lb
Distance: 79 - 4.3 = 74.7 NM
Time: 15 - 1.4 = 13.6 min

**NOTE:** The fuel consumption related to the takeoff phase is provided on the Section 1-05-07.

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 5000 AND 6000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 5000 FT ISA + °C | | | | | 6000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 164 | 171 | 177 | 186 | 213 | 198 | 205 | 214 | 224 | 258 |
| | DISTANCE | NM | 8 | 8 | 9 | 9 | 12 | 10 | 10 | 11 | 11 | 15 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| 48000 | FUEL | LB | 154 | 160 | 167 | 175 | 200 | 186 | 193 | 201 | 211 | 241 |
| | DISTANCE | NM | 8 | 8 | 8 | 9 | 11 | 9 | 10 | 10 | 11 | 14 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |
| 46000 | FUEL | LB | 146 | 152 | 158 | 165 | 188 | 176 | 182 | 190 | 198 | 227 |
| | DISTANCE | NM | 7 | 8 | 8 | 8 | 11 | 9 | 9 | 10 | 10 | 13 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 44000 | FUEL | LB | 137 | 143 | 148 | 155 | 176 | 165 | 171 | 178 | 186 | 212 |
| | DISTANCE | NM | 7 | 7 | 7 | 8 | 10 | 8 | 9 | 9 | 9 | 12 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 42000 | FUEL | LB | 129 | 134 | 139 | 145 | 164 | 155 | 161 | 167 | 174 | 198 |
| | DISTANCE | NM | 6 | 7 | 7 | 7 | 9 | 8 | 8 | 8 | 9 | 11 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 40000 | FUEL | LB | 121 | 125 | 130 | 136 | 154 | 145 | 151 | 157 | 163 | 185 |
| | DISTANCE | NM | 6 | 6 | 6 | 7 | 9 | 7 | 8 | 8 | 8 | 11 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 38000 | FUEL | LB | 113 | 117 | 122 | 127 | 143 | 136 | 141 | 147 | 153 | 172 |
| | DISTANCE | NM | 6 | 6 | 6 | 6 | 8 | 7 | 7 | 7 | 8 | 10 |
| | TIME | MIN | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 36000 | FUEL | LB | 106 | 110 | 114 | 119 | 133 | 127 | 132 | 137 | 143 | 161 |
| | DISTANCE | NM | 5 | 5 | 6 | 6 | 7 | 6 | 7 | 7 | 7 | 9 |
| | TIME | MIN | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| 34000 | FUEL | LB | 98 | 102 | 106 | 111 | 124 | 118 | 123 | 128 | 133 | 149 |
| | DISTANCE | NM | 5 | 5 | 5 | 6 | 7 | 6 | 6 | 6 | 7 | 8 |
| | TIME | MIN | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 |
| 32000 | FUEL | LB | 92 | 95 | 99 | 103 | 115 | 110 | 114 | 119 | 124 | 138 |
| | DISTANCE | NM | 5 | 5 | 5 | 5 | 6 | 5 | 6 | 6 | 6 | 8 |
| | TIME | MIN | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 |
| 30000 | FUEL | LB | 85 | 88 | 91 | 95 | 106 | 102 | 106 | 110 | 114 | 128 |
| | DISTANCE | NM | 4 | 4 | 4 | 5 | 6 | 5 | 5 | 5 | 6 | 7 |
| | TIME | MIN | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| 28000 | FUEL | LB | 78 | 81 | 84 | 88 | 98 | 94 | 98 | 101 | 106 | 118 |
| | DISTANCE | NM | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 7 |
| | TIME | MIN | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |

ANTI ICE ON CORRECTIONS
FUEL — BELOW ISA INCREASE 8% — ISA INCREASE 8% — ABOVE ISA INCREASE 15%

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 7000 AND 8000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 7000 FT ISA + °C | | | | | 8000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| | FUEL | LB | 231 | 240 | 250 | 263 | 303 | 265 | 276 | 287 | 302 | 349 |
| 50000 | DISTANCE | NM | 12 | 12 | 13 | 14 | 18 | 14 | 14 | 15 | 16 | 21 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 4 | 4 | 5 |
| | FUEL | LB | 217 | 226 | 235 | 247 | 283 | 249 | 259 | 270 | 283 | 326 |
| 48000 | DISTANCE | NM | 11 | 12 | 12 | 13 | 16 | 13 | 14 | 14 | 15 | 19 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |
| | FUEL | LB | 205 | 213 | 222 | 232 | 266 | 236 | 245 | 254 | 266 | 306 |
| 46000 | DISTANCE | NM | 11 | 11 | 11 | 12 | 16 | 12 | 13 | 13 | 14 | 18 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |
| | FUEL | LB | 193 | 200 | 208 | 218 | 249 | 221 | 230 | 239 | 249 | 286 |
| 44000 | DISTANCE | NM | 10 | 10 | 11 | 11 | 14 | 12 | 12 | 13 | 13 | 17 |
| | TIME | MIN | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| | FUEL | LB | 181 | 188 | 195 | 204 | 232 | 207 | 215 | 224 | 234 | 267 |
| 42000 | DISTANCE | NM | 9 | 10 | 10 | 11 | 14 | 11 | 11 | 12 | 12 | 16 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 |
| | FUEL | LB | 170 | 176 | 183 | 191 | 217 | 194 | 202 | 210 | 219 | 249 |
| 40000 | DISTANCE | NM | 9 | 9 | 9 | 10 | 13 | 10 | 11 | 11 | 12 | 15 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| | FUEL | LB | 159 | 165 | 171 | 179 | 202 | 182 | 189 | 196 | 205 | 232 |
| 38000 | DISTANCE | NM | 8 | 8 | 9 | 9 | 12 | 9 | 10 | 10 | 11 | 14 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |
| | FUEL | LB | 148 | 154 | 160 | 167 | 188 | 169 | 176 | 183 | 191 | 216 |
| 36000 | DISTANCE | NM | 8 | 8 | 8 | 9 | 11 | 9 | 9 | 10 | 10 | 13 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 |
| | FUEL | LB | 138 | 143 | 149 | 155 | 174 | 158 | 164 | 170 | 178 | 200 |
| 34000 | DISTANCE | NM | 7 | 7 | 8 | 8 | 10 | 8 | 9 | 9 | 9 | 12 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| | FUEL | LB | 128 | 133 | 138 | 144 | 162 | 147 | 152 | 158 | 165 | 185 |
| 32000 | DISTANCE | NM | 7 | 7 | 7 | 7 | 9 | 8 | 8 | 8 | 9 | 11 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| | FUEL | LB | 119 | 123 | 128 | 134 | 149 | 136 | 141 | 147 | 153 | 171 |
| 30000 | DISTANCE | NM | 6 | 6 | 7 | 7 | 9 | 7 | 7 | 8 | 8 | 10 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| | FUEL | LB | 110 | 114 | 118 | 123 | 137 | 125 | 130 | 135 | 141 | 157 |
| 28000 | DISTANCE | NM | 6 | 6 | 6 | 6 | 8 | 6 | 7 | 7 | 7 | 9 |
| | TIME | MIN | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

ANTI ICE ON CORRECTIONS
FUEL — BELOW ISA INCREASE 8% — ISA INCREASE 8% — ABOVE ISA INCREASE 15%

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 9000 AND 10000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 9000 FT ISA + °C | | | | | 10000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 300 | 312 | 324 | 341 | 396 | 335 | 348 | 362 | 381 | 444 |
| | DISTANCE | NM | 16 | 17 | 17 | 18 | 24 | 18 | 19 | 20 | 21 | 27 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 5 | 5 | 6 |
| 48000 | FUEL | LB | 282 | 293 | 305 | 320 | 369 | 314 | 327 | 340 | 357 | 414 |
| | DISTANCE | NM | 15 | 16 | 16 | 17 | 22 | 17 | 18 | 18 | 20 | 25 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 6 |
| 46000 | FUEL | LB | 266 | 276 | 287 | 300 | 347 | 296 | 308 | 320 | 335 | 388 |
| | DISTANCE | NM | 14 | 15 | 15 | 16 | 21 | 16 | 17 | 17 | 18 | 24 |
| | TIME | MIN | 3 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 5 |
| 44000 | FUEL | LB | 249 | 259 | 270 | 282 | 324 | 278 | 289 | 301 | 314 | 362 |
| | DISTANCE | NM | 13 | 14 | 14 | 15 | 20 | 15 | 16 | 16 | 17 | 22 |
| | TIME | MIN | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 5 |
| 42000 | FUEL | LB | 234 | 243 | 253 | 264 | 302 | 261 | 271 | 282 | 294 | 338 |
| | DISTANCE | NM | 12 | 13 | 13 | 14 | 18 | 14 | 15 | 15 | 16 | 21 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 4 | 4 | 5 |
| 40000 | FUEL | LB | 219 | 227 | 237 | 247 | 282 | 244 | 253 | 264 | 275 | 315 |
| | DISTANCE | NM | 12 | 12 | 13 | 13 | 17 | 13 | 14 | 14 | 15 | 19 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |
| 38000 | FUEL | LB | 205 | 213 | 221 | 231 | 262 | 228 | 237 | 246 | 257 | 293 |
| | DISTANCE | NM | 11 | 11 | 12 | 12 | 16 | 12 | 13 | 13 | 14 | 18 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |
| 36000 | FUEL | LB | 191 | 198 | 206 | 215 | 244 | 213 | 221 | 230 | 240 | 272 |
| | DISTANCE | NM | 10 | 11 | 11 | 12 | 15 | 11 | 12 | 12 | 13 | 17 |
| | TIME | MIN | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 34000 | FUEL | LB | 178 | 185 | 192 | 200 | 226 | 198 | 206 | 214 | 223 | 252 |
| | DISTANCE | NM | 9 | 10 | 10 | 11 | 14 | 11 | 11 | 12 | 12 | 16 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 32000 | FUEL | LB | 165 | 172 | 178 | 186 | 209 | 184 | 191 | 198 | 207 | 233 |
| | DISTANCE | NM | 9 | 9 | 9 | 10 | 13 | 10 | 10 | 11 | 11 | 14 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 |
| 30000 | FUEL | LB | 153 | 159 | 165 | 172 | 193 | 170 | 177 | 184 | 192 | 215 |
| | DISTANCE | NM | 8 | 8 | 9 | 9 | 12 | 9 | 9 | 10 | 10 | 13 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 |
| 28000 | FUEL | LB | 141 | 146 | 152 | 159 | 178 | 157 | 163 | 169 | 177 | 198 |
| | DISTANCE | NM | 7 | 8 | 8 | 8 | 11 | 8 | 9 | 9 | 10 | 12 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |

ANTI ICE ON CORRECTIONS
FUEL — BELOW ISA INCREASE 8% — ISA INCREASE 8% — ABOVE ISA INCREASE 15%

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 11000 AND 12000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 11000 FT ISA + °C | | | | | 12000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 371 | 386 | 402 | 423 | 495 | 411 | 427 | 445 | 469 | 554 |
| | DISTANCE | NM | 21 | 21 | 22 | 24 | 31 | 23 | 24 | 25 | 27 | 36 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 6 | 6 | 6 | 8 |
| 48000 | FUEL | LB | 348 | 362 | 377 | 396 | 461 | 385 | 401 | 417 | 439 | 516 |
| | DISTANCE | NM | 19 | 20 | 21 | 22 | 29 | 22 | 23 | 24 | 26 | 34 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 6 | 5 | 5 | 5 | 6 | 7 |
| 46000 | FUEL | LB | 328 | 341 | 355 | 371 | 433 | 363 | 377 | 392 | 411 | 483 |
| | DISTANCE | NM | 18 | 19 | 20 | 21 | 27 | 21 | 22 | 23 | 24 | 32 |
| | TIME | MIN | 4 | 4 | 5 | 5 | 6 | 5 | 5 | 5 | 5 | 7 |
| 44000 | FUEL | LB | 308 | 320 | 333 | 348 | 403 | 340 | 353 | 368 | 385 | 450 |
| | DISTANCE | NM | 17 | 18 | 18 | 20 | 26 | 19 | 20 | 21 | 22 | 29 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 6 | 5 | 5 | 5 | 5 | 6 |
| 42000 | FUEL | LB | 288 | 300 | 312 | 326 | 376 | 318 | 331 | 344 | 360 | 419 |
| | DISTANCE | NM | 16 | 17 | 17 | 18 | 24 | 18 | 19 | 20 | 21 | 27 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 5 | 6 |
| 40000 | FUEL | LB | 270 | 280 | 292 | 305 | 350 | 298 | 309 | 322 | 336 | 389 |
| | DISTANCE | NM | 15 | 16 | 16 | 17 | 22 | 17 | 18 | 18 | 19 | 25 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 6 |
| 38000 | FUEL | LB | 252 | 262 | 272 | 284 | 325 | 278 | 289 | 300 | 314 | 362 |
| | DISTANCE | NM | 14 | 14 | 15 | 16 | 21 | 16 | 16 | 17 | 18 | 24 |
| | TIME | MIN | 3 | 3 | 3 | 4 | 5 | 4 | 4 | 4 | 4 | 5 |
| 36000 | FUEL | LB | 235 | 244 | 254 | 265 | 302 | 259 | 269 | 280 | 292 | 336 |
| | DISTANCE | NM | 13 | 13 | 14 | 15 | 19 | 15 | 15 | 16 | 17 | 22 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 5 |
| 34000 | FUEL | LB | 219 | 227 | 236 | 247 | 280 | 241 | 250 | 260 | 272 | 311 |
| | DISTANCE | NM | 12 | 13 | 13 | 14 | 18 | 14 | 14 | 15 | 16 | 20 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |
| 32000 | FUEL | LB | 203 | 211 | 219 | 229 | 259 | 223 | 232 | 241 | 252 | 287 |
| | DISTANCE | NM | 11 | 12 | 12 | 13 | 16 | 13 | 13 | 14 | 14 | 19 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |
| 30000 | FUEL | LB | 188 | 195 | 203 | 212 | 239 | 207 | 215 | 223 | 233 | 265 |
| | DISTANCE | NM | 10 | 11 | 11 | 12 | 15 | 12 | 12 | 13 | 13 | 17 |
| | TIME | MIN | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 28000 | FUEL | LB | 173 | 180 | 187 | 195 | 219 | 190 | 198 | 206 | 215 | 243 |
| | DISTANCE | NM | 9 | 10 | 10 | 11 | 14 | 11 | 11 | 12 | 12 | 16 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 9% | INCREASE 9% | INCREASE 15% |
| DISTANCE | NA | INCREASE 10% | INCREASE 20% |
| TIME | NA | INCREASE 10% | INCREASE 20% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 13000 AND 14000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 13000 FT ISA + °C | | | | | 14000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 454 | 472 | 491 | 519 | 622 | 498 | 518 | 539 | 570 | 694 |
| | DISTANCE | NM | 27 | 28 | 29 | 31 | 42 | 30 | 32 | 33 | 36 | 49 |
| | TIME | MIN | 6 | 6 | 6 | 7 | 9 | 7 | 7 | 7 | 8 | 10 |
| 48000 | FUEL | LB | 425 | 442 | 460 | 485 | 577 | 466 | 485 | 505 | 533 | 642 |
| | DISTANCE | NM | 25 | 26 | 27 | 29 | 39 | 28 | 29 | 31 | 33 | 45 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 6 | 7 | 7 | 9 |
| 46000 | FUEL | LB | 400 | 416 | 433 | 453 | 540 | 438 | 455 | 474 | 497 | 600 |
| | DISTANCE | NM | 24 | 25 | 26 | 27 | 37 | 27 | 28 | 29 | 31 | 42 |
| | TIME | MIN | 5 | 6 | 6 | 6 | 8 | 6 | 6 | 6 | 7 | 9 |
| 44000 | FUEL | LB | 374 | 389 | 405 | 424 | 502 | 410 | 426 | 443 | 465 | 557 |
| | DISTANCE | NM | 22 | 23 | 24 | 25 | 34 | 25 | 26 | 27 | 29 | 39 |
| | TIME | MIN | 5 | 5 | 5 | 6 | 7 | 6 | 6 | 6 | 6 | 8 |
| 42000 | FUEL | LB | 350 | 364 | 379 | 396 | 466 | 383 | 398 | 414 | 434 | 516 |
| | DISTANCE | NM | 21 | 21 | 22 | 24 | 32 | 23 | 24 | 25 | 27 | 36 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 5 | 5 | 6 | 8 |
| 40000 | FUEL | LB | 327 | 340 | 354 | 370 | 433 | 358 | 372 | 387 | 405 | 479 |
| | DISTANCE | NM | 19 | 20 | 21 | 22 | 29 | 22 | 23 | 24 | 25 | 34 |
| | TIME | MIN | 4 | 5 | 5 | 5 | 6 | 5 | 5 | 5 | 5 | 7 |
| 38000 | FUEL | LB | 305 | 317 | 330 | 345 | 402 | 333 | 347 | 361 | 378 | 444 |
| | DISTANCE | NM | 18 | 19 | 19 | 21 | 27 | 20 | 21 | 22 | 23 | 31 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 6 | 5 | 5 | 5 | 5 | 6 |
| 36000 | FUEL | LB | 284 | 296 | 308 | 322 | 372 | 310 | 323 | 336 | 351 | 411 |
| | DISTANCE | NM | 17 | 17 | 18 | 19 | 25 | 19 | 20 | 20 | 22 | 29 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 5 | 6 |
| 34000 | FUEL | LB | 264 | 275 | 286 | 299 | 344 | 288 | 300 | 312 | 326 | 379 |
| | DISTANCE | NM | 15 | 16 | 17 | 18 | 23 | 17 | 18 | 19 | 20 | 26 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 6 |
| 32000 | FUEL | LB | 245 | 255 | 265 | 277 | 318 | 267 | 278 | 289 | 302 | 350 |
| | DISTANCE | NM | 14 | 15 | 16 | 16 | 21 | 16 | 17 | 17 | 18 | 24 |
| | TIME | MIN | 3 | 3 | 3 | 4 | 5 | 4 | 4 | 4 | 4 | 5 |
| 30000 | FUEL | LB | 226 | 235 | 245 | 256 | 293 | 247 | 257 | 267 | 279 | 322 |
| | DISTANCE | NM | 13 | 14 | 14 | 15 | 20 | 15 | 15 | 16 | 17 | 22 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 4 | 4 | 5 |
| 28000 | FUEL | LB | 209 | 217 | 226 | 236 | 269 | 227 | 236 | 246 | 257 | 295 |
| | DISTANCE | NM | 12 | 13 | 13 | 14 | 18 | 14 | 14 | 15 | 16 | 20 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 9% | INCREASE 9% | INCREASE 15% |
| DISTANCE | NA | INCREASE 10% | INCREASE 20% |
| TIME | NA | INCREASE 10% | INCREASE 20% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 15000 AND 16000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 15000 FT ISA + °C | | | | | 16000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| | FUEL | LB | 544 | 566 | 589 | 624 | 770 | 592 | 616 | 641 | 680 | 853 |
| 50000 | DISTANCE | NM | 34 | 36 | 37 | 40 | 56 | 38 | 40 | 42 | 45 | 64 |
| | TIME | MIN | 8 | 8 | 8 | 8 | 11 | 8 | 8 | 9 | 9 | 13 |
| | FUEL | LB | 508 | 529 | 551 | 583 | 711 | 552 | 575 | 598 | 634 | 785 |
| 48000 | DISTANCE | NM | 32 | 33 | 35 | 37 | 52 | 36 | 37 | 39 | 42 | 59 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 10 | 8 | 8 | 8 | 9 | 12 |
| | FUEL | LB | 477 | 497 | 517 | 543 | 664 | 518 | 539 | 561 | 590 | 731 |
| 46000 | DISTANCE | NM | 30 | 31 | 33 | 35 | 48 | 33 | 35 | 36 | 39 | 55 |
| | TIME | MIN | 7 | 7 | 7 | 7 | 10 | 7 | 7 | 8 | 8 | 11 |
| | FUEL | LB | 446 | 464 | 483 | 507 | 614 | 484 | 503 | 524 | 550 | 675 |
| 44000 | DISTANCE | NM | 28 | 29 | 30 | 32 | 45 | 31 | 32 | 34 | 36 | 51 |
| | TIME | MIN | 6 | 6 | 6 | 7 | 9 | 7 | 7 | 7 | 7 | 10 |
| | FUEL | LB | 417 | 433 | 451 | 473 | 569 | 451 | 470 | 489 | 513 | 624 |
| 42000 | DISTANCE | NM | 26 | 27 | 28 | 30 | 41 | 29 | 30 | 32 | 34 | 47 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 6 | 7 | 7 | 9 |
| | FUEL | LB | 389 | 404 | 421 | 441 | 527 | 421 | 438 | 456 | 478 | 577 |
| 40000 | DISTANCE | NM | 24 | 25 | 26 | 28 | 38 | 27 | 28 | 29 | 31 | 43 |
| | TIME | MIN | 5 | 5 | 6 | 6 | 8 | 6 | 6 | 6 | 6 | 9 |
| | FUEL | LB | 362 | 377 | 392 | 411 | 487 | 392 | 408 | 424 | 445 | 533 |
| 38000 | DISTANCE | NM | 23 | 24 | 25 | 26 | 35 | 25 | 26 | 27 | 29 | 40 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 6 | 6 | 6 | 8 |
| | FUEL | LB | 337 | 351 | 365 | 382 | 450 | 364 | 379 | 394 | 413 | 492 |
| 36000 | DISTANCE | NM | 21 | 22 | 23 | 24 | 32 | 23 | 24 | 25 | 27 | 37 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 5 | 5 | 6 | 7 |
| | FUEL | LB | 313 | 325 | 339 | 354 | 416 | 338 | 352 | 366 | 383 | 453 |
| 34000 | DISTANCE | NM | 19 | 20 | 21 | 22 | 30 | 22 | 22 | 23 | 25 | 34 |
| | TIME | MIN | 4 | 4 | 5 | 5 | 6 | 5 | 5 | 5 | 5 | 7 |
| | FUEL | LB | 290 | 301 | 314 | 328 | 383 | 313 | 325 | 339 | 355 | 417 |
| 32000 | DISTANCE | NM | 18 | 19 | 20 | 21 | 28 | 20 | 21 | 22 | 23 | 31 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 6 | 4 | 4 | 5 | 5 | 6 |
| | FUEL | LB | 267 | 278 | 290 | 303 | 352 | 289 | 300 | 312 | 327 | 383 |
| 30000 | DISTANCE | NM | 17 | 17 | 18 | 19 | 25 | 18 | 19 | 20 | 21 | 28 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 6 |
| | FUEL | LB | 246 | 256 | 266 | 279 | 322 | 265 | 276 | 287 | 301 | 350 |
| 28000 | DISTANCE | NM | 15 | 16 | 17 | 17 | 23 | 17 | 18 | 18 | 19 | 26 |
| | TIME | MIN | 3 | 3 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 5 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 9% | INCREASE 9% | INCREASE 15% |
| DISTANCE | NA | INCREASE 10% | INCREASE 20% |
| TIME | NA | INCREASE 10% | INCREASE 20% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 17000 AND 18000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 17000 FT ISA + °C | | | | | 18000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| | FUEL | LB | 641 | 667 | 695 | 739 | 942 | 686 | 714 | 744 | 793 | 1024 |
| 50000 | DISTANCE | NM | 43 | 44 | 46 | 50 | 73 | 47 | 49 | 51 | 55 | 82 |
| | TIME | MIN | 9 | 9 | 9 | 10 | 14 | 10 | 10 | 10 | 11 | 16 |
| | FUEL | LB | 597 | 622 | 648 | 688 | 864 | 638 | 665 | 693 | 737 | 936 |
| 48000 | DISTANCE | NM | 40 | 41 | 43 | 47 | 67 | 43 | 45 | 47 | 51 | 75 |
| | TIME | MIN | 8 | 9 | 9 | 9 | 13 | 9 | 9 | 10 | 10 | 14 |
| | FUEL | LB | 560 | 583 | 607 | 639 | 803 | 598 | 622 | 648 | 684 | 869 |
| 46000 | DISTANCE | NM | 37 | 39 | 40 | 43 | 63 | 41 | 42 | 44 | 47 | 69 |
| | TIME | MIN | 8 | 8 | 8 | 9 | 12 | 9 | 9 | 9 | 9 | 13 |
| | FUEL | LB | 522 | 543 | 566 | 595 | 740 | 557 | 580 | 604 | 637 | 799 |
| 44000 | DISTANCE | NM | 35 | 36 | 38 | 40 | 57 | 38 | 39 | 41 | 44 | 64 |
| | TIME | MIN | 7 | 8 | 8 | 8 | 11 | 8 | 8 | 8 | 9 | 12 |
| | FUEL | LB | 487 | 507 | 528 | 555 | 683 | 519 | 540 | 563 | 593 | 736 |
| 42000 | DISTANCE | NM | 32 | 34 | 35 | 37 | 53 | 35 | 37 | 38 | 41 | 58 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 10 | 7 | 8 | 8 | 8 | 11 |
| | FUEL | LB | 453 | 472 | 491 | 516 | 630 | 483 | 503 | 524 | 551 | 678 |
| 40000 | DISTANCE | NM | 30 | 31 | 33 | 35 | 49 | 33 | 34 | 35 | 38 | 54 |
| | TIME | MIN | 6 | 7 | 7 | 7 | 10 | 7 | 7 | 7 | 8 | 10 |
| | FUEL | LB | 422 | 439 | 457 | 480 | 581 | 449 | 467 | 487 | 512 | 624 |
| 38000 | DISTANCE | NM | 28 | 29 | 30 | 32 | 45 | 30 | 32 | 33 | 35 | 49 |
| | TIME | MIN | 6 | 6 | 6 | 7 | 9 | 6 | 7 | 7 | 7 | 10 |
| | FUEL | LB | 392 | 408 | 425 | 446 | 535 | 417 | 434 | 452 | 475 | 574 |
| 36000 | DISTANCE | NM | 26 | 27 | 28 | 30 | 41 | 28 | 29 | 31 | 33 | 45 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 6 | 6 | 7 | 9 |
| | FUEL | LB | 363 | 378 | 394 | 413 | 492 | 386 | 402 | 419 | 440 | 528 |
| 34000 | DISTANCE | NM | 24 | 25 | 26 | 28 | 38 | 26 | 27 | 28 | 30 | 41 |
| | TIME | MIN | 5 | 5 | 5 | 6 | 7 | 6 | 6 | 6 | 6 | 8 |
| | FUEL | LB | 336 | 350 | 364 | 382 | 453 | 357 | 372 | 387 | 406 | 485 |
| 32000 | DISTANCE | NM | 22 | 23 | 24 | 25 | 35 | 24 | 25 | 26 | 28 | 38 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 5 | 5 | 6 | 7 |
| | FUEL | LB | 310 | 322 | 336 | 352 | 415 | 329 | 343 | 357 | 374 | 444 |
| 30000 | DISTANCE | NM | 20 | 21 | 22 | 23 | 32 | 22 | 23 | 24 | 25 | 35 |
| | TIME | MIN | 4 | 4 | 5 | 5 | 6 | 5 | 5 | 5 | 5 | 7 |
| | FUEL | LB | 285 | 296 | 309 | 323 | 379 | 302 | 315 | 328 | 344 | 405 |
| 28000 | DISTANCE | NM | 19 | 19 | 20 | 21 | 29 | 20 | 21 | 22 | 23 | 32 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 6 | 4 | 4 | 5 | 5 | 6 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 10% | INCREASE 10% | INCREASE 20% |
| DISTANCE | NA | INCREASE 10% | INCREASE 20% |
| TIME | NA | INCREASE 10% | INCREASE 20% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 19000 AND 20000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 19000 FT ISA + °C | | | | | 20000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 726 | 756 | 787 | 841 | 1095 | 764 | 795 | 829 | 886 | 1161 |
| | DISTANCE | NM | 50 | 52 | 55 | 60 | 90 | 54 | 56 | 59 | 64 | 97 |
| | TIME | MIN | 10 | 11 | 11 | 12 | 17 | 11 | 11 | 12 | 12 | 18 |
| 48000 | FUEL | LB | 675 | 703 | 732 | 781 | 1000 | 710 | 740 | 771 | 823 | 1059 |
| | DISTANCE | NM | 47 | 49 | 51 | 55 | 81 | 50 | 52 | 54 | 59 | 88 |
| | TIME | MIN | 10 | 10 | 10 | 11 | 15 | 10 | 11 | 11 | 12 | 17 |
| 46000 | FUEL | LB | 632 | 658 | 685 | 724 | 926 | 664 | 692 | 721 | 763 | 979 |
| | DISTANCE | NM | 44 | 46 | 48 | 51 | 75 | 47 | 49 | 51 | 55 | 81 |
| | TIME | MIN | 9 | 9 | 10 | 10 | 14 | 10 | 10 | 10 | 11 | 15 |
| 44000 | FUEL | LB | 588 | 612 | 638 | 674 | 851 | 618 | 644 | 671 | 709 | 898 |
| | DISTANCE | NM | 41 | 42 | 44 | 47 | 69 | 43 | 45 | 47 | 51 | 74 |
| | TIME | MIN | 8 | 9 | 9 | 9 | 13 | 9 | 9 | 9 | 10 | 14 |
| 42000 | FUEL | LB | 548 | 570 | 594 | 627 | 782 | 575 | 599 | 624 | 659 | 825 |
| | DISTANCE | NM | 38 | 39 | 41 | 44 | 63 | 40 | 42 | 44 | 47 | 68 |
| | TIME | MIN | 8 | 8 | 8 | 9 | 12 | 8 | 9 | 9 | 9 | 13 |
| 40000 | FUEL | LB | 509 | 530 | 552 | 582 | 719 | 535 | 557 | 580 | 612 | 758 |
| | DISTANCE | NM | 35 | 37 | 38 | 41 | 58 | 37 | 39 | 41 | 44 | 62 |
| | TIME | MIN | 7 | 7 | 8 | 8 | 11 | 8 | 8 | 8 | 9 | 12 |
| 38000 | FUEL | LB | 473 | 493 | 513 | 541 | 662 | 497 | 517 | 539 | 568 | 697 |
| | DISTANCE | NM | 33 | 34 | 35 | 38 | 53 | 35 | 36 | 38 | 40 | 57 |
| | TIME | MIN | 7 | 7 | 7 | 7 | 10 | 7 | 7 | 8 | 8 | 11 |
| 36000 | FUEL | LB | 439 | 457 | 476 | 501 | 608 | 461 | 480 | 500 | 527 | 641 |
| | DISTANCE | NM | 30 | 31 | 33 | 35 | 49 | 32 | 33 | 35 | 37 | 52 |
| | TIME | MIN | 6 | 6 | 7 | 7 | 9 | 7 | 7 | 7 | 7 | 10 |
| 34000 | FUEL | LB | 407 | 423 | 441 | 464 | 559 | 426 | 444 | 463 | 487 | 588 |
| | DISTANCE | NM | 28 | 29 | 30 | 32 | 45 | 30 | 31 | 32 | 34 | 48 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 9 | 6 | 6 | 6 | 7 | 9 |
| 32000 | FUEL | LB | 376 | 391 | 407 | 428 | 513 | 394 | 410 | 427 | 450 | 539 |
| | DISTANCE | NM | 26 | 27 | 28 | 30 | 41 | 27 | 28 | 30 | 32 | 44 |
| | TIME | MIN | 5 | 6 | 6 | 6 | 8 | 6 | 6 | 6 | 6 | 8 |
| 30000 | FUEL | LB | 346 | 361 | 375 | 395 | 469 | 363 | 378 | 393 | 414 | 493 |
| | DISTANCE | NM | 24 | 25 | 26 | 27 | 37 | 25 | 26 | 27 | 29 | 40 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 5 | 5 | 6 | 8 |
| 28000 | FUEL | LB | 318 | 331 | 345 | 362 | 428 | 333 | 347 | 361 | 380 | 450 |
| | DISTANCE | NM | 22 | 22 | 23 | 25 | 34 | 23 | 24 | 25 | 27 | 36 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 5 | 5 | 5 | 7 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 10% | INCREASE 10% | INCREASE 20% |
| DISTANCE | NA | INCREASE 10% | INCREASE 20% |
| TIME | NA | INCREASE 10% | INCREASE 20% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 21000 AND 22000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 21000 FT ISA + °C | | | | | 22000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 801 | 835 | 870 | 931 | 1225 | 839 | 874 | 911 | 976 | 1291 |
| | DISTANCE | NM | 57 | 60 | 62 | 68 | 103 | 61 | 63 | 66 | 73 | 111 |
| | TIME | MIN | 12 | 12 | 12 | 13 | 19 | 12 | 13 | 13 | 14 | 21 |
| 48000 | FUEL | LB | 745 | 776 | 808 | 864 | 1116 | 779 | 812 | 846 | 905 | 1174 |
| | DISTANCE | NM | 53 | 55 | 58 | 63 | 94 | 56 | 59 | 61 | 67 | 100 |
| | TIME | MIN | 11 | 11 | 11 | 12 | 18 | 11 | 12 | 12 | 13 | 19 |
| 46000 | FUEL | LB | 696 | 725 | 755 | 801 | 1031 | 728 | 758 | 790 | 838 | 1084 |
| | DISTANCE | NM | 50 | 52 | 54 | 58 | 87 | 53 | 55 | 57 | 62 | 92 |
| | TIME | MIN | 10 | 10 | 11 | 11 | 16 | 11 | 11 | 11 | 12 | 17 |
| 44000 | FUEL | LB | 647 | 674 | 702 | 744 | 945 | 676 | 705 | 734 | 778 | 992 |
| | DISTANCE | NM | 46 | 48 | 50 | 54 | 79 | 49 | 51 | 53 | 57 | 84 |
| | TIME | MIN | 9 | 10 | 10 | 10 | 15 | 10 | 10 | 10 | 11 | 16 |
| 42000 | FUEL | LB | 602 | 627 | 653 | 691 | 867 | 629 | 655 | 682 | 723 | 909 |
| | DISTANCE | NM | 43 | 45 | 46 | 50 | 72 | 45 | 47 | 49 | 53 | 77 |
| | TIME | MIN | 9 | 9 | 9 | 10 | 14 | 9 | 9 | 10 | 10 | 14 |
| 40000 | FUEL | LB | 559 | 583 | 607 | 641 | 796 | 584 | 608 | 634 | 670 | 835 |
| | DISTANCE | NM | 40 | 41 | 43 | 46 | 66 | 42 | 44 | 46 | 49 | 70 |
| | TIME | MIN | 8 | 8 | 9 | 9 | 12 | 9 | 9 | 9 | 9 | 13 |
| 38000 | FUEL | LB | 519 | 541 | 564 | 595 | 732 | 542 | 565 | 588 | 622 | 766 |
| | DISTANCE | NM | 37 | 38 | 40 | 43 | 61 | 39 | 40 | 42 | 45 | 64 |
| | TIME | MIN | 8 | 8 | 8 | 8 | 11 | 8 | 8 | 8 | 9 | 12 |
| 36000 | FUEL | LB | 482 | 502 | 522 | 551 | 672 | 502 | 523 | 545 | 575 | 703 |
| | DISTANCE | NM | 34 | 35 | 37 | 40 | 56 | 36 | 37 | 39 | 42 | 59 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 11 | 7 | 8 | 8 | 8 | 11 |
| 34000 | FUEL | LB | 446 | 464 | 483 | 510 | 616 | 465 | 484 | 504 | 532 | 645 |
| | DISTANCE | NM | 31 | 33 | 34 | 37 | 51 | 33 | 35 | 36 | 39 | 54 |
| | TIME | MIN | 7 | 7 | 7 | 7 | 10 | 7 | 7 | 7 | 8 | 10 |
| 32000 | FUEL | LB | 411 | 429 | 446 | 470 | 565 | 429 | 447 | 465 | 491 | 590 |
| | DISTANCE | NM | 29 | 30 | 31 | 34 | 46 | 31 | 32 | 33 | 36 | 49 |
| | TIME | MIN | 6 | 6 | 6 | 7 | 9 | 6 | 6 | 7 | 7 | 9 |
| 30000 | FUEL | LB | 379 | 395 | 411 | 433 | 516 | 395 | 411 | 428 | 451 | 539 |
| | DISTANCE | NM | 27 | 28 | 29 | 31 | 42 | 28 | 29 | 30 | 33 | 45 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 6 | 6 | 6 | 8 |
| 28000 | FUEL | LB | 348 | 362 | 377 | 397 | 471 | 362 | 377 | 393 | 414 | 492 |
| | DISTANCE | NM | 24 | 25 | 26 | 28 | 38 | 26 | 27 | 28 | 30 | 41 |
| | TIME | MIN | 5 | 5 | 5 | 6 | 7 | 5 | 5 | 6 | 6 | 8 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 10% | INCREASE 10% | INCREASE 20% |
| DISTANCE | NA | INCREASE 10% | INCREASE 20% |
| TIME | NA | INCREASE 10% | INCREASE 20% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 23000 AND 24000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 23000 FT ISA + °C | | | | | 24000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| | FUEL | LB | 877 | 913 | 952 | 1022 | 1358 | 915 | 953 | 994 | 1068 | 1426 |
| 50000 | DISTANCE | NM | 64 | 67 | 70 | 77 | 118 | 68 | 71 | 74 | 82 | 126 |
| | TIME | MIN | 13 | 13 | 14 | 15 | 22 | 14 | 14 | 14 | 15 | 23 |
| | FUEL | LB | 814 | 848 | 884 | 946 | 1234 | 849 | 884 | 922 | 988 | 1295 |
| 48000 | DISTANCE | NM | 60 | 62 | 65 | 71 | 107 | 63 | 66 | 69 | 75 | 114 |
| | TIME | MIN | 12 | 12 | 13 | 14 | 20 | 13 | 13 | 13 | 14 | 21 |
| | FUEL | LB | 759 | 791 | 824 | 876 | 1137 | 791 | 825 | 859 | 915 | 1191 |
| 46000 | DISTANCE | NM | 56 | 58 | 60 | 66 | 98 | 59 | 61 | 64 | 69 | 105 |
| | TIME | MIN | 11 | 12 | 12 | 13 | 18 | 12 | 12 | 12 | 13 | 19 |
| | FUEL | LB | 705 | 735 | 766 | 813 | 1039 | 735 | 766 | 798 | 848 | 1088 |
| 44000 | DISTANCE | NM | 52 | 54 | 56 | 61 | 90 | 54 | 57 | 59 | 64 | 95 |
| | TIME | MIN | 10 | 11 | 11 | 12 | 17 | 11 | 11 | 12 | 12 | 18 |
| | FUEL | LB | 655 | 683 | 711 | 754 | 952 | 682 | 711 | 741 | 786 | 995 |
| 42000 | DISTANCE | NM | 48 | 50 | 52 | 56 | 82 | 50 | 52 | 55 | 59 | 87 |
| | TIME | MIN | 10 | 10 | 10 | 11 | 15 | 10 | 10 | 11 | 11 | 16 |
| | FUEL | LB | 608 | 634 | 660 | 699 | 873 | 633 | 660 | 687 | 729 | 911 |
| 40000 | DISTANCE | NM | 44 | 46 | 48 | 52 | 75 | 47 | 49 | 51 | 55 | 79 |
| | TIME | MIN | 9 | 9 | 9 | 10 | 14 | 9 | 10 | 10 | 10 | 15 |
| | FUEL | LB | 564 | 588 | 613 | 648 | 801 | 587 | 611 | 637 | 675 | 835 |
| 38000 | DISTANCE | NM | 41 | 43 | 45 | 48 | 68 | 43 | 45 | 47 | 51 | 72 |
| | TIME | MIN | 8 | 9 | 9 | 9 | 13 | 9 | 9 | 9 | 10 | 13 |
| | FUEL | LB | 523 | 545 | 567 | 600 | 734 | 543 | 566 | 590 | 624 | 765 |
| 36000 | DISTANCE | NM | 38 | 39 | 41 | 44 | 62 | 40 | 42 | 43 | 47 | 66 |
| | TIME | MIN | 8 | 8 | 8 | 9 | 12 | 8 | 8 | 8 | 9 | 12 |
| | FUEL | LB | 483 | 504 | 525 | 554 | 673 | 502 | 523 | 545 | 576 | 701 |
| 34000 | DISTANCE | NM | 35 | 36 | 38 | 41 | 57 | 37 | 38 | 40 | 43 | 60 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 11 | 7 | 8 | 8 | 8 | 11 |
| | FUEL | LB | 446 | 465 | 484 | 511 | 616 | 463 | 483 | 503 | 531 | 641 |
| 32000 | DISTANCE | NM | 32 | 34 | 35 | 38 | 52 | 34 | 35 | 37 | 40 | 55 |
| | TIME | MIN | 7 | 7 | 7 | 7 | 10 | 7 | 7 | 7 | 8 | 10 |
| | FUEL | LB | 411 | 428 | 446 | 470 | 562 | 426 | 444 | 463 | 488 | 585 |
| 30000 | DISTANCE | NM | 30 | 31 | 32 | 35 | 47 | 31 | 32 | 34 | 36 | 50 |
| | TIME | MIN | 6 | 6 | 6 | 7 | 9 | 6 | 6 | 7 | 7 | 9 |
| | FUEL | LB | 377 | 392 | 409 | 431 | 512 | 391 | 407 | 424 | 447 | 533 |
| 28000 | DISTANCE | NM | 27 | 28 | 29 | 32 | 43 | 28 | 30 | 31 | 33 | 45 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 6 | 6 | 6 | 9 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 10% | INCREASE 10% | INCREASE 20% |
| DISTANCE | NA | INCREASE 10% | INCREASE 20% |
| TIME | NA | INCREASE 10% | INCREASE 20% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 25000 AND 26000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 25000 FT ISA + °C | | | | | 26000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 956 | 994 | 1036 | 1114 | 1494 | 1000 | 1035 | 1079 | 1161 | 1562 |
| | DISTANCE | NM | 72 | 75 | 78 | 86 | 134 | 77 | 79 | 83 | 91 | 142 |
| | TIME | MIN | 14 | 15 | 15 | 16 | 24 | 15 | 16 | 16 | 17 | 26 |
| 48000 | FUEL | LB | 886 | 921 | 960 | 1031 | 1355 | 927 | 959 | 1000 | 1073 | 1415 |
| | DISTANCE | NM | 67 | 69 | 72 | 80 | 121 | 71 | 73 | 76 | 84 | 128 |
| | TIME | MIN | 13 | 14 | 14 | 15 | 22 | 14 | 14 | 15 | 16 | 23 |
| 46000 | FUEL | LB | 824 | 858 | 895 | 954 | 1246 | 857 | 893 | 931 | 992 | 1299 |
| | DISTANCE | NM | 62 | 65 | 67 | 73 | 111 | 65 | 68 | 71 | 77 | 117 |
| | TIME | MIN | 12 | 13 | 13 | 14 | 20 | 13 | 13 | 14 | 15 | 21 |
| 44000 | FUEL | LB | 764 | 797 | 830 | 884 | 1136 | 795 | 828 | 863 | 919 | 1184 |
| | DISTANCE | NM | 57 | 60 | 62 | 68 | 101 | 60 | 63 | 66 | 72 | 107 |
| | TIME | MIN | 12 | 12 | 12 | 13 | 19 | 12 | 12 | 13 | 14 | 20 |
| 42000 | FUEL | LB | 709 | 739 | 770 | 818 | 1038 | 737 | 768 | 800 | 851 | 1081 |
| | DISTANCE | NM | 53 | 55 | 58 | 63 | 92 | 56 | 58 | 61 | 66 | 97 |
| | TIME | MIN | 11 | 11 | 11 | 12 | 17 | 11 | 11 | 12 | 12 | 18 |
| 40000 | FUEL | LB | 658 | 685 | 714 | 758 | 950 | 683 | 712 | 742 | 787 | 988 |
| | DISTANCE | NM | 49 | 51 | 53 | 58 | 84 | 52 | 54 | 56 | 61 | 88 |
| | TIME | MIN | 10 | 10 | 10 | 11 | 15 | 10 | 11 | 11 | 12 | 16 |
| 38000 | FUEL | LB | 609 | 635 | 662 | 701 | 870 | 632 | 659 | 687 | 728 | 904 |
| | DISTANCE | NM | 45 | 47 | 49 | 53 | 76 | 48 | 50 | 52 | 56 | 80 |
| | TIME | MIN | 9 | 9 | 10 | 10 | 14 | 10 | 10 | 10 | 11 | 15 |
| 36000 | FUEL | LB | 564 | 588 | 613 | 649 | 796 | 585 | 610 | 635 | 673 | 827 |
| | DISTANCE | NM | 42 | 44 | 46 | 49 | 70 | 44 | 46 | 48 | 52 | 73 |
| | TIME | MIN | 8 | 9 | 9 | 9 | 13 | 9 | 9 | 9 | 10 | 14 |
| 34000 | FUEL | LB | 521 | 543 | 566 | 599 | 729 | 540 | 563 | 587 | 621 | 756 |
| | DISTANCE | NM | 39 | 40 | 42 | 45 | 64 | 41 | 42 | 44 | 48 | 67 |
| | TIME | MIN | 8 | 8 | 8 | 9 | 12 | 8 | 8 | 9 | 9 | 12 |
| 32000 | FUEL | LB | 481 | 501 | 522 | 551 | 666 | 498 | 519 | 541 | 571 | 691 |
| | DISTANCE | NM | 36 | 37 | 39 | 42 | 58 | 37 | 39 | 41 | 44 | 61 |
| | TIME | MIN | 7 | 7 | 8 | 8 | 11 | 8 | 8 | 8 | 8 | 11 |
| 30000 | FUEL | LB | 442 | 461 | 480 | 507 | 608 | 458 | 477 | 497 | 525 | 630 |
| | DISTANCE | NM | 33 | 34 | 35 | 38 | 53 | 34 | 36 | 37 | 40 | 55 |
| | TIME | MIN | 7 | 7 | 7 | 7 | 10 | 7 | 7 | 7 | 8 | 10 |
| 28000 | FUEL | LB | 405 | 422 | 440 | 464 | 553 | 419 | 437 | 455 | 481 | 573 |
| | DISTANCE | NM | 30 | 31 | 32 | 35 | 48 | 31 | 33 | 34 | 37 | 50 |
| | TIME | MIN | 6 | 6 | 6 | 7 | 9 | 6 | 6 | 7 | 7 | 9 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 10% | INCREASE 10% | INCREASE 20% |
| DISTANCE | NA | INCREASE 10% | INCREASE 20% |
| TIME | NA | INCREASE 10% | INCREASE 20% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 27000 AND 28000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 27000 FT ISA + °C | | | | | 28000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 1046 | 1078 | 1124 | 1209 | 1629 | 1095 | 1124 | 1171 | 1258 | 1697 |
| | DISTANCE | NM | 81 | 84 | 87 | 96 | 150 | 86 | 89 | 93 | 102 | 158 |
| | TIME | MIN | 16 | 16 | 17 | 18 | 27 | 17 | 17 | 18 | 19 | 29 |
| 48000 | FUEL | LB | 969 | 998 | 1041 | 1116 | 1474 | 1012 | 1039 | 1083 | 1161 | 1533 |
| | DISTANCE | NM | 75 | 77 | 81 | 89 | 135 | 80 | 82 | 85 | 94 | 142 |
| | TIME | MIN | 15 | 15 | 15 | 17 | 25 | 16 | 16 | 16 | 17 | 26 |
| 46000 | FUEL | LB | 891 | 929 | 968 | 1031 | 1352 | 926 | 965 | 1006 | 1071 | 1404 |
| | DISTANCE | NM | 69 | 72 | 75 | 82 | 124 | 73 | 76 | 79 | 86 | 130 |
| | TIME | MIN | 14 | 14 | 14 | 15 | 23 | 14 | 15 | 15 | 16 | 24 |
| 44000 | FUEL | LB | 826 | 861 | 897 | 954 | 1231 | 857 | 894 | 932 | 990 | 1277 |
| | DISTANCE | NM | 64 | 66 | 69 | 75 | 112 | 67 | 70 | 73 | 79 | 118 |
| | TIME | MIN | 13 | 13 | 13 | 14 | 21 | 13 | 14 | 14 | 15 | 21 |
| 42000 | FUEL | LB | 765 | 797 | 831 | 883 | 1123 | 794 | 828 | 863 | 916 | 1164 |
| | DISTANCE | NM | 59 | 61 | 64 | 69 | 102 | 62 | 65 | 68 | 73 | 107 |
| | TIME | MIN | 12 | 12 | 12 | 13 | 19 | 12 | 13 | 13 | 14 | 20 |
| 40000 | FUEL | LB | 708 | 739 | 770 | 817 | 1025 | 735 | 766 | 798 | 846 | 1062 |
| | DISTANCE | NM | 54 | 57 | 59 | 64 | 93 | 57 | 60 | 62 | 67 | 97 |
| | TIME | MIN | 11 | 11 | 11 | 12 | 17 | 11 | 12 | 12 | 13 | 18 |
| 38000 | FUEL | LB | 656 | 683 | 712 | 755 | 937 | 679 | 708 | 738 | 782 | 970 |
| | DISTANCE | NM | 50 | 52 | 55 | 59 | 84 | 53 | 55 | 57 | 62 | 88 |
| | TIME | MIN | 10 | 10 | 11 | 11 | 16 | 11 | 11 | 11 | 12 | 16 |
| 36000 | FUEL | LB | 606 | 632 | 658 | 697 | 857 | 627 | 654 | 682 | 721 | 886 |
| | DISTANCE | NM | 46 | 48 | 50 | 54 | 77 | 49 | 51 | 53 | 57 | 80 |
| | TIME | MIN | 9 | 10 | 10 | 10 | 14 | 10 | 10 | 10 | 11 | 15 |
| 34000 | FUEL | LB | 559 | 583 | 608 | 643 | 783 | 579 | 603 | 629 | 665 | 809 |
| | DISTANCE | NM | 43 | 44 | 46 | 50 | 70 | 45 | 47 | 49 | 52 | 73 |
| | TIME | MIN | 9 | 9 | 9 | 9 | 13 | 9 | 9 | 9 | 10 | 13 |
| 32000 | FUEL | LB | 515 | 537 | 560 | 591 | 715 | 533 | 556 | 579 | 612 | 739 |
| | DISTANCE | NM | 39 | 41 | 43 | 46 | 64 | 41 | 43 | 45 | 48 | 67 |
| | TIME | MIN | 8 | 8 | 8 | 9 | 12 | 8 | 8 | 9 | 9 | 12 |
| 30000 | FUEL | LB | 473 | 494 | 514 | 543 | 651 | 489 | 510 | 532 | 561 | 673 |
| | DISTANCE | NM | 36 | 37 | 39 | 42 | 58 | 38 | 39 | 41 | 44 | 61 |
| | TIME | MIN | 7 | 7 | 8 | 8 | 11 | 8 | 8 | 8 | 8 | 11 |
| 28000 | FUEL | LB | 434 | 452 | 471 | 497 | 592 | 448 | 467 | 487 | 513 | 611 |
| | DISTANCE | NM | 33 | 34 | 36 | 38 | 52 | 34 | 36 | 37 | 40 | 55 |
| | TIME | MIN | 7 | 7 | 7 | 7 | 10 | 7 | 7 | 7 | 8 | 10 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 10% | INCREASE 10% | INCREASE 20% |
| DISTANCE | NA | INCREASE 10% | INCREASE 20% |
| TIME | NA | INCREASE 10% | INCREASE 20% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 29000 AND 30000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 29000 FT ISA + °C | | | | | 30000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -15 | -10 | 0 | 10 | 20 | -15 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 1146 | 1171 | 1221 | 1310 | 1767 | 1199 | 1219 | 1271 | 1364 | 1842 |
| | DISTANCE | NM | 92 | 94 | 98 | 108 | 167 | 98 | 99 | 104 | 114 | 177 |
| | TIME | MIN | 18 | 18 | 19 | 20 | 30 | 19 | 19 | 20 | 21 | 32 |
| 48000 | FUEL | LB | 1058 | 1081 | 1127 | 1207 | 1594 | 1104 | 1123 | 1171 | 1255 | 1658 |
| | DISTANCE | NM | 85 | 86 | 90 | 99 | 150 | 90 | 91 | 95 | 104 | 158 |
| | TIME | MIN | 17 | 17 | 17 | 18 | 27 | 18 | 18 | 18 | 19 | 29 |
| 46000 | FUEL | LB | 982 | 1019 | 1062 | 1133 | 1457 | 1019 | 1075 | 1118 | 1196 | 1512 |
| | DISTANCE | NM | 78 | 80 | 84 | 91 | 137 | 83 | 85 | 88 | 96 | 144 |
| | TIME | MIN | 15 | 16 | 16 | 17 | 25 | 16 | 16 | 17 | 18 | 26 |
| 44000 | FUEL | LB | 908 | 942 | 982 | 1046 | 1324 | 942 | 992 | 1032 | 1102 | 1372 |
| | DISTANCE | NM | 72 | 74 | 77 | 84 | 124 | 76 | 78 | 81 | 88 | 130 |
| | TIME | MIN | 14 | 14 | 15 | 16 | 22 | 15 | 15 | 15 | 16 | 24 |
| 42000 | FUEL | LB | 840 | 871 | 908 | 965 | 1206 | 870 | 916 | 953 | 1016 | 1248 |
| | DISTANCE | NM | 67 | 68 | 71 | 77 | 112 | 70 | 72 | 75 | 81 | 118 |
| | TIME | MIN | 13 | 13 | 14 | 14 | 20 | 14 | 14 | 14 | 15 | 21 |
| 40000 | FUEL | LB | 777 | 806 | 839 | 891 | 1100 | 804 | 846 | 880 | 937 | 1138 |
| | DISTANCE | NM | 61 | 63 | 66 | 71 | 102 | 65 | 66 | 69 | 75 | 107 |
| | TIME | MIN | 12 | 12 | 13 | 13 | 19 | 13 | 13 | 13 | 14 | 19 |
| 38000 | FUEL | LB | 718 | 744 | 775 | 823 | 1004 | 743 | 780 | 812 | 864 | 1038 |
| | DISTANCE | NM | 57 | 58 | 60 | 65 | 93 | 59 | 61 | 64 | 69 | 97 |
| | TIME | MIN | 11 | 11 | 12 | 12 | 17 | 12 | 12 | 12 | 13 | 18 |
| 36000 | FUEL | LB | 663 | 687 | 715 | 758 | 916 | 685 | 720 | 749 | 796 | 946 |
| | DISTANCE | NM | 52 | 53 | 56 | 60 | 84 | 55 | 56 | 58 | 63 | 88 |
| | TIME | MIN | 10 | 10 | 11 | 11 | 15 | 11 | 11 | 11 | 12 | 16 |
| 34000 | FUEL | LB | 611 | 633 | 659 | 698 | 836 | 631 | 662 | 690 | 732 | 863 |
| | DISTANCE | NM | 48 | 49 | 51 | 55 | 77 | 50 | 51 | 54 | 58 | 80 |
| | TIME | MIN | 10 | 10 | 10 | 10 | 14 | 10 | 10 | 10 | 11 | 15 |
| 32000 | FUEL | LB | 562 | 582 | 606 | 641 | 762 | 580 | 609 | 634 | 672 | 786 |
| | DISTANCE | NM | 44 | 45 | 47 | 50 | 70 | 46 | 47 | 49 | 53 | 73 |
| | TIME | MIN | 9 | 9 | 9 | 10 | 13 | 9 | 9 | 9 | 10 | 13 |
| 30000 | FUEL | LB | 516 | 534 | 556 | 588 | 694 | 532 | 558 | 581 | 615 | 716 |
| | DISTANCE | NM | 40 | 41 | 43 | 46 | 63 | 42 | 43 | 45 | 48 | 66 |
| | TIME | MIN | 8 | 8 | 8 | 9 | 12 | 8 | 8 | 9 | 9 | 12 |
| 28000 | FUEL | LB | 472 | 489 | 509 | 538 | 630 | 487 | 510 | 531 | 562 | 650 |
| | DISTANCE | NM | 37 | 38 | 39 | 42 | 57 | 38 | 39 | 41 | 44 | 60 |
| | TIME | MIN | 7 | 7 | 8 | 8 | 11 | 8 | 8 | 8 | 8 | 11 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 15% | INCREASE 15% | INCREASE 30% |
| DISTANCE | INCREASE 20% | INCREASE 20% | INCREASE 30% |
| TIME | INCREASE 20% | INCREASE 20% | INCREASE 30% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 31000 AND 32000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 31000 FT ISA + °C | | | | | 32000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -15 | -10 | 0 | 10 | 20 | -15 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 1253 | 1268 | 1322 | 1421 | 1925 | 1308 | 1319 | 1374 | 1482 | 2020 |
| | DISTANCE | NM | 104 | 105 | 110 | 121 | 188 | 110 | 111 | 116 | 128 | 201 |
| | TIME | MIN | 20 | 20 | 21 | 22 | 34 | 21 | 21 | 22 | 24 | 36 |
| 48000 | FUEL | LB | 1152 | 1167 | 1216 | 1304 | 1728 | 1201 | 1210 | 1262 | 1356 | 1804 |
| | DISTANCE | NM | 95 | 96 | 100 | 110 | 167 | 100 | 101 | 106 | 116 | 178 |
| | TIME | MIN | 18 | 19 | 19 | 20 | 30 | 19 | 20 | 20 | 22 | 32 |
| 46000 | FUEL | LB | 1057 | 1113 | 1158 | 1239 | 1571 | 1095 | 1152 | 1199 | 1284 | 1635 |
| | DISTANCE | NM | 87 | 89 | 93 | 101 | 151 | 91 | 94 | 98 | 106 | 160 |
| | TIME | MIN | 17 | 17 | 18 | 19 | 27 | 18 | 18 | 18 | 20 | 29 |
| 44000 | FUEL | LB | 975 | 1026 | 1068 | 1140 | 1423 | 1009 | 1060 | 1104 | 1180 | 1477 |
| | DISTANCE | NM | 80 | 82 | 85 | 93 | 136 | 84 | 86 | 90 | 97 | 144 |
| | TIME | MIN | 16 | 16 | 16 | 17 | 25 | 16 | 17 | 17 | 18 | 26 |
| 42000 | FUEL | LB | 900 | 947 | 985 | 1051 | 1293 | 931 | 977 | 1017 | 1086 | 1339 |
| | DISTANCE | NM | 74 | 75 | 79 | 85 | 123 | 77 | 79 | 82 | 89 | 130 |
| | TIME | MIN | 14 | 15 | 15 | 16 | 22 | 15 | 15 | 16 | 17 | 23 |
| 40000 | FUEL | LB | 831 | 873 | 909 | 968 | 1177 | 858 | 901 | 938 | 999 | 1217 |
| | DISTANCE | NM | 68 | 69 | 72 | 78 | 112 | 71 | 72 | 76 | 82 | 117 |
| | TIME | MIN | 13 | 13 | 14 | 15 | 20 | 14 | 14 | 14 | 15 | 21 |
| 38000 | FUEL | LB | 767 | 805 | 839 | 892 | 1072 | 792 | 830 | 864 | 920 | 1108 |
| | DISTANCE | NM | 62 | 64 | 66 | 72 | 101 | 65 | 67 | 69 | 75 | 106 |
| | TIME | MIN | 12 | 12 | 13 | 13 | 18 | 13 | 13 | 13 | 14 | 19 |
| 36000 | FUEL | LB | 707 | 742 | 773 | 821 | 977 | 729 | 765 | 796 | 846 | 1009 |
| | DISTANCE | NM | 57 | 59 | 61 | 66 | 92 | 60 | 61 | 64 | 69 | 96 |
| | TIME | MIN | 11 | 11 | 12 | 12 | 17 | 12 | 12 | 12 | 13 | 18 |
| 34000 | FUEL | LB | 651 | 683 | 711 | 754 | 891 | 671 | 703 | 732 | 777 | 919 |
| | DISTANCE | NM | 52 | 54 | 56 | 60 | 84 | 55 | 56 | 59 | 63 | 87 |
| | TIME | MIN | 10 | 10 | 11 | 11 | 15 | 11 | 11 | 11 | 12 | 16 |
| 32000 | FUEL | LB | 598 | 627 | 653 | 692 | 811 | 616 | 645 | 672 | 713 | 836 |
| | DISTANCE | NM | 48 | 49 | 51 | 55 | 76 | 50 | 51 | 54 | 58 | 79 |
| | TIME | MIN | 10 | 10 | 10 | 10 | 14 | 10 | 10 | 10 | 11 | 14 |
| 30000 | FUEL | LB | 549 | 575 | 598 | 634 | 737 | 565 | 591 | 615 | 652 | 759 |
| | DISTANCE | NM | 44 | 45 | 47 | 50 | 69 | 46 | 47 | 49 | 53 | 72 |
| | TIME | MIN | 9 | 9 | 9 | 9 | 13 | 9 | 9 | 9 | 10 | 13 |
| 28000 | FUEL | LB | 501 | 525 | 547 | 579 | 669 | 516 | 540 | 562 | 595 | 688 |
| | DISTANCE | NM | 40 | 41 | 43 | 46 | 62 | 42 | 43 | 45 | 48 | 65 |
| | TIME | MIN | 8 | 8 | 8 | 9 | 11 | 8 | 8 | 9 | 9 | 12 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 15% | INCREASE 15% | INCREASE 30% |
| DISTANCE | INCREASE 20% | INCREASE 20% | INCREASE 30% |
| TIME | INCREASE 20% | INCREASE 20% | INCREASE 30% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 33000 AND 34000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 33000 FT ISA + °C | | | | | 34000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -15 | -10 | 0 | 10 | 20 | -10 | -5 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 1367 | 1372 | 1430 | 1547 | 2127 | 1432 | 1460 | 1491 | 1618 | 2248 |
| | DISTANCE | NM | 117 | 117 | 122 | 136 | 215 | 125 | 127 | 130 | 145 | 232 |
| | TIME | MIN | 23 | 23 | 23 | 25 | 39 | 24 | 24 | 24 | 27 | 42 |
| 48000 | FUEL | LB | 1252 | 1256 | 1309 | 1411 | 1889 | 1307 | 1333 | 1361 | 1471 | 1980 |
| | DISTANCE | NM | 106 | 107 | 111 | 123 | 189 | 113 | 115 | 118 | 131 | 202 |
| | TIME | MIN | 21 | 21 | 21 | 23 | 34 | 22 | 22 | 22 | 24 | 36 |
| 46000 | FUEL | LB | 1134 | 1192 | 1240 | 1331 | 1703 | 1228 | 1260 | 1252 | 1340 | 1803 |
| | DISTANCE | NM | 96 | 98 | 102 | 112 | 170 | 104 | 106 | 108 | 118 | 180 |
| | TIME | MIN | 19 | 19 | 19 | 21 | 31 | 20 | 20 | 20 | 22 | 32 |
| 44000 | FUEL | LB | 1044 | 1096 | 1140 | 1221 | 1535 | 1127 | 1156 | 1150 | 1227 | 1617 |
| | DISTANCE | NM | 88 | 90 | 94 | 102 | 152 | 95 | 97 | 98 | 107 | 160 |
| | TIME | MIN | 17 | 17 | 18 | 19 | 27 | 18 | 19 | 19 | 20 | 29 |
| 42000 | FUEL | LB | 961 | 1009 | 1050 | 1122 | 1388 | 1036 | 1062 | 1058 | 1127 | 1457 |
| | DISTANCE | NM | 81 | 83 | 86 | 94 | 136 | 87 | 89 | 90 | 98 | 144 |
| | TIME | MIN | 16 | 16 | 16 | 17 | 25 | 17 | 17 | 17 | 18 | 26 |
| 40000 | FUEL | LB | 886 | 929 | 967 | 1032 | 1259 | 953 | 977 | 973 | 1035 | 1318 |
| | DISTANCE | NM | 74 | 76 | 79 | 86 | 123 | 80 | 81 | 83 | 90 | 129 |
| | TIME | MIN | 15 | 15 | 15 | 16 | 22 | 15 | 16 | 16 | 17 | 23 |
| 38000 | FUEL | LB | 816 | 855 | 891 | 949 | 1145 | 876 | 899 | 896 | 951 | 1196 |
| | DISTANCE | NM | 68 | 70 | 73 | 79 | 111 | 73 | 74 | 76 | 82 | 117 |
| | TIME | MIN | 13 | 14 | 14 | 15 | 20 | 14 | 14 | 14 | 15 | 21 |
| 36000 | FUEL | LB | 751 | 787 | 820 | 872 | 1041 | 806 | 826 | 824 | 874 | 1086 |
| | DISTANCE | NM | 62 | 64 | 67 | 72 | 101 | 67 | 68 | 69 | 75 | 105 |
| | TIME | MIN | 12 | 12 | 13 | 13 | 18 | 13 | 13 | 13 | 14 | 19 |
| 34000 | FUEL | LB | 691 | 723 | 753 | 800 | 947 | 740 | 759 | 757 | 802 | 986 |
| | DISTANCE | NM | 57 | 58 | 61 | 66 | 91 | 61 | 62 | 64 | 69 | 95 |
| | TIME | MIN | 11 | 11 | 12 | 12 | 17 | 12 | 12 | 12 | 13 | 17 |
| 32000 | FUEL | LB | 634 | 664 | 691 | 734 | 861 | 679 | 696 | 695 | 735 | 896 |
| | DISTANCE | NM | 52 | 53 | 56 | 60 | 83 | 56 | 57 | 58 | 63 | 86 |
| | TIME | MIN | 10 | 10 | 11 | 11 | 15 | 11 | 11 | 11 | 12 | 16 |
| 30000 | FUEL | LB | 581 | 608 | 633 | 671 | 782 | 621 | 637 | 636 | 672 | 812 |
| | DISTANCE | NM | 48 | 49 | 51 | 55 | 75 | 51 | 52 | 53 | 57 | 78 |
| | TIME | MIN | 9 | 10 | 10 | 10 | 14 | 10 | 10 | 10 | 11 | 14 |
| 28000 | FUEL | LB | 530 | 555 | 578 | 612 | 708 | 566 | 581 | 580 | 613 | 735 |
| | DISTANCE | NM | 43 | 44 | 46 | 50 | 68 | 46 | 47 | 48 | 52 | 70 |
| | TIME | MIN | 9 | 9 | 9 | 9 | 12 | 9 | 9 | 9 | 10 | 13 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 15% | INCREASE 15% | INCREASE 30% |
| DISTANCE | INCREASE 20% | INCREASE 20% | INCREASE 30% |
| TIME | INCREASE 20% | INCREASE 20% | INCREASE 30% |

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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 35000 AND 36000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | 35000 FT ISA + °C | | | | | 36000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -9 | -5 | 0 | 10 | 20 | -8 | -5 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 1507 | 1529 | 1561 | 1696 | - | 1596 | 1613 | 1645 | 1786 | - |
| | DISTANCE | NM | 134 | 136 | 138 | 155 | - | 145 | 146 | 149 | 167 | - |
| | TIME | MIN | 26 | 26 | 26 | 29 | - | 28 | 28 | 28 | 31 | - |
| 48000 | FUEL | LB | 1369 | 1390 | 1419 | 1535 | 2082 | 1440 | 1455 | 1485 | 1605 | 2198 |
| | DISTANCE | NM | 120 | 122 | 125 | 139 | 217 | 129 | 131 | 133 | 148 | 234 |
| | TIME | MIN | 23 | 23 | 24 | 26 | 39 | 25 | 25 | 25 | 27 | 42 |
| 46000 | FUEL | LB | 1276 | 1308 | 1301 | 1395 | 1913 | 1328 | 1361 | 1356 | 1455 | 2001 |
| | DISTANCE | NM | 110 | 112 | 114 | 125 | 191 | 117 | 119 | 121 | 133 | 204 |
| | TIME | MIN | 21 | 21 | 21 | 23 | 34 | 22 | 23 | 23 | 25 | 37 |
| 44000 | FUEL | LB | 1167 | 1197 | 1192 | 1274 | 1705 | 1212 | 1242 | 1238 | 1324 | 1773 |
| | DISTANCE | NM | 100 | 102 | 104 | 113 | 169 | 106 | 108 | 110 | 120 | 180 |
| | TIME | MIN | 19 | 19 | 20 | 21 | 31 | 20 | 21 | 21 | 22 | 32 |
| 42000 | FUEL | LB | 1071 | 1098 | 1094 | 1167 | 1530 | 1108 | 1136 | 1133 | 1209 | 1586 |
| | DISTANCE | NM | 91 | 93 | 95 | 103 | 151 | 96 | 98 | 100 | 109 | 159 |
| | TIME | MIN | 18 | 18 | 18 | 19 | 27 | 19 | 19 | 19 | 20 | 29 |
| 40000 | FUEL | LB | 983 | 1008 | 1005 | 1070 | 1380 | 1016 | 1041 | 1039 | 1107 | 1426 |
| | DISTANCE | NM | 83 | 85 | 87 | 94 | 136 | 88 | 89 | 91 | 99 | 142 |
| | TIME | MIN | 16 | 16 | 16 | 17 | 25 | 17 | 17 | 17 | 18 | 26 |
| 38000 | FUEL | LB | 903 | 926 | 924 | 982 | 1248 | 932 | 955 | 954 | 1014 | 1287 |
| | DISTANCE | NM | 76 | 78 | 79 | 86 | 122 | 80 | 82 | 83 | 90 | 128 |
| | TIME | MIN | 15 | 15 | 15 | 16 | 22 | 15 | 16 | 16 | 17 | 23 |
| 36000 | FUEL | LB | 830 | 851 | 849 | 901 | 1131 | 855 | 876 | 875 | 929 | 1165 |
| | DISTANCE | NM | 70 | 71 | 73 | 79 | 110 | 73 | 75 | 76 | 82 | 115 |
| | TIME | MIN | 14 | 14 | 14 | 15 | 20 | 14 | 14 | 14 | 15 | 21 |
| 34000 | FUEL | LB | 761 | 781 | 780 | 826 | 1026 | 783 | 803 | 803 | 851 | 1056 |
| | DISTANCE | NM | 64 | 65 | 66 | 72 | 100 | 67 | 68 | 69 | 75 | 104 |
| | TIME | MIN | 12 | 13 | 13 | 13 | 18 | 13 | 13 | 13 | 14 | 19 |
| 32000 | FUEL | LB | 698 | 715 | 715 | 757 | 931 | 717 | 735 | 735 | 779 | 956 |
| | DISTANCE | NM | 58 | 60 | 61 | 65 | 90 | 61 | 62 | 63 | 68 | 94 |
| | TIME | MIN | 11 | 11 | 12 | 12 | 16 | 12 | 12 | 12 | 13 | 17 |
| 30000 | FUEL | LB | 638 | 654 | 654 | 692 | 843 | 655 | 672 | 672 | 711 | 866 |
| | DISTANCE | NM | 53 | 54 | 55 | 60 | 81 | 55 | 57 | 58 | 62 | 85 |
| | TIME | MIN | 10 | 10 | 11 | 11 | 15 | 11 | 11 | 11 | 12 | 15 |
| 28000 | FUEL | LB | 582 | 596 | 596 | 630 | 762 | 597 | 612 | 613 | 647 | 782 |
| | DISTANCE | NM | 48 | 49 | 50 | 54 | 73 | 50 | 51 | 52 | 56 | 76 |
| | TIME | MIN | 9 | 10 | 10 | 10 | 13 | 10 | 10 | 10 | 11 | 14 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 15% | INCREASE 15% | INCREASE 30% |
| DISTANCE | INCREASE 20% | INCREASE 20% | INCREASE 30% |
| TIME | INCREASE 20% | INCREASE 20% | INCREASE 30% |



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# CLIMB PLANNING - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: SEA LEVEL TO 37000 FT

SPEED SCHEDULE : 240 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 270 KIAS AT 12000 FT, MAINTAINING 270 KIAS UP TO 17400 FT AND M = 0.56 ABOVE 17400 FT
CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT LB | | | ISA + °C | | | | |
|---|---|---|---|---|---|---|---|
| | | | -8 | -5 | 0 | 10 | 20 |
| | FUEL | LB | - | - | - | - | - |
| 50000 | DISTANCE | NM | - | - | - | - | - |
| | TIME | MIN | - | - | - | - | - |
| | FUEL | LB | 1519 | 1539 | 1570 | 1693 | - |
| 48000 | DISTANCE | NM | 140 | 142 | 145 | 160 | - |
| | TIME | MIN | 27 | 27 | 27 | 29 | - |
| | FUEL | LB | 1393 | 1427 | 1422 | 1525 | 2112 |
| 46000 | DISTANCE | NM | 125 | 128 | 130 | 143 | 221 |
| | TIME | MIN | 24 | 24 | 25 | 26 | 40 |
| | FUEL | LB | 1263 | 1294 | 1291 | 1381 | 1855 |
| 44000 | DISTANCE | NM | 113 | 115 | 117 | 128 | 192 |
| | TIME | MIN | 22 | 22 | 22 | 24 | 35 |
| | FUEL | LB | 1151 | 1180 | 1178 | 1256 | 1650 |
| 42000 | DISTANCE | NM | 102 | 104 | 106 | 115 | 169 |
| | TIME | MIN | 20 | 20 | 20 | 21 | 31 |
| | FUEL | LB | 1052 | 1078 | 1077 | 1146 | 1478 |
| 40000 | DISTANCE | NM | 93 | 94 | 96 | 104 | 150 |
| | TIME | MIN | 18 | 18 | 18 | 19 | 27 |
| | FUEL | LB | 963 | 987 | 986 | 1048 | 1331 |
| 38000 | DISTANCE | NM | 84 | 86 | 87 | 95 | 134 |
| | TIME | MIN | 16 | 16 | 17 | 18 | 24 |
| | FUEL | LB | 882 | 904 | 903 | 959 | 1202 |
| 36000 | DISTANCE | NM | 77 | 78 | 80 | 86 | 121 |
| | TIME | MIN | 15 | 15 | 15 | 16 | 22 |
| | FUEL | LB | 807 | 827 | 827 | 877 | 1087 |
| 34000 | DISTANCE | NM | 70 | 71 | 73 | 79 | 109 |
| | TIME | MIN | 14 | 14 | 14 | 15 | 20 |
| | FUEL | LB | 738 | 756 | 757 | 801 | 984 |
| 32000 | DISTANCE | NM | 64 | 65 | 66 | 72 | 98 |
| | TIME | MIN | 12 | 13 | 13 | 13 | 18 |
| | FUEL | LB | 674 | 691 | 691 | 731 | 890 |
| 30000 | DISTANCE | NM | 58 | 59 | 60 | 65 | 88 |
| | TIME | MIN | 11 | 11 | 11 | 12 | 16 |
| | FUEL | LB | 614 | 629 | 630 | 665 | 803 |
| 28000 | DISTANCE | NM | 52 | 54 | 55 | 59 | 79 |
| | TIME | MIN | 10 | 10 | 10 | 11 | 14 |

| ANTI ICE ON CORRECTIONS | BELOW ISA | ISA | ABOVE ISA |
|---|---|---|---|
| FUEL | INCREASE 15% | INCREASE 15% | INCREASE 30% |
| DISTANCE | INCREASE 20% | INCREASE 20% | INCREASE 30% |
| TIME | INCREASE 20% | INCREASE 20% | INCREASE 30% |

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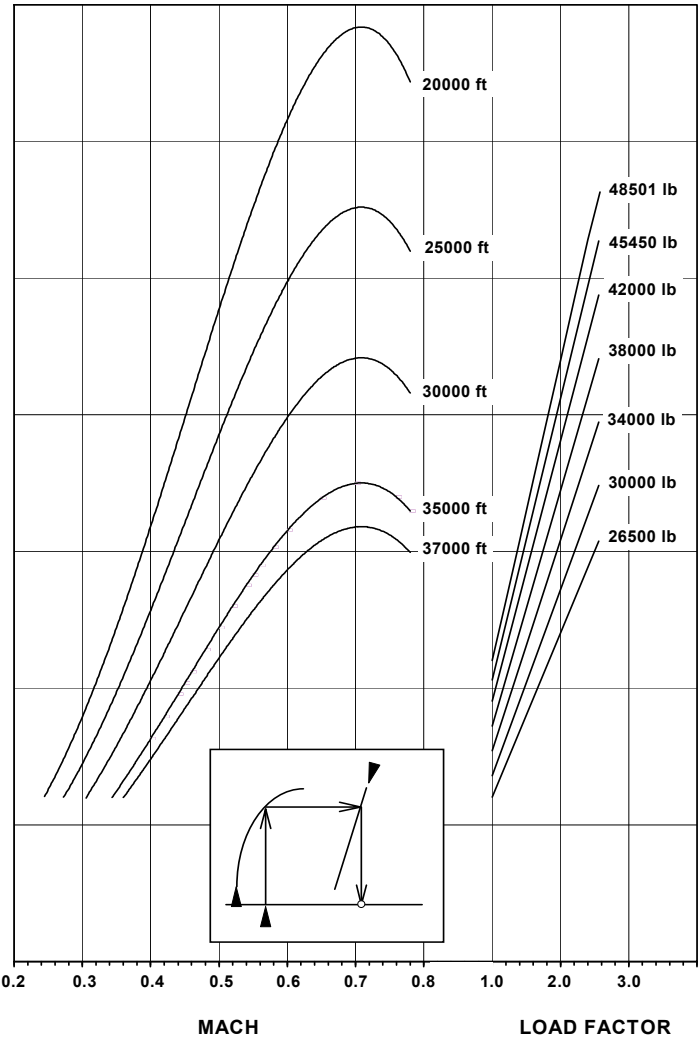
# CRUISE

## MANEUVER CAPABILITY

**NOTE:** The recommended cruise altitude must ensure a maneuver load factor of 1.3 g before buffet onset.

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# CRUISE TABLES

The long range cruise and maximum speed cruise tables show N1, fuel flow, indicated airspeed, true airspeed, indicated Mach number, buffet margin and specific range. Data are presented for various weights ISA conditions and corrections for ISA deviation.

In the long range cruise schedule, all engines operating or one engine inoperative, the airplane is flown at a speed corresponding to a specific range equal to 99% of maximum specific range. It is used when range is the principal factor.

In the maximum speed schedule, the airplane is flown in a speed resulting from maximum cruise power setting. It is used when minimum flight time is desired.

Thrust selection in cruise condition is adjusted to CRZ mode. The climb to cruise transition should be made as follows:

- After reaching the cruise level, allow the airplane to accelerate past 0.60M, before selecting cruise mode.
- When in cruise mode, adjust thrust to keep N1 or cruise speed constant (whichever occurs first).

The associated conditions are:

- Flaps .....UP
- Gear .....UP
- Bleeds .....OPEN
- Anti-Ice .....OFF

**NOTE:** The corrections (N1, Fuel Flow and TAS) given in the Long Range Cruise and Maximum Speed Cruise tables are applicable only to ISA-15°C to ISA+15°C range.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE : 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 50000 | N1 | % | 66.7 | 71.6 | 72.2 | 72.8 | 73.5 | 74.1 | 74.7 | 75.4 | 76.1 | 76.9 |
| | Fuel Flow | LB/H/ENG | 1285 | 1317 | 1308 | 1299 | 1291 | 1281 | 1274 | 1268 | 1263 | 1258 |
| | IAS | KT | 250 | 261 | 260 | 259 | 258 | 256 | 255 | 254 | 253 | 252 |
| | TAS | KT | 269 | 301 | 305 | 308 | 311 | 314 | 318 | 321 | 325 | 329 |
| | INDICATED | MACH | 0.414 | 0.471 | 0.478 | 0.485 | 0.492 | 0.499 | 0.506 | 0.514 | 0.522 | 0.530 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.52 |
| | SR | NM/LB | 0.105 | 0.114 | 0.116 | 0.118 | 0.120 | 0.123 | 0.125 | 0.127 | 0.129 | 0.131 |
| 48000 | N1 | % | 66.1 | 70.7 | 71.3 | 71.9 | 72.5 | 73.1 | 73.8 | 74.5 | 75.2 | 75.9 |
| | Fuel Flow | LB/H/ENG | 1259 | 1270 | 1259 | 1250 | 1242 | 1234 | 1226 | 1220 | 1215 | 1208 |
| | IAS | KT | 250 | 257 | 256 | 255 | 254 | 253 | 252 | 251 | 250 | 248 |
| | TAS | KT | 269 | 296 | 300 | 303 | 306 | 310 | 313 | 317 | 321 | 324 |
| | INDICATED | MACH | 0.413 | 0.464 | 0.471 | 0.478 | 0.485 | 0.492 | 0.500 | 0.507 | 0.515 | 0.523 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.107 | 0.117 | 0.119 | 0.121 | 0.123 | 0.126 | 0.128 | 0.130 | 0.132 | 0.134 |
| 46000 | N1 | % | 65.3 | 69.7 | 70.1 | 70.6 | 71.1 | 71.7 | 72.3 | 72.9 | 73.6 | 74.3 |
| | F FLOW | LB/H/ENG | 1232 | 1224 | 1213 | 1203 | 1194 | 1186 | 1178 | 1171 | 1165 | 1159 |
| | IAS | KT | 248 | 252 | 251 | 250 | 249 | 248 | 247 | 246 | 245 | 244 |
| | TAS | KT | 267 | 292 | 295 | 298 | 301 | 305 | 308 | 312 | 315 | 319 |
| | INDICATED | MACH | 0.41 | 0.457 | 0.463 | 0.47 | 0.477 | 0.484 | 0.491 | 0.499 | 0.506 | 0.514 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.108 | 0.119 | 0.122 | 0.124 | 0.126 | 0.129 | 0.131 | 0.133 | 0.135 | 0.138 |
| 44000 | N1 | % | 64.9 | 68.8 | 69.4 | 69.8 | 70.2 | 70.7 | 71.3 | 71.9 | 72.5 | 73.2 |
| | F FLOW | LB/H/ENG | 1214 | 1180 | 1169 | 1158 | 1147 | 1138 | 1130 | 1122 | 1115 | 1109 |
| | IAS | KT | 249 | 249 | 248 | 246 | 245 | 244 | 243 | 242 | 241 | 240 |
| | TAS | KT | 268 | 288 | 291 | 294 | 297 | 300 | 303 | 306 | 310 | 314 |
| | INDICATED | MACH | 0.411 | 0.45 | 0.457 | 0.463 | 0.469 | 0.476 | 0.483 | 0.49 | 0.498 | 0.506 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.11 | 0.122 | 0.124 | 0.127 | 0.129 | 0.132 | 0.134 | 0.137 | 0.139 | 0.141 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.6 % AND FUEL FLOW BY 8%.
DECREASE SR BY 9%.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE : 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 42000 | N1 | % | 64.6 | 67.8 | 68.4 | 69 | 69.4 | 69.9 | 70.4 | 70.9 | 71.5 | 72.1 |
| | F FLOW | LB/H/ENG | 1196 | 1133 | 1122 | 1112 | 1102 | 1093 | 1084 | 1076 | 1068 | 1061 |
| | IAS | KT | 250 | 245 | 243 | 242 | 241 | 240 | 239 | 238 | 237 | 236 |
| | TAS | KT | 268 | 283 | 285 | 289 | 292 | 295 | 298 | 301 | 305 | 308 |
| | INDICATED MACH | | 0.413 | 0.443 | 0.449 | 0.455 | 0.462 | 0.469 | 0.476 | 0.483 | 0.49 | 0.498 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.112 | 0.125 | 0.127 | 0.13 | 0.132 | 0.135 | 0.138 | 0.14 | 0.143 | 0.145 |
| 40000 | N1 | % | 63.7 | 66.7 | 67.3 | 67.9 | 68.5 | 69 | 69.4 | 70 | 70.5 | 71.1 |
| | F FLOW | LB/H/ENG | 1158 | 1090 | 1078 | 1066 | 1056 | 1046 | 1037 | 1029 | 1021 | 1013 |
| | IAS | KT | 247 | 241 | 239 | 238 | 237 | 236 | 235 | 234 | 233 | 232 |
| | TAS | KT | 265 | 278 | 281 | 283 | 286 | 289 | 293 | 296 | 299 | 303 |
| | INDICATED MACH | | 0.408 | 0.436 | 0.442 | 0.448 | 0.454 | 0.461 | 0.468 | 0.475 | 0.482 | 0.489 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.114 | 0.127 | 0.13 | 0.133 | 0.136 | 0.138 | 0.141 | 0.144 | 0.147 | 0.149 |
| 38000 | N1 | % | 62.5 | 65.6 | 66.2 | 66.8 | 67.4 | 68 | 68.5 | 69 | 69.5 | 70 |
| | F FLOW | LB/H/ENG | 1116 | 1046 | 1035 | 1023 | 1012 | 1002 | 992 | 983 | 974 | 967 |
| | IAS | KT | 243 | 237 | 235 | 234 | 233 | 232 | 231 | 230 | 229 | 228 |
| | TAS | KT | 260 | 273 | 276 | 279 | 281 | 284 | 287 | 290 | 294 | 297 |
| | INDICATED MACH | | 0.401 | 0.428 | 0.434 | 0.44 | 0.447 | 0.453 | 0.459 | 0.466 | 0.473 | 0.48 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.117 | 0.13 | 0.133 | 0.136 | 0.139 | 0.142 | 0.145 | 0.148 | 0.151 | 0.154 |
| 36000 | N1 | % | 61.4 | 64.4 | 65 | 65.6 | 66.2 | 66.9 | 67.5 | 68.1 | 68.5 | 69 |
| | F FLOW | LB/H/ENG | 1075 | 1002 | 990 | 978 | 968 | 957 | 947 | 938 | 930 | 921 |
| | IAS | KT | 239 | 232 | 231 | 230 | 229 | 228 | 227 | 226 | 225 | 223 |
| | TAS | KT | 256 | 268 | 270 | 273 | 276 | 279 | 282 | 285 | 288 | 291 |
| | INDICATED MACH | | 0.395 | 0.42 | 0.426 | 0.432 | 0.438 | 0.445 | 0.451 | 0.458 | 0.465 | 0.472 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.119 | 0.134 | 0.137 | 0.14 | 0.143 | 0.146 | 0.149 | 0.152 | 0.155 | 0.158 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.6 % AND FUEL FLOW BY 8%.
DECREASE SR BY 9%.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE : 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 34000 | N1 | % | 60.1 | 63.2 | 63.8 | 64.4 | 65 | 65.6 | 66.2 | 66.9 | 67.5 | 68 |
| | F FLOW | LB/H/ENG | 1032 | 961 | 948 | 935 | 924 | 913 | 903 | 893 | 884 | 876 |
| | IAS | KT | 234 | 228 | 227 | 225 | 224 | 223 | 222 | 221 | 220 | 219 |
| | TAS | KT | 251 | 263 | 265 | 268 | 270 | 273 | 276 | 279 | 282 | 285 |
| | INDICATED | MACH | 0.387 | 0.413 | 0.418 | 0.424 | 0.43 | 0.436 | 0.442 | 0.449 | 0.455 | 0.462 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.121 | 0.137 | 0.14 | 0.143 | 0.146 | 0.15 | 0.153 | 0.156 | 0.159 | 0.163 |
| 31000 | N1 | % | 58.3 | 61.2 | 61.8 | 62.4 | 63 | 63.6 | 64.3 | 64.9 | 65.5 | 66.2 |
| | F FLOW | LB/H/ENG | 971 | 898 | 884 | 872 | 860 | 849 | 839 | 828 | 819 | 809 |
| | IAS | KT | 228 | 221 | 220 | 219 | 217 | 216 | 215 | 214 | 213 | 212 |
| | TAS | KT | 243 | 255 | 257 | 259 | 262 | 264 | 267 | 270 | 273 | 276 |
| | INDICATED | MACH | 0.377 | 0.401 | 0.406 | 0.411 | 0.417 | 0.423 | 0.429 | 0.435 | 0.441 | 0.448 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.125 | 0.142 | 0.145 | 0.149 | 0.152 | 0.156 | 0.159 | 0.163 | 0.167 | 0.17 |
| 28000 | N1 | % | 56.3 | 59 | 59.6 | 60.2 | 60.9 | 61.5 | 62.1 | 62.7 | 63.4 | 64 |
| | F FLOW | LB/H/ENG | 911 | 836 | 823 | 810 | 798 | 786 | 775 | 765 | 755 | 745 |
| | IAS | KT | 221 | 214 | 213 | 211 | 210 | 209 | 208 | 207 | 206 | 205 |
| | TAS | KT | 236 | 246 | 248 | 250 | 253 | 255 | 258 | 261 | 263 | 266 |
| | INDICATED | MACH | 0.365 | 0.388 | 0.393 | 0.398 | 0.403 | 0.409 | 0.415 | 0.42 | 0.426 | 0.433 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.129 | 0.147 | 0.151 | 0.155 | 0.159 | 0.162 | 0.166 | 0.17 | 0.174 | 0.178 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.6 % AND FUEL FLOW BY 8%.
DECREASE SR BY 9%.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE : 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| 50000 | N1 % | 77.7 | 78.5 | 79.3 | 80.1 | 80.8 | 81.5 | 82.1 | 82.8 | 83.5 | 84.2 |
| | F FLOW LB/H/ENG | 1255 | 1252 | 1252 | 1246 | 1246 | 1243 | 1243 | 1244 | 1245 | 1248 |
| | IAS KT | 251 | 250 | 250 | 249 | 249 | 248 | 248 | 248 | 249 | 249 |
| | TAS KT | 333 | 337 | 341 | 345 | 351 | 356 | 362 | 368 | 374 | 380 |
| | INDICATED MACH | 0.539 | 0.548 | 0.557 | 0.566 | 0.577 | 0.588 | 0.600 | 0.612 | 0.625 | 0.638 |
| | BUFFET MARGIN G | 2.47 | 2.43 | 2.38 | 2.33 | 2.29 | 2.24 | 2.20 | 2.15 | 2.10 | 2.04 |
| | SR NM/LB | 0.133 | 0.135 | 0.136 | 0.139 | 0.141 | 0.143 | 0.145 | 0.148 | 0.150 | 0.152 |
| 48000 | N1 % | 76.6 | 77.4 | 78.2 | 79.0 | 79.8 | 80.5 | 81.2 | 81.9 | 82.6 | 83.2 |
| | F FLOW LB/H/ENG | 1203 | 1200 | 1199 | 1195 | 1192 | 1189 | 1189 | 1189 | 1190 | 1192 |
| | IAS KT | 247 | 247 | 246 | 245 | 244 | 244 | 244 | 244 | 244 | 244 |
| | TAS KT | 328 | 332 | 336 | 340 | 344 | 349 | 355 | 361 | 367 | 373 |
| | INDICATED MACH | 0.531 | 0.540 | 0.549 | 0.557 | 0.567 | 0.578 | 0.589 | 0.601 | 0.614 | 0.627 |
| | BUFFET MARGIN G | 2.51 | 2.47 | 2.43 | 2.38 | 2.33 | 2.28 | 2.24 | 2.19 | 2.14 | 2.09 |
| | SR NM/LB | 0.136 | 0.138 | 0.140 | 0.142 | 0.144 | 0.147 | 0.149 | 0.152 | 0.154 | 0.157 |
| 46000 | N1 % | 75 | 75.8 | 76.7 | 77.6 | 78.4 | 79.2 | 80 | 80.6 | 81.2 | 81.9 |
| | F FLOW LB/H/ENG | 1154 | 1150 | 1146 | 1144 | 1141 | 1138 | 1136 | 1135 | 1135 | 1135 |
| | IAS KT | 243 | 242 | 241 | 240 | 239 | 239 | 238 | 238 | 238 | 238 |
| | TAS KT | 323 | 326 | 330 | 334 | 339 | 343 | 348 | 354 | 359 | 365 |
| | INDICATED MACH | 0.522 | 0.53 | 0.539 | 0.548 | 0.557 | 0.566 | 0.577 | 0.589 | 0.601 | 0.613 |
| | BUFFET MARGIN G | 2.56 | 2.52 | 2.47 | 2.42 | 2.38 | 2.33 | 2.28 | 2.24 | 2.19 | 2.14 |
| | SR NM/LB | 0.14 | 0.142 | 0.144 | 0.146 | 0.148 | 0.151 | 0.153 | 0.156 | 0.158 | 0.161 |
| 44000 | N1 % | 73.9 | 74.7 | 75.5 | 76.3 | 77.2 | 78.1 | 78.9 | 79.6 | 80.3 | 80.9 |
| | F FLOW LB/H/ENG | 1104 | 1099 | 1095 | 1091 | 1089 | 1088 | 1084 | 1082 | 1081 | 1081 |
| | IAS KT | 239 | 238 | 237 | 236 | 235 | 235 | 234 | 234 | 233 | 233 |
| | TAS KT | 317 | 321 | 325 | 329 | 333 | 337 | 341 | 347 | 352 | 358 |
| | INDICATED MACH | 0.514 | 0.522 | 0.53 | 0.539 | 0.548 | 0.557 | 0.566 | 0.577 | 0.589 | 0.601 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.52 | 2.47 | 2.43 | 2.38 | 2.33 | 2.28 | 2.24 | 2.19 |
| | SR NM/LB | 0.144 | 0.146 | 0.148 | 0.151 | 0.153 | 0.155 | 0.157 | 0.16 | 0.163 | 0.166 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.6 % AND FUEL FLOW BY 8%.
DECREASE SR BY 9%.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE : 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| | N1 | % | 72.8 | 73.5 | 74.3 | 75.1 | 75.9 | 76.8 | 77.7 | 78.5 | 79.2 | 79.9 |
| | F FLOW | LB/H/ENG | 1055 | 1049 | 1045 | 1041 | 1038 | 1035 | 1034 | 1029 | 1028 | 1027 |
| | IAS | KT | 235 | 234 | 233 | 232 | 231 | 231 | 230 | 229 | 228 | 228 |
| 42000 | TAS | KT | 312 | 315 | 319 | 323 | 327 | 331 | 335 | 339 | 345 | 350 |
| | INDICATED | MACH | 0.505 | 0.513 | 0.521 | 0.53 | 0.539 | 0.548 | 0.557 | 0.566 | 0.577 | 0.589 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.52 | 2.48 | 2.43 | 2.38 | 2.33 | 2.28 | 2.24 |
| | SR | NM/LB | 0.148 | 0.15 | 0.153 | 0.155 | 0.158 | 0.16 | 0.162 | 0.165 | 0.168 | 0.17 |
| | N1 | % | 71.7 | 72.4 | 73.1 | 73.9 | 74.7 | 75.5 | 76.4 | 77.3 | 78 | 78.8 |
| | F FLOW | LB/H/ENG | 1007 | 1001 | 996 | 992 | 988 | 985 | 983 | 979 | 976 | 975 |
| | IAS | KT | 231 | 230 | 229 | 228 | 227 | 226 | 226 | 224 | 223 | 223 |
| 40000 | TAS | KT | 306 | 310 | 313 | 317 | 321 | 325 | 329 | 333 | 337 | 343 |
| | INDICATED | MACH | 0.497 | 0.504 | 0.512 | 0.521 | 0.529 | 0.538 | 0.547 | 0.556 | 0.565 | 0.577 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.53 | 2.49 | 2.44 | 2.38 | 2.33 | 2.29 |
| | SR | NM/LB | 0.152 | 0.155 | 0.157 | 0.16 | 0.163 | 0.165 | 0.168 | 0.17 | 0.173 | 0.176 |
| | N1 | % | 70.6 | 71.2 | 71.9 | 72.6 | 73.3 | 74.1 | 75 | 75.9 | 76.8 | 77.6 |
| | F FLOW | LB/H/ENG | 960 | 953 | 947 | 942 | 937 | 933 | 930 | 928 | 926 | 924 |
| | IAS | KT | 227 | 226 | 225 | 224 | 223 | 222 | 221 | 220 | 219 | 218 |
| 38000 | TAS | KT | 300 | 304 | 307 | 311 | 315 | 318 | 322 | 327 | 331 | 335 |
| | INDICATED | MACH | 0.488 | 0.495 | 0.503 | 0.511 | 0.519 | 0.528 | 0.537 | 0.546 | 0.555 | 0.564 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.54 | 2.49 | 2.44 | 2.39 | 2.34 |
| | SR | NM/LB | 0.156 | 0.159 | 0.162 | 0.165 | 0.168 | 0.171 | 0.173 | 0.176 | 0.179 | 0.181 |
| | N1 | % | 69.5 | 70.1 | 70.7 | 71.4 | 72.1 | 72.8 | 73.6 | 74.4 | 75.3 | 76.2 |
| | F FLOW | LB/H/ENG | 914 | 907 | 900 | 895 | 890 | 885 | 881 | 878 | 875 | 873 |
| | IAS | KT | 222 | 221 | 220 | 219 | 219 | 218 | 217 | 216 | 215 | 214 |
| 36000 | TAS | KT | 294 | 298 | 301 | 305 | 309 | 312 | 316 | 320 | 324 | 328 |
| | INDICATED | MACH | 0.479 | 0.486 | 0.494 | 0.502 | 0.51 | 0.518 | 0.527 | 0.535 | 0.544 | 0.554 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.55 | 2.5 | 2.45 | 2.4 |
| | SR | NM/LB | 0.161 | 0.164 | 0.167 | 0.17 | 0.173 | 0.176 | 0.179 | 0.182 | 0.185 | 0.188 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.6 % AND FUEL FLOW BY 8%.
DECREASE SR BY 9%.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE : 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| 34000 | N1 | % | 68.4 | 69 | 69.5 | 70.1 | 70.8 | 71.5 | 72.2 | 73 | 73.8 | 74.7 |
| | F FLOW | LB/H/ENG | 868 | 860 | 854 | 848 | 842 | 838 | 833 | 830 | 825 | 822 |
| | IAS | KT | 218 | 217 | 216 | 215 | 214 | 213 | 212 | 211 | 210 | 209 |
| | TAS | KT | 288 | 292 | 295 | 298 | 302 | 306 | 310 | 313 | 317 | 321 |
| | INDICATED MACH | | 0.469 | 0.476 | 0.484 | 0.492 | 0.500 | 0.508 | 0.516 | 0.525 | 0.533 | 0.542 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.52 | 2.47 |
| | SR | NM/LB | 0.166 | 0.169 | 0.173 | 0.176 | 0.179 | 0.183 | 0.186 | 0.189 | 0.192 | 0.195 |
| 31000 | N1 | % | 66.8 | 67.3 | 67.8 | 68.3 | 68.9 | 69.5 | 70.1 | 70.8 | 71.5 | 72.3 |
| | F FLOW | LB/H/ENG | 801 | 793 | 786 | 780 | 773 | 768 | 763 | 758 | 752 | 748 |
| | IAS | KT | 211 | 210 | 209 | 208 | 207 | 206 | 205 | 204 | 203 | 202 |
| | TAS | KT | 279 | 282 | 285 | 289 | 292 | 296 | 299 | 303 | 306 | 310 |
| | INDICATED MACH | | 0.454 | 0.461 | 0.469 | 0.476 | 0.484 | 0.492 | 0.500 | 0.508 | 0.515 | 0.524 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.174 | 0.178 | 0.181 | 0.185 | 0.189 | 0.192 | 0.196 | 0.200 | 0.203 | 0.207 |
| 28000 | N1 | % | 64.6 | 65.3 | 66 | 66.5 | 67 | 67.5 | 68.1 | 68.6 | 69.2 | 69.9 |
| | F FLOW | LB/H/ENG | 737 | 729 | 721 | 713 | 706 | 700 | 694 | 688 | 682 | 677 |
| | IAS | KT | 203 | 202 | 202 | 200 | 199 | 199 | 198 | 197 | 195 | 194 |
| | TAS | KT | 269 | 272 | 275 | 278 | 281 | 285 | 288 | 291 | 294 | 298 |
| | INDICATED MACH | | 0.439 | 0.446 | 0.453 | 0.46 | 0.467 | 0.474 | 0.482 | 0.489 | 0.497 | 0.505 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.183 | 0.187 | 0.191 | 0.195 | 0.199 | 0.203 | 0.208 | 0.212 | 0.216 | 0.220 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.6 % AND FUEL FLOW BY 8%.
DECREASE SR BY 9%.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE : 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 50000 | N1 % | 84.9 | 85.6 | 86.3 | 87.1 | 88.2 | 89.3 | 90.2 | 90.7 | 91.2 |
| | F FLOW LB/H/ENG | 1251 | 1255 | 1261 | 1268 | 1275 | 1284 | 1293 | 1314 | 1214 |
| | IAS KT | 249 | 250 | 250 | 251 | 252 | 253 | 255 | 258 | 237 |
| | TAS KT | 387 | 394 | 401 | 409 | 417 | 426 | 435 | 448 | 424 |
| | INDICATED MACH | 0.652 | 0.667 | 0.683 | 0.699 | 0.716 | 0.734 | 0.754 | 0.779 | 0.738 |
| | BUFFET MARGIN G | 1.98 | 1.92 | 1.85 | 1.78 | 1.70 | 1.61 | 1.51 | 1.39 | 1.39 |
| | SR NM/LB | 0.155 | 0.157 | 0.159 | 0.161 | 0.164 | 0.166 | 0.168 | 0.170 | 0.174 |
| 48000 | N1 % | 83.9 | 84.6 | 85.3 | 86.1 | 86.9 | 88.0 | 89.1 | 90.0 | 91.0 |
| | F FLOW LB/H/ENG | 1194 | 1197 | 1202 | 1207 | 1212 | 1221 | 1229 | 1238 | 1233 |
| | IAS KT | 244 | 245 | 245 | 246 | 246 | 248 | 249 | 250 | 248 |
| | TAS KT | 379 | 386 | 393 | 401 | 408 | 417 | 426 | 435 | 440 |
| | INDICATED MACH | 0.641 | 0.655 | 0.670 | 0.685 | 0.701 | 0.720 | 0.738 | 0.757 | 0.767 |
| | BUFFET MARGIN G | 2.04 | 1.98 | 1.91 | 1.84 | 1.77 | 1.68 | 1.59 | 1.49 | 1.41 |
| | SR NM/LB | 0.159 | 0.161 | 0.164 | 0.166 | 0.168 | 0.171 | 0.173 | 0.176 | 0.178 |
| 46000 | N1 % | 82.7 | 83.4 | 84.2 | 84.8 | 85.4 | 86.2 | 87.1 | 88.5 | 90.1 |
| | F FLOW LB/H/ENG | 1137 | 1139 | 1143 | 1148 | 1152 | 1158 | 1165 | 1174 | 1188 |
| | IAS KT | 239 | 239 | 239 | 240 | 240 | 241 | 242 | 243 | 245 |
| | TAS KT | 371 | 378 | 385 | 392 | 399 | 407 | 416 | 424 | 436 |
| | INDICATED MACH | 0.627 | 0.64 | 0.655 | 0.67 | 0.685 | 0.702 | 0.72 | 0.738 | 0.759 |
| | BUFFET MARGIN G | 2.09 | 2.03 | 1.97 | 1.91 | 1.84 | 1.76 | 1.68 | 1.58 | 1.48 |
| | SR NM/LB | 0.163 | 0.166 | 0.168 | 0.171 | 0.173 | 0.176 | 0.178 | 0.181 | 0.183 |
| 44000 | N1 % | 81.6 | 82.3 | 83.1 | 83.8 | 84.5 | 85.1 | 85.9 | 86.9 | 88.6 |
| | F FLOW LB/H/ENG | 1082 | 1084 | 1086 | 1088 | 1092 | 1097 | 1103 | 1111 | 1124 |
| | IAS KT | 234 | 234 | 234 | 234 | 235 | 235 | 236 | 237 | 239 |
| | TAS KT | 364 | 370 | 377 | 383 | 391 | 398 | 406 | 415 | 425 |
| | INDICATED MACH | 0.614 | 0.628 | 0.641 | 0.656 | 0.671 | 0.687 | 0.704 | 0.722 | 0.741 |
| | BUFFET MARGIN G | 2.14 | 2.09 | 2.03 | 1.97 | 1.9 | 1.83 | 1.76 | 1.67 | 1.58 |
| | SR NM/LB | 0.168 | 0.171 | 0.173 | 0.176 | 0.179 | 0.181 | 0.184 | 0.187 | 0.189 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.6 % AND FUEL FLOW BY 8%.
DECREASE SR BY 9%.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE : 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 42000 | N1 % | 80.5 | 81.2 | 82 | 82.8 | 83.5 | 84.1 | 84.8 | 85.6 | 86.9 |
| | F FLOW LB/H/ENG | 1027 | 1029 | 1031 | 1032 | 1035 | 1039 | 1044 | 1050 | 1061 |
| | IAS KT | 229 | 229 | 229 | 229 | 229 | 230 | 231 | 232 | 232 |
| | TAS KT | 356 | 362 | 369 | 375 | 382 | 389 | 397 | 405 | 415 |
| | INDICATED MACH | 0.602 | 0.615 | 0.628 | 0.642 | 0.657 | 0.672 | 0.688 | 0.706 | 0.724 |
| | BUFFET MARGIN G | 2.19 | 2.14 | 2.09 | 2.03 | 1.97 | 1.9 | 1.83 | 1.75 | 1.67 |
| | SR NM/LB | 0.173 | 0.176 | 0.179 | 0.182 | 0.185 | 0.187 | 0.19 | 0.193 | 0.196 |
| 40000 | N1 % | 79.5 | 80.2 | 80.8 | 81.6 | 82.4 | 83.1 | 83.7 | 84.4 | 85.5 |
| | F FLOW LB/H/ENG | 975 | 975 | 976 | 977 | 979 | 982 | 986 | 991 | 1000 |
| | IAS KT | 223 | 224 | 224 | 224 | 224 | 225 | 225 | 226 | 226 |
| | TAS KT | 348 | 354 | 360 | 367 | 373 | 380 | 388 | 395 | 405 |
| | INDICATED MACH | 0.589 | 0.602 | 0.615 | 0.628 | 0.642 | 0.657 | 0.673 | 0.689 | 0.706 |
| | BUFFET MARGIN G | 2.25 | 2.2 | 2.15 | 2.09 | 2.04 | 1.97 | 1.91 | 1.83 | 1.75 |
| | SR NM/LB | 0.179 | 0.182 | 0.185 | 0.188 | 0.191 | 0.194 | 0.197 | 0.199 | 0.202 |
| 38000 | N1 % | 78.4 | 79.1 | 79.7 | 80.4 | 81.1 | 81.9 | 82.7 | 83.3 | 84.3 |
| | F FLOW LB/H/ENG | 923 | 922 | 922 | 922 | 923 | 925 | 928 | 931 | 939 |
| | IAS KT | 218 | 218 | 218 | 218 | 218 | 219 | 219 | 219 | 220 |
| | TAS KT | 341 | 346 | 352 | 358 | 364 | 371 | 378 | 385 | 394 |
| | INDICATED MACH | 0.576 | 0.588 | 0.601 | 0.614 | 0.627 | 0.641 | 0.656 | 0.672 | 0.688 |
| | BUFFET MARGIN G | 2.30 | 2.25 | 2.2 | 2.15 | 2.1 | 2.04 | 1.98 | 1.91 | 1.84 |
| | SR NM/LB | 0.184 | 0.188 | 0.191 | 0.194 | 0.197 | 0.200 | 0.204 | 0.207 | 0.21 |
| 36000 | N1 % | 77 | 77.8 | 78.5 | 79.2 | 79.8 | 80.6 | 81.4 | 82.1 | 83.1 |
| | F FLOW LB/H/ENG | 870 | 869 | 868 | 867 | 868 | 869 | 871 | 873 | 880 |
| | IAS KT | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 214 |
| | TAS KT | 332 | 337 | 343 | 349 | 355 | 361 | 368 | 374 | 383 |
| | INDICATED MACH | 0.562 | 0.574 | 0.586 | 0.598 | 0.611 | 0.625 | 0.639 | 0.654 | 0.67 |
| | BUFFET MARGIN G | 2.35 | 2.3 | 2.26 | 2.21 | 2.16 | 2.11 | 2.05 | 1.99 | 1.92 |
| | SR NM/LB | 0.191 | 0.194 | 0.198 | 0.201 | 0.204 | 0.208 | 0.211 | 0.214 | 0.218 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.6 % AND FUEL FLOW BY 8%.
DECREASE SR BY 9%.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE : 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 34000 | N1 % | 75.6 | 76.4 | 77.2 | 78 | 78.6 | 79.3 | 80 | 80.8 | 81.9 |
| | F FLOW LB/H/ENG | 820 | 819 | 816 | 815 | 814 | 815 | 815 | 817 | 823 |
| | IAS KT | 209 | 208 | 207 | 207 | 207 | 207 | 207 | 207 | 208 |
| | TAS KT | 325 | 329 | 334 | 339 | 345 | 351 | 358 | 364 | 372 |
| | INDICATED MACH | 0.552 | 0.561 | 0.571 | 0.583 | 0.596 | 0.609 | 0.623 | 0.637 | 0.652 |
| | BUFFET MARGIN G | 2.42 | 2.37 | 2.31 | 2.27 | 2.22 | 2.17 | 2.12 | 2.06 | 2.00 |
| | SR NM/LB | 0.198 | 0.201 | 0.205 | 0.208 | 0.212 | 0.216 | 0.219 | 0.223 | 0.226 |
| 31000 | N1 % | 73.1 | 74 | 74.9 | 75.8 | 76.6 | 77.4 | 78 | 78.7 | 79.7 |
| | F FLOW LB/H/ENG | 745 | 743 | 741 | 740 | 738 | 737 | 737 | 738 | 742 |
| | IAS KT | 201 | 200 | 200 | 199 | 198 | 198 | 198 | 198 | 199 |
| | TAS KT | 314 | 318 | 322 | 327 | 331 | 337 | 343 | 349 | 357 |
| | INDICATED MACH | 0.533 | 0.542 | 0.552 | 0.562 | 0.573 | 0.585 | 0.598 | 0.612 | 0.626 |
| | BUFFET MARGIN G | 2.52 | 2.47 | 2.42 | 2.37 | 2.32 | 2.27 | 2.22 | 2.17 | 2.12 |
| | SR NM/LB | 0.21 | 0.214 | 0.217 | 0.221 | 0.224 | 0.229 | 0.233 | 0.237 | 0.241 |
| 28000 | N1 % | 70.7 | 71.4 | 72.3 | 73.2 | 74.1 | 75 | 75.8 | 76.5 | 77.5 |
| | F FLOW LB/H/ENG | 673 | 670 | 668 | 666 | 665 | 664 | 661 | 660 | 662 |
| | IAS KT | 194 | 193 | 192 | 191 | 191 | 190 | 189 | 189 | 189 |
| | TAS KT | 302 | 306 | 310 | 314 | 319 | 323 | 327 | 333 | 340 |
| | INDICATED MACH | 0.513 | 0.522 | 0.532 | 0.541 | 0.552 | 0.562 | 0.572 | 0.584 | 0.597 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.53 | 2.48 | 2.43 | 2.38 | 2.33 | 2.28 | 2.23 |
| | SR NM/LB | 0.224 | 0.228 | 0.232 | 0.236 | 0.24 | 0.243 | 0.248 | 0.252 | 0.257 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.6 % AND FUEL FLOW BY 8%.
DECREASE SR BY 9%.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## PRESSURE ALTITUDE: 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 50000 | N1 % | 66.7 | 78.1 | 78.9 | 79.8 | 80.5 | 81.3 | 82.2 | 83.0 | 83.7 | 84.4 |
| | F FLOW LB/H/ENG | 1285 | 1776 | 1776 | 1777 | 1778 | 1781 | 1784 | 1788 | 1793 | 1799 |
| | IAS KT | 250 | 318 | 318 | 318 | 318 | 318 | 318 | 318 | 318 | 318 |
| | TAS KT | 269 | 368 | 373 | 379 | 384 | 390 | 395 | 401 | 407 | 413 |
| | INDICATED MACH | 0.414 | 0.574 | 0.584 | 0.595 | 0.606 | 0.617 | 0.628 | 0.640 | 0.652 | 0.664 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.105 | 0.104 | 0.105 | 0.106 | 0.108 | 0.109 | 0.111 | 0.112 | 0.114 | 0.115 |
| 48000 | N1 % | 66.1 | 77.7 | 78.5 | 79.4 | 80.2 | 81.0 | 81.8 | 82.7 | 83.4 | 84.1 |
| | F FLOW LB/H/ENG | 1259 | 1756 | 1755 | 1755 | 1757 | 1759 | 1761 | 1765 | 1769 | 1774 |
| | IAS KT | 250 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 |
| | TAS KT | 269 | 368 | 373 | 379 | 384 | 390 | 395 | 401 | 407 | 413 |
| | INDICATED MACH | 0.413 | 0.575 | 0.585 | 0.596 | 0.607 | 0.618 | 0.629 | 0.641 | 0.653 | 0.665 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.107 | 0.105 | 0.106 | 0.108 | 0.109 | 0.111 | 0.112 | 0.114 | 0.115 | 0.116 |
| 46000 | N1 % | 65.7 | 77.4 | 78.2 | 79 | 79.8 | 80.7 | 81.6 | 83.3 | 83.2 | 83.9 |
| | F FLOW LB/H/ENG | 1240 | 1747 | 1746 | 1746 | 1747 | 1748 | 1751 | 1771 | 1758 | 1762 |
| | IAS KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS KT | 269 | 369 | 374 | 380 | 385 | 391 | 397 | 406 | 408 | 414 |
| | INDICATED MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.62 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.108 | 0.106 | 0.107 | 0.109 | 0.11 | 0.112 | 0.113 | 0.115 | 0.116 | 0.118 |
| 44000 | N1 % | 65.2 | 77 | 77.8 | 78.6 | 79.4 | 80.3 | 81.2 | 82.8 | 82.8 | 83.6 |
| | F FLOW LB/H/ENG | 1218 | 1722 | 1721 | 1721 | 1721 | 1722 | 1724 | 1743 | 1730 | 1734 |
| | IAS KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS KT | 269 | 369 | 374 | 379 | 385 | 390 | 396 | 406 | 408 | 414 |
| | INDICATED MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.62 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.110 | 0.107 | 0.109 | 0.110 | 0.112 | 0.113 | 0.115 | 0.116 | 0.118 | 0.119 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW STD ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW STD ISA CONDITIONS.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

### PRESSURE ALTITUDE: 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITIONS

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| | N1 % | 64.6 | 76.7 | 77.4 | 78.2 | 79 | 79.8 | 80.7 | 82.4 | 82.4 | 83.1 |
| | F FLOW LB/H/ENG | 1197 | 1699 | 1697 | 1696 | 1696 | 1696 | 1697 | 1716 | 1702 | 1706 |
| | IAS KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| 42000 | TAS KT | 268 | 368 | 373 | 379 | 384 | 390 | 395 | 405 | 407 | 413 |
| | INDICATED MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.112 | 0.108 | 0.110 | 0.112 | 0.113 | 0.115 | 0.116 | 0.118 | 0.120 | 0.121 |
| | N1 % | 64.1 | 76.3 | 77 | 77.8 | 78.6 | 79.4 | 80.3 | 81.9 | 81.9 | 82.7 |
| | F FLOW LB/H/ENG | 1177 | 1675 | 1673 | 1672 | 1671 | 1671 | 1672 | 1689 | 1675 | 1678 |
| | IAS KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| 40000 | TAS KT | 268 | 367 | 373 | 378 | 384 | 389 | 395 | 404 | 406 | 412 |
| | INDICATED MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.62 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.114 | 0.110 | 0.111 | 0.113 | 0.115 | 0.116 | 0.118 | 0.12 | 0.121 | 0.123 |
| | N1 % | 63.6 | 76.0 | 76.7 | 77.4 | 78.2 | 79.0 | 79.8 | 80.7 | 81.5 | 82.3 |
| | F FLOW LB/H/ENG | 1157 | 1653 | 1650 | 1648 | 1647 | 1647 | 1647 | 1648 | 1650 | 1652 |
| | IAS KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| 38000 | TAS KT | 268 | 367 | 372 | 377 | 383 | 389 | 394 | 400 | 406 | 412 |
| | INDICATED MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.116 | 0.111 | 0.113 | 0.115 | 0.116 | 0.118 | 0.120 | 0.121 | 0.123 | 0.125 |
| | N1 % | 63.1 | 75.6 | 76.3 | 77.0 | 77.8 | 78.6 | 79.4 | 80.3 | 81.1 | 81.9 |
| | F FLOW LB/H/ENG | 1138 | 1631 | 1628 | 1626 | 1624 | 1623 | 1623 | 1623 | 1624 | 1626 |
| | IAS KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| 36000 | TAS KT | 268 | 366 | 372 | 377 | 382 | 388 | 394 | 399 | 405 | 411 |
| | INDICATED MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.118 | 0.112 | 0.114 | 0.116 | 0.118 | 0.120 | 0.121 | 0.123 | 0.125 | 0.126 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW STD ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW STD ISA CONDITIONS.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## PRESSURE ALTITUDE: 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITIONS

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 34000 | N1 % | 62.5 | 75.3 | 76.0 | 76.7 | 77.4 | 78.2 | 79.0 | 79.8 | 80.7 | 81.5 |
| | F FLOW LB/H/ENG | 1119 | 1610 | 1606 | 1604 | 1602 | 1600 | 1599 | 1599 | 1600 | 1601 |
| | IAS KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS KT | 267 | 366 | 371 | 376 | 382 | 387 | 393 | 399 | 405 | 411 |
| | INDICATED MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.62 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.119 | 0.114 | 0.116 | 0.117 | 0.119 | 0.121 | 0.123 | 0.125 | 0.126 | 0.128 |
| 31000 | N1 % | 61.8 | 74.8 | 75.4 | 76.1 | 76.8 | 77.6 | 78.4 | 79.2 | 80.0 | 80.8 |
| | F FLOW LB/H/ENG | 1093 | 1578 | 1574 | 1571 | 1568 | 1566 | 1564 | 1563 | 1563 | 1563 |
| | IAS KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS KT | 267 | 365 | 370 | 375 | 381 | 386 | 392 | 398 | 404 | 410 |
| | INDICATED MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.122 | 0.116 | 0.118 | 0.120 | 0.121 | 0.123 | 0.125 | 0.127 | 0.129 | 0.131 |
| 28000 | N1 % | 61.0 | 74.3 | 74.9 | 75.6 | 76.3 | 77.0 | 77.7 | 78.5 | 79.3 | 80.2 |
| | F FLOW LB/H/ENG | 1068 | 1547 | 1542 | 1538 | 1535 | 1532 | 1530 | 1528 | 1527 | 1526 |
| | IAS KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS KT | 266 | 364 | 369 | 375 | 380 | 386 | 391 | 397 | 403 | 409 |
| | INDICATED MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.125 | 0.118 | 0.120 | 0.122 | 0.124 | 0.126 | 0.128 | 0.130 | 0.132 | 0.134 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW STD ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW STD ISA CONDITIONS.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

### PRESSURE ALTITUDE: 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITIONS

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| 50000 | N1 % | 85.2 | 85.9 | 86.5 | 86.8 | 87.1 | 87.4 | 87.6 | 87.9 | 87.9 | 87.9 |
| | F FLOW LB/H/ENG | 1806 | 1813 | 1816 | 1789 | 1762 | 1733 | 1709 | 1685 | 1632 | 1579 |
| | IAS KT | 318 | 318 | 317 | 314 | 312 | 309 | 307 | 305 | 299 | 293 |
| | TAS KT | 419 | 425 | 430 | 433 | 436 | 439 | 442 | 446 | 445 | 444 |
| | INDICATED MACH | 0.676 | 0.689 | 0.700 | 0.707 | 0.716 | 0.723 | 0.732 | 0.742 | 0.743 | 0.745 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.44 | 2.32 | 2.21 | 2.11 |
| | SR NM/LB | 0.116 | 0.117 | 0.118 | 0.121 | 0.124 | 0.127 | 0.129 | 0.132 | 0.136 | 0.141 |
| 48000 | N1 % | 84.9 | 85.6 | 86.2 | 86.8 | 87.1 | 87.3 | 87.6 | 87.9 | 87.9 | 87.9 |
| | F FLOW LB/H/ENG | 1780 | 1787 | 1795 | 1794 | 1763 | 1735 | 1711 | 1688 | 1635 | 1581 |
| | IAS KT | 319 | 319 | 319 | 318 | 314 | 312 | 309 | 307 | 302 | 296 |
| | TAS KT | 419 | 425 | 432 | 437 | 438 | 441 | 445 | 449 | 449 | 447 |
| | INDICATED MACH | 0.677 | 0.690 | 0.703 | 0.715 | 0.719 | 0.728 | 0.738 | 0.747 | 0.751 | 0.750 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.53 | 2.40 | 2.29 | 2.19 |
| | SR NM/LB | 0.118 | 0.119 | 0.120 | 0.122 | 0.124 | 0.127 | 0.130 | 0.133 | 0.137 | 0.141 |
| 46000 | N1 % | 84.5 | 85.2 | 85.9 | 86.6 | 87 | 87.3 | 87.6 | 87.9 | 87.9 | 87.9 |
| | F FLOW LB/H/ENG | 1768 | 1774 | 1781 | 1789 | 1765 | 1738 | 1714 | 1691 | 1638 | 1585 |
| | IAS KT | 320 | 320 | 320 | 320 | 317 | 314 | 311 | 309 | 304 | 299 |
| | TAS KT | 421 | 427 | 433 | 440 | 442 | 444 | 448 | 452 | 452 | 451 |
| | INDICATED MACH | 0.68 | 0.692 | 0.706 | 0.719 | 0.726 | 0.733 | 0.742 | 0.752 | 0.755 | 0.757 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.48 | 2.36 | 2.25 |
| | SR NM/LB | 0.119 | 0.120 | 0.122 | 0.123 | 0.125 | 0.128 | 0.131 | 0.134 | 0.138 | 0.142 |
| 44000 | N1 % | 84.2 | 84.8 | 85.5 | 86.2 | 87 | 87.3 | 87.6 | 87.9 | 87.9 | 87.9 |
| | F FLOW LB/H/ENG | 1738 | 1744 | 1750 | 1757 | 1765 | 1740 | 1715 | 1693 | 1640 | 1587 |
| | IAS KT | 320 | 320 | 320 | 320 | 320 | 317 | 314 | 311 | 306 | 301 |
| | TAS KT | 420 | 426 | 432 | 439 | 445 | 448 | 450 | 454 | 454 | 454 |
| | INDICATED MACH | 0.680 | 0.692 | 0.706 | 0.719 | 0.733 | 0.740 | 0.747 | 0.756 | 0.760 | 0.762 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.46 | 2.35 |
| | SR NM/LB | 0.121 | 0.122 | 0.124 | 0.125 | 0.126 | 0.129 | 0.131 | 0.134 | 0.139 | 0.143 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW STD ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW STD ISA CONDITIONS.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## PRESSURE ALTITUDE: 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| | N1 | % | 83.8 | 84.4 | 85.1 | 85.8 | 86.5 | 87.3 | 87.6 | 87.9 | 87.9 | 87.8 |
| | F FLOW | LB/H/ENG | 1710 | 1715 | 1720 | 1727 | 1734 | 1741 | 1717 | 1695 | 1641 | 1589 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 317 | 313 | 309 | 303 |
| 42000 | TAS | KT | 419 | 425 | 432 | 438 | 445 | 452 | 454 | 456 | 457 | 456 |
| | INDICATED | MACH | 0.680 | 0.692 | 0.706 | 0.719 | 0.733 | 0.747 | 0.754 | 0.761 | 0.765 | 0.767 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.44 |
| | SR | NM/LB | 0.123 | 0.124 | 0.126 | 0.127 | 0.128 | 0.13 | 0.132 | 0.135 | 0.139 | 0.143 |
| | N1 | % | 83.5 | 84.1 | 84.7 | 85.4 | 86.1 | 86.9 | 87.6 | 87.9 | 87.8 | 87.8 |
| | F FLOW | LB/H/ENG | 1682 | 1686 | 1691 | 1697 | 1703 | 1710 | 1717 | 1698 | 1643 | 1590 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 317 | 311 | 305 |
| 40000 | TAS | KT | 419 | 425 | 431 | 438 | 444 | 451 | 458 | 460 | 459 | 458 |
| | INDICATED | MACH | 0.68 | 0.692 | 0.706 | 0.719 | 0.733 | 0.747 | 0.761 | 0.769 | 0.770 | 0.772 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.55 |
| | SR | NM/LB | 0.124 | 0.126 | 0.127 | 0.129 | 0.13 | 0.132 | 0.133 | 0.135 | 0.14 | 0.144 |
| | N1 | % | 83.1 | 83.7 | 84.3 | 85 | 85.7 | 86.4 | 87.2 | 87.8 | 87.8 | 87.8 |
| | F FLOW | LB/H/ENG | 1655 | 1658 | 1663 | 1668 | 1673 | 1679 | 1686 | 1693 | 1646 | 1592 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 314 | 307 |
| 38000 | TAS | KT | 418 | 424 | 431 | 437 | 444 | 450 | 457 | 464 | 463 | 461 |
| | INDICATED | MACH | 0.68 | 0.692 | 0.706 | 0.719 | 0.733 | 0.747 | 0.761 | 0.776 | 0.778 | 0.777 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.126 | 0.128 | 0.129 | 0.131 | 0.133 | 0.134 | 0.136 | 0.137 | 0.141 | 0.145 |
| | N1 | % | 82.7 | 83.4 | 84 | 84.6 | 85.2 | 86 | 86.7 | 87.4 | 87.5 | 87.5 |
| | F FLOW | LB/ /ENG | 1628 | 1631 | 1635 | 1639 | 1644 | 1649 | 1655 | 1662 | 1621 | 1565 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 315 | 309 |
| 36000 | TAS | KT | 417 | 424 | 430 | 436 | 443 | 450 | 456 | 463 | 464 | 462 |
| | INDICATED | MACH | 0.68 | 0.692 | 0.706 | 0.719 | 0.733 | 0.747 | 0.761 | 0.776 | 0.78 | 0.78 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.128 | 0.13 | 0.131 | 0.133 | 0.135 | 0.136 | 0.138 | 0.139 | 0.143 | 0.148 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW STD ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW STD ISA CONDITIONS.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## PRESSURE ALTITUDE: 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| | N1 | % | 82.3 | 83 | 83.6 | 84.2 | 84.8 | 85.5 | 86.3 | 87 | 87.1 | 87 |
| | F FLOW | LB/ /ENG | 1603 | 1605 | 1608 | 1611 | 1616 | 1620 | 1625 | 1631 | 1590 | 1534 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 315 | 309 |
| 34000 | TAS | KT | 417 | 423 | 429 | 436 | 442 | 449 | 456 | 463 | 463 | 461 |
| | INDICATED | MACH | 0.68 | 0.692 | 0.706 | 0.719 | 0.733 | 0.747 | 0.761 | 0.776 | 0.78 | 0.78 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.13 | 0.132 | 0.133 | 0.135 | 0.137 | 0.139 | 0.14 | 0.142 | 0.146 | 0.15 |
| | N1 | % | 81.6 | 82.4 | 83.1 | 83.7 | 84.3 | 84.9 | 85.6 | 86.3 | 86.5 | 86.4 |
| | F FLOW | LB/ /ENG | 1564 | 1565 | 1567 | 1570 | 1573 | 1577 | 1581 | 1585 | 1544 | 1488 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 315 | 309 |
| 31000 | TAS | KT | 416 | 422 | 428 | 435 | 441 | 448 | 455 | 462 | 462 | 460 |
| | INDICATED | MACH | 0.68 | 0.692 | 0.706 | 0.719 | 0.733 | 0.747 | 0.761 | 0.776 | 0.78 | 0.78 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.133 | 0.135 | 0.137 | 0.138 | 0.14 | 0.142 | 0.144 | 0.146 | 0.15 | 0.155 |
| | N1 | % | 81 | 81.7 | 82.5 | 83.1 | 83.7 | 84.3 | 84.9 | 85.6 | 85.7 | 85.7 |
| | F FLOW | LB/ /ENG | 1526 | 1527 | 1528 | 1529 | 1531 | 1534 | 1537 | 1540 | 1499 | 1443 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 315 | 309 |
| 28000 | TAS | KT | 415 | 421 | 427 | 434 | 440 | 447 | 454 | 460 | 461 | 459 |
| | INDICATED | MACH | 0.68 | 0.692 | 0.706 | 0.719 | 0.733 | 0.747 | 0.761 | 0.776 | 0.78 | 0.78 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.136 | 0.138 | 0.14 | 0.142 | 0.144 | 0.146 | 0.148 | 0.149 | 0.154 | 0.159 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW STD ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW STD ISA CONDITIONS.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## PRESSURE ALTITUDE: 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 50000 | N1 % | 87.9 | 87.9 | 88.3 | 88.7 | 89.2 | 89.7 | 90.2 | 90.7 | 91.2 |
| | F FLOW LB/H/ENG | 1525 | 1472 | 1438 | 1406 | 1380 | 1355 | 1337 | 1314 | 1214 |
| | IAS KT | 287 | 281 | 276 | 272 | 268 | 264 | 262 | 258 | 237 |
| | TAS KT | 441 | 439 | 440 | 441 | 442 | 443 | 446 | 448 | 424 |
| | INDICATED MACH | 0.744 | 0.744 | 0.748 | 0.753 | 0.759 | 0.764 | 0.773 | 0.779 | 0.738 |
| | BUFFET MARGIN G | 2.02 | 1.93 | 1.84 | 1.74 | 1.65 | 1.57 | 1.47 | 1.39 | 1.39 |
| | SR NM/LB | 0.145 | 0.149 | 0.153 | 0.157 | 0.160 | 0.164 | 0.167 | 0.170 | 0.174 |
| 48000 | N1 % | 87.8 | 87.8 | 88.2 | 88.6 | 89.1 | 89.5 | 89.7 | 90.1 | 91.0 |
| | F FLOW LB/H/ENG | 1529 | 1476 | 1443 | 1412 | 1389 | 1364 | 1323 | 1286 | 1233 |
| | IAS KT | 291 | 284 | 280 | 276 | 273 | 270 | 264 | 258 | 248 |
| | TAS KT | 446 | 444 | 445 | 446 | 449 | 452 | 450 | 448 | 440 |
| | INDICATED MACH | 0.753 | 0.752 | 0.757 | 0.762 | 0.771 | 0.779 | 0.780 | 0.780 | 0.767 |
| | BUFFET MARGIN G | 2.08 | 1.99 | 1.89 | 1.79 | 1.69 | 1.59 | 1.52 | 1.44 | 1.41 |
| | SR NM/LB | 0.146 | 0.150 | 0.154 | 0.158 | 0.162 | 0.166 | 0.170 | 0.174 | 0.178 |
| 46000 | N1 % | 87.9 | 87.9 | 88 | 88.5 | 88.9 | 89.2 | 89.6 | 90.1 | 90.8 |
| | F FLOW LB/H/ENG | 1530 | 1479 | 1428 | 1416 | 1390 | 1344 | 1302 | 1263 | 1232 |
| | IAS KT | 292 | 287 | 280 | 280 | 277 | 271 | 264 | 258 | 252 |
| | TAS KT | 449 | 448 | 446 | 452 | 454 | 452 | 450 | 448 | 448 |
| | INDICATED MACH | 0.757 | 0.759 | 0.758 | 0.772 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 |
| | BUFFET MARGIN G | 2.16 | 2.06 | 1.97 | 1.84 | 1.73 | 1.65 | 1.58 | 1.5 | 1.43 |
| | SR NM/LB | 0.147 | 0.151 | 0.156 | 0.159 | 0.163 | 0.168 | 0.173 | 0.177 | 0.182 |
| 44000 | N1 % | 87.8 | 87.8 | 87.9 | 88.3 | 88.4 | 88.5 | 88.9 | 89.3 | 90.1 |
| | F FLOW LB/H/ENG | 1533 | 1482 | 1431 | 1418 | 1367 | 1320 | 1277 | 1236 | 1204 |
| | IAS KT | 295 | 290 | 284 | 283 | 277 | 271 | 264 | 258 | 252 |
| | TAS KT | 453 | 452 | 450 | 456 | 454 | 452 | 450 | 448 | 448 |
| | INDICATED MACH | 0.764 | 0.767 | 0.766 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 |
| | BUFFET MARGIN G | 2.24 | 2.13 | 2.04 | 1.9 | 1.81 | 1.73 | 1.65 | 1.57 | 1.5 |
| | SR NM/LB | 0.148 | 0.153 | 0.157 | 0.161 | 0.166 | 0.171 | 0.176 | 0.181 | 0.186 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW STD ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW STD ISA CONDITIONS.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## PRESSURE ALTITUDE: 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 42000 | N1 | % | 87.8 | 87.8 | 87.8 | 87.9 | 87.9 | 88 | 88.2 | 88.5 | 89.3 |
| | F FLOW | LB/H/ENG | 1535 | 1484 | 1433 | 1397 | 1345 | 1297 | 1253 | 1211 | 1177 |
| | IAS | KT | 298 | 292 | 287 | 283 | 277 | 271 | 264 | 258 | 252 |
| | TAS | KT | 455 | 455 | 454 | 456 | 454 | 452 | 450 | 448 | 447 |
| | INDICATED MACH | | 0.769 | 0.772 | 0.775 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 |
| | BUFFET MARGIN | G | 2.33 | 2.22 | 2.11 | 1.99 | 1.9 | 1.82 | 1.73 | 1.65 | 1.57 |
| | SR | NM/LB | 0.148 | 0.153 | 0.159 | 0.163 | 0.169 | 0.174 | 0.179 | 0.185 | 0.19 |
| 40000 | N1 | % | 87.8 | 87.7 | 87.7 | 87.6 | 87.5 | 87.5 | 87.6 | 87.7 | 88.5 |
| | F FLOW | LB/H/ENG | 1536 | 1485 | 1432 | 1377 | 1324 | 1276 | 1230 | 1187 | 1152 |
| | IAS | KT | 300 | 294 | 289 | 283 | 277 | 271 | 264 | 258 | 252 |
| | TAS | KT | 458 | 458 | 457 | 455 | 453 | 451 | 449 | 447 | 447 |
| | INDICATED MACH | | 0.775 | 0.777 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 |
| | BUFFET MARGIN | G | 2.43 | 2.31 | 2.19 | 2.1 | 2 | 1.91 | 1.82 | 1.73 | 1.65 |
| | SR | NM/LB | 0.149 | 0.154 | 0.16 | 0.165 | 0.171 | 0.177 | 0.183 | 0.188 | 0.194 |
| 38000 | N1 | % | 87.7 | 87.5 | 87.4 | 87.2 | 87.1 | 87.1 | 87.1 | 87.2 | 87.6 |
| | F FLOW | LB/H/ENG | 1534 | 1472 | 1413 | 1357 | 1304 | 1254 | 1208 | 1164 | 1127 |
| | IAS | KT | 302 | 296 | 289 | 283 | 277 | 271 | 264 | 258 | 252 |
| | TAS | KT | 461 | 459 | 457 | 455 | 453 | 451 | 449 | 447 | 447 |
| | INDICATED MACH | | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 |
| | BUFFET MARGIN | G | 2.54 | 2.42 | 2.31 | 2.21 | 2.11 | 2.01 | 1.92 | 1.83 | 1.74 |
| | SR | NM/LB | 0.15 | 0.156 | 0.162 | 0.168 | 0.174 | 0.18 | 0.186 | 0.192 | 0.198 |
| 36000 | N1 | % | 87.5 | 87.3 | 87.1 | 86.9 | 86.8 | 86.7 | 86.6 | 86.6 | 87 |
| | F FLOW | LB/H/ENG | 1517 | 1454 | 1395 | 1338 | 1284 | 1234 | 1186 | 1141 | 1104 |
| | IAS | KT | 302 | 296 | 289 | 283 | 277 | 271 | 264 | 258 | 252 |
| | TAS | KT | 460 | 458 | 456 | 454 | 452 | 450 | 448 | 446 | 446 |
| | INDICATED MACH | | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.45 | 2.34 | 2.23 | 2.13 | 2.03 | 1.93 | 1.84 |
| | SR | NM/LB | 0.152 | 0.158 | 0.163 | 0.17 | 0.176 | 0.182 | 0.189 | 0.196 | 0.202 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW STD ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW STD ISA CONDITIONS.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

## PRESSURE ALTITUDE: 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 34000 | N1 % | 87 | 86.9 | 86.8 | 86.7 | 86.5 | 86.3 | 86.2 | 86.2 | 86.5 |
| | F FLOW LB/H/ENG | 1481 | 1431 | 1378 | 1320 | 1266 | 1215 | 1166 | 1121 | 1082 |
| | IAS KT | 302 | 296 | 289 | 283 | 277 | 271 | 264 | 258 | 252 |
| | TAS KT | 459 | 458 | 456 | 454 | 452 | 450 | 448 | 446 | 446 |
| | INDICATED MACH | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.48 | 2.37 | 2.26 | 2.15 | 2.05 | 1.95 |
| | SR NM/LB | 0.155 | 0.16 | 0.165 | 0.172 | 0.178 | 0.185 | 0.192 | 0.199 | 0.206 |
| 31000 | N1 % | 86.3 | 86.3 | 86.2 | 86.2 | 86.1 | 85.8 | 85.7 | 85.5 | 85.8 |
| | F FLOW LB/H/ENG | 1435 | 1384 | 1335 | 1289 | 1240 | 1188 | 1138 | 1092 | 1052 |
| | IAS KT | 302 | 296 | 289 | 283 | 277 | 271 | 264 | 258 | 252 |
| | TAS KT | 458 | 457 | 455 | 453 | 451 | 449 | 447 | 445 | 445 |
| | INDICATED MACH | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.48 | 2.37 | 2.26 | 2.15 |
| | SR NM/LB | 0.16 | 0.165 | 0.17 | 0.176 | 0.182 | 0.189 | 0.196 | 0.204 | 0.211 |
| 28000 | N1 % | 85.6 | 85.6 | 85.5 | 85.4 | 85.4 | 85.3 | 85.2 | 85 | 85.2 |
| | F FLOW LB/H/ENG | 1390 | 1339 | 1290 | 1243 | 1199 | 1156 | 1113 | 1066 | 1025 |
| | IAS KT | 302 | 296 | 289 | 283 | 277 | 271 | 264 | 258 | 252 |
| | TAS KT | 457 | 455 | 454 | 452 | 450 | 448 | 446 | 444 | 444 |
| | INDICATED MACH | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 | 0.78 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.5 | 2.38 |
| | SR NM/LB | 0.164 | 0.17 | 0.176 | 0.182 | 0.188 | 0.194 | 0.2 | 0.208 | 0.217 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW STD ISA CONDITIONS.
INCREASE / DECREASE TAS BY 5 KT PER 5°C ABOVE / BELOW STD ISA CONDITIONS.

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# DESCENT

The descent table shows fuel consumption, distance and time from the top of descent to sea level for various cruise altitudes. The data are calculated for flight idle thrust setting, maintaining 250 KIAS up to 10000 ft and 240 KIAS below 10000 ft.

The approach and landing fuel consumption is not considered in the following tables.

The associated conditions are:

- Flaps.....UP
- Gear.....UP
- Bleeds .....OPEN
- Anti-Ice .....OFF

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## EXAMPLE:

Given:

Arrival Airport Elevation .....3500 ft
Top of Descent Weight .....38000 lb
ISA Condition
Cruise Altitude.....35000 ft

## RESULTS

Data provided from 35000 ft (Top of Descent) to Sea Level table:

Fuel: 227 lb
Distance: 87 NM
Time: 16 min

Data for 5000 ft (3500 ft + 1500 ft above arrival airport) obtained from the 5000 ft descent table:

Fuel: 53 lb
Distance: 12 NM
Time: 3 min

The fuel, distance and time spent during the descent phase (from 35000 ft to 5000 ft) are:

Fuel: 227 - 53 = 174 lb
Distance: 87 - 12 = 75 NM
Time: 16 - 3 = 13 min

**NOTE:** The fuel consumption related to the approach and landing phase is provided on the Section 1-05-07.

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# DESCENT - ALL ENGINES OPERATING

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED : OPEN
FLIGHT IDLE
AIRSPEED : MMO / 250 KIAS / 240 KIAS
ISA CONDITIONS

| WEIGHT (LB) | | | TOP OF DESCENT (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 35000 | 37000 |
| 49000 | FUEL | LB | 57 | 102 | 142 | 176 | 204 | 228 | 251 | 260 |
| | DIST | NM | 13 | 26 | 40 | 53 | 67 | 81 | 96 | 102 |
| | TIME | MIN | 3 | 6 | 9 | 11 | 14 | 16 | 18 | 19 |
| 48000 | FUEL | LB | 57 | 102 | 141 | 175 | 203 | 227 | 249 | 258 |
| | DIST | NM | 13 | 26 | 39 | 53 | 66 | 80 | 95 | 101 |
| | TIME | MIN | 3 | 6 | 9 | 11 | 14 | 16 | 18 | 19 |
| 46000 | FUEL | LB | 56 | 101 | 139 | 173 | 200 | 224 | 246 | 254 |
| | DIST | NM | 13 | 26 | 39 | 52 | 66 | 79 | 94 | 100 |
| | TIME | MIN | 3 | 6 | 9 | 11 | 13 | 15 | 17 | 18 |
| 44000 | FUEL | LB | 55 | 99 | 137 | 171 | 198 | 220 | 242 | 250 |
| | DIST | NM | 13 | 26 | 38 | 52 | 65 | 78 | 92 | 98 |
| | TIME | MIN | 3 | 6 | 9 | 11 | 13 | 15 | 17 | 18 |
| 42000 | FUEL | LB | 55 | 98 | 135 | 168 | 194 | 216 | 237 | 246 |
| | DIST | NM | 13 | 25 | 38 | 51 | 64 | 77 | 90 | 96 |
| | TIME | MIN | 3 | 6 | 8 | 11 | 13 | 15 | 17 | 18 |
| 40000 | FUEL | LB | 54 | 96 | 133 | 165 | 191 | 212 | 233 | 241 |
| | DIST | NM | 12 | 25 | 37 | 50 | 62 | 75 | 89 | 94 |
| | TIME | MIN | 3 | 6 | 8 | 11 | 13 | 15 | 17 | 17 |
| 38000 | FUEL | LB | 53 | 94 | 130 | 162 | 187 | 208 | 227 | 235 |
| | DIST | NM | 12 | 24 | 36 | 49 | 61 | 73 | 87 | 92 |
| | TIME | MIN | 3 | 6 | 8 | 10 | 13 | 14 | 16 | 17 |
| 36000 | FUEL | LB | 52 | 92 | 127 | 158 | 182 | 203 | 222 | 229 |
| | DIST | NM | 12 | 24 | 35 | 48 | 60 | 72 | 84 | 90 |
| | TIME | MIN | 3 | 6 | 8 | 10 | 12 | 14 | 16 | 17 |
| 34000 | FUEL | LB | 50 | 90 | 124 | 154 | 178 | 197 | 216 | 223 |
| | DIST | NM | 12 | 23 | 34 | 46 | 58 | 70 | 82 | 87 |
| | TIME | MIN | 3 | 5 | 8 | 10 | 12 | 14 | 15 | 16 |
| 32000 | FUEL | LB | 49 | 87 | 120 | 149 | 172 | 191 | 209 | 216 |
| | DIST | NM | 11 | 22 | 33 | 45 | 56 | 68 | 79 | 84 |
| | TIME | MIN | 3 | 5 | 8 | 10 | 12 | 13 | 15 | 16 |
| 30000 | FUEL | LB | 47 | 84 | 116 | 144 | 166 | 185 | 202 | 208 |
| | DIST | NM | 11 | 21 | 32 | 43 | 54 | 65 | 77 | 81 |
| | TIME | MIN | 3 | 5 | 7 | 9 | 11 | 13 | 14 | 15 |

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# HOLDING

The holding tables show indicated airspeed, Mach number, N1, fuel flow and fuel consumption for various weights, altitudes, anti-ice on (with and without ice accretion) and off condition. Data are presented in ISA condition for all engines operating configuration.

The associated conditions are:

- Flaps .....UP
- Gear .....UP
- Bleeds .....OPEN
- Airspeed.....1.3 $V_S$ or 200 KIAS
- Anti-Ice.....ON or OFF

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# HOLDING - ALL ENGINES

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED: OPEN
ANTI-ICE: OFF
MINIMUM FUEL CONSUMPTION SPEED
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1500 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 37000 |
| | IAS | KT | 180 | 179 | 176 | 173 | 171 | 171 | 174 | 179 | 184 |
| | TAS | KT | 180 | 182 | 189 | 200 | 214 | 232 | 256 | 287 | 333 |
| 50000 | MACH | | 0.272 | 0.277 | 0.290 | 0.313 | 0.342 | 0.379 | 0.426 | 0.487 | 0.581 |
| | N1 | % | 57.7 | 58.8 | 61.6 | 65.8 | 69.7 | 73.9 | 78.2 | 82.4 | 90.3 |
| | FF | LB/H/ENG | 1104 | 1090 | 1061 | 1032 | 1016 | 1013 | 1014 | 1027 | 1078 |
| | FC | LB/H | 2209 | 2180 | 2123 | 2065 | 2032 | 2026 | 2029 | 2055 | 2157 |
| | IAS | KT | 178 | 176 | 173 | 170 | 168 | 168 | 170 | 174 | 184 |
| | TAS | KT | 177.6 | 179.8 | 185.8 | 196.3 | 209.9 | 227.4 | 250.1 | 279.6 | 333.6 |
| 48000 | MACH | | 0.268 | 0.273 | 0.286 | 0.308 | 0.336 | 0.371 | 0.416 | 0.475 | 0.581 |
| | N1 | % | 56.7 | 57.8 | 60.4 | 64.7 | 68.6 | 72.6 | 77.4 | 81.5 | 88.9 |
| | FF | LB/H/ENG | 1054 | 1039 | 1009 | 977 | 959 | 952 | 952 | 961 | 1003 |
| | FC | LB/H | 2108 | 2078 | 2018 | 1955 | 1917 | 1904 | 1904 | 1921 | 2007 |
| | IAS | KT | 175 | 174 | 170 | 167 | 165 | 164 | 166 | 170 | 180 |
| | TAS | KT | 175.1 | 177.2 | 182.8 | 192.8 | 205.8 | 222.4 | 244.0 | 272.1 | 327.9 |
| 46000 | MACH | | 0.265 | 0.270 | 0.282 | 0.303 | 0.329 | 0.363 | 0.406 | 0.462 | 0.572 |
| | N1 | % | 55.6 | 56.6 | 59.3 | 63.5 | 67.7 | 71.4 | 76.2 | 80.3 | 87.4 |
| | FF | LB/H/ENG | 1018 | 1003 | 972 | 939 | 918 | 909 | 908 | 914 | 952 |
| | FC | LB/H | 2036 | 2005 | 1943 | 1877 | 1836 | 1818 | 1817 | 1829 | 1904 |
| | IAS | KT | 173 | 171 | 168 | 164 | 161 | 161 | 162 | 165 | 175 |
| | TAS | KT | 172.5 | 174.5 | 179.8 | 189.3 | 201.6 | 217.4 | 237.9 | 264.6 | 317.8 |
| 44000 | MACH | | 0.261 | 0.266 | 0.277 | 0.297 | 0.323 | 0.355 | 0.397 | 0.450 | 0.555 |
| | N1 | % | 54.5 | 55.5 | 58.1 | 62.3 | 66.6 | 70.2 | 74.9 | 79.2 | 85.7 |
| | FF | LB/H/ENG | 983 | 967 | 935 | 900 | 878 | 867 | 866 | 869 | 900 |
| | FC | LB/H | 1966 | 1934 | 1870 | 1800 | 1756 | 1733 | 1731 | 1738 | 1801 |
| | IAS | KT | 170 | 169 | 165 | 161 | 158 | 157 | 158 | 161 | 169 |
| | TAS | KT | 170.0 | 171.8 | 176.9 | 185.8 | 197.4 | 212.4 | 231.9 | 257.2 | 307.7 |
| 42000 | MACH | | 0.258 | 0.262 | 0.273 | 0.292 | 0.316 | 0.347 | 0.387 | 0.438 | 0.538 |
| | N1 | % | 53.3 | 54.3 | 56.8 | 61.0 | 65.3 | 69.1 | 73.6 | 78.1 | 84.2 |
| | FF | LB/H/ENG | 948 | 932 | 898 | 862 | 838 | 825 | 823 | 824 | 850 |
| | FC | LB/H | 1896 | 1863 | 1797 | 1725 | 1676 | 1650 | 1647 | 1649 | 1700 |
| | IAS | KT | 168 | 166 | 162 | 158 | 155 | 153 | 154 | 156 | 164 |
| | TAS | KT | 167.4 | 169.2 | 173.9 | 182.4 | 193.3 | 207.4 | 225.8 | 249.9 | 297.7 |
| 40000 | MACH | | 0.254 | 0.258 | 0.269 | 0.287 | 0.310 | 0.339 | 0.377 | 0.426 | 0.521 |
| | N1 | % | 52.2 | 53.1 | 55.6 | 59.6 | 64.0 | 67.9 | 72.2 | 76.9 | 82.9 |
| | FF | LB/H/ENG | 914 | 897 | 863 | 825 | 799 | 784 | 780 | 780 | 801 |
| | FC | LB/H | 1827 | 1794 | 1725 | 1650 | 1598 | 1569 | 1560 | 1561 | 1602 |

**NOTE:** MACH setting and FF LB/H/ENG remain constant, regardless of the temperature change.

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# HOLDING - ALL ENGINES

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED: OPEN
ANTI-ICE: OFF
MINIMUM FUEL CONSUMPTION SPEED
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1500 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 37000 |
| | IAS | KT | 166 | 164 | 160 | 155 | 152 | 150 | 150 | 151 | 158 |
| | TAS | KT | 164.9 | 166.6 | 171.0 | 178.9 | 189.0 | 202.3 | 219.6 | 242.3 | 287.7 |
| 38000 | MACH | | 0.250 | 0.254 | 0.264 | 0.282 | 0.304 | 0.331 | 0.367 | 0.414 | 0.504 |
| | N1 | % | 50.9 | 51.9 | 54.3 | 58.2 | 62.6 | 66.8 | 70.7 | 75.6 | 81.7 |
| | FF | LB/H/ENG | 880 | 863 | 827 | 788 | 761 | 744 | 738 | 737 | 753 |
| | FC | LB/H | 1760 | 1725 | 1655 | 1576 | 1522 | 1488 | 1475 | 1475 | 1506 |
| | IAS | KT | 163 | 161 | 157 | 152 | 148 | 146 | 145 | 147 | 152 |
| | TAS | KT | 162.4 | 163.9 | 168.0 | 175.3 | 184.9 | 197.3 | 213.6 | 234.9 | 277.6 |
| 36000 | MACH | | 0.247 | 0.250 | 0.260 | 0.276 | 0.297 | 0.324 | 0.357 | 0.401 | 0.487 |
| | N1 | % | 49.7 | 50.6 | 53.0 | 56.8 | 61.1 | 65.5 | 69.3 | 74.1 | 80.5 |
| | FF | LB/H/ENG | 847 | 829 | 793 | 752 | 723 | 705 | 696 | 695 | 707 |
| | FC | LB/H | 1694 | 1658 | 1585 | 1504 | 1446 | 1409 | 1392 | 1390 | 1413 |
| | IAS | KT | 161 | 159 | 154 | 149 | 145 | 142 | 141 | 142 | 147 |
| | TAS | KT | 159.9 | 161.2 | 165.0 | 171.8 | 180.7 | 192.4 | 207.7 | 227.6 | 267.6 |
| 34000 | MACH | | 0.243 | 0.247 | 0.256 | 0.271 | 0.291 | 0.316 | 0.348 | 0.389 | 0.470 |
| | N1 | % | 48.5 | 49.3 | 51.6 | 55.4 | 59.6 | 64.0 | 67.9 | 72.5 | 79.0 |
| | FF | LB/H/ENG | 814 | 796 | 759 | 716 | 686 | 666 | 655 | 654 | 661 |
| | FC | LB/H | 1629 | 1592 | 1517 | 1433 | 1372 | 1332 | 1310 | 1308 | 1322 |
| | IAS | KT | 158 | 156 | 152 | 146 | 142 | 139 | 137 | 138 | 141 |
| | TAS | KT | 157.3 | 158.6 | 162.1 | 168.4 | 176.7 | 187.6 | 201.8 | 220.4 | 257.9 |
| 32000 | MACH | | 0.239 | 0.243 | 0.251 | 0.266 | 0.284 | 0.308 | 0.338 | 0.377 | 0.453 |
| | N1 | % | 47.2 | 48.0 | 50.2 | 53.8 | 57.9 | 62.4 | 66.4 | 70.8 | 77.4 |
| | FF | LB/H/ENG | 782 | 764 | 725 | 682 | 650 | 628 | 615 | 611 | 616 |
| | FC | LB/H | 1565 | 1527 | 1451 | 1363 | 1299 | 1255 | 1230 | 1223 | 1233 |
| | IAS | KT | 156 | 154 | 149 | 143 | 139 | 135 | 133 | 133 | 136 |
| | TAS | KT | 154.9 | 156.1 | 159.3 | 165.0 | 172.7 | 182.7 | 195.9 | 213.2 | 248.1 |
| 30000 | MACH | | 0.236 | 0.239 | 0.247 | 0.261 | 0.278 | 0.300 | 0.328 | 0.365 | 0.436 |
| | N1 | % | 45.9 | 46.7 | 48.7 | 52.3 | 56.2 | 60.7 | 65.0 | 69.0 | 75.9 |
| | FF | LB/H/ENG | 751 | 732 | 693 | 647 | 614 | 590 | 576 | 570 | 573 |
| | FC | LB/H | 1503 | 1465 | 1385 | 1295 | 1227 | 1180 | 1151 | 1139 | 1146 |
| | IAS | KT | 154 | 151 | 146 | 140 | 135 | 132 | 129 | 128 | 130 |
| | TAS | KT | 152.5 | 153.6 | 156.4 | 161.7 | 168.7 | 177.8 | 189.9 | 205.9 | 238.3 |
| 28000 | MACH | | 0.232 | 0.235 | 0.242 | 0.255 | 0.271 | 0.292 | 0.318 | 0.352 | 0.419 |
| | N1 | % | 44.6 | 45.3 | 47.3 | 50.6 | 54.5 | 58.8 | 63.3 | 67.3 | 74.2 |
| | FF | LB/H/ENG | 721 | 702 | 661 | 614 | 579 | 554 | 537 | 529 | 530 |
| | FC | LB/H | 1442 | 1403 | 1322 | 1228 | 1157 | 1107 | 1074 | 1058 | 1061 |

**NOTE:** MACH setting and FF LB/H/ENG remain constant, regardless of the temperature change.

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# HOLDING - ALL ENGINES

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED: OPEN
ANTI-ICE: ON (WITHOUT ICE ACCRETION)
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1500 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 37000 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 200.4 | 204.7 | 215.4 | 232.0 | 250.4 | 271.0 | 293.9 | 319.5 | 361.8 |
| 49000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 58.4 | 59.4 | 62.2 | 66.4 | 69.9 | 74.0 | 78.8 | 83.0 | 91.4 |
| | FF | LB/H/ENG | 1227 | 1208 | 1171 | 1128 | 1099 | 1087 | 1083 | 1092 | 1141 |
| | FC | LB/H | 2453 | 2417 | 2341 | 2256 | 2198 | 2173 | 2165 | 2183 | 2282 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 200.4 | 204.7 | 215.4 | 232.0 | 250.4 | 271.0 | 293.9 | 319.5 | 361.8 |
| 48000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 57.9 | 59.0 | 61.7 | 65.9 | 69.5 | 73.5 | 78.4 | 82.5 | 90.8 |
| | FF | LB/H/ENG | 1212 | 1194 | 1155 | 1112 | 1082 | 1069 | 1065 | 1072 | 1117 |
| | FC | LB/H | 2424 | 2387 | 2311 | 2224 | 2165 | 2137 | 2129 | 2143 | 2235 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 200.3 | 204.7 | 215.3 | 231.9 | 250.4 | 271.0 | 293.9 | 319.4 | 361.7 |
| 46000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 57.1 | 58.2 | 60.8 | 65.0 | 68.8 | 72.6 | 77.4 | 81.5 | 89.3 |
| | FF | LB/H/ENG | 1183 | 1165 | 1126 | 1081 | 1050 | 1034 | 1030 | 1033 | 1073 |
| | FC | LB/H | 2367 | 2329 | 2252 | 2163 | 2100 | 2067 | 2059 | 2067 | 2145 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 200.1 | 204.5 | 215.1 | 231.7 | 250.2 | 270.7 | 293.6 | 319.1 | 361.4 |
| 44000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 56.3 | 57.3 | 59.9 | 64.1 | 68.1 | 71.6 | 76.5 | 80.6 | 87.6 |
| | FF | LB/H/ENG | 1155 | 1137 | 1097 | 1051 | 1019 | 1000 | 996 | 997 | 1030 |
| | FC | LB/H | 2311 | 2273 | 2194 | 2103 | 2037 | 2000 | 1992 | 1993 | 2059 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.9 | 204.3 | 214.9 | 231.5 | 249.9 | 270.4 | 293.3 | 318.8 | 361.1 |
| 42000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 55.5 | 56.5 | 59.1 | 63.3 | 67.3 | 70.8 | 75.4 | 79.7 | 85.9 |
| | FF | LB/H/ENG | 1129 | 1110 | 1070 | 1023 | 989 | 968 | 963 | 962 | 989 |
| | FC | LB/H | 2257 | 2219 | 2139 | 2046 | 1977 | 1936 | 1927 | 1924 | 1979 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.7 | 204.1 | 214.7 | 231.3 | 249.7 | 270.2 | 293.0 | 318.5 | 360.8 |
| 40000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 54.6 | 55.7 | 58.3 | 62.4 | 66.5 | 69.9 | 74.4 | 78.9 | 84.8 |
| | FF | LB/H/ENG | 1103 | 1084 | 1043 | 996 | 960 | 937 | 930 | 929 | 951 |
| | FC | LB/H | 2206 | 2168 | 2087 | 1991 | 1920 | 1875 | 1860 | 1859 | 1903 |

**NOTE:** MACH setting and FF LB/H/ENG remain constant, regardless of the temperature change.

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# HOLDING - ALL ENGINES

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED: OPEN
ANTI-ICE: ON (WITHOUT ICE ACCRETION)
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1500 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 37000 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.5 | 203.9 | 214.5 | 231.1 | 249.5 | 269.9 | 292.8 | 318.2 | 360.4 |
| 38000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 53.8 | 54.9 | 57.4 | 61.5 | 65.6 | 69.1 | 73.3 | 78.2 | 84.0 |
| | FF | LB/H/ENG | 1079 | 1059 | 1018 | 970 | 933 | 908 | 899 | 899 | 916 |
| | FC | LB/H | 2157 | 2119 | 2037 | 1940 | 1866 | 1817 | 1797 | 1798 | 1831 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.4 | 203.7 | 214.3 | 230.8 | 249.2 | 269.7 | 292.5 | 318.0 | 360.1 |
| 36000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 53.1 | 54.1 | 56.6 | 60.6 | 64.8 | 68.4 | 72.4 | 77.3 | 83.1 |
| | FF | LB/H/ENG | 1055 | 1036 | 995 | 945 | 907 | 881 | 869 | 870 | 882 |
| | FC | LB/H | 2111 | 2072 | 1989 | 1890 | 1814 | 1762 | 1738 | 1740 | 1765 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.2 | 203.5 | 214.1 | 230.6 | 249.0 | 269.5 | 292.3 | 317.7 | 359.8 |
| 34000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 52.3 | 53.3 | 55.8 | 59.7 | 63.9 | 67.7 | 71.4 | 76.4 | 82.3 |
| | FF | LB/H/ENG | 1033 | 1014 | 972 | 922 | 883 | 855 | 841 | 842 | 851 |
| | FC | LB/H | 2067 | 2027 | 1944 | 1844 | 1765 | 1710 | 1681 | 1685 | 1703 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.0 | 203.3 | 213.9 | 230.5 | 248.8 | 269.2 | 292.0 | 317.4 | 359.6 |
| 32000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 51.6 | 52.6 | 55.0 | 58.9 | 63.1 | 67.0 | 70.6 | 75.3 | 81.4 |
| | FF | LB/H/ENG | 1012 | 993 | 951 | 900 | 859 | 830 | 814 | 813 | 823 |
| | FC | LB/H | 2025 | 1985 | 1901 | 1799 | 1719 | 1661 | 1628 | 1626 | 1646 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 198.9 | 203.2 | 213.8 | 230.3 | 248.6 | 269.0 | 291.8 | 317.2 | 359.3 |
| 30000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 50.9 | 51.8 | 54.3 | 58.1 | 62.3 | 66.3 | 69.7 | 74.3 | 80.5 |
| | FF | LB/H/ENG | 993 | 973 | 930 | 879 | 838 | 807 | 789 | 785 | 796 |
| | FC | LB/H | 1986 | 1946 | 1861 | 1758 | 1675 | 1615 | 1578 | 1570 | 1593 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 198.7 | 203.0 | 213.6 | 230.1 | 248.4 | 268.8 | 291.6 | 317.0 | 359.0 |
| 28000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 50.2 | 51.1 | 53.6 | 57.4 | 61.5 | 65.5 | 68.9 | 73.3 | 79.8 |
| | FF | LB/H/ENG | 974 | 954 | 911 | 859 | 817 | 785 | 765 | 759 | 772 |
| | FC | LB/H | 1948 | 1908 | 1823 | 1718 | 1634 | 1571 | 1531 | 1518 | 1544 |

**NOTE:** MACH setting and FF LB/H/ENG remain constant, regardless of the temperature change.

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# HOLDING - ALL ENGINES

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED: OPEN
ANTI-ICE: ON (WITH ICE ACCRETION)
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1500 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 37000 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 200.4 | 204.7 | 215.4 | 232.0 | 250.4 | 271.0 | 293.9 | 319.5 | 361.8 |
| 49000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 58.4 | 59.4 | 62.2 | 66.4 | 69.9 | 74.0 | 78.8 | 83.0 | 91.4 |
| | FF | LB/H/ENG | 1358 | 1335 | 1286 | 1227 | 1184 | 1159 | 1145 | 1148 | 1195 |
| | FC | LB/H | 2717 | 2670 | 2571 | 2454 | 2369 | 2318 | 2291 | 2296 | 2390 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 200.4 | 204.7 | 215.4 | 232.0 | 250.4 | 271.0 | 293.9 | 319.5 | 361.8 |
| 48000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 57.9 | 59.0 | 61.7 | 65.9 | 69.5 | 73.5 | 78.4 | 82.5 | 90.8 |
| | FF | LB/H/ENG | 1344 | 1320 | 1271 | 1212 | 1168 | 1141 | 1127 | 1127 | 1170 |
| | FC | LB/H | 2688 | 2641 | 2541 | 2423 | 2335 | 2282 | 2254 | 2255 | 2340 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 200.3 | 204.7 | 215.3 | 231.9 | 250.4 | 271.0 | 293.9 | 319.4 | 361.7 |
| 46000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 57.1 | 58.2 | 60.8 | 65.0 | 68.8 | 72.6 | 77.4 | 81.5 | 89.3 |
| | FF | LB/H/ENG | 1316 | 1292 | 1241 | 1181 | 1135 | 1106 | 1092 | 1088 | 1123 |
| | FC | LB/H | 2631 | 2584 | 2483 | 2362 | 2271 | 2212 | 2184 | 2176 | 2246 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 200.1 | 204.5 | 215.1 | 231.7 | 250.2 | 270.7 | 293.6 | 319.1 | 361.4 |
| 44000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 56.3 | 57.3 | 59.9 | 64.1 | 68.1 | 71.6 | 76.5 | 80.6 | 87.6 |
| | FF | LB/H/ENG | 1288 | 1264 | 1213 | 1152 | 1104 | 1073 | 1058 | 1050 | 1078 |
| | FC | LB/H | 2576 | 2528 | 2426 | 2303 | 2208 | 2145 | 2116 | 2101 | 2156 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.9 | 204.3 | 214.9 | 231.5 | 249.9 | 270.4 | 293.3 | 318.8 | 361.1 |
| 42000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 55.5 | 56.5 | 59.1 | 63.3 | 67.3 | 70.8 | 75.4 | 79.7 | 85.9 |
| | FF | LB/H/ENG | 1262 | 1237 | 1186 | 1123 | 1074 | 1040 | 1025 | 1015 | 1036 |
| | FC | LB/H | 2523 | 2475 | 2372 | 2247 | 2149 | 2081 | 2050 | 2030 | 2072 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.7 | 204.1 | 214.7 | 231.3 | 249.7 | 270.2 | 293.0 | 318.5 | 360.8 |
| 40000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 54.6 | 55.7 | 58.3 | 62.4 | 66.5 | 69.9 | 74.4 | 78.9 | 84.8 |
| | FF | LB/H/ENG | 1236 | 1212 | 1160 | 1097 | 1046 | 1010 | 991 | 982 | 996 |
| | FC | LB/H | 2473 | 2424 | 2320 | 2193 | 2092 | 2020 | 1983 | 1963 | 1993 |

**NOTE:** MACH setting and FF LB/H/ENG remain constant, regardless of the temperature change.

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# HOLDING - ALL ENGINES

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED: OPEN
ANTI-ICE: ON (WITH ICE ACCRETION)
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1500 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 37000 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.5 | 203.9 | 214.5 | 231.1 | 249.5 | 269.9 | 292.8 | 318.2 | 360.4 |
| 38000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 53.8 | 54.9 | 57.4 | 61.5 | 65.6 | 69.1 | 73.3 | 78.2 | 84.0 |
| | FF | LB/H/ENG | 1212 | 1188 | 1135 | 1071 | 1019 | 981 | 960 | 951 | 960 |
| | FC | LB/H | 2425 | 2376 | 2271 | 2142 | 2039 | 1963 | 1919 | 1901 | 1919 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.4 | 203.7 | 214.3 | 230.8 | 249.2 | 269.7 | 292.5 | 318.0 | 360.1 |
| 36000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 53.1 | 54.1 | 56.6 | 60.6 | 64.8 | 68.4 | 72.4 | 77.3 | 83.1 |
| | FF | LB/H/ENG | 1189 | 1165 | 1112 | 1047 | 994 | 954 | 930 | 922 | 925 |
| | FC | LB/H | 2379 | 2330 | 2224 | 2093 | 1988 | 1908 | 1860 | 1843 | 1850 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.2 | 203.5 | 214.1 | 230.6 | 249.0 | 269.5 | 292.3 | 317.7 | 359.8 |
| 34000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 52.3 | 53.3 | 55.8 | 59.7 | 63.9 | 67.7 | 71.4 | 76.4 | 82.3 |
| | FF | LB/H/ENG | 1168 | 1143 | 1090 | 1024 | 970 | 928 | 902 | 893 | 893 |
| | FC | LB/H | 2335 | 2286 | 2179 | 2047 | 1939 | 1856 | 1803 | 1787 | 1786 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 199.0 | 203.3 | 213.9 | 230.5 | 248.8 | 269.2 | 292.0 | 317.4 | 359.6 |
| 32000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 51.6 | 52.6 | 55.0 | 58.9 | 63.1 | 67.0 | 70.6 | 75.3 | 81.4 |
| | FF | LB/H/ENG | 1147 | 1122 | 1068 | 1002 | 947 | 904 | 875 | 864 | 864 |
| | FC | LB/H | 2294 | 2244 | 2137 | 2004 | 1894 | 1808 | 1750 | 1727 | 1727 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 198.9 | 203.2 | 213.8 | 230.3 | 248.6 | 269.0 | 291.8 | 317.2 | 359.3 |
| 30000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 50.9 | 51.8 | 54.3 | 58.1 | 62.3 | 66.3 | 69.7 | 74.3 | 80.5 |
| | FF | LB/H/ENG | 1128 | 1103 | 1049 | 981 | 925 | 881 | 850 | 836 | 836 |
| | FC | LB/H | 2255 | 2205 | 2097 | 1963 | 1851 | 1762 | 1700 | 1671 | 1673 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| | TAS | KT | 198.7 | 203.0 | 213.6 | 230.1 | 248.4 | 268.8 | 291.6 | 317.0 | 359.0 |
| 28000 | MACH | | 0.302 | 0.311 | 0.331 | 0.363 | 0.399 | 0.440 | 0.487 | 0.541 | 0.630 |
| | N1 | % | 50.2 | 51.1 | 53.6 | 57.4 | 61.5 | 65.5 | 68.9 | 73.3 | 79.8 |
| | FF | LB/H/ENG | 1109 | 1084 | 1030 | 962 | 905 | 860 | 827 | 809 | 811 |
| | FC | LB/H | 2219 | 2168 | 2060 | 1924 | 1810 | 1719 | 1653 | 1619 | 1623 |

**NOTE:** MACH setting and FF LB/H/ENG remain constant, regardless of the temperature change.

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# ONE ENGINE INOPERATIVE PERFORMANCE

## CRUISE TABLES

The one engine inoperative long range cruise tables show N1, fuel flow, indicated airspeed, true airspeed, indicated Mach number, buffet margin and specific range. Data are presented for various weights, altitudes, and corrections for ISA deviation.

The associated conditions are:

- Flaps .....UP
- Gear .....UP
- Bleeds .....OPEN
- Anti-Ice .....OFF

**NOTE:** The corrections (N1, Fuel Flow and TAS) given in the tables are applicable only to ISA-15°C to ISA+15°C range.

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# LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: 5000 FT TO 14000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 5000 | 7000 | 9000 | 10000 | 11000 | 12000 | 13000 | 14000 |
| 49000 | N1 % | 83.7 | 85.1 | 86.4 | 87.3 | 88.1 | 88.7 | 88.3 | 88.2 |
| | F FLOW LB/H/ENG | 2382 | 2377 | 2373 | 2376 | 2378 | 2364 | 2294 | 2233 |
| | IAS KT | 249 | 247 | 245 | 245 | 244 | 242 | 234 | 227 |
| | TAS KT | 268 | 274 | 280 | 283 | 287 | 288 | 284 | 280 |
| | INDICATED MACH | 0.411 | 0.423 | 0.436 | 0.443 | 0.450 | 0.454 | 0.449 | 0.444 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.53 | 2.38 | 2.24 |
| | SR NM/LB | 0.112 | 0.115 | 0.118 | 0.119 | 0.121 | 0.122 | 0.123 | 0.124 |
| 46000 | N1 % | 81.9 | 83.4 | 84.7 | 85.6 | 86.3 | 87.1 | 87.9 | 88.6 |
| | F FLOW LB/H/ENG | 2231 | 2223 | 2215 | 2216 | 2215 | 2216 | 2219 | 2224 |
| | IAS KT | 243 | 241 | 239 | 239 | 238 | 237 | 236 | 236 |
| | TAS KT | 261 | 267 | 273 | 276 | 280 | 283 | 286 | 290 |
| | INDICATED MACH | 0.401 | 0.413 | 0.425 | 0.432 | 0.439 | 0.445 | 0.452 | 0.460 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.54 |
| | SR NM/LB | 0.117 | 0.120 | 0.123 | 0.125 | 0.126 | 0.128 | 0.129 | 0.130 |
| 44000 | N1 % | 80.6 | 82.2 | 83.6 | 84.4 | 85.1 | 85.8 | 86.6 | 87.5 |
| | F FLOW LB/H/ENG | 2133 | 2120 | 2114 | 2111 | 2108 | 2111 | 2113 | 2114 |
| | IAS KT | 239 | 237 | 236 | 235 | 234 | 233 | 232 | 232 |
| | TAS KT | 257 | 262 | 269 | 272 | 275 | 278 | 281 | 285 |
| | INDICATED MACH | 0.394 | 0.406 | 0.419 | 0.425 | 0.431 | 0.438 | 0.445 | 0.452 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.120 | 0.124 | 0.127 | 0.129 | 0.130 | 0.132 | 0.133 | 0.135 |
| 42000 | N1 % | 79.3 | 80.8 | 82.4 | 83.2 | 83.9 | 84.6 | 85.3 | 86.1 |
| | F FLOW LB/H/ENG | 2038 | 2022 | 2012 | 2007 | 2008 | 2006 | 2004 | 2005 |
| | IAS KT | 235 | 233 | 231 | 230 | 230 | 229 | 228 | 227 |
| | TAS KT | 252 | 258 | 264 | 266 | 270 | 273 | 276 | 279 |
| | INDICATED MACH | 0.388 | 0.399 | 0.411 | 0.417 | 0.424 | 0.431 | 0.437 | 0.444 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.124 | 0.127 | 0.131 | 0.133 | 0.134 | 0.136 | 0.138 | 0.139 |
| 40000 | N1 % | 77.9 | 79.4 | 81.0 | 81.9 | 82.6 | 83.3 | 84.0 | 84.8 |
| | F FLOW LB/H/ENG | 1942 | 1927 | 1912 | 1909 | 1906 | 1901 | 1901 | 1902 |
| | IAS KT | 230 | 229 | 227 | 226 | 226 | 225 | 224 | 223 |
| | TAS KT | 247 | 253 | 258 | 262 | 265 | 268 | 271 | 274 |
| | INDICATED MACH | 0.381 | 0.392 | 0.404 | 0.410 | 0.417 | 0.423 | 0.429 | 0.437 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.127 | 0.131 | 0.135 | 0.137 | 0.139 | 0.141 | 0.142 | 0.144 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 3 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.7 % AND FUEL FLOW BY 8%.
DECREASE SR BY 7%.

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# LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: 5000 FT TO 14000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 5000 | 7000 | 9000 | 10000 | 11000 | 12000 | 13000 | 14000 |
| 38000 | N1 % | 76.5 | 78.0 | 79.6 | 80.5 | 81.2 | 82.0 | 82.8 | 83.4 |
| | F FLOW LB/H/ENG | 1849 | 1830 | 1815 | 1812 | 1804 | 1801 | 1801 | 1796 |
| | IAS KT | 226 | 224 | 223 | 222 | 221 | 220 | 220 | 219 |
| | TAS KT | 243 | 248 | 253 | 257 | 259 | 262 | 266 | 268 |
| | INDICATED MACH | 0.374 | 0.385 | 0.396 | 0.403 | 0.408 | 0.415 | 0.422 | 0.428 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.131 | 0.135 | 0.140 | 0.142 | 0.144 | 0.146 | 0.148 | 0.149 |
| 36000 | N1 % | 75.2 | 76.5 | 78.0 | 78.9 | 79.7 | 80.6 | 81.3 | 82.1 |
| | F FLOW LB/H/ENG | 1758 | 1738 | 1721 | 1715 | 1707 | 1705 | 1698 | 1695 |
| | IAS KT | 222 | 220 | 218 | 218 | 217 | 216 | 215 | 214 |
| | TAS KT | 238 | 243 | 248 | 251 | 254 | 257 | 260 | 263 |
| | INDICATED MACH | 0.367 | 0.377 | 0.389 | 0.395 | 0.400 | 0.407 | 0.413 | 0.419 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.135 | 0.140 | 0.144 | 0.146 | 0.149 | 0.151 | 0.153 | 0.155 |
| 34000 | N1 % | 73.8 | 75.1 | 76.5 | 77.3 | 78.1 | 79.0 | 79.8 | 80.6 |
| | F FLOW LB/H/ENG | 1668 | 1647 | 1629 | 1619 | 1613 | 1608 | 1600 | 1599 |
| | IAS KT | 217 | 216 | 214 | 213 | 212 | 212 | 210 | 210 |
| | TAS KT | 233 | 238 | 243 | 245 | 248 | 251 | 254 | 257 |
| | INDICATED MACH | 0.359 | 0.370 | 0.381 | 0.386 | 0.392 | 0.398 | 0.404 | 0.411 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.139 | 0.144 | 0.149 | 0.152 | 0.154 | 0.156 | 0.159 | 0.161 |
| 32000 | N1 % | 72.5 | 73.6 | 74.9 | 75.6 | 76.5 | 77.2 | 78.1 | 78.9 |
| | F FLOW LB/H/ENG | 1578 | 1556 | 1536 | 1526 | 1522 | 1512 | 1508 | 1501 |
| | IAS KT | 213 | 211 | 209 | 208 | 208 | 207 | 206 | 205 |
| | TAS KT | 227 | 232 | 237 | 240 | 243 | 245 | 248 | 251 |
| | INDICATED MACH | 0.351 | 0.362 | 0.372 | 0.377 | 0.384 | 0.389 | 0.395 | 0.401 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.144 | 0.149 | 0.154 | 0.157 | 0.160 | 0.162 | 0.165 | 0.167 |
| 30000 | N1 % | 71.1 | 72.1 | 73.3 | 74.0 | 74.7 | 75.5 | 76.3 | 77.0 |
| | F FLOW LB/H/ENG | 1492 | 1467 | 1445 | 1438 | 1429 | 1421 | 1415 | 1406 |
| | IAS KT | 208 | 206 | 204 | 203 | 203 | 202 | 201 | 200 |
| | TAS KT | 222 | 226 | 231 | 234 | 237 | 239 | 242 | 245 |
| | INDICATED MACH | 0.344 | 0.353 | 0.363 | 0.369 | 0.375 | 0.380 | 0.386 | 0.391 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.149 | 0.154 | 0.160 | 0.163 | 0.166 | 0.169 | 0.171 | 0.174 |
| 28000 | N1 % | 69.8 | 70.7 | 71.8 | 72.5 | 73.0 | 73.7 | 74.4 | 75.2 |
| | F FLOW LB/H/ENG | 1407 | 1381 | 1358 | 1351 | 1338 | 1332 | 1321 | 1316 |
| | IAS KT | 203 | 201 | 199 | 199 | 197 | 197 | 196 | 195 |
| | TAS KT | 217 | 221 | 226 | 228 | 230 | 233 | 236 | 239 |
| | INDICATED MACH | 0.335 | 0.345 | 0.354 | 0.360 | 0.365 | 0.371 | 0.376 | 0.382 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.154 | 0.160 | 0.166 | 0.169 | 0.172 | 0.175 | 0.178 | 0.181 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 3 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.7 % AND FUEL FLOW BY 8%.
DECREASE SR BY 7%.

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# LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: 15000 FT TO 22000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 15000 | 16000 | 17000 | 18000 | 19000 | 20000 | 21000 | 22000 |
| | N1 % | 89.1 | 89.0 | 89.0 | - | - | - | - | - |
| | F FLOW LB/H/ENG | 2192 | 2112 | 2030 | - | - | - | - | - |
| | IAS KT | 221 | 210 | 192 | - | - | - | - | - |
| 49000 | TAS KT | 277 | 267 | 248 | - | - | - | - | - |
| | INDICATED MACH | 0.441 | 0.427 | 0.398 | - | - | - | - | - |
| | BUFFET MARGIN G | 2.12 | 1.92 | 1.61 | - | - | - | - | - |
| | SR NM/LB | 0.126 | 0.126 | 0.122 | - | - | - | - | - |
| | N1 % | 88.7 | 88.1 | 88.9 | 89.1 | 89.6 | 90.2 | - | - |
| | F FLOW LB/H/ENG | 2191 | 2103 | 2048 | 1994 | 1956 | 1908 | - | - |
| | IAS KT | 231 | 222 | 214 | 206 | 198 | 183 | - | - |
| 46000 | TAS KT | 289 | 282 | 277 | 270 | 263 | 248 | - | - |
| | INDICATED MACH | 0.461 | 0.450 | 0.444 | 0.436 | 0.426 | 0.404 | - | - |
| | BUFFET MARGIN G | 2.45 | 2.26 | 2.12 | 1.96 | 1.80 | 1.56 | - | - |
| | SR NM/LB | 0.132 | 0.133 | 0.135 | 0.135 | 0.135 | 0.130 | - | - |
| | N1 % | 88.2 | 88.9 | 88.1 | 89.0 | 89.5 | 89.9 | 90.3 | - |
| | F FLOW LB/H/ENG | 2118 | 2125 | 2034 | 2001 | 1965 | 1922 | 1859 | - |
| | IAS KT | 231 | 230 | 220 | 216 | 210 | 203 | 190 | - |
| 44000 | TAS KT | 288 | 292 | 284 | 282 | 280 | 274 | 262 | - |
| | INDICATED MACH | 0.460 | 0.467 | 0.456 | 0.456 | 0.453 | 0.446 | 0.428 | - |
| | BUFFET MARGIN G | 2.55 | 2.52 | 2.32 | 2.22 | 2.11 | 1.97 | 1.74 | - |
| | SR NM/LB | 0.136 | 0.137 | 0.139 | 0.141 | 0.142 | 0.143 | 0.141 | - |
| | N1 % | 87.0 | 87.7 | 88.4 | 88.6 | 88.7 | 88.8 | 90.1 | 90.4 |
| | F FLOW LB/H/ENG | 2011 | 2013 | 2016 | 1993 | 1952 | 1908 | 1873 | 1810 |
| | IAS KT | 227 | 226 | 225 | 222 | 216 | 210 | 204 | 194 |
| 42000 | TAS KT | 283 | 286 | 290 | 290 | 288 | 284 | 280 | 272 |
| | INDICATED MACH | 0.452 | 0.459 | 0.466 | 0.468 | 0.466 | 0.463 | 0.458 | 0.446 |
| | BUFFET MARGIN G | 2.56 | 2.55 | 2.52 | 2.44 | 2.32 | 2.20 | 2.07 | 1.89 |
| | SR NM/LB | 0.141 | 0.142 | 0.144 | 0.145 | 0.146 | 0.148 | 0.150 | 0.150 |
| | N1 % | 85.5 | 86.4 | 87.2 | 87.8 | 88.6 | 89.5 | 89.2 | 90.2 |
| | F FLOW LB/H/ENG | 1901 | 1903 | 1909 | 1910 | 1918 | 1925 | 1860 | 1823 |
| | IAS KT | 223 | 222 | 221 | 220 | 220 | 219 | 211 | 205 |
| 40000 | TAS KT | 277 | 281 | 285 | 288 | 292 | 296 | 290 | 286 |
| | INDICATED MACH | 0.443 | 0.450 | 0.458 | 0.465 | 0.473 | 0.481 | 0.474 | 0.470 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.53 | 2.50 | 2.47 | 2.30 | 2.17 |
| | SR NM/LB | 0.146 | 0.148 | 0.149 | 0.151 | 0.152 | 0.153 | 0.155 | 0.157 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 3 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.7 % AND FUEL FLOW BY 8%.
DECREASE SR BY 7%.

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# LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: 15000 FT TO 22000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 15000 | 16000 | 17000 | 18000 | 19000 | 20000 | 21000 | 22000 |
| 38000 | N1 % | 84.1 | 84.9 | 85.7 | 86.6 | 87.2 | 88.0 | 88.9 | 90.0 |
| | F FLOW LB/H/ENG | 1796 | 1797 | 1797 | 1805 | 1805 | 1811 | 1820 | 1831 |
| | IAS KT | 218 | 217 | 217 | 216 | 215 | 215 | 214 | 214 |
| | TAS KT | 272 | 275 | 278 | 283 | 286 | 289 | 293 | 298 |
| | INDICATED MACH | 0.435 | 0.442 | 0.449 | 0.457 | 0.464 | 0.472 | 0.480 | 0.489 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.53 | 2.50 | 2.48 | 2.45 |
| | SR NM/LB | 0.151 | 0.153 | 0.155 | 0.157 | 0.158 | 0.160 | 0.161 | 0.163 |
| 36000 | N1 % | 82.8 | 83.5 | 84.2 | 85.0 | 85.9 | 86.6 | 87.3 | 88.2 |
| | F FLOW LB/H/ENG | 1696 | 1695 | 1695 | 1693 | 1698 | 1699 | 1704 | 1711 |
| | IAS KT | 214 | 213 | 212 | 211 | 211 | 210 | 209 | 209 |
| | TAS KT | 266 | 270 | 273 | 276 | 280 | 283 | 287 | 291 |
| | INDICATED MACH | 0.427 | 0.433 | 0.440 | 0.447 | 0.455 | 0.462 | 0.470 | 0.478 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.54 | 2.51 | 2.48 |
| | SR NM/LB | 0.157 | 0.159 | 0.161 | 0.163 | 0.165 | 0.167 | 0.168 | 0.170 |
| 34000 | N1 % | 81.3 | 82.0 | 82.7 | 83.5 | 84.3 | 85.1 | 86.0 | 86.6 |
| | F FLOW LB/H/ENG | 1594 | 1590 | 1589 | 1592 | 1590 | 1593 | 1599 | 1599 |
| | IAS KT | 209 | 208 | 207 | 207 | 206 | 206 | 205 | 204 |
| | TAS KT | 260 | 263 | 266 | 270 | 273 | 277 | 281 | 284 |
| | INDICATED MACH | 0.417 | 0.423 | 0.430 | 0.438 | 0.444 | 0.452 | 0.461 | 0.467 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.52 |
| | SR NM/LB | 0.163 | 0.165 | 0.168 | 0.170 | 0.172 | 0.174 | 0.176 | 0.177 |
| 32000 | N1 % | 79.7 | 80.5 | 81.3 | 81.9 | 82.7 | 83.4 | 84.3 | 85.2 |
| | F FLOW LB/H/ENG | 1496 | 1493 | 1492 | 1489 | 1488 | 1488 | 1489 | 1494 |
| | IAS KT | 204 | 204 | 203 | 202 | 201 | 201 | 200 | 200 |
| | TAS KT | 254 | 257 | 261 | 263 | 267 | 270 | 273 | 278 |
| | INDICATED MACH | 0.407 | 0.414 | 0.421 | 0.427 | 0.435 | 0.442 | 0.449 | 0.458 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.170 | 0.172 | 0.175 | 0.177 | 0.179 | 0.181 | 0.184 | 0.186 |
| 30000 | N1 % | 77.9 | 78.8 | 79.6 | 80.3 | 81.1 | 81.8 | 82.6 | 83.4 |
| | F FLOW LB/H/ENG | 1403 | 1399 | 1394 | 1389 | 1389 | 1387 | 1389 | 1386 |
| | IAS KT | 200 | 199 | 198 | 197 | 196 | 196 | 195 | 194 |
| | TAS KT | 248 | 251 | 254 | 257 | 260 | 263 | 267 | 270 |
| | INDICATED MACH | 0.398 | 0.405 | 0.411 | 0.417 | 0.424 | 0.431 | 0.439 | 0.446 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.177 | 0.179 | 0.182 | 0.185 | 0.187 | 0.190 | 0.192 | 0.195 |
| 28000 | N1 % | 76.0 | 76.8 | 77.7 | 78.6 | 79.3 | 80.1 | 80.8 | 81.6 |
| | F FLOW LB/H/ENG | 1310 | 1302 | 1297 | 1296 | 1290 | 1290 | 1285 | 1287 |
| | IAS KT | 194 | 193 | 193 | 192 | 191 | 191 | 190 | 189 |
| | TAS KT | 241 | 244 | 247 | 250 | 253 | 257 | 259 | 263 |
| | INDICATED MACH | 0.388 | 0.394 | 0.400 | 0.407 | 0.413 | 0.421 | 0.427 | 0.434 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.184 | 0.187 | 0.190 | 0.193 | 0.196 | 0.199 | 0.202 | 0.204 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 3 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.7 % AND FUEL FLOW BY 8%.
DECREASE SR BY 7%.

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# LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: 23000 FT TO 30000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 | 29000 | 30000 |
| | N1 % | - | - | - | - | - | - | - | - |
| | F FLOW LB/H/ENG | - | - | - | - | - | - | - | - |
| | IAS KT | - | - | - | - | - | - | - | - |
| 49000 | TAS KT | - | - | - | - | - | - | - | - |
| | INDICATED MACH | - | - | - | - | - | - | - | - |
| | BUFFET MARGIN G | - | - | - | - | - | - | - | - |
| | SR NM/LB | - | - | - | - | - | - | - | - |
| | N1 % | - | - | - | - | - | - | - | - |
| | F FLOW LB/H/ENG | - | - | - | - | - | - | - | - |
| | IAS KT | - | - | - | - | - | - | - | - |
| 46000 | TAS KT | - | - | - | - | - | - | - | - |
| | INDICATED MACH | - | - | - | - | - | - | - | - |
| | BUFFET MARGIN G | - | - | - | - | - | - | - | - |
| | SR NM/LB | - | - | - | - | - | - | - | - |
| | N1 % | - | - | - | - | - | - | - | - |
| | F FLOW LB/H/ENG | - | - | - | - | - | - | - | - |
| | IAS KT | - | - | - | - | - | - | - | - |
| 44000 | TAS KT | - | - | - | - | - | - | - | - |
| | INDICATED MACH | - | - | - | - | - | - | - | - |
| | BUFFET MARGIN G | - | - | - | - | - | - | - | - |
| | SR NM/LB | - | - | - | - | - | - | - | - |
| | N1 % | - | - | - | - | - | - | - | - |
| | F FLOW LB/H/ENG | - | - | - | - | - | - | - | - |
| | IAS KT | - | - | - | - | - | - | - | - |
| 42000 | TAS KT | - | - | - | - | - | - | - | - |
| | INDICATED MACH | - | - | - | - | - | - | - | - |
| | BUFFET MARGIN G | - | - | - | - | - | - | - | - |
| | SR NM/LB | - | - | - | - | - | - | - | - |
| | N1 % | 90.5 | 90.8 | - | - | - | - | - | - |
| | F FLOW LB/H/ENG | 1761 | 1691 | - | - | - | - | - | - |
| | IAS KT | 196 | 183 | - | - | - | - | - | - |
| 40000 | TAS KT | 279 | 264 | - | - | - | - | - | - |
| | INDICATED MACH | 0.460 | 0.438 | - | - | - | - | - | - |
| | BUFFET MARGIN G | 2.00 | 1.75 | - | - | - | - | - | - |
| | SR NM/LB | 0.158 | 0.156 | - | - | - | - | - | - |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 3 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.7 % AND FUEL FLOW BY 8%.
DECREASE SR BY 7%.

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# LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

## AE3007A1 AND AE3007A1P ENGINES

## ALTITUDE: 23000 FT TO 30000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 | 29000 | 30000 |
| | N1 % | 89.7 | 90.7 | 90.9 | 91.3 | - | - | - | - |
| | F FLOW LB/H/ENG | 1756 | 1711 | 1646 | 1577 | - | - | - | - |
| | IAS KT | 205 | 198 | 187 | 170 | - | - | - | - |
| 38000 | TAS KT | 290 | 285 | 274 | 254 | - | - | - | - |
| | INDICATED MACH | 0.479 | 0.472 | 0.456 | 0.425 | - | - | - | - |
| | BUFFET MARGIN G | 2.26 | 2.11 | 1.90 | 1.60 | - | - | - | - |
| | SR NM/LB | 0.164 | 0.166 | 0.166 | 0.161 | - | - | - | - |
| | N1 % | 89.3 | 90.3 | 90.0 | 91.1 | 91.3 | - | - | - |
| | F FLOW LB/H/ENG | 1721 | 1713 | 1643 | 1603 | 1543 | - | - | - |
| | IAS KT | 209 | 206 | 197 | 190 | 179 | - | - | - |
| 36000 | TAS KT | 295 | 296 | 288 | 283 | 271 | - | - | - |
| | INDICATED MACH | 0.487 | 0.492 | 0.481 | 0.474 | 0.456 | - | - | - |
| | BUFFET MARGIN G | 2.45 | 2.39 | 2.20 | 2.05 | 1.83 | - | - | - |
| | SR NM/LB | 0.171 | 0.173 | 0.174 | 0.177 | 0.176 | - | - | - |
| | N1 % | 87.4 | 88.4 | 89.7 | 90.7 | 90.5 | 91.5 | 91.7 | - |
| | F FLOW LB/H/ENG | 1605 | 1611 | 1619 | 1607 | 1547 | 1509 | 1454 | - |
| | IAS KT | 203 | 203 | 202 | 199 | 191 | 184 | 173 | - |
| 34000 | TAS KT | 288 | 291 | 295 | 296 | 289 | 284 | 272 | - |
| | INDICATED MACH | 0.476 | 0.484 | 0.493 | 0.496 | 0.486 | 0.479 | 0.462 | - |
| | BUFFET MARGIN G | 2.49 | 2.46 | 2.43 | 2.35 | 2.17 | 2.02 | 1.81 | - |
| | SR NM/LB | 0.179 | 0.181 | 0.182 | 0.184 | 0.185 | 0.188 | 0.187 | - |
| | N1 % | 85.9 | 86.6 | 87.5 | 88.7 | 90.2 | 91.1 | 90.9 | 91.9 |
| | F FLOW LB/H/ENG | 1497 | 1500 | 1505 | 1513 | 1521 | 1511 | 1459 | 1431 |
| | IAS KT | 199 | 198 | 197 | 197 | 196 | 194 | 186 | 180 |
| 32000 | TAS KT | 281 | 284 | 288 | 292 | 296 | 297 | 291 | 287 |
| | INDICATED MACH | 0.465 | 0.473 | 0.481 | 0.490 | 0.499 | 0.503 | 0.494 | 0.489 |
| | BUFFET MARGIN G | 2.54 | 2.50 | 2.47 | 2.44 | 2.40 | 2.33 | 2.16 | 2.03 |
| | SR NM/LB | 0.188 | 0.190 | 0.192 | 0.193 | 0.195 | 0.196 | 0.198 | 0.200 |
| | N1 % | 84.2 | 85.0 | 85.7 | 86.5 | 87.6 | 89.0 | 90.5 | 91.7 |
| | F FLOW LB/H/ENG | 1389 | 1393 | 1397 | 1400 | 1406 | 1414 | 1424 | 1434 |
| | IAS KT | 194 | 193 | 192 | 192 | 191 | 191 | 190 | 190 |
| 30000 | TAS KT | 274 | 278 | 281 | 285 | 289 | 293 | 297 | 301 |
| | INDICATED MACH | 0.454 | 0.462 | 0.470 | 0.478 | 0.486 | 0.495 | 0.505 | 0.515 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.52 | 2.49 | 2.45 | 2.42 | 2.39 | 2.35 |
| | SR NM/LB | 0.197 | 0.199 | 0.201 | 0.203 | 0.205 | 0.207 | 0.209 | 0.210 |
| | N1 % | 82.4 | 83.2 | 84.1 | 84.8 | 85.5 | 86.5 | 87.6 | 89.2 |
| | F FLOW LB/H/ENG | 1287 | 1286 | 1290 | 1293 | 1297 | 1301 | 1308 | 1315 |
| | IAS KT | 189 | 188 | 187 | 187 | 186 | 185 | 185 | 184 |
| 28000 | TAS KT | 266 | 270 | 273 | 277 | 281 | 285 | 289 | 293 |
| | INDICATED MACH | 0.442 | 0.449 | 0.457 | 0.465 | 0.474 | 0.482 | 0.491 | 0.500 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.54 | 2.51 | 2.47 | 2.44 | 2.41 |
| | SR NM/LB | 0.207 | 0.210 | 0.212 | 0.214 | 0.217 | 0.219 | 0.221 | 0.223 |

INCREASE / DECREASE N1% BY 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE FUEL FLOW 1 % PER 5°C ABOVE / BELOW ISA CONDITIONS.
INCREASE / DECREASE TAS BY 3 KT PER 5°C ABOVE / BELOW ISA CONDITIONS.

FOR ANTI-ICE ON:
INCREASE N1 BY 0.7 % AND FUEL FLOW BY 8%.
DECREASE SR BY 7%.

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# DRIFTDOWN TABLE

In the event of an engine failure during cruise it will generally be necessary to reduce speed and descent to a lower altitude.

Immediately after engine failure set maximum continuous N1 and allow the airplane to decelerate from the cruise speed to the initial drift down speed shown in the driftdown table. When this speed is achieved start the descend profile.

The airplane should level off at the gross altitude and weight shown in the driftdown table.

## NET LEVEL OFF ALTITUDE

Federal regulations require terrain clearance flight planning based on net performance which is the gross (or real) gradient performance degraded by 1.1%.

To estimate the net level off pressure altitude, enter with the gross weight, proceed to the ISA deviation, and find the value within bracket. This is the net level off pressure altitude. The net level off geometric altitude must clear all en-route obstacle by at least 1000 ft.

In case the obstacles heights are close to the values published in the following tables, a detailed driftdown analysis must be accomplished.

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## DRIFTDOWN TABLE
## EMB-145 - AE3007A1 AND AE3007A1P ENGINES - FAA CERTIFICATION
## BLEEDS ON/ANTI ICE OFF

| WEIGHT (LB) | | INITIAL DRIFTDOWN SPEED (KIAS) | GROSS LEVEL OFF ALTITUDE - FT (NET LEVEL OFF ALTITUDE - FT) | | |
|---|---|---|---|---|---|
| START DRIFTDOWN | LEVEL OFF | | ISA +10 & BELOW | ISA +15 | ISA +20 |
| 50000 | 48000 | 179 | 17900 (13800) | 17700 (13700) | 17400 (12900) |
| 48000 | 46100 | 176 | 19100 (14400) | 19000 (14300) | 18800 (14000) |
| 46000 | 44200 | 172 | 20770 (16010) | 20640 (15930) | 20220 (15690) |
| 44000 | 42300 | 169 | 22030 (17490) | 21880 (17390) | 21470 (17180) |
| 42000 | 40500 | 165 | 23430 (19400) | 23050 (19250) | 22710 (18760) |
| 40000 | 38700 | 161 | 24860 (21055) | 24520 (20910) | 23950 (20410) |
| 38000 | 36900 | 157 | 26440 (22460) | 26170 (22260) | 25470 (21950) |
| 36000 | 34900 | 154 | 28150 (24110) | 27520 (23730) | 26920 (23250) |
| 34000 | 33000 | 149 | 29820 (25850) | 29220 (25560) | 28260 (24890) |
| 32000 | 31100 | 145 | 31870 (27550) | 30784 (27000) | 29680 (26410) |

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## DRIFTDOWN TABLE
## EMB-145 - AE3007A1 AND AE3007A1P ENGINES - FAA CERTIFICATION
## BLEEDS ON/ANTI ICE ON

| WEIGHT (LB) | | INITIAL DRIFT DOWN SPEED (KIAS) | GROSS LEVEL OFF ALTITUDE - FT (NET LEVEL OFF ALTITUDE - FT) | | | | |
|---|---|---|---|---|---|---|---|
| START DRIFT DOWN | LEVEL OFF | | ISA-10 & BELOW | ISA-5 | ISA | ISA +5 | ISA +10 |
| 50000 | 47400 | 179 | 14100 (10000) | 13900 (9900) | 13100 (9400) | 11500 (6800) | 9900 (6000) |
| 48000 | 45700 | 176 | 15700 (11500) | 15500 (11400) | 14500 (10900) | 12800 (8800) | 11300 (7500) |
| 46000 | 43600 | 173 | 17190 (13220) | 17090 (13030) | 15980 (12280) | 14260 (10670) | 12630 (8550) |
| 44000 | 42000 | 169 | 18730 (14620) | 18540 (14410) | 17480 (13460) | 15620 (11890) | 13850 (10330) |
| 42000 | 40100 | 165 | 20390 (16150) | 20200 (15940) | 19200 (14940) | 17370 (13260) | 15350 (11750) |
| 40000 | 38200 | 161 | 21790 (17840) | 21450 (17780) | 20600 (16620) | 18920 (14830) | 16960 (13220) |
| 38000 | 36300 | 158 | 23180 (19780) | 22730 (19570) | 21840 (18350) | 20540 (16590) | 18450 (14670) |
| 36000 | 34400 | 154 | 24590 (21390) | 24300 (21050) | 23150 (20270) | 21850 (18450) | 20010 (16400) |
| 34000 | 32600 | 149 | 26080 (22990) | 25340 (22580) | 24420 (21670) | 23190 (20370) | 21410 (18250) |
| 32000 | 30700 | 145 | 27370 (24460) | 26550 (23900) | 25660 (23020) | 24390 (21700) | 22690 (19810) |

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# HOLDING

The holding tables show indicated airspeed, mach number, N1, fuel flow and fuel consumption for various weights and altitudes. Data are presented in ISA condition for all engines operating and one engine inoperative configuration. For both conditions, tables for anti-ice on (with and without ice accretion) and off are provided.

The associated conditions are:

- Flaps.....UP
- Gears.....UP
- Bleeds .....OPEN
- Airspeed .....1.3 $V_S$ or 200 KIAS
- Anti-Ice .....ON or OFF

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# HOLDING - ONE ENGINE INOPERATIVE

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED: OPEN
ANTI-ICE: OFF
MINIMUM FUEL CONSUMPTION SPEED
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 35000 | 37000 |
| | IAS | KT | 179 | 174 | 171 | 169 | - | - | - | - | - |
| | TAS | KT | 178.6 | 187 | 197.8 | 211.7 | - | - | - | - | - |
| 49000 | Mach | | 0.27 | 0.288 | 0.311 | 0.339 | - | - | - | - | - |
| | N1 | % | 74.3 | 78.4 | 83.1 | 87.4 | - | - | - | - | - |
| | FF | LB/H/ENG | 1931 | 1925 | 1946 | 1995 | - | - | - | - | - |
| | FC | LB/H | 1931 | 1925 | 1946 | 1995 | - | - | - | - | - |
| | IAS | KT | 175 | 170 | 167 | 165 | 164 | - | - | - | - |
| | TAS | KT | 174.9 | 182.6 | 192.6 | 205.5 | 222.2 | - | - | - | - |
| 46000 | Mach | | 0.265 | 0.282 | 0.303 | 0.329 | 0.363 | - | - | - | - |
| | N1 | % | 72.6 | 76.4 | 81.1 | 85.6 | 90.9 | - | - | - | - |
| | FF | LB/H/ENG | 1809 | 1796 | 1807 | 1845 | 1910 | - | - | - | - |
| | FC | LB/H | 1809 | 1796 | 1807 | 1845 | 1910 | - | - | - | - |
| | IAS | KT | 173 | 168 | 164 | 161 | 161 | - | - | - | - |
| | TAS | KT | 172.3 | 179.6 | 189.1 | 201.3 | 217.1 | - | - | - | - |
| 44000 | Mach | | 0.261 | 0.277 | 0.298 | 0.323 | 0.355 | - | - | - | - |
| | N1 | % | 71.3 | 75.1 | 79.7 | 84.3 | 89 | - | - | - | - |
| | FF | LB/H/ENG | 1730 | 1711 | 1717 | 1747 | 1804 | - | - | - | - |
| | FC | LB/H | 1730 | 1711 | 1717 | 1747 | 1804 | - | - | - | - |
| | IAS | KT | 170 | 165 | 161 | 158 | 157 | - | - | - | - |
| | TAS | KT | 169.7 | 176.7 | 185.6 | 197.1 | 212.1 | - | - | - | - |
| 42000 | Mach | | 0.258 | 0.273 | 0.292 | 0.316 | 0.347 | - | - | - | - |
| | N1 | % | 70 | 73.8 | 78.2 | 82.8 | 87.3 | - | - | - | - |
| | FF | LB/H/ENG | 1653 | 1629 | 1629 | 1652 | 1700 | - | - | - | - |
| | FC | LB/H | 1653 | 1629 | 1629 | 1652 | 1700 | - | - | - | - |
| | IAS | KT | 168 | 162 | 158 | 155 | 153 | - | - | - | - |
| | TAS | KT | 167.2 | 173.7 | 182.1 | 193 | 207.1 | - | - | - | - |
| 40000 | Mach | | 0.254 | 0.269 | 0.287 | 0.31 | 0.339 | - | - | - | - |
| | N1 | % | 68.6 | 72.5 | 76.6 | 81.4 | 85.8 | - | - | - | - |
| | FF | LB/H/ENG | 1577 | 1548 | 1542 | 1559 | 1599 | - | - | - | - |
| | FC | LB/H | 1577 | 1548 | 1542 | 1559 | 1599 | - | - | - | - |
| | IAS | KT | 166 | 160 | 155 | 152 | 150 | 150 | - | - | - |
| | TAS | KT | 164.7 | 170.7 | 178.5 | 188.7 | 202 | 219.3 | - | - | - |
| 38000 | Mach | | 0.25 | 0.264 | 0.282 | 0.304 | 0.331 | 0.367 | - | - | - |
| | N1 | % | 67.3 | 71.1 | 75 | 79.8 | 84.4 | 90.1 | - | - | - |
| | FF | LB/H/ENG | 1503 | 1469 | 1457 | 1468 | 1501 | 1558 | - | - | - |
| | FC | LB/H | 1503 | 1469 | 1457 | 1468 | 1501 | 1558 | - | - | - |

**NOTE:** MACH setting and FF KG/H/ENG remain constant, regardless of the temperature change.

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# HOLDING - ONE ENGINE INOPERATIVE

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED: OPEN
ANTI-ICE: OFF
MINIMUM FUEL CONSUMPTION SPEED
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 35000 | 37000 |
| | IAS | KT | 163 | 157 | 152 | 148 | 146 | 145 | - | - | - |
| | TAS | KT | 162.2 | 167.7 | 175 | 184.6 | 197 | 213.3 | - | - | - |
| 36000 | Mach | | 0.247 | 0.26 | 0.276 | 0.297 | 0.324 | 0.357 | - | - | - |
| | N1 | % | 65.7 | 69.6 | 73.5 | 78.1 | 82.8 | 87.8 | - | - | - |
| | FF | LB/H/ENG | 1430 | 1391 | 1375 | 1379 | 1405 | 1453 | - | - | - |
| | FC | LB/H | 1430 | 1391 | 1375 | 1379 | 1405 | 1453 | - | - | - |
| | IAS | KT | 161 | 154 | 149 | 145 | 142 | 141 | - | - | - |
| | TAS | KT | 159.7 | 164.8 | 171.6 | 180.5 | 192.2 | 207.4 | - | - | - |
| 34000 | Mach | | 0.243 | 0.256 | 0.271 | 0.291 | 0.316 | 0.348 | - | - | - |
| | N1 | % | 64.2 | 68 | 71.9 | 76.3 | 81.1 | 85.6 | - | - | - |
| | FF | LB/H/ENG | 1359 | 1316 | 1294 | 1292 | 1311 | 1351 | - | - | - |
| | FC | LB/H | 1359 | 1316 | 1294 | 1292 | 1311 | 1351 | - | - | - |
| | IAS | KT | 158 | 152 | 146 | 142 | 139 | 137 | 138 | - | - |
| | TAS | KT | 157.1 | 161.9 | 168.2 | 176.5 | 187.3 | 201.5 | 220.1 | - | - |
| 32000 | Mach | | 0.24 | 0.251 | 0.266 | 0.284 | 0.308 | 0.338 | 0.377 | - | - |
| | N1 | % | 62.6 | 66.4 | 70.3 | 74.4 | 79.3 | 83.8 | 90.3 | - | - |
| | FF | LB/H/ENG | 1290 | 1242 | 1215 | 1208 | 1220 | 1252 | 1306 | - | - |
| | FC | LB/H | 1290 | 1242 | 1215 | 1208 | 1220 | 1252 | 1306 | - | - |
| | IAS | KT | 156 | 149 | 143 | 139 | 135 | 133 | 133 | - | - |
| | TAS | KT | 154.7 | 159 | 164.8 | 172.4 | 182.5 | 195.6 | 212.8 | - | - |
| 30000 | Mach | | 0.236 | 0.247 | 0.261 | 0.278 | 0.3 | 0.328 | 0.365 | - | - |
| | N1 | % | 60.9 | 64.6 | 68.6 | 72.5 | 77.3 | 82.1 | 87.6 | - | - |
| | FF | LB/H/ENG | 1223 | 1170 | 1138 | 1126 | 1131 | 1156 | 1200 | - | - |
| | FC | LB/H | 1223 | 1170 | 1138 | 1126 | 1131 | 1156 | 1200 | - | - |
| | IAS | KT | 154 | 146 | 140 | 135 | 132 | 129 | 128 | 129 | - |
| | TAS | KT | 152.3 | 156.2 | 161.4 | 168.4 | 177.6 | 189.6 | 205.6 | 226.7 | - |
| 28000 | Mach | | 0.232 | 0.243 | 0.255 | 0.271 | 0.292 | 0.318 | 0.353 | 0.397 | - |
| | N1 | % | 59.2 | 62.8 | 66.7 | 70.7 | 75.2 | 80 | 84.9 | 92.7 | - |
| | FF | LB/H/ENG | 1159 | 1101 | 1064 | 1046 | 1045 | 1063 | 1098 | 1152 | - |
| | FC | LB/H | 1159 | 1101 | 1064 | 1046 | 1045 | 1063 | 1098 | 1152 | - |
| | IAS | KT | 151 | 144 | 137 | 132 | 128 | 125 | 124 | 124 | 125 |
| | TAS | KT | 149.9 | 153.4 | 158.1 | 164.3 | 172.7 | 183.7 | 198.3 | 217.7 | 228.1 |
| 26000 | Mach | | 0.229 | 0.238 | 0.25 | 0.265 | 0.284 | 0.309 | 0.34 | 0.382 | 0.402 |
| | N1 | % | 56.2 | 60.9 | 64.7 | 68.7 | 72.9 | 77.9 | 82.5 | 89.1 | 93.5 |
| | FF | LB/H/ENG | 1048 | 1034 | 992 | 969 | 962 | 973 | 1000 | 1047 | 1072 |
| | FC | LB/H | 1048 | 1034 | 992 | 969 | 962 | 973 | 1000 | 1047 | 1072 |

**NOTE:** MACH setting and FF KG/H/ENG remain constant, regardless of the temperature change.

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# HOLDING - ONE ENGINE INOPERATIVE

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED: OPEN
ANTI-ICE: ON (WITH ICE ACCRETION)
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 35000 | 37000 |
| | IAS | KT | 200 | 200 | 200 | 200 | - | - | - | - | - |
| | TAS | KT | 200.3 | 215.3 | 231.9 | 250.4 | - | - | - | - | - |
| 49000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | - | - | - | - | - |
| | N1 | % | 74.9 | 78.9 | 83.3 | 87.6 | - | - | - | - | - |
| | FF | LB/H/ENG | 2130 | 2110 | 2118 | 2159 | - | - | - | - | - |
| | FC | LB/H | 2130 | 2110 | 2118 | 2159 | - | - | - | - | - |
| | IAS | KT | 200 | 200 | 200 | 200 | - | - | - | - | - |
| | TAS | KT | 200 | 215 | 231.6 | 250 | - | - | - | - | - |
| 46000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | - | - | - | - | - |
| | N1 | % | 73.6 | 77.3 | 81.7 | 86.2 | - | - | - | - | - |
| | FF | LB/H/ENG | 2028 | 2003 | 2003 | 2033 | - | - | - | - | - |
| | FC | LB/H | 2028 | 2003 | 2003 | 2033 | - | - | - | - | - |
| | IAS | KT | 200 | 200 | 200 | 200 | - | - | - | - | - |
| | TAS | KT | 199.8 | 214.8 | 231.4 | 249.8 | - | - | - | - | - |
| 44000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | - | - | - | - | - |
| | N1 | % | 72.6 | 76.3 | 80.7 | 85.2 | - | - | - | - | - |
| | FF | LB/H/ENG | 1963 | 1935 | 1930 | 1954 | - | - | - | - | - |
| | FC | LB/H | 1963 | 1935 | 1930 | 1954 | - | - | - | - | - |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | - | - | - | - |
| | TAS | KT | 199.6 | 214.6 | 231.1 | 249.6 | 270 | - | - | - | - |
| 42000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | 0.44 | - | - | - | - |
| | N1 | % | 71.7 | 75.3 | 79.7 | 84.1 | 88.3 | - | - | - | - |
| | FF | LB/H/ENG | 1902 | 1870 | 1861 | 1879 | 1931 | - | - | - | - |
| | FC | LB/H | 1902 | 1870 | 1861 | 1879 | 1931 | - | - | - | - |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | - | - | - | - |
| | TAS | KT | 199.4 | 214.4 | 230.9 | 249.3 | 269.8 | - | - | - | - |
| 40000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | 0.44 | - | - | - | - |
| | N1 | % | 70.8 | 74.4 | 78.6 | 83.1 | 87.3 | - | - | - | - |
| | FF | LB/H/ENG | 1843 | 1809 | 1796 | 1808 | 1852 | - | - | - | - |
| | FC | LB/H | 1843 | 1809 | 1796 | 1808 | 1852 | - | - | - | - |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | - | - | - | - |
| | TAS | KT | 199.2 | 214.2 | 230.7 | 249.1 | 269.5 | - | - | - | - |
| 38000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | 0.44 | - | - | - | - |
| | N1 | % | 69.9 | 73.5 | 77.6 | 82 | 86.3 | - | - | - | - |
| | FF | LB/H/ENG | 1788 | 1750 | 1733 | 1741 | 1778 | - | - | - | - |
| | FC | LB/H | 1788 | 1750 | 1733 | 1741 | 1778 | - | - | - | - |

**NOTE:** MACH setting and FF KG/H/ENG remain constant, regardless of the temperature change.

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# HOLDING - ONE ENGINE INOPERATIVE

## AE3007A1 AND AE3007A1P ENGINES

CRUISE CONFIGURATION
BLEED: OPEN
ANTI-ICE: ON (WITH ICE ACCRETION)
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 35000 | 37000 |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | - | - | - | - |
| | TAS | KT | 199.1 | 214 | 230.5 | 248.9 | 269.3 | - | - | - | - |
| 36000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | 0.44 | - | - | - | - |
| | N1 | % | 69 | 72.7 | 76.5 | 81 | 85.4 | - | - | - | - |
| | FF | LB/H/ENG | 1735 | 1695 | 1675 | 1677 | 1708 | - | - | - | - |
| | FC | LB/H | 1735 | 1695 | 1675 | 1677 | 1708 | - | - | - | - |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | - | - | - | - |
| | TAS | KT | 198.9 | 213.8 | 230.3 | 248.6 | 269.1 | - | - | - | - |
| 34000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | 0.44 | - | - | - | - |
| | N1 | % | 68.1 | 71.7 | 75.5 | 80.1 | 84.4 | - | - | - | - |
| | FF | LB/H/ENG | 1685 | 1643 | 1619 | 1617 | 1642 | - | - | - | - |
| | FC | LB/H | 1685 | 1643 | 1619 | 1617 | 1642 | - | - | - | - |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | - | - | - | - |
| | TAS | KT | 198.7 | 213.6 | 230.1 | 248.4 | 268.8 | - | - | - | - |
| 32000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | 0.44 | - | - | - | - |
| | N1 | % | 67.2 | 70.9 | 74.6 | 79.2 | 83.4 | - | - | - | - |
| | FF | LB/H/ENG | 1637 | 1593 | 1567 | 1561 | 1580 | - | - | - | - |
| | FC | LB/H | 1637 | 1593 | 1567 | 1561 | 1580 | - | - | - | - |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | - | - | - |
| | TAS | KT | 198.5 | 213.4 | 229.9 | 248.2 | 268.6 | 291.3 | - | - | - |
| 30000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | 0.44 | 0.487 | - | - | - |
| | N1 | % | 66.3 | 70 | 73.7 | 78.2 | 82.4 | 86.7 | - | - | - |
| | FF | LB/H/ENG | 1593 | 1546 | 1517 | 1508 | 1521 | 1564 | - | - | - |
| | FC | LB/H | 1593 | 1546 | 1517 | 1508 | 1521 | 1564 | - | - | - |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | - | - | - |
| | TAS | KT | 198.3 | 213.2 | 229.7 | 248 | 268.3 | 291.1 | - | - | - |
| 28000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | 0.44 | 0.487 | - | - | - |
| | N1 | % | 65.5 | 69.2 | 72.9 | 77.1 | 81.4 | 85.8 | - | - | - |
| | FF | LB/H/ENG | 1551 | 1503 | 1471 | 1458 | 1467 | 1503 | - | - | - |
| | FC | LB/H | 1551 | 1503 | 1471 | 1458 | 1467 | 1503 | - | - | - |
| | IAS | KT | 200 | 200 | 200 | 200 | 200 | 200 | - | - | - |
| | TAS | KT | 198.2 | 213.1 | 229.5 | 247.8 | 268.2 | 290.9 | - | - | - |
| 26000 | Mach | | 0.302 | 0.331 | 0.363 | 0.399 | 0.44 | 0.487 | - | - | - |
| | N1 | % | 62.7 | 68.4 | 72.1 | 76.1 | 80.5 | 84.8 | - | - | - |
| | FF | LB/H/ENG | 1427 | 1462 | 1428 | 1411 | 1416 | 1446 | - | - | - |
| | FC | LB/H | 1427 | 1462 | 1428 | 1411 | 1416 | 1446 | - | - | - |

**NOTE:** MACH setting and FF KG/H/ENG remain constant, regardless of the temperature change.

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# FLIGHT WITH LANDING GEAR DOWN

This section presents climb, cruise, descent and holding data for flight with all engines operating and the landing gear locked down.

This set of data may be used in the following situations:

- Dispatch of the airplane with the landing gear down. In this case, the applicable AFM supplement must be observed for takeoff, driftdown and landing performance penalties.
- On board flight planning in case of landing gear not retracting after takeoff.

## OPERATIONAL LIMITATIONS

### AIRSPEED

Maximum Operating Limit Speed ..... 250 KIAS

**NOTE:** The nose landing gear doors must be installed.

### TEMPERATURE

Minimum Operating Temperature..... -40°C (SAT)

### KINDS OF OPERATION

The ferry flight is authorized only under the following conditions:

- No icing;

- Visual (VFR)
- Instrument (IFR).

### OCCUPANTS

In ferry flight, no passengers are allowed on board.

### FLAPS

For ferry flight:
Takeoff Flaps..... 9°

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## EMERGENCY AND ABNORMAL PROCEDURES

The Emergency and Abnormal Procedures remain unchanged, except that all procedures will be performed with landing gear down.

## NORMAL PROCEDURES

The Normal Procedures remain unchanged, except that all procedures will be performed with the landing gear down and during the cruise phase the fuel quantity should be monitored throughout the flight.

## CLIMB - FLIGHT WITH LANDING GEAR DOWN

The climb planning tables show fuel consumption, distance, and time elapsed from the Sea Level to the top of climb. Data is shown for various weights, ISA deviations and cruise altitudes.
The tables are based on a fixed climb speed of 150 KIAS.

The associated conditions are:

- Thrust Mode ..... CLB
- Flaps..... UP
- Landing Gear..... DOWN
- Bleeds..... OPEN
- Anti-Ice ..... OFF
- Airspeed ..... 150 KIAS

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# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

### ALTITUDE: SEA LEVEL TO 5000 AND 6000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 5000 FT ISA + °C | | | | | 6000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 273 | 284 | 295 | 311 | 372 | 329 | 342 | 356 | 376 | 451 |
| | DISTANCE | NM | 8 | 9 | 9 | 10 | 13 | 10 | 11 | 11 | 12 | 16 |
| | TIME | MIN | 3 | 3 | 4 | 4 | 5 | 4 | 4 | 4 | 5 | 6 |
| 46000 | FUEL | LB | 231 | 239 | 249 | 261 | 307 | 278 | 288 | 300 | 314 | 371 |
| | DISTANCE | NM | 7 | 7 | 8 | 8 | 11 | 9 | 9 | 10 | 10 | 13 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 |
| 42000 | FUEL | LB | 195 | 203 | 211 | 220 | 254 | 235 | 244 | 253 | 265 | 307 |
| | DISTANCE | NM | 6 | 6 | 7 | 7 | 9 | 7 | 8 | 8 | 9 | 11 |
| | TIME | MIN | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 38000 | FUEL | LB | 166 | 172 | 179 | 187 | 212 | 199 | 207 | 215 | 224 | 256 |
| | DISTANCE | NM | 5 | 5 | 6 | 6 | 7 | 6 | 7 | 7 | 7 | 9 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 34000 | FUEL | LB | 140 | 146 | 151 | 158 | 177 | 168 | 175 | 182 | 189 | 213 |
| | DISTANCE | NM | 4 | 5 | 5 | 5 | 6 | 5 | 6 | 6 | 6 | 8 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 30000 | FUEL | LB | 118 | 123 | 127 | 133 | 148 | 142 | 147 | 153 | 159 | 177 |
| | DISTANCE | NM | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 5 | 5 | 6 |
| | TIME | MIN | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 26000 | FUEL | LB | 98 | 102 | 106 | 110 | 122 | 118 | 122 | 127 | 132 | 146 |
| | DISTANCE | NM | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 |
| | TIME | MIN | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 |

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# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

### ALTITUDE: SEA LEVEL TO 7000 AND 8000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 7000 FT ISA + °C | | | | | 8000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 387 | 402 | 418 | 441 | 532 | 445 | 462 | 481 | 508 | 616 |
| | DISTANCE | NM | 12 | 13 | 13 | 14 | 19 | 15 | 15 | 16 | 17 | 23 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 6 | 6 | 6 | 6 | 8 |
| 46000 | FUEL | LB | 325 | 338 | 351 | 368 | 437 | 374 | 388 | 403 | 423 | 504 |
| | DISTANCE | NM | 11 | 11 | 11 | 12 | 16 | 12 | 13 | 13 | 14 | 19 |
| | TIME | MIN | 4 | 4 | 4 | 5 | 6 | 5 | 5 | 5 | 5 | 7 |
| 42000 | FUEL | LB | 275 | 285 | 296 | 310 | 360 | 315 | 327 | 340 | 355 | 414 |
| | DISTANCE | NM | 9 | 9 | 10 | 10 | 13 | 10 | 11 | 11 | 12 | 16 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 6 |
| 38000 | FUEL | LB | 233 | 241 | 251 | 262 | 299 | 266 | 276 | 287 | 300 | 343 |
| | DISTANCE | NM | 7 | 8 | 8 | 9 | 11 | 9 | 9 | 9 | 10 | 13 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 5 |
| 34000 | FUEL | LB | 197 | 204 | 212 | 221 | 249 | 225 | 233 | 242 | 253 | 286 |
| | DISTANCE | NM | 6 | 7 | 7 | 7 | 9 | 7 | 8 | 8 | 8 | 11 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 30000 | FUEL | LB | 165 | 172 | 178 | 186 | 207 | 189 | 196 | 204 | 212 | 237 |
| | DISTANCE | NM | 5 | 5 | 6 | 6 | 8 | 6 | 6 | 7 | 7 | 9 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 |
| 26000 | FUEL | LB | 137 | 143 | 148 | 154 | 171 | 157 | 163 | 169 | 176 | 195 |
| | DISTANCE | NM | 4 | 5 | 5 | 5 | 6 | 5 | 5 | 5 | 6 | 7 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |

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# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

### ALTITUDE: SEA LEVEL TO 9000 AND 10000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 9000 FT ISA + °C | | | | | 10000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 504 | 524 | 545 | 576 | 702 | 565 | 587 | 611 | 646 | 791 |
| | DISTANCE | NM | 17 | 17 | 18 | 20 | 27 | 19 | 20 | 21 | 22 | 31 |
| | TIME | MIN | 7 | 7 | 7 | 7 | 10 | 7 | 8 | 8 | 8 | 11 |
| 46000 | FUEL | LB | 422 | 439 | 456 | 478 | 572 | 472 | 490 | 510 | 535 | 643 |
| | DISTANCE | NM | 14 | 15 | 15 | 16 | 22 | 16 | 17 | 18 | 19 | 25 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 6 | 7 | 7 | 9 |
| 42000 | FUEL | LB | 355 | 369 | 384 | 401 | 469 | 396 | 412 | 428 | 448 | 525 |
| | DISTANCE | NM | 12 | 12 | 13 | 14 | 18 | 14 | 14 | 15 | 16 | 21 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 5 | 5 | 6 | 7 |
| 38000 | FUEL | LB | 300 | 311 | 324 | 338 | 388 | 334 | 347 | 361 | 377 | 434 |
| | DISTANCE | NM | 10 | 10 | 11 | 11 | 15 | 11 | 12 | 12 | 13 | 17 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 5 | 5 | 6 |
| 34000 | FUEL | LB | 253 | 263 | 273 | 285 | 322 | 281 | 292 | 304 | 317 | 359 |
| | DISTANCE | NM | 8 | 9 | 9 | 10 | 12 | 10 | 10 | 10 | 11 | 14 |
| | TIME | MIN | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 5 |
| 30000 | FUEL | LB | 212 | 220 | 229 | 239 | 267 | 236 | 245 | 255 | 265 | 297 |
| | DISTANCE | NM | 7 | 7 | 8 | 8 | 10 | 8 | 8 | 9 | 9 | 12 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |
| 26000 | FUEL | LB | 176 | 183 | 190 | 198 | 220 | 196 | 203 | 211 | 220 | 244 |
| | DISTANCE | NM | 6 | 6 | 6 | 7 | 8 | 7 | 7 | 7 | 7 | 9 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

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# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

**AE3007A1 and A1P ENGINES**

## ALTITUDE: SEA LEVEL TO 11000 AND 12000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 11000 FT ISA + °C | | | | | 12000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 628 | 652 | 679 | 718 | 885 | 692 | 719 | 748 | 792 | 983 |
| | DISTANCE | NM | 22 | 23 | 24 | 25 | 35 | 25 | 26 | 27 | 29 | 40 |
| | TIME | MIN | 8 | 9 | 9 | 9 | 13 | 9 | 10 | 10 | 10 | 14 |
| 46000 | FUEL | LB | 523 | 543 | 565 | 592 | 715 | 574 | 597 | 621 | 651 | 790 |
| | DISTANCE | NM | 18 | 19 | 20 | 21 | 29 | 21 | 21 | 22 | 24 | 32 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 10 | 8 | 8 | 8 | 8 | 11 |
| 42000 | FUEL | LB | 438 | 455 | 473 | 495 | 582 | 480 | 499 | 518 | 543 | 641 |
| | DISTANCE | NM | 15 | 16 | 17 | 18 | 23 | 17 | 18 | 19 | 20 | 26 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 7 | 7 | 7 | 7 | 9 |
| 38000 | FUEL | LB | 368 | 383 | 398 | 416 | 480 | 403 | 419 | 435 | 455 | 526 |
| | DISTANCE | NM | 13 | 13 | 14 | 15 | 19 | 14 | 15 | 16 | 16 | 21 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 6 | 6 | 6 | 8 |
| 34000 | FUEL | LB | 310 | 322 | 335 | 349 | 397 | 338 | 352 | 366 | 382 | 435 |
| | DISTANCE | NM | 11 | 11 | 12 | 12 | 16 | 12 | 12 | 13 | 14 | 18 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 6 | 5 | 5 | 5 | 5 | 6 |
| 30000 | FUEL | LB | 259 | 270 | 280 | 292 | 328 | 283 | 294 | 306 | 319 | 359 |
| | DISTANCE | NM | 9 | 9 | 10 | 10 | 13 | 10 | 10 | 11 | 11 | 14 |
| | TIME | MIN | 3 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 5 |
| 26000 | FUEL | LB | 215 | 223 | 232 | 242 | 269 | 235 | 244 | 253 | 264 | 294 |
| | DISTANCE | NM | 7 | 8 | 8 | 8 | 11 | 8 | 9 | 9 | 9 | 12 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |

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# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

### ALTITUDE: SEA LEVEL TO 13000 AND 14000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 13000 FT ISA + °C | | | | | 14000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 758 | 788 | 820 | 869 | 1087 | 827 | 860 | 895 | 949 | 1198 |
| | DISTANCE | NM | 28 | 29 | 30 | 32 | 45 | 31 | 32 | 33 | 36 | 51 |
| | TIME | MIN | 10 | 11 | 11 | 11 | 16 | 11 | 12 | 12 | 13 | 18 |
| 46000 | FUEL | LB | 627 | 652 | 678 | 711 | 869 | 681 | 708 | 737 | 774 | 950 |
| | DISTANCE | NM | 23 | 24 | 25 | 26 | 36 | 25 | 27 | 28 | 29 | 41 |
| | TIME | MIN | 9 | 9 | 9 | 9 | 13 | 9 | 10 | 10 | 10 | 14 |
| 42000 | FUEL | LB | 523 | 543 | 565 | 592 | 701 | 566 | 589 | 612 | 642 | 764 |
| | DISTANCE | NM | 19 | 20 | 21 | 22 | 29 | 21 | 22 | 23 | 24 | 33 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 10 | 8 | 8 | 8 | 9 | 11 |
| 38000 | FUEL | LB | 438 | 455 | 473 | 495 | 574 | 474 | 492 | 512 | 536 | 623 |
| | DISTANCE | NM | 16 | 17 | 17 | 18 | 24 | 18 | 18 | 19 | 20 | 27 |
| | TIME | MIN | 6 | 6 | 6 | 7 | 8 | 7 | 7 | 7 | 7 | 9 |
| 34000 | FUEL | LB | 367 | 382 | 397 | 415 | 473 | 397 | 412 | 429 | 448 | 512 |
| | DISTANCE | NM | 13 | 14 | 14 | 15 | 20 | 15 | 15 | 16 | 17 | 22 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 6 | 6 | 6 | 6 | 8 |
| 30000 | FUEL | LB | 307 | 319 | 332 | 346 | 390 | 331 | 344 | 358 | 373 | 421 |
| | DISTANCE | NM | 11 | 11 | 12 | 13 | 16 | 12 | 13 | 13 | 14 | 18 |
| | TIME | MIN | 4 | 4 | 4 | 5 | 6 | 5 | 5 | 5 | 5 | 6 |
| 26000 | FUEL | LB | 254 | 264 | 274 | 286 | 319 | 274 | 285 | 296 | 308 | 344 |
| | DISTANCE | NM | 9 | 9 | 10 | 10 | 13 | 10 | 10 | 11 | 11 | 14 |
| | TIME | MIN | 3 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 5 |

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

**AE3007A1 and A1P ENGINES**

## ALTITUDE: SEA LEVEL TO 15000 AND 16000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 15000 FT ISA + °C | | | | | 16000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 899 | 935 | 973 | 1033 | 1317 | 975 | 1014 | 1054 | 1122 | 1447 |
| | DISTANCE | NM | 34 | 36 | 37 | 40 | 58 | 38 | 39 | 41 | 45 | 65 |
| | TIME | MIN | 13 | 13 | 13 | 14 | 20 | 14 | 14 | 15 | 15 | 22 |
| 46000 | FUEL | LB | 738 | 767 | 798 | 838 | 1036 | 795 | 827 | 860 | 905 | 1127 |
| | DISTANCE | NM | 28 | 29 | 31 | 33 | 46 | 31 | 32 | 34 | 36 | 51 |
| | TIME | MIN | 10 | 11 | 11 | 11 | 16 | 11 | 12 | 12 | 12 | 17 |
| 42000 | FUEL | LB | 611 | 635 | 661 | 693 | 828 | 657 | 683 | 710 | 745 | 896 |
| | DISTANCE | NM | 23 | 24 | 25 | 27 | 36 | 26 | 27 | 28 | 29 | 40 |
| | TIME | MIN | 9 | 9 | 9 | 9 | 12 | 9 | 10 | 10 | 10 | 14 |
| 38000 | FUEL | LB | 510 | 530 | 551 | 577 | 674 | 547 | 569 | 591 | 619 | 726 |
| | DISTANCE | NM | 19 | 20 | 21 | 22 | 29 | 21 | 22 | 23 | 24 | 32 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 10 | 8 | 8 | 8 | 8 | 11 |
| 34000 | FUEL | LB | 426 | 443 | 461 | 482 | 552 | 456 | 475 | 493 | 516 | 593 |
| | DISTANCE | NM | 16 | 17 | 17 | 18 | 24 | 18 | 18 | 19 | 20 | 26 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 7 | 7 | 7 | 9 |
| 30000 | FUEL | LB | 355 | 369 | 384 | 401 | 453 | 380 | 395 | 411 | 429 | 486 |
| | DISTANCE | NM | 13 | 14 | 14 | 15 | 20 | 15 | 15 | 16 | 17 | 21 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 5 | 6 | 6 | 7 |
| 26000 | FUEL | LB | 293 | 305 | 317 | 331 | 370 | 313 | 326 | 339 | 353 | 396 |
| | DISTANCE | NM | 11 | 11 | 12 | 12 | 16 | 12 | 12 | 13 | 14 | 17 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 5 | 5 | 6 |

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# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

### ALTITUDE: SEA LEVEL TO 17000 AND 18000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 17000 FT ISA + °C | | | | | 18000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 1053 | 1095 | 1139 | 1214 | 1589 | 1133 | 1178 | 1226 | 1310 | 1744 |
| | DISTANCE | NM | 42 | 44 | 46 | 49 | 74 | 46 | 48 | 50 | 55 | 83 |
| | TIME | MIN | 15 | 16 | 16 | 17 | 25 | 17 | 17 | 17 | 19 | 27 |
| 46000 | FUEL | LB | 855 | 889 | 925 | 975 | 1225 | 916 | 953 | 991 | 1046 | 1329 |
| | DISTANCE | NM | 34 | 36 | 37 | 40 | 57 | 38 | 39 | 41 | 44 | 63 |
| | TIME | MIN | 12 | 13 | 13 | 14 | 19 | 13 | 14 | 14 | 15 | 21 |
| 42000 | FUEL | LB | 704 | 732 | 761 | 799 | 967 | 751 | 781 | 813 | 855 | 1040 |
| | DISTANCE | NM | 28 | 29 | 30 | 32 | 44 | 31 | 32 | 33 | 35 | 49 |
| | TIME | MIN | 10 | 10 | 11 | 11 | 15 | 11 | 11 | 11 | 12 | 16 |
| 38000 | FUEL | LB | 584 | 608 | 632 | 662 | 779 | 622 | 647 | 673 | 706 | 835 |
| | DISTANCE | NM | 23 | 24 | 25 | 27 | 36 | 25 | 26 | 27 | 29 | 39 |
| | TIME | MIN | 8 | 9 | 9 | 9 | 12 | 9 | 9 | 9 | 10 | 13 |
| 34000 | FUEL | LB | 487 | 506 | 526 | 551 | 635 | 517 | 538 | 559 | 586 | 678 |
| | DISTANCE | NM | 19 | 20 | 21 | 22 | 29 | 21 | 22 | 23 | 24 | 32 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 10 | 8 | 8 | 8 | 8 | 10 |
| 30000 | FUEL | LB | 404 | 421 | 437 | 457 | 519 | 429 | 446 | 464 | 485 | 553 |
| | DISTANCE | NM | 16 | 16 | 17 | 18 | 23 | 17 | 18 | 19 | 20 | 26 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 6 | 7 | 7 | 9 |
| 26000 | FUEL | LB | 333 | 347 | 360 | 376 | 422 | 353 | 368 | 382 | 399 | 449 |
| | DISTANCE | NM | 13 | 13 | 14 | 15 | 19 | 14 | 15 | 15 | 16 | 21 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 6 | 5 | 5 | 5 | 6 | 7 |

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

### ALTITUDE: SEA LEVEL TO 19000 AND 20000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 19000 FT ISA + °C | | | | | 20000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 1215 | 1263 | 1314 | 1408 | 1908 | 1297 | 1349 | 1403 | 1506 | 2073 |
| | DISTANCE | NM | 51 | 53 | 55 | 60 | 94 | 55 | 58 | 60 | 66 | 104 |
| | TIME | MIN | 18 | 18 | 19 | 20 | 30 | 19 | 20 | 20 | 22 | 34 |
| 46000 | FUEL | LB | 977 | 1016 | 1057 | 1118 | 1435 | 1038 | 1080 | 1124 | 1190 | 1543 |
| | DISTANCE | NM | 41 | 43 | 44 | 48 | 70 | 44 | 46 | 48 | 52 | 77 |
| | TIME | MIN | 14 | 15 | 15 | 16 | 23 | 16 | 16 | 16 | 17 | 25 |
| 42000 | FUEL | LB | 798 | 831 | 864 | 910 | 1116 | 846 | 880 | 915 | 966 | 1191 |
| | DISTANCE | NM | 33 | 35 | 36 | 39 | 54 | 36 | 37 | 39 | 42 | 59 |
| | TIME | MIN | 12 | 12 | 12 | 13 | 18 | 13 | 13 | 13 | 14 | 19 |
| 38000 | FUEL | LB | 660 | 686 | 714 | 750 | 891 | 697 | 725 | 755 | 794 | 947 |
| | DISTANCE | NM | 27 | 28 | 30 | 32 | 43 | 29 | 31 | 32 | 34 | 46 |
| | TIME | MIN | 10 | 10 | 10 | 11 | 14 | 10 | 11 | 11 | 11 | 15 |
| 34000 | FUEL | LB | 547 | 570 | 592 | 621 | 721 | 578 | 601 | 625 | 656 | 764 |
| | DISTANCE | NM | 22 | 23 | 24 | 26 | 34 | 24 | 25 | 26 | 28 | 37 |
| | TIME | MIN | 8 | 8 | 8 | 9 | 11 | 9 | 9 | 9 | 9 | 12 |
| 30000 | FUEL | LB | 454 | 472 | 491 | 514 | 587 | 478 | 498 | 517 | 542 | 621 |
| | DISTANCE | NM | 19 | 19 | 20 | 21 | 28 | 20 | 21 | 22 | 23 | 30 |
| | TIME | MIN | 7 | 7 | 7 | 7 | 9 | 7 | 7 | 7 | 8 | 10 |
| 26000 | FUEL | LB | 373 | 388 | 404 | 422 | 476 | 393 | 409 | 425 | 445 | 502 |
| | DISTANCE | NM | 15 | 16 | 16 | 17 | 22 | 16 | 17 | 18 | 19 | 24 |
| | TIME | MIN | 5 | 6 | 6 | 6 | 7 | 6 | 6 | 6 | 6 | 8 |

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

### ALTITUDE: SEA LEVEL TO 21000 AND 22000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 21000 FT ISA + °C | | | | | 22000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| | FUEL | LB | 1382 | 1438 | 1496 | 1609 | - | 1475 | 1535 | 1596 | 1722 | - |
| 50000 | DISTANCE | NM | 60 | 63 | 65 | 72 | - | 66 | 68 | 71 | 79 | - |
| | TIME | MIN | 21 | 21 | 22 | 24 | - | 23 | 23 | 24 | 25 | - |
| | FUEL | LB | 1101 | 1146 | 1192 | 1265 | 1656 | 1168 | 1215 | 1264 | 1345 | 1781 |
| 46000 | DISTANCE | NM | 48 | 50 | 52 | 56 | 85 | 52 | 54 | 56 | 61 | 94 |
| | TIME | MIN | 17 | 17 | 17 | 18 | 27 | 18 | 18 | 19 | 20 | 29 |
| | FUEL | LB | 894 | 930 | 968 | 1022 | 1269 | 944 | 983 | 1023 | 1082 | 1352 |
| 42000 | DISTANCE | NM | 39 | 40 | 42 | 45 | 64 | 42 | 43 | 45 | 49 | 70 |
| | TIME | MIN | 13 | 14 | 14 | 15 | 21 | 14 | 15 | 15 | 16 | 22 |
| | FUEL | LB | 735 | 765 | 796 | 838 | 1004 | 775 | 806 | 839 | 884 | 1065 |
| 38000 | DISTANCE | NM | 32 | 33 | 34 | 37 | 50 | 34 | 35 | 37 | 39 | 54 |
| | TIME | MIN | 11 | 11 | 12 | 12 | 16 | 12 | 12 | 12 | 13 | 17 |
| | FUEL | LB | 608 | 633 | 658 | 691 | 808 | 639 | 666 | 692 | 728 | 854 |
| 34000 | DISTANCE | NM | 26 | 27 | 28 | 30 | 40 | 28 | 29 | 30 | 32 | 43 |
| | TIME | MIN | 9 | 9 | 9 | 10 | 13 | 10 | 10 | 10 | 11 | 14 |
| | FUEL | LB | 503 | 523 | 544 | 571 | 655 | 528 | 549 | 571 | 600 | 690 |
| 30000 | DISTANCE | NM | 21 | 22 | 23 | 25 | 32 | 23 | 24 | 25 | 26 | 35 |
| | TIME | MIN | 8 | 8 | 8 | 8 | 10 | 8 | 8 | 8 | 9 | 11 |
| | FUEL | LB | 413 | 429 | 447 | 468 | 529 | 433 | 450 | 469 | 491 | 556 |
| 26000 | DISTANCE | NM | 17 | 18 | 19 | 20 | 26 | 19 | 19 | 20 | 21 | 28 |
| | TIME | MIN | 6 | 6 | 6 | 7 | 8 | 7 | 7 | 7 | 7 | 9 |

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

**AE3007A1 and A1P ENGINES**

## ALTITUDE: SEA LEVEL TO 23000 AND 24000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 23000 FT ISA + °C | | | | | 24000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 1577 | 1641 | 1707 | 1848 | - | 1692 | 1760 | 1830 | 1994 | - |
| | DISTANCE | NM | 72 | 75 | 78 | 87 | - | 79 | 83 | 86 | 96 | - |
| | TIME | MIN | 24 | 25 | 26 | 28 | - | 27 | 27 | 28 | 30 | - |
| 46000 | FUEL | LB | 1240 | 1290 | 1342 | 1432 | 1921 | 1318 | 1372 | 1427 | 1527 | 2084 |
| | DISTANCE | NM | 56 | 59 | 61 | 67 | 104 | 62 | 64 | 67 | 73 | 116 |
| | TIME | MIN | 19 | 20 | 20 | 21 | 32 | 21 | 21 | 22 | 23 | 35 |
| 42000 | FUEL | LB | 997 | 1038 | 1080 | 1145 | 1442 | 1054 | 1097 | 1141 | 1212 | 1541 |
| | DISTANCE | NM | 45 | 47 | 49 | 53 | 76 | 49 | 51 | 53 | 57 | 84 |
| | TIME | MIN | 15 | 16 | 16 | 17 | 24 | 16 | 17 | 17 | 18 | 26 |
| 38000 | FUEL | LB | 815 | 849 | 883 | 932 | 1128 | 858 | 893 | 930 | 983 | 1195 |
| | DISTANCE | NM | 36 | 38 | 40 | 43 | 59 | 39 | 41 | 43 | 46 | 64 |
| | TIME | MIN | 12 | 13 | 13 | 14 | 19 | 13 | 14 | 14 | 15 | 20 |
| 34000 | FUEL | LB | 672 | 699 | 727 | 765 | 901 | 705 | 734 | 764 | 805 | 950 |
| | DISTANCE | NM | 30 | 31 | 32 | 35 | 47 | 32 | 33 | 35 | 37 | 50 |
| | TIME | MIN | 10 | 10 | 11 | 11 | 15 | 11 | 11 | 11 | 12 | 16 |
| 30000 | FUEL | LB | 553 | 576 | 599 | 629 | 726 | 580 | 604 | 628 | 660 | 763 |
| | DISTANCE | NM | 24 | 25 | 26 | 28 | 37 | 26 | 27 | 28 | 30 | 40 |
| | TIME | MIN | 8 | 9 | 9 | 9 | 12 | 9 | 9 | 9 | 10 | 13 |
| 26000 | FUEL | LB | 453 | 472 | 491 | 514 | 584 | 474 | 494 | 513 | 539 | 613 |
| | DISTANCE | NM | 20 | 21 | 21 | 23 | 30 | 21 | 22 | 23 | 25 | 32 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 10 | 7 | 7 | 8 | 8 | 10 |

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

### ALTITUDE: SEA LEVEL TO 25000 FT

SPEED SCHEDULE: 150 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 25000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|
| | | | -19 | -10 | 0 | 10 | 20 |
| 50000 | FUEL | LB | 1835 | 1900 | 1974 | - | - |
| | DISTANCE | NM | 89 | 92 | 96 | - | - |
| | TIME | MIN | 29 | 30 | 30 | - | - |
| 46000 | FUEL | LB | 1405 | 1463 | 1521 | 1633 | - |
| | DISTANCE | NM | 68 | 70 | 73 | 81 | - |
| | TIME | MIN | 22 | 23 | 23 | 25 | - |
| 42000 | FUEL | LB | 1115 | 1161 | 1207 | 1285 | 1650 |
| | DISTANCE | NM | 53 | 55 | 57 | 62 | 93 |
| | TIME | MIN | 18 | 18 | 18 | 20 | 28 |
| 38000 | FUEL | LB | 903 | 941 | 979 | 1036 | 1268 |
| | DISTANCE | NM | 42 | 44 | 46 | 50 | 70 |
| | TIME | MIN | 14 | 14 | 15 | 16 | 21 |
| 34000 | FUEL | LB | 740 | 770 | 801 | 845 | 1002 |
| | DISTANCE | NM | 34 | 36 | 37 | 40 | 54 |
| | TIME | MIN | 12 | 12 | 12 | 13 | 17 |
| 30000 | FUEL | LB | 607 | 632 | 658 | 692 | 802 |
| | DISTANCE | NM | 28 | 29 | 30 | 33 | 43 |
| | TIME | MIN | 9 | 10 | 10 | 10 | 13 |
| 26000 | FUEL | LB | 495 | 516 | 537 | 563 | 643 |
| | DISTANCE | NM | 23 | 24 | 25 | 26 | 34 |
| | TIME | MIN | 8 | 8 | 8 | 8 | 11 |

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

## CRUISE - FLIGHT WITH LANDING GEAR DOWN

The Long Range Cruise and Maximum Speed Cruise tables show N1, fuel flow, indicated airspeed, true airspeed, indicated Mach number, buffet margin and specific range. Data is presented for ISA conditions and various weights, with corrections for ISA deviations.

In the Long Range Cruise schedule, all engines operating, the airplane is flown at a speed corresponding to a specific range equal to 99% of the maximum specific range. The LRC schedule is used when range is the main factor considered.

In the Maximum Speed Cruise schedule, the airplane is flown in a speed resulting from maximum cruise power setting or Vmo/Mmo, whichever is lower. It is used when minimum flight time is desired.

The associated conditions are:

- Flaps..... UP
- Landing Gear..... DOWN
- Bleeds..... OPEN
- Anti-Ice ..... OFF

The associated corrections for ISA deviation are:

- Increase/decrease N1% by 1% per 5°C above/below ISA conditions.
- Increase/decrease fuel flow 1% per 5°C above/below ISA conditions.
- Increase/decrease TAS by 2 kt per 5°C above/below ISA conditions.

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# LONG RANGE CRUISE - ALL ENGINES OPERATING
# FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

## ALTITUDE: 5000 FT TO 11000 FT

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 | 11000 |
| | N1 % | 73.3 | 74.0 | 74.6 | 75.3 | 75.9 | 76.8 | 77.6 |
| | F FLOW LB/H/ENG | 1631 | 1620 | 1610 | 1600 | 1589 | 1581 | 1576 |
| | IAS KT | 199 | 198 | 198 | 197 | 196 | 195 | 195 |
| 46000 | TAS KT | 214 | 217 | 219 | 222 | 224 | 227 | 230 |
| | INDICATED MACH | 0.329 | 0.334 | 0.339 | 0.344 | 0.349 | 0.355 | 0.361 |
| | BUFFET MARGIN G | 1.88 | 1.86 | 1.85 | 1.83 | 1.81 | 1.80 | 1.79 |
| | SR NM/LB | 0.066 | 0.067 | 0.068 | 0.069 | 0.071 | 0.072 | 0.073 |
| | N1 % | 71.4 | 72.0 | 72.5 | 73.0 | 73.6 | 74.4 | 75.2 |
| | F FLOW LB/H/ENG | 1505 | 1495 | 1483 | 1469 | 1459 | 1452 | 1443 |
| | IAS KT | 193 | 192 | 191 | 190 | 190 | 189 | 189 |
| 42000 | TAS KT | 207 | 210 | 212 | 214 | 216 | 219 | 222 |
| | INDICATED MACH | 0.319 | 0.324 | 0.328 | 0.333 | 0.338 | 0.343 | 0.349 |
| | BUFFET MARGIN G | 1.92 | 1.91 | 1.89 | 1.87 | 1.85 | 1.84 | 1.82 |
| | SR NM/LB | 0.069 | 0.070 | 0.071 | 0.073 | 0.074 | 0.075 | 0.077 |
| | N1 % | 69.4 | 69.9 | 70.4 | 70.9 | 71.4 | 72.1 | 72.7 |
| | F FLOW LB/H/ENG | 1386 | 1370 | 1356 | 1344 | 1335 | 1325 | 1313 |
| | IAS KT | 186 | 185 | 184 | 184 | 183 | 182 | 181 |
| 38000 | TAS KT | 200 | 202 | 204 | 206 | 208 | 211 | 213 |
| | INDICATED MACH | 0.308 | 0.312 | 0.316 | 0.321 | 0.326 | 0.331 | 0.336 |
| | BUFFET MARGIN G | 1.98 | 1.95 | 1.93 | 1.91 | 1.90 | 1.88 | 1.86 |
| | SR NM/LB | 0.072 | 0.074 | 0.075 | 0.077 | 0.078 | 0.080 | 0.081 |
| | N1 % | 66.8 | 67.4 | 68.0 | 68.7 | 69.3 | 69.8 | 70.3 |
| | F FLOW LB/H/ENG | 1264 | 1249 | 1236 | 1224 | 1214 | 1200 | 1189 |
| | IAS KT | 179 | 178 | 177 | 177 | 176 | 175 | 174 |
| 34000 | TAS KT | 192 | 193 | 195 | 198 | 200 | 202 | 204 |
| | INDICATED MACH | 0.296 | 0.300 | 0.304 | 0.309 | 0.314 | 0.318 | 0.322 |
| | BUFFET MARGIN G | 2.04 | 2.01 | 1.99 | 1.98 | 1.96 | 1.93 | 1.91 |
| | SR NM/LB | 0.076 | 0.077 | 0.079 | 0.081 | 0.082 | 0.084 | 0.086 |
| | N1 % | 64.0 | 64.6 | 65.2 | 65.9 | 66.5 | 67.1 | 67.8 |
| | F FLOW LB/H/ENG | 1146 | 1133 | 1120 | 1107 | 1094 | 1080 | 1069 |
| | IAS KT | 171 | 171 | 170 | 169 | 168 | 167 | 166 |
| 30000 | TAS KT | 183 | 185 | 187 | 189 | 191 | 193 | 195 |
| | INDICATED MACH | 0.283 | 0.287 | 0.291 | 0.296 | 0.300 | 0.303 | 0.308 |
| | BUFFET MARGIN G | 2.11 | 2.09 | 2.07 | 2.05 | 2.02 | 2.00 | 1.98 |
| | SR NM/LB | 0.080 | 0.082 | 0.083 | 0.085 | 0.087 | 0.089 | 0.091 |
| | N1 % | 60.8 | 61.5 | 62.1 | 62.6 | 63.2 | 63.9 | 64.6 |
| | F FLOW LB/H/ENG | 1034 | 1022 | 1007 | 991 | 977 | 965 | 955 |
| | IAS KT | 163 | 163 | 162 | 160 | 160 | 159 | 158 |
| 26000 | TAS KT | 174 | 176 | 178 | 179 | 181 | 183 | 185 |
| | INDICATED MACH | 0.270 | 0.274 | 0.278 | 0.281 | 0.284 | 0.288 | 0.293 |
| | BUFFET MARGIN G | 2.21 | 2.19 | 2.16 | 2.13 | 2.10 | 2.08 | 2.06 |
| | SR NM/LB | 0.084 | 0.086 | 0.088 | 0.090 | 0.093 | 0.095 | 0.097 |

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# LONG RANGE CRUISE - ALL ENGINES OPERATING
# FLIGHT WITH LANDING GEAR DOWN

**AE3007A1 and A1P ENGINES**

**ALTITUDE: 12000 FT TO 18000 FT**

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 46000 | N1 | % | 78.4 | 79.2 | 80.1 | 80.8 | 81.5 | 82.2 | 82.9 |
| | F FLOW | LB/H/ENG | 1566 | 1560 | 1557 | 1550 | 1549 | 1547 | 1544 |
| | IAS | KT | 194 | 193 | 193 | 192 | 192 | 191 | 190 |
| | TAS | KT | 232 | 235 | 238 | 241 | 244 | 247 | 250 |
| | INDICATED MACH | | 0.366 | 0.371 | 0.378 | 0.384 | 0.390 | 0.397 | 0.403 |
| | BUFFET MARGIN | G | 1.77 | 1.76 | 1.75 | 1.73 | 1.72 | 1.71 | 1.69 |
| | SR | NM/LB | 0.074 | 0.075 | 0.076 | 0.078 | 0.079 | 0.080 | 0.081 |
| 42000 | N1 | % | 75.9 | 76.7 | 77.6 | 78.3 | 79.2 | 80.0 | 80.7 |
| | F FLOW | LB/H/ENG | 1432 | 1427 | 1422 | 1413 | 1409 | 1407 | 1403 |
| | IAS | KT | 188 | 187 | 187 | 186 | 185 | 185 | 184 |
| | TAS | KT | 224 | 227 | 230 | 232 | 235 | 238 | 241 |
| | INDICATED MACH | | 0.354 | 0.359 | 0.366 | 0.371 | 0.377 | 0.384 | 0.390 |
| | BUFFET MARGIN | G | 1.80 | 1.79 | 1.78 | 1.76 | 1.75 | 1.74 | 1.72 |
| | SR | NM/LB | 0.078 | 0.079 | 0.081 | 0.082 | 0.083 | 0.085 | 0.086 |
| 38000 | N1 | % | 73.3 | 74.1 | 74.8 | 75.6 | 76.4 | 77.3 | 78.1 |
| | F FLOW | LB/H/ENG | 1303 | 1298 | 1288 | 1280 | 1274 | 1271 | 1265 |
| | IAS | KT | 181 | 180 | 179 | 179 | 178 | 178 | 177 |
| | TAS | KT | 215 | 218 | 220 | 223 | 226 | 229 | 232 |
| | INDICATED MACH | | 0.341 | 0.347 | 0.352 | 0.357 | 0.363 | 0.369 | 0.375 |
| | BUFFET MARGIN | G | 1.84 | 1.83 | 1.81 | 1.79 | 1.78 | 1.77 | 1.76 |
| | SR | NM/LB | 0.083 | 0.084 | 0.086 | 0.087 | 0.089 | 0.090 | 0.092 |
| 34000 | N1 | % | 70.8 | 71.5 | 72.0 | 72.8 | 73.5 | 74.3 | 75.1 |
| | F FLOW | LB/H/ENG | 1180 | 1172 | 1161 | 1153 | 1145 | 1139 | 1132 |
| | IAS | KT | 174 | 173 | 172 | 171 | 171 | 170 | 169 |
| | TAS | KT | 206 | 209 | 211 | 214 | 216 | 219 | 221 |
| | INDICATED MACH | | 0.327 | 0.333 | 0.337 | 0.343 | 0.348 | 0.354 | 0.359 |
| | BUFFET MARGIN | G | 1.90 | 1.88 | 1.86 | 1.84 | 1.82 | 1.81 | 1.79 |
| | SR | NM/LB | 0.087 | 0.089 | 0.091 | 0.093 | 0.094 | 0.096 | 0.098 |
| 30000 | N1 | % | 68.4 | 68.9 | 69.4 | 70.0 | 70.5 | 71.2 | 71.9 |
| | F FLOW | LB/H/ENG | 1061 | 1049 | 1038 | 1031 | 1021 | 1013 | 1005 |
| | IAS | KT | 166 | 165 | 164 | 164 | 163 | 162 | 161 |
| | TAS | KT | 197 | 199 | 201 | 204 | 206 | 208 | 211 |
| | INDICATED MACH | | 0.313 | 0.318 | 0.322 | 0.327 | 0.332 | 0.337 | 0.343 |
| | BUFFET MARGIN | G | 1.97 | 1.94 | 1.92 | 1.90 | 1.88 | 1.86 | 1.84 |
| | SR | NM/LB | 0.093 | 0.095 | 0.097 | 0.099 | 0.101 | 0.103 | 0.105 |
| 26000 | N1 | % | 65.3 | 65.9 | 66.5 | 67.2 | 67.7 | 68.2 | 68.7 |
| | F FLOW | LB/H/ENG | 943 | 931 | 920 | 913 | 901 | 892 | 884 |
| | IAS | KT | 157 | 156 | 156 | 155 | 154 | 153 | 153 |
| | TAS | KT | 187 | 189 | 191 | 193 | 195 | 197 | 200 |
| | INDICATED MACH | | 0.297 | 0.301 | 0.305 | 0.311 | 0.315 | 0.320 | 0.325 |
| | BUFFET MARGIN | G | 2.04 | 2.01 | 1.99 | 1.98 | 1.95 | 1.93 | 1.91 |
| | SR | NM/LB | 0.099 | 0.101 | 0.104 | 0.106 | 0.108 | 0.111 | 0.113 |

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# LONG RANGE CRUISE - ALL ENGINES OPERATING
# FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

## ALTITUDE: 19000 FT TO 25000 FT

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 |
| 46000 | N1 % | 83.7 | 84.6 | 85.5 | 86.1 | 86.9 | 87.7 | 89.0 |
| | F FLOW LB/H/ENG | 1543 | 1544 | 1549 | 1549 | 1555 | 1555 | 1563 |
| | IAS KT | 190 | 189 | 189 | 188 | 188 | 187 | 187 |
| | TAS KT | 253 | 257 | 260 | 264 | 268 | 271 | 276 |
| | INDICATED MACH | 0.410 | 0.417 | 0.425 | 0.432 | 0.441 | 0.448 | 0.458 |
| | BUFFET MARGIN G | 1.67 | 1.66 | 1.65 | 1.63 | 1.62 | 1.60 | 1.59 |
| | SR NM/LB | 0.082 | 0.083 | 0.084 | 0.085 | 0.086 | 0.087 | 0.088 |
| 42000 | N1 % | 81.4 | 82.1 | 83.0 | 83.8 | 84.6 | 85.3 | 86.1 |
| | F FLOW LB/H/ENG | 1398 | 1397 | 1400 | 1398 | 1401 | 1403 | 1405 |
| | IAS KT | 183 | 183 | 182 | 182 | 181 | 181 | 180 |
| | TAS KT | 244 | 247 | 251 | 254 | 258 | 261 | 265 |
| | INDICATED MACH | 0.396 | 0.403 | 0.411 | 0.417 | 0.425 | 0.433 | 0.440 |
| | BUFFET MARGIN G | 1.70 | 1.69 | 1.68 | 1.66 | 1.65 | 1.63 | 1.62 |
| | SR NM/LB | 0.087 | 0.088 | 0.090 | 0.091 | 0.092 | 0.093 | 0.094 |
| 38000 | N1 % | 78.9 | 79.7 | 80.4 | 81.1 | 81.9 | 82.8 | 83.6 |
| | F FLOW LB/H/ENG | 1260 | 1257 | 1257 | 1254 | 1253 | 1253 | 1254 |
| | IAS KT | 176 | 176 | 175 | 175 | 174 | 173 | 173 |
| | TAS KT | 234 | 237 | 241 | 244 | 247 | 250 | 254 |
| | INDICATED MACH | 0.381 | 0.388 | 0.395 | 0.402 | 0.408 | 0.416 | 0.423 |
| | BUFFET MARGIN G | 1.74 | 1.72 | 1.72 | 1.70 | 1.68 | 1.67 | 1.65 |
| | SR NM/LB | 0.093 | 0.094 | 0.096 | 0.097 | 0.099 | 0.100 | 0.101 |
| 34000 | N1 % | 75.9 | 76.8 | 77.6 | 78.4 | 79.2 | 79.9 | 80.6 |
| | F FLOW LB/H/ENG | 1126 | 1122 | 1119 | 1115 | 1112 | 1112 | 1109 |
| | IAS KT | 169 | 168 | 168 | 167 | 166 | 166 | 165 |
| | TAS KT | 224 | 227 | 230 | 233 | 236 | 240 | 243 |
| | INDICATED MACH | 0.365 | 0.371 | 0.378 | 0.384 | 0.391 | 0.398 | 0.405 |
| | BUFFET MARGIN G | 1.78 | 1.76 | 1.75 | 1.74 | 1.72 | 1.71 | 1.69 |
| | SR NM/LB | 0.099 | 0.101 | 0.103 | 0.104 | 0.106 | 0.108 | 0.109 |
| 30000 | N1 % | 72.6 | 73.4 | 74.3 | 75.1 | 76.0 | 76.8 | 77.6 |
| | F FLOW LB/H/ENG | 999 | 994 | 988 | 983 | 978 | 975 | 971 |
| | IAS KT | 161 | 160 | 159 | 159 | 158 | 158 | 157 |
| | TAS KT | 213 | 216 | 219 | 222 | 224 | 228 | 230 |
| | INDICATED MACH | 0.348 | 0.354 | 0.36 | 0.366 | 0.372 | 0.379 | 0.385 |
| | BUFFET MARGIN G | 1.82 | 1.81 | 1.79 | 1.78 | 1.76 | 1.75 | 1.73 |
| | SR NM/LB | 0.107 | 0.109 | 0.111 | 0.113 | 0.115 | 0.117 | 0.119 |
| 26000 | N1 % | 69.4 | 70.0 | 70.7 | 71.4 | 72.2 | 73.0 | 73.9 |
| | F FLOW LB/H/ENG | 878 | 870 | 863 | 857 | 851 | 846 | 841 |
| | IAS KT | 152 | 152 | 151 | 150 | 150 | 149 | 148 |
| | TAS KT | 202 | 205 | 207 | 210 | 212 | 215 | 218 |
| | INDICATED MACH | 0.330 | 0.335 | 0.341 | 0.346 | 0.352 | 0.358 | 0.364 |
| | BUFFET MARGIN G | 1.89 | 1.87 | 1.85 | 1.83 | 1.81 | 1.80 | 1.78 |
| | SR NM/LB | 0.115 | 0.118 | 0.120 | 0.122 | 0.125 | 0.127 | 0.129 |

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING
# FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

## ALTITUDE: 5000 FT TO 11000 FT

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 | 11000 |
| | N1 | % | 79.5 | 80.0 | 80.5 | 81.0 | 81.4 | 81.8 | 82.1 |
| | F FLOW | LB/H/ENG | 2029 | 1999 | 1972 | 1945 | 1916 | 1888 | 1858 |
| | IAS | KT | 228 | 225 | 223 | 221 | 219 | 217 | 214 |
| 50000 | TAS | KT | 245 | 246 | 247 | 249 | 250 | 251 | 252 |
| | INDICATED | MACH | 0.377 | 0.379 | 0.383 | 0.387 | 0.389 | 0.393 | 0.395 |
| | BUFFET MARGIN | G | 2.26 | 2.21 | 2.17 | 2.13 | 2.07 | 2.04 | 1.98 |
| | SR | NM/LB | 0.060 | 0.061 | 0.063 | 0.064 | 0.065 | 0.067 | 0.068 |
| | N1 | % | 79.2 | 79.6 | 80.2 | 80.7 | 81.2 | 81.6 | 82 |
| | F FLOW | LB/H/ENG | 2022 | 1991 | 1966 | 1940 | 1915 | 1883 | 1853 |
| | IAS | KT | 231 | 228 | 227 | 225 | 223 | 220 | 218 |
| 46000 | TAS | KT | 249 | 249 | 252 | 253 | 255 | 255 | 257 |
| | INDICATED | MACH | 0.382 | 0.384 | 0.390 | 0.393 | 0.397 | 0.399 | 0.403 |
| | BUFFET MARGIN | G | 2.54 | 2.47 | 2.44 | 2.40 | 2.35 | 2.28 | 2.24 |
| | SR | NM/LB | 0.062 | 0.063 | 0.064 | 0.065 | 0.067 | 0.068 | 0.069 |
| | N1 | % | 79.1 | 79.6 | 80.1 | 80.6 | 81.2 | 81.6 | 82.0 |
| | F FLOW | LB/H/ENG | 2024 | 1993 | 1968 | 1942 | 1917 | 1885 | 1856 |
| | IAS | KT | 235 | 233 | 231 | 229 | 227 | 225 | 223 |
| 42000 | TAS | KT | 253 | 254 | 256 | 257 | 259 | 260 | 262 |
| | INDICATED | MACH | 0.389 | 0.393 | 0.396 | 0.400 | 0.404 | 0.408 | 0.412 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.55 |
| | SR | NM/LB | 0.062 | 0.064 | 0.065 | 0.066 | 0.068 | 0.069 | 0.071 |
| | N1 | % | 79.1 | 79.6 | 80.1 | 80.6 | 81.1 | 81.6 | 82.0 |
| | F FLOW | LB/H/ENG | 2025 | 1994 | 1970 | 1944 | 1919 | 1887 | 1859 |
| | IAS | KT | 238 | 236 | 235 | 233 | 231 | 229 | 227 |
| 38000 | TAS | KT | 255 | 257 | 260 | 261 | 263 | 264 | 266 |
| | INDICATED | MACH | 0.394 | 0.397 | 0.403 | 0.407 | 0.411 | 0.415 | 0.419 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.063 | 0.064 | 0.066 | 0.067 | 0.068 | 0.070 | 0.072 |
| | N1 | % | 79.1 | 79.6 | 80.1 | 80.6 | 81.1 | 81.5 | 82.0 |
| | F FLOW | LB/H/ENG | 2026 | 1996 | 1971 | 1946 | 1921 | 1889 | 1861 |
| | IAS | KT | 242 | 240 | 238 | 237 | 235 | 233 | 231 |
| 34000 | TAS | KT | 259 | 260 | 262 | 265 | 267 | 268 | 270 |
| | INDICATED | MACH | 0.400 | 0.404 | 0.408 | 0.414 | 0.418 | 0.422 | 0.426 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.064 | 0.065 | 0.066 | 0.068 | 0.069 | 0.071 | 0.073 |

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

## ALTITUDE: 5000 FT TO 11000 FT

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 | 11000 |
| 30000 | N1 | % | 79.1 | 79.5 | 80.1 | 80.6 | 81.1 | 81.5 | 81.9 |
| | F FLOW | LB/H/ENG | 2027 | 1997 | 1973 | 1947 | 1923 | 1892 | 1864 |
| | IAS | KT | 245 | 243 | 242 | 240 | 239 | 237 | 235 |
| | TAS | KT | 261 | 263 | 266 | 267 | 270 | 272 | 274 |
| | INDICATED | MACH | 0.405 | 0.409 | 0.415 | 0.419 | 0.425 | 0.429 | 0.433 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.064 | 0.066 | 0.067 | 0.069 | 0.070 | 0.072 | 0.073 |
| 26000 | N1 | % | 79.1 | 79.5 | 80.0 | 80.6 | 81.1 | 81.5 | 81.9 |
| | F FLOW | LB/H/ENG | 2028 | 1998 | 1974 | 1948 | 1924 | 1893 | 1866 |
| | IAS | KT | 248 | 246 | 245 | 243 | 242 | 240 | 238 |
| | TAS | KT | 264 | 266 | 268 | 270 | 273 | 275 | 277 |
| | INDICATED | MACH | 0.410 | 0.414 | 0.420 | 0.424 | 0.430 | 0.434 | 0.439 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.065 | 0.066 | 0.068 | 0.069 | 0.071 | 0.073 | 0.074 |

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING
# FLIGHT WITH LANDING GEAR DOWN

**AE3007A1 and A1P ENGINES**

**ALTITUDE: 12000 FT TO 18000 FT**

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| | N1 % | 82.5 | 82.9 | 83.2 | 83.9 | 84.5 | 85.3 | 86.0 |
| | F FLOW LB/H/ENG | 1829 | 1796 | 1763 | 1754 | 1746 | 1745 | 1747 |
| | IAS KT | 211 | 208 | 206 | 204 | 203 | 202 | 201 |
| 50000 | TAS KT | 252 | 253 | 253 | 255 | 258 | 261 | 264 |
| | INDICATED MACH | 0.398 | 0.400 | 0.402 | 0.406 | 0.413 | 0.419 | 0.426 |
| | BUFFET MARGIN G | 1.93 | 1.87 | 1.82 | 1.79 | 1.77 | 1.75 | 1.73 |
| | SR NM/LB | 0.069 | 0.070 | 0.072 | 0.073 | 0.074 | 0.075 | 0.076 |
| | N1 % | 82.4 | 82.7 | 83.0 | 83.3 | 84.2 | 85.2 | 85.9 |
| | F FLOW LB/H/ENG | 1825 | 1792 | 1758 | 1728 | 1745 | 1755 | 1746 |
| | IAS KT | 216 | 213 | 210 | 208 | 209 | 209 | 208 |
| 46000 | TAS KT | 258 | 259 | 259 | 260 | 265 | 269 | 272 |
| | INDICATED MACH | 0.407 | 0.409 | 0.411 | 0.415 | 0.425 | 0.433 | 0.439 |
| | BUFFET MARGIN G | 2.19 | 2.13 | 2.06 | 2.02 | 2.03 | 2.02 | 1.99 |
| | SR NM/LB | 0.071 | 0.072 | 0.074 | 0.075 | 0.076 | 0.077 | 0.078 |
| | N1 % | 82.4 | 82.7 | 83 | 83.3 | 84.2 | 85.2 | 85.9 |
| | F FLOW LB/H/ENG | 1828 | 1795 | 1761 | 1731 | 1748 | 1759 | 1751 |
| | IAS KT | 221 | 218 | 216 | 213 | 214 | 215 | 214 |
| 42000 | TAS KT | 264 | 264 | 266 | 266 | 271 | 277 | 279 |
| | INDICATED MACH | 0.416 | 0.418 | 0.422 | 0.424 | 0.434 | 0.445 | 0.451 |
| | BUFFET MARGIN G | 2.50 | 2.42 | 2.37 | 2.30 | 2.31 | 2.32 | 2.28 |
| | SR NM/LB | 0.072 | 0.074 | 0.075 | 0.077 | 0.078 | 0.079 | 0.080 |
| | N1 % | 82.4 | 82.7 | 83.0 | 83.3 | 84.2 | 85.2 | 85.9 |
| | F FLOW LB/H/ENG | 1830 | 1798 | 1764 | 1735 | 1752 | 1763 | 1755 |
| | IAS KT | 225 | 223 | 220 | 218 | 219 | 220 | 219 |
| 38000 | TAS KT | 268 | 269 | 270 | 271 | 277 | 282 | 285 |
| | INDICATED MACH | 0.423 | 0.427 | 0.430 | 0.434 | 0.444 | 0.455 | 0.461 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.073 | 0.075 | 0.076 | 0.078 | 0.079 | 0.080 | 0.081 |
| | N1 % | 82.4 | 82.7 | 83.0 | 83.3 | 84.2 | 85.1 | 85.9 |
| | F FLOW LB/H/ENG | 1833 | 1801 | 1767 | 1737 | 1756 | 1766 | 1758 |
| | IAS KT | 229 | 227 | 225 | 222 | 224 | 223 | 222 |
| 34000 | TAS KT | 272 | 273 | 275 | 275 | 282 | 286 | 290 |
| | INDICATED MACH | 0.430 | 0.435 | 0.439 | 0.442 | 0.454 | 0.463 | 0.469 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.074 | 0.076 | 0.078 | 0.079 | 0.080 | 0.081 | 0.082 |

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

## ALTITUDE: 12000 FT TO 18000 FT

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 30000 | N1 | % | 82.4 | 82.7 | 83.0 | 83.3 | 84.2 | 85.1 | 85.8 |
| | F FLOW | LB/H/ENG | 1836 | 1803 | 1769 | 1739 | 1758 | 1770 | 1761 |
| | IAS | KT | 233 | 231 | 228 | 226 | 226 | 227 | 226 |
| | TAS | KT | 276 | 277 | 278 | 280 | 285 | 291 | 294 |
| | INDICATED | MACH | 0.438 | 0.442 | 0.445 | 0.449 | 0.460 | 0.471 | 0.478 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.075 | 0.077 | 0.079 | 0.080 | 0.081 | 0.082 | 0.083 |
| 26000 | N1 | % | 82.4 | 82.7 | 83.0 | 83.3 | 84.2 | 85.1 | 85.8 |
| | F FLOW | LB/H/ENG | 1838 | 1805 | 1771 | 1742 | 1761 | 1773 | 1765 |
| | IAS | KT | 236 | 234 | 232 | 230 | 231 | 231 | 230 |
| | TAS | KT | 278 | 280 | 282 | 284 | 289 | 295 | 298 |
| | INDICATED | MACH | 0.443 | 0.448 | 0.452 | 0.457 | 0.468 | 0.479 | 0.486 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.076 | 0.078 | 0.080 | 0.081 | 0.082 | 0.083 | 0.085 |

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING
# FLIGHT WITH LANDING GEAR DOWN

## AE3007A1 and A1P ENGINES

## ALTITUDE: 19000 FT TO 25000 FT

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 |
| 46000 | N1 % | 86.4 | 86.9 | 87.3 | 87.7 | 88.1 | 88.7 | 89.4 |
| | F FLOW LB/H/ENG | 1729 | 1719 | 1697 | 1669 | 1636 | 1615 | 1584 |
| | IAS KT | 205 | 204 | 202 | 199 | 195 | 192 | 189 |
| | TAS KT | 274 | 277 | 278 | 278 | 277 | 278 | 278 |
| | INDICATED MACH | 0.443 | 0.45 | 0.454 | 0.456 | 0.456 | 0.46 | 0.462 |
| | BUFFET MARGIN G | 1.94 | 1.91 | 1.86 | 1.80 | 1.72 | 1.68 | 1.62 |
| | SR NM/LB | 0.079 | 0.080 | 0.082 | 0.083 | 0.085 | 0.086 | 0.088 |
| 42000 | N1 % | 86.4 | 86.9 | 87.3 | 87.7 | 88.0 | 88.7 | 89.3 |
| | F FLOW LB/H/ENG | 1733 | 1724 | 1701 | 1674 | 1642 | 1622 | 1592 |
| | IAS KT | 211 | 210 | 208 | 205 | 202 | 200 | 196 |
| | TAS KT | 281 | 284 | 286 | 286 | 286 | 288 | 288 |
| | INDICATED MACH | 0.456 | 0.462 | 0.467 | 0.469 | 0.472 | 0.476 | 0.479 |
| | BUFFET MARGIN G | 2.23 | 2.19 | 2.14 | 2.07 | 2.00 | 1.95 | 1.88 |
| | SR NM/LB | 0.081 | 0.082 | 0.084 | 0.085 | 0.087 | 0.089 | 0.090 |
| 38000 | N1 % | 86.4 | 86.9 | 87.3 | 87.6 | 88.0 | 88.6 | 89.2 |
| | F FLOW LB/H/ENG | 1737 | 1727 | 1705 | 1678 | 1647 | 1628 | 1599 |
| | IAS KT | 216 | 215 | 213 | 211 | 208 | 206 | 203 |
| | TAS KT | 287 | 290 | 292 | 294 | 294 | 296 | 297 |
| | INDICATED MACH | 0.466 | 0.473 | 0.478 | 0.483 | 0.485 | 0.490 | 0.495 |
| | BUFFET MARGIN G | 2.56 | 2.51 | 2.45 | 2.39 | 2.31 | 2.25 | 2.19 |
| | SR NM/LB | 0.083 | 0.084 | 0.086 | 0.087 | 0.089 | 0.091 | 0.093 |
| 34000 | N1 % | 86.4 | 86.9 | 87.2 | 87.6 | 87.9 | 88.5 | 89.1 |
| | F FLOW LB/H/ENG | 1741 | 1731 | 1708 | 1682 | 1651 | 1633 | 1605 |
| | IAS KT | 221 | 220 | 218 | 216 | 213 | 211 | 208 |
| | TAS KT | 293 | 296 | 298 | 300 | 300 | 303 | 304 |
| | INDICATED MACH | 0.476 | 0.484 | 0.489 | 0.494 | 0.496 | 0.504 | 0.507 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.54 |
| | SR NM/LB | 0.084 | 0.085 | 0.087 | 0.089 | 0.091 | 0.093 | 0.095 |
| 30000 | N1 % | 86.4 | 86.9 | 87.2 | 87.6 | 87.9 | 88.5 | 89.0 |
| | F FLOW LB/H/ENG | 1744 | 1734 | 1711 | 1685 | 1655 | 1637 | 1610 |
| | IAS KT | 225 | 224 | 222 | 220 | 218 | 215 | 213 |
| | TAS KT | 297 | 300 | 302 | 304 | 306 | 308 | 310 |
| | INDICATED MACH | 0.485 | 0.492 | 0.497 | 0.502 | 0.508 | 0.513 | 0.518 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.085 | 0.087 | 0.088 | 0.090 | 0.093 | 0.094 | 0.096 |
| 26000 | N1 % | 86.3 | 86.9 | 87.2 | 87.5 | 87.8 | 88.4 | 89.0 |
| | F FLOW LB/H/ENG | 1746 | 1737 | 1714 | 1688 | 1658 | 1641 | 1614 |
| | IAS KT | 228 | 228 | 226 | 224 | 222 | 219 | 217 |
| | TAS KT | 300 | 305 | 307 | 309 | 311 | 313 | 315 |
| | INDICATED MACH | 0.491 | 0.501 | 0.506 | 0.511 | 0.517 | 0.522 | 0.528 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.086 | 0.088 | 0.090 | 0.092 | 0.094 | 0.095 | 0.098 |

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## DESCENT - FLIGHT WITH LANDING GEAR DOWN

The descent table shows fuel consumption, distance and time from the top of descent to sea level for various cruise altitudes. The data is calculated based on flight idle thrust and a fixed airspeed of 240 KIAS.

The associated conditions are:

- Flaps.....UP
- Landing Gear.....DOWN
- Bleeds.....OPEN
- Anti-Ice .....OFF
- Airspeed .....240 KIAS

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# DESCENT - ALL ENGINES OPERATING
# FLIGHT WITH LANDING GEAR DOWN

**AE3007A1 and A1P ENGINES**

BLEED: OPEN
AIRSPEED: 240 KIAS
ISA CONDITIONS

| WEIGHT (LB) | | | TOP OF DESCENT (FT) | | | | |
|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 15000 | 20000 | 25000 |
| | FUEL | LB | 21 | 42 | 60 | 76 | 90 |
| 46000 | DISTANCE | NM | 6 | 11 | 17 | 23 | 30 |
| | TIME | MIN | 1 | 3 | 4 | 5 | 6 |
| | FUEL | LB | 20 | 39 | 56 | 72 | 85 |
| 42000 | DISTANCE | NM | 5 | 11 | 16 | 22 | 28 |
| | TIME | MIN | 1 | 3 | 4 | 5 | 6 |
| | FUEL | LB | 19 | 37 | 53 | 67 | 79 |
| 38000 | DISTANCE | NM | 5 | 10 | 15 | 21 | 26 |
| | TIME | MIN | 1 | 2 | 3 | 4 | 5 |
| | FUEL | LB | 18 | 34 | 48 | 62 | 73 |
| 34000 | DISTANCE | NM | 4 | 9 | 14 | 19 | 24 |
| | TIME | MIN | 1 | 2 | 3 | 4 | 5 |
| | FUEL | LB | 16 | 31 | 44 | 56 | 66 |
| 30000 | DISTANCE | NM | 4 | 8 | 13 | 17 | 22 |
| | TIME | MIN | 1 | 2 | 3 | 4 | 5 |
| | FUEL | LB | 14 | 27 | 39 | 50 | 59 |
| 26000 | DISTANCE | NM | 4 | 7 | 11 | 15 | 19 |
| | TIME | MIN | 1 | 2 | 3 | 3 | 4 |

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## HOLDING - FLIGHT WITH LANDING GEAR DOWN

The holding tables show indicated airspeed, Mach number, N1, fuel flow and fuel consumption for various weights and altitudes. Data is presented for ISA condition and all engines operating.

The associated conditions are:

- Flaps.....UP
- Landing Gear.....DOWN
- Bleeds.....OPEN
- Airspeed .....1.3 $V_S$
- Anti-Ice .....OFF

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# HOLDING - ALL ENGINES OPERATING
# FLIGHT WITH LANDING GEAR DOWN

**AE3007A1 and A1P ENGINES**

BLEED: OPEN
ANTI ICE: OFF
MINIMUM FUEL CONSUMPTION SPEED
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1500 | 5000 | 10000 | 15000 | 20000 | 25000 |
| | IAS | KT | 175 | 174 | 170 | 167 | 165 | 164 | 166 |
| | TAS | KT | 175.1 | 177.2 | 182.8 | 192.8 | 205.8 | 222.4 | 244.0 |
| 46000 | MACH | | 0.265 | 0.270 | 0.282 | 0.303 | 0.329 | 0.363 | 0.406 |
| | N1 | % | 66.4 | 67.3 | 69.6 | 72.6 | 76.8 | 81.3 | 85.8 |
| | FF | LB/H/ENG | 1435 | 1412 | 1367 | 1323 | 1304 | 1312 | 1348 |
| | FC | LB/H | 2870 | 2824 | 2734 | 2646 | 2608 | 2623 | 2695 |
| | IAS | KT | 170 | 169 | 165 | 161 | 158 | 157 | 158 |
| | TAS | KT | 170.0 | 171.8 | 176.9 | 185.8 | 197.4 | 212.4 | 231.9 |
| 42000 | MACH | | 0.258 | 0.262 | 0.273 | 0.292 | 0.316 | 0.347 | 0.387 |
| | N1 | % | 64.2 | 65.1 | 67.3 | 70.4 | 74.1 | 78.7 | 83.4 |
| | FF | LB/H/ENG | 1336 | 1312 | 1263 | 1212 | 1184 | 1180 | 1203 |
| | FC | LB/H | 2673 | 2624 | 2526 | 2424 | 2368 | 2359 | 2406 |
| | IAS | KT | 166 | 164 | 160 | 155 | 152 | 150 | 150 |
| | TAS | KT | 164.9 | 166.6 | 171.0 | 178.9 | 189.0 | 202.3 | 219.6 |
| 38000 | MACH | | 0.250 | 0.254 | 0.264 | 0.282 | 0.304 | 0.331 | 0.367 |
| | N1 | % | 61.9 | 62.8 | 64.9 | 68.3 | 71.4 | 75.8 | 80.3 |
| | FF | LB/H/ENG | 1242 | 1216 | 1163 | 1106 | 1070 | 1055 | 1063 |
| | FC | LB/H | 2483 | 2432 | 2326 | 2212 | 2139 | 2109 | 2127 |
| | IAS | KT | 161 | 159 | 154 | 149 | 145 | 142 | 141 |
| | TAS | KT | 159.9 | 161.2 | 165.0 | 171.8 | 180.7 | 192.4 | 207.7 |
| 34000 | MACH | | 0.243 | 0.247 | 0.256 | 0.271 | 0.291 | 0.316 | 0.348 |
| | N1 | % | 59.5 | 60.3 | 62.3 | 65.6 | 68.8 | 72.5 | 77.3 |
| | FF | LB/H/ENG | 1151 | 1123 | 1067 | 1004 | 961 | 937 | 934 |
| | FC | LB/H | 2301 | 2246 | 2134 | 2009 | 1923 | 1875 | 1867 |
| | IAS | KT | 156 | 154 | 149 | 143 | 139 | 135 | 133 |
| | TAS | KT | 154.9 | 156.1 | 159.3 | 165.0 | 172.7 | 182.7 | 195.9 |
| 30000 | MACH | | 0.236 | 0.239 | 0.247 | 0.261 | 0.278 | 0.300 | 0.328 |
| | N1 | % | 57.1 | 57.7 | 59.5 | 62.6 | 66.1 | 69.3 | 73.7 |
| | FF | LB/H/ENG | 1064 | 1036 | 977 | 909 | 860 | 828 | 813 |
| | FC | LB/H | 2128 | 2071 | 1953 | 1818 | 1719 | 1655 | 1627 |
| | IAS | KT | 151 | 149 | 144 | 137 | 132 | 128 | 125 |
| | TAS | KT | 150.1 | 151.0 | 153.6 | 158.3 | 164.6 | 172.9 | 184.0 |
| 26000 | MACH | | 0.229 | 0.231 | 0.238 | 0.250 | 0.265 | 0.284 | 0.309 |
| | N1 | % | 54.6 | 55.1 | 56.7 | 59.5 | 62.8 | 66.3 | 69.7 |
| | FF | LB/H/ENG | 983 | 953 | 891 | 818 | 763 | 724 | 701 |
| | FC | LB/H | 1966 | 1906 | 1782 | 1637 | 1526 | 1449 | 1402 |

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# FLIGHT WITH FLAPS LOCKED AT 9°

This section presents climb, cruise, descent and holding data for flight with all engines operating and the flaps locked at 9°.

This set of data may be used in the following situations:

- Dispatch of the airplane with the flaps locked at 9°. In this case, the applicable AFM supplement must be observed for takeoff, driftdown and landing performance penalties.
- On board flight planning in case of flaps locked at 9° after takeoff.

## CLIMB - FLIGHT WITH FLAPS LOCKED AT 9°

The climb planning tables show fuel consumption, distance, and time elapsed from the Sea Level to the top of climb. Data is shown for various weights, ISA deviations and cruise altitudes.
The tables are based on a fixed climb speed of 190 KIAS.

The associated conditions are:

- Thrust Mode ..... CLB
- Flaps..... 9°
- Landing Gear..... UP
- Bleeds..... OPEN
- Anti-Ice ..... OFF
- Airspeed ..... 190 KIAS

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH FLAPS LOCKED AT 9°

## AE3007A1 and A1P ENGINES

### ALTITUDE: SEA LEVEL TO 5000 AND 6000 FT

SPEED SCHEDULE: 190 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 5000 FT ISA + °C | | | | | 6000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 46000 | FUEL | LB | 161 | 167 | 174 | 181 | 204 | 194 | 201 | 209 | 218 | 246 |
| | DISTANCE | NM | 6 | 7 | 7 | 7 | 9 | 8 | 8 | 8 | 9 | 11 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 3 |
| 42000 | FUEL | LB | 141 | 146 | 152 | 158 | 177 | 169 | 175 | 182 | 190 | 212 |
| | DISTANCE | NM | 6 | 6 | 6 | 6 | 8 | 7 | 7 | 7 | 8 | 10 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 38000 | FUEL | LB | 123 | 127 | 132 | 138 | 153 | 147 | 153 | 159 | 165 | 183 |
| | DISTANCE | NM | 5 | 5 | 5 | 5 | 7 | 6 | 6 | 6 | 7 | 8 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 34000 | FUEL | LB | 106 | 110 | 115 | 119 | 131 | 127 | 132 | 137 | 143 | 158 |
| | DISTANCE | NM | 4 | 4 | 4 | 5 | 6 | 5 | 5 | 5 | 6 | 7 |
| | TIME | MIN | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| 30000 | FUEL | LB | 91 | 95 | 98 | 102 | 112 | 109 | 113 | 118 | 123 | 134 |
| | DISTANCE | NM | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 5 | 5 | 6 |
| | TIME | MIN | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| 26000 | FUEL | LB | 77 | 80 | 83 | 87 | 94 | 93 | 96 | 100 | 104 | 113 |
| | DISTANCE | NM | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 |
| | TIME | MIN | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH FLAPS LOCKED AT 9°

## AE3007A1 and A1P ENGINES

## ALTITUDE: SEA LEVEL TO 7000 AND 8000 FT

SPEED SCHEDULE: 190 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 7000 FT ISA + °C | | | | | 8000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 46000 | FUEL | LB | 226 | 235 | 244 | 255 | 288 | 259 | 269 | 279 | 292 | 331 |
| | DISTANCE | NM | 9 | 10 | 10 | 11 | 13 | 11 | 11 | 12 | 12 | 16 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 4 | 5 |
| 42000 | FUEL | LB | 197 | 205 | 213 | 222 | 248 | 225 | 234 | 243 | 254 | 285 |
| | DISTANCE | NM | 8 | 8 | 9 | 9 | 12 | 9 | 10 | 10 | 11 | 13 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 38000 | FUEL | LB | 171 | 178 | 185 | 193 | 214 | 196 | 204 | 211 | 220 | 245 |
| | DISTANCE | NM | 7 | 7 | 8 | 8 | 10 | 8 | 8 | 9 | 9 | 12 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 34000 | FUEL | LB | 148 | 154 | 160 | 167 | 184 | 169 | 176 | 183 | 190 | 210 |
| | DISTANCE | NM | 6 | 6 | 6 | 7 | 8 | 7 | 7 | 8 | 8 | 10 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| 30000 | FUEL | LB | 127 | 132 | 137 | 143 | 157 | 145 | 151 | 157 | 163 | 179 |
| | DISTANCE | NM | 5 | 5 | 6 | 6 | 7 | 6 | 6 | 6 | 7 | 8 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 26000 | FUEL | LB | 108 | 112 | 116 | 121 | 132 | 123 | 128 | 133 | 138 | 151 |
| | DISTANCE | NM | 4 | 4 | 5 | 5 | 6 | 5 | 5 | 5 | 6 | 7 |
| | TIME | MIN | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |

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# CLIMB PLANNING - FLIGHT WITH FLAPS LOCKED AT 9°

## AE3007A1 and A1P ENGINES

## ALTITUDE: SEA LEVEL TO 9000 AND 10000 FT

SPEED SCHEDULE: 190 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 9000 FT ISA + °C | | | | | 10000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 46000 | FUEL | LB | 292 | 303 | 315 | 329 | 374 | 325 | 337 | 351 | 366 | 417 |
| | DISTANCE | NM | 12 | 13 | 13 | 14 | 18 | 14 | 15 | 15 | 16 | 21 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 5 | 6 |
| 42000 | FUEL | LB | 254 | 264 | 274 | 286 | 321 | 282 | 293 | 305 | 318 | 358 |
| | DISTANCE | NM | 11 | 11 | 12 | 12 | 15 | 12 | 13 | 13 | 14 | 18 |
| | TIME | MIN | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 5 |
| 38000 | FUEL | LB | 220 | 229 | 238 | 248 | 276 | 245 | 255 | 265 | 276 | 308 |
| | DISTANCE | NM | 9 | 10 | 10 | 11 | 13 | 11 | 11 | 11 | 12 | 15 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |
| 34000 | FUEL | LB | 190 | 198 | 206 | 214 | 237 | 212 | 220 | 228 | 238 | 264 |
| | DISTANCE | NM | 8 | 8 | 9 | 9 | 11 | 9 | 9 | 10 | 10 | 13 |
| | TIME | MIN | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 30000 | FUEL | LB | 163 | 170 | 176 | 183 | 202 | 181 | 188 | 196 | 204 | 224 |
| | DISTANCE | NM | 7 | 7 | 7 | 8 | 10 | 8 | 8 | 8 | 9 | 11 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |
| 26000 | FUEL | LB | 138 | 143 | 149 | 155 | 170 | 153 | 159 | 165 | 172 | 189 |
| | DISTANCE | NM | 6 | 6 | 6 | 7 | 8 | 6 | 7 | 7 | 7 | 9 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH FLAPS LOCKED AT 9°

## AE3007A1 and A1P ENGINES

## ALTITUDE: SEA LEVEL TO 11000 AND 12000 FT

SPEED SCHEDULE: 190 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 11000 FT ISA + °C | | | | | 12000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 46000 | FUEL | LB | 358 | 372 | 387 | 404 | 462 | 392 | 407 | 423 | 442 | 507 |
| | DISTANCE | NM | 16 | 16 | 17 | 18 | 23 | 18 | 18 | 19 | 20 | 26 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 5 | 6 | 6 | 7 |
| 42000 | FUEL | LB | 311 | 323 | 336 | 351 | 396 | 340 | 353 | 367 | 383 | 434 |
| | DISTANCE | NM | 14 | 14 | 15 | 16 | 20 | 15 | 16 | 16 | 17 | 22 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 6 | 5 | 5 | 5 | 5 | 6 |
| 38000 | FUEL | LB | 270 | 280 | 291 | 304 | 340 | 294 | 306 | 318 | 332 | 372 |
| | DISTANCE | NM | 12 | 12 | 13 | 13 | 17 | 13 | 14 | 14 | 15 | 19 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 5 |
| 34000 | FUEL | LB | 233 | 242 | 251 | 262 | 291 | 254 | 264 | 274 | 286 | 318 |
| | DISTANCE | NM | 10 | 11 | 11 | 12 | 15 | 11 | 12 | 12 | 13 | 16 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 4 | 4 | 5 |
| 30000 | FUEL | LB | 199 | 207 | 215 | 224 | 247 | 217 | 226 | 235 | 244 | 270 |
| | DISTANCE | NM | 9 | 9 | 9 | 10 | 12 | 10 | 10 | 10 | 11 | 14 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |
| 26000 | FUEL | LB | 168 | 175 | 182 | 189 | 208 | 183 | 191 | 198 | 206 | 227 |
| | DISTANCE | NM | 7 | 8 | 8 | 8 | 10 | 8 | 8 | 9 | 9 | 11 |
| | TIME | MIN | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH FLAPS LOCKED AT 9°

**AE3007A1 and A1P ENGINES**

## ALTITUDE: SEA LEVEL TO 13000 AND 14000 FT

SPEED SCHEDULE: 190 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 13000 FT ISA + °C | | | | | 14000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 46000 | FUEL | LB | 426 | 443 | 460 | 481 | 553 | 460 | 479 | 498 | 520 | 600 |
| | DISTANCE | NM | 20 | 20 | 21 | 22 | 29 | 22 | 22 | 23 | 25 | 32 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 6 | 7 | 7 | 9 |
| 42000 | FUEL | LB | 369 | 384 | 399 | 416 | 472 | 398 | 414 | 431 | 450 | 512 |
| | DISTANCE | NM | 17 | 18 | 18 | 19 | 25 | 19 | 19 | 20 | 21 | 27 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 6 | 6 | 6 | 6 | 7 |
| 38000 | FUEL | LB | 319 | 332 | 345 | 360 | 404 | 344 | 358 | 372 | 389 | 437 |
| | DISTANCE | NM | 15 | 15 | 16 | 17 | 21 | 16 | 17 | 17 | 18 | 23 |
| | TIME | MIN | 4 | 4 | 5 | 5 | 6 | 5 | 5 | 5 | 5 | 6 |
| 34000 | FUEL | LB | 275 | 286 | 297 | 310 | 345 | 297 | 308 | 321 | 334 | 373 |
| | DISTANCE | NM | 12 | 13 | 14 | 14 | 18 | 14 | 14 | 15 | 16 | 20 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 5 |
| 30000 | FUEL | LB | 235 | 245 | 254 | 265 | 293 | 253 | 263 | 274 | 285 | 316 |
| | DISTANCE | NM | 11 | 11 | 12 | 12 | 15 | 12 | 12 | 13 | 13 | 17 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 5 |
| 26000 | FUEL | LB | 199 | 206 | 215 | 224 | 246 | 214 | 222 | 231 | 241 | 265 |
| | DISTANCE | NM | 9 | 9 | 10 | 10 | 13 | 10 | 10 | 11 | 11 | 14 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 4 |

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH FLAPS LOCKED AT 9°

## AE3007A1 and A1P ENGINES

## ALTITUDE: SEA LEVEL TO 15000 AND 16000 FT

SPEED SCHEDULE: 190 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 15000 FT ISA + °C | | | | | 16000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 46000 | FUEL | LB | 495 | 515 | 536 | 560 | 648 | 531 | 552 | 574 | 601 | 697 |
| | DISTANCE | NM | 24 | 25 | 26 | 27 | 36 | 26 | 27 | 28 | 30 | 39 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 10 | 8 | 8 | 8 | 8 | 10 |
| 42000 | FUEL | LB | 428 | 445 | 463 | 484 | 552 | 458 | 477 | 496 | 518 | 592 |
| | DISTANCE | NM | 20 | 21 | 22 | 23 | 30 | 22 | 23 | 24 | 26 | 33 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 7 | 7 | 7 | 9 |
| 38000 | FUEL | LB | 370 | 385 | 400 | 417 | 471 | 395 | 411 | 428 | 447 | 504 |
| | DISTANCE | NM | 18 | 18 | 19 | 20 | 26 | 19 | 20 | 21 | 22 | 28 |
| | TIME | MIN | 5 | 5 | 5 | 6 | 7 | 6 | 6 | 6 | 6 | 8 |
| 34000 | FUEL | LB | 318 | 331 | 344 | 359 | 401 | 340 | 353 | 367 | 383 | 429 |
| | DISTANCE | NM | 15 | 16 | 16 | 17 | 22 | 16 | 17 | 18 | 19 | 24 |
| | TIME | MIN | 4 | 5 | 5 | 5 | 6 | 5 | 5 | 5 | 5 | 6 |
| 30000 | FUEL | LB | 272 | 282 | 294 | 306 | 340 | 290 | 302 | 313 | 327 | 363 |
| | DISTANCE | NM | 13 | 13 | 14 | 15 | 18 | 14 | 15 | 15 | 16 | 20 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 5 |
| 26000 | FUEL | LB | 229 | 238 | 248 | 258 | 285 | 244 | 254 | 264 | 275 | 304 |
| | DISTANCE | NM | 11 | 11 | 12 | 12 | 15 | 12 | 12 | 13 | 13 | 17 |
| | TIME | MIN | 3 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 5 |

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# CLIMB PLANNING - FLIGHT WITH FLAPS LOCKED AT 9°

## AE3007A1 and A1P ENGINES

## ALTITUDE: SEA LEVEL TO 17000 AND 18000 FT

SPEED SCHEDULE: 190 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 17000 FT ISA + °C | | | | | 18000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 46000 | FUEL | LB | 567 | 590 | 614 | 643 | 748 | 604 | 628 | 653 | 685 | 800 |
| | DISTANCE | NM | 28 | 30 | 31 | 33 | 43 | 31 | 32 | 33 | 36 | 47 |
| | TIME | MIN | 8 | 8 | 8 | 9 | 11 | 9 | 9 | 9 | 10 | 12 |
| 42000 | FUEL | LB | 489 | 509 | 529 | 553 | 634 | 519 | 540 | 562 | 588 | 676 |
| | DISTANCE | NM | 24 | 25 | 26 | 28 | 36 | 26 | 27 | 29 | 30 | 40 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 10 | 8 | 8 | 8 | 8 | 10 |
| 38000 | FUEL | LB | 421 | 438 | 456 | 476 | 539 | 447 | 465 | 484 | 506 | 574 |
| | DISTANCE | NM | 21 | 22 | 23 | 24 | 31 | 23 | 24 | 25 | 26 | 33 |
| | TIME | MIN | 6 | 6 | 6 | 7 | 8 | 6 | 7 | 7 | 7 | 9 |
| 34000 | FUEL | LB | 362 | 376 | 391 | 408 | 458 | 383 | 399 | 415 | 433 | 487 |
| | DISTANCE | NM | 18 | 19 | 19 | 20 | 26 | 19 | 20 | 21 | 22 | 28 |
| | TIME | MIN | 5 | 5 | 5 | 6 | 7 | 6 | 6 | 6 | 6 | 7 |
| 30000 | FUEL | LB | 308 | 321 | 333 | 348 | 387 | 327 | 340 | 353 | 369 | 411 |
| | DISTANCE | NM | 15 | 16 | 16 | 17 | 22 | 16 | 17 | 18 | 19 | 24 |
| | TIME | MIN | 4 | 4 | 5 | 5 | 6 | 5 | 5 | 5 | 5 | 6 |
| 26000 | FUEL | LB | 260 | 270 | 281 | 293 | 324 | 275 | 286 | 297 | 310 | 344 |
| | DISTANCE | NM | 13 | 13 | 14 | 15 | 18 | 14 | 14 | 15 | 16 | 20 |
| | TIME | MIN | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 5 |

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# CLIMB PLANNING - FLIGHT WITH FLAPS LOCKED AT 9°

## AE3007A1 and A1P ENGINES

## ALTITUDE: SEA LEVEL TO 19000 AND 20000 FT

SPEED SCHEDULE: 190 KIAS
ALL ENGINES OPERATING
BLEED: OPEN

| WEIGHT (LB) | | | 19000 FT ISA + °C | | | | | 20000 FT ISA + °C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | -20 | -10 | 0 | 10 | 20 | -20 | -10 | 0 | 10 | 20 |
| 46000 | FUEL | LB | 640 | 666 | 693 | 727 | 852 | 676 | 704 | 732 | 769 | 905 |
| | DISTANCE | NM | 33 | 35 | 36 | 39 | 51 | 36 | 37 | 39 | 42 | 56 |
| | TIME | MIN | 9 | 10 | 10 | 10 | 13 | 10 | 10 | 10 | 11 | 14 |
| 42000 | FUEL | LB | 550 | 572 | 595 | 624 | 718 | 580 | 604 | 628 | 659 | 761 |
| | DISTANCE | NM | 28 | 30 | 31 | 33 | 43 | 31 | 32 | 33 | 35 | 46 |
| | TIME | MIN | 8 | 8 | 8 | 9 | 11 | 9 | 9 | 9 | 9 | 12 |
| 38000 | FUEL | LB | 473 | 492 | 512 | 536 | 609 | 498 | 519 | 539 | 565 | 644 |
| | DISTANCE | NM | 24 | 25 | 26 | 28 | 36 | 26 | 27 | 28 | 30 | 39 |
| | TIME | MIN | 7 | 7 | 7 | 8 | 9 | 7 | 7 | 8 | 8 | 10 |
| 34000 | FUEL | LB | 405 | 422 | 438 | 459 | 516 | 427 | 444 | 462 | 483 | 545 |
| | DISTANCE | NM | 21 | 22 | 23 | 24 | 31 | 22 | 23 | 24 | 26 | 33 |
| | TIME | MIN | 6 | 6 | 6 | 6 | 8 | 6 | 6 | 7 | 7 | 9 |
| 30000 | FUEL | LB | 345 | 359 | 373 | 390 | 435 | 363 | 378 | 393 | 411 | 459 |
| | DISTANCE | NM | 18 | 18 | 19 | 20 | 26 | 19 | 20 | 20 | 22 | 28 |
| | TIME | MIN | 5 | 5 | 5 | 5 | 7 | 5 | 5 | 6 | 6 | 7 |
| 26000 | FUEL | LB | 290 | 302 | 314 | 328 | 363 | 305 | 318 | 330 | 345 | 383 |
| | DISTANCE | NM | 15 | 15 | 16 | 17 | 21 | 16 | 16 | 17 | 18 | 23 |
| | TIME | MIN | 4 | 4 | 4 | 5 | 6 | 4 | 5 | 5 | 5 | 6 |

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## CRUISE - FLIGHT WITH FLAPS LOCKED AT 9°

The Long Range Cruise and Maximum Speed Cruise tables show N1, fuel flow, indicated airspeed, true airspeed, indicated Mach number, buffet margin and specific range. Data is presented for ISA conditions and various weights, with corrections for ISA deviations.

In the Long Range Cruise schedule, all engines operating, the airplane is flown at a speed corresponding to a specific range equal to 99% of the maximum specific range. The LRC schedule is used when range is the main factor considered.

In the Maximum Speed Cruise schedule, the airplane is flown in a speed resulting from maximum cruise power setting or Vmo/Mmo, whichever is lower. It is used when minimum flight time is desired.

The associated conditions are:

- Flaps ..... 9°
- Landing Gear ..... UP
- Bleeds ..... OPEN
- Anti-Ice..... OFF

The associated corrections for ISA deviation are:

- Increase/decrease N1% by 1% per 5°C above/below ISA conditions.
- Increase/decrease fuel flow 1% per 5°C above/below ISA conditions.
- Increase/decrease TAS by 2 kt per 5°C above/below ISA conditions.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING
# FLIGHT WITH FLAPS LOCKED AT 9°

**AE3007A1 and A1P ENGINES**

**ALTITUDE: 5000 FT TO 12000 FT**

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 | 11000 | 12000 |
| | N1 % | 67.8 | 68.4 | 69.0 | 69.6 | 70.1 | 70.7 | 71.2 | 71.7 |
| | F FLOW LB/H/ENG | 1323 | 1311 | 1299 | 1287 | 1276 | 1267 | 1258 | 1250 |
| | IAS KT | 233 | 233 | 232 | 231 | 230 | 229 | 228 | 228 |
| 46000 | TAS KT | 251 | 254 | 257 | 259 | 262 | 265 | 269 | 272 |
| | INDICATED MACH | 0.386 | 0.391 | 0.397 | 0.403 | 0.409 | 0.415 | 0.422 | 0.428 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.53 | 2.51 | 2.49 | 2.46 | 2.44 | 2.42 |
| | SR NM/LB | 0.095 | 0.097 | 0.099 | 0.101 | 0.103 | 0.105 | 0.107 | 0.109 |
| | N1 % | 65.7 | 66.3 | 66.9 | 67.6 | 68.2 | 68.9 | 69.4 | 69.9 |
| | F FLOW LB/H/ENG | 1229 | 1215 | 1203 | 1191 | 1181 | 1170 | 1159 | 1150 |
| | IAS KT | 226 | 225 | 224 | 223 | 222 | 222 | 221 | 220 |
| 42000 | TAS KT | 243 | 245 | 248 | 251 | 254 | 256 | 259 | 262 |
| | INDICATED MACH | 0.373 | 0.379 | 0.384 | 0.390 | 0.396 | 0.402 | 0.408 | 0.414 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.55 | 2.52 | 2.50 | 2.47 |
| | SR NM/LB | 0.099 | 0.101 | 0.103 | 0.105 | 0.107 | 0.110 | 0.112 | 0.114 |
| | N1 % | 63.4 | 64.0 | 64.6 | 65.3 | 65.9 | 66.6 | 67.2 | 67.9 |
| | F FLOW LB/H/ENG | 1137 | 1124 | 1110 | 1097 | 1085 | 1074 | 1062 | 1052 |
| | IAS KT | 218 | 217 | 216 | 215 | 214 | 214 | 213 | 212 |
| 38000 | TAS KT | 234 | 236 | 239 | 241 | 244 | 247 | 249 | 252 |
| | INDICATED MACH | 0.360 | 0.366 | 0.371 | 0.376 | 0.382 | 0.387 | 0.393 | 0.399 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.55 | 2.53 |
| | SR NM/LB | 0.103 | 0.105 | 0.108 | 0.110 | 0.112 | 0.115 | 0.117 | 0.120 |
| | N1 % | 60.9 | 61.5 | 62.1 | 62.7 | 63.3 | 64.1 | 64.7 | 65.4 |
| | F FLOW LB/H/ENG | 1046 | 1032 | 1018 | 1005 | 992 | 981 | 970 | 960 |
| | IAS KT | 210 | 209 | 208 | 207 | 206 | 205 | 204 | 203 |
| 34000 | TAS KT | 225 | 227 | 229 | 231 | 234 | 236 | 239 | 242 |
| | INDICATED MACH | 0.347 | 0.352 | 0.356 | 0.361 | 0.366 | 0.372 | 0.377 | 0.383 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.107 | 0.110 | 0.113 | 0.115 | 0.118 | 0.121 | 0.123 | 0.126 |
| | N1 % | 58.1 | 58.7 | 59.3 | 59.9 | 60.6 | 61.3 | 61.9 | 62.6 |
| | F FLOW LB/H/ENG | 958 | 943 | 930 | 917 | 904 | 892 | 880 | 868 |
| | IAS KT | 201 | 200 | 199 | 198 | 197 | 196 | 195 | 194 |
| 30000 | TAS KT | 215 | 217 | 219 | 221 | 224 | 226 | 228 | 231 |
| | INDICATED MACH | 0.332 | 0.337 | 0.341 | 0.346 | 0.351 | 0.356 | 0.361 | 0.366 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.112 | 0.115 | 0.118 | 0.121 | 0.124 | 0.127 | 0.130 | 0.133 |
| | N1 % | 55.3 | 55.8 | 56.3 | 56.9 | 57.4 | 58.1 | 58.8 | 59.4 |
| | F FLOW LB/H/ENG | 873 | 858 | 843 | 829 | 815 | 803 | 791 | 780 |
| | IAS KT | 192 | 191 | 189 | 188 | 187 | 186 | 185 | 185 |
| 26000 | TAS KT | 205 | 206 | 208 | 210 | 212 | 214 | 217 | 219 |
| | INDICATED MACH | 0.317 | 0.321 | 0.325 | 0.329 | 0.334 | 0.338 | 0.343 | 0.348 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.117 | 0.120 | 0.124 | 0.127 | 0.130 | 0.133 | 0.137 | 0.140 |

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# LONG RANGE CRUISE - ALL ENGINES OPERATING
# FLIGHT WITH FLAPS LOCKED AT 9°

**AE3007A1 and A1P ENGINES**

**ALTITUDE: 13000 FT TO 20000 FT**

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 | 19000 | 20000 |
| | N1 % | 72.3 | 73.0 | 73.7 | 74.4 | 75.2 | 76.0 | 76.8 | 77.7 |
| | F FLOW LB/H/ENG | 1242 | 1235 | 1228 | 1221 | 1216 | 1212 | 1208 | 1206 |
| | IAS KT | 227 | 226 | 225 | 225 | 224 | 223 | 222 | 222 |
| 46000 | TAS KT | 275 | 278 | 282 | 285 | 289 | 292 | 296 | 300 |
| | INDICATED MACH | 0.435 | 0.442 | 0.449 | 0.456 | 0.463 | 0.471 | 0.479 | 0.487 |
| | BUFFET MARGIN G | 2.39 | 2.37 | 2.34 | 2.31 | 2.28 | 2.25 | 2.23 | 2.20 |
| | SR NM/LB | 0.111 | 0.113 | 0.115 | 0.117 | 0.119 | 0.121 | 0.122 | 0.124 |
| | N1 % | 70.4 | 70.9 | 71.5 | 72.2 | 72.9 | 73.6 | 74.4 | 75.3 |
| | F FLOW LB/H/ENG | 1140 | 1132 | 1124 | 1118 | 1112 | 1107 | 1103 | 1099 |
| | IAS KT | 219 | 218 | 217 | 217 | 216 | 215 | 215 | 214 |
| 42000 | TAS KT | 265 | 268 | 271 | 275 | 278 | 282 | 285 | 289 |
| | INDICATED MACH | 0.420 | 0.426 | 0.433 | 0.440 | 0.447 | 0.455 | 0.463 | 0.471 |
| | BUFFET MARGIN G | 2.45 | 2.42 | 2.39 | 2.37 | 2.34 | 2.32 | 2.29 | 2.26 |
| | SR NM/LB | 0.116 | 0.118 | 0.121 | 0.123 | 0.125 | 0.127 | 0.129 | 0.132 |
| | N1 % | 68.5 | 69.0 | 69.5 | 70.0 | 70.7 | 71.3 | 72.0 | 72.7 |
| | F FLOW LB/H/ENG | 1043 | 1034 | 1026 | 1019 | 1013 | 1007 | 1001 | 995 |
| | IAS KT | 211 | 210 | 210 | 209 | 208 | 208 | 207 | 206 |
| 38000 | TAS KT | 255 | 258 | 261 | 264 | 268 | 271 | 275 | 278 |
| | INDICATED MACH | 0.405 | 0.411 | 0.418 | 0.425 | 0.432 | 0.439 | 0.446 | 0.453 |
| | BUFFET MARGIN G | 2.51 | 2.48 | 2.46 | 2.44 | 2.41 | 2.39 | 2.36 | 2.33 |
| | SR NM/LB | 0.122 | 0.125 | 0.127 | 0.130 | 0.132 | 0.135 | 0.137 | 0.140 |
| | N1 % | 66.1 | 66.7 | 67.4 | 67.9 | 68.4 | 68.9 | 69.5 | 70.1 |
| | F FLOW LB/H/ENG | 951 | 941 | 931 | 922 | 913 | 906 | 899 | 893 |
| | IAS KT | 203 | 202 | 201 | 200 | 199 | 198 | 198 | 197 |
| 34000 | TAS KT | 245 | 248 | 250 | 253 | 256 | 259 | 262 | 266 |
| | INDICATED MACH | 0.389 | 0.395 | 0.401 | 0.407 | 0.413 | 0.420 | 0.427 | 0.434 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.53 | 2.50 | 2.47 | 2.45 | 2.42 | 2.40 |
| | SR NM/LB | 0.129 | 0.132 | 0.134 | 0.137 | 0.140 | 0.143 | 0.146 | 0.149 |
| | N1 % | 63.2 | 63.9 | 64.5 | 65.2 | 65.9 | 66.6 | 67.2 | 67.7 |
| | F FLOW LB/H/ENG | 857 | 846 | 837 | 828 | 820 | 812 | 805 | 798 |
| | IAS KT | 193 | 192 | 192 | 191 | 190 | 190 | 189 | 188 |
| 30000 | TAS KT | 233 | 236 | 238 | 241 | 244 | 247 | 250 | 253 |
| | INDICATED MACH | 0.371 | 0.377 | 0.383 | 0.389 | 0.395 | 0.401 | 0.408 | 0.415 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.53 | 2.51 | 2.48 |
| | SR NM/LB | 0.136 | 0.139 | 0.142 | 0.146 | 0.149 | 0.152 | 0.155 | 0.159 |
| | N1 % | 60.1 | 60.8 | 61.4 | 62.1 | 62.7 | 63.4 | 64.0 | 64.7 |
| | F FLOW LB/H/ENG | 770 | 760 | 748 | 738 | 729 | 720 | 711 | 704 |
| | IAS KT | 184 | 183 | 182 | 181 | 180 | 179 | 178 | 178 |
| 26000 | TAS KT | 222 | 224 | 226 | 229 | 231 | 234 | 236 | 239 |
| | INDICATED MACH | 0.354 | 0.359 | 0.364 | 0.369 | 0.374 | 0.380 | 0.386 | 0.392 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.144 | 0.147 | 0.151 | 0.155 | 0.159 | 0.162 | 0.166 | 0.170 |

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING
# FLIGHT WITH FLAPS LOCKED AT 9°

**AE3007A1 and A1P ENGINES**

**ALTITUDE: 5000 FT TO 12000 FT**

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 | 11000 | 12000 |
| | N1 % | 70.3 | 70.8 | 71.3 | 71.9 | 72.5 | 73.3 | 74.0 | 74.8 |
| | F FLOW LB/H/ENG | 1450 | 1445 | 1439 | 1435 | 1431 | 1427 | 1425 | 1423 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 46000 | TAS KT | 269 | 273 | 277 | 281 | 285 | 289 | 294 | 298 |
| | INDICATED MACH | 0.413 | 0.420 | 0.428 | 0.436 | 0.444 | 0.452 | 0.461 | 0.469 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.093 | 0.094 | 0.096 | 0.098 | 0.100 | 0.101 | 0.103 | 0.105 |
| | N1 % | 69.5 | 70.2 | 70.7 | 71.3 | 71.9 | 72.6 | 73.2 | 74.0 |
| | F FLOW LB/H/ENG | 1412 | 1406 | 1400 | 1395 | 1390 | 1386 | 1383 | 1380 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 42000 | TAS KT | 268 | 272 | 276 | 280 | 285 | 289 | 293 | 297 |
| | INDICATED MACH | 0.413 | 0.420 | 0.428 | 0.436 | 0.444 | 0.452 | 0.461 | 0.469 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.095 | 0.097 | 0.099 | 0.100 | 0.102 | 0.104 | 0.106 | 0.108 |
| | N1 % | 68.8 | 69.5 | 70.2 | 70.7 | 71.2 | 71.9 | 72.5 | 73.2 |
| | F FLOW LB/H/ENG | 1377 | 1370 | 1364 | 1358 | 1353 | 1349 | 1345 | 1341 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 38000 | TAS KT | 268 | 272 | 276 | 280 | 284 | 288 | 292 | 297 |
| | INDICATED MACH | 0.413 | 0.420 | 0.428 | 0.436 | 0.444 | 0.452 | 0.461 | 0.469 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.097 | 0.099 | 0.101 | 0.103 | 0.105 | 0.107 | 0.109 | 0.111 |
| | N1 % | 68.1 | 68.8 | 69.5 | 70.1 | 70.7 | 71.3 | 71.9 | 72.5 |
| | F FLOW LB/H/ENG | 1344 | 1337 | 1330 | 1324 | 1318 | 1313 | 1309 | 1305 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 34000 | TAS KT | 267 | 271 | 275 | 279 | 283 | 287 | 292 | 296 |
| | INDICATED MACH | 0.413 | 0.420 | 0.428 | 0.436 | 0.444 | 0.452 | 0.461 | 0.469 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.099 | 0.101 | 0.103 | 0.105 | 0.107 | 0.109 | 0.111 | 0.113 |
| | N1 % | 67.5 | 68.2 | 68.9 | 69.6 | 70.1 | 70.7 | 71.3 | 71.9 |
| | F FLOW LB/H/ENG | 1315 | 1307 | 1300 | 1293 | 1287 | 1282 | 1277 | 1272 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 30000 | TAS KT | 267 | 270 | 274 | 278 | 283 | 287 | 291 | 295 |
| | INDICATED MACH | 0.413 | 0.420 | 0.428 | 0.436 | 0.444 | 0.452 | 0.461 | 0.469 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.101 | 0.103 | 0.106 | 0.108 | 0.110 | 0.112 | 0.114 | 0.116 |
| | N1 % | 66.9 | 67.6 | 68.3 | 69.0 | 69.7 | 70.3 | 70.8 | 71.4 |
| | F FLOW LB/H/ENG | 1289 | 1281 | 1274 | 1267 | 1260 | 1254 | 1249 | 1244 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 26000 | TAS KT | 266 | 270 | 274 | 278 | 282 | 286 | 290 | 295 |
| | INDICATED MACH | 0.413 | 0.420 | 0.428 | 0.436 | 0.444 | 0.452 | 0.461 | 0.469 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.103 | 0.105 | 0.107 | 0.110 | 0.112 | 0.114 | 0.116 | 0.118 |

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING
# FLIGHT WITH FLAPS LOCKED AT 9°

**AE3007A1 and A1P ENGINES**

**ALTITUDE: 13000 FT TO 20000 FT**

BLEED: OPEN
ISA CONDITION

| WEIGHT (LB) | | ALTITUDE (FT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 | 19000 | 20000 |
| | N1 % | 75.6 | 76.4 | 77.3 | 78.2 | 79.1 | 80.0 | 80.9 | 81.7 |
| | F FLOW LB/H/ENG | 1421 | 1421 | 1421 | 1421 | 1423 | 1425 | 1428 | 1432 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 46000 | TAS KT | 302 | 307 | 312 | 316 | 321 | 326 | 331 | 337 |
| | INDICATED MACH | 0.478 | 0.487 | 0.497 | 0.506 | 0.516 | 0.526 | 0.536 | 0.547 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.106 | 0.108 | 0.110 | 0.111 | 0.113 | 0.114 | 0.116 | 0.118 |
| | N1 % | 74.7 | 75.5 | 76.4 | 77.2 | 78.1 | 79.1 | 80.0 | 80.9 |
| | F FLOW LB/H/ENG | 1378 | 1377 | 1376 | 1376 | 1377 | 1378 | 1380 | 1383 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 42000 | TAS KT | 302 | 307 | 311 | 316 | 321 | 326 | 331 | 336 |
| | INDICATED MACH | 0.478 | 0.487 | 0.497 | 0.506 | 0.516 | 0.526 | 0.536 | 0.547 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.110 | 0.111 | 0.113 | 0.115 | 0.116 | 0.118 | 0.120 | 0.121 |
| | N1 % | 73.9 | 74.7 | 75.5 | 76.4 | 77.2 | 78.2 | 79.1 | 80.0 |
| | F FLOW LB/H/ENG | 1339 | 1336 | 1335 | 1334 | 1334 | 1334 | 1335 | 1337 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 38000 | TAS KT | 301 | 306 | 311 | 315 | 320 | 325 | 330 | 335 |
| | INDICATED MACH | 0.478 | 0.487 | 0.497 | 0.506 | 0.516 | 0.526 | 0.536 | 0.547 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.113 | 0.114 | 0.116 | 0.118 | 0.120 | 0.122 | 0.124 | 0.125 |
| | N1 % | 73.2 | 74.0 | 74.7 | 75.5 | 76.4 | 77.3 | 78.2 | 79.1 |
| | F FLOW LB/H/ENG | 1302 | 1299 | 1297 | 1295 | 1294 | 1294 | 1294 | 1295 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 34000 | TAS KT | 301 | 305 | 310 | 315 | 319 | 324 | 329 | 335 |
| | INDICATED MACH | 0.478 | 0.487 | 0.497 | 0.506 | 0.516 | 0.526 | 0.536 | 0.547 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.115 | 0.117 | 0.119 | 0.121 | 0.123 | 0.125 | 0.127 | 0.129 |
| | N1 % | 72.6 | 73.3 | 74.0 | 74.8 | 75.6 | 76.5 | 77.3 | 78.3 |
| | F FLOW LB/H/ENG | 1268 | 1265 | 1262 | 1260 | 1258 | 1257 | 1257 | 1257 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 30000 | TAS KT | 300 | 304 | 309 | 314 | 319 | 324 | 329 | 334 |
| | INDICATED MACH | 0.478 | 0.487 | 0.497 | 0.506 | 0.516 | 0.526 | 0.536 | 0.547 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.118 | 0.120 | 0.122 | 0.125 | 0.127 | 0.129 | 0.131 | 0.133 |
| | N1 % | 72.0 | 72.7 | 73.4 | 74.1 | 74.9 | 75.7 | 76.6 | 77.5 |
| | F FLOW LB/H/ENG | 1239 | 1235 | 1232 | 1229 | 1227 | 1225 | 1224 | 1223 |
| | IAS KT | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| 26000 | TAS KT | 299 | 304 | 308 | 313 | 318 | 323 | 328 | 333 |
| | INDICATED MACH | 0.478 | 0.487 | 0.497 | 0.506 | 0.516 | 0.526 | 0.536 | 0.547 |
| | BUFFET MARGIN G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR NM/LB | 0.121 | 0.123 | 0.125 | 0.127 | 0.130 | 0.132 | 0.134 | 0.136 |

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## DESCENT - FLIGHT WITH FLAPS LOCKED AT 9°

The descent table shows fuel consumption, distance and time from the top of descent to sea level for various cruise altitudes. The data is calculated based on flight idle thrust and a fixed airspeed of 240 KIAS.

The associated conditions are:

- Flaps ..... 9°
- Landing Gear ..... UP
- Bleeds ..... OPEN
- Anti-Ice ..... OFF
- Airspeed ..... 240 KIAS

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# DESCENT - ALL ENGINES OPERATING

## FLIGHT WITH FLAPS LOCKED AT 9°

### AE3007A1 and A1P ENGINES

BLEED: OPEN
AIRSPEED: 240 KIAS
ISA CONDITIONS

| WEIGHT (LB) | | | TOP OF DESCENT (FT) | | | |
|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 15000 | 20000 |
| 46000 | FUEL | LB | 39 | 75 | 107 | 136 |
| | DISTANCE | NM | 10 | 20 | 31 | 42 |
| | TIME | MIN | 2 | 5 | 7 | 9 |
| 42000 | FUEL | LB | 38 | 72 | 102 | 130 |
| | DISTANCE | NM | 9 | 19 | 29 | 40 |
| | TIME | MIN | 2 | 4 | 7 | 9 |
| 38000 | FUEL | LB | 36 | 68 | 96 | 123 |
| | DISTANCE | NM | 9 | 18 | 28 | 38 |
| | TIME | MIN | 2 | 4 | 6 | 8 |
| 34000 | FUEL | LB | 33 | 63 | 90 | 114 |
| | DISTANCE | NM | 8 | 17 | 26 | 35 |
| | TIME | MIN | 2 | 4 | 6 | 8 |
| 30000 | FUEL | LB | 30 | 58 | 82 | 105 |
| | DISTANCE | NM | 7 | 15 | 23 | 32 |
| | TIME | MIN | 2 | 4 | 5 | 7 |
| 26000 | FUEL | LB | 27 | 52 | 74 | 94 |
| | DISTANCE | NM | 7 | 14 | 21 | 29 |
| | TIME | MIN | 2 | 3 | 5 | 6 |

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## HOLDING - FLIGHT WITH FLAPS LOCKED AT 9°

The holding tables show indicated airspeed, Mach number, N1, fuel flow and fuel consumption for various weights and altitudes. Data is presented for ISA condition and all engines operating.

The associated conditions are:

- Flaps ..... 9°
- Landing Gear ..... UP
- Bleeds ..... OPEN
- Airspeed ..... 1.3 $V_S$
- Anti-Ice ..... OFF

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# HOLDING - ALL ENGINES OPERATING

## FLIGHT WITH FLAPS LOCKED AT 9°

### AE3007A1 and A1P ENGINES

BLEED: OPEN
ANTI ICE: OFF
MINIMUM FUEL CONSUMPTION SPEED
STANDARD ATMOSPHERE

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 0 | 1500 | 5000 | 10000 | 15000 | 20000 |
| | IAS | KT | 175 | 174 | 170 | 167 | 165 | 164 |
| | TAS | KT | 175.1 | 177.2 | 182.8 | 192.8 | 205.8 | 222.4 |
| 46000 | MACH | | 0.265 | 0.270 | 0.282 | 0.303 | 0.329 | 0.363 |
| | N1 | % | 57.7 | 58.8 | 61.4 | 65.5 | 69.2 | 73.4 |
| | FF | LB/H/ENG | 1089 | 1072 | 1039 | 1004 | 984 | 978 |
| | FC | LB/H | 2177 | 2144 | 2077 | 2009 | 1969 | 1957 |
| | IAS | KT | 170 | 169 | 165 | 161 | 158 | 157 |
| | TAS | KT | 170.0 | 171.8 | 176.9 | 185.8 | 197.4 | 212.4 |
| 42000 | MACH | | 0.258 | 0.262 | 0.273 | 0.292 | 0.316 | 0.347 |
| | N1 | % | 55.5 | 56.4 | 58.9 | 63.0 | 67.2 | 70.9 |
| | FF | LB/H/ENG | 1014 | 996 | 960 | 922 | 898 | 886 |
| | FC | LB/H | 2027 | 1992 | 1920 | 1844 | 1796 | 1773 |
| | IAS | KT | 166 | 164 | 160 | 155 | 152 | 150 |
| | TAS | KT | 164.9 | 166.6 | 171.0 | 178.9 | 189.0 | 202.3 |
| 38000 | MACH | | 0.250 | 0.254 | 0.264 | 0.282 | 0.304 | 0.331 |
| | N1 | % | 53.1 | 54.0 | 56.4 | 60.3 | 64.5 | 68.3 |
| | FF | LB/H/ENG | 941 | 922 | 884 | 842 | 814 | 798 |
| | FC | LB/H | 1882 | 1845 | 1768 | 1685 | 1628 | 1596 |
| | IAS | KT | 161 | 159 | 154 | 149 | 145 | 142 |
| | TAS | KT | 159.9 | 161.2 | 165.0 | 171.8 | 180.7 | 192.4 |
| 34000 | MACH | | 0.243 | 0.247 | 0.256 | 0.271 | 0.291 | 0.316 |
| | N1 | % | 50.7 | 51.5 | 53.7 | 57.4 | 61.5 | 65.8 |
| | FF | LB/H/ENG | 872 | 852 | 811 | 765 | 733 | 713 |
| | FC | LB/H | 1743 | 1703 | 1621 | 1531 | 1466 | 1425 |
| | IAS | KT | 156 | 154 | 149 | 143 | 139 | 135 |
| | TAS | KT | 154.9 | 156.1 | 159.3 | 165.0 | 172.7 | 182.7 |
| 30000 | MACH | | 0.236 | 0.239 | 0.247 | 0.261 | 0.278 | 0.300 |
| | N1 | % | 48.2 | 48.9 | 50.9 | 54.3 | 58.2 | 62.6 |
| | FF | LB/H/ENG | 805 | 784 | 741 | 692 | 655 | 631 |
| | FC | LB/H | 1611 | 1568 | 1482 | 1383 | 1311 | 1262 |
| | IAS | KT | 151 | 149 | 144 | 137 | 132 | 128 |
| | TAS | KT | 150.1 | 151.0 | 153.6 | 158.3 | 164.6 | 172.9 |
| 26000 | MACH | | 0.229 | 0.231 | 0.238 | 0.250 | 0.265 | 0.284 |
| | N1 | % | 45.6 | 46.2 | 47.9 | 51.0 | 54.6 | 58.8 |
| | FF | LB/H/ENG | 743 | 721 | 675 | 621 | 581 | 553 |
| | FC | LB/H | 1486 | 1442 | 1349 | 1243 | 1163 | 1106 |

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# INFLIGHT DIVERSION

These charts are provided for the pilots to determine if the fuel remaining is enough to complete the trip at Long Range Cruise (LRC) mode from one point in cruise to an alternate airport. The charts also enable rapid determination of fuel and time required to proceed to an alternate airport.

Fuel and time are determined in the same way as the simplified flight planning charts, with distance to destination instead of trip distance, disregarding the climb phase.

The pilots can also use the charts in the opposite direction, i.e., entering with the fuel remaining on board and finding the range at a given flight level at LRC.

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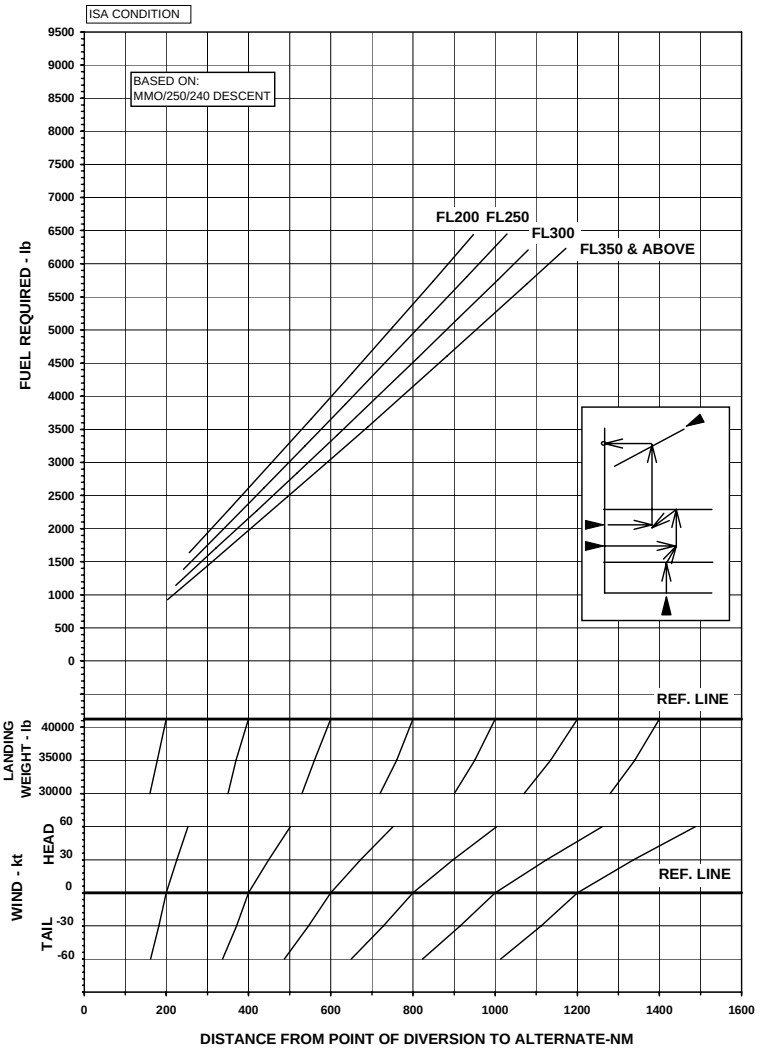
**EMB-145 INFLIGHT DIVERSION**
**AE3007A1 ENGINE**
**LONG RANGE CRUISE**

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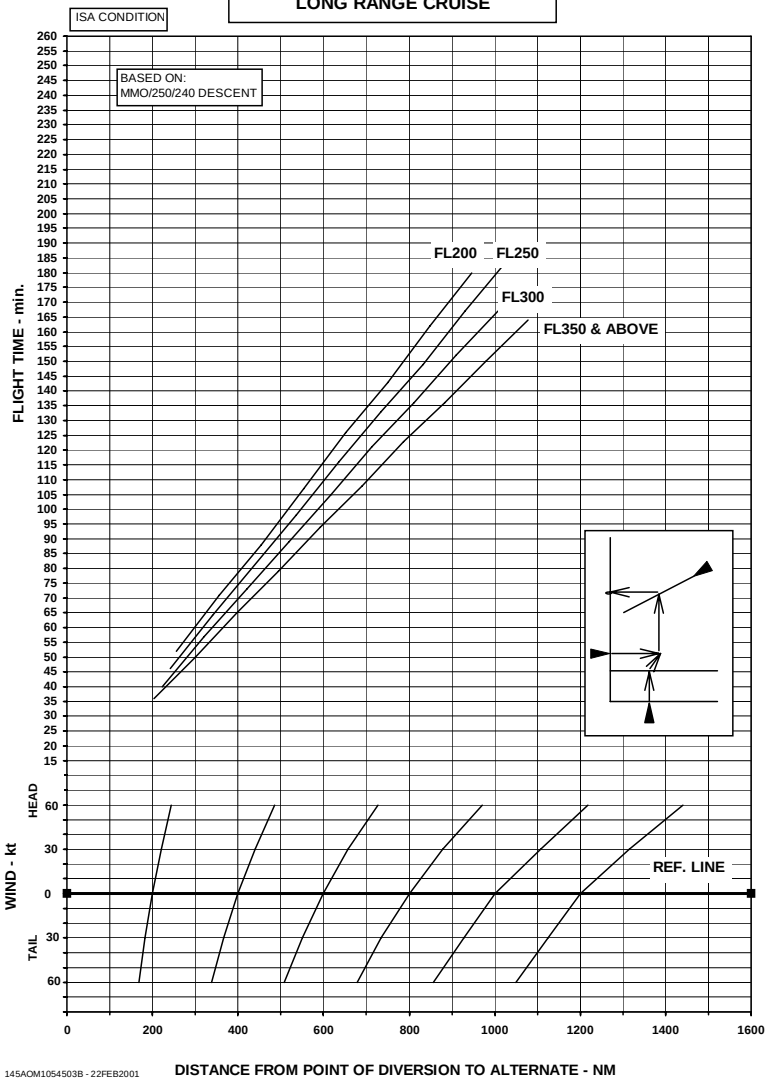
## EMB-145 INFLIGHT DIVERSION TIME
## AE3007A1 ENGINE
## LONG RANGE CRUISE




145AOM1054503B - 22FEB2001

# FLIGHT OVER MOUNTAINOUS AREA

Two situations must be considered when flying over mountainous areas, in order to clear route obstacles:

**Engine Failure**

For most normal cruise weights and altitudes, an airplane will not be able to maintain its cruise altitude following an engine failure, and will begin to descend (driftdown). In order to remain as high as possible, the pilot will use maximum continuous thrust on the remaining engine and slow down to the optimum driftdown speed, which is the speed that results in the lower descent gradient. The airplane will then descend along what is called the optimum driftdown profile. The optimum driftdown profile will keep the airplane as high as possible during the descent.

Regulations require that the actual airplane performance be calculated in the most conservative airplane configuration and then further decreased by a 1.1% climb gradient for two-engine airplanes. This reduced gradient path is called the en-route net flight path and is used toensure en-route obstacle clearance (FAR 25.123 / CS 25.123).

During a driftdown, the available thrust increases as the airplane descends. Eventually, at a certain altitude the available thrust will become equal to the airplane drag, and the airplane will level off. This altitude is called the gross level off altitude. The gross level-off altitude, when corrected by the 1.1% gradient margin, is called the net level-off altitude and will depend on the atmospheric temperature and the airplane weight.

The airplane actual climb gradient (gross gradient) at the net level-off altitude will be 1.1%. The net gradient is the gross gradient subtracted by 1.1%. Obviously, the net gradient is zero at the net level off altitude, and the gross gradient is zero at the gross level off altitude.

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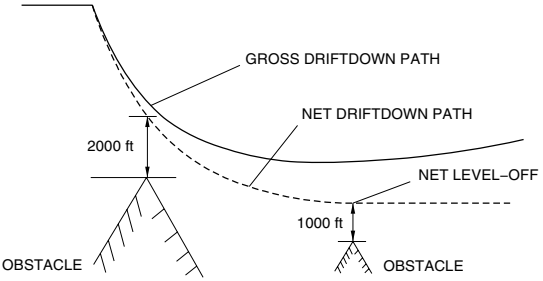
Regulations (FAR 121.191 / EU OPS 1.500) require that the airplane be able to clear all terrain by a given margin when an engine fails. Two means of compliance for en-route obstacle clearance are allowed:

– The net level-off altitude must clear all en-route obstacles by at least

1000 ft; or

– The net flight path must clear all en-route obstacles between the point where the engine is assumed to fail and an airport where a landing can be made by at least 2000 ft.




Prior to departure a detailed analysis of the route should be made using contour maps of the high terrain and plotting the highest points within the corridor's width along the route (or, alternatively, using Minimum En-Route Altitude, MEA, or Minimum Off Route Altitude, MORA). The next step is to determine if it is possible to maintain level flight with one engine inoperative 1000 ft above the highest point of the crossing. If this is not possible, or if the associated weight penalties are unacceptable, a driftdown procedure should be worked out, based on engine failure at the most critical point and clearing critical obstacles during the driftdown by at least 2000 ft. The minimum cruise altitude and the point of no return (PNR) are determined by the intersection of the two driftdown paths.

If an engine failure occurs after the PNR, the airplane will drift down on course. If the failure occurs before PNR, the airplane will have to turn back. In either flight direction the net flight path must clear the obstacles by 2000 ft.

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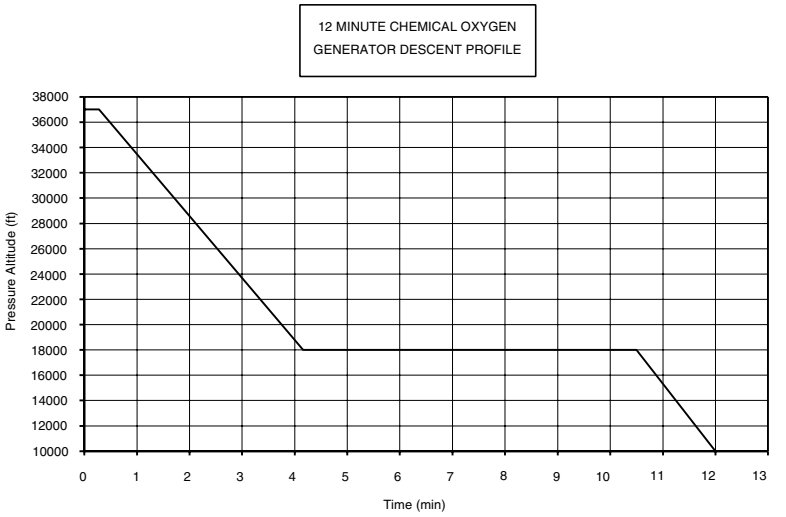
## Depressurization

The following charts present the passenger chemical oxygen generator descent profile. In case of an emergency descent, the airplane path must be at or below the generator profile in order to ensure sufficient supplemental breathing oxygen to the passengers.

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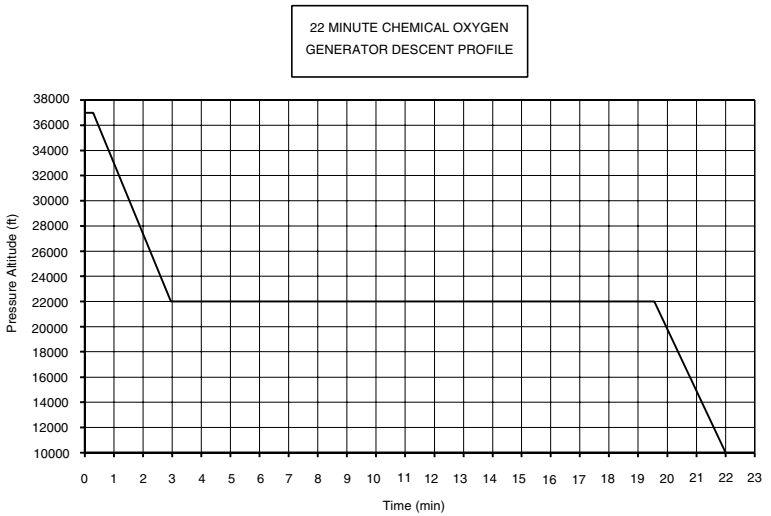


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# FLIGHT WITH ENGINE ANTI ICE VALVE LOCKED OPEN

This section presents altitude capability and cruise data for flight with all engines operating and the Engine Anti Ice Valve Locked Open according to DDPM procedure (30-21-01).

This set of data may be used in the following situations:

- Dispatch of the airplane with the Engine Anti Ice Valve Locked Open. In this case, the applicable AFM supplement must be observed for takeoff, driftdown and landing performance penalties.

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# CRUISE - ALTITUDE CAPABILITY TABLE

The table below permits quick determination of the altitude capability, based on the initial cruise weight. The table data are presented for various ISA conditions, all engines operating and Maximum Speed Cruise schedule. This table must be used only when the airplane is dispatched with the Engine Anti Ice Valve Locked Open in agreement with MEL and DDPM.

The established associated conditions are:

- Flaps ..... UP
- Gears ..... UP
- Bleeds ..... OPEN
- Anti Ice……..ON (Engine or all)

## CRUISE ALTITUDE CAPABILITY
## ENGINE ANTI ICE VALVE LOCKED OPEN
## ALL ENGINES OPERATING

**AE3007A1 AND A1P ENGINES, MAX SPEED CRUISE, CRUISE THRUST LIMITED**

| | ISA + °C | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Weight (lb)** | **-10** | **-5** | **0** | **5** | **10** | **15** | **20** | **25** | **30** | **35** |
| 50000 | 330 | 350 | 350 | 320 | 300 | 280 | 260 | 220 | 220 | 200 |
| 48000 | 330 | 360 | 360 | 330 | 310 | 290 | 270 | 240 | 230 | 220 |
| 46000 | 330 | 370 | 360 | 360 | 330 | 300 | 280 | 260 | 240 | 240 |
| 44000 | 330 | 370 | 370 | 370 | 350 | 320 | 290 | 270 | 250 | 250 |
| 42000 | 330 | 370 | 370 | 370 | 360 | 350 | 300 | 280 | 270 | 260 |
| 40000 | 330 | 370 | 370 | 370 | 370 | 360 | 330 | 290 | 280 | 270 |
| 38000 | 330 | 370 | 370 | 370 | 370 | 370 | 360 | 310 | 290 | 270 |
| 36000 | 330 | 370 | 370 | 370 | 370 | 370 | 360 | 340 | 300 | 290 |
| 34000 | 330 | 370 | 370 | 370 | 370 | 370 | 370 | 360 | 330 | 300 |
| 32000 | 330 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 360 | 320 |
| 30000 | 330 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 350 |
| 28000 | 330 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 370 | 360 |

**NOTE:** The weight values refer to the initial cruise weight.

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## CRUISE TABLES

The long range cruise and maximum speed cruise tables show N1, fuel flow, indicated airspeed, true airspeed, indicated Mach number, buffet margin and specific range. Data are presented for various weights in ISA conditions and corrections for ISA deviation.

In the long range cruise schedule, all engines operating or one engine inoperative, the airplane is flown at a speed corresponding to a specific range equal to 99% of maximum specific range. It is used when range is the principal factor.

In the maximum speed schedule, the airplane is flown in a speed resulting from maximum cruise power setting. It is used when minimum flight time is desired.

Thrust selection in cruise condition is adjusted to CRZ mode. The climb to cruise transition should be made as follows:

- After reaching the cruise level, allow the airplane to accelerate past 0.60M, before selecting cruise mode.
- When in cruise mode, adjust thrust to keep N1 or cruise speed constant (whichever occurs first).

The associated conditions are:

- Flaps.....UP
- Gear.....UP
- Bleeds.....OPEN
- Anti-Ice .....ON (Engine or all)

**NOTE:** The corrections (N1, Fuel Flow and TAS) given in the Long Range Cruise and Maximum Speed Cruise tables are applicable only to ISA -15°C to ISA +15°C range.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| | N1 | % | 66.7 | 71.6 | 72.1 | 72.7 | 73.2 | 73.9 | 74.5 | 75.2 | 75.9 | 76.6 |
| | F FLOW | LB/H/ENG | 1425 | 1447 | 1434 | 1420 | 1406 | 1396 | 1384 | 1376 | 1366 | 1358 |
| | IAS | KT | 250 | 260 | 258 | 257 | 255 | 254 | 253 | 252 | 250 | 249 |
| 50000 | TAS | KT | 269 | 300 | 303 | 306 | 309 | 312 | 315 | 319 | 322 | 325 |
| | INDICATED | MACH | 0.414 | 0.470 | 0.476 | 0.482 | 0.488 | 0.496 | 0.502 | 0.510 | 0.517 | 0.524 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.52 | 2.47 |
| | SR | NM/LB | 0.095 | 0.104 | 0.106 | 0.108 | 0.110 | 0.112 | 0.114 | 0.116 | 0.118 | 0.120 |
| | N1 | % | 66.1 | 70.7 | 71.2 | 71.8 | 72.3 | 73.0 | 73.6 | 74.2 | 74.9 | 75.6 |
| | F FLOW | LB/H/ENG | 1398 | 1396 | 1383 | 1370 | 1356 | 1347 | 1334 | 1325 | 1315 | 1306 |
| | IAS | KT | 250 | 256 | 255 | 254 | 252 | 251 | 249 | 248 | 247 | 246 |
| 48000 | TAS | KT | 269 | 296 | 299 | 302 | 304 | 308 | 311 | 314 | 317 | 320 |
| | INDICATED | MACH | 0.413 | 0.463 | 0.469 | 0.476 | 0.482 | 0.489 | 0.495 | 0.503 | 0.510 | 0.517 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.52 |
| | SR | NM/LB | 0.096 | 0.106 | 0.108 | 0.110 | 0.112 | 0.114 | 0.117 | 0.118 | 0.121 | 0.123 |
| | N1 | % | 65.6 | 69.8 | 70.3 | 70.9 | 71.4 | 72.1 | 72.6 | 73.3 | 73.9 | 74.6 |
| | F FLOW | LB/H/ENG | 1375 | 1348 | 1334 | 1320 | 1307 | 1298 | 1284 | 1275 | 1264 | 1255 |
| | IAS | KT | 250 | 252 | 251 | 250 | 248 | 247 | 246 | 245 | 243 | 242 |
| 46000 | TAS | KT | 268 | 291 | 294 | 297 | 300 | 303 | 306 | 310 | 313 | 316 |
| | INDICATED | MACH | 0.413 | 0.456 | 0.462 | 0.469 | 0.475 | 0.482 | 0.488 | 0.496 | 0.503 | 0.510 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.098 | 0.108 | 0.110 | 0.113 | 0.115 | 0.117 | 0.119 | 0.121 | 0.124 | 0.126 |
| | N1 | % | 65.0 | 68.9 | 69.5 | 70.0 | 70.5 | 71.1 | 71.6 | 72.3 | 72.9 | 73.5 |
| | F FLOW | LB/H/ENG | 1352 | 1302 | 1288 | 1275 | 1259 | 1249 | 1235 | 1226 | 1214 | 1205 |
| | IAS | KT | 250 | 249 | 248 | 246 | 245 | 244 | 242 | 241 | 240 | 238 |
| 44000 | TAS | KT | 268 | 287 | 290 | 293 | 295 | 299 | 301 | 305 | 308 | 311 |
| | INDICATED | MACH | 0.413 | 0.450 | 0.456 | 0.463 | 0.468 | 0.475 | 0.481 | 0.489 | 0.495 | 0.502 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.099 | 0.110 | 0.113 | 0.115 | 0.117 | 0.120 | 0.122 | 0.124 | 0.127 | 0.129 |
| | N1 | % | 64.5 | 68.0 | 68.5 | 69.0 | 69.6 | 70.1 | 70.7 | 71.3 | 71.8 | 72.5 |
| | F FLOW | LB/H/ENG | 1331 | 1254 | 1239 | 1226 | 1213 | 1200 | 1187 | 1177 | 1165 | 1155 |
| | IAS | KT | 250 | 245 | 243 | 242 | 241 | 240 | 238 | 237 | 236 | 235 |
| 42000 | TAS | KT | 268 | 282 | 285 | 288 | 291 | 294 | 297 | 300 | 303 | 306 |
| | INDICATED | MACH | 0.413 | 0.443 | 0.449 | 0.455 | 0.462 | 0.468 | 0.474 | 0.481 | 0.488 | 0.495 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.101 | 0.113 | 0.115 | 0.117 | 0.120 | 0.122 | 0.125 | 0.127 | 0.130 | 0.132 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 40000 | N1 | % | 64.1 | 66.9 | 67.5 | 68.1 | 68.6 | 69.1 | 69.7 | 70.2 | 70.8 | 71.4 |
| | F FLOW | LB/H/ENG | 1294 | 1207 | 1192 | 1178 | 1164 | 1152 | 1139 | 1128 | 1117 | 1107 |
| | IAS | KT | 247 | 241 | 239 | 238 | 237 | 236 | 235 | 233 | 232 | 231 |
| | TAS | KT | 265 | 278 | 280 | 283 | 286 | 289 | 292 | 295 | 298 | 301 |
| | INDICATED | MACH | 0.409 | 0.436 | 0.442 | 0.448 | 0.454 | 0.460 | 0.467 | 0.473 | 0.480 | 0.487 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.102 | 0.115 | 0.117 | 0.120 | 0.123 | 0.125 | 0.128 | 0.131 | 0.133 | 0.136 |
| 38000 | N1 | % | 62.9 | 65.9 | 66.5 | 67.1 | 67.6 | 68.1 | 68.6 | 69.2 | 69.7 | 70.3 |
| | F FLOW | LB/H/ENG | 1248 | 1163 | 1148 | 1134 | 1117 | 1104 | 1092 | 1080 | 1069 | 1058 |
| | IAS | KT | 243 | 237 | 236 | 235 | 233 | 232 | 231 | 229 | 228 | 227 |
| | TAS | KT | 260 | 273 | 276 | 279 | 281 | 284 | 286 | 289 | 292 | 295 |
| | INDICATED | MACH | 0.402 | 0.429 | 0.435 | 0.441 | 0.446 | 0.453 | 0.459 | 0.466 | 0.472 | 0.479 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.104 | 0.117 | 0.120 | 0.123 | 0.126 | 0.128 | 0.131 | 0.134 | 0.137 | 0.140 |
| 36000 | N1 | % | 61.7 | 64.7 | 65.3 | 65.9 | 66.5 | 67.1 | 67.6 | 68.1 | 68.6 | 69.2 |
| | F FLOW | LB/H/ENG | 1203 | 1116 | 1101 | 1087 | 1073 | 1060 | 1045 | 1033 | 1021 | 1011 |
| | IAS | KT | 239 | 233 | 232 | 230 | 229 | 228 | 226 | 225 | 224 | 223 |
| | TAS | KT | 256 | 268 | 270 | 273 | 276 | 279 | 281 | 284 | 287 | 290 |
| | INDICATED | MACH | 0.395 | 0.421 | 0.427 | 0.433 | 0.439 | 0.445 | 0.451 | 0.457 | 0.464 | 0.470 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.106 | 0.120 | 0.123 | 0.126 | 0.129 | 0.132 | 0.135 | 0.138 | 0.141 | 0.143 |
| 34000 | N1 | % | 60.6 | 63.5 | 64.1 | 64.7 | 65.3 | 65.8 | 66.4 | 67.0 | 67.5 | 68.0 |
| | F FLOW | LB/H/ENG | 1160 | 1070 | 1055 | 1040 | 1026 | 1013 | 1000 | 988 | 976 | 964 |
| | IAS | KT | 235 | 228 | 227 | 226 | 225 | 224 | 222 | 221 | 220 | 219 |
| | TAS | KT | 251 | 263 | 265 | 268 | 270 | 273 | 276 | 279 | 282 | 284 |
| | INDICATED | MACH | 0.389 | 0.414 | 0.419 | 0.425 | 0.431 | 0.437 | 0.443 | 0.449 | 0.456 | 0.462 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.108 | 0.123 | 0.126 | 0.129 | 0.132 | 0.135 | 0.138 | 0.141 | 0.144 | 0.147 |
| 32000 | N1 | % | 59.3 | 62.3 | 62.8 | 63.4 | 64.0 | 64.6 | 65.2 | 65.7 | 66.3 | 66.9 |
| | F FLOW | LB/H/ENG | 1115 | 1028 | 1010 | 995 | 980 | 967 | 954 | 941 | 929 | 918 |
| | IAS | KT | 231 | 224 | 223 | 221 | 220 | 219 | 218 | 217 | 215 | 214 |
| | TAS | KT | 246 | 258 | 260 | 262 | 265 | 267 | 270 | 273 | 276 | 278 |
| | INDICATED | MACH | 0.382 | 0.407 | 0.411 | 0.416 | 0.422 | 0.428 | 0.434 | 0.440 | 0.446 | 0.453 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.111 | 0.125 | 0.129 | 0.132 | 0.135 | 0.138 | 0.142 | 0.145 | 0.148 | 0.152 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 30000 | N1 | % | 58.1 | 60.8 | 61.5 | 62.1 | 62.6 | 63.2 | 63.8 | 64.4 | 65.0 | 65.6 |
| | F FLOW | LB/H/ENG | 1071 | 983 | 968 | 951 | 936 | 922 | 909 | 896 | 884 | 872 |
| | IAS | KT | 226 | 220 | 218 | 217 | 216 | 214 | 213 | 212 | 211 | 209 |
| | TAS | KT | 241 | 252 | 255 | 257 | 259 | 261 | 264 | 267 | 269 | 272 |
| | INDICATED | MACH | 0.374 | 0.398 | 0.403 | 0.408 | 0.413 | 0.419 | 0.425 | 0.431 | 0.437 | 0.443 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.113 | 0.128 | 0.132 | 0.135 | 0.138 | 0.142 | 0.145 | 0.149 | 0.152 | 0.156 |
| 28000 | N1 | % | 56.8 | 59.4 | 60.0 | 60.6 | 61.2 | 61.8 | 62.4 | 63.0 | 63.6 | 64.2 |
| | F FLOW | LB/H/ENG | 1029 | 939 | 923 | 908 | 894 | 878 | 864 | 851 | 839 | 827 |
| | IAS | KT | 222 | 215 | 214 | 212 | 211 | 210 | 208 | 207 | 206 | 205 |
| | TAS | KT | 236 | 246 | 249 | 251 | 253 | 256 | 258 | 261 | 263 | 266 |
| | INDICATED | MACH | 0.367 | 0.389 | 0.395 | 0.400 | 0.405 | 0.410 | 0.415 | 0.421 | 0.427 | 0.433 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.115 | 0.131 | 0.135 | 0.138 | 0.142 | 0.145 | 0.149 | 0.153 | 0.157 | 0.161 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| | N1 | % | 77.3 | 78.1 | 78.8 | 79.6 | 80.3 | 81.0 | 81.6 | 82.2 | 82.9 | 83.6 |
| | F FLOW | LB/H/ENG | 1352 | 1346 | 1341 | 1336 | 1330 | 1327 | 1325 | 1322 | 1322 | 1326 |
| | IAS | KT | 248 | 247 | 245 | 244 | 244 | 243 | 243 | 242 | 241 | 242 |
| 50000 | TAS | KT | 329 | 332 | 336 | 340 | 344 | 349 | 354 | 358 | 364 | 370 |
| | INDICATED | MACH | 0.532 | 0.540 | 0.548 | 0.556 | 0.566 | 0.576 | 0.587 | 0.597 | 0.608 | 0.621 |
| | BUFFET MARGIN | G | 2.42 | 2.37 | 2.33 | 2.28 | 2.23 | 2.19 | 2.14 | 2.09 | 2.04 | 1.99 |
| | SR | NM/LB | 0.122 | 0.123 | 0.125 | 0.127 | 0.129 | 0.131 | 0.134 | 0.136 | 0.138 | 0.139 |
| | N1 | % | 76.3 | 77.1 | 77.8 | 78.6 | 79.3 | 80.1 | 80.7 | 81.3 | 82.0 | 82.7 |
| | F FLOW | LB/H/ENG | 1299 | 1293 | 1287 | 1284 | 1276 | 1272 | 1269 | 1265 | 1265 | 1266 |
| | IAS | KT | 245 | 243 | 242 | 241 | 240 | 239 | 238 | 238 | 237 | 237 |
| 48000 | TAS | KT | 324 | 327 | 331 | 335 | 338 | 343 | 348 | 352 | 357 | 363 |
| | INDICATED | MACH | 0.525 | 0.533 | 0.540 | 0.549 | 0.557 | 0.567 | 0.577 | 0.587 | 0.598 | 0.610 |
| | BUFFET MARGIN | G | 2.47 | 2.42 | 2.37 | 2.33 | 2.27 | 2.23 | 2.18 | 2.13 | 2.09 | 2.04 |
| | SR | NM/LB | 0.125 | 0.127 | 0.129 | 0.130 | 0.133 | 0.135 | 0.137 | 0.139 | 0.141 | 0.143 |
| | N1 | % | 75.2 | 76.0 | 76.7 | 77.5 | 78.2 | 79.0 | 79.7 | 80.4 | 81.0 | 81.7 |
| | F FLOW | LB/H/ENG | 1247 | 1240 | 1233 | 1229 | 1224 | 1218 | 1214 | 1210 | 1209 | 1207 |
| | IAS | KT | 241 | 240 | 238 | 237 | 236 | 235 | 234 | 233 | 233 | 233 |
| 46000 | TAS | KT | 319 | 323 | 326 | 330 | 333 | 337 | 342 | 346 | 351 | 356 |
| | INDICATED | MACH | 0.517 | 0.525 | 0.532 | 0.541 | 0.549 | 0.557 | 0.567 | 0.577 | 0.588 | 0.599 |
| | BUFFET MARGIN | G | 2.52 | 2.47 | 2.42 | 2.37 | 2.32 | 2.27 | 2.23 | 2.18 | 2.13 | 2.08 |
| | SR | NM/LB | 0.128 | 0.130 | 0.132 | 0.134 | 0.136 | 0.138 | 0.141 | 0.143 | 0.145 | 0.148 |
| | N1 | % | 74.2 | 74.9 | 75.6 | 76.4 | 77.1 | 77.9 | 78.6 | 79.4 | 80.1 | 80.7 |
| | F FLOW | LB/H/ENG | 1196 | 1188 | 1181 | 1176 | 1170 | 1166 | 1160 | 1155 | 1154 | 1150 |
| | IAS | KT | 237 | 236 | 235 | 234 | 232 | 231 | 230 | 229 | 229 | 228 |
| 44000 | TAS | KT | 314 | 318 | 321 | 325 | 328 | 332 | 335 | 340 | 345 | 350 |
| | INDICATED | MACH | 0.510 | 0.517 | 0.525 | 0.533 | 0.541 | 0.549 | 0.557 | 0.567 | 0.578 | 0.588 |
| | BUFFET MARGIN | G | 2.56 | 2.52 | 2.47 | 2.43 | 2.37 | 2.33 | 2.27 | 2.23 | 2.18 | 2.13 |
| | SR | NM/LB | 0.131 | 0.134 | 0.136 | 0.138 | 0.140 | 0.142 | 0.145 | 0.147 | 0.149 | 0.152 |
| | N1 | % | 73.1 | 73.8 | 74.5 | 75.2 | 76.0 | 76.7 | 77.5 | 78.2 | 79.0 | 79.6 |
| | F FLOW | LB/H/ENG | 1146 | 1137 | 1130 | 1124 | 1117 | 1112 | 1108 | 1102 | 1100 | 1095 |
| | IAS | KT | 233 | 232 | 231 | 230 | 229 | 227 | 226 | 225 | 225 | 224 |
| 42000 | TAS | KT | 309 | 312 | 316 | 319 | 323 | 326 | 330 | 333 | 339 | 343 |
| | INDICATED | MACH | 0.502 | 0.509 | 0.517 | 0.525 | 0.532 | 0.540 | 0.549 | 0.557 | 0.568 | 0.578 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.53 | 2.48 | 2.43 | 2.38 | 2.33 | 2.27 | 2.23 | 2.18 |
| | SR | NM/LB | 0.135 | 0.137 | 0.140 | 0.142 | 0.144 | 0.147 | 0.149 | 0.151 | 0.154 | 0.157 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| | N1 | % | 72.0 | 72.7 | 73.3 | 74.0 | 74.7 | 75.5 | 76.3 | 77.0 | 77.8 | 78.5 |
| | F FLOW | LB/H/ENG | 1096 | 1087 | 1080 | 1072 | 1065 | 1059 | 1054 | 1050 | 1047 | 1041 |
| | IAS | KT | 230 | 228 | 227 | 226 | 225 | 224 | 222 | 221 | 220 | 219 |
| 40000 | TAS | KT | 304 | 307 | 310 | 314 | 317 | 321 | 324 | 328 | 332 | 336 |
| | INDICATED | MACH | 0.494 | 0.501 | 0.509 | 0.516 | 0.524 | 0.532 | 0.540 | 0.548 | 0.558 | 0.567 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.53 | 2.48 | 2.43 | 2.38 | 2.33 | 2.28 | 2.23 |
| | SR | NM/LB | 0.139 | 0.141 | 0.144 | 0.146 | 0.149 | 0.151 | 0.154 | 0.156 | 0.159 | 0.161 |
| | N1 | % | 70.9 | 71.5 | 72.2 | 72.8 | 73.5 | 74.2 | 75.0 | 75.8 | 76.6 | 77.3 |
| | F FLOW | LB/H/ENG | 1048 | 1038 | 1031 | 1022 | 1015 | 1008 | 1002 | 998 | 995 | 988 |
| | IAS | KT | 226 | 224 | 223 | 222 | 221 | 220 | 218 | 217 | 216 | 215 |
| 38000 | TAS | KT | 299 | 302 | 305 | 308 | 312 | 315 | 318 | 322 | 326 | 329 |
| | INDICATED | MACH | 0.486 | 0.493 | 0.500 | 0.507 | 0.515 | 0.523 | 0.531 | 0.539 | 0.548 | 0.555 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.54 | 2.49 | 2.44 | 2.39 | 2.35 | 2.28 |
| | SR | NM/LB | 0.142 | 0.145 | 0.148 | 0.151 | 0.153 | 0.156 | 0.159 | 0.161 | 0.164 | 0.167 |
| | N1 | % | 69.8 | 70.4 | 71.0 | 71.6 | 72.3 | 73.0 | 73.7 | 74.5 | 75.2 | 76.0 |
| | F FLOW | LB/H/ENG | 1000 | 990 | 981 | 972 | 966 | 958 | 952 | 948 | 941 | 938 |
| | IAS | KT | 222 | 220 | 219 | 218 | 217 | 216 | 214 | 214 | 212 | 211 |
| 36000 | TAS | KT | 293 | 296 | 299 | 302 | 306 | 309 | 312 | 316 | 320 | 323 |
| | INDICATED | MACH | 0.477 | 0.484 | 0.491 | 0.498 | 0.506 | 0.514 | 0.521 | 0.530 | 0.538 | 0.546 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.51 | 2.46 | 2.40 | 2.35 |
| | SR | NM/LB | 0.146 | 0.149 | 0.152 | 0.155 | 0.158 | 0.161 | 0.164 | 0.167 | 0.170 | 0.172 |
| | N1 | % | 68.6 | 69.2 | 69.8 | 70.4 | 71.0 | 71.7 | 72.4 | 73.1 | 73.8 | 74.6 |
| | F FLOW | LB/H/ENG | 953 | 943 | 934 | 925 | 918 | 910 | 903 | 897 | 890 | 888 |
| | IAS | KT | 217 | 216 | 215 | 214 | 213 | 212 | 210 | 209 | 208 | 207 |
| 34000 | TAS | KT | 287 | 290 | 294 | 297 | 300 | 303 | 307 | 310 | 313 | 317 |
| | INDICATED | MACH | 0.468 | 0.475 | 0.482 | 0.489 | 0.497 | 0.504 | 0.512 | 0.520 | 0.527 | 0.537 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.53 | 2.47 | 2.43 |
| | SR | NM/LB | 0.151 | 0.154 | 0.157 | 0.160 | 0.164 | 0.167 | 0.170 | 0.173 | 0.176 | 0.179 |
| | N1 | % | 67.4 | 68.0 | 68.6 | 69.1 | 69.7 | 70.4 | 71.0 | 71.7 | 72.4 | 73.1 |
| | F FLOW | LB/H/ENG | 907 | 897 | 888 | 878 | 870 | 863 | 855 | 846 | 840 | 835 |
| | IAS | KT | 213 | 212 | 211 | 210 | 208 | 208 | 206 | 205 | 204 | 203 |
| 32000 | TAS | KT | 281 | 285 | 288 | 291 | 294 | 297 | 301 | 303 | 307 | 310 |
| | INDICATED | MACH | 0.459 | 0.466 | 0.473 | 0.480 | 0.487 | 0.495 | 0.502 | 0.509 | 0.517 | 0.525 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.54 | 2.49 |
| | SR | NM/LB | 0.155 | 0.159 | 0.162 | 0.166 | 0.169 | 0.172 | 0.176 | 0.179 | 0.182 | 0.186 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| 30000 | N1 | % | 66.2 | 66.7 | 67.2 | 67.8 | 68.4 | 69.0 | 69.6 | 70.2 | 71.0 | 71.6 |
| | F FLOW | LB/H/ENG | 861 | 850 | 840 | 831 | 823 | 815 | 806 | 798 | 793 | 785 |
| | IAS | KT | 208 | 207 | 206 | 205 | 204 | 203 | 201 | 200 | 199 | 198 |
| | TAS | KT | 275 | 278 | 281 | 284 | 287 | 290 | 293 | 296 | 300 | 303 |
| | INDICATED | MACH | 0.449 | 0.456 | 0.462 | 0.469 | 0.477 | 0.484 | 0.491 | 0.498 | 0.506 | 0.513 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.160 | 0.163 | 0.167 | 0.171 | 0.175 | 0.178 | 0.182 | 0.186 | 0.189 | 0.193 |
| 28000 | N1 | % | 64.8 | 65.3 | 65.9 | 66.4 | 67.0 | 67.6 | 68.2 | 68.8 | 69.4 | 70.1 |
| | F FLOW | LB/H/ENG | 816 | 805 | 794 | 785 | 775 | 767 | 758 | 751 | 745 | 737 |
| | IAS | KT | 203 | 202 | 201 | 200 | 199 | 198 | 196 | 195 | 195 | 193 |
| | TAS | KT | 269 | 271 | 274 | 277 | 280 | 283 | 286 | 289 | 293 | 296 |
| | INDICATED | MACH | 0.439 | 0.445 | 0.452 | 0.458 | 0.465 | 0.472 | 0.479 | 0.487 | 0.495 | 0.502 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.165 | 0.169 | 0.173 | 0.177 | 0.181 | 0.185 | 0.189 | 0.193 | 0.197 | 0.201 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 50000 | N1 | % | 84.2 | 84.9 | 85.6 | 85.6 | 86.1 | 86.6 | 86.8 | - | - |
| | F FLOW | LB/H/ENG | 1327 | 1330 | 1335 | 1312 | 1303 | 1285 | 1198 | - | - |
| | IAS | KT | 241 | 241 | 241 | 236 | 234 | 230 | 210 | - | - |
| | TAS | KT | 375 | 381 | 388 | 386 | 390 | 390 | 364 | - | - |
| | INDICATED | MACH | 0.633 | 0.646 | 0.659 | 0.660 | 0.669 | 0.672 | 0.630 | - | - |
| | BUFFET MARGIN | G | 1.94 | 1.88 | 1.82 | 1.74 | 1.68 | 1.60 | 1.47 | - | - |
| | SR | NM/LB | 0.141 | 0.143 | 0.145 | 0.147 | 0.150 | 0.152 | 0.152 | - | - |
| 48000 | N1 | % | 83.3 | 84.0 | 84.7 | 85.3 | 86.1 | 86.6 | 86.6 | 86.8 | - |
| | F FLOW | LB/H/ENG | 1266 | 1270 | 1273 | 1278 | 1285 | 1311 | 1236 | 1163 | - |
| | IAS | KT | 237 | 237 | 237 | 237 | 237 | 240 | 226 | 210 | - |
| | TAS | KT | 368 | 375 | 380 | 387 | 394 | 405 | 390 | 371 | - |
| | INDICATED | MACH | 0.622 | 0.635 | 0.648 | 0.661 | 0.676 | 0.700 | 0.676 | 0.646 | - |
| | BUFFET MARGIN | G | 1.98 | 1.93 | 1.87 | 1.81 | 1.75 | 1.69 | 1.60 | 1.48 | - |
| | SR | NM/LB | 0.145 | 0.147 | 0.149 | 0.151 | 0.153 | 0.155 | 0.158 | 0.160 | - |
| 46000 | N1 | % | 82.3 | 83.0 | 83.7 | 84.4 | 85.1 | 85.8 | 86.8 | 86.6 | - |
| | F FLOW | LB/H/ENG | 1207 | 1208 | 1213 | 1215 | 1221 | 1229 | 1236 | 1190 | - |
| | IAS | KT | 232 | 232 | 232 | 232 | 232 | 233 | 233 | 224 | - |
| | TAS | KT | 362 | 367 | 373 | 379 | 386 | 393 | 400 | 392 | - |
| | INDICATED | MACH | 0.611 | 0.623 | 0.636 | 0.649 | 0.663 | 0.679 | 0.694 | 0.684 | - |
| | BUFFET MARGIN | G | 2.03 | 1.98 | 1.93 | 1.87 | 1.81 | 1.75 | 1.68 | 1.59 | - |
| | SR | NM/LB | 0.150 | 0.152 | 0.154 | 0.156 | 0.158 | 0.160 | 0.162 | 0.165 | - |
| 44000 | N1 | % | 81.4 | 82.0 | 82.7 | 83.4 | 84.1 | 84.7 | 85.5 | 86.5 | 86.3 |
| | F FLOW | LB/H/ENG | 1151 | 1151 | 1152 | 1156 | 1158 | 1162 | 1171 | 1178 | 1098 |
| | IAS | KT | 228 | 228 | 227 | 227 | 227 | 227 | 228 | 228 | 211 |
| | TAS | KT | 355 | 360 | 366 | 372 | 378 | 384 | 392 | 399 | 380 |
| | INDICATED | MACH | 0.601 | 0.612 | 0.624 | 0.638 | 0.650 | 0.664 | 0.681 | 0.696 | 0.663 |
| | BUFFET MARGIN | G | 2.09 | 2.03 | 1.98 | 1.93 | 1.87 | 1.80 | 1.74 | 1.67 | 1.56 |
| | SR | NM/LB | 0.154 | 0.157 | 0.159 | 0.161 | 0.163 | 0.165 | 0.167 | 0.170 | 0.173 |
| 42000 | N1 | % | 80.4 | 81.0 | 81.6 | 82.3 | 83.0 | 83.7 | 84.4 | 85.1 | 86.1 |
| | F FLOW | LB/H/ENG | 1097 | 1094 | 1092 | 1094 | 1098 | 1101 | 1105 | 1112 | 1117 |
| | IAS | KT | 224 | 223 | 223 | 222 | 222 | 223 | 222 | 223 | 221 |
| | TAS | KT | 349 | 354 | 358 | 364 | 370 | 377 | 383 | 390 | 396 |
| | INDICATED | MACH | 0.590 | 0.601 | 0.612 | 0.624 | 0.638 | 0.652 | 0.665 | 0.681 | 0.692 |
| | BUFFET MARGIN | G | 2.14 | 2.09 | 2.03 | 1.98 | 1.93 | 1.87 | 1.80 | 1.74 | 1.66 |
| | SR | NM/LB | 0.159 | 0.162 | 0.164 | 0.166 | 0.169 | 0.171 | 0.173 | 0.175 | 0.177 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 40000 | N1 | % | 79.2 | 79.9 | 80.5 | 81.2 | 81.9 | 82.6 | 83.3 | 84.0 | 85.4 |
| | F FLOW | LB/H/ENG | 1039 | 1037 | 1036 | 1035 | 1036 | 1040 | 1045 | 1048 | 1058 |
| | IAS | KT | 219 | 218 | 218 | 218 | 217 | 217 | 218 | 217 | 218 |
| | TAS | KT | 341 | 346 | 351 | 356 | 362 | 368 | 375 | 381 | 390 |
| | INDICATED | MACH | 0.578 | 0.588 | 0.600 | 0.612 | 0.624 | 0.638 | 0.652 | 0.666 | 0.681 |
| | BUFFET MARGIN | G | 2.19 | 2.14 | 2.09 | 2.04 | 1.98 | 1.93 | 1.87 | 1.81 | 1.74 |
| | SR | NM/LB | 0.164 | 0.167 | 0.170 | 0.172 | 0.175 | 0.177 | 0.179 | 0.182 | 0.184 |
| 38000 | N1 | % | 78.1 | 78.7 | 79.4 | 80.1 | 80.8 | 81.4 | 82.1 | 82.8 | 84.2 |
| | F FLOW | LB/H/ENG | 985 | 982 | 981 | 980 | 979 | 980 | 982 | 987 | 995 |
| | IAS | KT | 214 | 214 | 213 | 213 | 213 | 212 | 212 | 212 | 212 |
| | TAS | KT | 334 | 338 | 344 | 349 | 354 | 360 | 366 | 373 | 381 |
| | INDICATED | MACH | 0.566 | 0.576 | 0.588 | 0.600 | 0.611 | 0.623 | 0.637 | 0.651 | 0.666 |
| | BUFFET MARGIN | G | 2.24 | 2.19 | 2.15 | 2.10 | 2.04 | 1.99 | 1.93 | 1.87 | 1.81 |
| | SR | NM/LB | 0.169 | 0.172 | 0.175 | 0.178 | 0.181 | 0.184 | 0.186 | 0.189 | 0.191 |
| 36000 | N1 | % | 76.7 | 77.5 | 78.3 | 78.9 | 79.6 | 80.2 | 80.9 | 81.6 | 83.0 |
| | F FLOW | LB/H/ENG | 932 | 929 | 928 | 926 | 924 | 923 | 923 | 925 | 932 |
| | IAS | KT | 209 | 209 | 209 | 208 | 208 | 207 | 207 | 207 | 207 |
| | TAS | KT | 326 | 331 | 336 | 342 | 347 | 352 | 357 | 363 | 371 |
| | INDICATED | MACH | 0.554 | 0.564 | 0.576 | 0.587 | 0.598 | 0.610 | 0.622 | 0.635 | 0.649 |
| | BUFFET MARGIN | G | 2.29 | 2.25 | 2.21 | 2.16 | 2.11 | 2.05 | 2.00 | 1.94 | 1.88 |
| | SR | NM/LB | 0.175 | 0.178 | 0.181 | 0.184 | 0.188 | 0.191 | 0.193 | 0.196 | 0.199 |
| 34000 | N1 | % | 75.4 | 76.1 | 76.9 | 77.7 | 78.3 | 79.0 | 79.7 | 80.3 | 81.8 |
| | F FLOW | LB/H/ENG | 881 | 878 | 875 | 873 | 870 | 868 | 867 | 867 | 874 |
| | IAS | KT | 206 | 205 | 204 | 203 | 203 | 202 | 202 | 202 | 202 |
| | TAS | KT | 320 | 324 | 329 | 334 | 338 | 343 | 349 | 354 | 362 |
| | INDICATED | MACH | 0.544 | 0.553 | 0.563 | 0.574 | 0.585 | 0.596 | 0.608 | 0.620 | 0.634 |
| | BUFFET MARGIN | G | 2.37 | 2.31 | 2.27 | 2.22 | 2.17 | 2.12 | 2.06 | 2.01 | 1.95 |
| | SR | NM/LB | 0.182 | 0.185 | 0.188 | 0.191 | 0.195 | 0.198 | 0.201 | 0.204 | 0.207 |
| 32000 | N1 | % | 73.9 | 74.7 | 75.5 | 76.2 | 77.0 | 77.7 | 78.4 | 79.0 | 80.4 |
| | F FLOW | LB/H/ENG | 831 | 828 | 823 | 819 | 817 | 814 | 813 | 812 | 815 |
| | IAS | KT | 202 | 201 | 199 | 198 | 198 | 197 | 197 | 196 | 196 |
| | TAS | KT | 314 | 318 | 321 | 325 | 330 | 335 | 340 | 345 | 352 |
| | INDICATED | MACH | 0.534 | 0.543 | 0.551 | 0.560 | 0.571 | 0.582 | 0.594 | 0.606 | 0.618 |
| | BUFFET MARGIN | G | 2.44 | 2.39 | 2.33 | 2.28 | 2.23 | 2.18 | 2.13 | 2.08 | 2.02 |
| | SR | NM/LB | 0.189 | 0.192 | 0.195 | 0.199 | 0.202 | 0.206 | 0.209 | 0.213 | 0.216 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# LONG RANGE CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 30000 | N1 | % | 72.4 | 73.1 | 73.9 | 74.7 | 75.5 | 76.3 | 77.0 | 77.6 | 79.0 |
| | F FLOW | LB/H/ENG | 782 | 775 | 771 | 767 | 764 | 762 | 760 | 758 | 759 |
| | IAS | KT | 197 | 196 | 195 | 193 | 192 | 192 | 191 | 191 | 190 |
| | TAS | KT | 307 | 310 | 314 | 318 | 321 | 326 | 331 | 336 | 342 |
| | INDICATED | MACH | 0.523 | 0.530 | 0.538 | 0.547 | 0.556 | 0.567 | 0.578 | 0.590 | 0.601 |
| | BUFFET MARGIN | G | 2.52 | 2.46 | 2.40 | 2.35 | 2.29 | 2.25 | 2.20 | 2.15 | 2.09 |
| | SR | NM/LB | 0.197 | 0.200 | 0.204 | 0.207 | 0.210 | 0.214 | 0.218 | 0.222 | 0.226 |
| 28000 | N1 | % | 70.8 | 71.5 | 72.2 | 73.0 | 73.8 | 74.6 | 75.4 | 76.2 | 77.6 |
| | F FLOW | LB/H/ENG | 731 | 725 | 721 | 717 | 713 | 711 | 707 | 705 | 706 |
| | IAS | KT | 192 | 191 | 190 | 189 | 188 | 187 | 186 | 185 | 185 |
| | TAS | KT | 299 | 303 | 306 | 310 | 314 | 318 | 322 | 327 | 333 |
| | INDICATED | MACH | 0.510 | 0.518 | 0.526 | 0.535 | 0.543 | 0.553 | 0.562 | 0.574 | 0.585 |
| | BUFFET MARGIN | G | 2.56 | 2.54 | 2.49 | 2.44 | 2.38 | 2.33 | 2.27 | 2.22 | 2.17 |
| | SR | NM/LB | 0.205 | 0.209 | 0.212 | 0.216 | 0.220 | 0.224 | 0.228 | 0.232 | 0.236 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

### ALTITUDE: 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 50000 | N1 | % | 66.7 | 78.1 | 78.9 | 79.8 | 80.1 | 80.6 | 80.8 | 82.1 | 82.5 | 83.6 |
| | F FLOW | LB/H/ENG | 1425 | 1968 | 1969 | 1970 | 1942 | 1916 | 1872 | 1903 | 1876 | 1922 |
| | IAS | KT | 250 | 318 | 318 | 318 | 316 | 313 | 309 | 310 | 307 | 310 |
| | TAS | KT | 269 | 368 | 373 | 379 | 380 | 382 | 383 | 391 | 393 | 403 |
| | INDICATED | MACH | 0.414 | 0.574 | 0.584 | 0.595 | 0.600 | 0.606 | 0.609 | 0.624 | 0.630 | 0.648 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.095 | 0.093 | 0.095 | 0.096 | 0.098 | 0.100 | 0.102 | 0.103 | 0.105 | 0.105 |
| 48000 | N1 | % | 66.1 | 77.7 | 78.5 | 79.4 | 80.1 | 80.6 | 80.8 | 82.0 | 82.5 | 83.6 |
| | F FLOW | LB/H/ENG | 1398 | 1947 | 1947 | 1948 | 1945 | 1922 | 1876 | 1909 | 1882 | 1929 |
| | IAS | KT | 250 | 319 | 319 | 319 | 318 | 316 | 311 | 314 | 311 | 314 |
| | TAS | KT | 269 | 368 | 373 | 379 | 383 | 386 | 386 | 395 | 397 | 407 |
| | INDICATED | MACH | 0.413 | 0.575 | 0.585 | 0.596 | 0.605 | 0.612 | 0.614 | 0.631 | 0.637 | 0.655 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.096 | 0.095 | 0.096 | 0.097 | 0.098 | 0.100 | 0.103 | 0.103 | 0.105 | 0.105 |
| 46000 | N1 | % | 65.6 | 77.4 | 78.2 | 79.0 | 79.8 | 80.6 | 80.8 | 82.0 | 82.5 | 83.6 |
| | F FLOW | LB/H/ENG | 1375 | 1926 | 1925 | 1926 | 1928 | 1927 | 1882 | 1912 | 1886 | 1936 |
| | IAS | KT | 250 | 320 | 320 | 320 | 320 | 318 | 314 | 316 | 313 | 317 |
| | TAS | KT | 268 | 368 | 373 | 379 | 384 | 388 | 389 | 397 | 399 | 410 |
| | INDICATED | MACH | 0.413 | 0.576 | 0.586 | 0.597 | 0.608 | 0.617 | 0.621 | 0.636 | 0.642 | 0.662 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.098 | 0.096 | 0.097 | 0.098 | 0.100 | 0.101 | 0.103 | 0.104 | 0.106 | 0.106 |
| 44000 | N1 | % | 65.0 | 77.1 | 77.9 | 78.7 | 79.5 | 80.2 | 80.8 | 82.0 | 82.4 | 83.4 |
| | F FLOW | LB/H/ENG | 1352 | 1905 | 1904 | 1905 | 1906 | 1909 | 1886 | 1916 | 1893 | 1932 |
| | IAS | KT | 250 | 320 | 320 | 320 | 320 | 320 | 317 | 319 | 317 | 320 |
| | TAS | KT | 268 | 368 | 373 | 379 | 384 | 390 | 392 | 400 | 403 | 413 |
| | INDICATED | MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.609 | 0.620 | 0.625 | 0.641 | 0.649 | 0.667 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.099 | 0.097 | 0.098 | 0.099 | 0.101 | 0.102 | 0.104 | 0.104 | 0.106 | 0.107 |
| 42000 | N1 | % | 64.5 | 76.7 | 77.5 | 78.3 | 79.1 | 79.8 | 80.6 | 81.5 | 82.4 | 83.0 |
| | F FLOW | LB/H/ENG | 1331 | 1880 | 1878 | 1878 | 1879 | 1881 | 1884 | 1889 | 1897 | 1902 |
| | IAS | KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 319 | 320 |
| | TAS | KT | 268 | 367 | 373 | 378 | 383 | 389 | 395 | 400 | 406 | 412 |
| | INDICATED | MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.654 | 0.667 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.101 | 0.098 | 0.099 | 0.101 | 0.102 | 0.103 | 0.105 | 0.106 | 0.107 | 0.108 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 40000 | N1 | % | 64.1 | 76.4 | 77.1 | 77.9 | 78.7 | 79.4 | 80.2 | 81.0 | 81.9 | 82.7 |
| | F FLOW | LB/H/ENG | 1310 | 1855 | 1853 | 1852 | 1853 | 1854 | 1857 | 1861 | 1866 | 1872 |
| | IAS | KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS | KT | 268 | 367 | 372 | 377 | 383 | 388 | 394 | 400 | 406 | 412 |
| | INDICATED | MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.102 | 0.099 | 0.100 | 0.102 | 0.103 | 0.105 | 0.106 | 0.107 | 0.109 | 0.110 |
| 38000 | N1 | % | 63.5 | 76.0 | 76.7 | 77.5 | 78.3 | 79.0 | 79.8 | 80.6 | 81.4 | 82.3 |
| | F FLOW | LB/H/ENG | 1289 | 1832 | 1829 | 1828 | 1827 | 1828 | 1830 | 1833 | 1838 | 1843 |
| | IAS | KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS | KT | 267 | 366 | 371 | 377 | 382 | 388 | 394 | 399 | 405 | 411 |
| | INDICATED | MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.104 | 0.100 | 0.102 | 0.103 | 0.105 | 0.106 | 0.107 | 0.109 | 0.110 | 0.112 |
| 36000 | N1 | % | 62.9 | 75.6 | 76.4 | 77.1 | 77.9 | 78.6 | 79.4 | 80.2 | 81.0 | 81.9 |
| | F FLOW | LB/H/ENG | 1270 | 1809 | 1805 | 1803 | 1803 | 1803 | 1804 | 1807 | 1810 | 1815 |
| | IAS | KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS | KT | 267 | 366 | 371 | 376 | 382 | 387 | 393 | 399 | 405 | 411 |
| | INDICATED | MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.105 | 0.101 | 0.103 | 0.104 | 0.106 | 0.107 | 0.109 | 0.110 | 0.112 | 0.113 |
| 34000 | N1 | % | 62.4 | 75.3 | 76.0 | 76.7 | 77.5 | 78.2 | 79.0 | 79.7 | 80.6 | 81.4 |
| | F FLOW | LB/H/ENG | 1251 | 1786 | 1782 | 1780 | 1778 | 1778 | 1779 | 1781 | 1784 | 1788 |
| | IAS | KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS | KT | 267 | 365 | 370 | 376 | 381 | 387 | 392 | 398 | 404 | 410 |
| | INDICATED | MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.107 | 0.102 | 0.104 | 0.105 | 0.107 | 0.109 | 0.110 | 0.112 | 0.113 | 0.115 |
| 32000 | N1 | % | 61.9 | 75.0 | 75.6 | 76.4 | 77.1 | 77.8 | 78.6 | 79.3 | 80.1 | 81.0 |
| | F FLOW | LB/H/ENG | 1232 | 1764 | 1759 | 1756 | 1754 | 1753 | 1754 | 1755 | 1757 | 1761 |
| | IAS | KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS | KT | 266 | 365 | 370 | 375 | 381 | 386 | 392 | 398 | 403 | 409 |
| | INDICATED | MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.108 | 0.103 | 0.105 | 0.107 | 0.108 | 0.110 | 0.112 | 0.113 | 0.115 | 0.116 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 5000 FT TO 18000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 5000 | 10000 | 11000 | 12000 | 13000 | 14000 | 15000 | 16000 | 17000 | 18000 |
| 30000 | N1 | % | 61.4 | 74.7 | 75.3 | 76.0 | 76.7 | 77.4 | 78.2 | 78.9 | 79.7 | 80.5 |
| | F FLOW | LB/H/ENG | 1214 | 1741 | 1737 | 1733 | 1730 | 1729 | 1728 | 1729 | 1731 | 1733 |
| | IAS | KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS | KT | 266 | 364 | 369 | 374 | 380 | 385 | 391 | 397 | 403 | 409 |
| | INDICATED | MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.110 | 0.104 | 0.106 | 0.108 | 0.110 | 0.112 | 0.113 | 0.115 | 0.116 | 0.118 |
| 28000 | N1 | % | 60.9 | 74.3 | 75.0 | 75.6 | 76.3 | 77.0 | 77.7 | 78.5 | 79.2 | 80.0 |
| | F FLOW | LB/H/ENG | 1197 | 1719 | 1714 | 1710 | 1707 | 1705 | 1704 | 1704 | 1705 | 1707 |
| | IAS | KT | 250 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| | TAS | KT | 266 | 363 | 369 | 374 | 379 | 385 | 390 | 396 | 402 | 408 |
| | INDICATED | MACH | 0.413 | 0.576 | 0.587 | 0.598 | 0.608 | 0.620 | 0.631 | 0.643 | 0.655 | 0.667 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SPECIFIC RANGE | NM/LB | 0.111 | 0.106 | 0.107 | 0.109 | 0.111 | 0.113 | 0.115 | 0.116 | 0.118 | 0.119 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| | N1 | % | 83.7 | 84.3 | 85.1 | 85.4 | 85.4 | 86.0 | 85.9 | 86.7 | 86.1 | 86.4 |
| | F FLOW | LB/H/ENG | 1873 | 1866 | 1881 | 1851 | 1802 | 1803 | 1732 | 1767 | 1639 | 1616 |
| | IAS | KT | 305 | 304 | 304 | 301 | 297 | 297 | 290 | 293 | 280 | 277 |
| 50000 | TAS | KT | 402 | 407 | 413 | 415 | 415 | 421 | 419 | 430 | 417 | 421 |
| | INDICATED | MACH | 0.650 | 0.660 | 0.672 | 0.679 | 0.682 | 0.696 | 0.695 | 0.715 | 0.698 | 0.707 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.55 | 2.44 | 2.34 | 2.24 | 2.14 |
| | SR | NM/LB | 0.107 | 0.109 | 0.110 | 0.112 | 0.115 | 0.117 | 0.121 | 0.122 | 0.127 | 0.130 |
| | N1 | % | 83.7 | 84.3 | 85.1 | 85.4 | 85.4 | 86.0 | 85.8 | 86.7 | 86.0 | 86.3 |
| | F FLOW | LB/H/ENG | 1879 | 1872 | 1889 | 1859 | 1807 | 1808 | 1737 | 1772 | 1647 | 1624 |
| | IAS | KT | 309 | 308 | 308 | 304 | 299 | 299 | 292 | 295 | 283 | 281 |
| 48000 | TAS | KT | 406 | 411 | 417 | 419 | 418 | 424 | 422 | 433 | 422 | 425 |
| | INDICATED | MACH | 0.657 | 0.667 | 0.680 | 0.686 | 0.688 | 0.701 | 0.700 | 0.721 | 0.706 | 0.715 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.54 | 2.43 | 2.33 | 2.22 |
| | SR | NM/LB | 0.108 | 0.110 | 0.110 | 0.113 | 0.116 | 0.117 | 0.121 | 0.122 | 0.128 | 0.131 |
| | N1 | % | 83.7 | 84.2 | 85.1 | 85.3 | 85.4 | 85.9 | 85.8 | 86.7 | 86.0 | 86.3 |
| | F FLOW | LB/H/ENG | 1885 | 1879 | 1896 | 1868 | 1815 | 1813 | 1743 | 1777 | 1655 | 1629 |
| | IAS | KT | 312 | 311 | 311 | 308 | 303 | 301 | 295 | 298 | 287 | 283 |
| 46000 | TAS | KT | 410 | 415 | 421 | 423 | 422 | 427 | 425 | 436 | 427 | 428 |
| | INDICATED | MACH | 0.664 | 0.674 | 0.687 | 0.694 | 0.695 | 0.706 | 0.705 | 0.726 | 0.714 | 0.721 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.53 | 2.42 | 2.31 |
| | SR | NM/LB | 0.109 | 0.110 | 0.111 | 0.113 | 0.116 | 0.118 | 0.122 | 0.122 | 0.129 | 0.132 |
| | N1 | % | 83.6 | 84.2 | 85.0 | 85.3 | 85.4 | 85.9 | 85.8 | 86.6 | 86.0 | 86.3 |
| | F FLOW | LB/H/ENG | 1889 | 1883 | 1904 | 1876 | 1822 | 1821 | 1748 | 1782 | 1661 | 1637 |
| | IAS | KT | 315 | 314 | 315 | 312 | 306 | 305 | 297 | 300 | 289 | 287 |
| 44000 | TAS | KT | 413 | 417 | 425 | 427 | 427 | 431 | 428 | 439 | 430 | 433 |
| | INDICATED | MACH | 0.669 | 0.680 | 0.695 | 0.701 | 0.703 | 0.714 | 0.711 | 0.732 | 0.720 | 0.729 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.53 | 2.41 |
| | SR | NM/LB | 0.109 | 0.111 | 0.112 | 0.114 | 0.117 | 0.118 | 0.122 | 0.123 | 0.129 | 0.132 |
| | N1 | % | 83.6 | 84.2 | 85.0 | 85.3 | 85.3 | 85.9 | 85.7 | 86.6 | 86.0 | 86.2 |
| | F FLOW | LB/H/ENG | 1895 | 1890 | 1912 | 1885 | 1828 | 1826 | 1755 | 1784 | 1666 | 1642 |
| | IAS | KT | 318 | 317 | 318 | 315 | 309 | 308 | 301 | 302 | 292 | 289 |
| 42000 | TAS | KT | 417 | 421 | 429 | 431 | 429 | 434 | 432 | 440 | 433 | 436 |
| | INDICATED | MACH | 0.676 | 0.687 | 0.702 | 0.709 | 0.709 | 0.720 | 0.719 | 0.735 | 0.726 | 0.735 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.51 |
| | SR | NM/LB | 0.110 | 0.112 | 0.112 | 0.114 | 0.117 | 0.119 | 0.123 | 0.123 | 0.130 | 0.133 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| | N1 | % | 83.3 | 84.2 | 84.8 | 85.3 | 85.3 | 85.8 | 85.7 | 86.5 | 85.9 | 86.2 |
| | F FLOW | LB/H/ENG | 1879 | 1894 | 1898 | 1890 | 1836 | 1835 | 1763 | 1791 | 1671 | 1647 |
| | IAS | KT | 320 | 320 | 320 | 318 | 312 | 311 | 305 | 306 | 294 | 292 |
| 40000 | TAS | KT | 418 | 424 | 430 | 434 | 434 | 439 | 436 | 444 | 436 | 439 |
| | INDICATED | MACH | 0.680 | 0.692 | 0.706 | 0.714 | 0.717 | 0.728 | 0.727 | 0.744 | 0.732 | 0.741 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.111 | 0.112 | 0.113 | 0.115 | 0.118 | 0.119 | 0.124 | 0.124 | 0.130 | 0.133 |
| | N1 | % | 83.0 | 83.7 | 84.4 | 85.1 | 85.3 | 85.8 | 85.7 | 86.5 | 85.9 | 86.2 |
| | F FLOW | LB/H/ENG | 1850 | 1858 | 1867 | 1876 | 1844 | 1843 | 1769 | 1798 | 1679 | 1649 |
| | IAS | KT | 320 | 320 | 320 | 320 | 316 | 315 | 307 | 309 | 298 | 293 |
| 38000 | TAS | KT | 417 | 423 | 430 | 436 | 438 | 443 | 439 | 449 | 440 | 441 |
| | INDICATED | MACH | 0.680 | 0.693 | 0.706 | 0.719 | 0.724 | 0.736 | 0.733 | 0.752 | 0.740 | 0.744 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.113 | 0.114 | 0.115 | 0.116 | 0.119 | 0.120 | 0.124 | 0.125 | 0.131 | 0.134 |
| | N1 | % | 82.6 | 83.3 | 84.0 | 84.7 | 85.2 | 85.8 | 85.6 | 86.4 | 85.8 | 86.1 |
| | F FLOW | LB/H/ENG | 1821 | 1828 | 1836 | 1845 | 1850 | 1852 | 1777 | 1803 | 1687 | 1656 |
| | IAS | KT | 320 | 320 | 320 | 320 | 319 | 319 | 311 | 312 | 302 | 297 |
| 36000 | TAS | KT | 417 | 423 | 429 | 436 | 441 | 447 | 444 | 452 | 445 | 445 |
| | INDICATED | MACH | 0.680 | 0.693 | 0.706 | 0.719 | 0.730 | 0.744 | 0.741 | 0.758 | 0.749 | 0.753 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.114 | 0.116 | 0.117 | 0.118 | 0.119 | 0.121 | 0.125 | 0.125 | 0.132 | 0.134 |
| | N1 | % | 82.2 | 82.9 | 83.6 | 84.3 | 84.9 | 85.5 | 85.6 | 86.3 | 85.8 | 86.0 |
| | F FLOW | LB/H/ENG | 1793 | 1799 | 1807 | 1815 | 1824 | 1834 | 1785 | 1809 | 1693 | 1663 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 315 | 316 | 304 | 301 |
| 34000 | TAS | KT | 416 | 422 | 429 | 435 | 442 | 448 | 448 | 456 | 448 | 450 |
| | INDICATED | MACH | 0.680 | 0.693 | 0.706 | 0.719 | 0.733 | 0.747 | 0.750 | 0.766 | 0.755 | 0.762 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.116 | 0.117 | 0.119 | 0.120 | 0.121 | 0.122 | 0.126 | 0.126 | 0.132 | 0.135 |
| | N1 | % | 81.8 | 82.5 | 83.2 | 83.9 | 84.5 | 85.1 | 85.5 | 86.3 | 85.7 | 85.9 |
| | F FLOW | LB/H/ENG | 1765 | 1771 | 1777 | 1785 | 1793 | 1802 | 1790 | 1814 | 1700 | 1670 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 317 | 318 | 308 | 305 |
| 32000 | TAS | KT | 415 | 422 | 428 | 434 | 441 | 448 | 451 | 459 | 452 | 454 |
| | INDICATED | MACH | 0.680 | 0.693 | 0.706 | 0.719 | 0.733 | 0.747 | 0.755 | 0.773 | 0.763 | 0.771 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.118 | 0.119 | 0.120 | 0.122 | 0.123 | 0.124 | 0.126 | 0.127 | 0.133 | 0.136 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 19000 FT TO 28000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 19000 | 20000 | 21000 | 22000 | 23000 | 24000 | 25000 | 26000 | 27000 | 28000 |
| 30000 | N1 | % | 81.4 | 82.1 | 82.8 | 83.5 | 84.1 | 84.7 | 85.3 | 86.1 | 85.7 | 85.9 |
| | F FLOW | LB/H/ENG | 1737 | 1742 | 1748 | 1754 | 1762 | 1770 | 1779 | 1809 | 1708 | 1675 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 322 | 312 | 307 |
| | TAS | KT | 415 | 421 | 427 | 434 | 440 | 447 | 454 | 463 | 457 | 458 |
| | INDICATED | MACH | 0.680 | 0.693 | 0.706 | 0.719 | 0.733 | 0.747 | 0.761 | 0.780 | 0.772 | 0.777 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.119 | 0.121 | 0.122 | 0.124 | 0.125 | 0.126 | 0.128 | 0.128 | 0.134 | 0.137 |
| 28000 | N1 | % | 80.9 | 81.7 | 82.4 | 83.0 | 83.7 | 84.3 | 84.9 | 85.7 | 85.6 | 85.4 |
| | F FLOW | LB/H/ENG | 1710 | 1714 | 1719 | 1725 | 1732 | 1739 | 1747 | 1776 | 1714 | 1645 |
| | IAS | KT | 320 | 320 | 320 | 320 | 320 | 320 | 320 | 322 | 315 | 309 |
| | TAS | KT | 414 | 420 | 426 | 433 | 439 | 446 | 453 | 462 | 460 | 458 |
| | INDICATED | MACH | 0.680 | 0.693 | 0.706 | 0.719 | 0.733 | 0.747 | 0.761 | 0.780 | 0.779 | 0.780 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 |
| | SR | NM/LB | 0.121 | 0.123 | 0.124 | 0.126 | 0.127 | 0.128 | 0.130 | 0.130 | 0.134 | 0.139 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 50000 | N1 | % | 86.1 | 85.7 | 85.8 | 85.6 | 86.1 | 86.6 | 86.8 | - | - |
| | F FLOW | LB/H/ENG | 1525 | 1439 | 1391 | 1312 | 1303 | 1285 | 1198 | - | - |
| | IAS | KT | 266 | 256 | 249 | 236 | 234 | 230 | 210 | - | - |
| | TAS | KT | 412 | 402 | 399 | 386 | 390 | 390 | 364 | - | - |
| | INDICATED | MACH | 0.695 | 0.682 | 0.680 | 0.660 | 0.669 | 0.672 | 0.630 | - | - |
| | BUFFET MARGIN | G | 2.04 | 1.94 | 1.85 | 1.74 | 1.68 | 1.60 | 1.47 | - | - |
| | SR | NM/LB | 0.135 | 0.140 | 0.144 | 0.147 | 0.150 | 0.152 | 0.152 | - | - |
| 48000 | N1 | % | 86.0 | 85.7 | 85.7 | 85.6 | 86.0 | 86.6 | 86.6 | 86.8 | - |
| | F FLOW | LB/H/ENG | 1535 | 1454 | 1405 | 1335 | 1326 | 1311 | 1236 | 1163 | - |
| | IAS | KT | 271 | 261 | 255 | 245 | 243 | 240 | 226 | 210 | - |
| | TAS | KT | 418 | 410 | 408 | 400 | 403 | 405 | 390 | 371 | - |
| | INDICATED | MACH | 0.706 | 0.696 | 0.694 | 0.684 | 0.693 | 0.700 | 0.676 | 0.646 | - |
| | BUFFET MARGIN | G | 2.13 | 2.03 | 1.94 | 1.84 | 1.77 | 1.69 | 1.60 | 1.48 | - |
| | SR | NM/LB | 0.136 | 0.141 | 0.145 | 0.150 | 0.152 | 0.155 | 0.158 | 0.160 | - |
| 46000 | N1 | % | 86.0 | 85.7 | 85.7 | 85.5 | 86.0 | 86.5 | 86.5 | 86.6 | - |
| | F FLOW | LB/H/ENG | 1543 | 1466 | 1417 | 1349 | 1340 | 1329 | 1259 | 1190 | - |
| | IAS | KT | 275 | 266 | 259 | 251 | 249 | 247 | 236 | 224 | - |
| | TAS | KT | 423 | 417 | 414 | 408 | 412 | 416 | 406 | 392 | - |
| | INDICATED | MACH | 0.714 | 0.707 | 0.706 | 0.698 | 0.708 | 0.718 | 0.704 | 0.684 | - |
| | BUFFET MARGIN | G | 2.21 | 2.12 | 2.02 | 1.93 | 1.84 | 1.76 | 1.68 | 1.59 | - |
| | SR | NM/LB | 0.137 | 0.142 | 0.146 | 0.151 | 0.154 | 0.156 | 0.161 | 0.165 | - |
| 44000 | N1 | % | 85.9 | 85.7 | 85.7 | 85.5 | 86.0 | 86.5 | 86.4 | 86.4 | 86.3 |
| | F FLOW | LB/H/ENG | 1550 | 1475 | 1428 | 1361 | 1355 | 1343 | 1275 | 1208 | 1098 |
| | IAS | KT | 278 | 269 | 264 | 255 | 255 | 253 | 243 | 233 | 211 |
| | TAS | KT | 427 | 422 | 420 | 414 | 420 | 424 | 416 | 407 | 380 |
| | INDICATED | MACH | 0.723 | 0.716 | 0.717 | 0.710 | 0.723 | 0.733 | 0.723 | 0.709 | 0.663 |
| | BUFFET MARGIN | G | 2.31 | 2.21 | 2.11 | 2.02 | 1.92 | 1.82 | 1.75 | 1.67 | 1.56 |
| | SR | NM/LB | 0.138 | 0.143 | 0.147 | 0.152 | 0.155 | 0.158 | 0.163 | 0.168 | 0.173 |
| 42000 | N1 | % | 85.9 | 85.7 | 85.7 | 85.5 | 85.9 | 86.5 | 86.3 | 86.2 | 86.1 |
| | F FLOW | LB/H/ENG | 1555 | 1484 | 1436 | 1372 | 1366 | 1356 | 1289 | 1222 | 1117 |
| | IAS | KT | 280 | 273 | 267 | 260 | 259 | 257 | 249 | 240 | 221 |
| | TAS | KT | 430 | 426 | 425 | 421 | 427 | 431 | 425 | 417 | 396 |
| | INDICATED | MACH | 0.729 | 0.725 | 0.726 | 0.722 | 0.735 | 0.746 | 0.739 | 0.728 | 0.692 |
| | BUFFET MARGIN | G | 2.41 | 2.31 | 2.20 | 2.11 | 2.00 | 1.89 | 1.81 | 1.74 | 1.66 |
| | SR | NM/LB | 0.139 | 0.144 | 0.148 | 0.153 | 0.156 | 0.159 | 0.165 | 0.171 | 0.177 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 40000 | N1 | % | 85.8 | 85.6 | 85.6 | 85.5 | 85.9 | 86.5 | 86.3 | 86.1 | 86.0 |
| | F FLOW | LB/H/ENG | 1559 | 1493 | 1444 | 1381 | 1375 | 1369 | 1301 | 1231 | 1133 |
| | IAS | KT | 283 | 276 | 271 | 264 | 263 | 262 | 254 | 244 | 229 |
| | TAS | KT | 434 | 431 | 430 | 426 | 432 | 438 | 432 | 424 | 409 |
| | INDICATED | MACH | 0.735 | 0.733 | 0.735 | 0.731 | 0.744 | 0.758 | 0.751 | 0.741 | 0.715 |
| | BUFFET MARGIN | G | 2.52 | 2.41 | 2.30 | 2.20 | 2.08 | 1.96 | 1.88 | 1.81 | 1.74 |
| | SR | NM/LB | 0.139 | 0.144 | 0.149 | 0.154 | 0.157 | 0.160 | 0.166 | 0.172 | 0.181 |
| 38000 | N1 | % | 85.8 | 85.6 | 85.6 | 85.4 | 85.9 | 86.5 | 86.3 | 86.1 | 85.9 |
| | F FLOW | LB/H/ENG | 1563 | 1499 | 1450 | 1389 | 1384 | 1380 | 1314 | 1242 | 1144 |
| | IAS | KT | 286 | 279 | 274 | 267 | 266 | 266 | 259 | 249 | 235 |
| | TAS | KT | 437 | 434 | 433 | 431 | 437 | 443 | 439 | 432 | 418 |
| | INDICATED | MACH | 0.741 | 0.740 | 0.741 | 0.740 | 0.754 | 0.768 | 0.764 | 0.754 | 0.732 |
| | BUFFET MARGIN | G | 2.56 | 2.52 | 2.40 | 2.30 | 2.17 | 2.03 | 1.95 | 1.88 | 1.82 |
| | SR | NM/LB | 0.140 | 0.145 | 0.149 | 0.155 | 0.158 | 0.161 | 0.167 | 0.174 | 0.183 |
| 36000 | N1 | % | 85.8 | 85.6 | 85.6 | 85.4 | 85.9 | 86.5 | 86.3 | 86.0 | 85.8 |
| | F FLOW | LB/H/ENG | 1565 | 1505 | 1455 | 1398 | 1394 | 1391 | 1326 | 1255 | 1157 |
| | IAS | KT | 287 | 282 | 276 | 271 | 270 | 270 | 262 | 254 | 241 |
| | TAS | KT | 438 | 437 | 437 | 436 | 442 | 448 | 444 | 439 | 427 |
| | INDICATED | MACH | 0.744 | 0.746 | 0.748 | 0.750 | 0.763 | 0.778 | 0.774 | 0.768 | 0.748 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.52 | 2.40 | 2.26 | 2.10 | 2.02 | 1.95 | 1.90 |
| | SR | NM/LB | 0.140 | 0.145 | 0.150 | 0.156 | 0.159 | 0.161 | 0.168 | 0.175 | 0.185 |
| 34000 | N1 | % | 85.6 | 85.6 | 85.5 | 85.4 | 85.9 | 86.1 | 86.0 | 86.0 | 85.8 |
| | F FLOW | LB/H/ENG | 1573 | 1514 | 1461 | 1404 | 1400 | 1375 | 1319 | 1267 | 1166 |
| | IAS | KT | 292 | 285 | 279 | 273 | 273 | 271 | 264 | 258 | 245 |
| | TAS | KT | 445 | 442 | 440 | 439 | 445 | 449 | 447 | 445 | 433 |
| | INDICATED | MACH | 0.756 | 0.755 | 0.754 | 0.756 | 0.770 | 0.780 | 0.780 | 0.780 | 0.759 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.52 | 2.36 | 2.21 | 2.11 | 2.01 | 1.98 |
| | SR | NM/LB | 0.141 | 0.146 | 0.150 | 0.156 | 0.159 | 0.163 | 0.169 | 0.176 | 0.186 |
| 32000 | N1 | % | 85.6 | 85.5 | 85.5 | 85.4 | 85.9 | 85.7 | 85.6 | 85.5 | 85.9 |
| | F FLOW | LB/H/ENG | 1577 | 1523 | 1469 | 1407 | 1406 | 1355 | 1299 | 1246 | 1179 |
| | IAS | KT | 295 | 289 | 283 | 275 | 275 | 271 | 264 | 258 | 250 |
| | TAS | KT | 448 | 447 | 445 | 441 | 449 | 448 | 447 | 445 | 440 |
| | INDICATED | MACH | 0.762 | 0.764 | 0.764 | 0.760 | 0.777 | 0.780 | 0.780 | 0.780 | 0.772 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.47 | 2.35 | 2.24 | 2.13 | 2.06 |
| | SR | NM/LB | 0.142 | 0.147 | 0.151 | 0.157 | 0.160 | 0.165 | 0.172 | 0.178 | 0.187 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# MAXIMUM SPEED CRUISE - ALL ENGINES OPERATING

## AE3007A1 and AE3007A1P ENGINES

## ALTITUDE: 29000 FT TO 37000 FT

CRUISE CONFIGURATION
BLEED: OPEN
ANTI ICE: ON (Engine or all)
ISA CONDITION

| WEIGHT (LB) | | | ALTITUDE (FT) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 29000 | 30000 | 31000 | 32000 | 33000 | 34000 | 35000 | 36000 | 37000 |
| 30000 | N1 | % | 85.5 | 85.5 | 85.4 | 85.3 | 85.6 | 85.4 | 85.2 | 85.1 | 85.7 |
| | F FLOW | LB/H/ENG | 1582 | 1532 | 1478 | 1419 | 1396 | 1337 | 1280 | 1226 | 1180 |
| | IAS | KT | 298 | 293 | 286 | 280 | 277 | 271 | 264 | 258 | 252 |
| | TAS | KT | 452 | 452 | 450 | 447 | 450 | 448 | 446 | 444 | 444 |
| | INDICATED | MACH | 0.771 | 0.774 | 0.773 | 0.773 | 0.780 | 0.780 | 0.780 | 0.780 | 0.780 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.50 | 2.38 | 2.27 | 2.16 |
| | SR | NM/LB | 0.143 | 0.147 | 0.152 | 0.158 | 0.161 | 0.168 | 0.174 | 0.181 | 0.188 |
| 28000 | N1 | % | 85.3 | 85.2 | 85.1 | 85.1 | 85.0 | 85.0 | 84.9 | 84.7 | 85.3 |
| | F FLOW | LB/H/ENG | 1583 | 1523 | 1467 | 1413 | 1361 | 1311 | 1262 | 1207 | 1160 |
| | IAS | KT | 302 | 296 | 289 | 283 | 277 | 271 | 264 | 258 | 252 |
| | TAS | KT | 457 | 455 | 453 | 451 | 449 | 447 | 445 | 443 | 443 |
| | INDICATED | MACH | 0.780 | 0.780 | 0.780 | 0.780 | 0.780 | 0.780 | 0.780 | 0.780 | 0.780 |
| | BUFFET MARGIN | G | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.54 | 2.43 | 2.31 |
| | SR | NM/LB | 0.144 | 0.149 | 0.154 | 0.160 | 0.165 | 0.171 | 0.176 | 0.184 | 0.191 |

INCREASE/DECREASE N1% BY 1.1% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE FUEL FLOW BY 1.2% PER 5°C ABOVE/BELOW ISA CONDITION.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITION.

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# SECTION 1-06

# WEIGHT AND BALANCE

TABLE OF CONTENTS

Page Block

Introduction ..... 1-06-00
Standard Terms and Definitions ..... 1-06-10
General Data ..... 1-06-15
Index System ..... 1-06-30
Center of Gravity Curtailments ..... 1-06-40
Balance Chart ..... 1-06-50
Sample Balance Chart (*) ..... 1-06-55

**NOTE:** Items marked with an asterisk (*) may not be present in this manual.

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# INTRODUCTION

This Section contains information equivalent to the Weight and Balance manual and is intended to assist the operator in defining the weight and balance system and constrained CG limits.

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# STANDARD TERMS AND DEFINITIONS

## EQUIPPED EMPTY WEIGHT (EEW) OR MANUFACTURER EMPTY WEIGHT (MEW)

It is the weight of structure, power plant, instruments, interior furnishings, systems, optional, portable, and emergency equipment and other items of equipment that are an integral part of the airplane configuration. It is essentially a dry weight, including only those fluids contained in closed systems such as oxygen, fire extinguisher agent, landing gear shock absorber fluid, etc...

## BASIC EMPTY WEIGHT (BEW)

It is the MEW plus the weight of the following items:

- APU oil
- Engine oil
- Hydraulic fluid
- Unusable fuel

## OPERATIONAL EMPTY WEIGHT (OEW) OR DRY OPERATING WEIGHT (DOW)

It is the BEW plus the weight of the operational items.

Operational items are those necessary for airplane operation and not included in the BEW.

The operational items are:

- Crew and crew baggage
- Navigation kit (manuals, charts, etc.)
- Catering (beverages and foods) and removable service equipment for galley (such as standard units, etc.)
- Lavatory rinse water
- Lavatory chemical fluid

## ACTUAL ZERO FUEL WEIGHT (AZFW)

This is the OEW plus actual payload.

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## PAYLOAD OR TOTAL TRAFFIC LOAD

This is the weight of passengers, baggage and cargo.

## MAXIMUM ALLOWABLE PAYLOAD

It is the maximum approved weight that can be loaded into the airplane. Maximum payload is the Maximum Zero Fuel Weight (MZFW) less Operational Empty Weight (OEW).

## MAXIMUM DESIGN ZERO FUEL WEIGHT (MZFW)

This is the maximum authorized weight before usable fuel be loaded. The MZFW is related to airplane structural limitations.

## MAXIMUM DESIGN RAMP WEIGHT (MRW)

This is the maximum authorized ramp weight.

## MAXIMUM DESIGN TAKEOFF WEIGHT (MTOW)

This is the maximum authorized weight for takeoff.

## MAXIMUM DESIGN LANDING WEIGHT (MLW)

This is the maximum authorized weight for landing.

## MINIMUM OPERATING WEIGHT (MOW)

This is the minimum authorized weight to operate the airplane.

## CENTER OF GRAVITY (CG)

This is the position where the mass of the aircraft is considered concentrated for balance purposes. It is normally referred to in terms of %MAC.

## AIRPLANE DATUM

This is a plane perpendicular to the fuselage centerline from where all arm measurements are taken.

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## MEAN AERODYNAMIC CHORD (MAC)

This is the chord of an imaginary rectangular airfoil with the same area of the actual wing and which produces the same resulting force vectors of the actual wing. The aircraft forward and aft CG limits are referred to in terms of %MAC.

## INDEX SYSTEM

This is a convention for presenting aircraft or body moments. It is the moment of the body converted to a different measuring system.

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# GENERAL DATA

The general data presented in this section is intended to be used for specific weight and balance calculations and is equivalent to the information contained in the Weight & Balance Manual.

## MAXIMUM GROSS WEIGHTS AND CENTER OF GRAVITY LIMITS

Refer to section 1-01-05.

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# BALANCE REFERENCE SYSTEM (EMB-145 MODELS)

## BALANCE ARMS/BODY STATION

Longitudinal location of the Centers of Gravity (CG) identified throughout this Manual regarding airplane and components will be referred to as Balance Arms. Balance Arms are the distance in inches from the Airplane Datum which is located at the zero station of the fuselage.

Balance Arms (BA) are equivalent to Body Station (BS) on the EMB-145 models.

## AIRPLANE DATUM

The Airplane Datum is a plane, perpendicular to the fuselage centerline, located at 535.47 in ahead of the wing stub front spar.

For external reference, the Datum is located at 649.61 in ahead of the wing jack points.

## WING MEAN AERODYNAMIC CHORD (MAC)

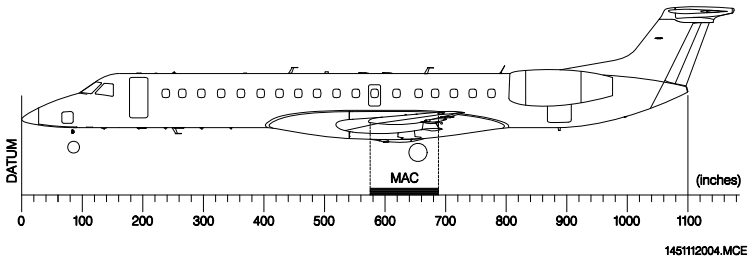
The length of the MAC is 112.80 in.

The leading edge of the MAC (LEMAC) is Balance Arm 574.80 in.

Percentage of MAC is obtained using the following formula:

$$\%MAC = \frac{(X - 574.80) \times 100}{112.80}$$

where X = Balance Arm of airplane CG measured in inches.

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# BALANCE REFERENCE SYSTEM (ERJ-140 ER AND LR MODELS)

## BALANCE ARMS/BODY STATION

Longitudinal location of the Centers of Gravity (CG) identified throughout this Manual regarding airplane and components will be referred to as Balance Arms. Balance Arms are the distance in inches from the Airplane Datum which is located at the zero station of the fuselage.

Balance Arms (BA) are equivalent to Body Station (BS) on the ERJ-140 ER and LR models.

## AIRPLANE DATUM

The Airplane Datum is a plane, perpendicular to the fuselage centerline, located at 499.45 in ahead of the wing stub front spar.

For external reference, the Datum is located at 613.58 in ahead of the wing jack points.

## WING MEAN AERODYNAMIC CHORD (MAC)

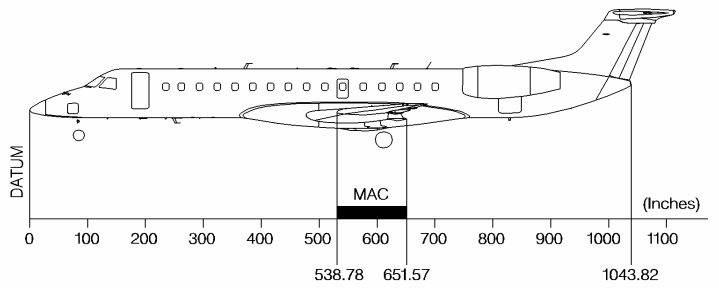
The length of the MAC is 112.80 in.

The leading edge of the MAC (LEMAC) is Balance Arm 538.78 in.

Percentage of MAC is obtained using the following formula:

$$\%MAC = \frac{(X - 538.78) \times 100}{112.80}$$

where X = Balance Arm of airplane CG measured in inches.

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# BALANCE REFERENCE SYSTEM (EMB-135 ER AND LR MODELS)

## BALANCE ARMS/BODY STATION

Longitudinal location of the Centers of Gravity (CG) identified throughout this Manual regarding airplane and components will be referred to as Balance Arms. Balance Arms are the distance in inches from the Airplane Datum which is located at the zero station of the fuselage.

Balance Arms (BA) are equivalent to Body Station (BS) on the EMB-135 ER and LR models.

## AIRPLANE DATUM

The Airplane Datum is a plane, perpendicular to the fuselage centerline, located at 456.50 in ahead of the wing stub front spar.

For external reference, the Datum is located at 570.63 in ahead of the wing jack points.

## WING MEAN AERODYNAMIC CHORD (MAC)

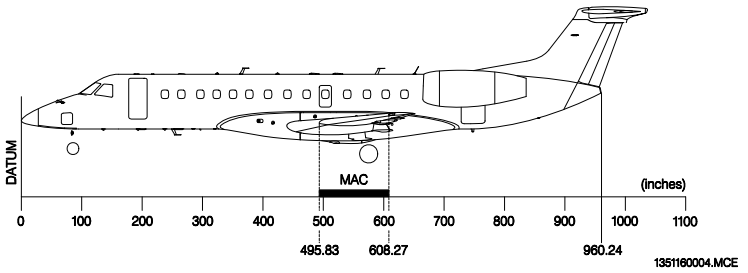
The length of the MAC is 112.80 in.

The leading edge of the MAC (LEMAC) is Balance Arm 495.83 in.

Percentage of MAC is obtained using the following formula:

$$\%MAC = \frac{(X - 495.83) \times 100}{112.80}$$

where X = Balance Arm of airplane CG measured in inches.

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# FUEL DATA

## FUEL DEFINITIONS

- USABLE FUEL - Is the fuel to be effectively consumed by the engines.
- UNUSABLE FUEL - Is the fuel remaining after total usable fuel has been consumed.
- DRAINABLE FUEL - Is that portion of fuel which can be drawn off through fuel drains with the airplane leveled.
- UNDRAINABLE FUEL - Is that portion of fuel which can not be drawn off by standard draining procedures.

## FUEL QUANTITIES (EMB-145 MODELS)

**EMB-145 ER, EP and MP Models:**

| FUEL CATEGORY | VOLUME (US Gal) | WEIGHT (lb) | CG BALANCE ARM (in) |
|---|---|---|---|
| UNUSABLE UNDRAINABLE | 1.6 | 11 | 580.31 |
| UNUSABLE DRAINABLE | 12.6 | 85 | 580.31 |
| TOTAL UNUSABLE | 14.2 | 96 | 580.31 |
| USABLE | 1359.6 | 9200 | 603.62 |

**EMB-145 LR Model:**

| FUEL CATEGORY | VOLUME (US Gal) | WEIGHT (lb) | CG BALANCE ARM (in) |
|---|---|---|---|
| UNUSABLE UNDRAINABLE | 2.6 | 17.6 | 580.31 |
| UNUSABLE DRAINABLE | 9.0 | 60.8 | 580.31 |
| TOTAL UNUSABLE | 11.6 | 78.4 | 580.31 |
| USABLE | 1689.8 | 11434.8 | 596.57 |

**NOTE:** Fuel density may range from 6.550 to 6.770 lb/US Gal. The values above have been determined for an adopted fuel density of 6.767 lb/US Gal.

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**EMB-145 XR Model:**

Wing Tank

| FUEL CATEGORY | VOLUME (US Gal) | WEIGHT (lb) | CG BALANCE ARM (in) |
|---|---|---|---|
| UNUSABLE UNDRAINABLE | 2.6 | 17.6 | 580.31 |
| UNUSABLE DRAINABLE | 9.0 | 60.8 | 580.31 |
| TOTAL UNUSABLE | 11.6 | 78.4 | 580.31 |
| USABLE | 1689.8 | 11434.8 | 596.57 |

Ventral Tank

| FUEL CATEGORY | VOLUME (US Gal) | WEIGHT (lb) | CG BALANCE ARM (in) |
|---|---|---|---|
| UNUSABLE UNDRAINABLE | 0.7 | 5.0 | 678.43 |
| UNUSABLE DRAINABLE | 2.4 | 16.1 | 680.63 |
| TOTAL UNUSABLE | 3.1 | 21.1 | 680.91 |
| USABLE | 275.3 | 1862.7 | 696.38 |

**NOTE:** The values above have been determined for an adopted fuel density of 6.767 lb/US Gal.

**FUEL QUANTITIES (ERJ-140 MODELS)**

**ERJ-140 ER Model:**

| FUEL CATEGORY | VOLUME (US Gal) | WEIGHT (lb) | CG BALANCE ARM (in) |
|---|---|---|---|
| UNUSABLE UNDRAINABLE | 1.6 | 11 | 544.29 |
| UNUSABLE DRAINABLE | 12.6 | 85 | 544.29 |
| TOTAL UNUSABLE | 14.2 | 96 | 544.29 |
| USABLE | 1359.6 | 9200 | 567.60 |

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**ERJ-140 LR Model:**

| FUEL CATEGORY | VOLUME (US Gal) | WEIGHT (lb) | CG BALANCE ARM (in) |
|---|---|---|---|
| UNUSABLE UNDRAINABLE | 2.6 | 17.6 | 544.29 |
| UNUSABLE DRAINABLE | 9.0 | 60.8 | 544.29 |
| TOTAL UNUSABLE | 11.6 | 78.4 | 544.29 |
| USABLE | 1689.8 | 11434.8 | 560.55 |

**NOTE:** Fuel density may range from 6.550 to 6.770 lb/US Gal. The values above have been determined for an adopted fuel density of 6.767 lb/US Gal.

**FUEL QUANTITIES (EMB-135 MODELS)**

**EMB-135 ER Model:**

| FUEL CATEGORY | VOLUME (US Gal) | WEIGHT (lb) | CG BALANCE ARM (in) |
|---|---|---|---|
| UNUSABLE UNDRAINABLE | 1.6 | 11 | 501.34 |
| UNUSABLE DRAINABLE | 12.6 | 85 | 501.34 |
| TOTAL UNUSABLE | 14.2 | 96 | 501.34 |
| USABLE | 1359.6 | 9200 | 524.65 |

**EMB-135 LR Model:**

| FUEL CATEGORY | VOLUME (US Gal) | WEIGHT (lb) | CG BALANCE ARM (in) |
|---|---|---|---|
| UNUSABLE UNDRAINABLE | 2.6 | 17.6 | 501.34 |
| UNUSABLE DRAINABLE | 9.0 | 60.8 | 501.34 |
| TOTAL UNUSABLE | 11.6 | 78.4 | 501.34 |
| USABLE | 1689.8 | 11434.8 | 518.00 |

**NOTE:** Fuel density may range from 6.550 to 6.770 lb/US Gal. The values above have been determined for an adopted fuel density of 6.767 lb/US Gal.

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## MISCELLANEOUS FLUIDS (EMB-145 MODELS)

| FLUID | WEIGHT (lb) | BALANCE ARM (in) |
|---|---|---|
| ENGINE OIL (1) | 53.0 | 879.13 |
| APU OIL (1) | 4.4 | 1070.47 |
| HYDRAULIC (2) | | |
| • *WITH THRUST REVERSER* | 79.4 | 735.43 |
| • *WITHOUT THRUST REVERSER* | 72.8 | 716.54 |
| LAVATORY CHEMICAL FLUID | 15.4 | 810.24 |
| LAVATORY RINSE WATER | 44.1 | 813.39 |

## (ERJ-140 MODELS)

| FLUID | WEIGHT (lb) | BALANCE ARM (in) |
|---|---|---|
| ENGINE OIL (1) | 53.0 | 823.43 |
| APU OIL (1) | 4.4 | 1014.76 |
| HYDRAULIC (2) | | |
| WITH THRUST REVERSER | 75.0 | 699.2 |
| WITHOUT THRUST REVERSER | 68.3 | 684.2 |
| LAVATORY CHEMICAL FLUID | 15.4 | 754.13 |
| LAVATORY RINSE WATER | 44.1 | 716.57 |

## (EMB-135 MODELS)

| FLUID | WEIGHT (lb) | BALANCE ARM (in) |
|---|---|---|
| ENGINE OIL (1) | 53.0 | 739.65 |
| APU OIL (1) | 4.4 | 930.71 |
| HYDRAULIC (2) | | |
| WITH THRUST REVERSER | 75.0 | 608.27 |
| WITHOUT THRUST REVERSER | 68.3 | 594.49 |
| LAVATORY CHEMICAL FLUID | 15.4 | 670.47 |
| LAVATORY RINSE WATER | 44.1 | 673.62 |

**NOTE: (1)** Adopted engine oil density (ref. MIL-L-7808): 8.17 lb/US Gal.
**(2)** Adopted hydraulic fluid density (ref. SAE AS 1241A TYPE IV): 8.26 lb/US Gal.

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## PITCH TRIM SETTING

**NOTE:** For takeoff when setting pitch trim to 8, first select 7 and stop trimming immediately when the value 8 is displayed. When setting pitch trim to 4, first select 5 and stop trimming immediately when the value 4 is displayed.

**EMB-145 MODELS**

| **CG POSITION (%)** | LESS THAN OR EQUAL TO 27.5 | 27.6 UP TO 32.5 | 32.6 UP TO 36.5 | 36.6 UP TO 41.5 | ABOVE OR EQUAL TO 41.6 |
|---|---|---|---|---|---|
| **PITCH TRIM UNITS** | 8 | 7 | 6 | 5 | 4 |

**ERJ-140 MODELS**

| **CG POSITION (%)** | LESS THAN OR EQUAL TO 27 | 27.1 UP TO 31.0 | 31.1 UP TO 34.0 | 34.1 UP TO 39.0 | ABOVE OR EQUAL TO 39.1 |
|---|---|---|---|---|---|
| **PITCH TRIM UNITS** | 8 | 7 | 6 | 5 | 4 |

**EMB-135 MODELS**

| **CG POSITION (%)** | LESS THAN OR EQUAL TO 26.5 | 26.6 UP TO 30.0 | 30.1 UP TO 33.0 | 33.1 UP TO 36.5 | ABOVE OR EQUAL TO 36.6 |
|---|---|---|---|---|---|
| **PITCH TRIM UNITS** | 8 | 7 | 6 | 5 | 4 |

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# PASSENGERS

## PASSENGER LOCATION

The passenger location and respective balance arm are shown in the applicable Interior Arrangement (Section 1-07-30).

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## PASSENGER WEIGHT

Actual or average passenger weights may be used to compute passenger loads.

Actual passenger weights should be used in case of flights carrying large groups of passengers whose average weight obviously does not conform with the normal standard weight such as athletic squads or other groups which are smaller or larger than the local average. The actual passenger weight may be either determined by scale weighing of each passenger, or by asking each passenger their weight and adding there to a predetermined constant to compensate the handcarried articles and clothing.

According to AC 120-27E, the following standard average weights may be adopted:

Summer Operation

- Adult passenger (*) ..... 190 lb
- Male ..... 200 lb
- Female ..... 179 lb
- Children (age 2-12) ..... 82 lb

Winter Operation

- Adult passenger (*) ..... 195 lb
- Male ..... 205 lb
- Female ..... 184 lb
- Children (age 2-12) ..... 87 lb

(*) Adult passenger weights are applicable only where the mix of male and female passengers is 60% / 40% respectively.

**NOTE: -** All passengers weights, except children, include 16 lb of carry-on baggage.
- Children under age 2 are considered "babies-in-arms" and children over age 12 should be treated as adult passengers for purposes of standard average weights.

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## FLIGHT CREW ITEMS

**(EMB-145 MODELS)**

| ITEM | WEIGHT (lb) | BALANCE ARM (in) |
|---|---|---|
| PILOT | 190 | 145.08 |
| COPILOT | 190 | 145.08 |
| OBSERVER | 190 | 167.64 |
| FWD ATTENDANT | 170 | 185.00 |
| AFT ATTENDANT | 170 | 787.44 |
| PILOT FLIGHT BAG | 20 | 152.87 |

**(ERJ-140 MODELS)**

| ITEM | WEIGHT (lb) | BALANCE ARM (in) |
|---|---|---|
| PILOT | 190 | 145.08 |
| COPILOT | 190 | 145.08 |
| OBSERVER | 190 | 167.64 |
| FWD ATTENDANT | 170 | 185.00 |
| AFT ATTENDANT | 170 | 731.97 |
| PILOT FLIGHT BAG | 20 | 152.87 |

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**(EMB-135 MODELS)**

| ITEM | WEIGHT (lb) | BALANCE ARM (in) |
|---|---|---|
| PILOT | 190 | 145.08 |
| COPILOT | 190 | 145.08 |
| OBSERVER | 190 | 167.64 |
| FWD ATTENDANT | 170 | 185.00 |
| AFT ATTENDANT | 170 | 646.46 |
| PILOT FLIGHT BAG | 20 | 152.87 |

**NOTE: -** The adopted flight crew items are in accordance with the approved average weight, not including the respective carry-on baggage.
- The crewmembers and attendants weights presented herein refer to male. (FAA AC120-27E).
- The balance arm of the Crewmember Roller Bag and the Flight Attendant Kit is the same as the balance arm of the Wardrobe or Galley in which they are located (refer to section 1-07-30 for more information).

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# INDEX SYSTEM

When determining the airplane center of gravity position it is necessary to make calculations adding and/or subtracting the moment caused by each individual item loaded in the airplane.

Moment, per definition, is weight multiplied by the distance to a reference point. If the moment of the airplane and of the items loaded on it are computed in reference to the airplane datum, very long numeric expressions would result.

As the operational usage of long numeric expressions may result in safety problems (since personnel may get confused with the long numbers), airlines usually adopt an **Index System** for weight and balance purposes.

The Index System is just a convention for presenting airplane or body moments on a different measuring system. When using the Index System, short numeric expressions result.

The Index System formula is presented below:

$$I = \frac{W \times (Arm - A)}{B} + C$$

where:

I = Index

W = Airplane or body weight

Arm = Airplane or body center of gravity

A = Reference arm. Selected arm around which all index values are calculated. On the balance chart CG envelope, the Reference Arm CG% line is the only vertical CG% line. (*)

B = Constant used as a denominator to convert moment values into index values. On the balance chart CG envelope, B controls the CG% lines splay (splay decreases with increasing B). (*)

C = Constant used as a plus value to avoid negative index figures. It is only used when computing the airplane Operating Empty Weight Index (OEI), and is not used when computing individual bodies index influence. On the balance chart CG envelope, the Reference Arm CG% vertical line is at C index units. (*)

(*) - Values for A, B and C may be chosen at the operator discretion.

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The Embraer recommended Index System formulas are:

EMB-145 Models: $$I = \frac{W \times (Arm - 590)}{17400} + 13$$

ERJ-140 Models: $$I = \frac{W \times (Arm - 550)}{17400} + 13$$

EMB-135 Models: $$I = \frac{W \times (Arm - 515)}{17400} + 13$$

## INDEX INFLUENCE

Index influence is the variation of index when a body is loaded or unloaded from the airplane. It is usually referred in index units per kilogram for variable weight bodies (cargo, catering, etc.), index units per passenger when computing passenger influence or index units for fixed weight bodies (flight attendant, cockpit observer, etc.).

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The following tables show the index influence for various items:

**INDEX INFLUENCE FOR EMB-145 MODELS**

| Item | Arm (in) | Reference Weight (lb) | Index Influence |
|---|---|---|---|
| Cargo / Baggage | 889.76 | 1 | + 0.017 IU/lb |
| Forward Galley (*) | 218.50 | 1 | - 0.021 IU/lb |
| Aft Galley (*) | 267.72 | 1 | - 0.018 IU/lb |
| Wardrobe (*) | 196.85 | 1 | - 0.023 IU/lb |
| RH Fwd Stowage Compt. | 218.50 | 1 | - 0.021 IU/lb |
| LH Fwd Stowage Compt. | 210.63 | 1 | - 0.022 IU/lb |
| Emerg. Equip. Stowage Unit | 210.63 | 1 | - 0.022 IU/lb |
| RH Aft Stowage Compt. | 728.40 | 1 | - 0.008 IU/lb |
| LH Aft Stowage Compt. | 728.40 | 1 | - 0.008 IU/lb |
| 2nd Flight Attendant | 782.68 | 180 | + 1.99 IU |
| Cockpit Observer | 165.35 | 190 | - 4.64 IU |
| Pax Cabin A (**) | 338.98 | 190 | - 2.74 IU/Pax |
| Pax Cabin B (**) | 508.66 | 190 | - 0.89 IU/Pax |
| Pax Cabin C (**) | 702.36 | 190 | + 1.23 IU/Pax |

(*) The galley and wardrobe arms are for the standard configuration. Check the airplane actual configuration arms in the AOM Loading Section.

(**) For the purposes of this table, the passenger cabin was divided in three sections. On a standard configuration (50 seats) airplane, section A refers to rows 1 to 6, section B refers to rows 7 to 12 and section C refers to rows 13 to 18.

Example: Computation of cargo index influence for the EMB-145.
The EMB-145 cargo compartment centroid is located 889.76 inches from the airplane datum.

The index influence per lb is:

$$I = \frac{1 \times (889.76 - 590)}{17400} = 0.017 IU/lb$$

So, for each lb of cargo loaded in the cargo compartment, the index increases by 0.017 index units.

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## INDEX INFLUENCE FOR ERJ-140 MODELS

| Item | Arm (in) | Reference Weight (lb) | Index Influence |
|---|---|---|---|
| Cargo / Baggage | 833.66 | 1 | + 0.016 IU/lb |
| Forward Galley (*) | 208.58 | 1 | - 0.020 IU/lb |
| Aft Galley (*) | 258.26 | 1 | - 0.017 IU/lb |
| Wardrobe (*) | 190.55 | 1 | - 0.021 IU/lb |
| RH Aft Stowage Cmpt. | 728.43 | 1 | + 0.010 IU/lb |
| LH Aft Stowage Cmpt. | 728.43 | 1 | + 0.010 IU/lb |
| Cockpit Observer | 165.35 | 190 | - 4.20 IU |
| Pax Cabin A (**) | 337.37 | 190 | - 2.32 IU/Pax |
| Pax Cabin B (**) | 491.88 | 190 | - 0.63 IU/Pax |
| Pax Cabin C (**) | 654.02 | 190 | + 1.14 IU/Pax |

(*) The galley and wardrobe arms are for the standard configuration. Check the airplane actual configuration arms in the AOM Loading Section.

(**) For the purposes of this table, the passenger cabin was divided in three sections. On a standard configuration (44 seats) airplane, section A refers to rows 1 to 6, section B refers to rows 7 to 11 and section C refers to rows 12 to 16.

Example: Computation of cargo index influence for the ERJ-140.
The ERJ-140 cargo compartment centroid is located 833.66 inches from the airplane datum.

The index influence per lb is:

$$I = \frac{1 \times (833.66 - 550)}{17400} = 0.016 \text{IU/lb}$$

So, for each lb of cargo loaded in the cargo compartment, the index increases by 0.016 index units.

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## INDEX INFLUENCE FOR EMB-135 MODELS

| Item | Arm (in) | Reference Weight (lb) | Index Influence |
|---|---|---|---|
| Cargo / Baggage | 750.00 | 1 | + 0.014 IU/lb |
| Forward Galley (*) | 190.55 | 1 | - 0.019 IU/lb |
| Aft Galley (*) | 216.54 | 1 | - 0.017 IU/lb |
| Wardrobe (*) | 216.54 | 1 | - 0.017 IU/lb |
| Cockpit Observer | 165.35 | 190 | - 3.82 IU |
| Pax Cabin A (**) | 330.71 | 190 | - 2.01 IU/Pax |
| Pax Cabin B (**) | 462.99 | 190 | - 0.57 IU/Pax |
| Pax Cabin C (**) | 593.70 | 190 | + 0.86 IU/Pax |

(*) The galley and wardrobe arms are for the option 1 configuration. Check the airplane actual configuration arms in the AOM Loading Section.

(**) For the purposes of this table, the passenger cabin was divided in three sections. On a standard configuration (37 seats) airplane, section A refers to rows 1 to 5, section B refers to rows 6 to 9 and section C refers to rows 10 to 13.

Example: Computation of cargo index influence for the EMB-135.
The EMB-135 cargo compartment centroid is located 750 inches from the airplane datum.

The index influence per lb is:

$$I = \frac{1 \times (750 - 515)}{17400} = 0.014 \text{IU/lb}$$

So, for each lb of cargo loaded in the cargo compartment, the index increases by 0.014 index units.

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# FUEL INDEX VARIATION

## EMB-145 ER, EP AND MP MODEL

| Volume (US Gal) | Weight (lb) | Arm (in) | Index (IU) |
|---|---|---|---|
| 50 | 335 | 575.28 | -0.3 |
| 100 | 670 | 577.01 | -0.5 |
| 150 | 1005 | 578.43 | -0.7 |
| 200 | 1340 | 579.61 | -0.8 |
| 250 | 1675 | 580.67 | -0.9 |
| 300 | 2010 | 581.65 | -1.0 |
| 350 | 2345 | 582.52 | -1.0 |
| 400 | 2680 | 583.35 | -1.0 |
| 450 | 3015 | 584.17 | -1.0 |
| 500 | 3350 | 585.04 | -1.0 |
| 550 | 3685 | 585.91 | -0.9 |
| 600 | 4020 | 586.81 | -0.7 |
| 650 | 4355 | 587.68 | -0.6 |
| 700 | 4690 | 588.54 | -0.4 |
| 750 | 5025 | 589.37 | -0.2 |
| 800 | 5360 | 590.20 | 0.1 |
| 850 | 5695 | 591.02 | 0.3 |
| 900 | 6030 | 591.77 | 0.6 |
| 950 | 6365 | 592.56 | 0.9 |
| 1000 | 6700 | 593.39 | 1.3 |
| 1050 | 7035 | 594.37 | 1.8 |
| 1100 | 7370 | 595.43 | 2.3 |
| 1150 | 7705 | 596.69 | 3.0 |
| 1200 | 8040 | 598.07 | 3.7 |
| 1250 | 8375 | 599.65 | 4.6 |
| 1300 | 8710 | 601.34 | 5.7 |
| 1350 | 9045 | 603.23 | 6.9 |
| 1359.6 | 9109 | 603.62 | 7.1 |

**NOTE:** Adopted fuel density of 6.7 lb/US Gal.

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## EMB-145 LR MODEL

| Volume (US Gal) | Weight (lb) | Arm (in) | Index (IU) |
|---|---|---|---|
| 50 | 335 | 570.00 | -0.4 |
| 100 | 670 | 570.89 | -0.7 |
| 150 | 1005 | 571.77 | -1.1 |
| 200 | 1340 | 572.55 | -1.3 |
| 250 | 1675 | 573.34 | -1.6 |
| 300 | 2010 | 574.01 | -1.8 |
| 350 | 2345 | 574.78 | -2.1 |
| 400 | 2680 | 575.44 | -2.2 |
| 450 | 3015 | 576.01 | -2.4 |
| 500 | 3350 | 576.77 | -2.5 |
| 550 | 3685 | 577.33 | -2.7 |
| 600 | 4020 | 577.89 | -2.8 |
| 650 | 4355 | 578.44 | -2.9 |
| 700 | 4690 | 579.00 | -3.0 |
| 750 | 5025 | 579.66 | -3.0 |
| 800 | 5360 | 580.22 | -3.0 |
| 850 | 5695 | 580.89 | -3.0 |
| 900 | 6030 | 581.55 | -2.9 |
| 950 | 6365 | 582.12 | -2.9 |
| 1000 | 6700 | 582.78 | -2.8 |
| 1050 | 7035 | 583.34 | -2.7 |
| 1100 | 7370 | 584.00 | -2.5 |
| 1150 | 7705 | 584.66 | -2.4 |
| 1200 | 8040 | 585.22 | -2.2 |
| 1250 | 8375 | 585.88 | -2.0 |
| 1300 | 8710 | 586.55 | -1.7 |
| 1350 | 9045 | 587.33 | -1.4 |
| 1400 | 9380 | 588.33 | -0.9 |
| 1450 | 9715 | 589.44 | -0.3 |
| 1500 | 10050 | 590.66 | 0.4 |
| 1550 | 10385 | 591.99 | 1.2 |
| 1600 | 10720 | 593.44 | 2.1 |
| 1650 | 11055 | 595.04 | 3.2 |
| 1690 | 11323 | 596.58 | 4.3 |

**NOTE:** Adopted fuel density of 6.7 lb/US Gal.

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## EMB-145 XR MODEL

Wing Tank

| Volume (US Gal) | Weight (lb) | Arm (in) | Index (IU) |
|---|---|---|---|
| 50 | 335 | 570.00 | -0.4 |
| 100 | 670 | 570.89 | -0.7 |
| 150 | 1005 | 571.77 | -1.1 |
| 200 | 1340 | 572.55 | -1.3 |
| 250 | 1675 | 573.34 | -1.6 |
| 300 | 2010 | 574.01 | -1.8 |
| 350 | 2345 | 574.78 | -2.1 |
| 400 | 2680 | 575.44 | -2.2 |
| 450 | 3015 | 576.01 | -2.4 |
| 500 | 3350 | 576.77 | -2.5 |
| 550 | 3685 | 577.33 | -2.7 |
| 600 | 4020 | 577.89 | -2.8 |
| 650 | 4355 | 578.44 | -2.9 |
| 700 | 4690 | 579.00 | -3.0 |
| 750 | 5025 | 579.66 | -3.0 |
| 800 | 5360 | 580.22 | -3.0 |
| 850 | 5695 | 580.89 | -3.0 |
| 900 | 6030 | 581.55 | -2.9 |
| 950 | 6365 | 582.12 | -2.9 |
| 1000 | 6700 | 582.78 | -2.8 |
| 1050 | 7035 | 583.34 | -2.7 |
| 1100 | 7370 | 584.00 | -2.5 |
| 1150 | 7705 | 584.66 | -2.4 |
| 1200 | 8040 | 585.22 | -2.2 |
| 1250 | 8375 | 585.88 | -2.0 |
| 1300 | 8710 | 586.55 | -1.7 |
| 1350 | 9045 | 587.33 | -1.4 |
| 1400 | 9380 | 588.33 | -0.9 |
| 1450 | 9715 | 589.44 | -0.3 |
| 1500 | 10050 | 590.66 | 0.4 |
| 1550 | 10385 | 591.99 | 1.2 |
| 1600 | 10720 | 593.44 | 2.1 |
| 1650 | 11055 | 595.04 | 3.2 |
| 1690 | 11323 | 596.58 | 4.3 |

**NOTE:** Adopted fuel density of 6.7 lb/US Gal.

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**EMB-145 XR MODEL**

Ventral Tank

| Volume (US Gal) | Weight (lb) | Arm (in) | Index (IU) |
|---|---|---|---|
| 50 | 335 | 691.70 | 2.0 |
| 100 | 670 | 695.58 | 4.1 |
| 150 | 1005 | 697.72 | 6.2 |
| 200 | 1340 | 698.69 | 8.4 |
| 250 | 1675 | 696.81 | 10.3 |
| 275 | 1843 | 695.79 | 11.2 |

**NOTE:** Adopted fuel density of 6.7 lb/US Gal.

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**ERJ-140 ER MODEL**

| Volume (US Gal ) | Weight (lb) | Arm (in) | Index (IU) |
|---|---|---|---|
| 50 | 335 | 539.32 | -0.2 |
| 100 | 670 | 540.95 | -0.3 |
| 150 | 1005 | 542.36 | -0.4 |
| 200 | 1340 | 543.55 | -0.5 |
| 250 | 1675 | 544.62 | -0.5 |
| 300 | 2010 | 545.59 | -0.5 |
| 350 | 2345 | 546.49 | -0.5 |
| 400 | 2680 | 547.34 | -0.4 |
| 450 | 3015 | 548.16 | -0.3 |
| 500 | 3350 | 549.00 | -0.2 |
| 550 | 3685 | 549.87 | 0.0 |
| 600 | 4020 | 550.77 | 0.2 |
| 650 | 4355 | 551.65 | 0.4 |
| 700 | 4690 | 552.51 | 0.7 |
| 750 | 5025 | 553.36 | 1.0 |
| 800 | 5360 | 554.17 | 1.3 |
| 850 | 5695 | 554.96 | 1.6 |
| 900 | 6030 | 555.77 | 2.0 |
| 950 | 6365 | 556.56 | 2.4 |
| 1000 | 6700 | 557.36 | 2.8 |
| 1050 | 7035 | 558.31 | 3.4 |
| 1100 | 7370 | 559.39 | 4.0 |
| 1150 | 7705 | 560.67 | 4.7 |
| 1200 | 8040 | 562.03 | 5.6 |
| 1250 | 8375 | 563.58 | 6.5 |
| 1300 | 8710 | 565.23 | 7.6 |
| 1350 | 9045 | 567.22 | 9.0 |
| 1359.4 | 9107.98 | 567.60 | 9.2 |

**NOTE:** Adopted fuel density of 6.7 lb/US Gal.

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**ERJ-140 LR MODEL**

| Volume (US Gal) | Weight (lb) | Arm (in) | Index (IU) |
|---|---|---|---|
| 50 | 335 | 534.00 | -0.3 |
| 100 | 670 | 534.83 | -0.6 |
| 150 | 1005 | 535.68 | -0.8 |
| 200 | 1340 | 536.50 | -1.0 |
| 250 | 1675 | 537.30 | -1.2 |
| 300 | 2010 | 538.02 | -1.4 |
| 350 | 2345 | 538.73 | -1.5 |
| 400 | 2680 | 539.40 | -1.6 |
| 450 | 3015 | 540.05 | -1.7 |
| 500 | 3350 | 540.68 | -1.8 |
| 550 | 3685 | 541.28 | -1.8 |
| 600 | 4020 | 541.86 | -1.9 |
| 650 | 4355 | 542.43 | -1.9 |
| 700 | 4690 | 543.03 | -1.9 |
| 750 | 5025 | 543.62 | -1.8 |
| 800 | 5360 | 544.23 | -1.8 |
| 850 | 5695 | 544.90 | -1.7 |
| 900 | 6030 | 545.53 | -1.5 |
| 950 | 6365 | 546.13 | -1.4 |
| 1000 | 6700 | 546.76 | -1.2 |
| 1050 | 7035 | 547.40 | -1.1 |
| 1100 | 7370 | 547.99 | -0.9 |
| 1150 | 7705 | 548.63 | -0.6 |
| 1200 | 8040 | 549.23 | -0.4 |
| 1250 | 8375 | 549.77 | -0.1 |
| 1300 | 8710 | 550.44 | 0.2 |
| 1350 | 9045 | 551.33 | 0.7 |
| 1400 | 9380 | 552.26 | 1.2 |
| 1450 | 9715 | 553.35 | 1.9 |
| 1500 | 10050 | 554.52 | 2.6 |
| 1550 | 10385 | 555.80 | 3.5 |
| 1600 | 10720 | 557.21 | 4.4 |
| 1650 | 11055 | 559.07 | 5.8 |
| 1690 | 11323 | 560.56 | 6.9 |

**NOTE:** Adopted fuel density of 6.7 lb/US Gal.

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**EMB-135 ER MODEL**

| Volume (US Gal) | Weight (lb) | Arm (in) | Index (IU) |
|---|---|---|---|
| 50 | 335 | 496.37 | -0.4 |
| 100 | 670 | 498.00 | -0.7 |
| 150 | 1005 | 499.41 | -0.9 |
| 200 | 1340 | 500.60 | -1.1 |
| 250 | 1675 | 501.67 | -1.3 |
| 300 | 2010 | 502.64 | -1.4 |
| 350 | 2345 | 503.54 | -1.5 |
| 400 | 2680 | 504.39 | -1.6 |
| 450 | 3015 | 505.21 | -1.7 |
| 500 | 3350 | 506.05 | -1.7 |
| 550 | 3685 | 506.92 | -1.7 |
| 600 | 4020 | 507.82 | -1.7 |
| 650 | 4355 | 508.70 | -1.6 |
| 700 | 4690 | 509.56 | -1.5 |
| 750 | 5025 | 510.41 | -1.3 |
| 800 | 5360 | 511.22 | -1.2 |
| 850 | 5695 | 512.01 | -1.0 |
| 900 | 6030 | 512.82 | -0.8 |
| 950 | 6365 | 513.61 | -0.5 |
| 1000 | 6700 | 514.41 | -0.2 |
| 1050 | 7035 | 515.36 | 0.1 |
| 1100 | 7370 | 516.44 | 0.6 |
| 1150 | 7705 | 517.72 | 1.2 |
| 1200 | 8040 | 519.08 | 1.9 |
| 1250 | 8375 | 520.63 | 2.7 |
| 1300 | 8710 | 522.28 | 3.6 |
| 1350 | 9045 | 524.27 | 4.8 |
| 1359.4 | 9107.98 | 524.65 | 5.1 |

**NOTE:** Adopted fuel density of 6.7 lb/US Gal.

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**EMB-135 LR MODEL**

| Volume (US Gal) | Weight (lb) | Arm (in) | Index (IU) |
|---|---|---|---|
| 50 | 335 | 491.05 | -0.5 |
| 100 | 670 | 491.88 | -0.9 |
| 150 | 1005 | 492.73 | -1.3 |
| 200 | 1340 | 493.55 | -1.7 |
| 250 | 1675 | 494.35 | -2.0 |
| 300 | 2010 | 495.07 | -2.3 |
| 350 | 2345 | 495.78 | -2.6 |
| 400 | 2680 | 496.45 | -2.9 |
| 450 | 3015 | 497.10 | -3.1 |
| 500 | 3350 | 497.73 | -3.3 |
| 550 | 3685 | 498.33 | -3.5 |
| 600 | 4020 | 498.91 | -3.7 |
| 650 | 4355 | 499.48 | -3.9 |
| 700 | 4690 | 500.08 | -4.0 |
| 750 | 5025 | 500.67 | -4.1 |
| 800 | 5360 | 501.28 | -4.2 |
| 850 | 5695 | 501.95 | -4.3 |
| 900 | 6030 | 502.58 | -4.3 |
| 950 | 6365 | 503.18 | -4.3 |
| 1000 | 6700 | 503.81 | -4.3 |
| 1050 | 7035 | 504.45 | -4.3 |
| 1100 | 7370 | 505.04 | -4.2 |
| 1150 | 7705 | 505.68 | -4.1 |
| 1200 | 8040 | 506.28 | -4.0 |
| 1250 | 8375 | 506.82 | -3.9 |
| 1300 | 8710 | 507.49 | -3.8 |
| 1350 | 9045 | 508.38 | -3.4 |
| 1400 | 9380 | 509.31 | -3.1 |
| 1450 | 9715 | 510.40 | -2.6 |
| 1500 | 10050 | 511.57 | -2.0 |
| 1550 | 10385 | 512.85 | -1.3 |
| 1600 | 10720 | 514.26 | -0.5 |
| 1650 | 11055 | 516.12 | 0.7 |
| 1690 | 11323 | 517.61 | 1.7 |

**NOTE:** Adopted fuel density of 6.7 lb/US Gal.

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## OEW/OEI DETERMINATION

The OEW (Operational Empty Weight) is the BEW plus the weight of the operational items (crew, catering, lavatory fluid, etc.). The OEI (Operational Empty Index) is the index for the OEW.
In order to determine the OEW and OEI, it is necessary to add to the BEW all the weight and moment variations referent to the operational items. The BEW is obtained from the airplane weighting record.

Example: Computation of OEW/OEI for the EMB-145.

For a BEW equal 26572 lb and BEW moment equal 16546149.55 lb.in:

| Item | Weight (lb) | Arm (in) | Moment (lb.in) |
|---|---|---|---|
| BEW | 26572 | - | 16546149.55 |
| Lavatory fluid | 44<br>15.43 | 813.38<br>810.24 | 35788.72<br>12502.00 |
| Pilot & Co-Pilot | 380 | 142.91 | 54305.80 |
| Flight attendant (fwd) | 170 | 188.97 | 32124.90 |
| CREWMEMBER ROLLER BAG | 30 | 196.85 | 5905.50 |
| PILOT FLIGHT BAG | 20 | 155.51 | 3110.20 |
| FLIGHT ATTENDANT KIT | 10 | 196.85 | 1968.50 |
| **OEW** (not including catering) | **27241.43** | **-** | **16691855.17** |

Airplane arm = $16691855.17 / 27241.43 = 612.74$ inches

$$\text{Airplane Index} = \frac{27241.43 \times (612.74 - 590)}{17400} + 13 = 49\text{IU}$$

(not including catering)

**NOTE: -** Catering weight was not considered above because its weight is not constant. In our example we are considering catering as a separate item (see Index Influences).
- Unusable fuel, hydraulic fluid, engine and APU oil are considered included in the BEW.
- The values above are an example. Use the airplane actual BEW for determining the OEW.

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# CENTER OF GRAVITY CURTAILMENTS

The airplane weight and balance calculations are normally performed assuming that passengers are evenly distributed along the airplane cabin and that the crew, passengers and movable items are fixed in a pre-determined position.

For all practical purposes, however, it is known that passengers may not be evenly seated, flight attendants move along the cabin, the landing gear retracts, etc. All these movements, not previously expected in the weight and balance calculations, may result in deviations from the assumed load distribution.

For these reasons, some aeronautical authorities (including FAA AC120-27E) require that airlines use an Operational CG envelope, which is the AFM certified CG envelope reduced by a CG margin to account for the possible deviations from the assumed load distribution. This process is known as Center of Gravity Curtailment.

There are 3 basic types of CG curtailments:

- Takeoff and landing allowances: These are the deviations that affect the CG position for takeoff and landing. Uneven distribution of passengers, flap and landing gear movement and cargo/baggage shift are considered takeoff and landing allowances.
- Flight allowances: These are the deviations that affect the CG position in flight. All takeoff and landing allowances plus flight attendant and catering service movement are considered in-flight allowances.
- Fuel allowances: If the airline does not wish to check the CG position at the landing weight, it is necessary to consider a fuel allowance due to CG shift caused by the reduction of fuel quantity during the flight. In addition, it may be necessary to consider an allowance due to variations in the fuel density.

The CG curtailment process is a critical procedure because the amount of CG margin (curtailment) depends on the possible deviations considered by the airline. If excessive deviations (allowances) are considered by the airline, a very thin Operational CG envelope may be obtained, resulting in huge difficulties to balance the airplane during airline operations. On the other hand, if few deviations (allowances) are considered, a large Operational CG envelope is obtained, but safety may be jeopardized by CG deviations from the assumed load distribution.

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**NOTE:** For Ferry and Training flights, in which passenger or flight attendant movement is not an issue, a constrained center of gravity envelope without the seat and flight allowances may be used so as not to limit these types of flight unnecessarily. For flights with more than 33 or 45 passengers (with the unoccupied seats at the forward portion of the cabin), for EMB-135 and EMB-145, respectively, a constrained center of gravity envelope without the seat allowances may be used so as not to limit these types of flight unnecessarily.

## FLAP MOVEMENT ALLOWANCES

Flap movement has negligible effects on the airplane Center of Gravity.

## FUEL DENSITY ALLOWANCES

The variation of fuel density has negligible effects on the airplane Center of Gravity.

## LANDING GEAR ALLOWANCES

When the landing gear is retracted, there is a reduction of -10155.15 lb.in of the moment in respect to the airplane datum.

## FORWARD FLIGHT ALLOWANCES

Considers the movement of the forward flight attendant to the cockpit.

Example:

**EMB-135LR**

| Forward Allowance | Weight (lb) | from Arm (in) | to Arm (in) | Moment (lb.in) |
|---|---|---|---|---|
| Fwd attendant to cockpit | 170 | 188.98 | 165.35 | -4017 |

User: fhherna0f - Printed By myTechCare - Nov 21/24 - 00:45:44

**EMB-145LR**

| Forward Allowance | Weight (lb) | from Arm (in) | to Arm (in) | Moment (lb.in) |
|---|---|---|---|---|
| Fwd attendant to cockpit | 170 | 188.98 | 165.35 | - 4017 |

## AFT FLIGHT ALLOWANCES

A reasonable aft flight allowance is to consider the movement of the forward flight attendant and a trolley to the aftermost row combined with the movement of a mid cabin passenger to the lavatory.

Example:

**EMB-135ER**

| Aft Allowance | Weight (lb) | from Arm (in) | to Arm (in) | Moment (lb.in) |
|---|---|---|---|---|
| Mid cabin pax to lavatory | 170 * | 429.53 | 672.05 | +41228 |
| Fwd attendant to aft cabin | 170 | 188.98 | 609.06 | +71414 |
| Trolley to aft cabin | 88 | 190.55 | 624.90 | +38223 |
| | | | Total = | +150865 |
| * Passenger is assumed to have no hand baggage when moving to lavatory. | | | | |

So, the aft flight allowance will be +109637 lb.in, adopting the most restrictive situation.

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**EMB-145LR**

| Aft Allowance | Weight (lb) | from Arm (in) | to Arm (in) | Moment (lb.in) |
|---|---|---|---|---|
| Mid cabin pax to lavatory | 170 * | 522.83 | 811.02 | +48992 |
| Fwd attendant to aft cabin | 170 | 188.98 | 748.02 | +95037 |
| Trolley to aft cabin | 88 | 218.50 | 767.72 | +48331 |
| | | | Total = | +192360 |
| * Passenger is assumed to have no hand baggage when moving to lavatory. | | | | |

So the aft flight allowance will be +143368 lb.in taking the most restrictive situation.

## SEATING ALLOWANCES

Seating allowance is a result of uneven passenger distribution along the cabin. If the mass of all passengers is assumed to be equally distributed along the cabin, a margin (called seating allowance) must be considered to compensate for the variation in passenger seating locations. Manual load sheets usually use the Cabin Area Trim method, where passengers are considered evenly distributed along the passenger cabin, thus requiring seating allowance consideration.

The typical passenger loading sequence is based on the window and aisle seating concept, according to which, for forward seating allowances, window seats are filled from forward to aft and, after all windows are occupied, the aisle seats are filled from the most forward to the most aft. For aft seating allowances, the same concept is used but with an aft-to-front filling sequence.

In order to determine the total seating allowance of the aircraft the operator may divide the passenger cabin into zones. Each zone has its own centroid where the total weight of the related passengers may be concentrated. The centroid is determined by the weight average arms of each passenger position considered inside each zone.

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The seating allowance applied to the CG envelope is the sum of the largest moment variation of each cabin zone. The moment variation is defined by the difference between the actual pax distribution moment and the moment of the same amount of passengers concentrated in the centroid of the cabin zone considered.

**NOTE:** Seating allowance does not need to be considered if passenger index influence is calculated by seat row, i.e., if the individual moment variation for each passenger is considered. Seat Row Trim is normally used on computerized weight and balance systems, like Departure Control Systems (DCS).

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

## FUEL ALLOWANCES

There are some conditions under which it is possible to have both ZFW-CG and TOW-CG located inside the CG envelope and the LW-CG outside of the CG envelope. This behavior is caused by the particular fuel loading characteristics of the aircraft, where the initial fuel loaded causes a forward moment and then higher fuel loading causes an aft moment (see the fuel index tables, where light fuel loads result in negative indexes and high fuel loads results in positive indexes).

In order to prevent the LW CG from being located outside of the CG envelope, the idea is to determine a constrained ZFW envelope, in which the fuel loading curve is always located inside the CG envelope.

## CONSTRAINED CENTER OF GRAVITY LIMITS

In order to determine the constrained CG envelope, the allowances must be added to the certified CG envelope.

## CONSTRAINED ZFW LIMITS

In order to determine the constrained ZFW CG envelope, it is necessary to convert the constrained CG envelope to the index system and then apply the fuel allowances.

When the fuel quantity is equal to or less than the one specified in the table below, the ZFW envelope without constraint may be used, because fuel burn always makes the CG move backward. In this case, it must be checked if ZFW-CG, TOW-CG and LW-CG are located inside the CG envelope.

| Model | Fuel Weight (lb) |
|---|---|
| EMB-135 ER | 3527 |
| EMB-135 LR | 6349 |
| EMB-145 STD, EU, EP, ER, MP and MK | 3175 |
| EMB-145 LU and LR | 5291 |

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## EXAMPLE 1 (EMB-135 MODEL LR):

For the EMB-135 LR on an option 1 configuration (37 seats), with the passenger cabin divided in three sections.

Section A refers to rows 1 to 4, section B refers to rows 5 to 8 and section C refers to rows 9 to 13.

Considering the window and aisle seating concept, the first seat to be occupied is window-row 1, then window-row 2, then windows-row 3, then windows-row 4, ..., then windows-row 13, then aisle-row 2, then aisle-row 3, ..., then aisle-row 13.

When window-row 1 is occupied, there is a moment margin of the passenger weight times the distance between cabin A centroid and row 1 centroid. When window-row 2 is occupied, the moment margin is increased by the passenger weight times the distance between cabin A centroid and row 2 centroid. The moment margin keeps increasing until the seats aft of the cabin centroid start being filled and then moment margin decreases.

When cabin B starts being filled, the moment margin starts increasing again and then decreases when the seats aft of cabin B centroid are filled. The same occurs with cabin C.

The forward seating allowance to be used in the determination of the constrained CG envelope is the sum of the most negative moment change of each cabin section.

For the aft seating allowance, a very similar procedure is performed, but considering the aircraft being loaded from the aft portion of the cabin.

The following tables show the determination of the forward and aft seating allowances:

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## FORWARD SEATING ALLOWANCE:

| Seat type & row number | Arm (in) | Cab Arm (in) | Weight (lb) | PAX Total | Moment (lb.in) | Accumul. (lb.in) | Minimum Accumul. |
|---|---|---|---|---|---|---|---|
| Windows 01 | 261.23 | 327.64 | 0 | 1 | 0.00 | 0.00 | |
| Windows 02 | 292.48 | 327.64 | 190 | 1 | -6681.38 | -6681.38 | |
| Windows 03 | 323.72 | 327.64 | 380 | 2 | -1489.78 | -8171.16 | |
| Windows 04 | 355.01 | 327.64 | 380 | 2 | 10398.29 | 2227.13 | -8171.16 |
| Aisle 02 | 292.48 | 327.64 | 190 | 1 | -6681.38 | -4454.25 | |
| Aisle 03 | 323.72 | 327.64 | 190 | 1 | -744.89 | -5199.14 | |
| Aisle 04 | 355.01 | 327.64 | 190 | 1 | 5199.14 | 0.00 | |
| Windows 05 | 386.25 | 450.59 | 380 | 2 | -24448.99 | -24448.99 | |
| Windows 06 | 417.54 | 450.59 | 380 | 2 | -12560.92 | -37009.91 | |
| Windows 07 | 448.78 | 450.59 | 380 | 2 | -687.94 | -37697.85 | |
| Windows 08 | 480.02 | 450.59 | 380 | 2 | 11185.04 | -26512.80 | |
| Windows 09 | 520.36 | 450.59 | 380 | 2 | 26512.80 | 0.00 | |
| Aisle 05 | 386.25 | 450.59 | 190 | 1 | -12224.49 | -12224.49 | -37697.85 |
| Aisle 06 | 417.54 | 450.59 | 190 | 1 | -6280.46 | -18504.95 | |
| Aisle 07 | 448.78 | 450.59 | 190 | 1 | -343.97 | -18848.92 | |
| Aisle 08 | 480.02 | 450.59 | 190 | 1 | 5592.52 | -13256.40 | |
| Aisle 09 | 520.36 | 450.59 | 190 | 1 | 13256.40 | 0.00 | |
| Windows 10 | 551.65 | 598.53 | 380 | 1 | -17817.01 | -17817.01 | |
| Windows 11 | 582.89 | 598.53 | 380 | 1 | -5944.03 | -23761.05 | |
| Windows 12 | 614.17 | 598.53 | 380 | 1 | 5944.03 | -17817.01 | |
| Windows 13 | 645.42 | 598.53 | 380 | 1 | 17817.01 | 0.00 | |
| Aisle 10 | 551.65 | 598.53 | 190 | 1 | -8908.51 | -8908.51 | -23761.05 |
| Aisle 11 | 582.89 | 598.53 | 190 | 1 | -2972.02 | -11880.52 | |
| Aisle 12 | 614.17 | 598.53 | 190 | 1 | 2972.02 | -8908.51 | |
| Aisle 13 | 645.42 | 598.53 | 190 | 1 | 8908.51 | 0.00 | |
| **Forward Seating Allowance** | | | | | | | **-69630.06** |

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## AFT SEATING ALLOWANCE:

| Seat type & row number | Arm (in) | Cab Arm (in) | Weight (lb) | PAX Total | Moment (lb.in) | Accumul. (lb.in) | Maximum Accumul. |
|---|---|---|---|---|---|---|---|
| Windows 13 | 645.42 | 598.53 | 380 | 2 | 17817.01 | 17817.01 | |
| Windows 12 | 614.17 | 598.53 | 380 | 2 | 5944.03 | 23761.05 | |
| Windows 11 | 582.89 | 598.53 | 380 | 2 | -5944.03 | 17817.01 | |
| Windows 10 | 551.65 | 598.53 | 380 | 2 | -17817.01 | 0.00 | |
| Aisle 13 | 645.42 | 598.53 | 190 | 1 | 8908.51 | 8908.51 | 23761.05 |
| Aisle 12 | 614.17 | 598.53 | 190 | 1 | 2972.02 | 11880.52 | |
| Aisle 11 | 582.89 | 598.53 | 190 | 1 | -2972.02 | 8908.51 | |
| Aisle 10 | 551.65 | 598.53 | 190 | 1 | -8908.51 | 0.00 | |
| Windows 9 | 520.36 | 450.59 | 380 | 2 | 26512.80 | 26512.80 | |
| Windows 8 | 480.02 | 450.59 | 380 | 2 | 11185.04 | 37697.85 | |
| Windows 7 | 448.78 | 450.59 | 380 | 2 | -687.94 | 37009.91 | |
| Windows 6 | 417.54 | 450.59 | 380 | 2 | -12560.92 | 24448.99 | |
| Windows 5 | 386.25 | 450.59 | 380 | 2 | -24448.99 | 0.00 | |
| Aisle 9 | 520.36 | 450.59 | 190 | 1 | 13256.40 | 13256.40 | 37697.85 |
| Aisle 8 | 480.02 | 450.59 | 190 | 1 | 5592.52 | 18848.92 | |
| Aisle 7 | 448.78 | 450.59 | 190 | 1 | -343.97 | 18504.95 | |
| Aisle 6 | 417.54 | 450.59 | 190 | 1 | -6280.46 | 12224.49 | |
| Aisle 5 | 386.25 | 450.59 | 190 | 1 | -12224.49 | 0.00 | |
| Windows 4 | 355.01 | 327.64 | 380 | 2 | 10398.29 | 10398.29 | |
| Windows 3 | 323.72 | 327.64 | 380 | 2 | -1489.78 | 8908.51 | |
| Windows 2 | 292.48 | 327.64 | 190 | 1 | -6681.38 | 2227.13 | |
| Windows 1 | 261.23 | 327.64 | 0 | 0 | 0.00 | 2227.13 | 10398.29 |
| Aisle 4 | 355.01 | 327.64 | 190 | 1 | 5199.14 | 7426.27 | |
| Aisle 3 | 323.72 | 327.64 | 190 | 1 | -744.89 | 6681.38 | |
| Aisle 2 | 292.48 | 327.64 | 190 | 1 | -6681.38 | 0.00 | |
| **Aft Seating Allowance** | | | | | | | **71857.19** |

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**FUEL ALLOWANCES:**

There are some conditions under which it is possible to have both ZFW-CG and TOW-CG located inside the CG envelope and the LW-CG outside of the CG envelope (see Figure 1).

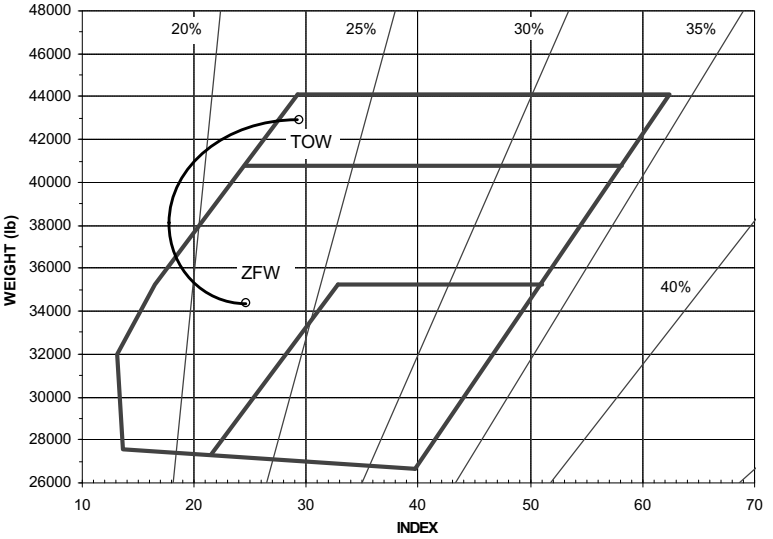


Figure 1

In order to prevent the LW CG from being located outside of the CG envelope, the idea is to determine a constrained ZFW envelope.

CONSTRAINED ZFW LIMITS

In order to determine the constrained ZFW CG envelope, it is necessary to convert the constrained CG envelope to the index system and then apply the fuel allowances.

Converting the previously defined forward and aft limits to the index system using the formula:

$$I = \frac{W \times (arm - 515)}{17500} + 13$$

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**Forward limits**

| Weight (lb) | Arm (in) | CG (%) | Index (IU) |
|---|---|---|---|
| 25353 | 529.67 | 30.0 | 34.3 |
| 27558 | 512.75 | 15.0 | 9.5 |
| 31967 | 512.75 | 15.0 | 8.9 |
| 35274 | 514.44 | 16.5 | 11.9 |
| 44092 | 519.63 | 21.1 | 24.7 |

**Aft limits**

| Weight (lb) | Arm (in) | CG (%) | Index (IU) |
|---|---|---|---|
| 25353 | 529.67 | 30.0 | 34.3 |
| 26455 | 538.69 | 38.0 | 48.8 |
| 35274 | 538.69 | 38.0 | 60.8 |
| 44092 | 538.69 | 38.0 | 72.7 |

Drawing the fuel index lines over the constrained CG envelope and searching for the tangency points, we determine the following constrained ZFW CG points (see Figure 2):

| Weight (lb) | Index (IU) |
|---|---|
| 27360 | 22.7 |
| 35273 | 32.9 |

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## EMB-135LR Constrained CG Envelope (Standard)

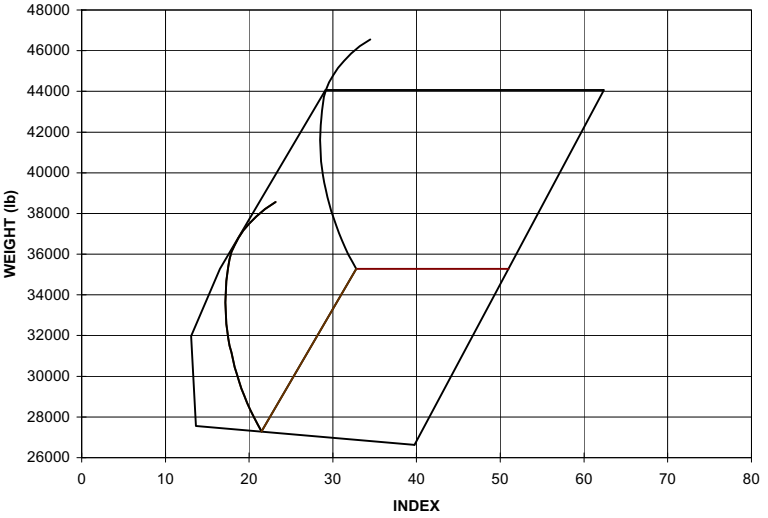


Figure 2

CONSTRAINED CENTER OF GRAVITY LIMITS

In order to determine the constrained CG envelope, the allowances must be added to the certified CG envelope.

The table below shows the determination of the forward constrained limit for the EMB-135LR model.

For Takeoff & Landing & In-flight limits the allowance used was:

- -10155.15 lb.in (landing gear)
- -4017.00 lb.in (forward flight allowance)
- -69630.06 lb.in (forward seating allowance)
  -83802.21 lb.in = total fwd allowance

**NOTE:** The allowance at 25353 lb is -10155.15 lb.in, because in this range of weight it is impossible to have passengers loaded, so the seating allowance was disregarded and also the flight allowance.

For Takeoff & Landing limits the allowance used was:

- -69630.06 lb.in (forward seating allowance)

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**Forward Center of Gravity Limits:**

| AFM values | | | | Allow-ance | Constrained values | | |
|---|---|---|---|---|---|---|---|
| Wt. (lb) | CG (%) | arm (in) | Mom. (lb.in) | (lb.in) | Mom. (lb.in) | arm (in) | CG (%) |
| Takeoff & Landing & In-flight limits: | | | | | | | |
| 25353 | 30.0 | 529.67 | 13428724 | -10155 | 13438879 | 530.07 | 30.4 |
| 27558 | 15.0 | 512.75 | 14130365 | -83802 | 14214167 | 515.79 | 17.7 |
| 31967 | 15.0 | 512.75 | 16391079 | -83802 | 16474881 | 515.37 | 17.3 |
| Takeoff & Landing limits: | | | | | | | |
| 35274 | 16.5 | 514.44 | 18146357 | -69630 | 18215987 | 516.41 | 18.3* |
| 44092 | 21.1 | 519.63 | 22911526 | -69630 | 22981156 | 521.21 | 22.5* |
| In-flight limit: | | | | | | | |
| 35274 | 15.0 | 514.44 | 18146357 | -83802 | 18230159 | 516.82 | 18.6 |
| 44092 | 18.9 | 519.63 | 22911526 | -83802 | 22995328 | 521.53 | 22.8 |

* points disregarded because of the existence of more limiting points at the same weight.

The table below shows the determination of the aft constrained limit for the EMB-135LR model.

For Takeoff & Landing & In-flight limits the allowance used was:

- +150865.00 lb.in (aft flight allowance)
- + 71857.19 lb.in (aft seating allowance)
  +222722.19 lb.in = total aft allowance

**NOTE:** The allowance at 25353 lb is zero because in this weight range it is impossible to have passengers loaded, so the seating allowance was disregarded and also the flight allowance.

**Aft Center of Gravity Limits:**

| AFM values | | | | Allow-ance | Constrained values | | |
|---|---|---|---|---|---|---|---|
| Wt. (lb) | CG (%) | arm (in) | Mom. (lb.in) | (lb.in) | Mom. (lb.in) | arm (in) | CG (%) |
| Takeoff & Landing & In-flight limits: | | | | | | | |
| 25353 | 30.0 | 529.67 | 13428724 | 0.0 | 13428724 | 529.67 | 30.0 |
| 26455 | 38.0 | 538.69 | 14251044 | 222722 | 14028322 | 530.27 | 30.5 |
| 35274 | 38.0 | 538.69 | 19001751 | 222722 | 18779029 | 532.38 | 32.4 |
| 44092 | 38.0 | 538.69 | 23751919 | 222722 | 23529197 | 533.64 | 33.5 |

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## EMB-135LR - CONSTRAINED ENVELOPE

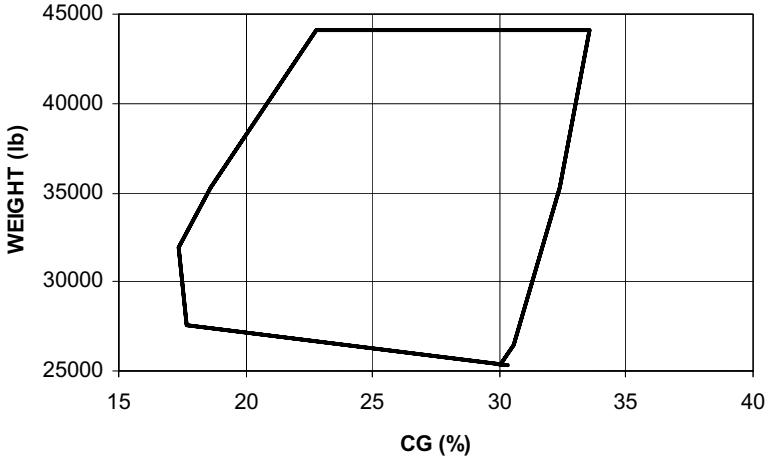


Figure 3

The complete constrained CG envelope for the EMB-135LR is shown in Figure 4:

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## EMB-135LR Constrained CG Envelope (Standard)

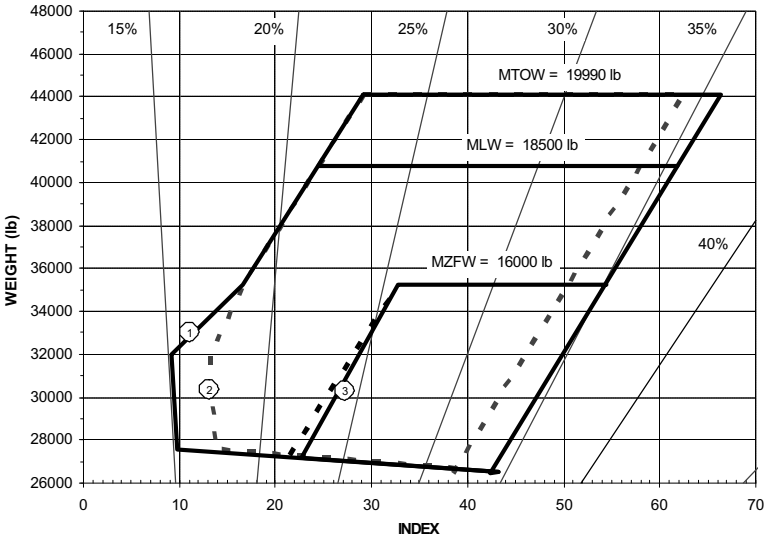


Figure 4

1 - TOW limit (more than 33 paxs).

2 - TOW limit (with 33 paxs or less).

3 - ZFW limit.

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## EXAMPLE 2 (EMB-145 MODEL LR):

For the EMB-145LR on a standard configuration (50 seats) with the passenger cabin divided in three sections.

Section A refers to rows 1 to 6, section B refers to rows 7 to 12 and section C refers to rows 13 to 18.

Considering the window and aisle seating concept, the first seat to be occupied is window-row 1, then window-row 2, then windows-row 3, then windows-row 4, ..., then windows-row 18, then aisle-row 3, then aisle-row 4, ..., then aisle-row 18.

When window-row 1 is occupied, there is a moment margin of the passenger weight times the distance between cabin A centroid and row 1 centroid. When window-row 2 is occupied, the moment margin is increased by the passenger weight times the distance between cabin A centroid and row 2 centroid. The moment margin keeps increasing until the seats aft of the cabin centroid start being filled and then moment margin decreases.

When cabin B starts being filled, the moment margin starts increasing again and then decreases when the seats aft of cabin B centroid are filled. The same occurs with cabin C.

The forward seating allowance to be used in the determination of the constrained CG envelope is the summation of the most negative moment change of each cabin section.

For the aft seating allowance, a very similar procedure is performed, but considering the aircraft being loaded from the aft portion of the cabin, and considering the most positive moment change of each cabin section.

The following tables show the determination of the forward and aft seating allowances:

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## FORWARD SEATING ALLOWANCE:

| Seat type & row number | Arm (in) | Cab Arm (in) | Weight (lb) | PAX Total | Moment (lb.in) | Accumul. (lb.in) | Maximum Accumul. |
|---|---|---|---|---|---|---|---|
| Windows 01 | 245.87 | 341.89 | 190 | 1 | -18243.21 | -18243.21 | |
| Windows 02 | 277.11 | 341.89 | 190 | 1 | -12306.71 | -30549.92 | |
| Windows 03 | 308.40 | 341.89 | 380 | 2 | -12725.36 | -43275.28 | |
| Windows 04 | 339.64 | 341.89 | 380 | 2 | -852.38 | -44127.66 | |
| Windows 05 | 370.93 | 341.89 | 380 | 2 | 11035.69 | -33091.97 | |
| Windows 06 | 402.17 | 341.89 | 380 | 2 | 22908.67 | -10183.31 | -44127.66 |
| Aisle 03 | 308.40 | 341.89 | 190 | 1 | -6362.68 | -16545.99 | |
| Aisle 04 | 339.64 | 341.89 | 190 | 1 | -426.19 | -16972.18 | |
| Aisle 05 | 370.93 | 341.89 | 190 | 1 | 5517.84 | -11454.33 | |
| Aisle 06 | 402.17 | 341.89 | 190 | 1 | 11454.33 | 0.00 | |
| Windows 07 | 433.42 | 513.10 | 380 | 2 | -30278.36 | -30278.36 | |
| Windows 08 | 464.70 | 513.10 | 380 | 2 | -18390.30 | -48668.66 | |
| Windows 09 | 495.94 | 513.10 | 380 | 2 | -6517.32 | -55185.98 | |
| Windows 10 | 527.23 | 513.10 | 380 | 2 | 5370.75 | -49815.23 | |
| Windows 11 | 558.47 | 513.10 | 380 | 2 | 17243.73 | -32571.49 | |
| Windows 12 | 598.81 | 513.10 | 380 | 2 | 32571.49 | 0.00 | |
| Aisle 07 | 433.42 | 513.10 | 190 | 1 | -15139.18 | -15139.18 | -55185.98 |
| Aisle 08 | 464.70 | 513.10 | 190 | 1 | -9195.15 | -24334.33 | |
| Aisle 09 | 495.94 | 513.10 | 190 | 1 | -3258.66 | -27592.99 | |
| Aisle 10 | 527.23 | 513.10 | 190 | 1 | 2685.38 | -24907.61 | |
| Aisle 11 | 558.47 | 513.10 | 190 | 1 | 8621.87 | -16285.75 | |
| Aisle 12 | 598.81 | 513.10 | 190 | 1 | 16285.75 | 0.00 | |
| Windows 13 | 630.05 | 708.22 | 380 | 2 | -29702.57 | -29702.57 | |
| Windows 14 | 661.34 | 708.22 | 380 | 2 | -17814.50 | -47517.07 | |
| Windows 15 | 692.58 | 708.22 | 380 | 2 | -5941.52 | -53458.59 | |
| Windows 16 | 723.87 | 708.22 | 380 | 2 | 5946.55 | -47512.04 | |
| Windows 17 | 755.11 | 708.22 | 380 | 2 | 17819.53 | -29692.51 | |
| Windows 18 | 786.36 | 708.22 | 380 | 2 | 29692.51 | 0.00 | |
| Aisle 13 | 630.05 | 708.22 | 190 | 1 | -14851.28 | -14851.28 | -53458.59 |
| Aisle 14 | 661.34 | 708.22 | 190 | 1 | -8907.25 | -23758.53 | |
| Aisle 15 | 692.58 | 708.22 | 190 | 1 | -2970.76 | -26729.29 | |
| Aisle 16 | 723.87 | 708.22 | 190 | 1 | 2973.27 | -23756.02 | |
| Aisle 17 | 755.11 | 708.22 | 190 | 1 | 8909.76 | -14846.26 | |
| Aisle 18 | 786.36 | 708.22 | 190 | 1 | 14846.26 | 0.00 | |
| **Forward Seating Allowance** | | | | | | | **-152772.23** |

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## AFT SEATING ALLOWANCE:

| Seat type & row number | Arm (in) | Cab Arm (in) | Weight (lb) | PAX Total | Moment (lb.in) | Accumul. (lb.in) | Maximum Accumul. |
|---|---|---|---|---|---|---|---|
| Windows 18 | 786.36 | 708.22 | 380 | 2 | 29692.51 | 29692.51 | |
| Windows 17 | 755.11 | 708.22 | 380 | 2 | 17819.53 | 47512.04 | |
| Windows 16 | 723.87 | 708.22 | 380 | 2 | 5946.55 | 53458.59 | |
| Windows 15 | 692.58 | 708.22 | 380 | 2 | -5941.52 | 47517.07 | |
| Windows 14 | 661.34 | 708.22 | 380 | 2 | -17814.50 | 29702.57 | |
| Windows 13 | 630.05 | 708.22 | 380 | 2 | -29702.57 | 0.00 | |
| Aisle 18 | 786.36 | 708.22 | 190 | 1 | 14846.26 | 14846.26 | 53458.59 |
| Aisle 17 | 755.11 | 708.22 | 190 | 1 | 8909.76 | 23756.02 | |
| Aisle 16 | 723.87 | 708.22 | 190 | 1 | 2973.27 | 26729.29 | |
| Aisle 15 | 692.58 | 708.22 | 190 | 1 | -2970.76 | 23758.53 | |
| Aisle 14 | 661.34 | 708.22 | 190 | 1 | -8907.25 | 14851.28 | |
| Aisle 13 | 630.05 | 708.22 | 190 | 1 | -14851.28 | 0.00 | |
| Windows 12 | 598.81 | 513.10 | 380 | 2 | 32571.49 | 32571.49 | |
| Windows 11 | 558.47 | 513.10 | 380 | 2 | 17243.73 | 49815.23 | |
| Windows 10 | 527.23 | 513.10 | 380 | 2 | 5370.75 | 55185.98 | |
| Windows 09 | 495.94 | 513.10 | 380 | 2 | -6517.32 | 48668.66 | |
| Windows 08 | 464.70 | 513.10 | 380 | 2 | -18390.30 | 30278.36 | |
| Windows 07 | 433.42 | 513.10 | 380 | 2 | -30278.36 | 0.00 | |
| Aisle 12 | 598.81 | 513.10 | 190 | 1 | 16285.75 | 16285.75 | 55185.98 |
| Aisle 11 | 558.47 | 513.10 | 190 | 1 | 8621.87 | 24907.61 | |
| Aisle 10 | 527.23 | 513.10 | 190 | 1 | 2685.38 | 27592.99 | |
| Aisle 09 | 495.94 | 513.10 | 190 | 1 | -3258.66 | 24334.33 | |
| Aisle 08 | 464.70 | 513.10 | 190 | 1 | -9195.15 | 15139.18 | |
| Aisle 07 | 433.42 | 513.10 | 190 | 1 | -15139.18 | 0.00 | |
| Windows 06 | 402.17 | 341.89 | 380 | 2 | 22908.67 | 22908.67 | |
| Windows 05 | 370.93 | 341.89 | 380 | 2 | 11035.69 | 33944.35 | |
| Windows 04 | 339.64 | 341.89 | 380 | 2 | -852.38 | 33091.97 | |
| Windows 03 | 308.40 | 341.89 | 380 | 2 | -12725.36 | 20366.61 | |
| Windows 02 | 277.11 | 341.89 | 190 | 1 | -12306.71 | 8059.90 | |
| Windows 01 | 245.87 | 341.89 | 190 | 1 | -18243.21 | -10183.31 | 33944.35 |
| Aisle 06 | 402.17 | 341.89 | 190 | 1 | 11454.33 | 1271.03 | |
| Aisle 05 | 370.93 | 341.89 | 190 | 1 | 5517.84 | 6788.87 | |
| Aisle 04 | 339.64 | 341.89 | 190 | 1 | -426.19 | 6362.68 | |
| Aisle 03 | 308.40 | 341.89 | 190 | 1 | -6362.68 | 0.00 | |
| **Aft Seating Allowance** | | | | | | | **142588.92** |

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## FUEL ALLOWANCES:

There are some conditions under which it is possible to have both ZFW-CG and TOW-CG located inside the CG envelope and the LW-CG outside of the CG envelope (see Figure 1).

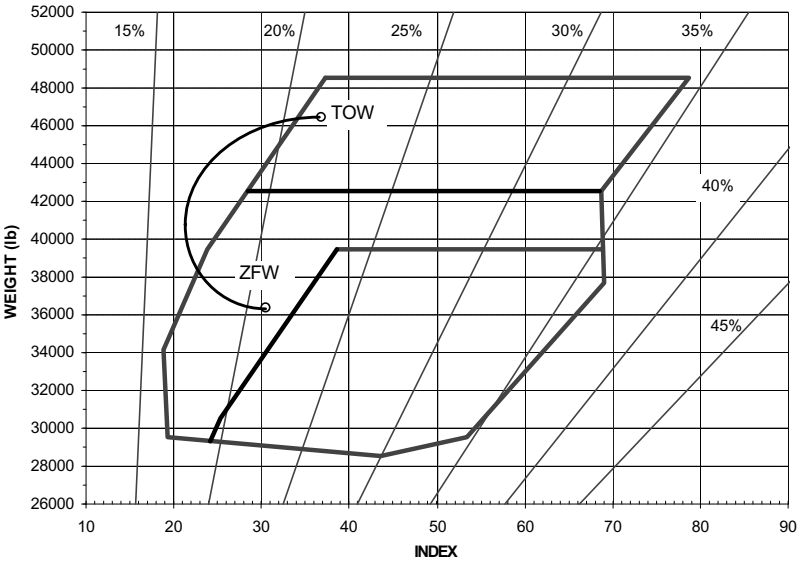


Figure 1

In order to prevent the LW CG from being located outside of the CG envelope, the idea is to determine a constrained ZFW envelope.

## CONSTRAINED ZFW LIMITS

In order to determine the constrained ZFW CG envelope, it is necessary to convert the constrained CG envelope to the index system and then apply the fuel allowances.

Converting the previously defined forward and aft limits to the index system using the formula:

$$I = \frac{W \times (arm - 590)}{17400} + 13$$

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**Forward limits**

| Weight (lb) | Arm (in) | CG (%) | Index (IU) |
|---|---|---|---|
| 27337 | 608.64 | 30.0 | 42.3 |
| 29542 | 588.34 | 12.0 | 10.2 |
| 34170 | 588.34 | 12.0 | 9.7 |
| 38000 | 588.34 | 12.0 | 9.4 |
| 48501 | 595.56 | 18.4 | 28.5 |

**Aft limits**

| Weight (lb) | Arm (in) | CG (%) | Index (IU) |
|---|---|---|---|
| 27337 | 608.64 | 30.0 | 42.3 |
| 29542 | 623.30 | 43.0 | 69.5 |
| 34170 | 623.30 | 43.0 | 78.4 |
| 38000 | 619.36 | 39.5 | 77.1 |
| 48501 | 619.36 | 39.5 | 94.8 |

Drawing the fuel index lines over the constrained CG envelope and searching for the tangency points, we determine the following constrained ZFW CG points (see Figure 2):

| Weight (lb) | Index (IU) |
|---|---|
| 29414 | 27.7 |
| 31252 | 28.7 |
| 39462 | 38.5 |

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**EMB-145LR Constrained CG Envelope**

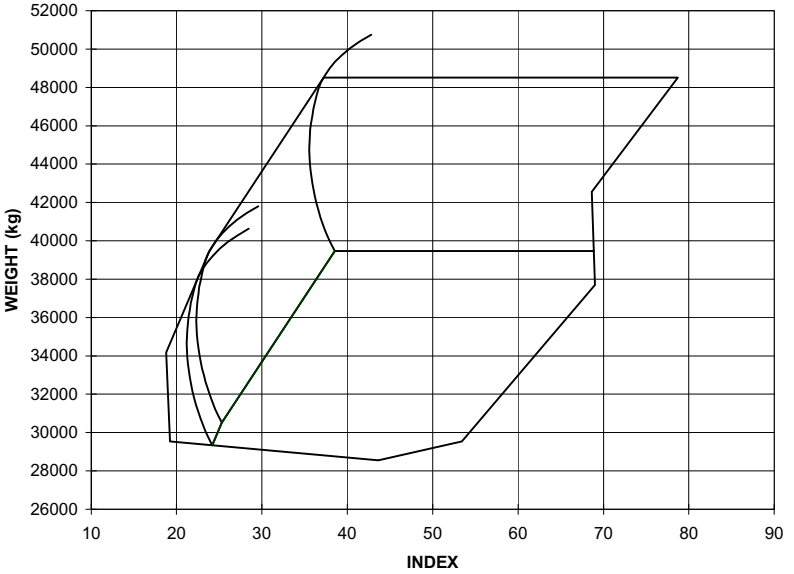


Figure 2

## CONSTRAINED CENTER OF GRAVITY LIMITS

In order to determine the constrained CG envelope, the allowances must be added to the certified CG envelope.

The table below shows the determination of the forward constrained limit for the EMB-145LR.

For Takeoff & Landing & In-flight limits the allowance used was:

- -10155.15 lb.in (landing gear)
- -4017.00 lb.in (forward flight allowance)
- -152772.23 lb.in (forward seating allowance)
  -166944.38 lb.in = total fwd allowance

**NOTE:** The allowance at 27337 lb is -10155.15 lb.in , because in this range of weight it is impossible to have passengers loaded, so the seating allowance was disregarded and also the flight allowance.

For Takeoff & Landing limits the allowance used was:

- -152772.23 lb.in (forward seating allowance)

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**Forward Center of Gravity Limits:**

| AFM values | | | | Allow- | Constrained values | | |
|---|---|---|---|---|---|---|---|
| Wt. (lb) | CG (%) | arm (in) | Mom. (lb.in) | ance (lb.in) | Mom. (lb.in) | arm (in) | CG (%) |
| Takeoff & Landing & In-flight limits: | | | | | | | |
| 27337 | 30.0 | 608.64 | 16638392 | -10155 | 16648547 | 609.01 | 30.3 |
| 29542 | 12.0 | 588.34 | 17380740 | -166944 | 17547684 | 593.99 | 17.0 |
| 34170 | 12.0 | 588.34 | 20103578 | -166944 | 20270522 | 593.23 | 16.3 |
| Takeoff & Landing limits: | | | | | | | |
| 38000 | 14.0 | 588.34 | 22356920 | -152772 | 22509692 | 592.36 | 15.6 * |
| 48501 | 18.4 | 595.56 | 28885256 | -152772 | 29038028 | 598.71 | 21.2 * |
| In-flight limit: | | | | | | | |
| 38000 | 12.0 | 588.34 | 22356920 | -166944 | 22523864 | 592.73 | 15.9 |
| 48501 | 16.2 | 595.56 | 28885256 | -166944 | 29052200 | 599.00 | 21.5 |

* points disregarded because of the existence of more limiting points at the same weight.

The table below shows the determination of the aft constrained limit for the EMB-145LR.

For Takeoff & Landing & In-flight limits the allowance used was:

- +192360.00 lb.in (aft flight allowance)
- +142588.92 lb.in (aft seating allowance)

+334948.92 lb.in = total aft allowance

**NOTE:** The allowance at 27337 lb is zero because in this weight range it is impossible to have passengers loaded, so the seating allowance was disregarded and also the flight allowance.

**Aft Center of Gravity Limits:**

| AFM values | | | | Allow- | Constrained values | | |
|---|---|---|---|---|---|---|---|
| Wt. (lb) | CG (%) | arm (in) | Mom. (lb.in) | ance (lb.in) | Mom. (lb.in) | arm (in) | CG (%) |
| Takeoff & Landing & In-flight limits: | | | | | | | |
| 27337 | 30.0 | 608.64 | 16638392 | 0.0 | 16638392 | 608.64 | 30.0 |
| 29542 | 43.0 | 623.30 | 18413529 | 334948 | 18078581 | 611.96 | 32.9 |
| 37698 | 43.0 | 623.30 | 23497163 | 334948 | 23162215 | 614.41 | 35.1 |
| 42594 | 39.5 | 619.36 | 26381020 | 334948 | 26046072 | 611.50 | 32.5 |
| 48501 | 39.5 | 619.36 | 30039579 | 334948 | 29704631 | 612.45 | 33.4 |

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## EMB-145LR - CONSTRAINED ENVELOPE

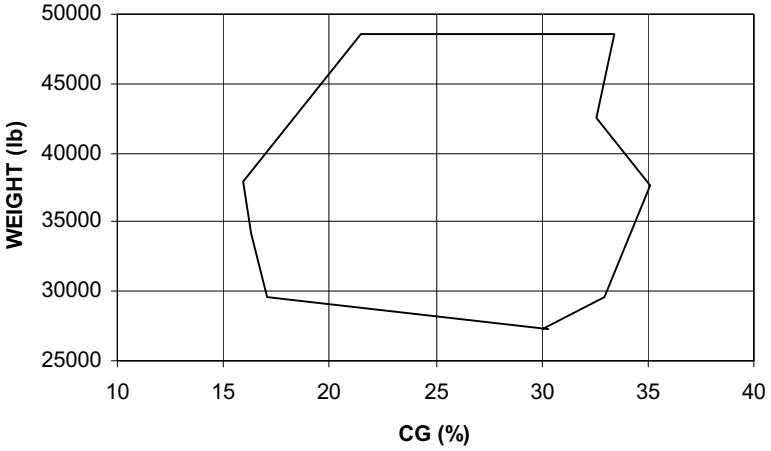


Figure 3

The complete constrained CG envelope for the EMB-145LR is shown in Figure 4:

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## EMB-145LR Constrained CG Envelope

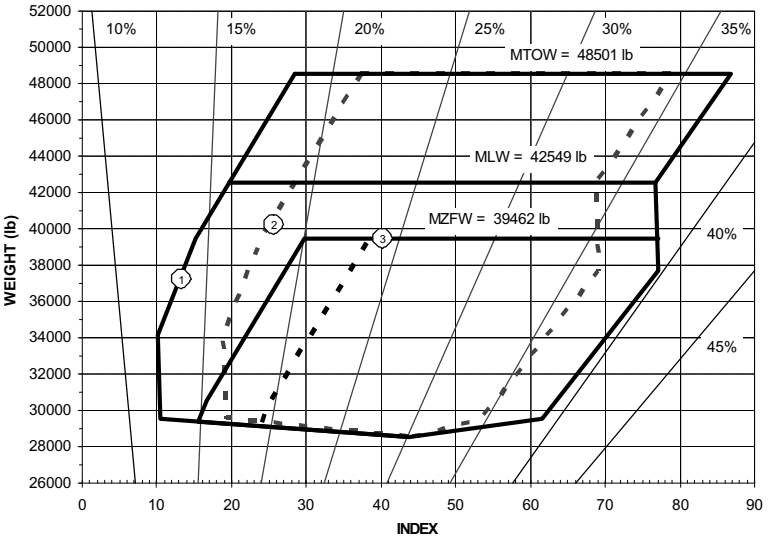


Figure 4

1 - TOW limit (more than 45 paxs).

2 - TOW limit (with 45 paxs or less).

3 - ZFW limit.

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# BALANCE CHART

The balance chart is a document used to check whether the aircraft center of gravity is located within the approved limits.

Balance charts may be prepared in two basic formats:

- Diagram format: is a balance chart with vertical lines for the moment scales, in which the pitch between each line refers to a predetermined load. To determine the aircraft trim it is necessary to draw vertical lines moving to the left and right depending on aircraft load.
- Table format: is a balance chart with index influence tables for each compartment or passenger cabin. To determine the aircraft trim it is necessary to perform addition and subtraction calculations and then draw the result into the CG envelope.

The example shown in the next page is a diagram format balance chart. In order to use it, the following steps must be followed:

1. Enter the aircraft OEI in the Basic Index scale.

2. Write the wardrobe (WRDB), cargo compartment (CGO 1) and number of passengers per cabin (PAX A, B and C) into the appropriate boxes.

3. Draw from the BOI value in the Basic Index scale the CG shift due to WRDB load. From the WRDB final point draw the CG shift due to CGO 1 and so subsequently for PAX A, B and C. The direction for each CG shift is indicated by the arrow.

4. Enter the aircraft OEW in the Basic Weight box and the total payload in the Payload box. Add the values to obtain the ZFW, enter the takeoff fuel weight into the Fuel box and add them to obtain the TOW.

5. From the last position determined in step 3, draw a vertical line into the CG envelope until it crosses a horizontal line at the ZFW. The crossing point determines the ZFW-CG and if it is located outside of the ZFW envelope, a new loading distribution must be made.

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6. Enter the Fuel Index table with the fuel weight and read the fuel index.
7. Enter the Fuel box with the fuel weight and index and draw the CG shift from the last position determined in step 3.
8. From the position determined in step 7, draw a vertical line into the CG envelope until it crosses a horizontal line at the TOW. The crossing point determines the TOW-CG, and if it is located outside of the TOW envelope, a new loading distribution must be made.
9. Enter the Stab Trim table with the TOW-CG and read the stab trim setting (pitch trim).
10. Complete the flight identification box with Flight Number, Date, Origin airport, Destination airport, Aircraft Registration and Crew Configuration.
11. Complete the results box with the ZFW, ZFW-CG, TOW, TOW-CG and Stab Trim setting and sign the load sheet in the Prepared By box.

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## SAMPLE EMB-145 EP BALANCE CHART

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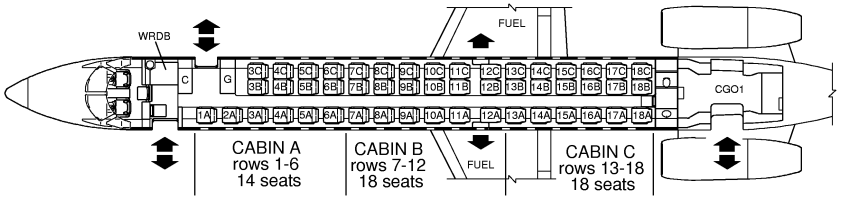
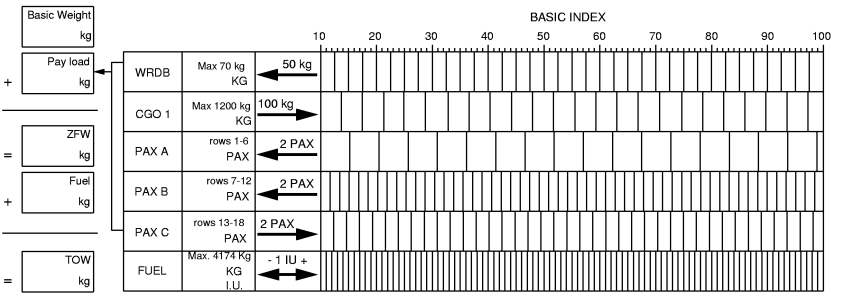
### BALANCE CHART EMB-145 EP

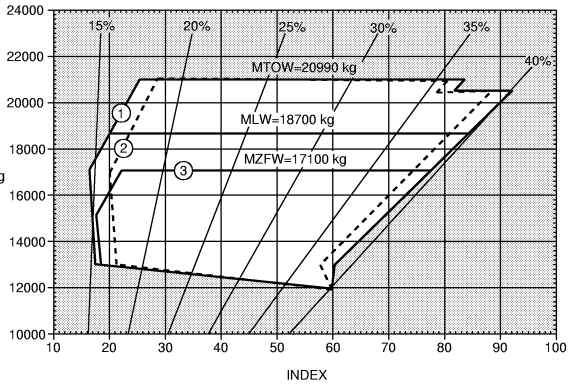
| FLIGHT | DATE |
|---|---|
| FROM | TO |
| A/C REG | CREW Config |




| FUEL INDEX | |
|---|---|
| kg | IU |
| 0 | 0 |
| 500 | -1 |
| 1000 | -1 |
| 1500 | -1 |
| 2000 | -1 |
| 2500 | 0 |
| 3000 | 1 |
| 3500 | 3 |
| 4000 | 6 |
| 4200 | 7 |

| STAB TRIM | |
|---|---|
| CG % | units |
| < 25 | 8 |
| 30 | 7 |
| 35 | 6 |
| 40 | 5 |
| 43 | 4 |




| | | |
|---|---|---|
| ZFW | CG | kg<br>% |
| TOW | CG | kg<br>% |
| STAB TRIM | | Units |

Prepared by:

1-TOW limit (more than 45 paxs) 2-TOW limit (with 45 paxs or less) 3-ZFW limit

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# SECTION 1-07

# LOADING

Introduction ..... 1-07-00
External Dimensions ..... 1-07-10
Cabin Cross Section ..... 1-07-20
Interior Arrangement ..... 1-07-30
Carry-on baggage ..... 1-07-50
Baggage Door ..... 1-07-60
Baggage Compartment ..... 1-07-70
Cargo Nets ..... 1-07-80
Live Animals Transportation ..... 1-07-90
Dry Ice Transportation ..... 1-07-95

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# INTRODUCTION

This Section contains airplane dimensions, interior arrangement data for loading purposes and loading capacity information in the passenger cabin and baggage compartment.

Instructions for loading and unloading the airplane, live animals and dry ice transportation are also included in this Section.

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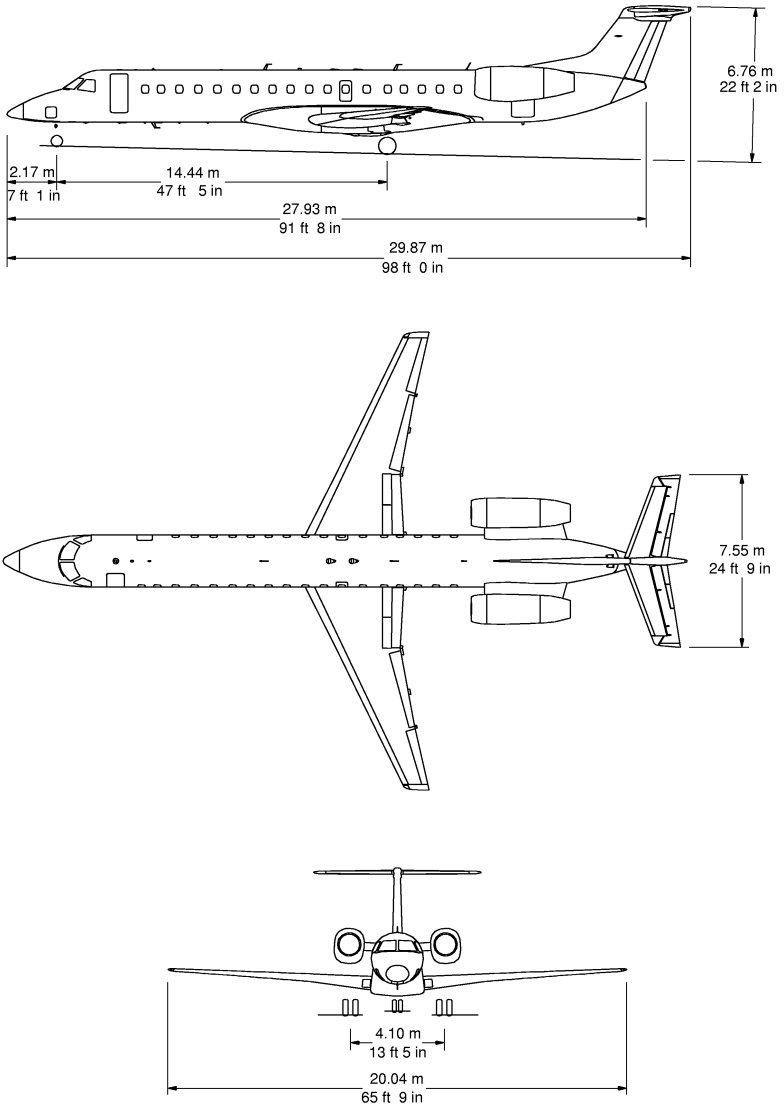
# EXTERNAL DIMENSIONS

## EMB-145 THREE VIEW DRAWING

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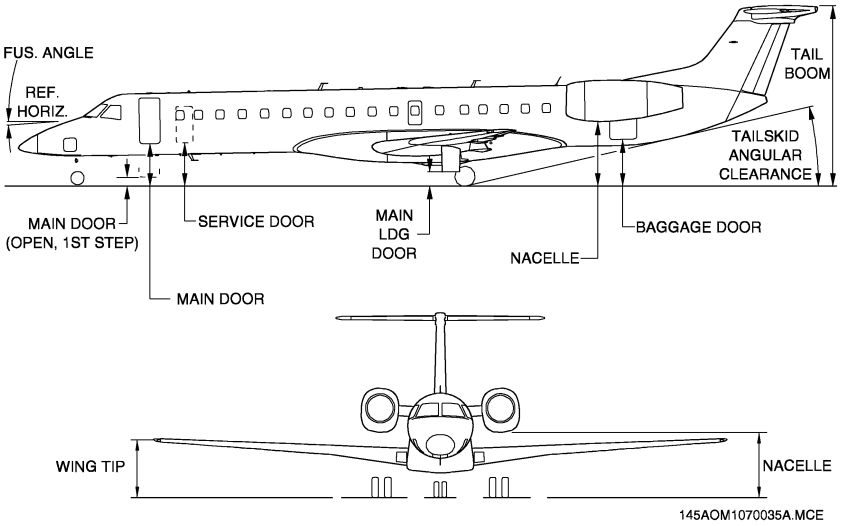
# EMB-145 GROUND CLEARANCES




| Vertical Clearance | Maximum | Minimum |
|---|---|---|
| Fuselage Angle | 1° 21’ 24” | 0° 52’ 00” |
| Main Door | 1.598 m<br>5 ft 3 in | 1.481 m<br>4 ft 10 in |
| Main Door Open (1st step) | 0.480 m<br>1 ft 7 in | 0.360 m<br>1 ft 2¼ in |
| Service Door | 1.595 m<br>5 ft 3 in | 1.408 m<br>4 ft 7 in |
| Main Landing Gear Door | 0.471 m<br>1 ft 6½ in | 0.398 m<br>1 ft 3¾ in |
| Nacelle | 2.425 m<br>7 ft 11 in | 2.315 m<br>7 ft 7 in |
| Baggage Door | 1.806 m<br>5 ft 11 in | 1.663 m<br>5 ft 5 in |
| Tail Boom | 6.810 m<br>22 ft 4 in | 6.619 m<br>21 ft 9 in |
| Wing Tip | 2.022 m<br>6 ft 8 in | 1.920 m<br>6 ft 4 in |
| Tailskid Angular Clearance | 12° 41’ 00” | 11° 43’ 59” |

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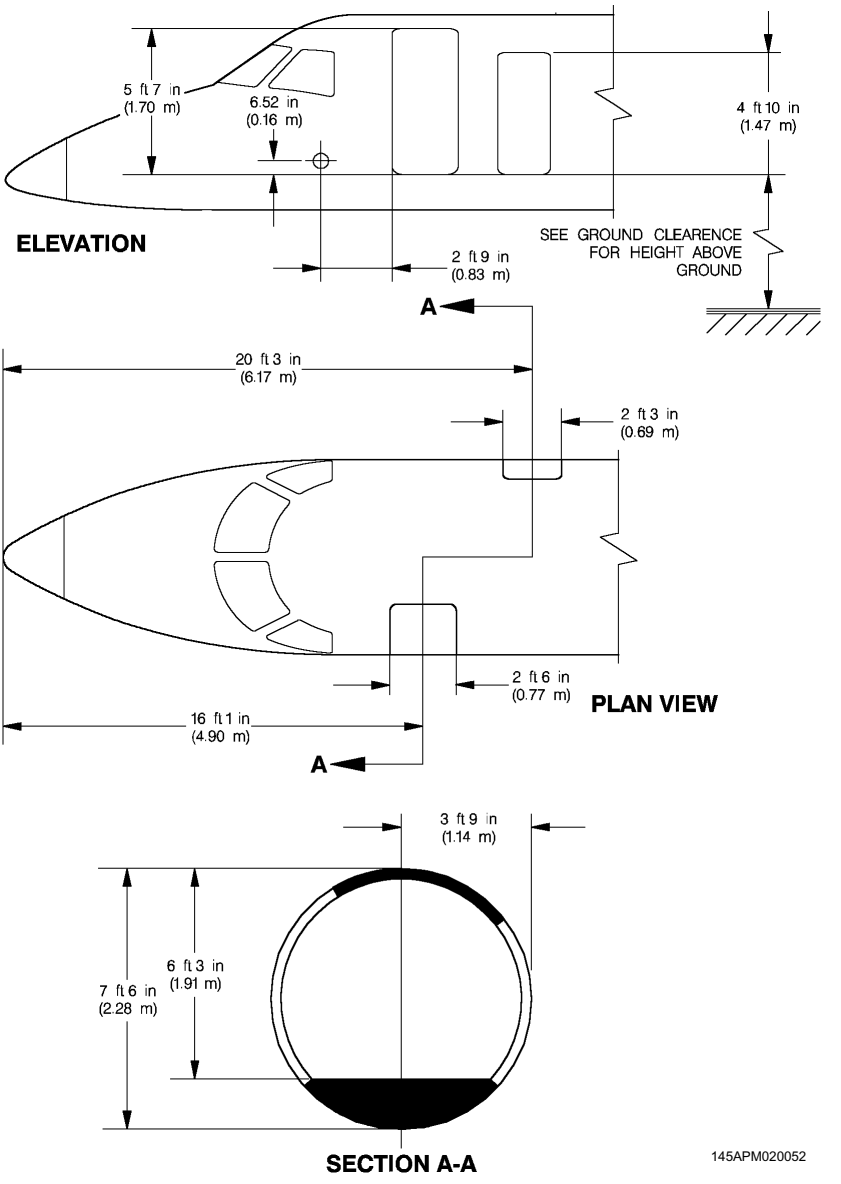
# EMB-145 DOOR CLEARANCES

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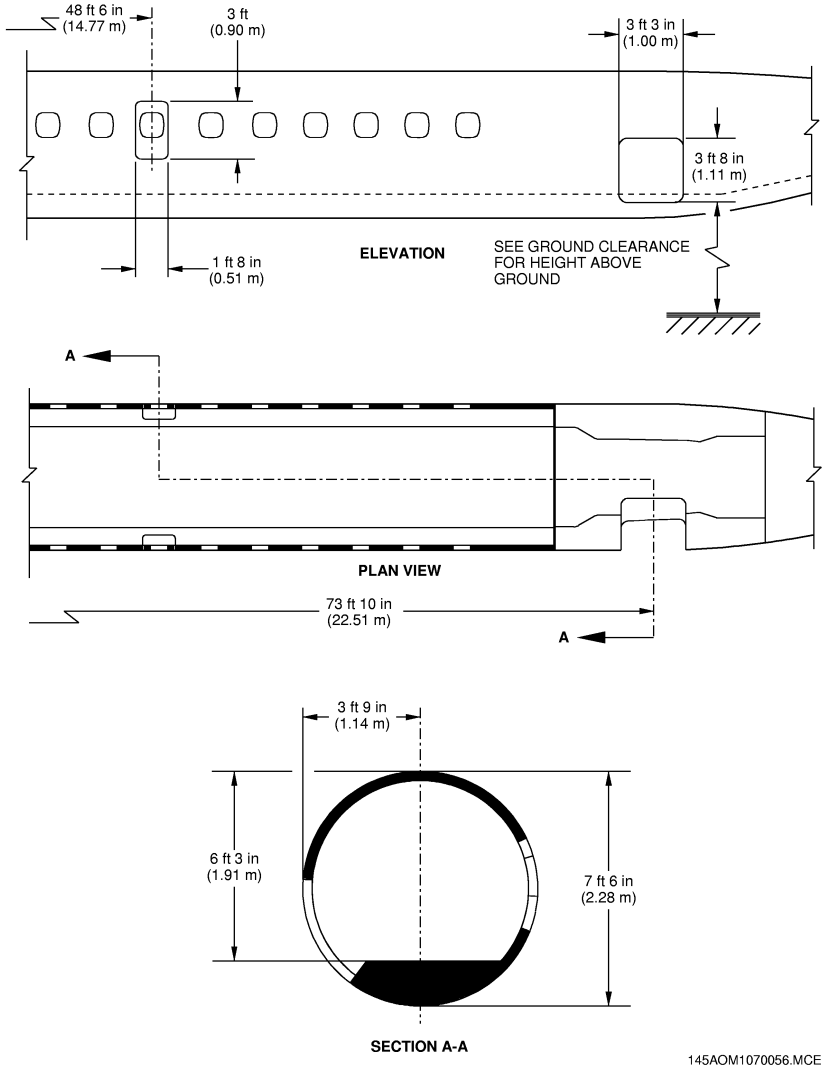
## EMB-145 DOOR CLEARANCES

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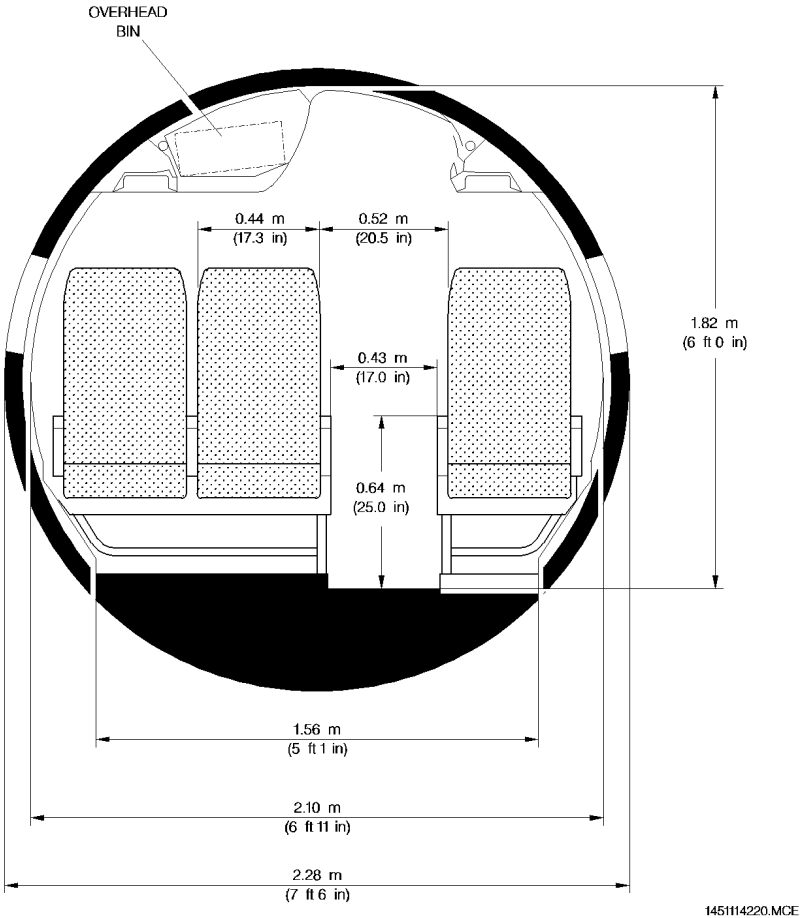
# CABIN CROSS SECTION

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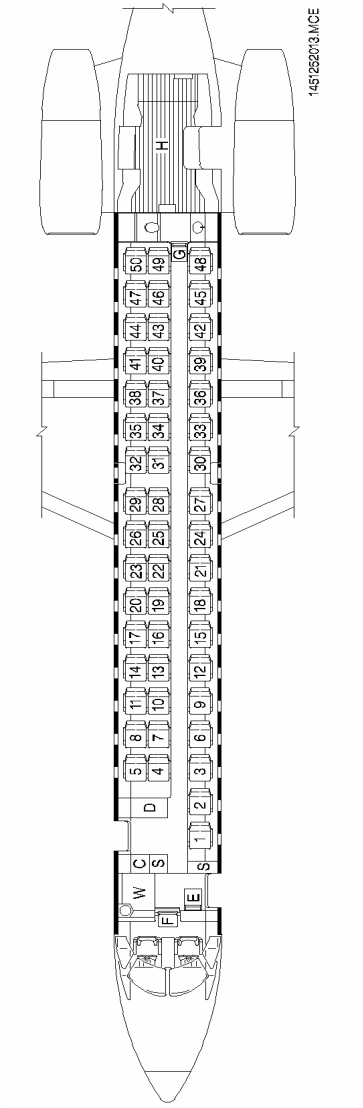
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 1A




W: Wardrobe

S: Stowage Compartment

C: Forward Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

50 seats

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## EMB-145 CONFIGURATION OPTION 1A

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | BALANCE ARM (in) |
|---|---|---|---|
| 1 | 1 | 6.324 | 248.98 |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3, 4, 5 | 7.899 | 310.98 |
| 4 | 6, 7, 8 | 8.686 | 341.97 |
| 5 | 9, 10, 11 | 9.474 | 372.99 |
| 6 | 12, 13, 14 | 10.261 | 403.98 |
| 7 | 15, 16, 17 | 11.048 | 434.96 |
| 8 | 18, 19, 20 | 11.836 | 465.98 |
| 9 | 21, 22, 23 | 12.623 | 496.97 |
| 10 | 24, 25, 26 | 13.411 | 527.99 |
| 11 | 27, 28, 29 | 14.198 | 558.98 |
| 12 | 30, 31, 32 | 15.163 | 596.97 |
| 13 | 33, 34, 35 | 15.951 | 627.99 |
| 14 | 36, 37, 38 | 16.738 | 658.98 |
| 15 | 39, 40, 41 | 17.525 | 689.96 |
| 16 | 42, 43, 44 | 18.313 | 720.98 |
| 17 | 45, 46, 47 | 19.100 | 751.97 |
| 18 | 48, 49, 50 | 19.888 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 4.90 (192.91) | 0.93 (32.9) | 70 (154) ** |
| RH STOWAGE COMPARTMENT | 5.53 (217.72) | 0.17 (6.0) | 61 (135) ** |
| LH STOWAGE COMPARTMENT | 5.38 (211.81) | 0.11 (3.9) | 2.3 (5.1) ** |
| FWD GALLEY | 5.53 (217.72) | * | 51 (113) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 1.27 $m^3$ (44.7 cu.ft)/3 half trolleys.

** Reference values. Check airplane placards for actual values.

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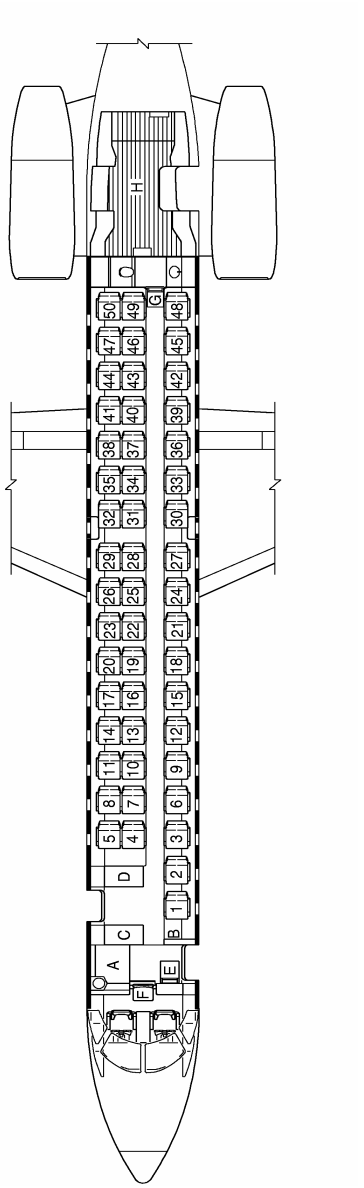
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 2




A: Wardrobe

B: Stowage Compartment

C: Forward Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

50 seats

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## EMB-145 CONFIGURATION OPTION 2

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | BALANCE ARM (in) |
|---|---|---|---|
| 1 | 1 | 6.324 | 248.98 |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3,4,5 | 7.899 | 310.98 |
| 4 | 6,7,8 | 8.686 | 341.97 |
| 5 | 9,10,11 | 9.474 | 372.99 |
| 6 | 12,13,14 | 10.261 | 403.98 |
| 7 | 15,16,17 | 11.048 | 434.96 |
| 8 | 18,19,20 | 11.836 | 465.98 |
| 9 | 21,22,23 | 12.623 | 496.97 |
| 10 | 24,25,26 | 13.411 | 527.99 |
| 11 | 27,28,29 | 14.198 | 558.98 |
| 12 | 30,31,32 | 15.163 | 596.97 |
| 13 | 33,34,35 | 15.951 | 627.99 |
| 14 | 36,37,38 | 16.738 | 658.98 |
| 15 | 39,40,41 | 17.525 | 689.96 |
| 16 | 42,43,44 | 18.313 | 720.98 |
| 17 | 45,46,47 | 19.100 | 751.97 |
| 18 | 48,49,50 | 19.888 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 4.90 (192.91) | 0.93 (32.9) | 70 (154) ** |
| LH STOWAGE COMPARTMENT | 5.38 (211.81) | 0.11 (3.9) | 2.3 (5.1) ** |
| FWD GALLEY | 5.53 (217.72) | * | 113 (249) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 1.49 $m^3$ (52.7 cu.ft) / 4 half trolleys.
** Reference values. Check aircraft placards for actual values.

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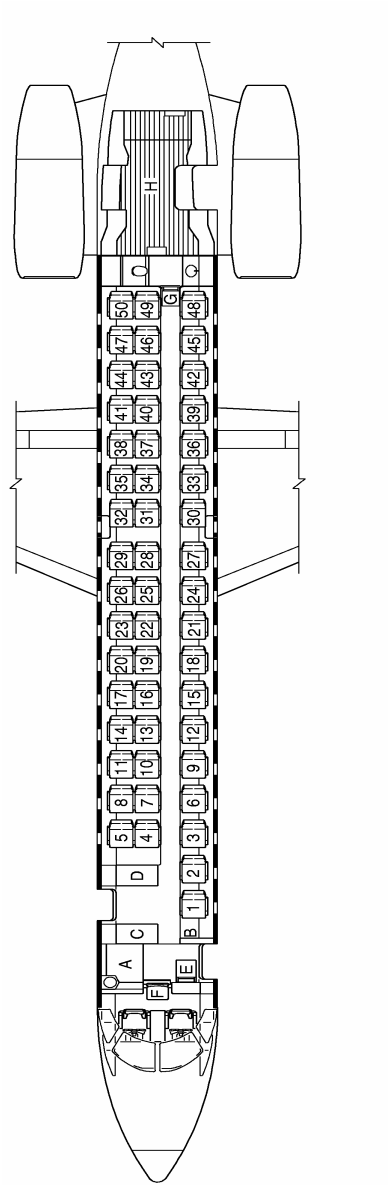
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 3




A: Outboard Galley

B: Stowage Compartment

C: Fwd Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

50 seats

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## EMB-145 CONFIGURATION OPTION 3

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | BALANCE ARM (in) |
|---|---|---|---|
| 1 | 1 | 6.324 | 248.98 |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3, 4, 5 | 7.899 | 310.98 |
| 4 | 6, 7, 8 | 8.686 | 341.97 |
| 5 | 9, 10, 11 | 9.474 | 372.99 |
| 6 | 12, 13, 14 | 10.261 | 403.98 |
| 7 | 15, 16, 17 | 11.048 | 434.96 |
| 8 | 18, 19, 20 | 11.836 | 465.98 |
| 9 | 21, 22, 23 | 12.623 | 496.97 |
| 10 | 24, 25, 26 | 13.411 | 527.99 |
| 11 | 27, 28, 29 | 14.198 | 558.98 |
| 12 | 30, 31, 32 | 15.163 | 596.97 |
| 13 | 33, 34, 35 | 15.951 | 627.99 |
| 14 | 36, 37, 38 | 16.738 | 658.98 |
| 15 | 39, 40, 41 | 17.525 | 689.96 |
| 16 | 42, 43, 44 | 18.313 | 720.98 |
| 17 | 45, 46, 47 | 19.100 | 751.97 |
| 18 | 48, 49, 50 | 19.888 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| LH STOWAGE COMPARTMENT | 5.38 (211.81) | 0.11 (3.9) | 2.3 (5.1) ** |
| OUTBOARD GALLEY | 4.90 (192.91) | * | 82 (181) ** |
| FWD GALLEY | 5.53 (217.72) | * | 113 (249) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 2.42 $m^3$ (85.4 cu.ft)/6 or 4 half trolleys.

** Reference values. Check airplane placards for actual values.

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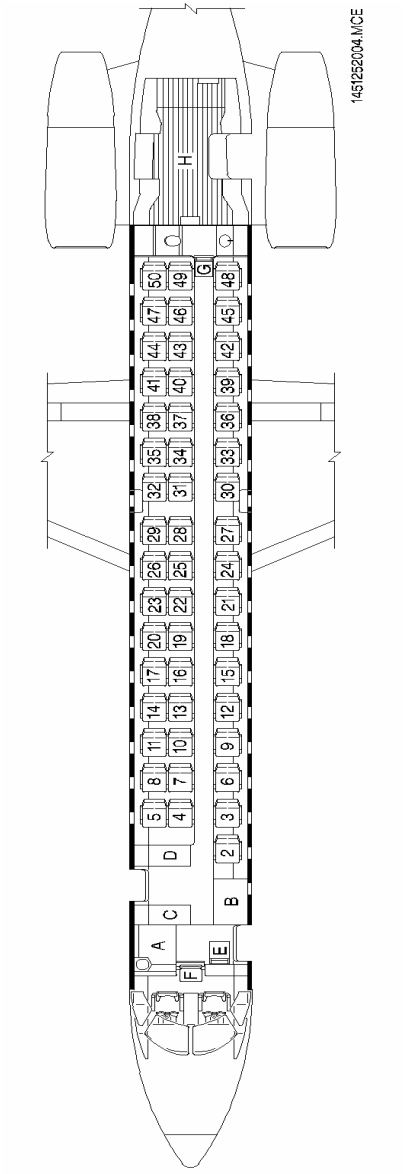
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 4




A: Forward Galley

B: Wardrobe

C: Mid Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

49 seats

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## EMB-145 CONFIGURATION OPTION 4

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | - | - | - |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3,4,5 | 7.898 | 310.98 |
| 4 | 6,7,8 | 8.686 | 341.97 |
| 5 | 9,10,11 | 9.473 | 372.99 |
| 6 | 12,13,14 | 10.261 | 403.98 |
| 7 | 15,16,17 | 11.048 | 434.96 |
| 8 | 18,19,20 | 11.835 | 465.98 |
| 9 | 21,22,23 | 12.623 | 496.97 |
| 10 | 24,25,26 | 13.410 | 527.99 |
| 11 | 27,28,29 | 14.198 | 558.98 |
| 12 | 30,31,32 | 15.163 | 596.97 |
| 13 | 33,34,35 | 15.950 | 627.99 |
| 14 | 36,37,38 | 16.738 | 658.98 |
| 15 | 39,40,41 | 17.525 | 689.96 |
| 16 | 42,43,44 | 18.312 | 720.98 |
| 17 | 45,46,47 | 19.100 | 751.97 |
| 18 | 48,49,50 | 19.887 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 5.78 (227.48) | 0.57 (20.2) | 57 (126) ** |
| FWD GALLEY | 4.90 (192.91) | * | 82 (181) ** |
| MID GALLEY | 5.53 (217.72) | * | 113 (249) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 2.42 $m^3$ (85.4 cu.ft) / 6 half trolleys.
** Reference values. Check aircraft placards for actual values.

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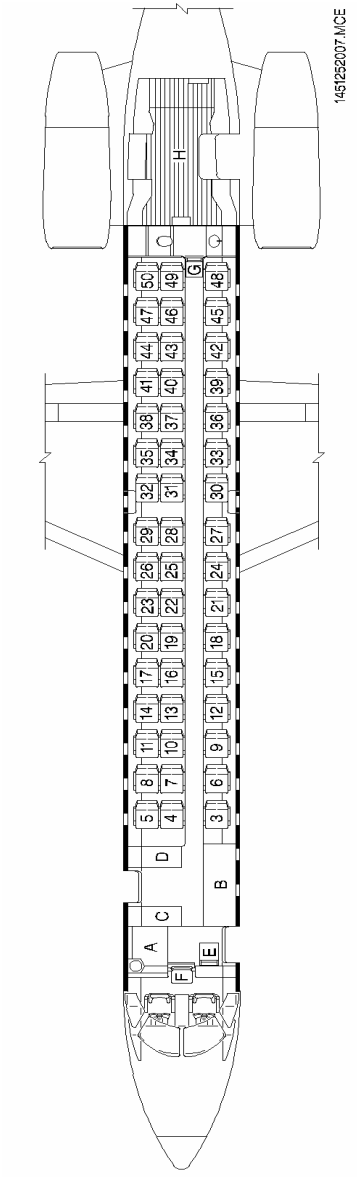
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 5




A: Forward Galley

B: Wardrobe

C: Mid Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

48 seats

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## EMB-145 CONFIGURATION OPTION 5

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | BALANCE ARM (in) |
|---|---|---|---|
| 1 | - | - | - |
| 2 | - | - | - |
| 3 | 3,4,5 | 7.898 | 310.98 |
| 4 | 6,7,8 | 8.685 | 341.97 |
| 5 | 9,10,11 | 9.473 | 372.99 |
| 6 | 12,13,14 | 10.260 | 403.98 |
| 7 | 15,16,17 | 11.048 | 434.96 |
| 8 | 18,19,20 | 11.835 | 465.98 |
| 9 | 21,22,23 | 12.622 | 496.97 |
| 10 | 24,25,26 | 13.410 | 527.99 |
| 11 | 27,28,29 | 14.197 | 558.98 |
| 12 | 30,31,32 | 15.162 | 596.97 |
| 13 | 33,34,35 | 15.950 | 627.99 |
| 14 | 36,37,38 | 16.737 | 658.98 |
| 15 | 39,40,41 | 17.525 | 689.96 |
| 16 | 42,43,44 | 18.312 | 720.98 |
| 17 | 45,46,47 | 19.099 | 751.97 |
| 18 | 48,49,50 | 19.887 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 6.153 (242.24) | 1.07 (37.6) | 80 (176) ** |
| FWD GALLEY | 4.90 (192.91) | * | 82 (181) ** |
| MID GALLEY | 5.53 (217.72) | * | 113 (249) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 2.42 $m^3$ (85.4 cu.ft)/6 half trolleys.

** Reference values. Check airplane placards for actual values.

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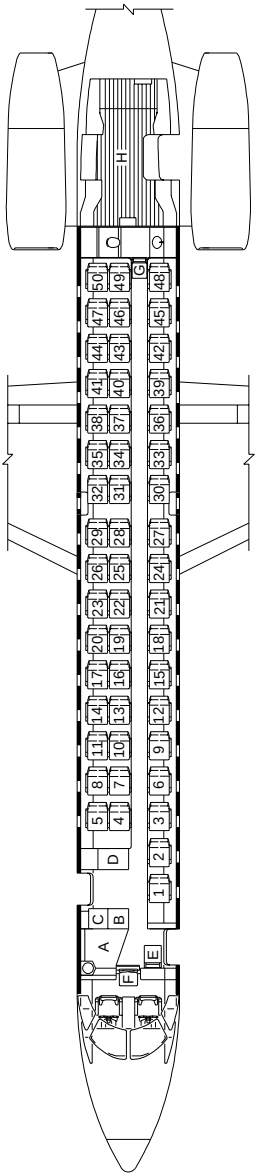
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 6




A: WARDROBE
B: STOWAGE COMPARTMENT
C: FORWARD GALLEY
D: AFT GALLEY
E: FORWARD FLIGHT ATTENDANT
F: COCKPIT OBSERVER
G: AFT FLIGHT ATTENDANT
H: BAGGAGE COMPARTMENT

50 SEATS
BUYER FURNISHED INTERIOR

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## EMB-145 CONFIGURATION OPTION 6

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1 | 6.324 | 248.98 |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3, 4, 5 | 7.899 | 310.98 |
| 4 | 6, 7, 8 | 8.686 | 341.97 |
| 5 | 9, 10, 11 | 9.474 | 372.99 |
| 6 | 12, 13, 14 | 10.261 | 403.98 |
| 7 | 15, 16, 17 | 11.048 | 434.96 |
| 8 | 18, 19, 20 | 11.836 | 465.98 |
| 9 | 21, 22, 23 | 12.623 | 496.97 |
| 10 | 24, 25, 26 | 13.411 | 527.99 |
| 11 | 27, 28, 29 | 14.198 | 558.98 |
| 12 | 30, 31, 32 | 15.163 | 596.97 |
| 13 | 33, 34, 35 | 15.951 | 627.99 |
| 14 | 36, 37, 38 | 16.738 | 658.98 |
| 15 | 39, 40, 41 | 17.525 | 689.96 |
| 16 | 42, 43, 44 | 18.313 | 720.98 |
| 17 | 45, 46, 47 | 19.100 | 751.97 |
| 18 | 48, 49, 50 | 19.888 | 782.99 |

**NOTE:** Passenger seats are installed by the operator.

**PASSENGER AVERAGE CG:** 13.596 m / 535.26 in

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity Kg (lb) |
|---|---|---|---|
| WARDROBE | 5.014 (197.40) | 1.12 (39.6) | 66 (145.5) ** |
| RH STOWAGE COMPARTMENT | 5.380 (211.81) | 0.17 (6.0) | 67 (147.7) ** |
| FWD GALLEY | 5.530 (217.72) | * | 106 (233.7) ** |
| AFT GALLEY | 6.790 (267.32) | * | 191 (421) ** |

* Total Galley Volume: 1.27 $m^3$ (44.7 cu.ft) / 3 half trolleys.
** Reference values. Check aircraft placards for actual values.



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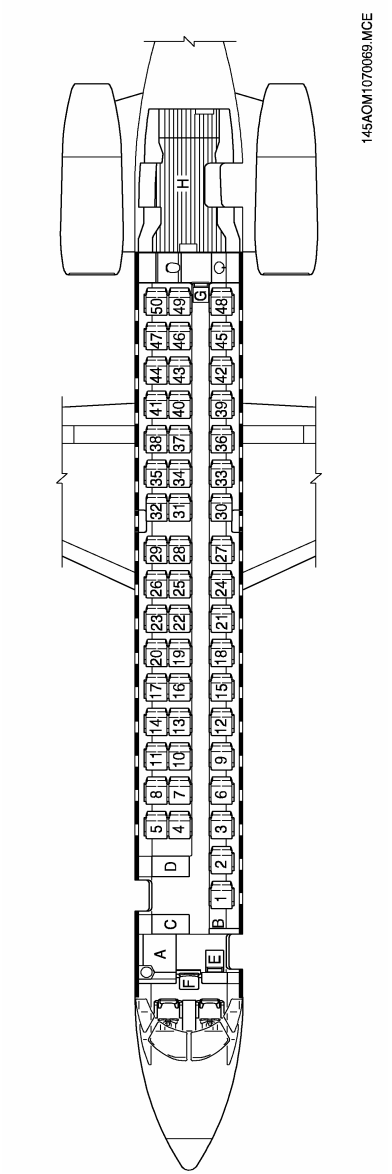
# INTERIOR ARRANGEMENT

## EMB-145 STD CONFIGURATION




A: Wardrobe

B: Stowage Unit

C: Stowage Compartment

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

50 seats

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## EMB-145 STD CONFIGURATION

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1 | 6.324 | 248.98 |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3, 4, 5 | 7.899 | 310.98 |
| 4 | 6, 7, 8 | 8.686 | 341.97 |
| 5 | 9, 10, 11 | 9.474 | 372.99 |
| 6 | 12, 13, 14 | 10.261 | 403.98 |
| 7 | 15, 16, 17 | 11.048 | 434.96 |
| 8 | 18, 19, 20 | 11.836 | 465.98 |
| 9 | 21, 22, 23 | 12.623 | 496.97 |
| 10 | 24, 25, 26 | 13.411 | 527.99 |
| 11 | 27, 28, 29 | 14.198 | 558.98 |
| 12 | 30, 31, 32 | 15.163 | 596.97 |
| 13 | 33, 34, 35 | 15.951 | 627.99 |
| 14 | 36, 37, 38 | 16.738 | 658.98 |
| 15 | 39, 40, 41 | 17.525 | 689.96 |
| 16 | 42, 43, 44 | 18.313 | 720.98 |
| 17 | 45, 46, 47 | 19.100 | 751.97 |
| 18 | 48, 49, 50 | 19.888 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 4.90 (192.91) | 0.93 (32.9) | 70 (154) ** |
| RH STOWAGE COMPARTMENT | 5.53 (217.72) | 0.45 (16.0) | ** |
| STOWAGE UNIT | 5.38 (211.81) | 0.17 (6.0) | 61 (135)** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 0.99 $m^3$ (34.8 cu.ft)/2 half trolleys.

** Reference values. Check airplane placards for actual values.

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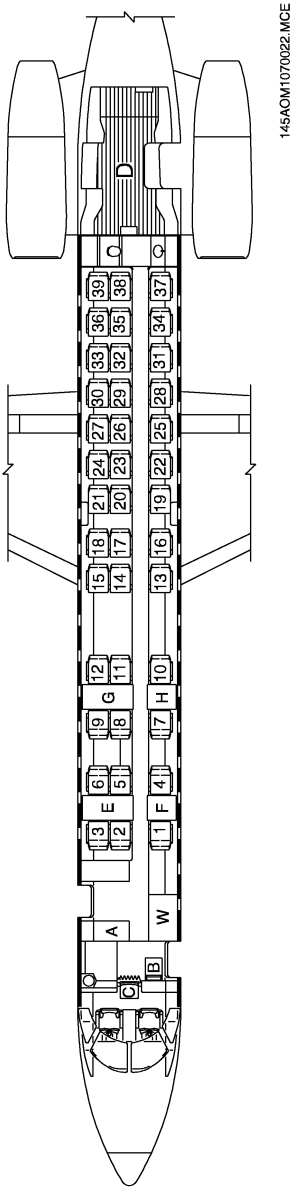
# INTERIOR ARRANGEMENT

## EMB-145 BAF CORPORATE CONFIGURATION




A: Galley

B: Flight Attendant Seat

C: Cockpit Observer

D: Baggage Compartment

E, G: Double Table

F, H: Single Table

W: Wardrobe

39 seats

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## EMB-145 BAF CORPORATE CONFIGURATION

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1, 2, 3 | 7.538 | 296.77 |
| 2 | 4, 5, 6 | 8.884 | 349.76 |
| 3 | 7, 8, 9 | 10.114 | 398.19 |
| 4 | 10, 11, 12 | 11.460 | 451.18 |
| 5 | 13, 14, 15 | 13.280 | 522.83 |
| 6 | 16, 17, 18 | 14.067 | 553.82 |
| 7 | 19, 20, 21 | 15.083 | 593.82 |
| 8 | 22, 23, 24 | 15.870 | 624.80 |
| 9 | 25, 26, 27 | 16.658 | 655.83 |
| 10 | 28, 29, 30 | 17.445 | 686.81 |
| 11 | 31, 32, 33 | 18.233 | 717.84 |
| 12 | 34, 35, 36 | 19.020 | 748.82 |
| 13 | 37, 38, 39 | 19.807 | 779.80 |

**PASSENGER AVERAGE CG:** 14.420 m / 567.72 in

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| FWD GALLEY | 5.55 (218.50) | 0.085 (3.00) | 184 (406) * |
| WARDROBE | 5.76 (226.77) | 0.490 (17.30) | 45 (99.2) |

* Reference values. Check aircraft placards for actual values.

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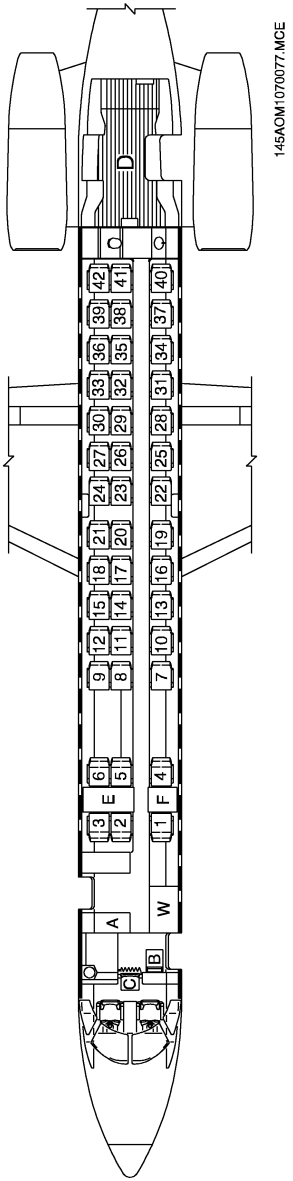
# EMB-145 BAF SECOND CORPORATE CONFIGURATION




A: Galley

B: Flight Attendant Seat

C: Cockpit Observer

D: Baggage Compartment

E: Double Table

F: Single Table

W: Wardrobe

42 seats

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## EMB-145 BAF SECOND CORPORATE CONFIGURATION

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1, 2, 3 | 7.538 | 296.77 |
| 2 | 4, 5, 6 | 8.884 | 349.76 |
| 3 | 7, 8, 9 | 10.917 | 429.80 |
| 4 | 10, 11, 12 | 11.705 | 460.83 |
| 5 | 13, 14, 15 | 12.492 | 491.81 |
| 6 | 16, 17, 18 | 13.280 | 522.83 |
| 7 | 19, 20, 21 | 14.067 | 553.82 |
| 8 | 22, 23, 24 | 15.083 | 593.82 |
| 9 | 25, 26, 27 | 15.870 | 624.80 |
| 10 | 28, 29, 30 | 16.658 | 655.83 |
| 11 | 31, 32, 33 | 17.445 | 686.81 |
| 12 | 34, 35, 36 | 18.233 | 717.84 |
| 13 | 37, 38, 39 | 19.020 | 748.82 |
| 14 | 40, 41, 42 | 19.807 | 779.80 |

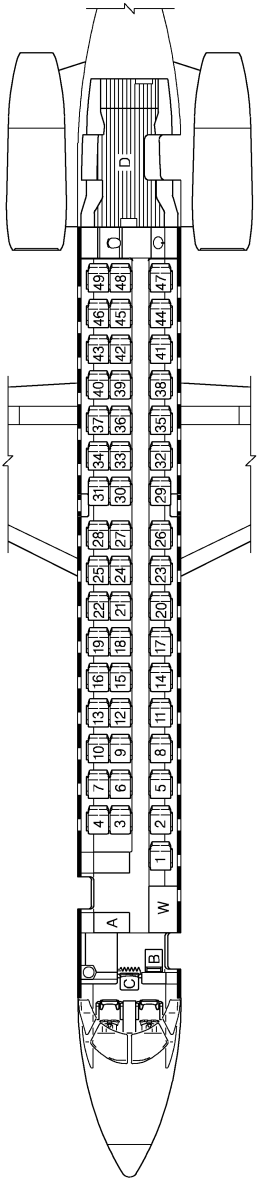
**PASSENGER AVERAGE CG:** 14.357 m / 565.24 in

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| FWD GALLEY | 5.55 (218.50) | 0.085 (3.00) | 184 (405) * |
| WARDROBE | 5.76 (226.77) | 0.490 (17.30) | 45 (99.2) |

* Reference values. Check aircraft placards for actual values.

# INTERIOR ARRANGEMENT

## EMB-145 BAF SHUTTLE CONFIGURATION




A: Galley

B: Flight Attendant Seat

C: Cockpit Observer

D: Baggage Compartment

W: Wardrobe

49 seats

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## EMB-145 BAF SHUTTLE CONFIGURATION

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1 | 6.980 | 274.80 |
| 2 | 2,3,4 | 7.768 | 305.83 |
| 3 | 5,6,7 | 8.555 | 336.81 |
| 4 | 8,9,10 | 9.343 | 367.83 |
| 5 | 11,12,13 | 10.130 | 398.82 |
| 6 | 14, 15,16 | 10.917 | 429.80 |
| 7 | 17, 18,19 | 11.705 | 460.83 |
| 8 | 20, 21,22 | 12.492 | 491.81 |
| 9 | 23,24,25 | 13.280 | 522.83 |
| 10 | 26, 27,28 | 14.067 | 553.82 |
| 11 | 29,30,31 | 15.083 | 593.82 |
| 12 | 32, 33,34 | 15.870 | 624.80 |
| 13 | 35, 36,37 | 16.658 | 655.83 |
| 14 | 38, 39,40 | 17.445 | 686.81 |
| 15 | 41, 42,43 | 18.233 | 717.84 |
| 16 | 44, 45,46 | 19.020 | 748.82 |
| 17 | 47, 48,49 | 19.807 | 779.80 |

**PASSENGER AVERAGE CG:** 13.374 m / 526.524 in

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity Kg (lb) |
|---|---|---|---|
| FWD GALLEY | 5.55 (218.50) | 0.085 (3.0) | 184 (405)* |
| WARDROBE | 5.76 (226.77) | 0.490 (17.30) | 45 (99.2) |

* Reference values. Check aircraft placards for actual values.

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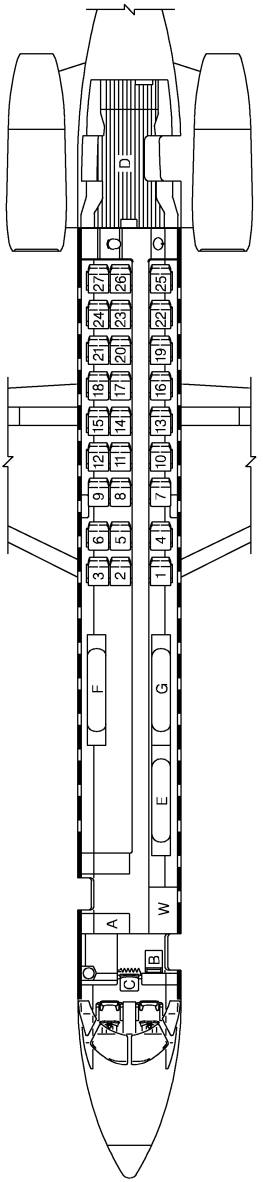
# INTERIOR ARRANGEMENT

## EMB-145 BAF MEDEVAC CONFIGURATION




A: Galley

B: Flight Attendant Seat

C: Cockpit Observer

D: Baggage Compartment

E,F,G: Stretcher

W: Wardrobe

27 seats

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## EMB-145 BAF MEDEVAC CONFIGURATION

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1, 2, 3 | 13.280 | 522.83 |
| 2 | 4, 5, 6 | 14.067 | 553.82 |
| 3 | 7, 8, 9 | 15.083 | 593.82 |
| 4 | 10, 11, 12 | 15.870 | 624.80 |
| 5 | 13, 14, 15 | 16.658 | 655.83 |
| 6 | 16, 17, 18 | 17.445 | 686.81 |
| 7 | 19, 20, 21 | 18.233 | 717.84 |
| 8 | 22, 23, 24 | 19.020 | 748.82 |
| 9 | 25, 26, 27 | 19.807 | 779.80 |

**PASSENGER AVERAGE CG:** 16.607 m / 653.819 in

| STRETCHER | BALANCE ARM (m) | (in) |
|---|---|---|
| E | 8.235 | 324.21 |
| F | 10.673 | 420.20 |
| G | 10.673 | 420.20 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity Kg (lb) |
|---|---|---|---|
| FWD GALLEY | 5.55 (218.50) | 0.085 (3.0) | 184 (405)* |
| WARDROBE | 5.76 (226.77) | 0.490 (17.30) | 45 (99.2) |

* Reference values. Check aircraft placards for actual values.

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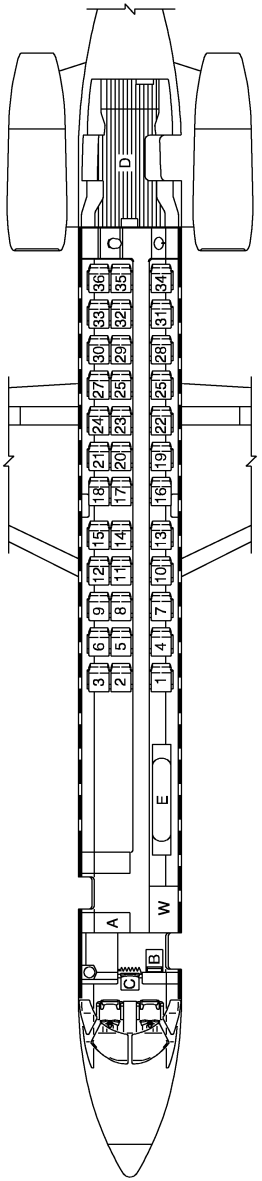
# EMB-145 BAF SECOND MEDEVAC CONFIGURATION




A: Galley

B: Flight Attendant Seat

C: Cockpit Observer

D: Baggage Compartment

E: Stretcher

W: Wardrobe

36 seats

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## EMB-145 BAF SECOND MEDEVAC CONFIGURATION

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1, 2, 3 | 10.917 | 429.80 |
| 2 | 4, 5, 6 | 11.705 | 460.83 |
| 3 | 7, 8, 9 | 12.492 | 491.81 |
| 4 | 10, 11, 12 | 13.280 | 522.83 |
| 5 | 13, 14, 15 | 14.067 | 553.82 |
| 6 | 16, 17, 18 | 15.083 | 593.82 |
| 7 | 19, 20, 21 | 15.870 | 624.80 |
| 8 | 22, 23, 24 | 16.658 | 655.83 |
| 9 | 25, 26, 27 | 17.445 | 686.81 |
| 10 | 28, 29, 30 | 18.233 | 717.84 |
| 11 | 31, 32, 33 | 19.020 | 748.82 |
| 12 | 34, 35, 36 | 19.807 | 779.80 |

**PASSENGER AVERAGE CG:** 15.381 m / 605.57 in

| STRETCHER | BALANCE ARM (m) | (in) |
|---|---|---|
| E | 8.235 | 324.21 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity Kg (lb) |
|---|---|---|---|
| FWD GALLEY | 5.55 (218.50) | 0.085 (3.0) | 184 (405)* |
| WARDROBE | 5.76 (226.77) | 0.490 (17.30) | 45 (99.2) |

* Reference values. Check aircraft placards for actual values.

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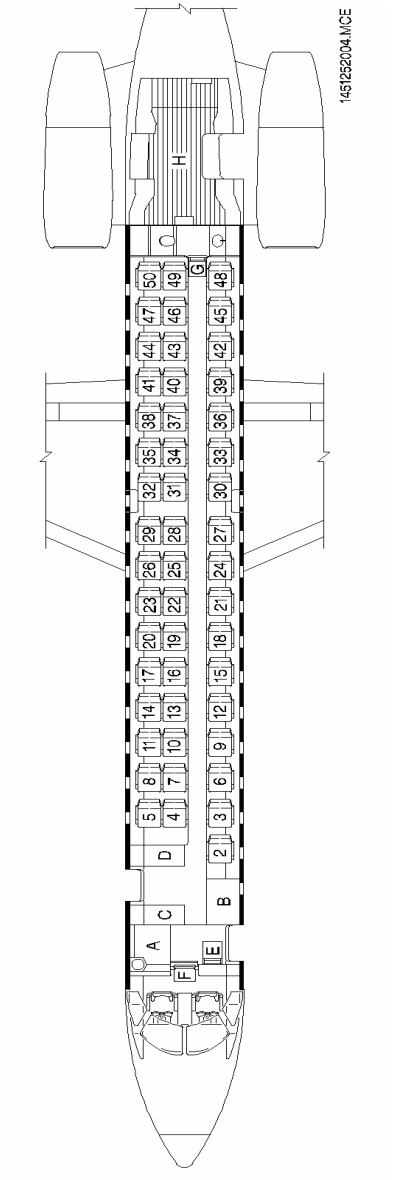
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 4A




A: Outboard Galley

B: Wardrobe

C: Forward Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

49 seats

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## EMB-145 CONFIGURATION OPTION 4A

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | - | - | - |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3,4,5 | 7.898 | 310.98 |
| 4 | 6,7,8 | 8.686 | 341.97 |
| 5 | 9,10,11 | 9.473 | 372.99 |
| 6 | 12,13,14 | 10.261 | 403.98 |
| 7 | 15,16,17 | 11.048 | 434.96 |
| 8 | 18,19,20 | 11.835 | 465.98 |
| 9 | 21,22,23 | 12.623 | 496.97 |
| 10 | 24,25,26 | 13.410 | 527.99 |
| 11 | 27,28,29 | 14.198 | 558.98 |
| 12 | 30,31,32 | 15.163 | 596.97 |
| 13 | 33,34,35 | 15.950 | 627.99 |
| 14 | 36,37,38 | 16.738 | 658.98 |
| 15 | 39,40,41 | 17.525 | 689.96 |
| 16 | 42,43,44 | 18.312 | 720.98 |
| 17 | 45,46,47 | 19.100 | 751.97 |
| 18 | 48,49,50 | 19.887 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 5.78 (227.48) | 0.57 (20.2) | 57 (126) ** |
| OUTBOARD GALLEY | 4.90 (192.91) | * | 82 (181) ** |
| FORWARD GALLEY | 5.53 (217.72) | * | 113 (249) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 2.42 $m^3$ (85.4 cu.ft)/6 half trolleys.

** Reference values. Check airplane placards for actual values.

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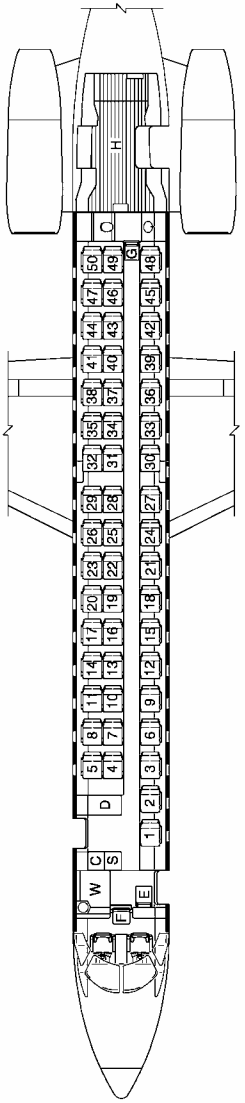
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 1




W: Wardrobe

S: Stowage Compartment

C: Forward Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

50 seats

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## EMB-145 CONFIGURATION OPTION 1

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1 | 6.324 | 248.98 |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3, 4, 5 | 7.899 | 310.98 |
| 4 | 6, 7, 8 | 8.686 | 341.97 |
| 5 | 9, 10, 11 | 9.474 | 372.99 |
| 6 | 12, 13, 14 | 10.261 | 403.98 |
| 7 | 15, 16, 17 | 11.048 | 434.96 |
| 8 | 18, 19, 20 | 11.836 | 465.98 |
| 9 | 21, 22, 23 | 12.623 | 496.97 |
| 10 | 24, 25, 26 | 13.411 | 527.99 |
| 11 | 27, 28, 29 | 14.198 | 558.98 |
| 12 | 30, 31, 32 | 15.163 | 596.97 |
| 13 | 33, 34, 35 | 15.951 | 627.99 |
| 14 | 36, 37, 38 | 16.738 | 658.98 |
| 15 | 39, 40, 41 | 17.525 | 689.96 |
| 16 | 42, 43, 44 | 18.313 | 720.98 |
| 17 | 45, 46, 47 | 19.100 | 751.97 |
| 18 | 48, 49, 50 | 19.888 | 782.99 |

**PASSENGER AVERAGE CG:** 13.595 m / 535.26 in.

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 4.90 (192.91) | 0.93 (32.9) | 70 (154) ** |
| RH STOWAGE COMPARTMENT | 5.53 (217.72) | 0.17 (6.0) | 61 (135)** |
| FWD GALLEY | 5.53 (217.72) | * | 51 (113) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 1.27 $m^3$ (44.7 cu.ft) / 3 half trolleys.
** Reference values. Check aircraft placards for actual values.

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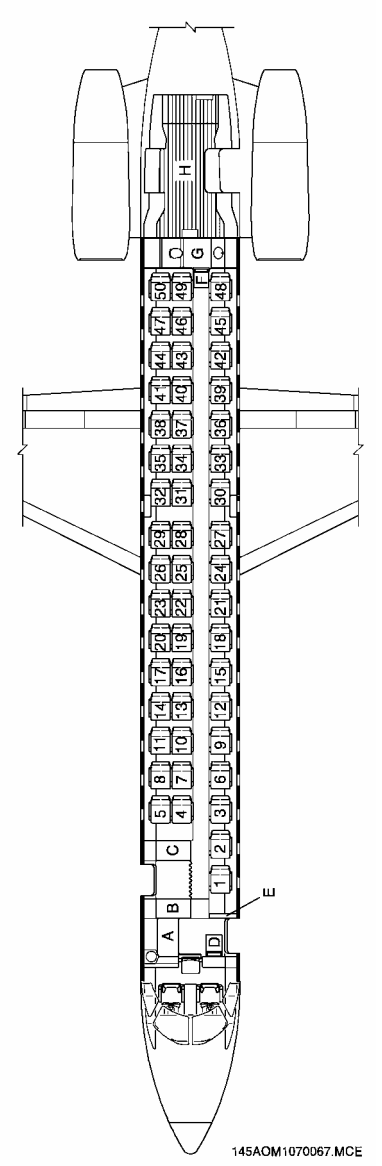
# INTERIOR ARRANGEMENT

## EMB-145XR CONFIGURATION




A: Wardrobe

B: Forward Galley

C: Aft Galley

D: Forward Flight Attendant

E: Stowage Compartment

F: Aft Flight Attendant

G: Lavatory

H: Baggage Compartment

50 seats

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## EMB-145XR CONFIGURATION

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1 | 6.324 | 248.98 |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3, 4, 5 | 7.899 | 310.98 |
| 4 | 6, 7, 8 | 8.686 | 341.97 |
| 5 | 9, 10, 11 | 9.474 | 372.99 |
| 6 | 12, 13, 14 | 10.261 | 403.98 |
| 7 | 15, 16, 17 | 11.048 | 434.96 |
| 8 | 18, 19, 20 | 11.836 | 465.98 |
| 9 | 21, 22, 23 | 12.623 | 496.97 |
| 10 | 24, 25, 26 | 13.411 | 527.99 |
| 11 | 27, 28, 29 | 14.198 | 558.98 |
| 12 | 30, 31, 32 | 15.163 | 596.97 |
| 13 | 33, 34, 35 | 15.951 | 627.99 |
| 14 | 36, 37, 38 | 16.738 | 658.98 |
| 15 | 39, 40, 41 | 17.525 | 689.96 |
| 16 | 42, 43, 44 | 18.313 | 720.98 |
| 17 | 45, 46, 47 | 19.100 | 751.97 |
| 18 | 48, 49, 50 | 19.888 | 782.99 |

**PASSENGER AVERAGE CG:** 13.595 m / 535.26 in.

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 4.90 (192.91) | 0.93 (32.9) | 70 (154) ** |
| EMERG. EQUIP. STOWAGE UNIT | 5.38 (211.81) | 0.11 (3.9) | 2.3 (5.1) ** |
| FWD GALLEY | 5.53 (217.72) | * | 51 (113) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 1.49 $m^3$ (52.7 cu.ft) / 4 half trolleys.
** Reference values. Check aircraft placards for actual values.

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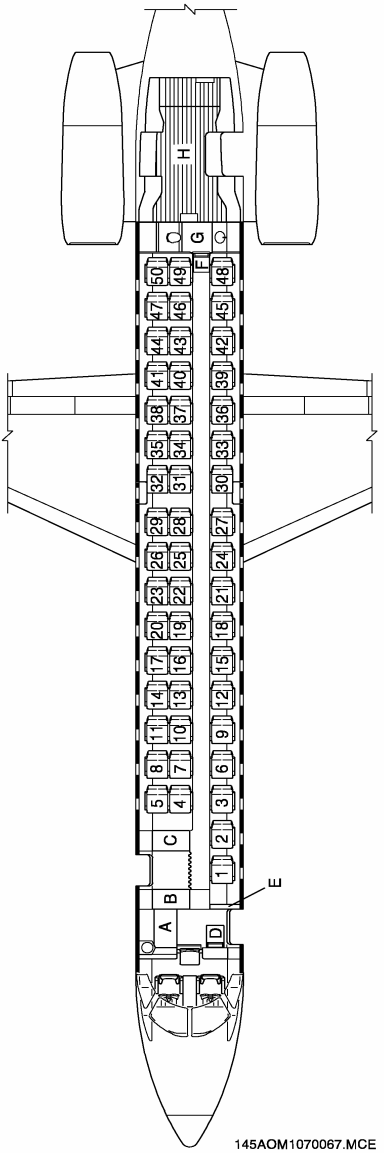
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 1B




A: Wardrobe
B: Forward Galley
C: Aft Galley
D: Forward Flight Attendant
E: Stowage Compartment
F: Aft Flight Attendant
G: Lavatory
H: Baggage Compartment

50 seats

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## EMB-145 CONFIGURATION OPTION 1B

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | BALANCE ARM (in) |
|---|---|---|---|
| 1 | 1 | 6.324 | 248.98 |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3,4,5 | 7.899 | 310.98 |
| 4 | 6,7,8 | 8.686 | 341.97 |
| 5 | 9,10,11 | 9.474 | 372.99 |
| 6 | 12,13,14 | 10.261 | 403.98 |
| 7 | 15,16,17 | 11.048 | 434.96 |
| 8 | 18,19,20 | 11.836 | 465.98 |
| 9 | 21,22,23 | 12.623 | 496.97 |
| 10 | 24,25,26 | 13.411 | 527.99 |
| 11 | 27,28,29 | 14.198 | 558.98 |
| 12 | 30,31,32 | 15.163 | 596.97 |
| 13 | 33,34,35 | 15.951 | 627.99 |
| 14 | 36,37,38 | 16.738 | 658.98 |
| 15 | 39,40,41 | 17.525 | 689.96 |
| 16 | 42,43,44 | 18.313 | 720.98 |
| 17 | 45,46,47 | 19.100 | 751.97 |
| 18 | 48,49,50 | 19.888 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 4.90 (192.91) | 0.93 (32.9) | 70 (154) ** |
| LH STOWAGE COMPARTMENT | 5.38 (211.81) | 0.11 (3.9) | 2.3 (5.1) ** |
| FWD GALLEY | 5.53 (217.72) | * | 113 (249) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 1.49 $m^3$ (52.7 cu.ft)/3 half trolleys.

** Reference values. Check airplane placards for actual values.

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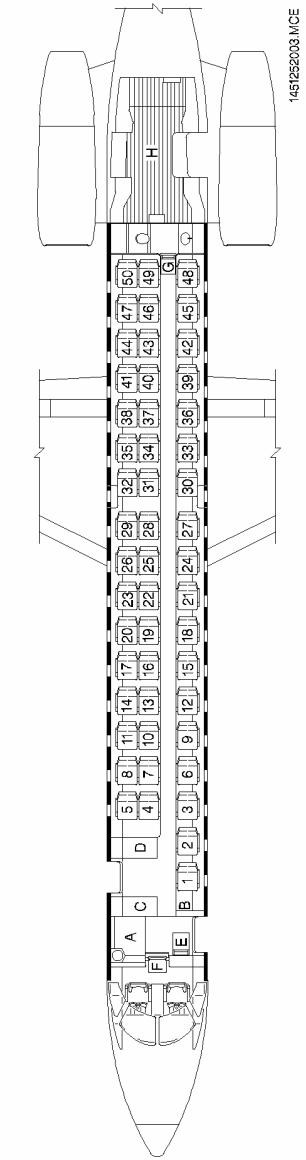
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION XZ




A: Outboard Galley

B: Stowage Compartment

C: Forward Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

50 seats

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## EMB-145 CONFIGURATION OPTION XZ

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | BALANCE ARM (in) |
|---|---|---|---|
| 1 | 1 | 6.324 | 248.98 |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3, 4, 5 | 7.899 | 310.98 |
| 4 | 6, 7, 8 | 8.686 | 341.97 |
| 5 | 9, 10, 11 | 9.474 | 372.99 |
| 6 | 12, 13, 14 | 10.261 | 403.98 |
| 7 | 15, 16, 17 | 11.048 | 434.96 |
| 8 | 18, 19, 20 | 11.836 | 465.98 |
| 9 | 21, 22, 23 | 12.623 | 496.97 |
| 10 | 24, 25, 26 | 13.411 | 527.99 |
| 11 | 27, 28, 29 | 14.198 | 558.98 |
| 12 | 30, 31, 32 | 15.163 | 596.97 |
| 13 | 33, 34, 35 | 15.951 | 627.99 |
| 14 | 36, 37, 38 | 16.738 | 658.98 |
| 15 | 39, 40, 41 | 17.525 | 689.96 |
| 16 | 42, 43, 44 | 18.313 | 720.98 |
| 17 | 45, 46, 47 | 19.100 | 751.97 |
| 18 | 48, 49, 50 | 19.888 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| LH STOWAGE COMPARTMENT | 5.38 (211.81) | 0.11 (3.9) | 2.3 (5.1) ** |
| OUTBOARD GALLEY | 4.90 (192.91) | * | 82 (181) ** |
| FORWARD GALLEY | 5.53 (217.72) | * | 113 (249) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 2.42 $m^3$ (85.4 cu.ft)/6 half trolleys.

** Reference values. Check airplane placards for actual values.

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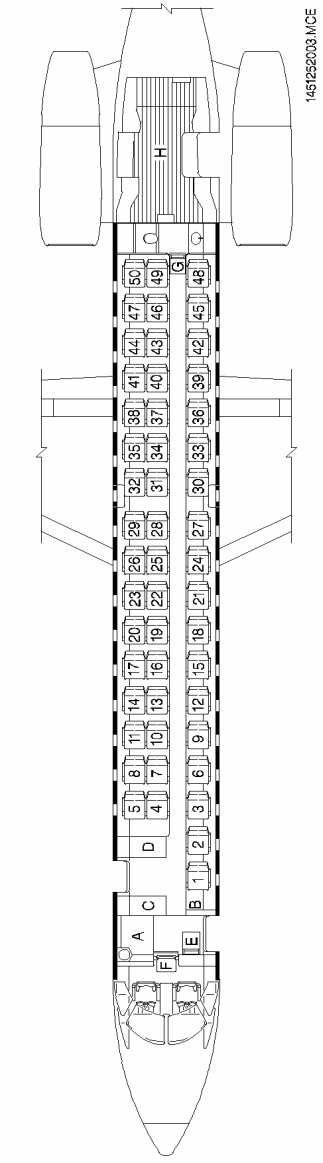
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION CZ




A: Outboard Galley

B: Stowage Compartment

C: Forward Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

50 seats

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## EMB-145 CONFIGURATION OPTION CZ

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | BALANCE ARM (in) |
|---|---|---|---|
| 1 | 1 | 6.324 | 248.98 |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3, 4, 5 | 7.899 | 310.98 |
| 4 | 6, 7, 8 | 8.686 | 341.97 |
| 5 | 9, 10, 11 | 9.474 | 372.99 |
| 6 | 12, 13, 14 | 10.261 | 403.98 |
| 7 | 15, 16, 17 | 11.048 | 434.96 |
| 8 | 18, 19, 20 | 11.836 | 465.98 |
| 9 | 21, 22, 23 | 12.623 | 496.97 |
| 10 | 24, 25, 26 | 13.411 | 527.99 |
| 11 | 27, 28, 29 | 14.198 | 558.98 |
| 12 | 30, 31, 32 | 15.163 | 596.97 |
| 13 | 33, 34, 35 | 15.951 | 627.99 |
| 14 | 36, 37, 38 | 16.738 | 658.98 |
| 15 | 39, 40, 41 | 17.525 | 689.96 |
| 16 | 42, 43, 44 | 18.313 | 720.98 |
| 17 | 45, 46, 47 | 19.100 | 751.97 |
| 18 | 48, 49, 50 | 19.888 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| STOWAGE COMPARTMENT | 5.38 (211.81) | 0.11 (3.9) | 2.3 (5.1) ** |
| OUTBOARD GALLEY | 4.90 (192.91) | * | 82 (181) ** |
| FORWARD GALLEY | 5.53 (217.72) | * | 113 (249) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 2.42 $m^3$ (85.4 cu.ft)/6 half trolleys.

** Reference values. Check airplane placards for actual values.

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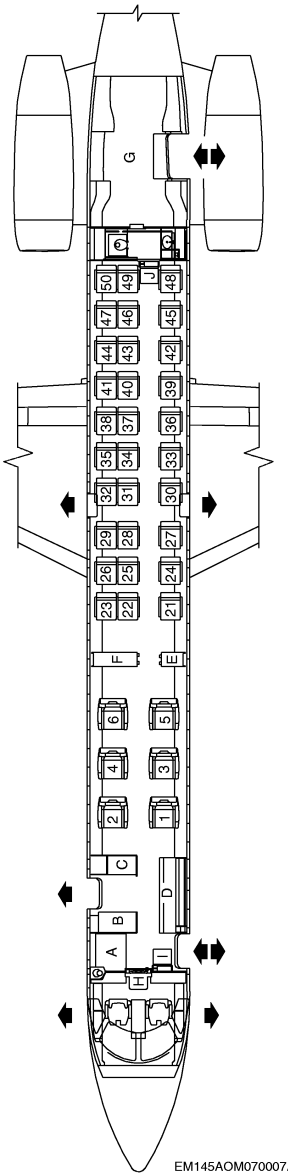
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION FAB VIP




EM145AOM070007A.DGN

A: RH Wardrobe
B: Fwd Galley Catering
C: Aft Galley Catering
D: LH Double Wardrobe
E: LH Stowage
F: RH Stowage
G: Baggage Compartment
H: Cockpit Observer
I: First Flight Attendant
J: Second Flight Attendant

36 seats

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## EMB-145 CONFIGURATION FAB VIP

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1, 2 | 7.998 | 314.88 |
| 2 | 3, 4 | 9.090 | 357.87 |
| 3 | 5, 6 | 10.182 | 400.87 |
| 4 | 7, 8, 9 | 12.623 | 496.97 |
| 5 | 10, 11, 12 | 13.411 | 527.99 |
| 6 | 13, 14, 15 | 14.198 | 558.98 |
| 7 | 16, 17, 18 | 15.163 | 596.97 |
| 8 | 19, 20, 21 | 15.951 | 627.99 |
| 9 | 22, 23, 24 | 16.738 | 658.98 |
| 10 | 25, 26, 27 | 17.525 | 689.96 |
| 11 | 28, 29, 30 | 18.313 | 720.98 |
| 12 | 31, 32, 33 | 19.100 | 751.97 |
| 13 | 34, 35, 36 | 19.888 | 782.99 |

**PASSENGER AVERAGE CG:** 15.030 m / 591.73 in.

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| RH WARDROBE | 4.88 (192.09) | 0.93 (32.8) | 70 (154) ** |
| FWD GALLEY CATERING | 5.53 (217.83) | * | 113 (249) ** |
| AFT GALLEY CATERING | 6.80 (267.56) | * | 149 (328) ** |
| LH DOUBLE WARDROBE | 6.14 (241.77) | 1.07 (37.6) | 80 (176) ** |
| LH STOWAGE | 11.35 (446.81) | 0.09 (3.3) | 23 (50) ** |
| RH STOWAGE | 11.35 (446.81) | 0.25 (8.8) | 36 (80) ** |

* Total Galley Volume: 1.49 $m^3$ (52.7 cu.ft) / 4 half trolleys.
** Reference values. Check aircraft placards for actual values.

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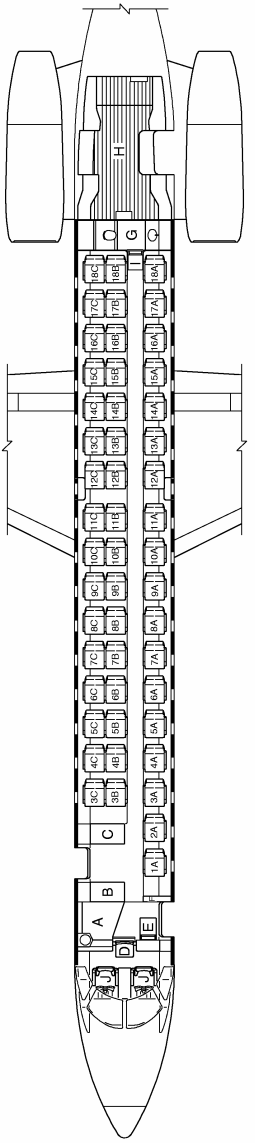
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 6A




A: RH Wardrobe

B: Forward Galley Catering

C: Aft Galley Catering

D: Observer Seat

E: 1st Attendant

F: Emergency Equipment Unit

G: Lavatory

H: Baggage Compartment

I: 2nd Attendant

J: Pilot Seats

50 seats

EM145AOM070026A.DGN

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## EMB-145 CONFIGURATION OPTION 6A

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1A | 6.324 | 248.98 |
| 2 | 2A | 7.111 | 279.96 |
| 3 | 3A, 3B, 3C | 7.899 | 310.98 |
| 4 | 4A, 4B, 4C | 8.686 | 341.97 |
| 5 | 5A, 5B, 5C | 9.474 | 372.99 |
| 6 | 6A, 6B, 6C | 10.261 | 403.98 |
| 7 | 7A, 7B, 7C | 11.048 | 434.96 |
| 8 | 8A, 8B, 8C | 11.836 | 465.98 |
| 9 | 9A, 9B, 9C | 12.623 | 496.97 |
| 10 | 10A, 10B, 10C | 13.411 | 527.99 |
| 11 | 11A, 11B, 11C | 14.198 | 558.98 |
| 12 | 12A, 12B, 12C | 15.163 | 596.97 |
| 13 | 13A, 13B, 13C | 15.951 | 627.99 |
| 14 | 14A, 14B, 14C | 16.738 | 658.98 |
| 15 | 15A, 15B, 15C | 17.525 | 689.96 |
| 16 | 16A, 16B, 16C | 18.313 | 720.98 |
| 17 | 17A, 17B, 17C | 19.100 | 751.97 |
| 18 | 18A, 18B, 18C | 19.888 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| EMERGENCY EQUIPMENT UNIT | 5.38 (211.81) | 0.11 (3.9) | 2.3 (5.1) ** |
| RH WARDROBE | 5.014 (197.40) | 1.12 (39.6) | 82 (181) ** |
| FORWARD GALLEY | 5.53 (217.72) | * | 113 (249) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 3.26 $m^3$ (115.07 cu.ft)/2 half trolleys.

** Reference values. Check airplane placards for actual values.

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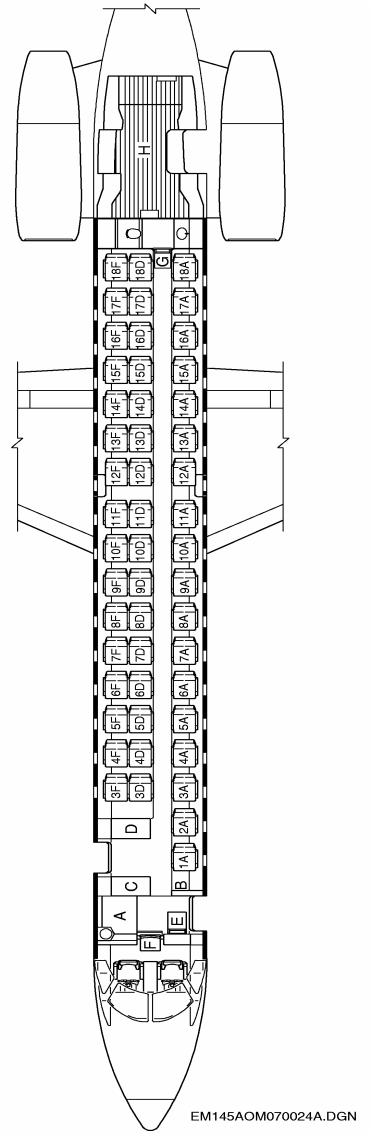
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 7




A: Wardrobe

B: Stowage Compartment

C: Forward Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

50 seats

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## EMB-145 CONFIGURATION OPTION 7

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | BALANCE ARM (in) |
|---|---|---|---|
| 1 | 1A | 6.324 | 248.98 |
| 2 | 2A | 7.111 | 279.96 |
| 3 | 3A, 3D, 3F | 7.899 | 310.98 |
| 4 | 4A, 4D, 4F | 8.686 | 341.97 |
| 5 | 5A, 5D, 5F | 9.474 | 372.99 |
| 6 | 6A, 6D, 6F | 10.261 | 403.98 |
| 7 | 7A, 7D, 7F | 11.048 | 434.96 |
| 8 | 8A, 8D, 8F | 11.836 | 465.98 |
| 9 | 9A, 9D, 9F | 12.623 | 496.97 |
| 10 | 10A, 10D, 10F | 13.411 | 527.99 |
| 11 | 11A, 11D, 11F | 14.198 | 558.98 |
| 12 | 12A, 12D, 12F | 15.163 | 596.97 |
| 13 | 13A, 13D, 13F | 15.951 | 627.99 |
| 14 | 14A, 14D, 14F | 16.738 | 658.98 |
| 15 | 15A, 15D, 15F | 17.525 | 689.96 |
| 16 | 16A, 16D, 16F | 18.313 | 720.98 |
| 17 | 17A, 17D, 17F | 19.100 | 751.97 |
| 18 | 18A, 18D, 18F | 19.888 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 4.90 (192.91) | 0.93 (32.9) | 70 (154) ** |
| LH STOWAGE COMPARTMENT | 5.38 (211.81) | 0.11 (3.9) | 10.2 (22.6) ** |
| FWD GALLEY | 5.53 (217.72) | * | 83 (183) ** |
| AFT GALLEY | 6.79 (267.32) | * | 89 (195.5) ** |

* Total Galley Volume: 1.49 $m^3$ (52.7 cu.ft)/4 half trolleys.

** Reference values. Check airplane placards for actual values.

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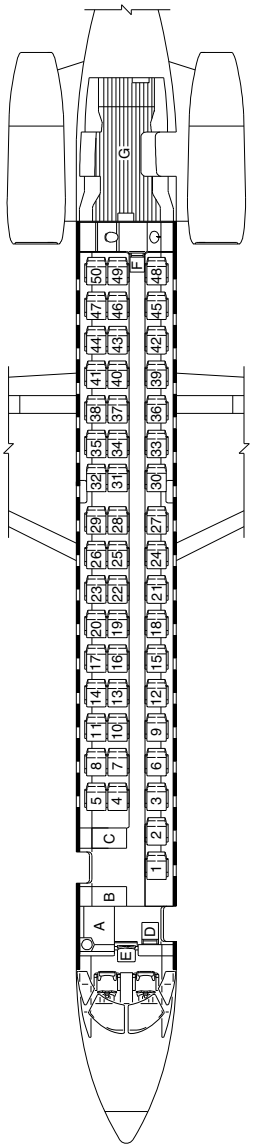
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 8




A: Outboard Galley

B: Forward Galley

C: Aft Galley

D: Forward Flight Attendant

E: Cockpit Observer

F: Aft Flight Attendant

G: Baggage Compartment

50 seats

EM145AOM070030B.DGN

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## EMB-145 CONFIGURATION OPTION 8

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | 1 | 6.193 | 243.82 |
| 2 | 2 | 6.980 | 274.80 |
| 3 | 3, 4, 5 | 7.768 | 305.83 |
| 4 | 6, 7, 8 | 8.555 | 336.81 |
| 5 | 9, 10, 11 | 9.343 | 367.83 |
| 6 | 12, 13, 14 | 10.130 | 398.82 |
| 7 | 15, 16, 17 | 10.917 | 429.80 |
| 8 | 18, 19, 20 | 11.705 | 460.83 |
| 9 | 21, 22, 23 | 12.492 | 491.81 |
| 10 | 24, 25, 26 | 13.280 | 522.83 |
| 11 | 27, 28, 29 | 14.067 | 553.82 |
| 12 | 30, 31, 32 | 15.134 | 593.82 |
| 13 | 33, 34, 35 | 15.895 | 624.80 |
| 14 | 36, 37, 38 | 16.658 | 655.83 |
| 15 | 39, 40, 41 | 17.445 | 686.81 |
| 16 | 42, 43, 44 | 18.223 | 717.84 |
| 17 | 45, 46, 47 | 19.020 | 748.82 |
| 18 | 48, 49, 50 | 19.807 | 779.80 |

**PASSENGER AVERAGE CG:** 13.490 m / 531.10 in.

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| FWD GALLEY | 5.00 (196.85) | * | 82 (181) ** |
| MID GALLEY | 5.55 (218.50) | * | 113 (249) ** |
| AFT GALLEY | 6.8 (267.72) | * | 149 (328) ** |

* Total Galley Volume: 2.42 $m^3$ (85.4 cu.ft) / 6 half trolleys.
** Reference values. Check aircraft placards for actual values.

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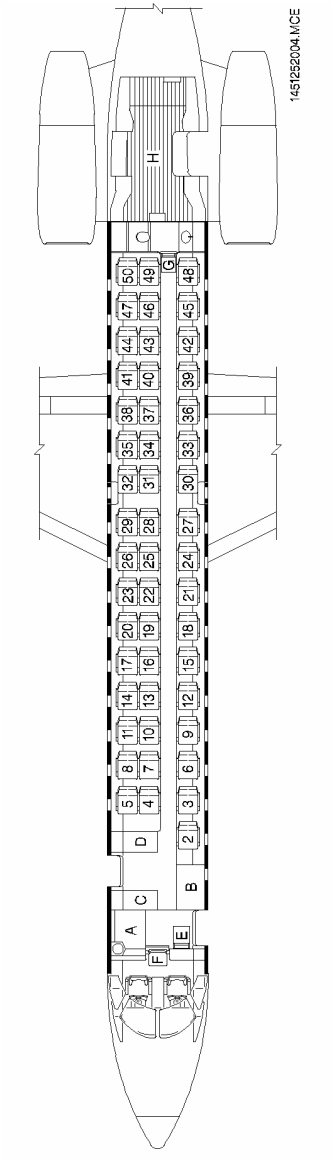
# INTERIOR ARRANGEMENT

## EMB-145 CONFIGURATION OPTION 4B




A: Wardrobe

B: Stowage Compartment

C: Forward Galley

D: Aft Galley

E: Forward Flight Attendant

F: Cockpit Observer

G: Aft Flight Attendant

H: Baggage Compartment

49 seats

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## EMB-145 CONFIGURATION OPTION 4B

| SEATS ROW | PASSENGER SEATS | BALANCE ARM (m) | (in) |
|---|---|---|---|
| 1 | - | - | - |
| 2 | 2 | 7.111 | 279.96 |
| 3 | 3,4,5 | 7.898 | 310.98 |
| 4 | 6,7,8 | 8.686 | 341.97 |
| 5 | 9,10,11 | 9.473 | 372.99 |
| 6 | 12,13,14 | 10.261 | 403.98 |
| 7 | 15,16,17 | 11.048 | 434.96 |
| 8 | 18,19,20 | 11.835 | 465.98 |
| 9 | 21,22,23 | 12.623 | 496.97 |
| 10 | 24,25,26 | 13.410 | 527.99 |
| 11 | 27,28,29 | 14.198 | 558.98 |
| 12 | 30,31,32 | 15.163 | 596.97 |
| 13 | 33,34,35 | 15.950 | 627.99 |
| 14 | 36,37,38 | 16.738 | 658.98 |
| 15 | 39,40,41 | 17.525 | 689.96 |
| 16 | 42,43,44 | 18.312 | 720.98 |
| 17 | 45,46,47 | 19.100 | 751.97 |
| 18 | 48,49,50 | 19.887 | 782.99 |

| | Balance Arm m (in) | Volume $m^3$ (cu.ft) | Capacity kg (lb) |
|---|---|---|---|
| WARDROBE | 4.90 (192.91) | 0.57 (20.2) | 57 (126) ** |
| FWD GALLEY | 5.53 (217.72) | * | 82 (181) ** |
| AFT GALLEY | 6.79 (267.32) | * | 149 (328) ** |

* Total Galley Volume: 2.42 $m^3$ (85.4 cu.ft) / 6 half trolleys.
** Reference values. Check aircraft placards for actual values.

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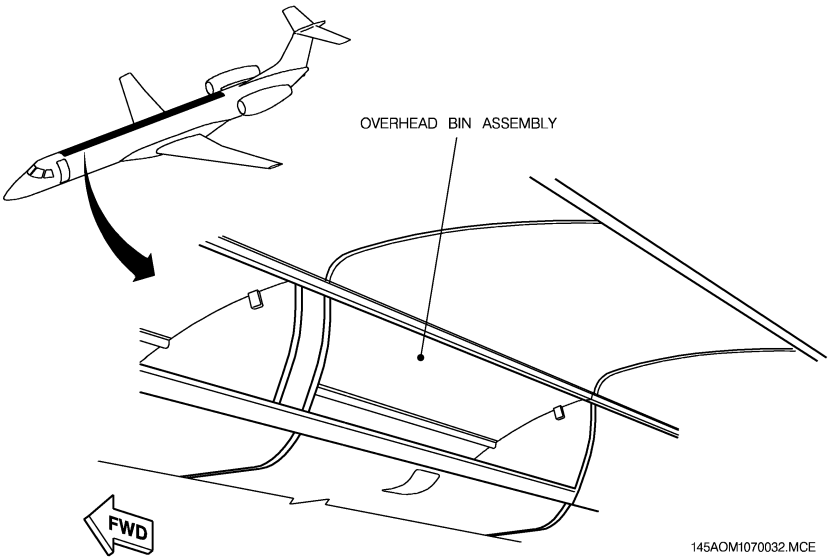
# CARRY-ON BAGGAGE

Carry-on volumes may be stowed in the overhead bins and in the wardrobe.

There is no specific requirement for underseat carry-on volumes; however a maximum of 9.0 kg (20.0 lb) is allowable, provided the volume is properly restrained to avoid sliding.

## OVERHEAD BINS

The overhead bins comprise 10 standard overhead bin assemblies and 1 short overhead bin assembly for EMB-145 models, 9 standard overhead assemblies and 1 short for ERJ-140 models and 8 standard overhead bin assemblies, 1 short overhead bin assembly and 1 very-short overhead bin assembly for EMB-135 models.
The bins present a total volume of 1.9 $m^3$ (67.1 cu.ft) on the EMB-145 models, 1.44 $m^3$ (49.3 cu.ft) on the ERJ-140 models and 1.2 $m^3$ (42.3 cu.ft) on the EMB-135 models.
The overhead bins are installed on the right side of the passenger cabin.

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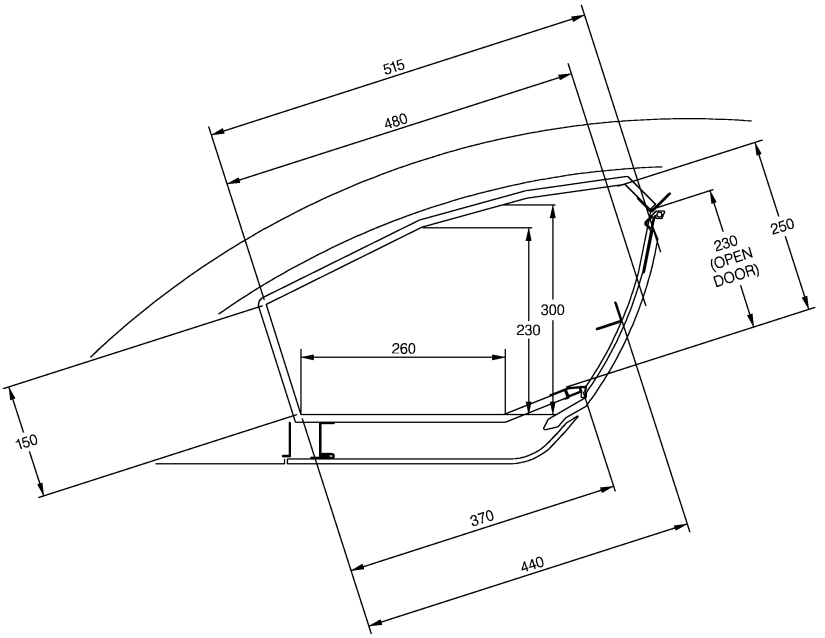
## OVERHEAD BIN CAPACITY AND LENGTH

| | Length m (in) | Capacity kg (lb) |
|---|---|---|
| Standard Assembly | 1.16 (45.67) | 27 (60) |
| Short Assembly | 0.83 (32.68) | 20 (45) |
| Very-Short Assembly | 0.49 (19.29) | 14 (31) |

## OVERHEAD BIN CROSS SECTION




- DIMENSIONS IN mm

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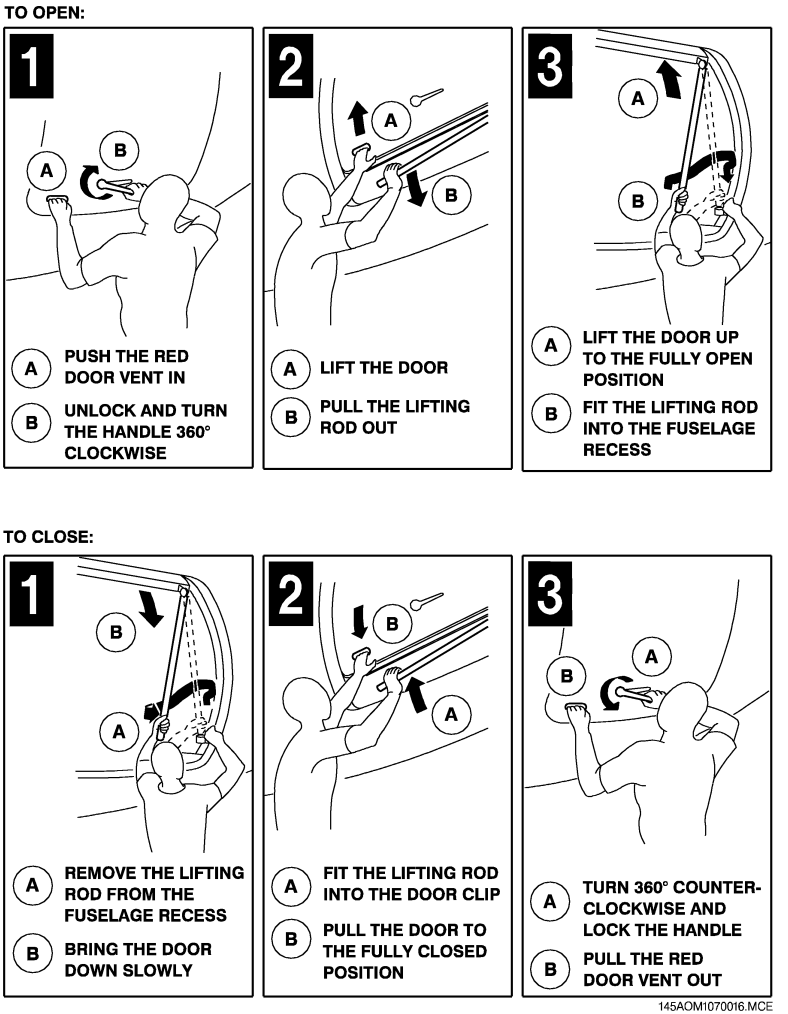
# BAGGAGE DOOR

The baggage door, located on the rear left side of the fuselage, is 1.00 meter (39 in) wide and 1.11 meters (44 in) high.
The baggage door is manually operated from the outside. The initial opening movement (displacement of the door inward) and final closing and latching movement (displacement of the door outward) are achieved by means of a door locking mechanism controlled by an external handle which is stowed in the lower half of the door.

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# BAGGAGE COMPARTMENT

## DESCRIPTION

The baggage compartment is located in the rear part of the fuselage.

All EMB-135, ERJ-140 and some EMB-145 are fitted with a “class-C” baggage compartment. Airplanes with the “class-C” baggage compartment have the following systems installed:

- Baggage Compartment Smoke Detection System.
- Baggage Compartment Fire Extinguishing System.
- Baggage Compartment Ventilation System.

Although no dedicated temperature control is available (the “class-C” baggage compartment is heated by passenger cabin air flowing into it), the baggage ventilation system provides an adequate environment for carrying live animals in the compartment.

EMB-145 airplanes with a “class-D” baggage compartment (i.e., a fire occurring in it will be completely confined without endangering the safety of the airplane or the occupants) have the following systems installed:

- Baggage Compartment Smoke Detection System.

Since ventilation and temperature control are not available on “class-D” compartments, the transportation of live animals is not recommended.

Both “class-C” and “class-D” compartments are pressurized.

The following cargo nets may be installed in the baggage compartment:

- Cargo Restraint Nets (horizontal net).
- Baggage Compartment Door Safety Net.
- Cargo Barrier Net (vertical net).

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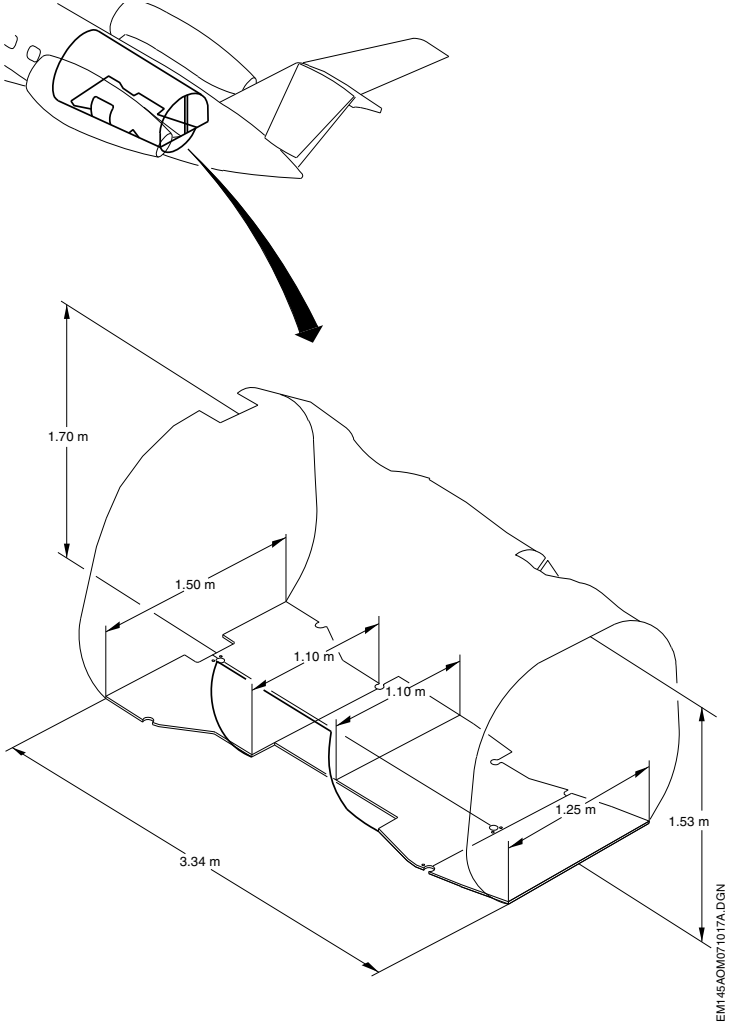
# DIMENSIONS AND LIMITS




| | Baggage Compartment Balance Arm m (in) |
|---|---|
| EMB-145 | 22.601 (889.80) |
| ERJ-140 | 21.186 (834.09) |
| EMB-135 | 19.061 (750.43) |

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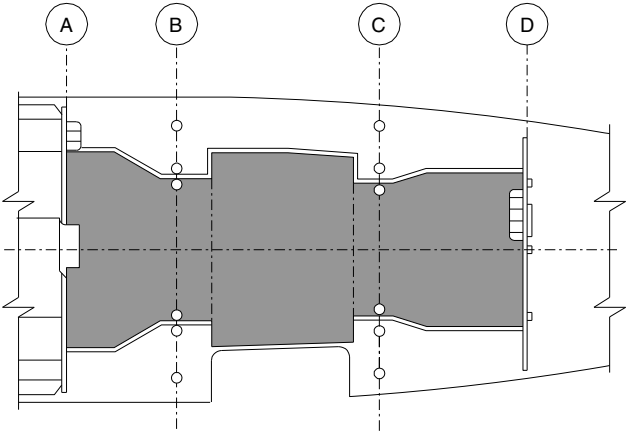


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**Compartment and Vertical Net Position - m (in)**

| | | EMB-145 | ERJ-140 | EMB-135 |
|---|---|---|---|---|
| A | Forward Division Position | 20.97 (825.59) | 19.55 (769.88) | 17.42 (685.83) |
| B | Forward Vertical Net (*) | 21.78 (857.48) | 20.36 (801.77) | 18.23 (717.72) |
| C | Aft Vertical Net (*) | 23.25 (915.35) | 21.83 (859.64) | 19.70 (775.59) |
| D | Aft Division Position | 24.31 (957.09) | 22.89 (901.38) | 20.76 (817.32) |

* - For airplanes with the optional Cargo Barrier Nets (vertical nets) installed.

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**Balance Arm for each Section (*) - m (in)**

| | EMB-145 | ERJ-140 | EMB-135 |
|---|---|---|---|
| Forward Section | 21.38 (841.54) | 19.96 (785.82) | 17.82 (701.57) |
| Central Section | 22.515 (886.42) | 21.095 (830.51) | 18.965 (746.65) |
| Aft Section | 23.78 (936.22) | 22.36 (880.31) | 20.23 (796.46) |

**EMB-145 Compartment Limits:**

Baggage Compartment Available Volume..... 9.2 $m^3$ (325 cu.ft)

Maximum Floor Distributed Load.....390 $kg/m^2$ (80 $lb/ft^2$)

Maximum Floor Concentrated Load (**) .....0.70 $kg/m^2$ (10 $lb/in^2$)

Total Maximum Capacity .....1200 kg (2646 lb)

Maximum Capacity per Section (*) .....400 kg (882 lb)

**ERJ-140 Compartment Limits:**

Baggage Compartment Available Volume..... 9.2 $m^3$ (325 cu.ft)

Maximum Floor Distributed Load.....390 $kg/m^2$ (80 $lb/ft^2$)

Total Maximum Capacity .....1200 kg (2646 lb)

Maximum Capacity per Section (*) .....400 kg (882 lb)

**EMB-135 Compartment Limits:**

Baggage Compartment Available Volume..... 9.2 $m^3$ (325 cu.ft)

Maximum Floor Distributed Load.....390 $kg/m^2$ (80 $lb/ft^2$)

Total Maximum Capacity .....1000 kg (2205 lb)

Maximum Capacity per Section (*) .....333 kg (735 lb)

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* - For airplanes with the optional Cargo Barrier Nets (vertical nets) installed.

** - Loading application in this condition is limited to an area not greater than 4.66 $in^2$ per panel

## PACKAGE SIZE TABLE

The table below shows the approximate rectangular package maximum dimensions which will pass through the baggage door without interference with the baggage door, airplane fuselage or compartment interior.
Enter the table with the package width and height and read the maximum length of the package that can be stowed in the baggage compartment.

| WIDTH – in cm | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |
| 12.7 | 25.4 | 38.1 | 50.8 | 63.5 | 76.2 | 88.9 | 101.6 |

| Height in cm | MAXIMUM PACKAGE LENGTH – in cm | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5<br>12.7 | 104<br>264.16 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 8<br>20.32 | 104<br>264.16 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 10<br>25.4 | 104<br>264.16 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 13<br>33.02 | 104<br>264.16 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 16<br>40.64 | 104<br>264.16 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 19<br>48.26 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 22<br>55.88 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 80<br>203.2 | 70<br>177.8 | 60<br>152.4 | 45<br>114.3 |
| 25<br>63.5 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 80<br>203.2 | 70<br>177.8 | 60<br>152.4 | 45<br>114.3 |
| 28<br>71.12 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 80<br>203.2 | 70<br>177.8 | 60<br>152.4 | 45<br>114.3 |
| 31<br>78.74 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 80<br>203.2 | 70<br>177.8 | 60<br>152.4 | 45<br>114.3 |
| 34<br>86.36 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 80<br>203.2 | 70<br>177.8 | 60<br>152.4 | 45<br>114.3 |

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# BAGGAGE AND CARGO LOADING

Baggage and cargo should be evenly distributed over the baggage compartment to avoid load concentration.

Cargo and baggage loading up to 990 kg (2182 lb) are not required to be tied down. If the baggage compartment is loaded with more than 990 kg (2182 lb), only the exceeding load must be tied down with the horizontal net.

For airplanes Post-Mod. SB 145-25-0261 (reinforced liners) or equipped with an equivalent modification factory incorporated, the use of the horizontal net is not required.

Cargo must not become a hazard to the airplane structure or systems as a result of shifting under operational loads. Sharp edges (like wooden or metal containers) or dense cargo (objects significantly more dense than typical passenger baggage) must be placed under the cargo restraint net to prevent shifting.

If the baggage compartment is to be loaded with higher values than those listed below, the following simultaneous conditions must be observed:

- Airplane shall be with a minimum required fuel of 907 kg (2000 lb).
- No more than one person can be at the airplane cone either inside the baggage compartment or inside the rear electronic compartment.

  EMB-145 models without Thrust Reverser: 1000 kg (2205 lb).

  EMB-145 models with Thrust Reverser: 800 kg (1764 lb).

  ERJ-140 models with Thrust Reverser: 1000 kg (2205 lb)

  EMB-135 models: 800 kg (1764 lb).

**CAUTION:** IF THE CONDITIONS ABOVE ARE NOT OBSERVED, AIRPLANE TILTING (TAIL DOWN) MAY OCCUR.

Before loading or unloading the baggage compartment, the Cargo Loading/Unloading Ramp (also known as Door Jamb Barrier) must be lowered in order to protect the baggage door latching mechanism.

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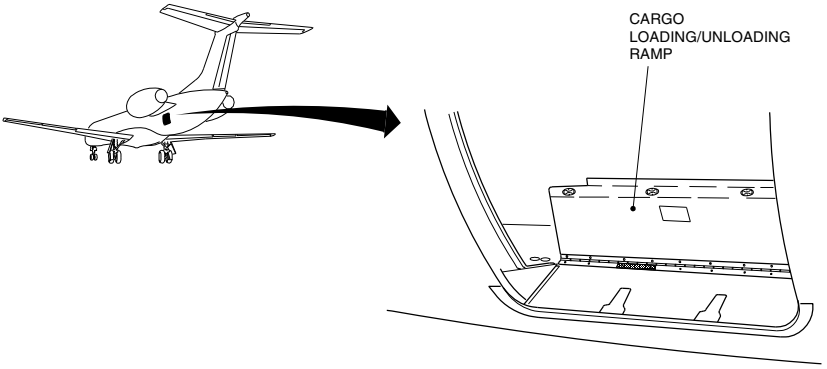


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# BAGGAGE COMPARTMENT

## DESCRIPTION

The baggage compartment is located in the rear part of the fuselage.

The EMB-145 is fitted with a “class-C” baggage compartment. Airplanes with the “class-C” baggage compartment have the following systems installed:

- Baggage Compartment Smoke Detection System.
- Baggage Compartment Fire Extinguishing System.
- Baggage Compartment Ventilation System.

Although no dedicated temperature control is available (the “class-C” baggage compartment is heated by passenger cabin air flowing into it), the baggage ventilation system provides an adequate environment for carrying live animals in the compartment. The “class-C” compartment is pressurized.

The following cargo nets are installed in the baggage compartment:

- Baggage Compartment Door Safety Net.
- Cargo Arresting Net (horizontal net).

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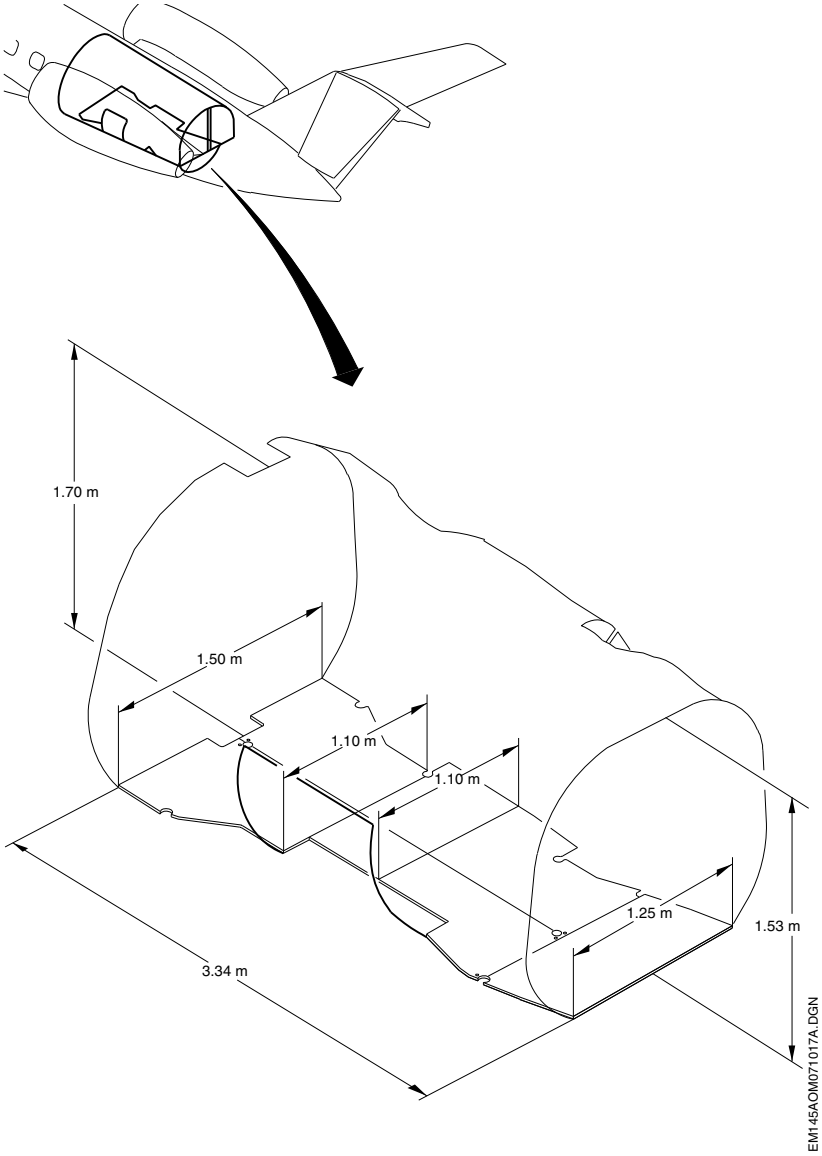
# DIMENSIONS AND LIMITS

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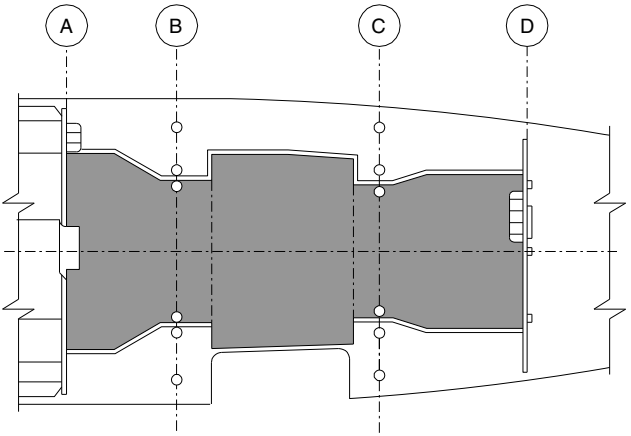


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**Forward and Aft Division Position – m (in)**

| | | |
|---|---|---|
| A | Forward Division Position | 20.97 (825.59) |
| B | Aft Division Position | 24.31 (957.09) |

**Compartment Limits for airplanes equipped with Cart Stowage Unit:**

Baggage Compartment Available Volume ..... 8.6 $m^3$ (304 cu.ft)

Maximum Floor Distributed Load..... 390 $kg/m^2$ (80 $lb/ft^2$)

Maximum Floor Concentrated Load (*) ..... 0.70 $kg/m^2$ (10 $lb/in^2$)

Baggage Compartment Capacity ..... 1000 kg (2205 lb)

Baggage Compartment Balance Arm..... 22.85 m (900 in)

Cart Stowage Unit Capacity ..... 120 kg (265 lb)

Cart Stowage Unit Balance Arm..... 21.40 m (843 in)

Maximum Load on the Top of Cart Stowage Unit ..... 14 kg (30 lb)

* - Loading application in this condition is limited to an area not greater than 4.66 $in^2$ per panel.

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**CAUTION:**

- THE CART STOWAGE UNIT MUST BE LOADED WHEN OPERATING THE AIRPLANE WITH BAGGAGE OR CARGO ON THE BAGGAGE COMPARTMENT.
- BAGGAGE COMPARTMENT PARTITION DOOR MUST BE CLOSED FOR FLIGHT. ANY DAMAGE TO THE DOOR OR DOOR FRAME SHALL BE COMMUNICATED TO THE FLIGHT CREW BEFORE DISPATCH.

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# PACKAGE SIZE TABLE

The table below shows the approximate rectangular package maximum dimensions which will pass through the baggage door without interference with the baggage door, airplane fuselage or compartment interior.

Enter the table with the package width and height and read the maximum length of the package that can be stowed in the baggage compartment.

**NOTE:** This table was calculated not considering the cart stowage unit on the baggage compartment.

| WIDTH – in cm | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |
| 12.7 | 25.4 | 38.1 | 50.8 | 63.5 | 76.2 | 88.9 | 101.6 |

| Height in cm | MAXIMUM PACKAGE LENGTH – in cm | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5<br>12.7 | 104<br>264.16 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 8<br>20.32 | 104<br>264.16 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 10<br>25.4 | 104<br>264.16 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 13<br>33.02 | 104<br>264.16 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 16<br>40.64 | 104<br>264.16 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 19<br>48.26 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 85<br>215.9 | 75<br>190.5 | 60<br>152.4 | 45<br>114.3 |
| 22<br>55.88 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 80<br>203.2 | 70<br>177.8 | 60<br>152.4 | 45<br>114.3 |
| 25<br>63.5 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 80<br>203.2 | 70<br>177.8 | 60<br>152.4 | 45<br>114.3 |
| 28<br>71.12 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 80<br>203.2 | 70<br>177.8 | 60<br>152.4 | 45<br>114.3 |
| 31<br>78.74 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 80<br>203.2 | 70<br>177.8 | 60<br>152.4 | 45<br>114.3 |
| 34<br>86.36 | 100<br>254 | 97<br>246.38 | 95<br>241.3 | 90<br>228.6 | 80<br>203.2 | 70<br>177.8 | 60<br>152.4 | 45<br>114.3 |

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# BAGGAGE AND CARGO LOADING

Baggage and cargo should be evenly distributed over the baggage compartment to avoid load concentration.

Cargo and baggage loading up to 990 kg (2182 lb) are not required to be tied down. If the baggage compartment is loaded with more than 990 kg (2182 lb), only the exceeding load must be tied down with the horizontal net.

For airplanes Post-Mod. SB 145-25-0261 (reinforced liners) or equipped with an equivalent modification factory incorporated, the use of the horizontal net is not required.

Cargo must not become a hazard to the airplane structure or systems as a result of shifting under operational loads. Sharp edges (like wooden or metal containers) or dense cargo (objects significantly more dense than typical passenger baggage) must be placed under the cargo restraint net to prevent shifting.

If the baggage compartment is to be loaded with higher values than those listed in the table 1 below, the following simultaneous conditions must be observed:

- Airplane shall be with a minimum required fuel of 907 kg (2000 lb).
- No more than one person can be at the airplane cone either inside the baggage compartment or inside the rear electronic compartment.

**CAUTION:** IF THE CONDITIONS ABOVE ARE NOT OBSERVED, AIRPLANE TILTING (TAIL DOWN) MAY OCCUR.

| Table 1 | |
|---|---|
| Without Thrust Reverser | 1000 kg (2205 lb) |
| With Thrust Reverser | 800 kg (1764 lb) |

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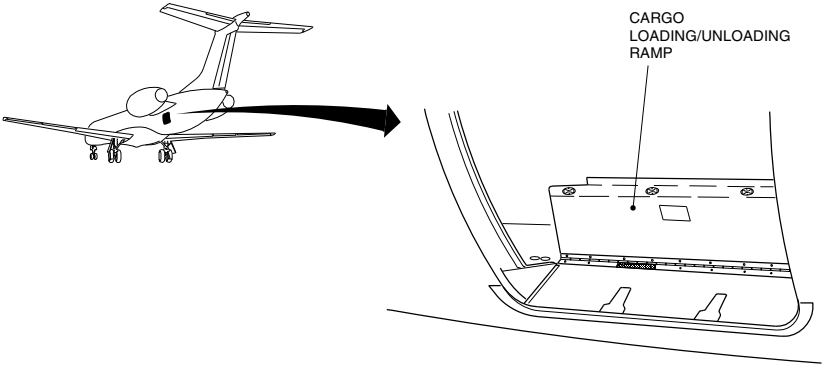
Before loading or unloading the baggage compartment, the Cargo Loading/Unloading Ramp (also known as Door Jamb Barrier) must be lowered in order to protect the baggage door latching mechanism.

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# CARGO NETS

## BAGGAGE COMPARTMENT DOOR SAFETY NET

The safety barrier net secures the baggage and prevents the cargo door from jamming (the door slides inboard before opening upward).
The net attaches to two pulley assemblies which attach to the net beam assembly. The net beam assembly is attached to an upper attach bracket. A cargo net adapter attaches the cargo door safety net to the upper attach bracket. Decals on the net assembly indicate orientation (FWD, AFT, UPSIDE, or R/L). Straps on the net attach to anchor plates on the cargo loading/unloading ramp (door jamb barrier). The cargo door safety net is held to the cargo compartment floor by six anchor plates. Two shock lanyard assemblies extend the door jamb barrier assembly when the baggage door is opened.

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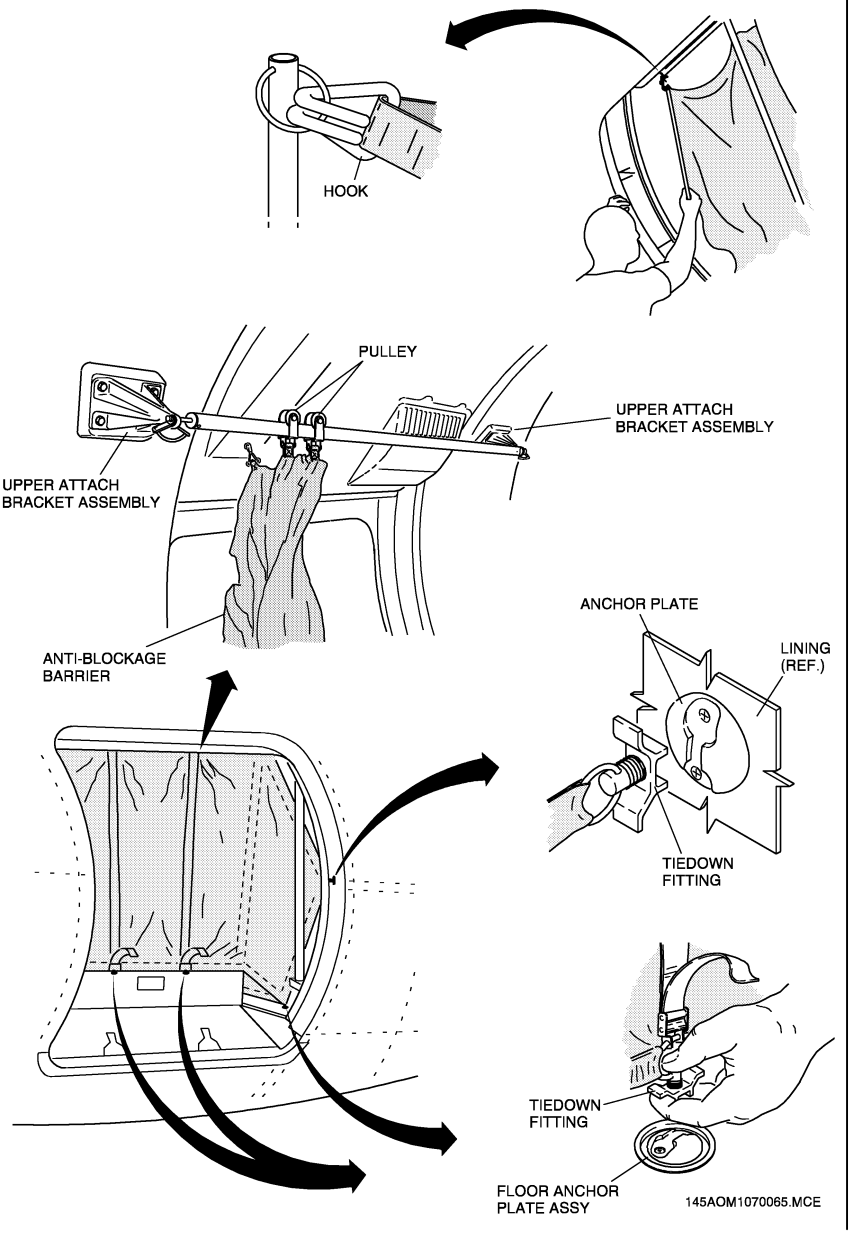


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## CARGO RESTRAINT NET (HORIZONTAL NET)

The cargo restraint net (tie-down) provides vertical restraint for the baggage and cargo. It is attached to the cargo compartment floor with anchor plates. Adjustable straps allow the arresting net to extend and retract. Some airplanes are equipped with retaining strips located at the upside of the baggage compartment which are used to hold the net while the baggage is placed under it. Decals on the cargo net assembly indicate orientation (FWD, AFT, UPSIDE, or R/L) of the net in the cargo compartment. The net may be a two-piece assembly.

For the cargo restraint net P/Ns 7162041-501 or -503 the maximum load that can be placed under it is 450 kg (992 lb) and, for the cargo restraint net P/N 7162041-505, it is limited to the maximum capacity of the baggage compartment.

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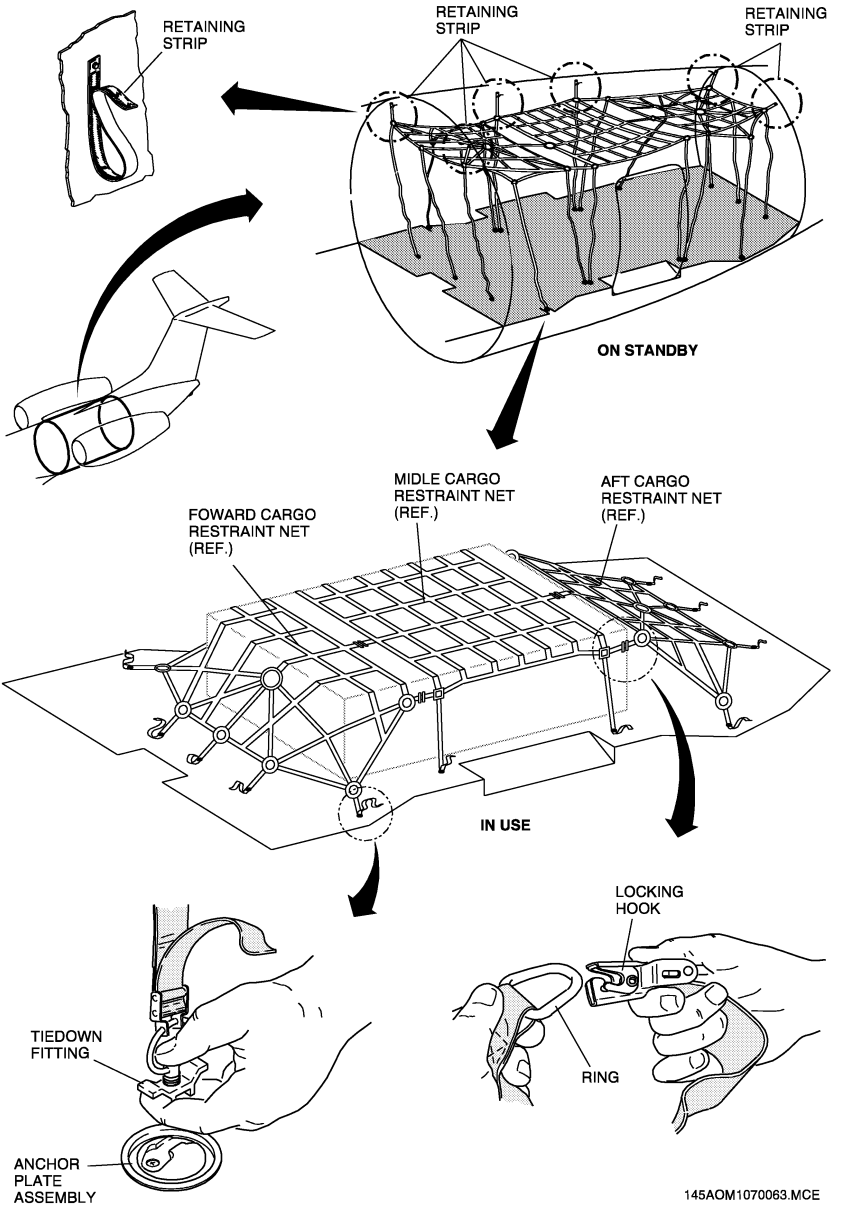


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## CARGO BARRIER NET (VERTICAL NET)

The optional cargo barrier net is a two-piece assembly that divides the cargo compartment into three areas and provides horizontal restraint. The vertical net is solely intended to optimize the cargo compartment loading. The cargo barrier net attaches to the cargo compartment floor with six anchor plates each. Adjustable straps and pigtails allow the restraint net to extend and retract. Decals on the cargo net assembly indicate orientation (FWD, AFT, UPSIDE, or R/L) of the net in the cargo compartment.

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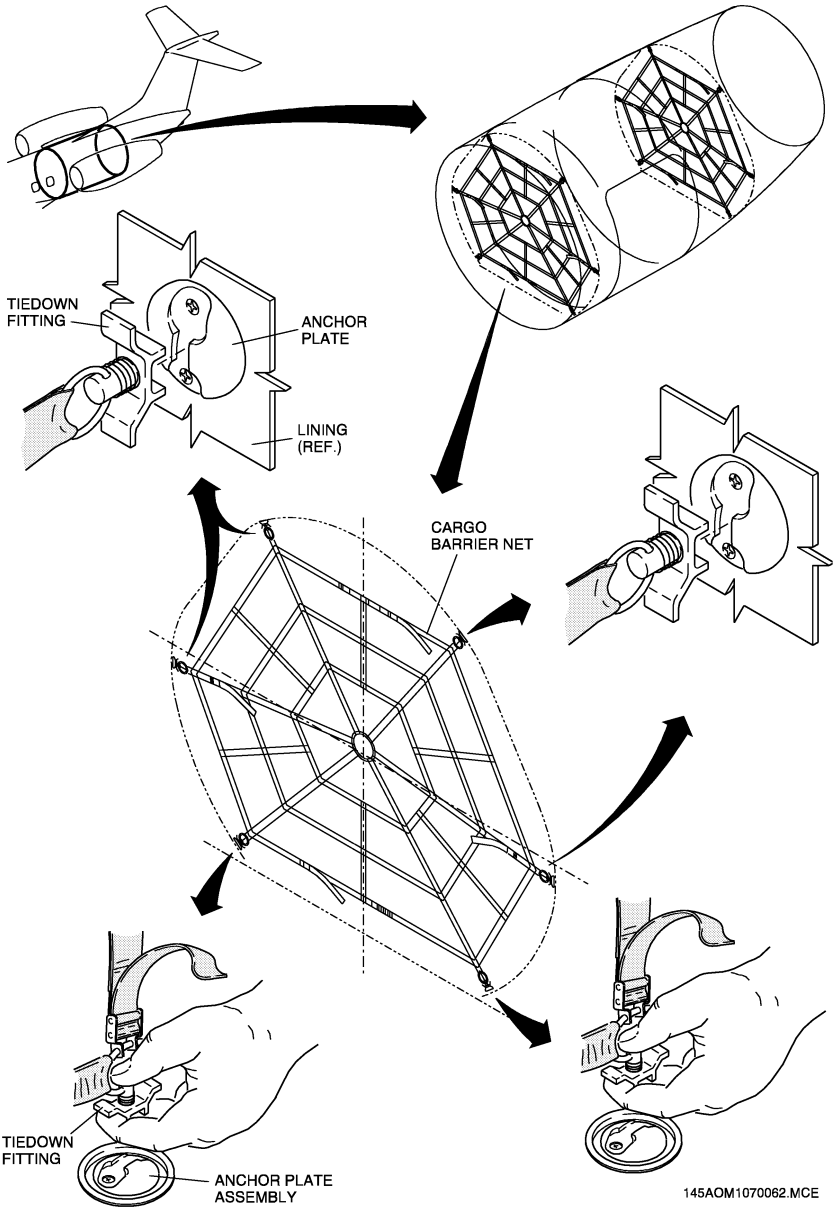


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# LIVE ANIMALS TRANSPORTATION

This section presents the general conditions for live animal transportation in the EMB-145 and EMB-135 Class C Baggage Compartment. Live animals transportation on aircraft equipped with Class D Baggage Compartments is not recommended.

The main references that regulate and state methods and procedures to handling, appropriate packaging, legal aspects for animal transportation, etc. are the IATA Live Animal Regulations and SAE AIR1600.

## GENERAL RECOMMENDATIONS

Generically, animals should be protected from stressing situations, like excessive noise, solar radiation, draft, high or low temperatures.

The containers should be appropriate for the type of animal to be transported, as recommended by IATA Live Animal Regulations.

Animals shall be handled with great care, to minimize the stress associated to handling. While waiting for the shipment, animals should be maintained in a waiting room with temperature control and protected from noise and draught. The adverse climatic conditions could cause additional stress to the animals. The ambient should be dark to make the animals more calm and comfortable while waiting for shipment. Animals of different species, specially which are natural enemies, such as cats and dogs, must be kept apart one from another. On the other hand, animals of the same species would be more calm if kept together.

Animals shall be loaded just before departure and unloaded just after arrival, in order to minimize the exposition to high or low temperatures on ground, where the baggage compartment ventilation is not completely effective. Specially in the hot season, it should be preferable to schedule the animal shipment for the night period, when the temperatures are lower than during the day. For the more sensitive animals, such as little birds, that would not resist to high temperatures, this is an important requirement. In addition, these animals would be too susceptible to low temperatures achieved during long cruise flights, so it could be necessary to limit the flight cruise altitude to reduce the temperature drop in the baggage compartment and protect them.

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The containers should not be placed near the compartment floor, in order to isolate the animals from low temperatures in that region. The recommendations for animal load limitations should be observed, in order to prevent animals being exposed to adverse environmental conditions.

## LOAD LIMITATIONS

The limitations for the load in the compartment are defined mainly by Temperature, Carbon Dioxide concentration and Humidity, that are a result of animal metabolism. These items have to be compensated with the baggage compartment ventilation system, that draws air from passenger cabin to the cargo compartment, as air exchange reduces $CO_2$ concentration and humidity and controls the compartment temperature.

The calculations to determine the maximum animal load for EMB-145/135 Class C Baggage Compartment were developed using the methodology stated in the reference SAE AIR1600. The estimate was developed for the animals that are most likely to be transported, and taking the baggage compartment characteristics into consideration.

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## 1 - DOGS AND CATS

The temperature limits for these animals are within 10°C to 30°C range. Considering this and the humidity and CO2 generation by animals metabolism, the number of animals as function of animal mass are stated in the table 1, as follows.

| Table 1: Dog and Cat Load | |
|---|---|
| Dog/Cat mass(kg) | Load Limitation |
| 1.0 | 50 |
| 5.0 | 24 |
| 10.0 | 12 |
| 25.0 | 8 |
| 50.0 | 4 |

## 2 - SMALL BIRDS

These are very sensitive animals. This kind of animal is very susceptible to high and low temperatures. It may be necessary to avoid flights at high temperatures during the day and schedule the shipment to night flights. In case of low temperatures during cruise flight, depending on the flight extension, it might be necessary to limit the maximum flight altitude in order to reduce the temperature drop in the baggage compartment. The containers should be placed at some distance from the compartment floor, avoiding the contact with low temperatures coming from the area below the floor.

The limitations for the maximum load of these animals are stated in the table 2, as follows.

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| Table 2: Small Birds Load | |
|---|---|
| Mass (kg) | Load |
| 0.03 | 3000 |
| 0.10 | 1000 |
| 0.25 | 400 |
| 0.50 | 200 |
| 1.00 | 100 |
| 2.50 | 80 |

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**3 - OTHERS**

For the other animals not mentioned in this section, estimations could be developed considering the data presented here. In case of special animal shipment, Embraer Customer Support may be consulted.

# DRY ICE TRANSPORTATION

This section presents the general conditions for dry ice (carbon solid dioxide) transportation in the EMB-145, ERJ-140 and EMB-135 cargo compartment.

The main reference that regulates and state methods and procedures to handling, appropriate packaging, legal aspects for dry ice transportation, etc. is the IATA Dangerous Goods Regulations.

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## GENERAL RECOMMENDATIONS

It is not recommended to transport dry ice in the cabin and in the galleys. If small quantities are present in the galley, it is required to compute this dry ice mass in the calculation of the total dry ice.

Prior to enter into the cargo compartment in which a large amount of dry ice has been loaded, ensure that adequate ventilation is provided checking that the cargo ventilation system is running properly. If this condition is not met, avoid storing dry ice on airplanes for extended periods of time.

Similar precautions must be followed when entering any area, adjacent to a cargo compartment, loaded with dry ice. If adequate ventilation is not provided, it is recommended to wear oxygen mask and portable oxygen cylinder inside these areas. In addition, animals should not be transported on a cargo compartment loaded with dry ice.

Both air conditioning packs (or equivalent ground cart ventilation) shall be operating while persons are on board of an airplane transporting dry ice.

In case of failure of the cargo ventilation system during flight, the $CO_2$ sublimated in the cargo compartment may spread in the airplane, but the fresh air flow that comes from the packs dilutes the $CO_2$ concentration below 0.5% $CO_2$ in volume. The airplane can continue the flight normally, but after landing it is required to follow special procedures to ventilate the place in which $CO_2$ buildup is suspected.

Notify the flight crew whenever the amount of dry ice stowed in the cargo compartment exceeds 440 lb (200 kg), as recommended by the IATA Dangerous Goods Regulations.

In case of suspect of $CO_2$ leakage from cargo compartment, the crew may start Emergency Procedures. If large quantities of dry ice appear in the cabin, it is recommended to start an emergency descent to FL 100 to allow activate the emergency ram air ventilation. It is also necessary to alert personnel for symptoms of excessive $CO_2$ gas concentrations when around dry ice.

## LOAD LIMITATIONS

Significant concentration of gaseous $CO_2$ by sublimation of dry ice in airplanes may affect the breathing of passengers and crew. For this reason, it is necessary to establish dry ice carriage limits. The table below provides the maximum load for dry ice transportation in EMB-145, ERJ-140 and EMB-135 cargo compartment.

| Dry Ice Load Limitation | | |
|---|---|---|
| EMB-135 | 322.50 kg | 711.00 lb |
| ERJ-140 | 322.50 kg | 711.00 lb |
| EMB-145 | 347.00 kg | 765.00 lb |

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# SECTION 1-08

# CONFIGURATION DEVIATION LIST

TABLE OF CONTENTS

Page Block

Introduction ..... 1-08-00
ATA Chapter 06 Dimensions and Areas ..... 1-08-06
ATA Chapter 23 Communications ..... 1-08-23
ATA Chapter 28 Fuel ..... 1-08-28
ATA Chapter 32 Landing Gear ..... 1-08-32
ATA Chapter 33 Lights ..... 1-08-33
ATA Chapter 49 Auxiliary Power Unit ..... 1-08-49
ATA Chapter 52 Doors ..... 1-08-52
ATA Chapter 54 Nacelle/Pylons ..... 1-08-54
ATA Chapter 55 Stabilizers ..... 1-08-55
ATA Chapter 57 Wings ..... 1-08-57
ATA Chapter 78 Engine Exhaust ..... 1-08-78

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# INTRODUCTION

This Configuration Deviation List contains additional certificate limitations for operation of all models of the EMB-145 airplanes without certain secondary airframe and engine parts as listed herein. When the airplane is operated using the CDL, it must be operated in accordance with the limitations specified in the AFM, as amended in the CDL. All the items which are related to the airworthiness of the airplane and not included on the list are automatically required.

The associated limitations must be listed on a placard affixed in the cockpit in clear view of the pilots and other appropriate crewmember(s). The pilot in command should be notified of each operation with a missing part(s) by listing the missing part(s) in the flight or dispatch release. The operator should list in the airplane logbook an appropriate notation covering the missing part(s) on each flight.

If an additional part is lost, the airplane may not depart the airport at which it landed following this event, until it complies with the limitation of the CDL. This, of course, does not preclude the issuance of a ferry permit to allow the airplane to be flown to a point where the necessary repairs or replacement can be made.

No more than one part for any one system may be missing, unless specific combinations of parts are included in the CDL. Unless otherwise specified, parts from different systems may be missing. The performance penalties are cumulative, unless specifically designated penalties are indicated for the combination of missing parts.

No more than three parts that have each been determined to cause negligible performance degradation may be missing for takeoff without applying a performance penalty. When more than three of such parts are missing, a performance penalty of 45 kilograms (100 pounds) must be applied for takeoff, en route, and landing for each missing part.

No more than ten parts that have each been determined to cause no performance penalty may be missing.

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Takeoff performance penalties should be applied to the takeoff weights that are limited by performance considerations (i.e., takeoff field length, first, second, or final segment climb, or takeoff flight path).

If the performance-limited takeoff weight is greater than the maximum certified takeoff weight, the takeoff performance penalties should be applied to the maximum certified takeoff weight to ensure compliance with the noise requirements.

Landing performance penalties should be applied to the landing weights that are limited by performance considerations (i.e., landing field length, landing climb, or approach climb). If the performance-limited landing weight is greater than the maximum certified landing weight, the landing performance penalties should be applied to the maximum certified landing weight to ensure compliance with the noise requirements.

En route performance penalties apply only to operations that are limited by the one-engine inoperative en route climb performance.

If the CDL item refers to a MMEL item, the MMEL repair interval must be applied.

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## COMPONENT LOCATION

The numbering and designation of systems in this section are based on ATA Spec. 100. The parts within each system are identified by their functional description and, when necessary, by door or panel identification, followed by the appropriate figure.

The access doors and panels in a zone are identified by an alphanumeric system which has three digits. They identify the zone where the access door or panel is located, followed by a two-letter or three-letter suffix.

- The first digit indicates a major zone of the airplane, which gives the necessary reference for the identification of the service areas or components:

| MAJOR ZONE | AREA |
|---|---|
| 100 | Lower fuselage (below the floor line) |
| 200 | Upper fuselage (above the floor line) |
| 300 | Tail cone and empennage group |
| 400 | Powerplant and nacelles |
| 500 | Left half-wing |
| 600 | Right half-wing |
| 700 | Landing gear wheel well doors |
| 800 | Doors (main, service, cargo, emergency) |

- The following two digits indicates sub-zones. For example: 111 - Radome; 510 - Wing Leading Edge.
- The first letter identifies a sequence which starts with the letter A.
- The second letter shows the location of each access door or panel in relation to the aircraft as follows:

  B: Bottom
  L: Left
  T: Top
  R: Right

- Each panel gets a fastener identification code, boxed, which identifies the type and quantity of the fasteners for each panel.
  L: Latch
  S: Screw
  C: Camloc

For further details on this system, please see Airplane Maintenance Manual, Chapter 6, for the part identification.

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# ATA CHAPTER 06 DIMENSIONS AND AREAS

| System & Sequence Number | 1. ITEM | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **6** | **DIMENSIONS AND AREAS** | | | |
| 41-1 | Exterior Main Door Control Panel Access Door (123AL - Figure 1) | 1 | 0 | May be missing with no penalty. |
| 41-2 | External Power Connection Access Door (113EL - Figure 1) | 1 | 0 | May be missing with no penalty. |
| 41-3 | Ground Air Conditioning Connection Access Door (191AR - Figures 3, 5) | 1 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |
| 41-4 | Air Conditioning Heat Exchanger Grills (191ML - Figures 2, 4) (191NR - Figures 3, 5) | 2 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |
| 41-5 | Pack Valve/Wing Anti-ice Valve Access Door (191KL - Figure 2) (191LR - Figure 3) | 2 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |
| 41-6 | Bleed Flexible Joint Access Door (195AL/CL - Figure 2) (194AR/CR - Figure 3) | 4 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |

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| System & Sequence Number | 1. ITEM | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **6 DIMENSIONS AND AREAS** | | | | |
| 41-7 | Red Beacon Fairing (192EL - Figure 2) | 1 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |
| 41-8 | Hydraulic Servicing Access Door (193DL/EL/FL - Figure 2) (193GR/HR/JR - Figure 3) | 6 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower |
| 41-9 | Fuel Tank Drain Valve Access Door (192CL - Figure 2, 4) (192DR - Figure 3, 5) | 2 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |
| 41-10 | Fuel Wing Stub Drain Valve Access Door (192HL - Figure 4) (192JR - Figure 5) (EMB-145 LR and XR) | 2 | 1 | One may be missing with no penalty. |
| 41-11 | Drip Stick Door (192FL - Figure 4) (192GR - Figure 5) (EMB-145 LR and XR) | 2 | 1 | One may be missing with no penalty. |
| 41-12 | Pneumatic Duct Joints Access Panel (193SL/XL - Figure 4) (193YR/TR - Figure 5) | 4 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |
| 41-13 | Hydraulic System Service Access Door (193WL - Figure 4) (193ZR - Figure 5) | 2 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |

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| System & Sequence Number | 1. ITEM | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **6 DIMENSIONS AND AREAS** | | | | |
| 41-14 | Hydraulic Oil Level Sight Glass Access Door (193UL - Figure 4) (193VR - Figure 5) | 2 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |
| 41-15 | Pneumatic Duct Junction Access Panel (198DL - Figure 4) (198ER - Figure 5) | 2 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |
| 42-1 | Pressure Fueling Panel Access Door (191BR - Figures 3, 5) | 1 | 0 | May be missing provided:<br>a) Door microswitch is locked actuated (simulating door closed);<br>b) Refueling, defueling and power switches are verified in the CLOSED/NORMAL position (Refer to RAMP Manual 52-78-01-DP);<br>c) Refueling cap is locked and latched; and<br>d) Maximum airspeed is limited to 250 KIAS/ 0.65 M, whichever is lower. |
| 42-2 | Potable Water Service Door (193MR - Figure 3) | 1 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |
| 42-3 | Potable Water Service Access Panel (198BR - Figure 5) | 1 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS/0.65 M, whichever is lower. |
| 42-4 | Waste Service Door (272AR - Figure 6) | 1 | 0 | May be missing with no penalty. |

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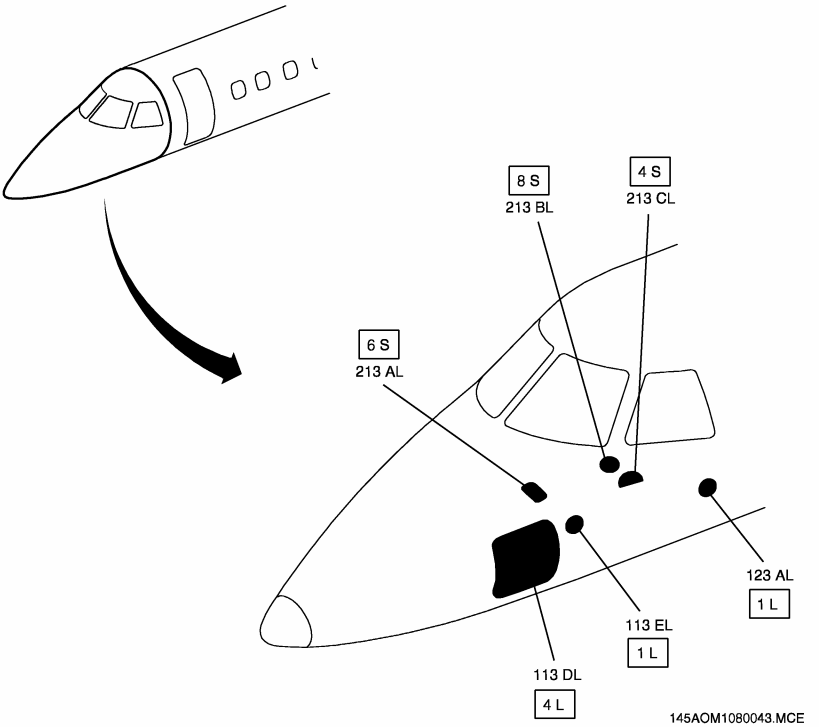


**FIGURE 1**

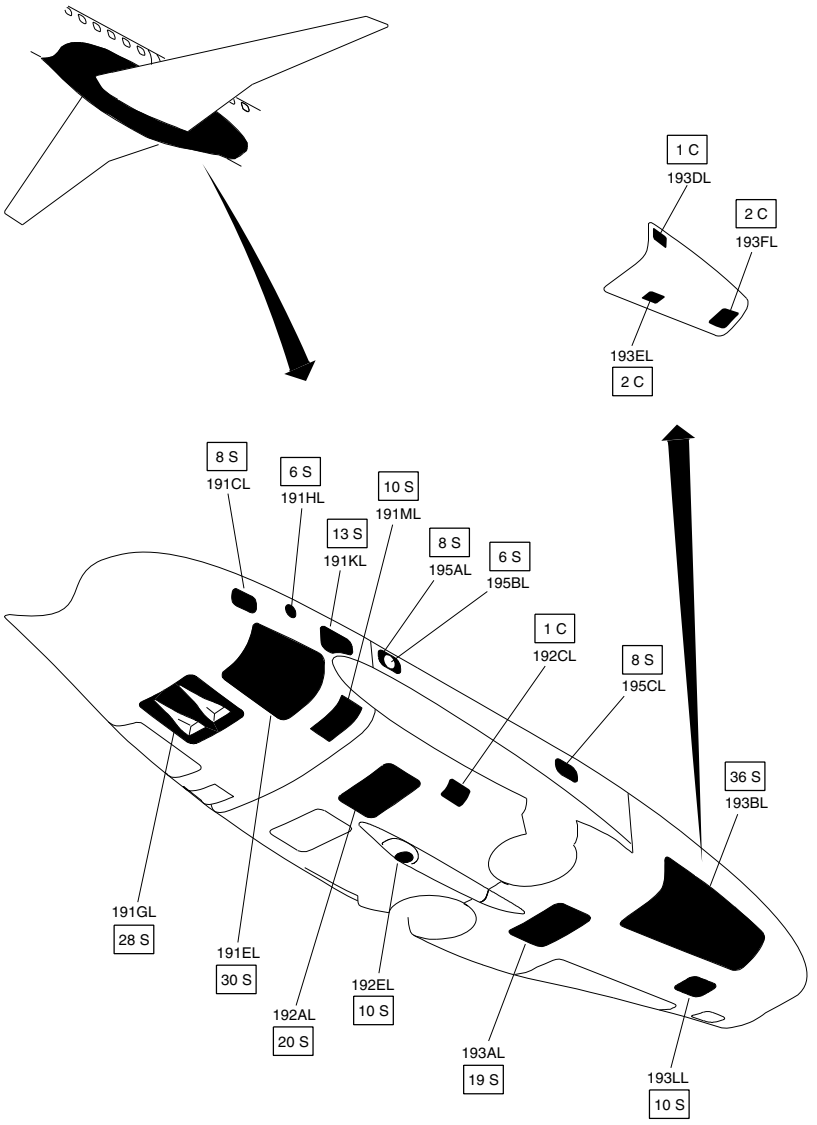


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**FIGURE 2 - ALL EXCEPT EMB-145XR**

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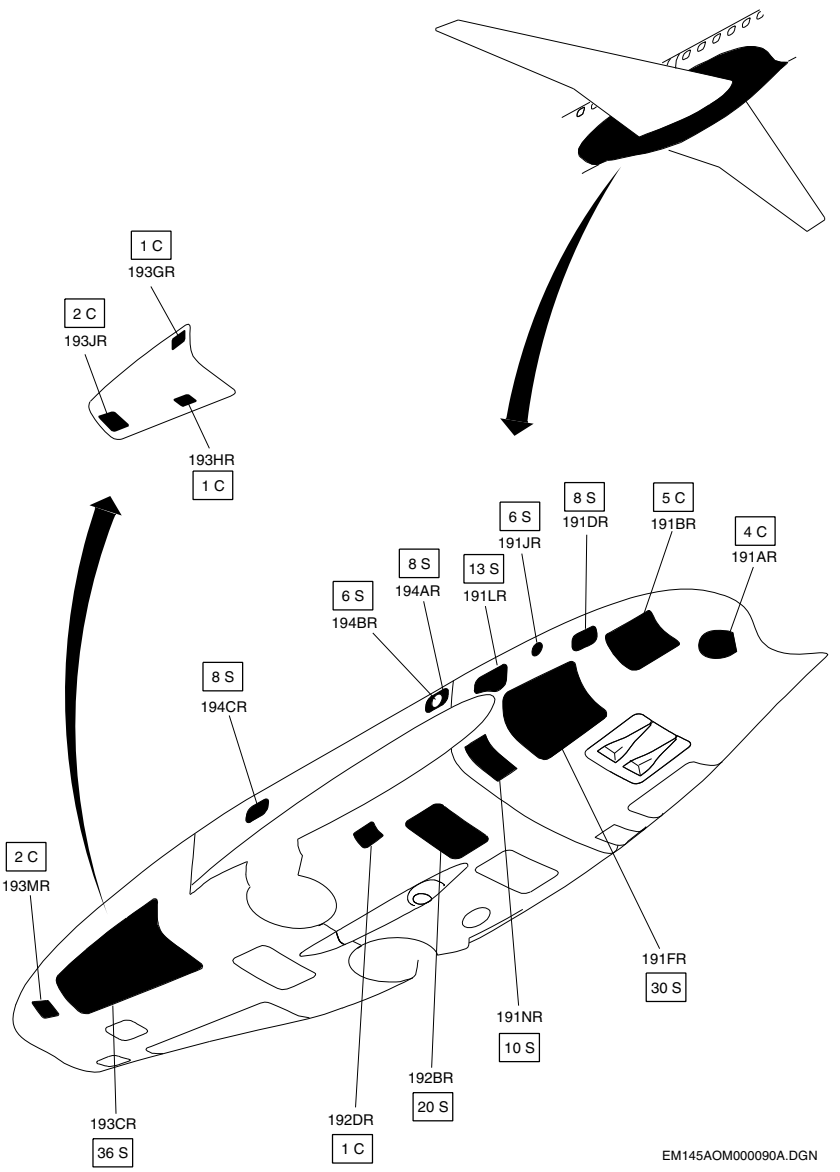


**FIGURE 3 - ALL EXCEPT EMB-145XR**

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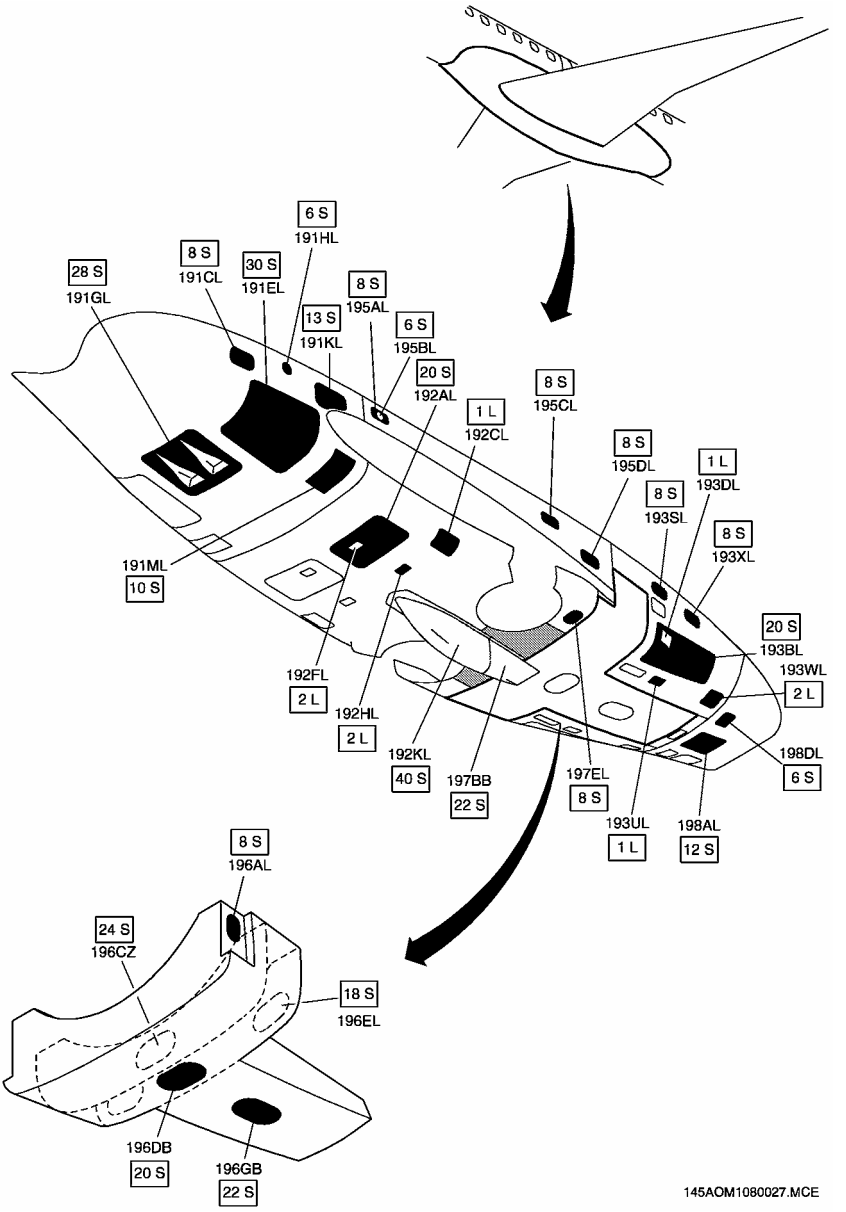


**FIGURE 4 - EMB-145XR**

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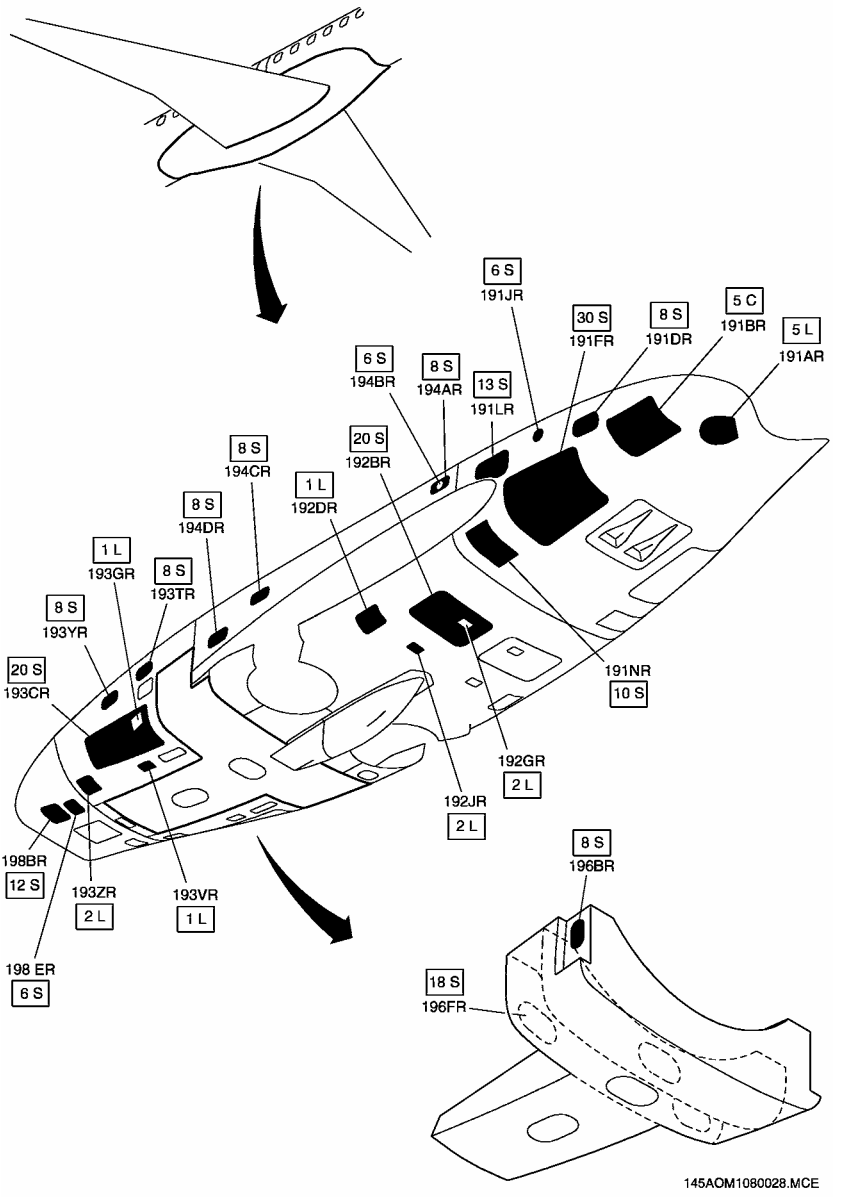


**FIGURE 5 - EMB-145XR**

| System & Sequence Number | 1. ITEM | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **6 DIMENSIONS AND AREAS** | | | | |
| 42-5 | Engine Starting Pneumatic Connection Door (272CR - Figure 6) | 1 | 0 | May be missing with no penalty. |
| 42-6 | Maintenance Interphone Connection Door (272BR - Figure 6) | 1 | 0 | May be missing with no penalty. |
| 42-7 | APU Tail Cone Attaching Bolt Access Door (313GR/DR/AL/BL - Figure 6) | 4 | 0 | May be missing with no penalty. |
| 42-8 | APU Servicing Access Door (313CL - Figure 6) | 1 | 0 | May be missing provided APU operates on the ground only.<br>**NOTE:** If the APU oil temperature increases to over 135°C (275°F) during ground operation, the APU OIL HIGH TEMP message will be displayed on the EICAS and the APU will be automatically shut down. |

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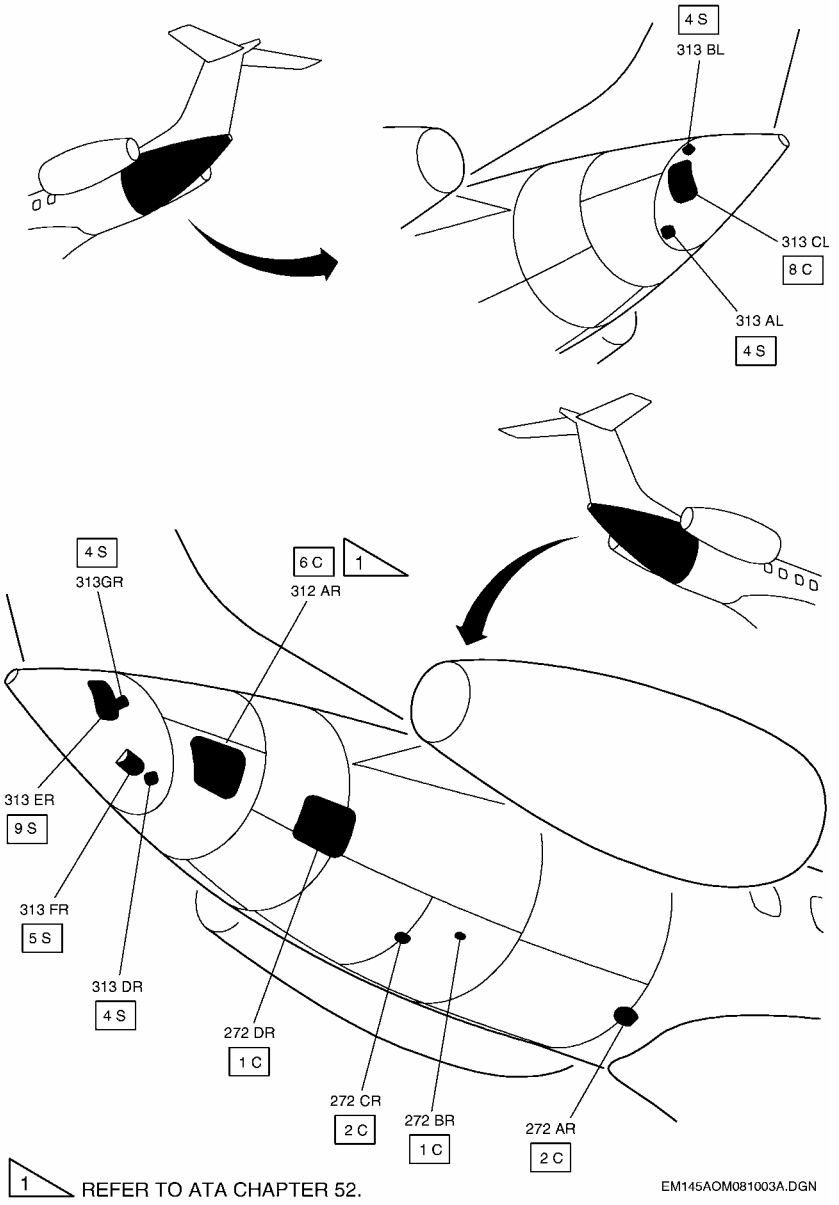


**FIGURE 6**

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# ATA CHAPTER 23 COMMUNICATIONS

| System & Sequence Number / ITEM 1. | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|
| **23 COMMUNICATIONS** | | | |
| 60-1 Static Dischargers (Figure 7) (All except EMB-145XR) | 22 | 13 | A maximum of 9 (nine) static dischargers may be missing with no penalty. At least the following dischargers are required to be installed:<br><br>a) 3 (three) are installed on each wing;<br>b) 1 (one) is installed on the rudder;<br>c) 3 (three) are installed on each elevator. |
| 60-2 Static Dischargers (Figure 7) (EMB-145 XR) | 26 | 17 | A maximum of 9 (nine) static dischargers may be missing with no penalty. At least the following dischargers are required to be installed:<br><br>a) 4 (four) are installed on each wing;<br>b) 1 (one) is installed on the rudder:<br>c) 3 (three) are installed on each elevator. |

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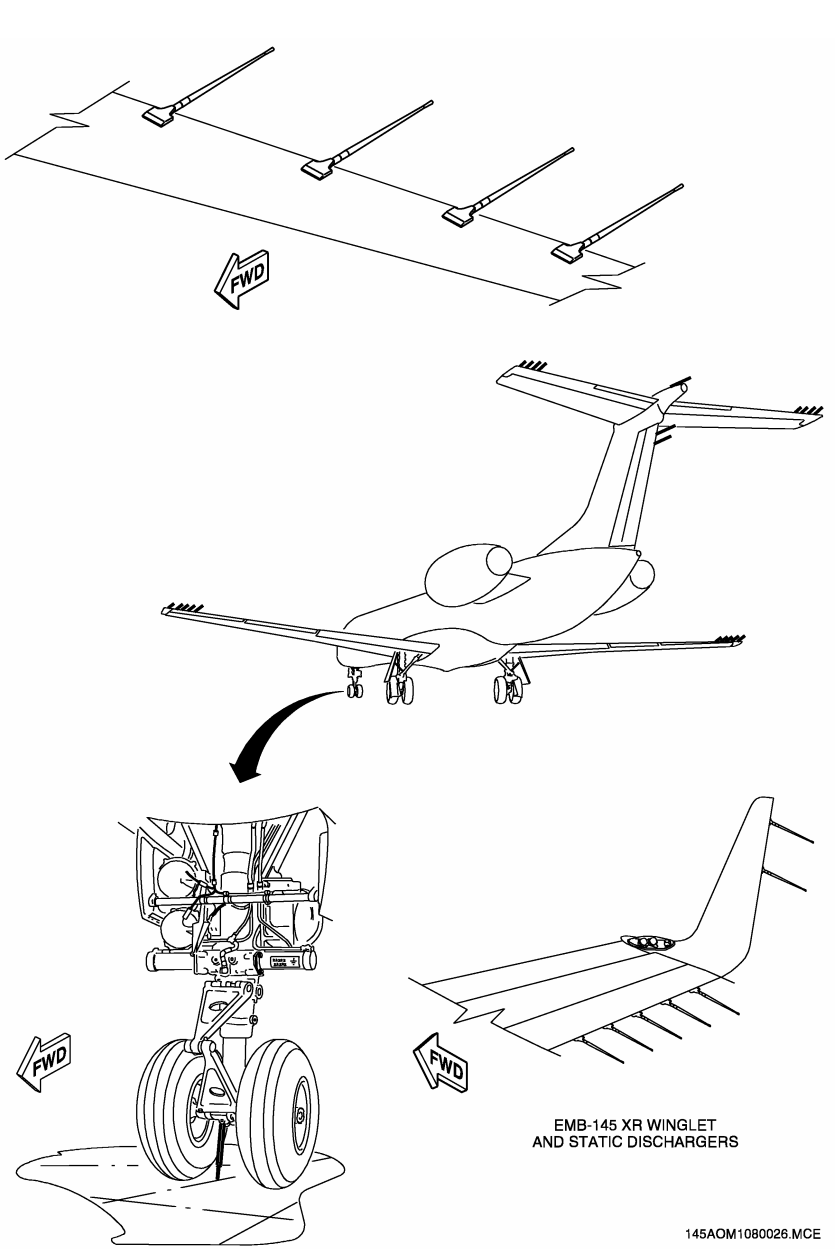


**FIGURE 7**

# ATA CHAPTER 28 FUEL

| System & Sequence ITEM Number 1. | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|
| **28 FUEL** | | | |
| 11-1 Fuel Tank Drain Access Door (192CL - Figures 2, 4) (192DR - Figures 3, 5) | 2 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS /0.65 M, whichever is lower. |
| 12-1 Vent Valves Screen Assembly (Figure 8) | 2 | 0 | May be missing with no penalty. |
| 42-1 Direct Quantity Measuring Sticks (Figure 9) | - | 0 | May be missing with no penalty. Refer to MMEL 28-42-01. |

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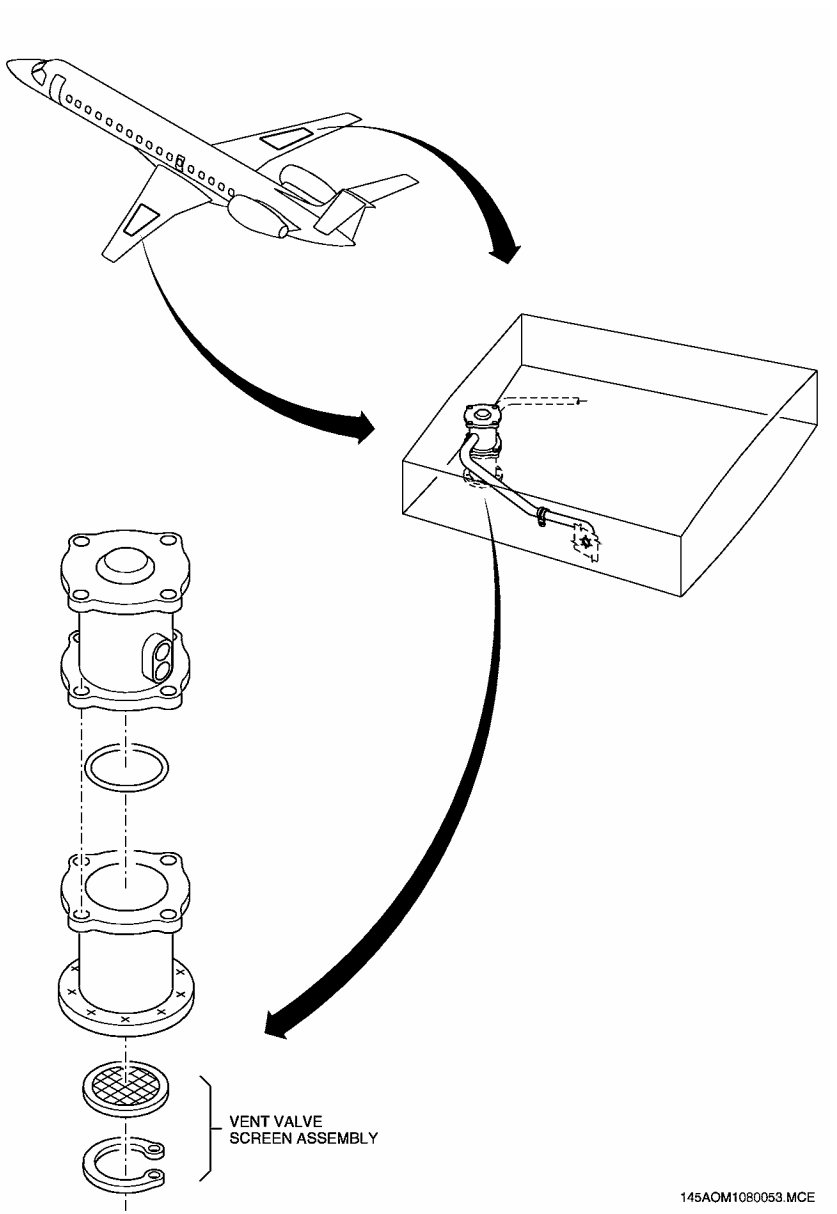


**FIGURE 8**

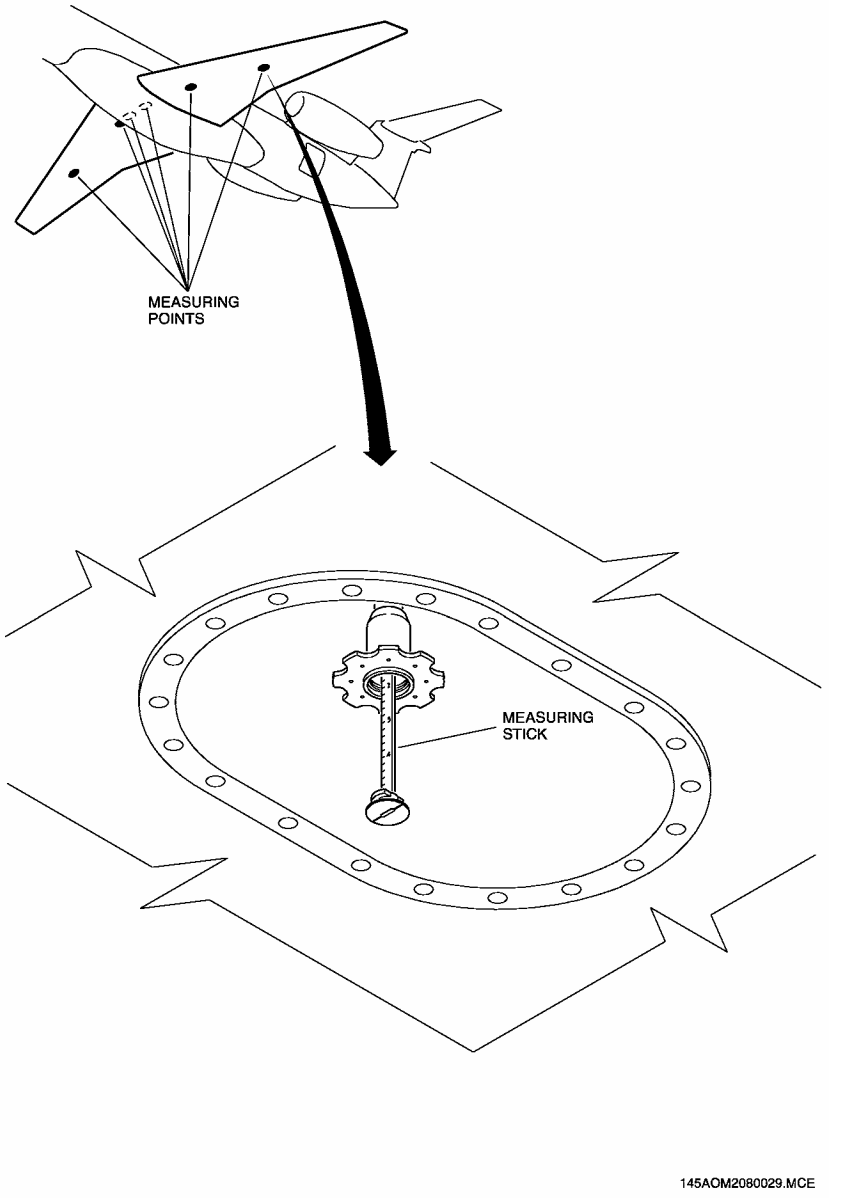


**FIGURE 9**

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# ATA CHAPTER 32 LANDING GEAR

| System & Sequence ITEM Number | 1. | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **32 LANDING GEAR** | | | | |
| 10-1 Main Landing Gear Doors (Figure 10) | | 2 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS / M 0.65, whichever is lower. |
| 10-2 Main Landing Gear Wheels Fairing (Figure 10) | | 2 | 0 | May be missing provided maximum airspeed is limited to 250 KIAS / M 0.65, whichever is lower. |

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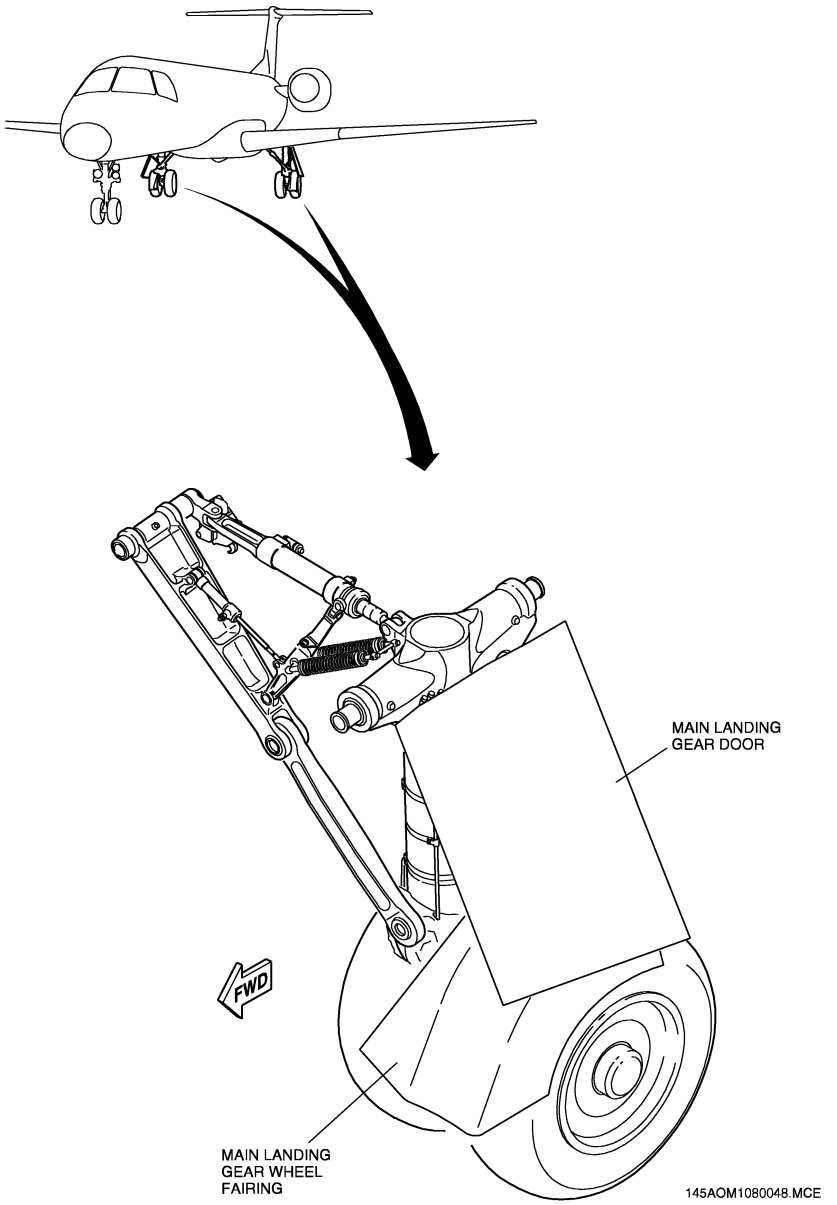


**FIGURE 10**

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# ATA CHAPTER 33 LIGHTS

| System & Sequence ITEM Number | 1. | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **33 LIGHTS** | | | | |
| 41-1 Nose Landing Light (Figure 11) | | 1 | 0 | May be missing with no penalty. Refer to MMEL 33-41-00. |
| 42-1 Taxi Light (Figure 11) | | 2 | 0 | May be missing with no penalty. Refer to MMEL 33-42-00. |
| 43-1 Navigation Light Protective Lens (Figure 12) (All except EMB-145XR) | | 3 | 0 | May be missing with no penalty. Refer to MMEL 33-43-00. |
| 43-2 Navigation Light Protective Lens (Figure 13) (EMB-145 XR) | | 6 | 0 | May be missing with no penalty. Refer to MMEL 33-43-00. |
| 44-1 Inspection Light Protective Lens (Figure 14) | | 2 | 0 | May be missing with no penalty. Refer to MMEL 33-44-00. |
| 46-1 Logotype Light Protective Lens (Figure 15) | | 2 | 0 | May be missing with no penalty. Refer to MMEL 33-46-00. |
| 47-1 Red Beacon Light Protective Lens (Figure 16) | | 2 | 0 | May be missing with no penalty. Refer to MMEL 33-47-05. |
| 50-1 Exterior Emergency Light Protective Lens (Figure 17) | | 4 | 0 | May be missing with no penalty. Refer to MMEL 33-50-00. |

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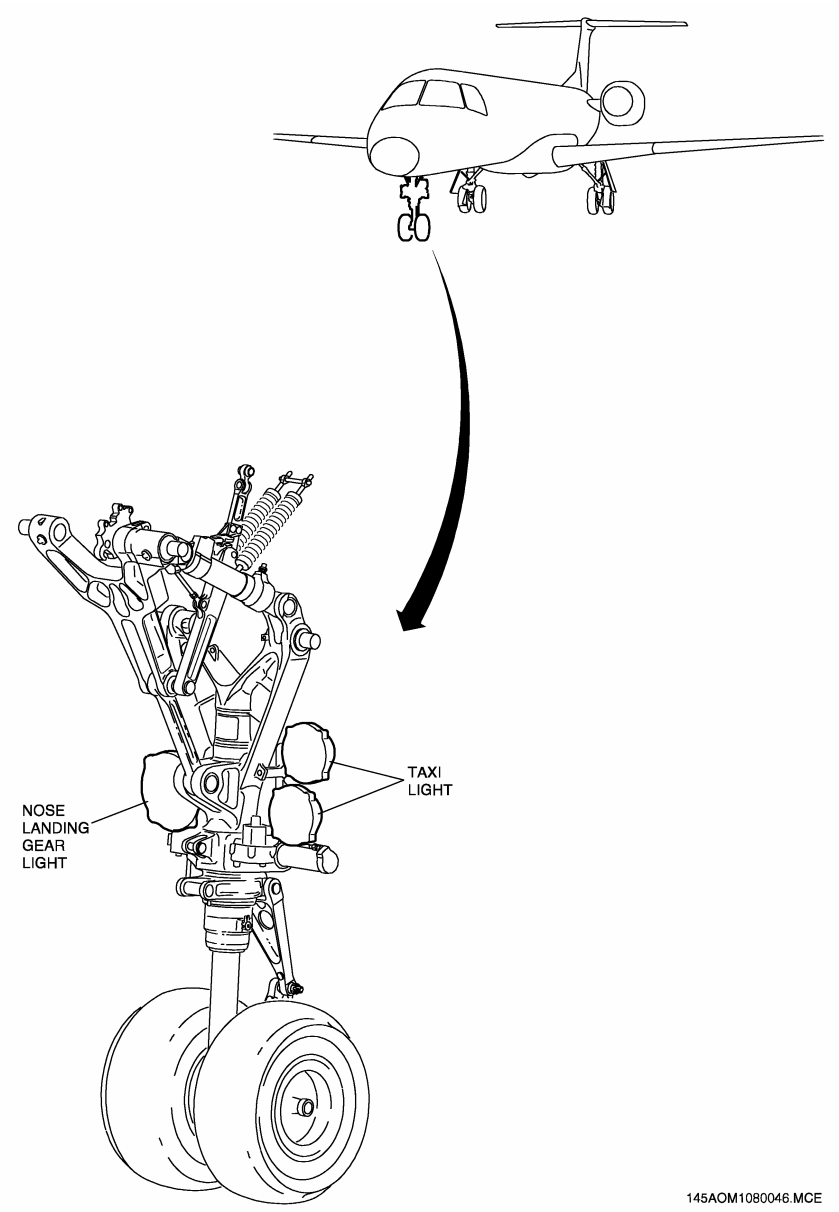


**FIGURE 11**

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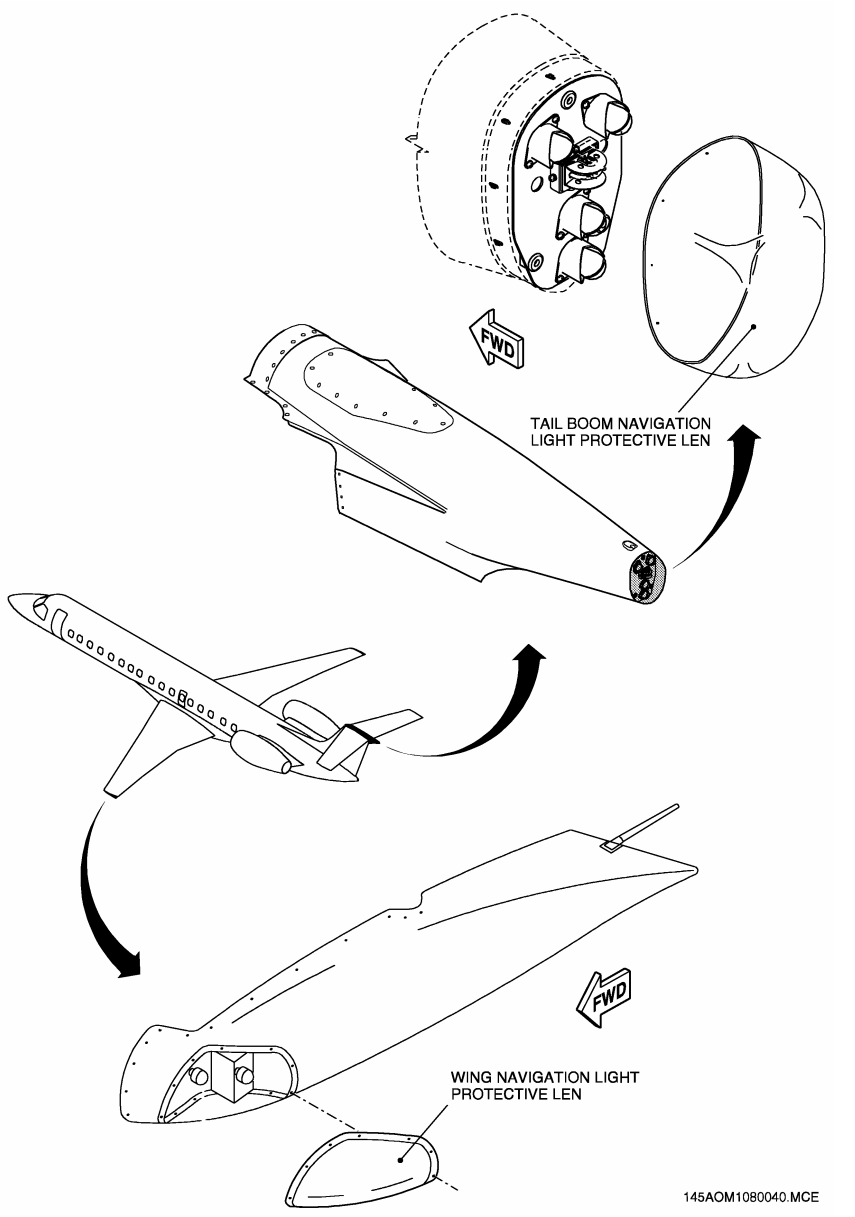


**FIGURE 12**

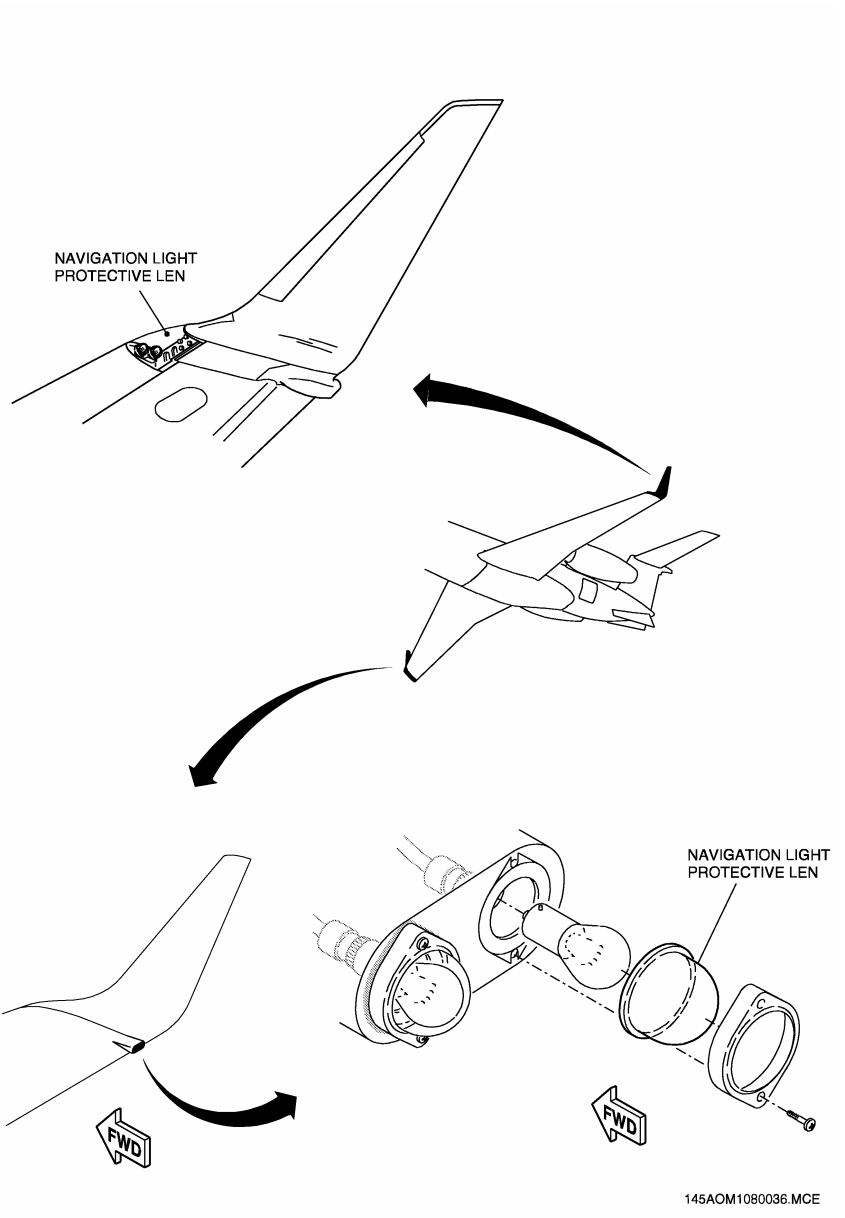


**FIGURE 13**

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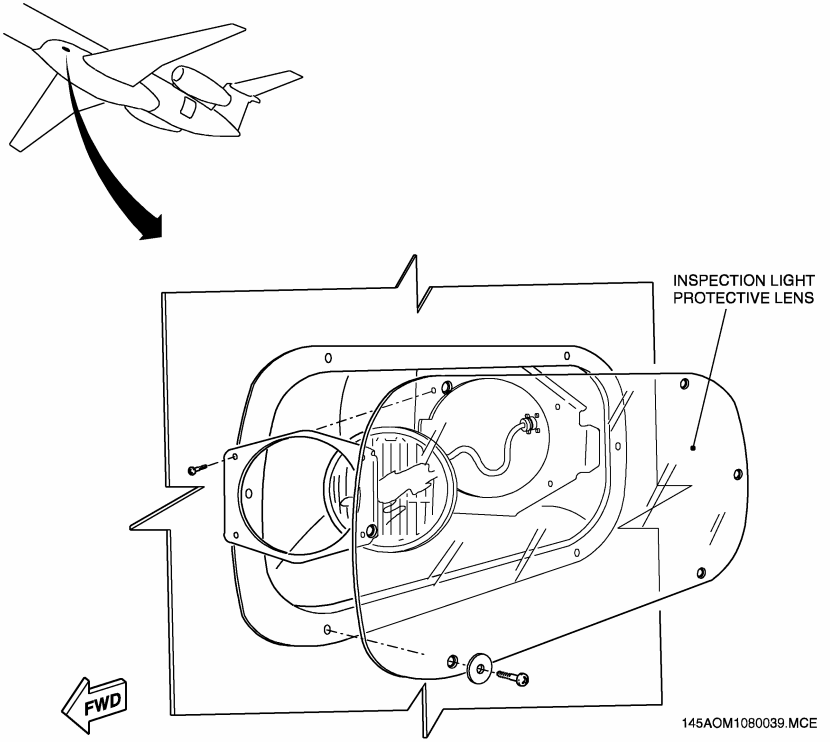


**FIGURE 14**

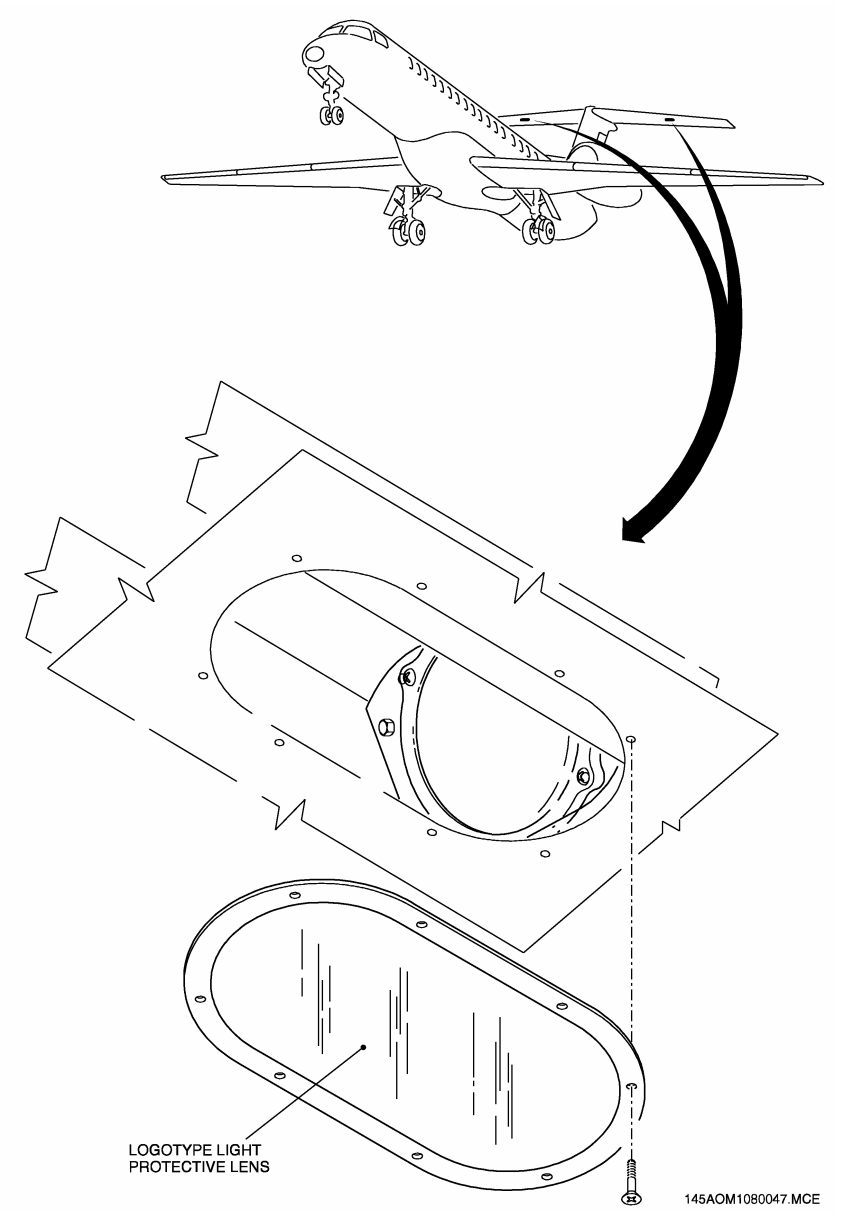


**FIGURE 15**

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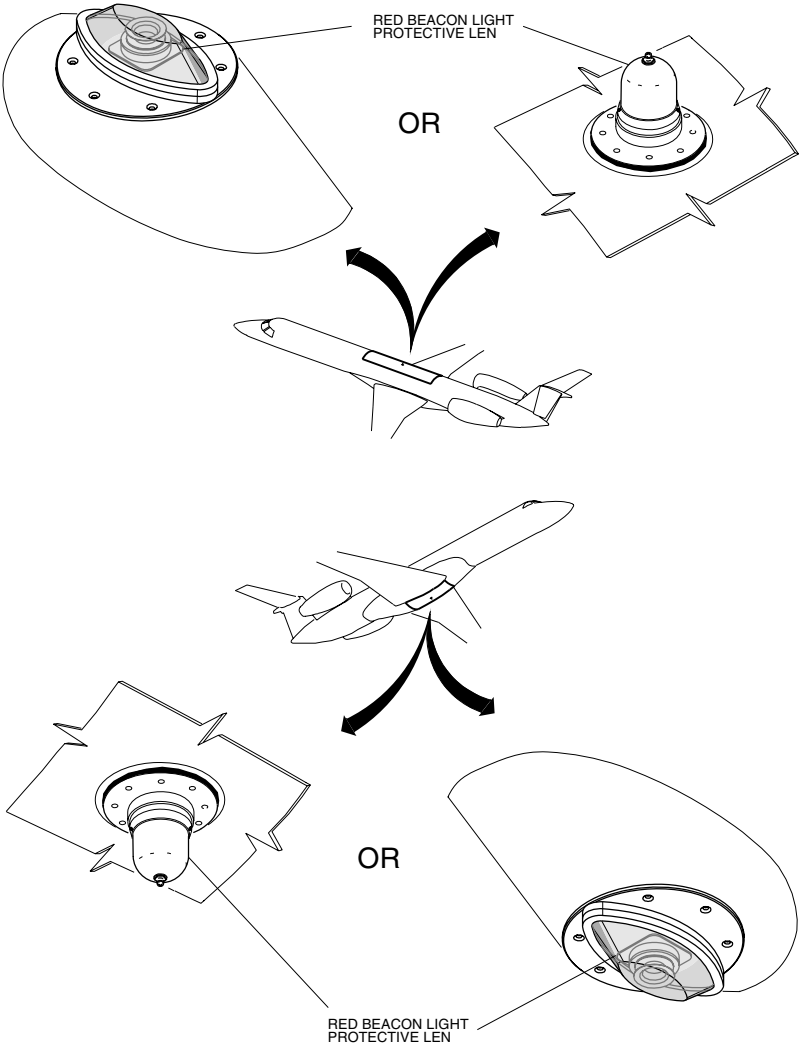


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**FIGURE 16**

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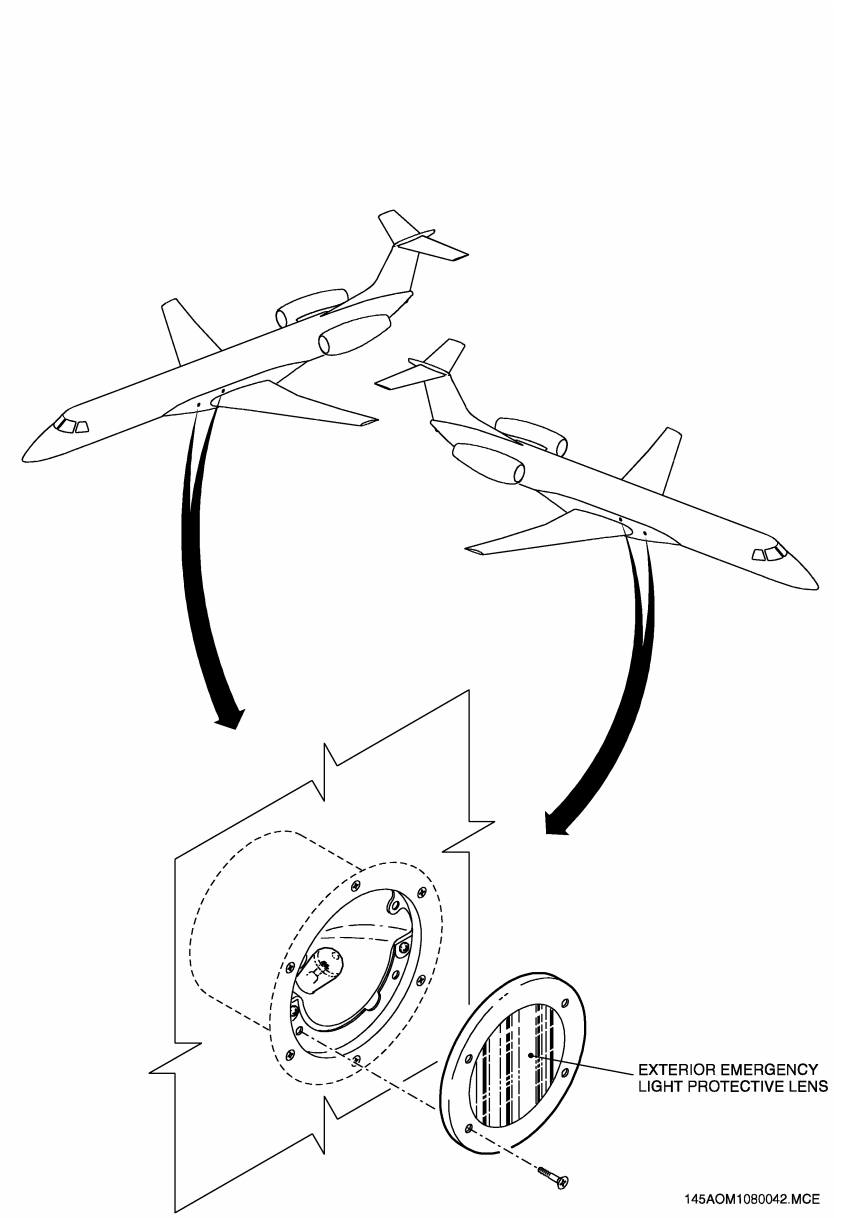


**FIGURE 17**

# ATA CHAPTER 49 AUXILIARY POWER UNIT

| System & Sequence ITEM Number | 1. | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **49 AUXILIARY POWER UNIT** | | | | |
| 42-1 APU Starter/Generator Air Intake Scoop (Figure 18) | | 1 | 0 | May be missing provided APU operates on the ground only. |
| 52-1 APU Compartment Cooling Air Intake Scoop (Figure 18) | | 1 | 0 | May be missing provided APU operates on the ground only. |

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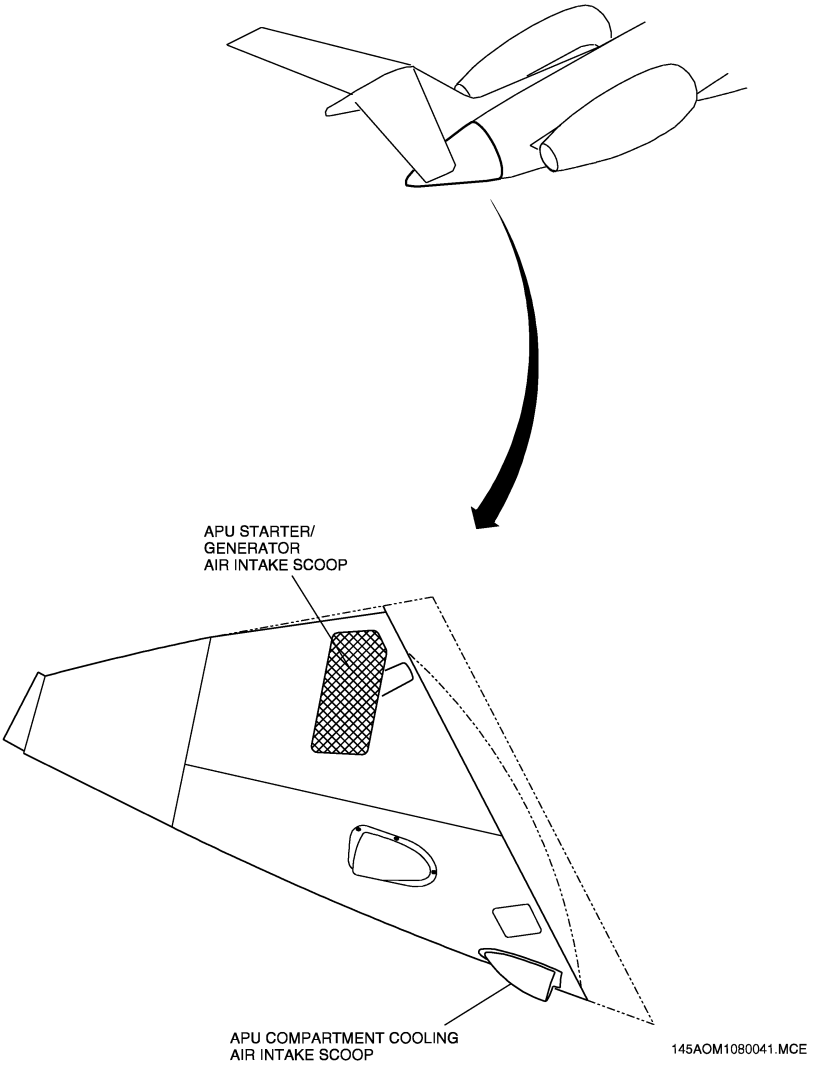


**FIGURE 18**

# ATA CHAPTER 52 DOORS

| System & Sequence ITEM Number | 1. | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **52 DOORS** | | | | |
| 10-1 Main Door Handgrip (Figure 19) | | 1 | 0 | May be missing with no penalty. |
| 42-1 Service Door Handgrip (Figure 19) | | 1 | 0 | May be missing with no penalty. |
| 43-1 Tail Cone Access Door (312AR - Figure 6) | | 1 | 0 | May be missing with no penalty. |

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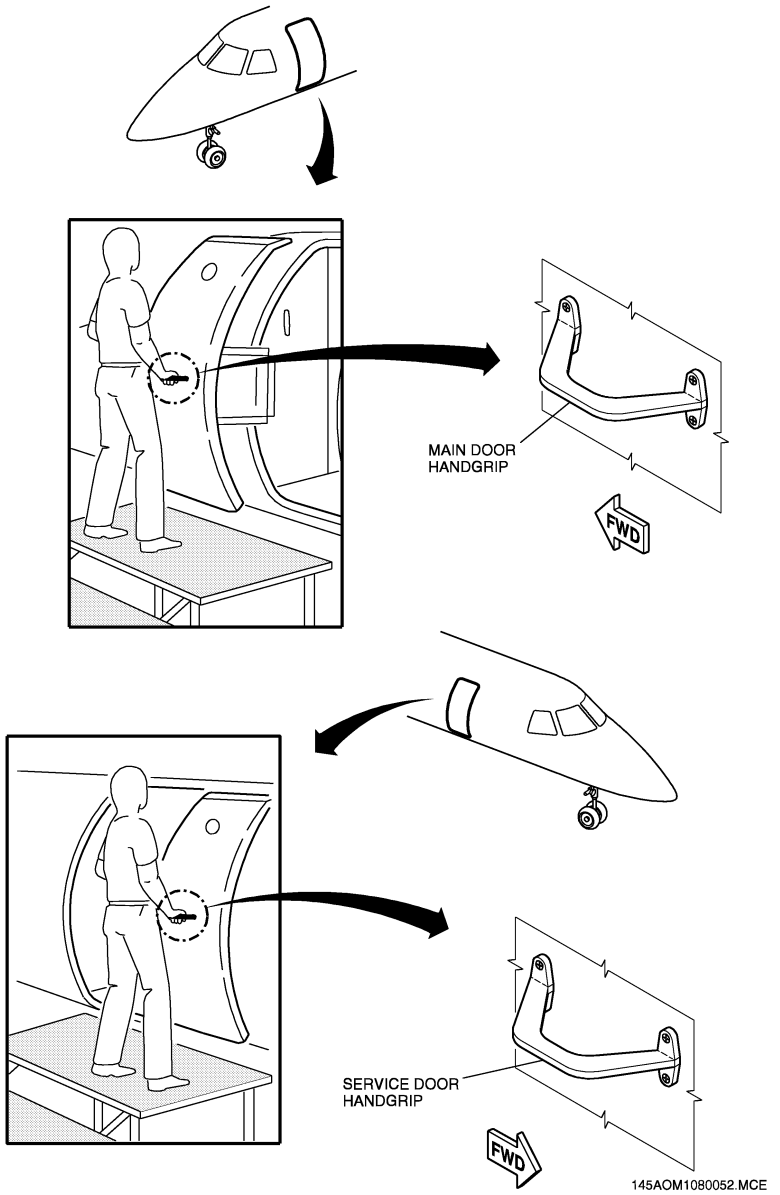


**FIGURE 19**

# ATA CHAPTER 54 NACELLE/PYLONS

| System & Sequence ITEM Number | 1. | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **54 NACELLE/PYLONS** | | | | |
| 50-1 Systems Access Door (414AB/BB/EB - Figure 20) (424AB/BB/EB - Figure 21) | | 6 | 4 | A maximum of 1 per pylon for a total of 2 may be missing provided maximum airspeed is limited to 250 KIAS / 0.65 M, whichever is lower. |
| 50-2 Bleed Valve Access Door (414DB - Figure 20) (424DB - Figure 21) | | 2 | 0 | May be missing with no penalty. |
| 50-3 Pre-cooler Access Door (414CB - Figure 20) (424CB - Figure 21) | | 2 | 0 | May be missing with no penalty. |
| 50-4 Engine Pylon Fairing (414HL - Figure 20) (424HR - Figure 21) | | 2 | 0 | May be missing with no penalty. |

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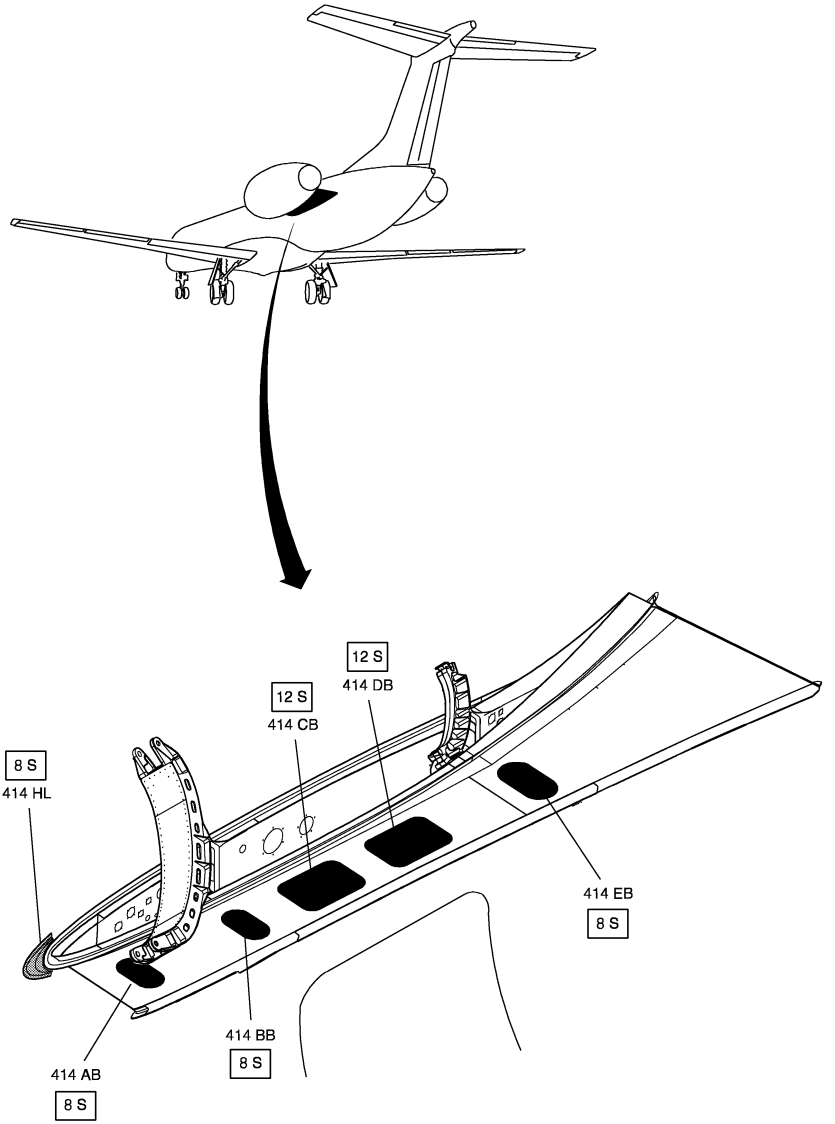


**FIGURE 20**

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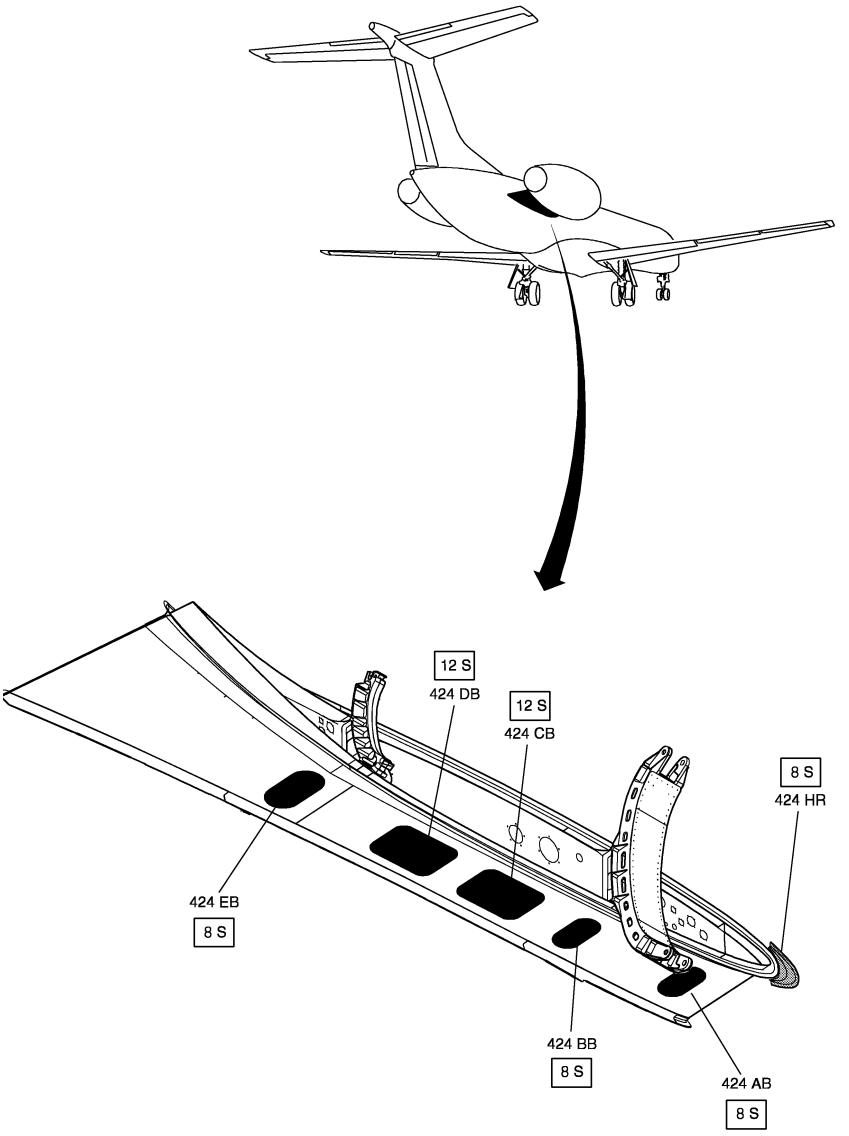


**FIGURE 21**

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# ATA CHAPTER 55 STABILIZERS

| System & Sequence ITEM Number | 1. | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **55 STABILIZERS** | | | | |
| 10-2 Horizontal Stabilizer Access Door (333AB/BB/CB - Figure 22) (334AB/BB/CB - Figure 23) | | 6 | 4 | A maximum of 1 per side for a total of 2 may be missing with no penalty. |
| 20-2 Elevator Control Rod Fairing (Figure 26) | | 4 | 0 | May be missing with no penalty. |
| 20-3 Elevator Trim Control Rod Fairing (Figure 26) | | 2 | 0 | May be missing with no penalty. |
| 20-4 Elevator Access Door (335AB/BB/CB/DB/EB/ FB/GB/HB - Figure 22) (336AB/BB/CB/DB/EB/ FB/GB/HB - Figure 23) | | 16 | 15 | One may be missing with no penalty. 335AB/BB/CB/DB/EB and 336 AB/BB/CB/DB/EB cannot be missing. |
| 30-1 Vertical Stabilizer Access Door (322AL, 324AL/BL/CL/DL/EL, 325AL/BL/CL/DL/EL - Figure 24) (322BR, 324FR, 325FR/ GR/HR/JR/KR/LR - Figure 25) | | 19 | 16 | A maximum of 3 in any combination may be missing with no penalty. 324 FR/EL and 325 EL/LR cannot be missing. |
| 40-1 Rudder Access Door (326AL/BL/CL/EL/FL/GL/HL, 327AL/BL/CL/DL - Figure 24) (327ER/FR/GR/HR - Figure 25) | | 15 | 13 | A maximum of 2 in any combination may be missing with no penalty. |

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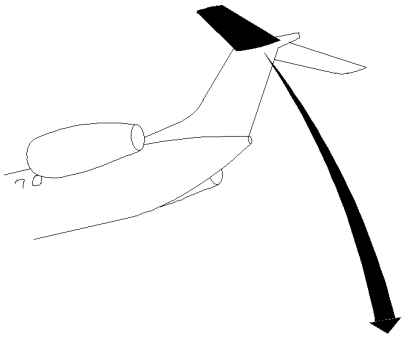

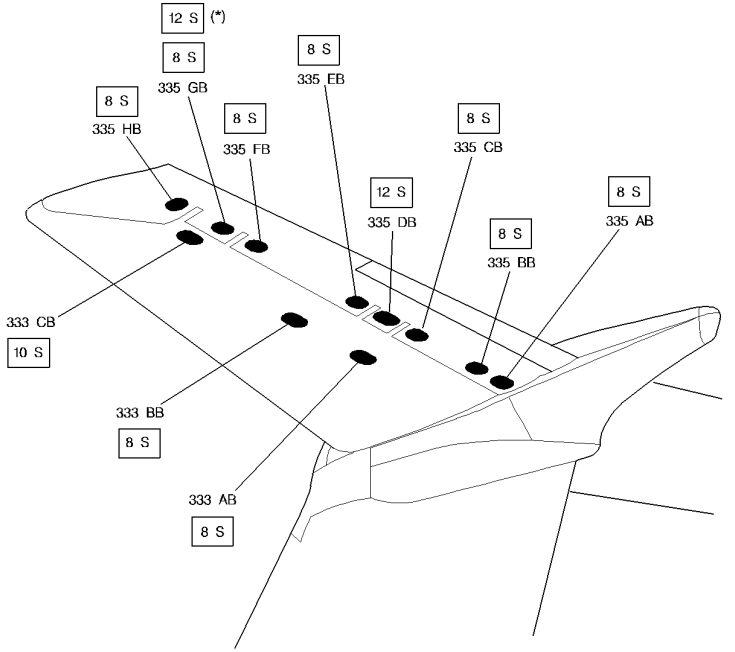


**NOTE:**
(*) APPLICABLE TO AIRCRAFT 012/999

1451114343.MCE

**FIGURE 22**

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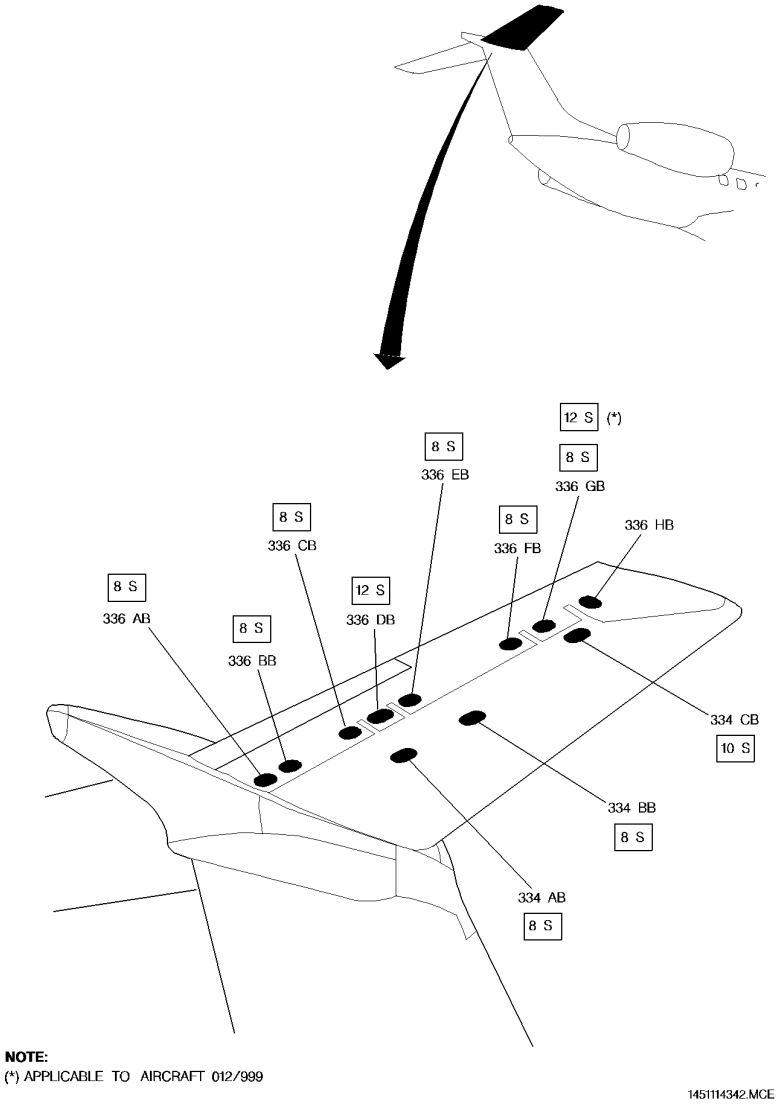


**FIGURE 23**

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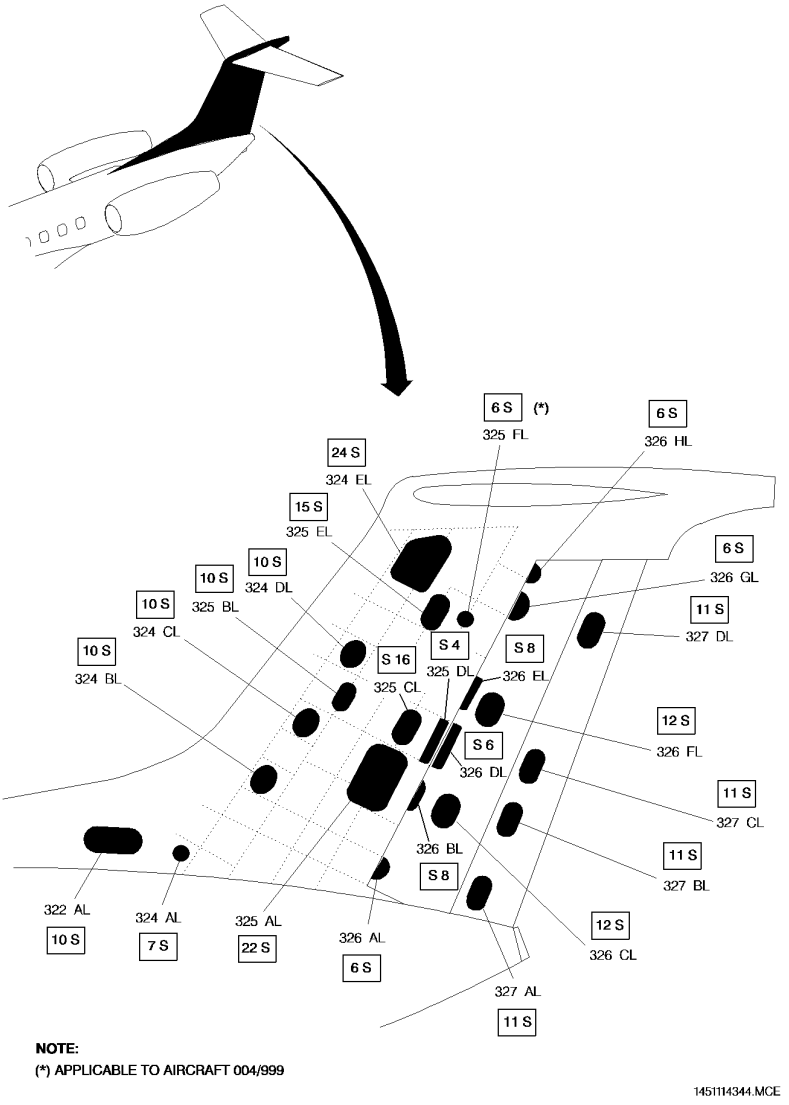


**FIGURE 24**

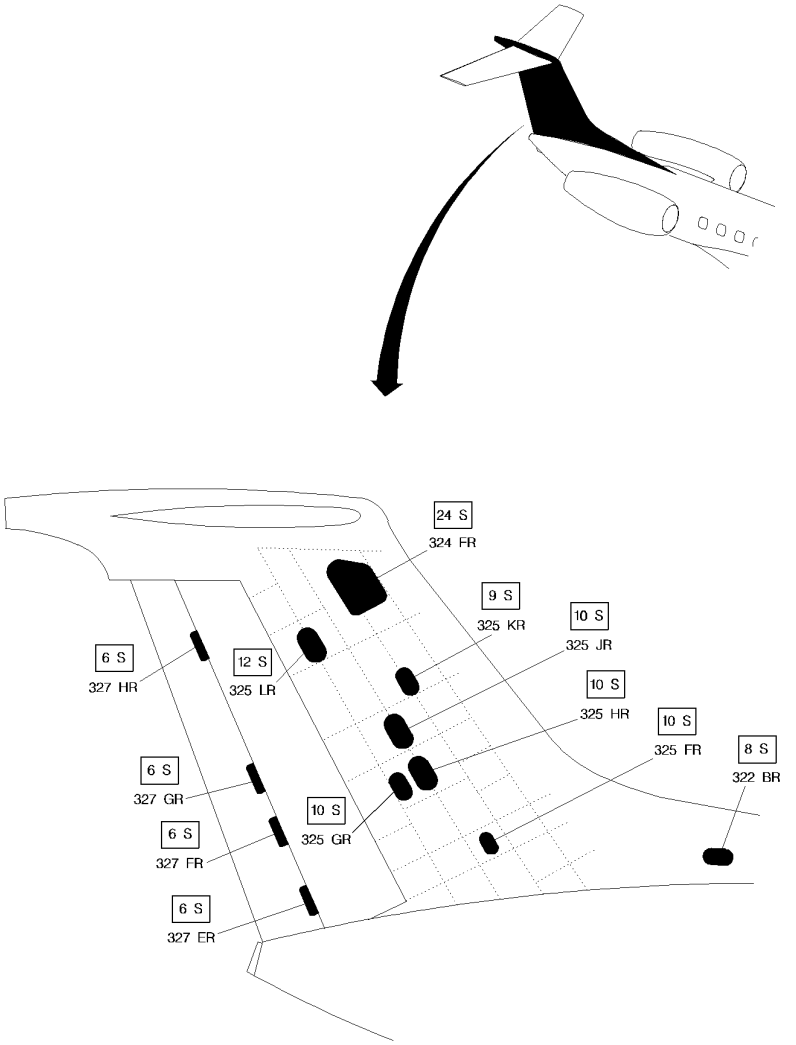


**FIGURE 25**

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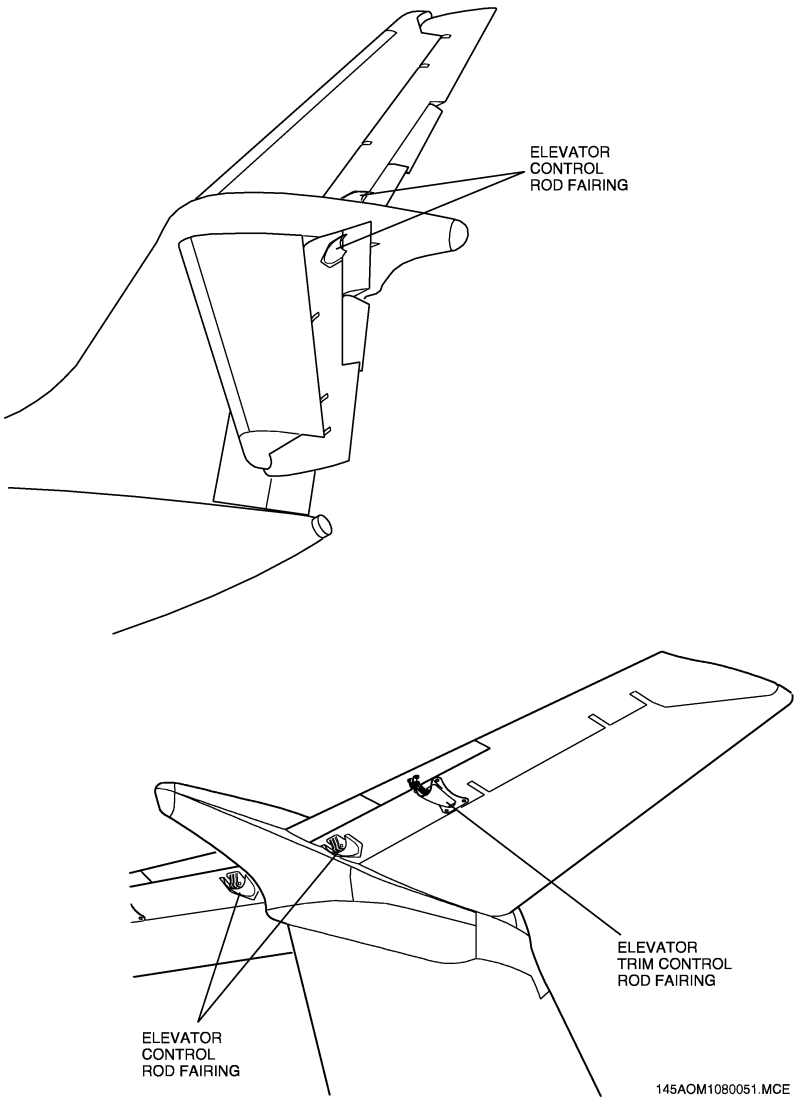


**FIGURE 26**

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# ATA CHAPTER 57 WINGS

| System & Sequence ITEM Number | 1. | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|---|
| **57 WINGS** | | | | |
| 20-1 Vortex Generator (Figure 27) | | 24 | 22 | A maximum of 1 per wing for a total of 2 may be missing with no penalty. |
| 30-2 Wing Tip Glareshield (Figure 28) | | 2 | 0 | May be missing with no penalty. |
| 42-1 Wing Grounding Point (Figure 29) | | 2 | 0 | One or both may be missing with no penalty provided:<br>a) The hole is covered with Scotch Brand Tape (Silver Tape) or similar product and,<br>b) The landing gear grounding point is available. |
| 52-1 Flap Track Fairing (Figure 30) | | 10 | 9 | One may be missing with no penalty. |
| 52-2 Wing-to-flap seal (Figure 31) | | 4 | 3 | One may be missing provided maximum airspeed is limited to 250 KIAS / M0.65, whichever is lower. |

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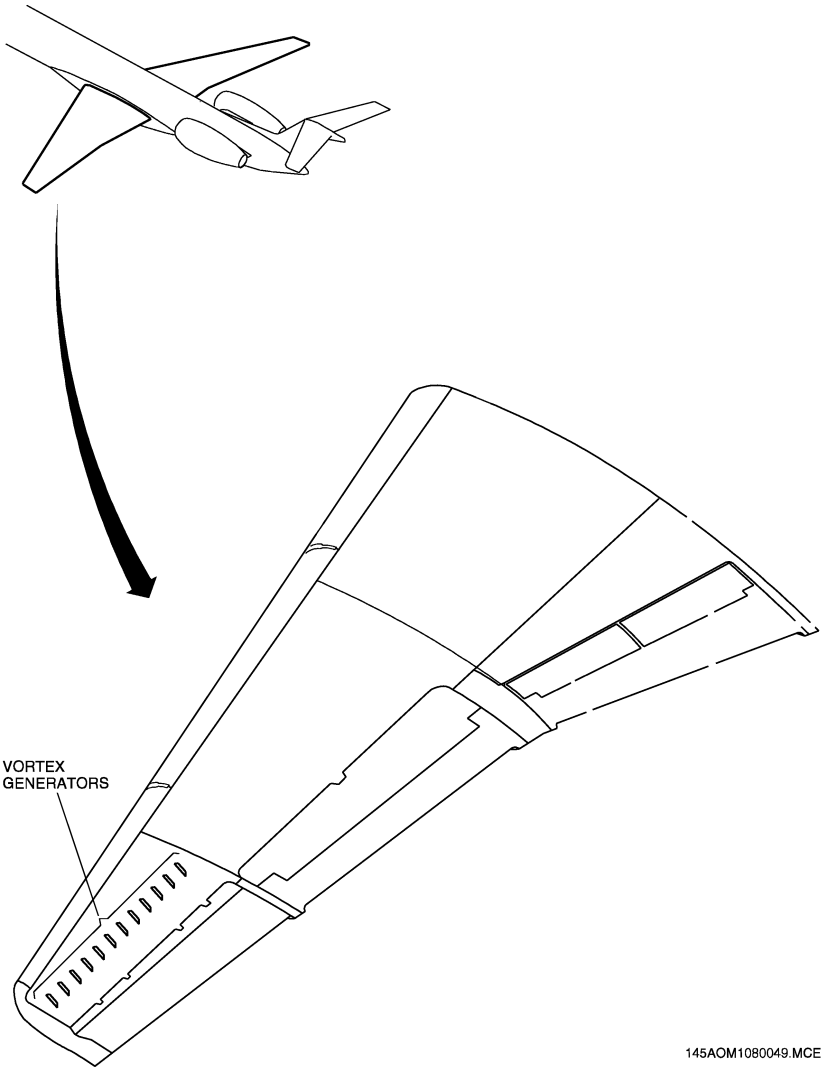


**FIGURE 27**

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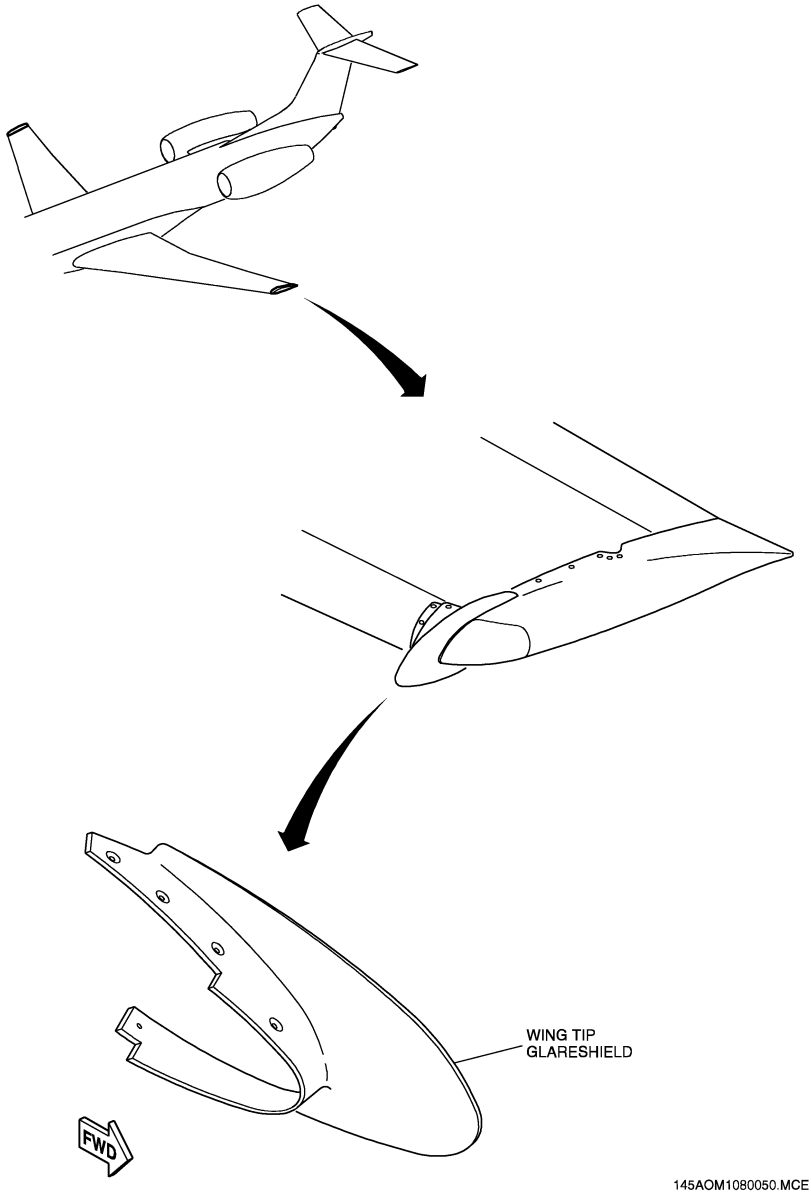


**FIGURE 28**

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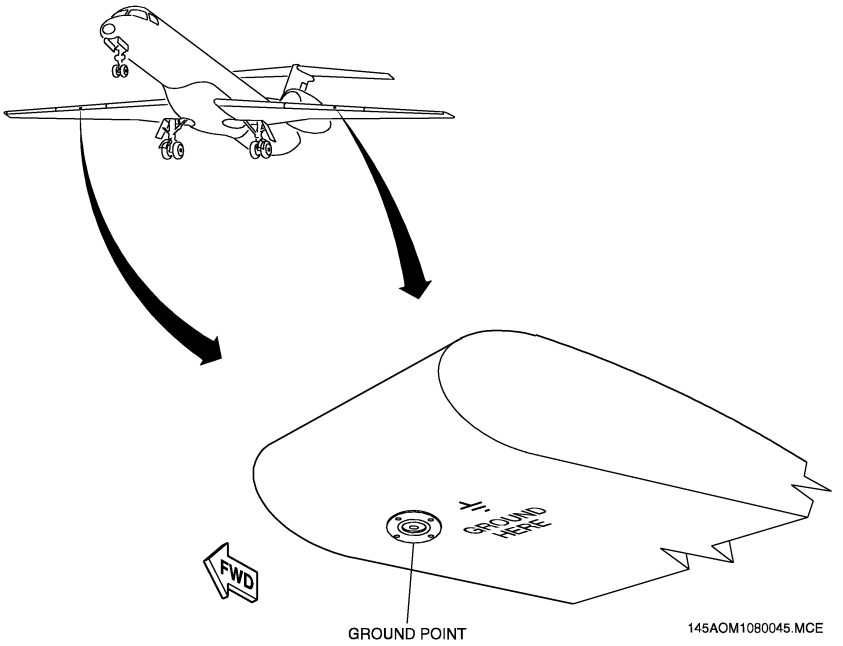


**FIGURE 29**

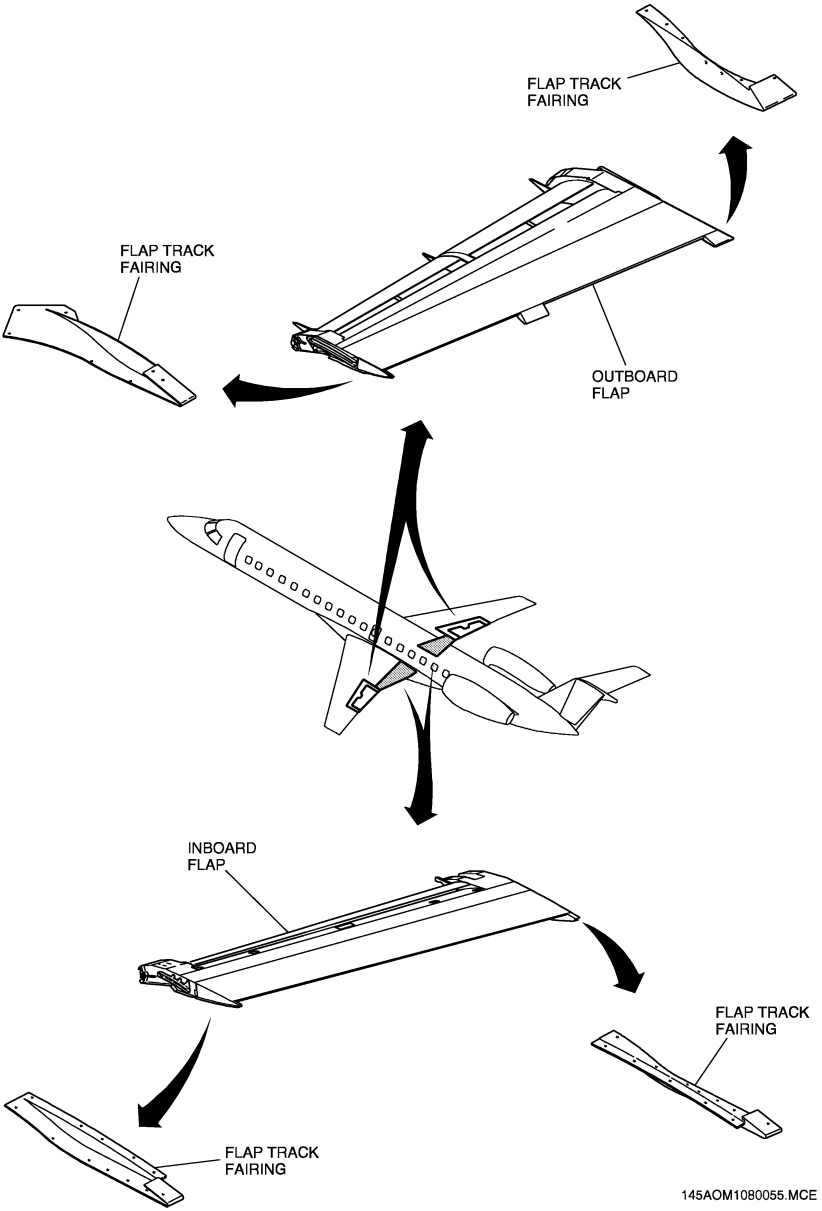


**FIGURE 30**

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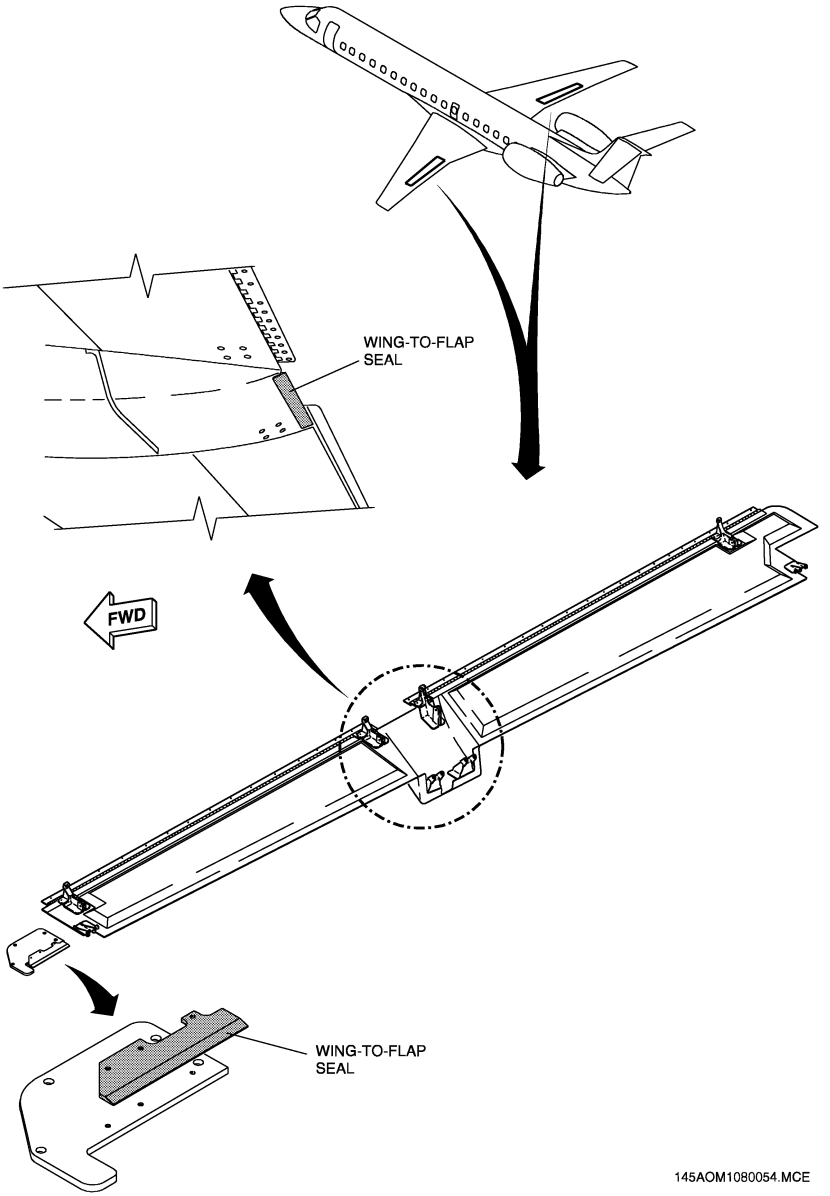


**FIGURE 31**

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# ATA CHAPTER 78 ENGINE EXHAUST

| System & Sequence ITEM Number 1. | 2. Number installed | 3. Number required for dispatch | 4. Remarks and/or exceptions |
|---|---|---|---|
| **78 ENGINE EXHAUST** | | | |
| 31-1 Plug Inhibition of the Thrust Reversers (Figure 32) | 4 | 0 | May be missing with no penalty |

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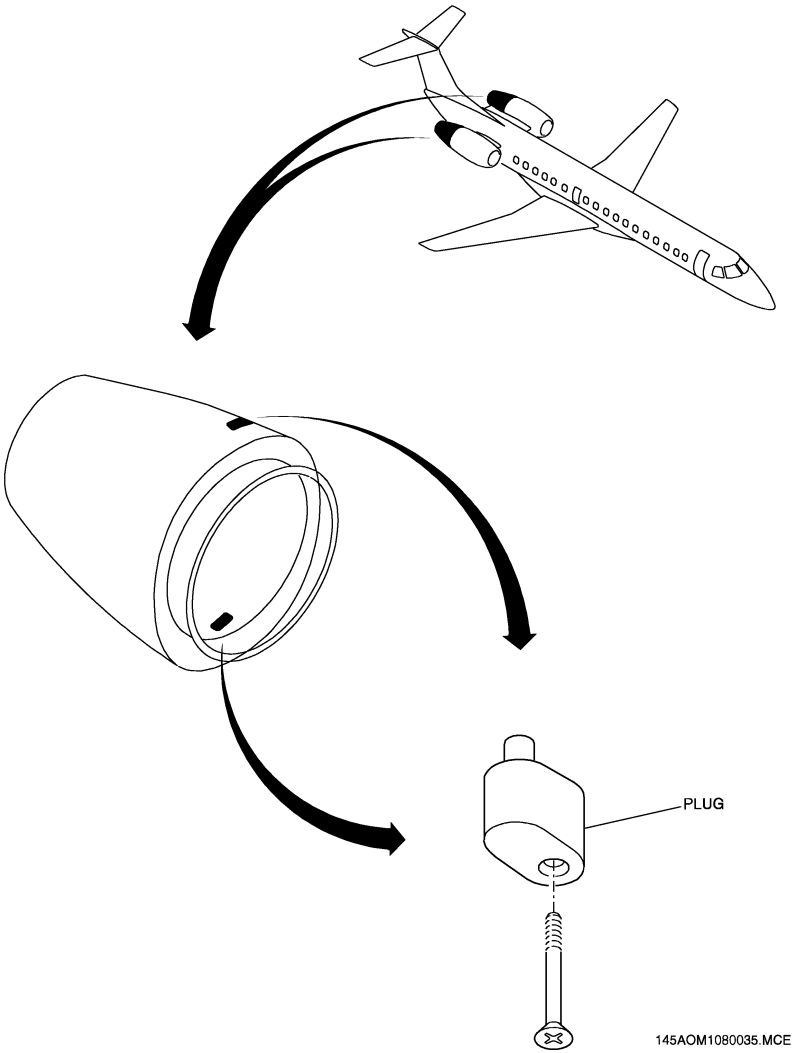


**FIGURE 32**

# SECTION 1-09

# DISPATCH DEVIATIONS PROCEDURES MANUAL

This section has been removed from your Airplane Operations Manual. For Dispach Deviations Procedures refer to the publication also named Dispatch Deviations Procedures Manual.

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# SECTION 1-10

# EMERGENCY INFORMATION

TABLE OF CONTENTS

Page Block

Emergency Equipment ..... 1-10-05
Emergency Equipment Layout (*) ..... 1-10-06
Passenger Oxygen Masks Location (*) ..... 1-10-08
Passenger Floatable Seat and Life Jacket ..... 1-10-10
Fire Extinguisher ..... 1-10-15
Emergency Locator Transmitter (ELT) ..... 1-10-20
Lighting ..... 1-10-25
Oxygen ..... 1-10-25
Navigation and Communication ..... 1-10-25
Least Risk Location (*) ..... 1-10-30
Emergency Exits ..... 1-10-35

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**NOTE:** Items marked with an asterisk (*) may not be present in this manual.

# INTRODUCTION

This Section presents emergency information which may be used, at operators discretion to develop customized emergency procedures. Such procedures may be associated to contingencies not related to the airplane.

Emergency equipment includes those items used during in-flight emergencies (such as first-aid kits and fire extinguishers), and to assist in the airplane evacuation (such as crash hatchet and escape ropes).

The information presented herein is focused on its technical aspects. Being so, it is not mandatory.

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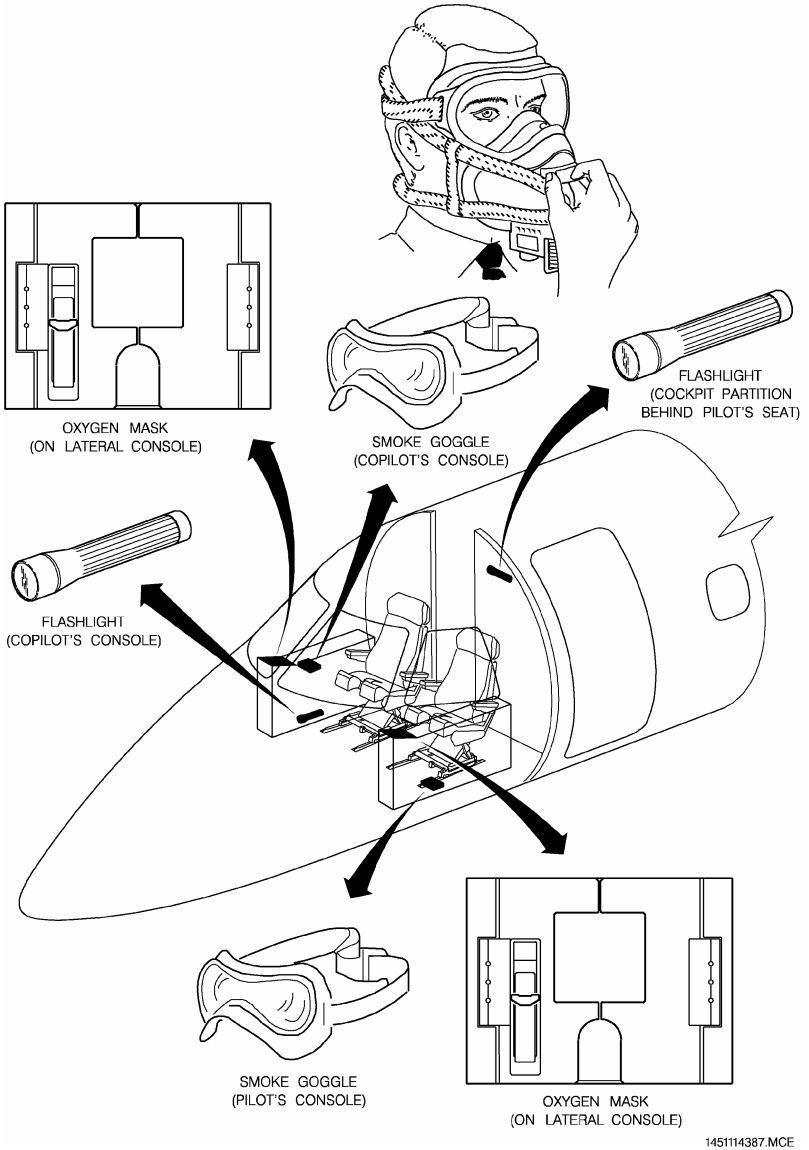
# EMERGENCY EQUIPMENT

## EMERGENCY EQUIPMENT LOCATION (TYPICAL)




**COCKPIT AREA (1 OF 3)**

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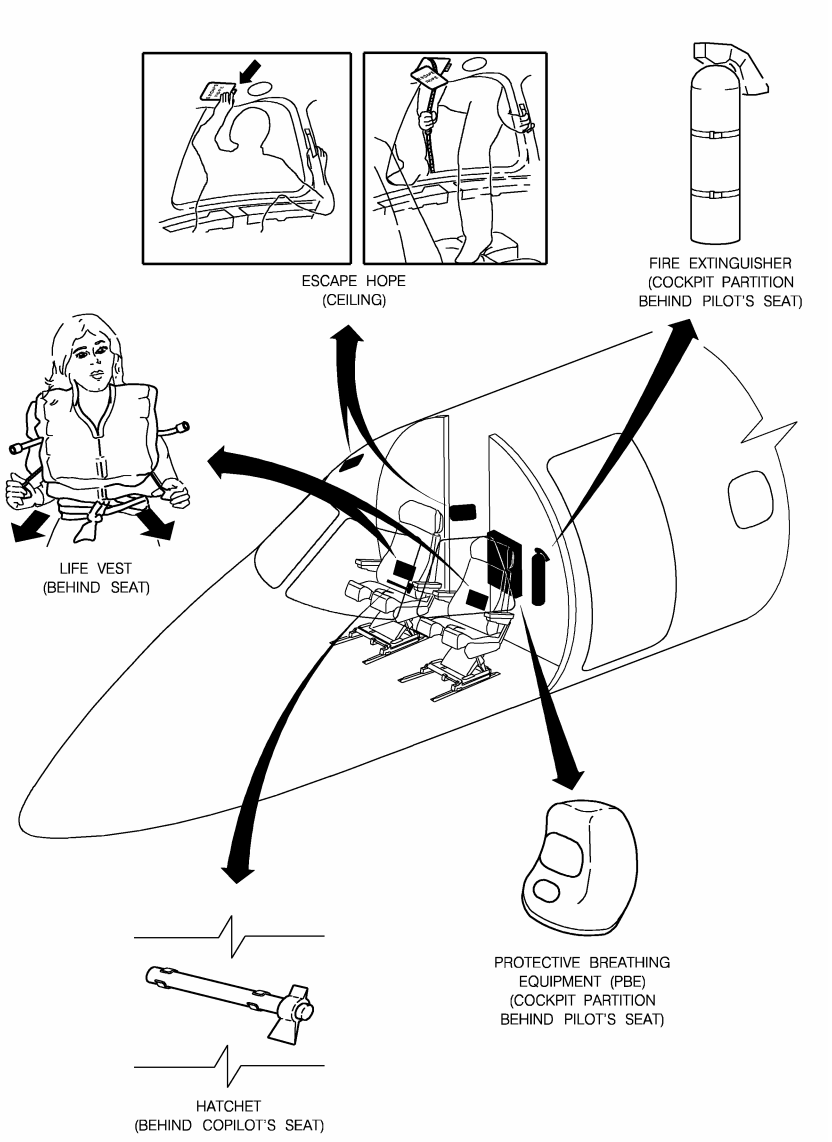


**COCKPIT AREA (2 OF 3)**

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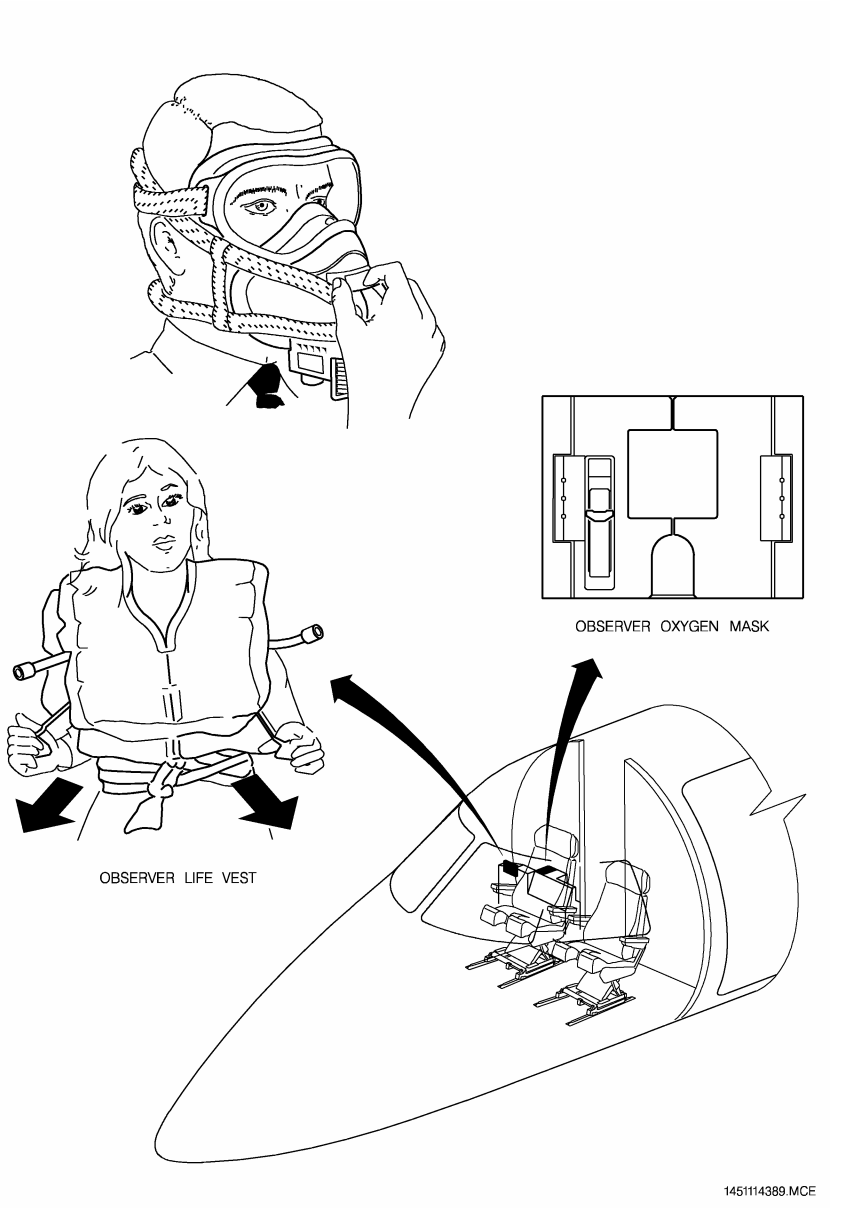


**COCKPIT AREA (3 OF 3)**

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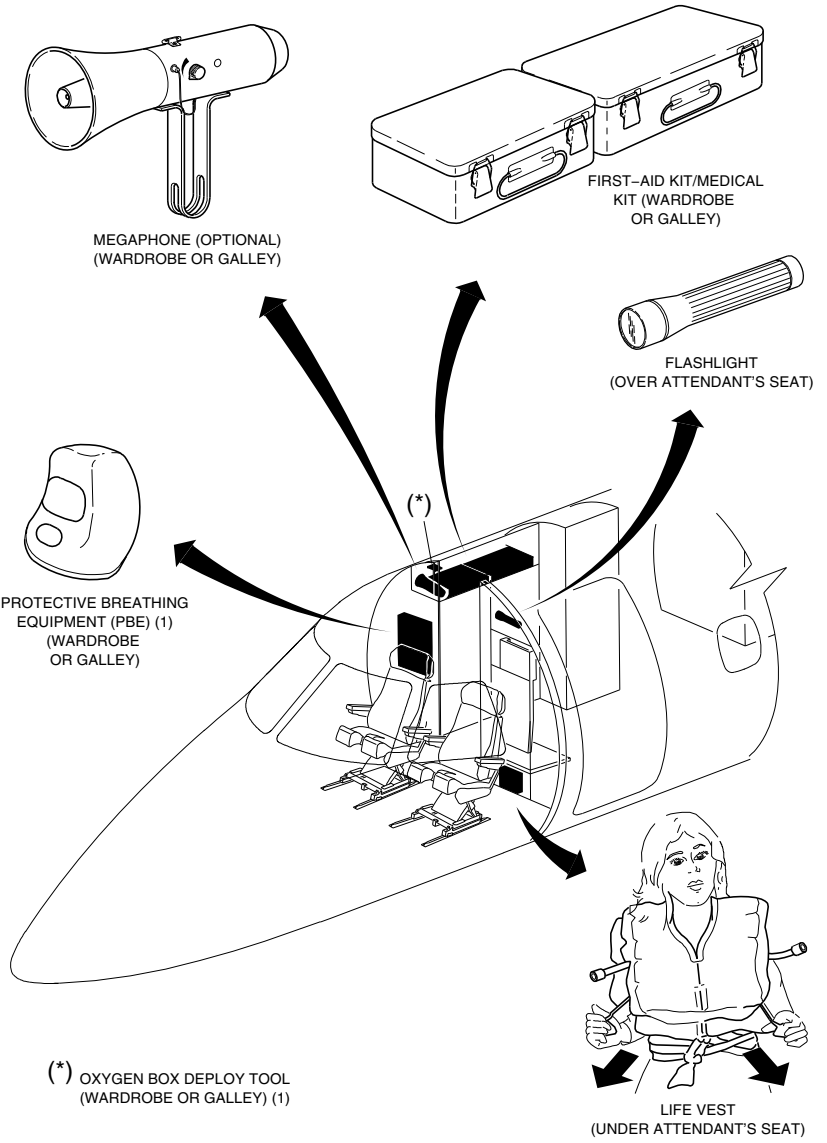


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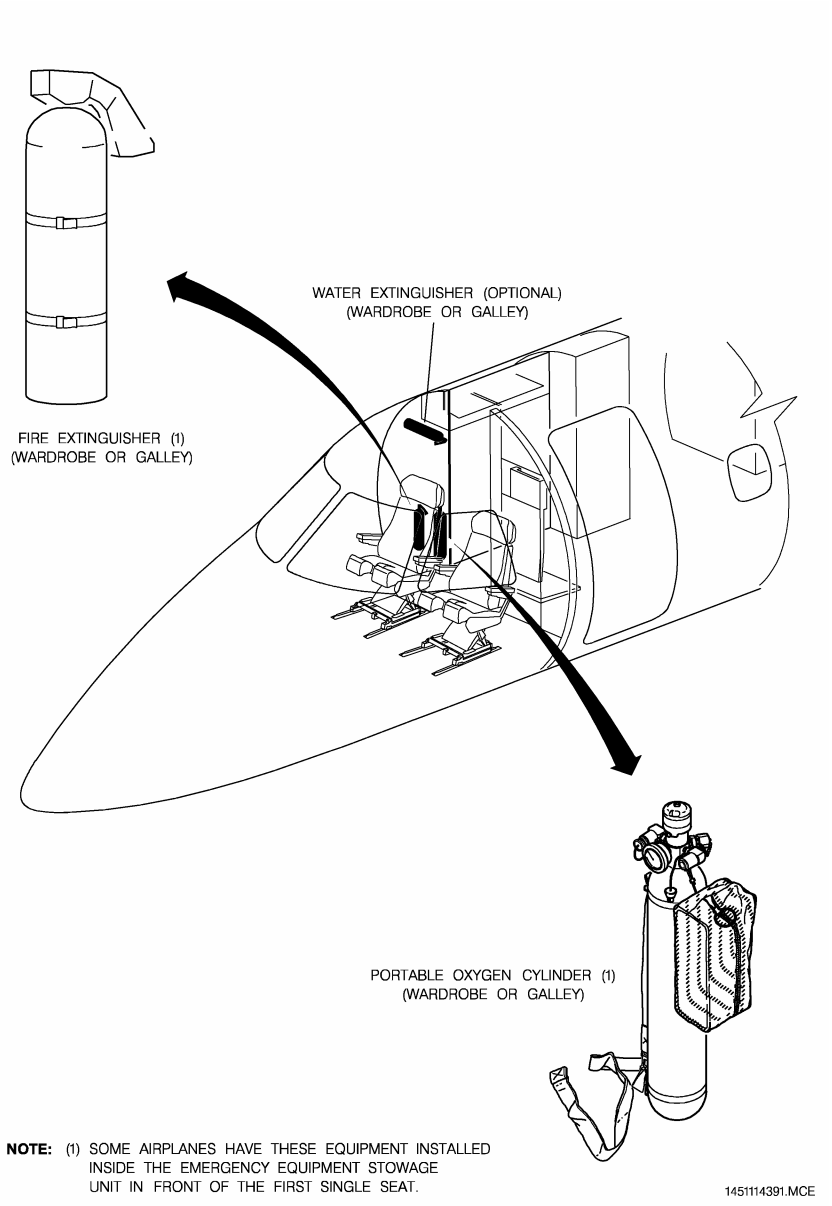
## FRONT PASSENGER AREA (1 OF 2)




## FRONT PASSENGER AREA (2 OF 2)

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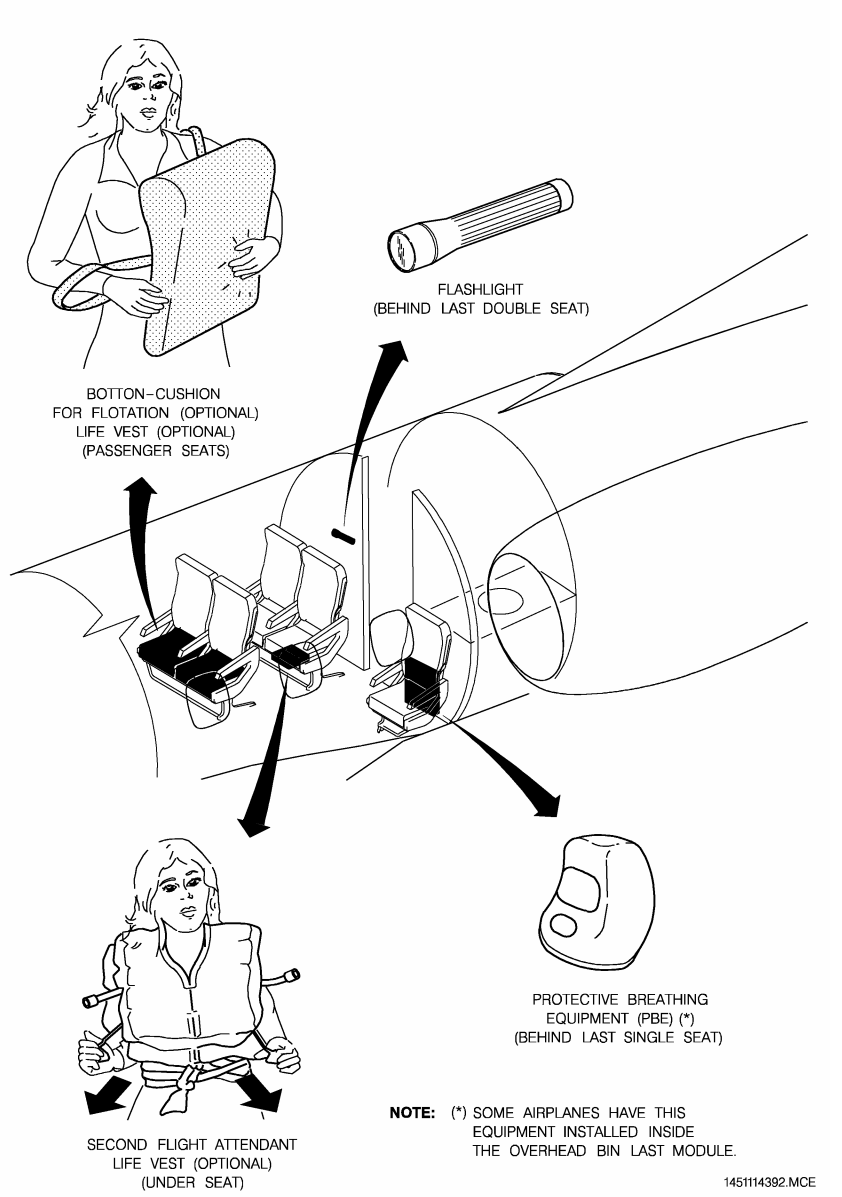


## REAR PASSENGER AREA (1 OF 2)

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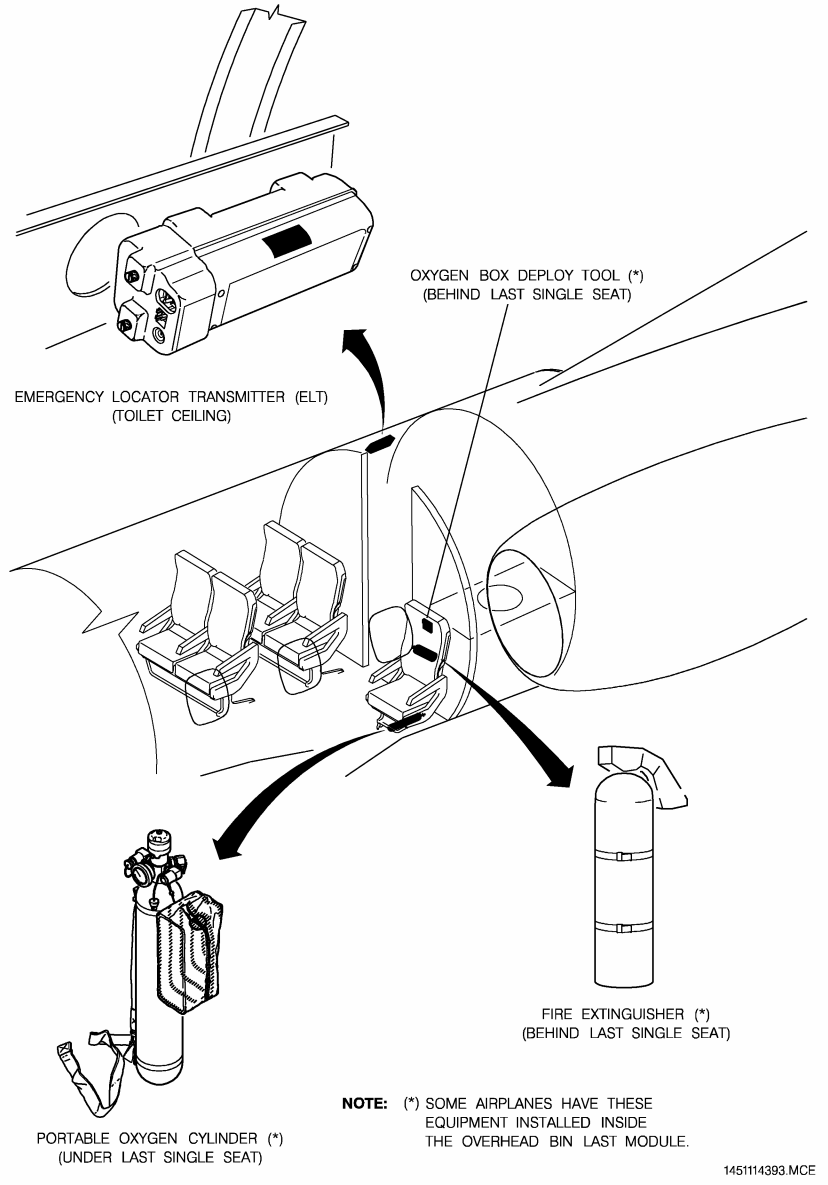


## REAR PASSENGER AREA (2 OF 2)

# EQUIPMENT CHECKLIST

## COCKPIT AREA

| | |
|---|---|
| Flashlight | CHECK RED LIGHT |
| Life Vest | ON BOARD |
| Hatchet | ON BOARD |
| Smoke Goggle | ON BOARD |
| Oxygen Mask | CHECK |
| Protective Breathing Equipment (PBE) | SEALED |
| Fire Extinguisher | CONDITION |

## FRONT PASSENGER CABIN AREA

| | |
|---|---|
| Flashlight | CHECK RED LIGHT |
| First-Aid Kit | CONDITION |
| Megaphone (optional) | ON BOARD |
| Water Extinguisher (optional) | CONDITION |
| Protective Breathing Equipment (PBE) | SEALED |
| Fire Extinguisher | CONDITION |
| Portable Oxygen Cylinder | CONDITION |
| Oxygen Box Deploy Tool | ON BOARD |
| Life Vest | ON BOARD |

## REAR PASSENGER CABIN AREA

| | |
|---|---|
| Flashlight | CHECK RED LIGHT |
| Life Vest (optional) | ON BOARD |
| Portable Oxygen Cylinder | CONDITION |
| Oxygen Box Deploy Tool | ON BOARD |
| Protective Breathing Equipment (PBE) | SEALED |
| Fire Extinguisher | CONDITION |

## LAVATORY

| | |
|---|---|
| Fire Extinguisher Bottle | CHECK GREEN RANGE |

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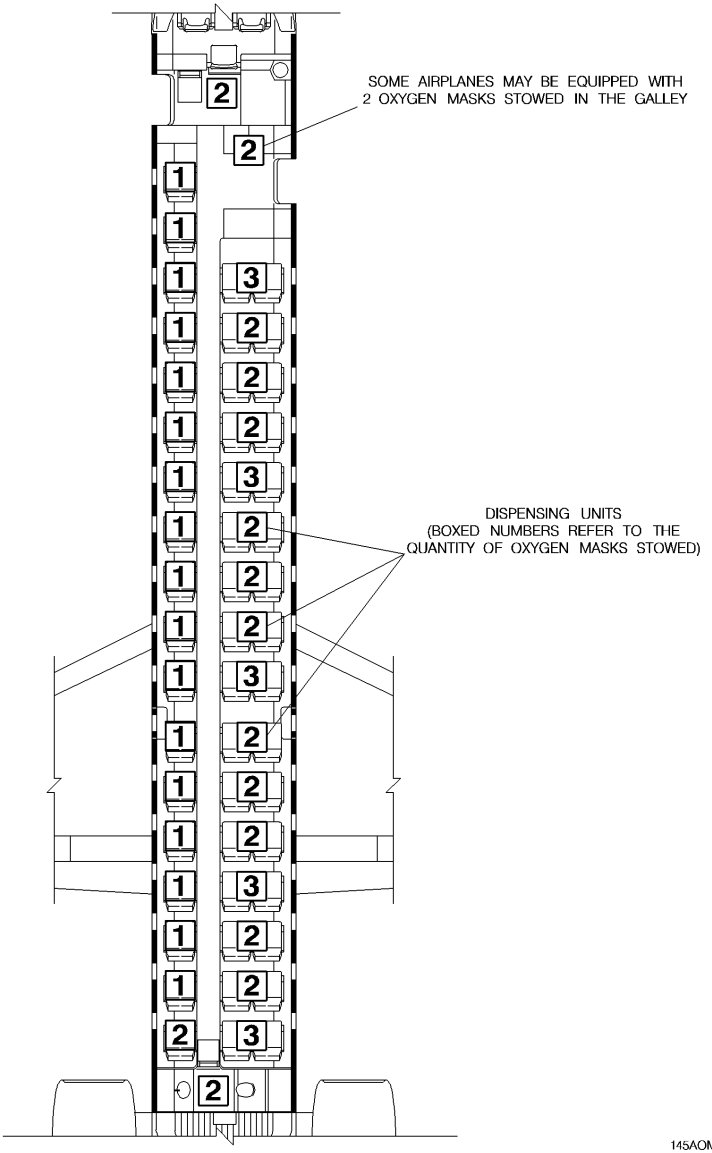
# EMB-145 PASSENGER OXYGEN MASKS LOCATION




## INTERIOR ARRANGEMENT OPTION 1 (50 SEATS)

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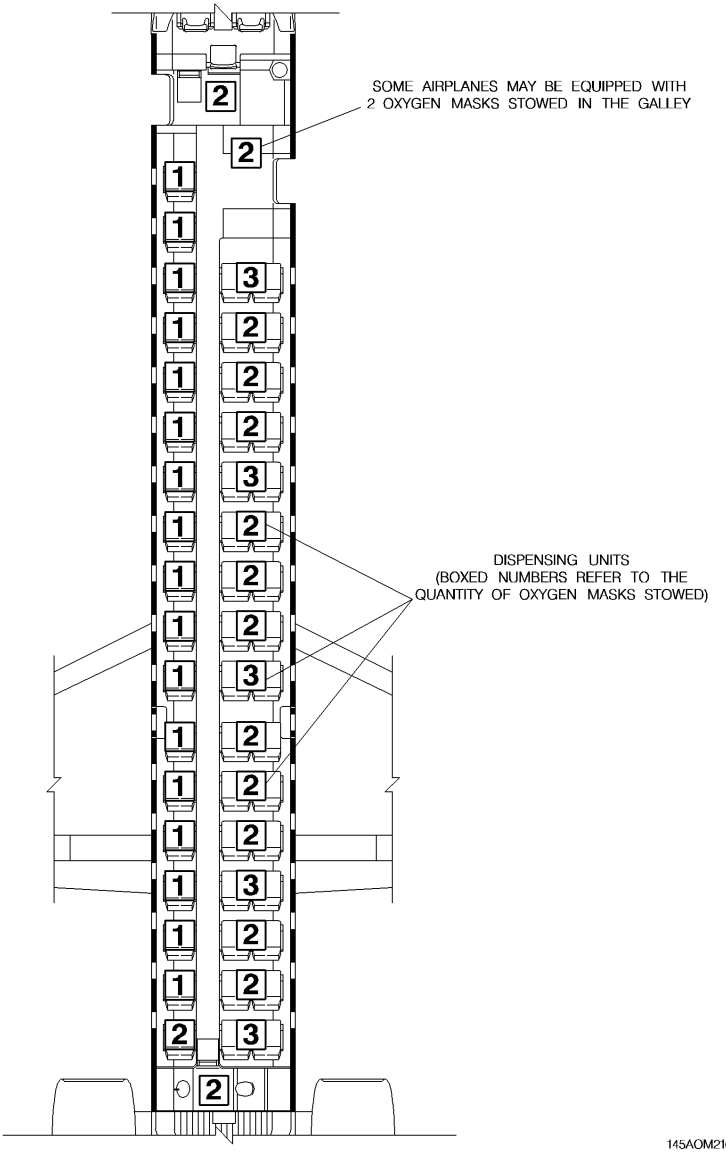
# EMB-145 PASSENGER OXYGEN MASKS LOCATION




## INTERIOR ARRANGEMENT OPTION 2 (50 SEATS)

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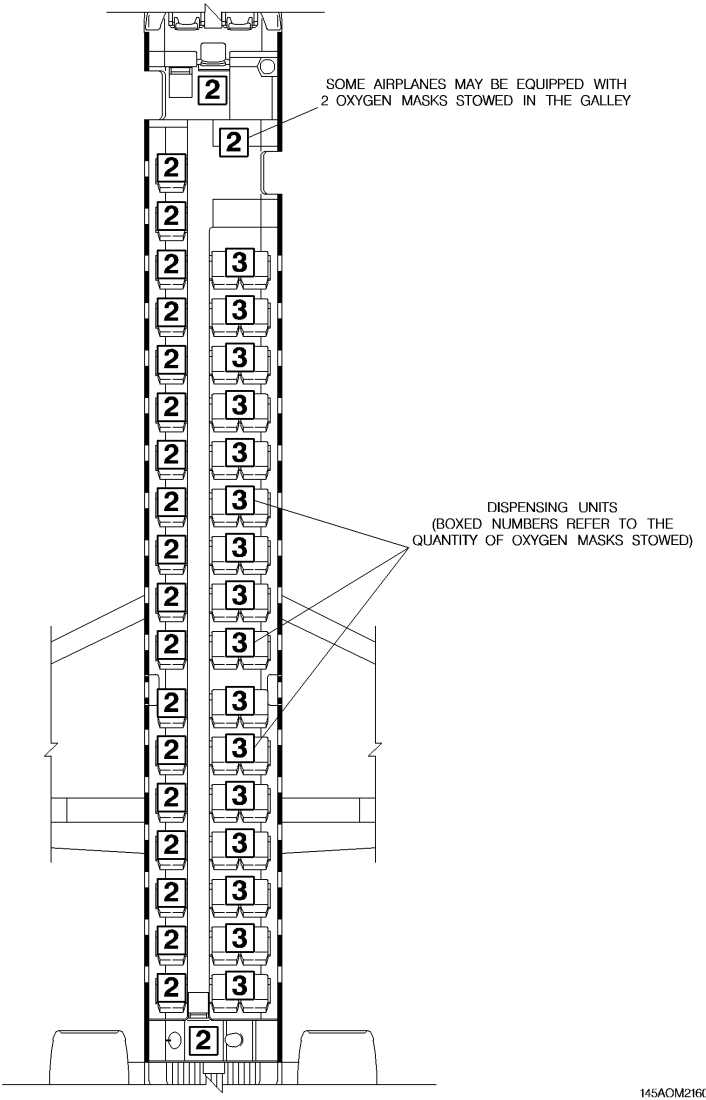


## INTERIOR ARRANGEMENT OPTION 3 (50 SEATS)

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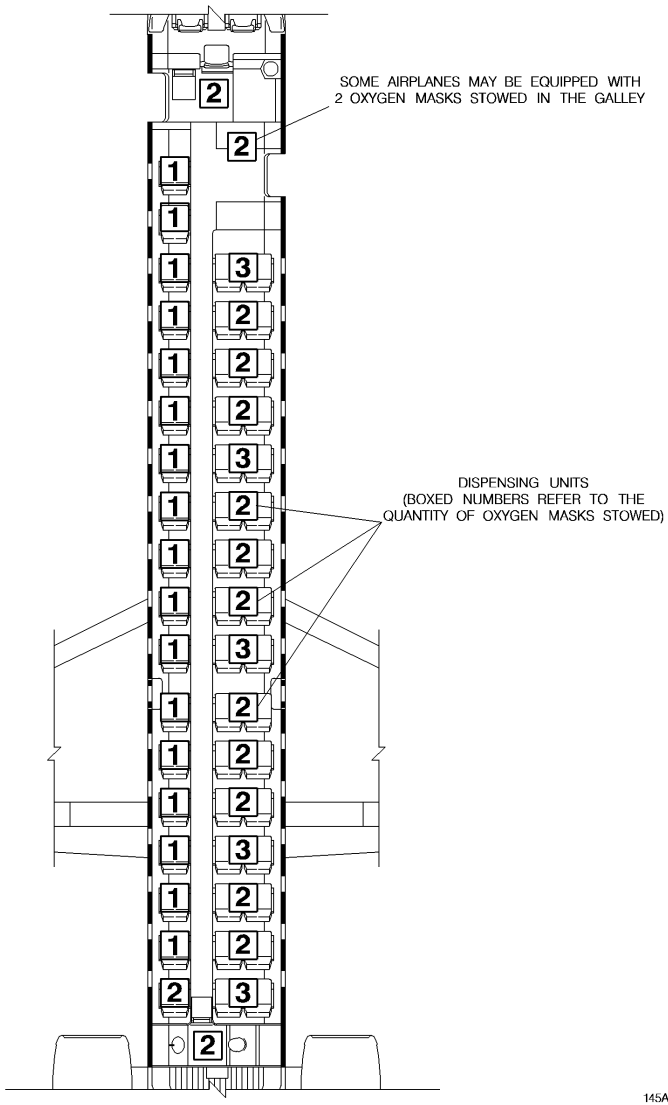
# EMB-145 PASSENGER OXYGEN MASKS LOCATION




## INTERIOR ARRANGEMENT OPTION 3 (50 SEATS)

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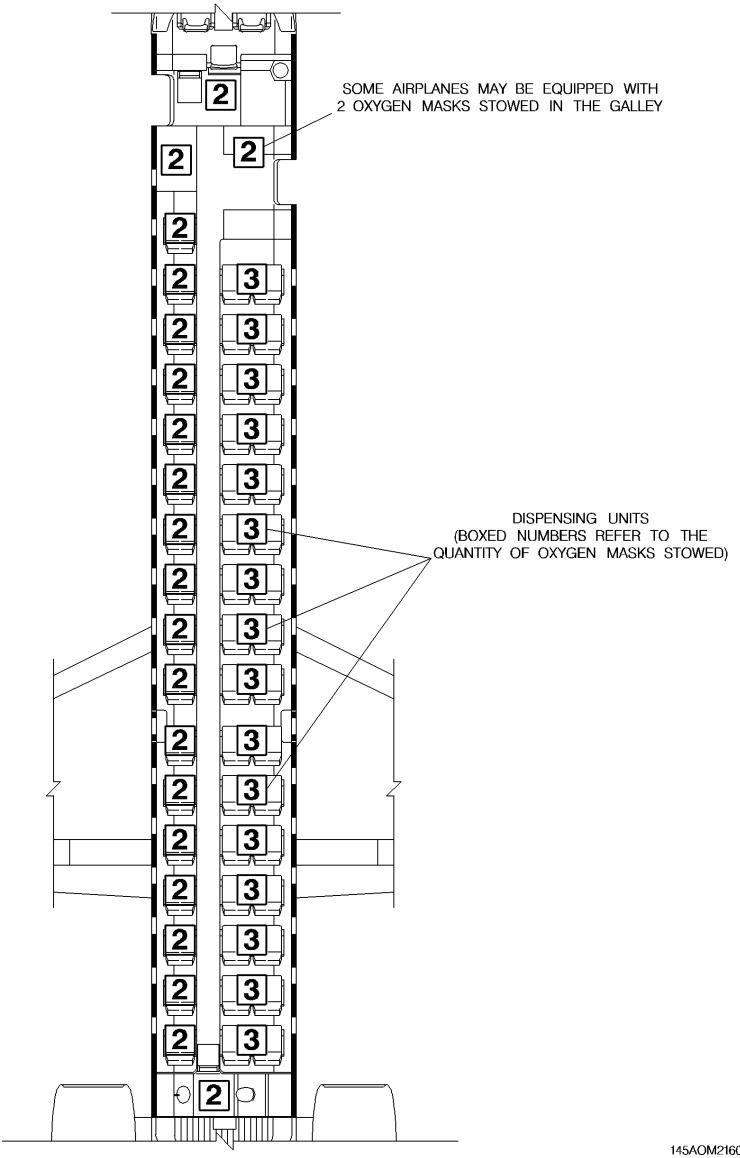


## INTERIOR ARRANGEMENT OPTION 4 (49 SEATS)

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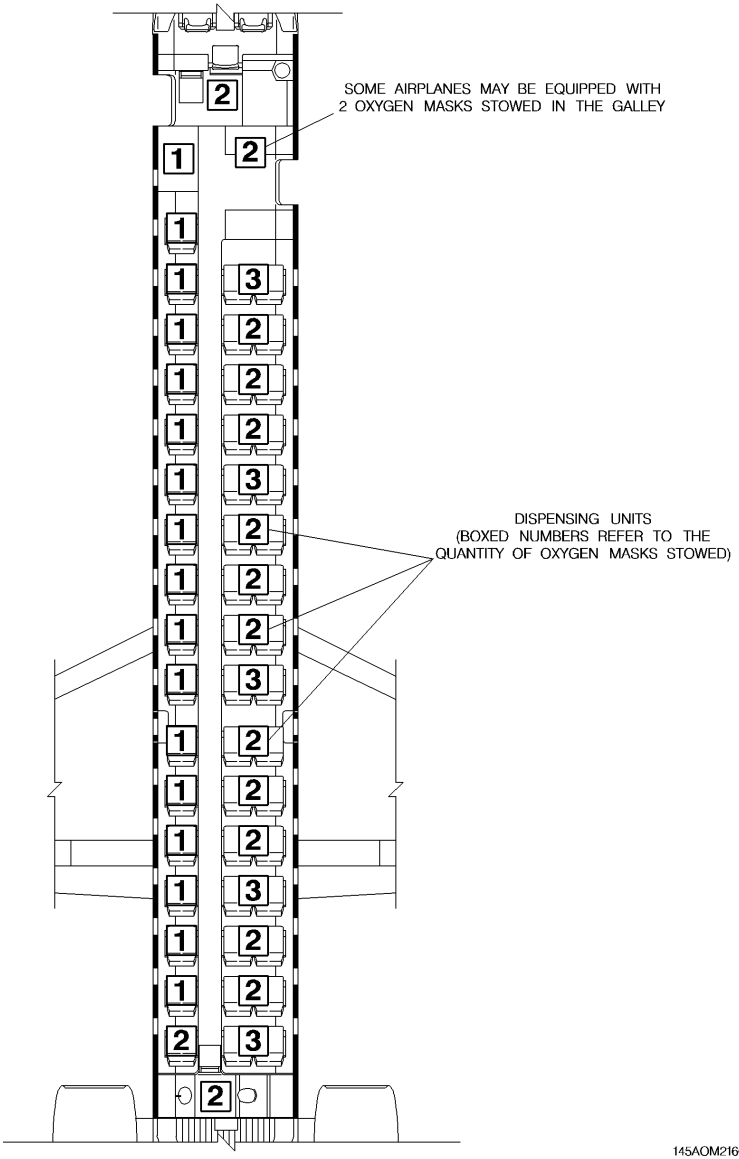


## INTERIOR ARRANGEMENT OPTION 4 (49 SEATS)

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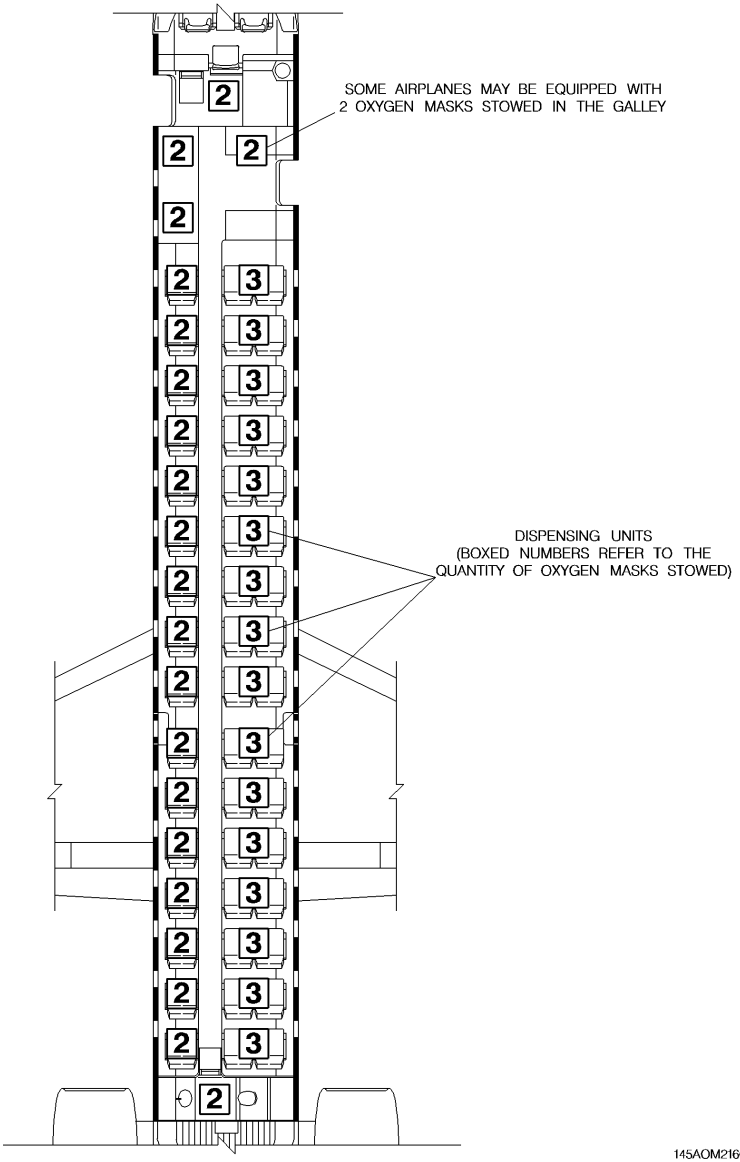


## INTERIOR ARRANGEMENT OPTION 5 (48 SEATS)

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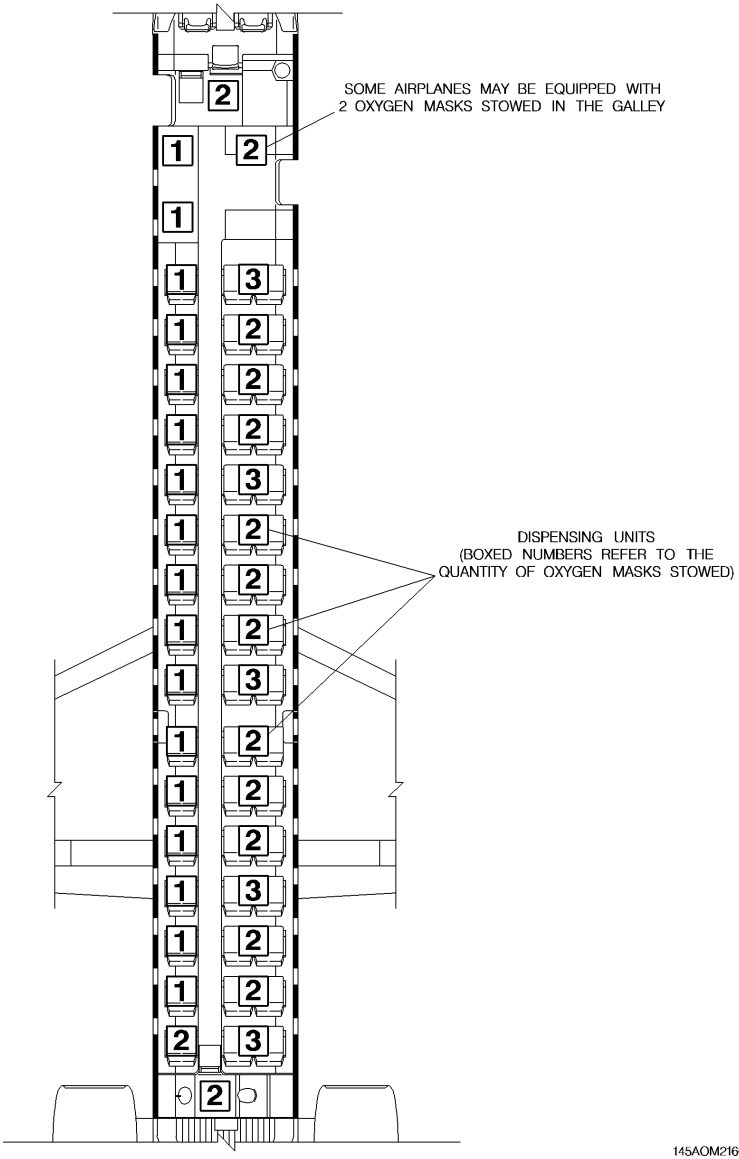
# EMB-145 PASSENGER OXYGEN MASKS LOCATION




## INTERIOR ARRANGEMENT OPTION 5 (48 SEATS)

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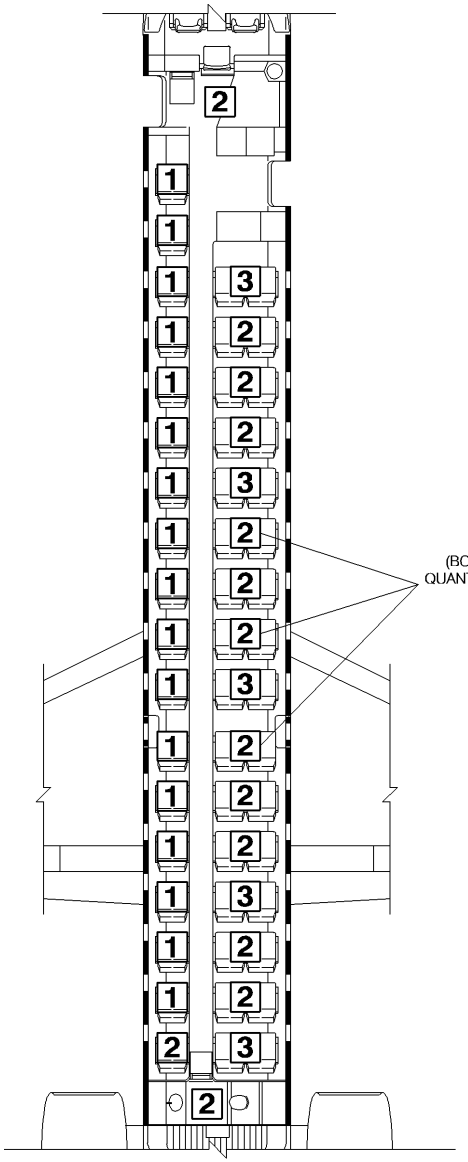
# EMB-145 PASSENGER OXYGEN MASKS LOCATION




## INTERIOR ARRANGEMENT OPTION 6 (50 SEATS)

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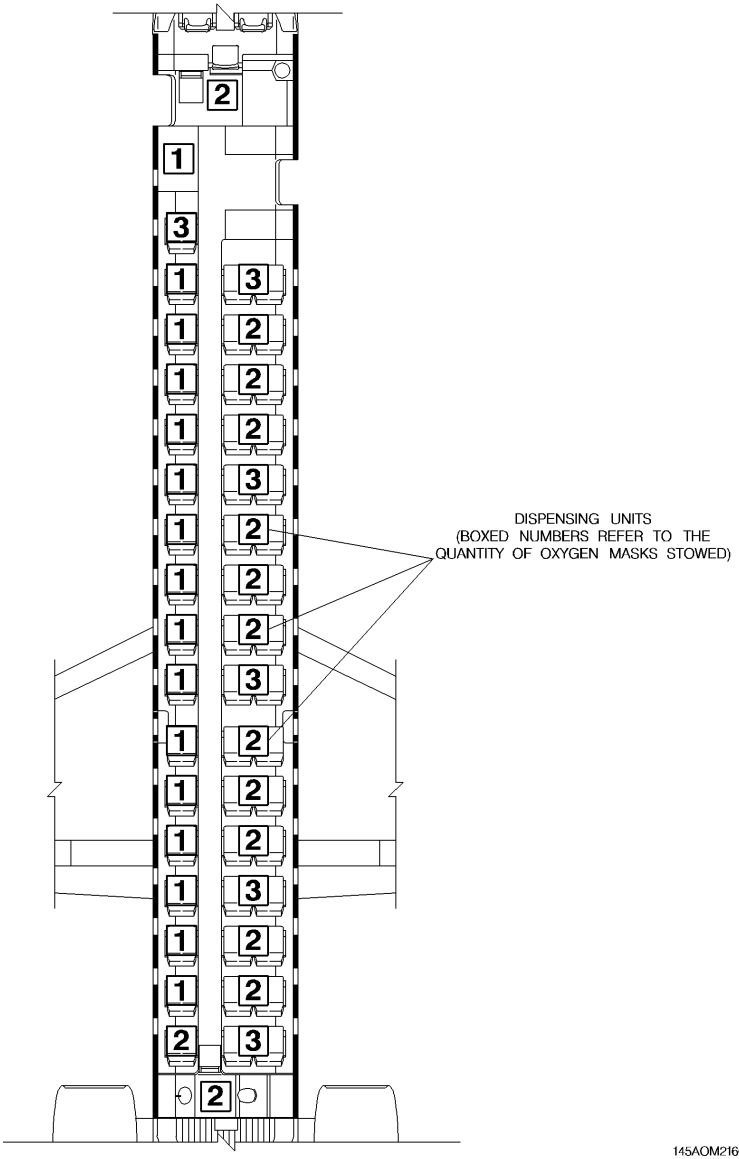
# EMB-145 PASSENGER OXYGEN MASKS LOCATION




## INTERIOR ARRANGEMENT OPTION 4 (49 SEATS)

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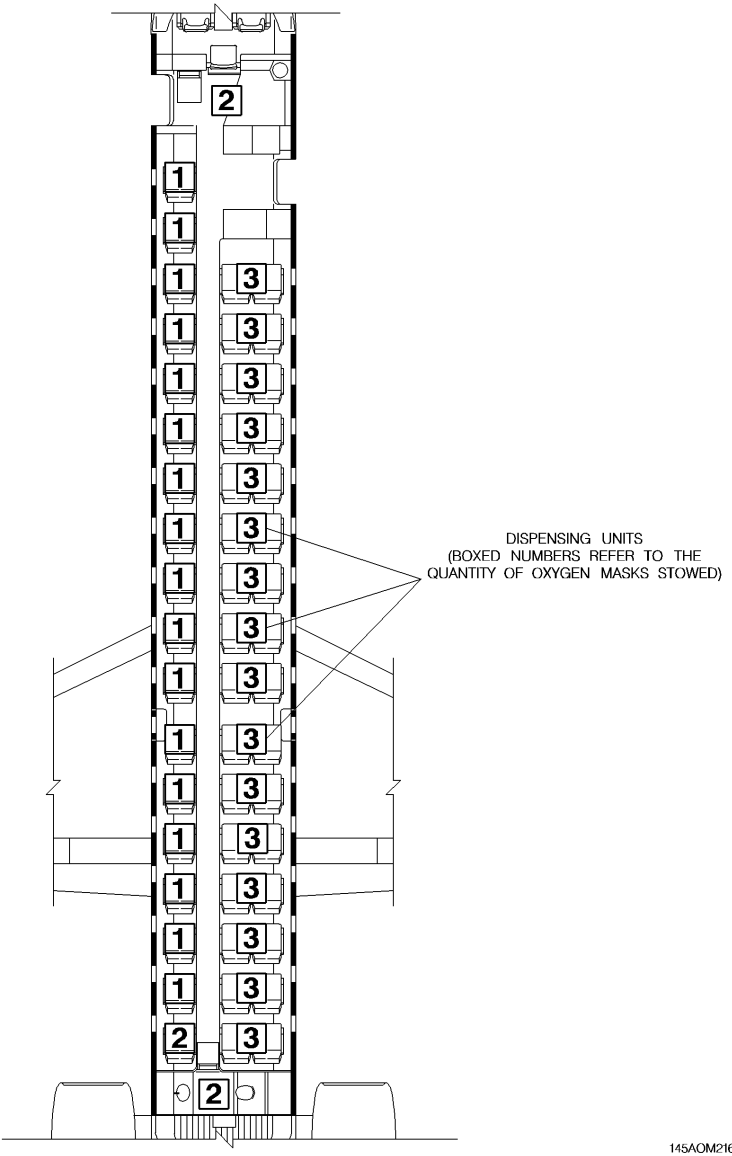
# EMB-145 PASSENGER OXYGEN MASKS LOCATION




**INTERIOR ARRANGEMENT OPTION 6 (50 SEATS)**

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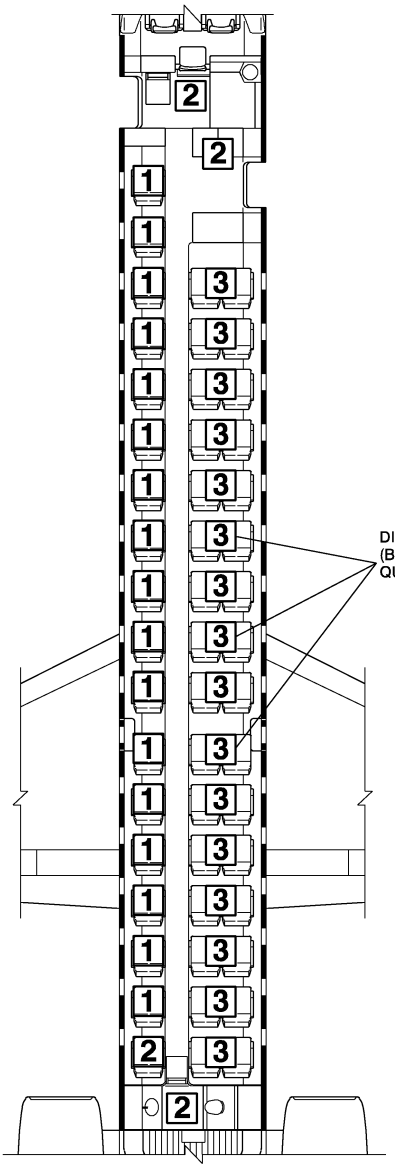


## INTERIOR ARRANGEMENT OPTION 1 (50 SEATS)

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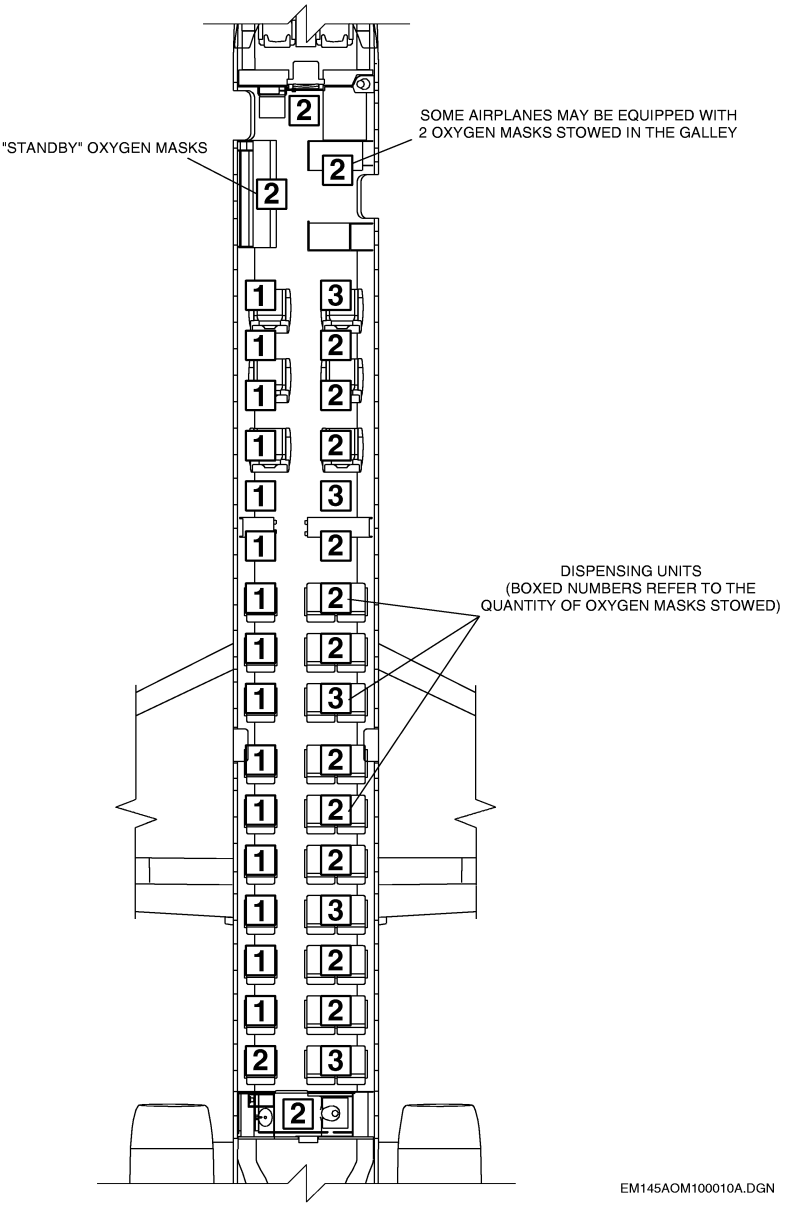


## INTERIOR ARRANGEMENT CONFIGURATION FAB VIP (36 SEATS)

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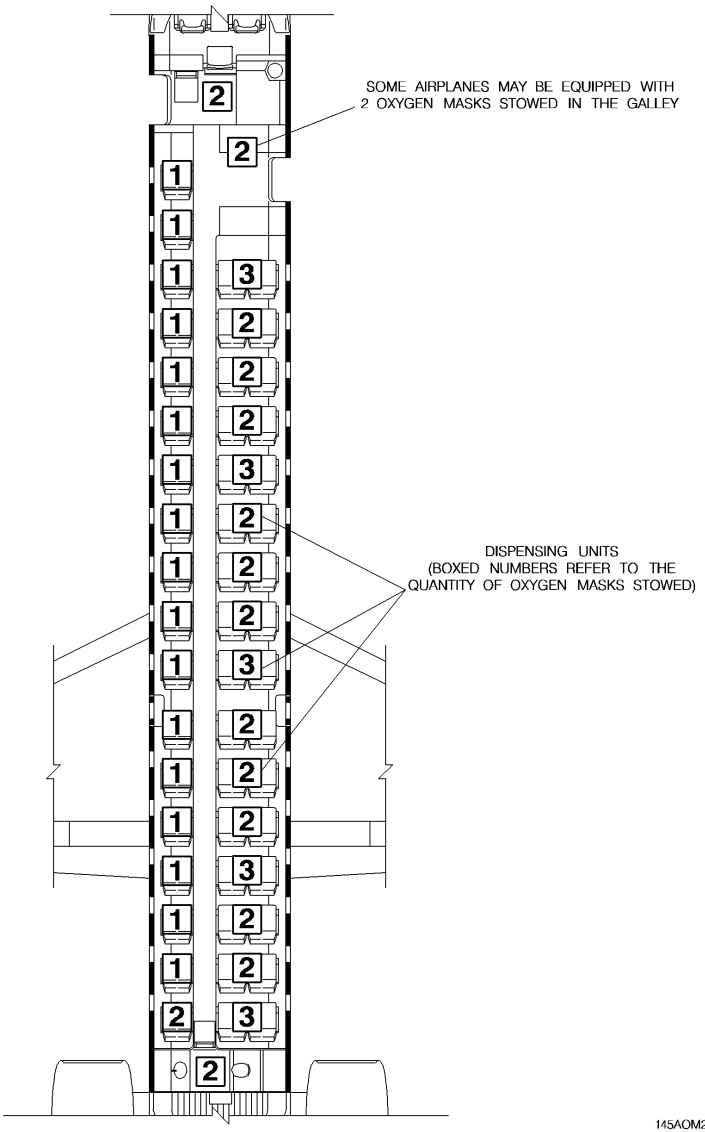


**INTERIOR ARRANGEMENT OPTION 6A (50 SEATS)**

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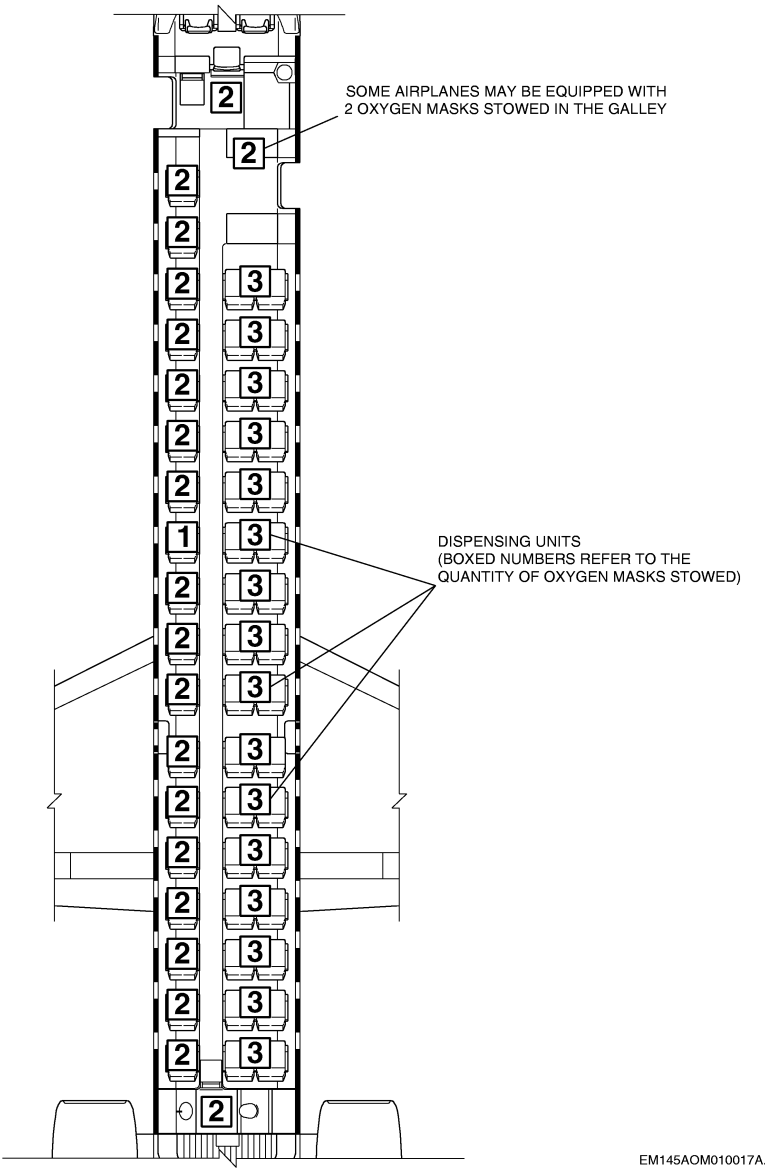


**INTERIOR ARRANGEMENT OPTION 3 (50 SEATS)**

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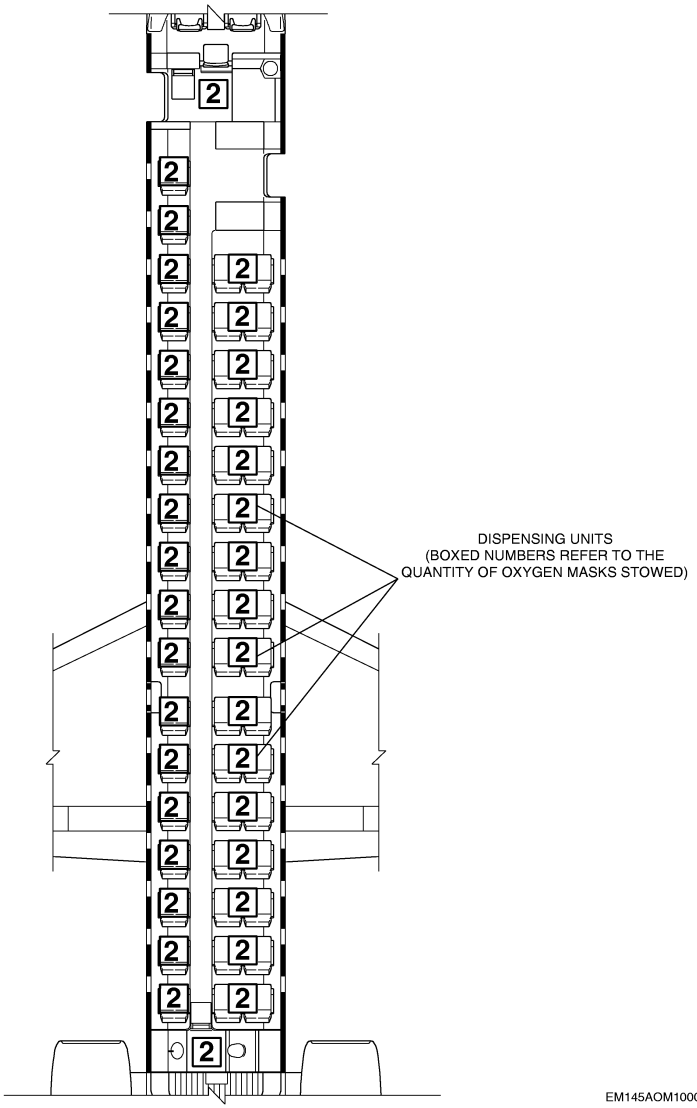
# EMB-145 PASSENGER OXYGEN MASKS LOCATION




## INTERIOR ARRANGEMENT OPTION 2A (50 SEATS)

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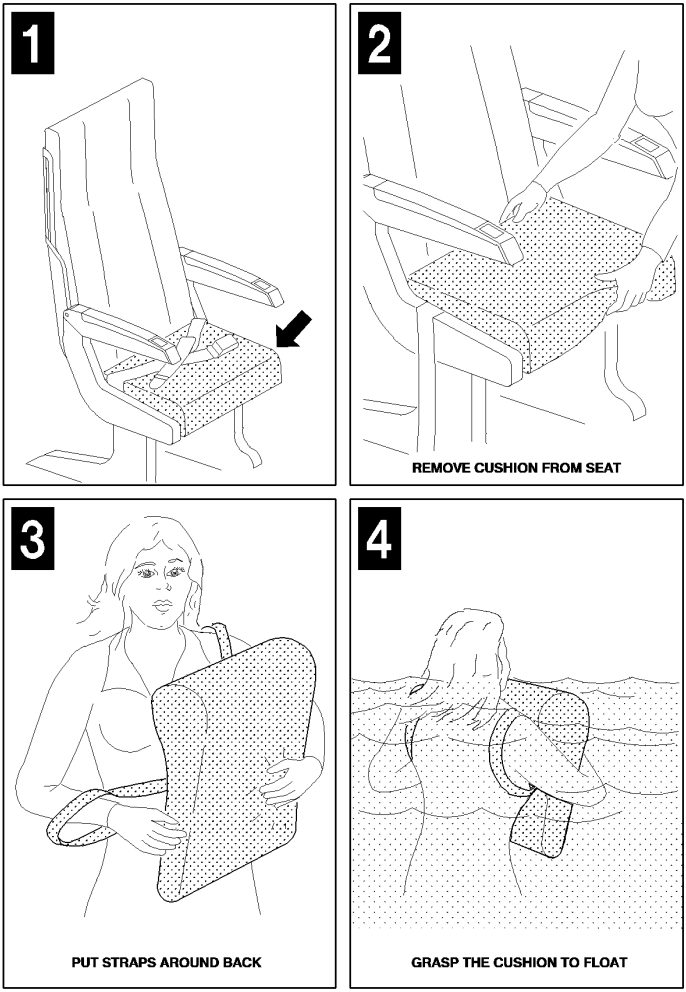
# PASSENGER FLOATABLE SEAT AND LIFE JACKET

## PASSENGER FLOATABLE SEAT OPERATION

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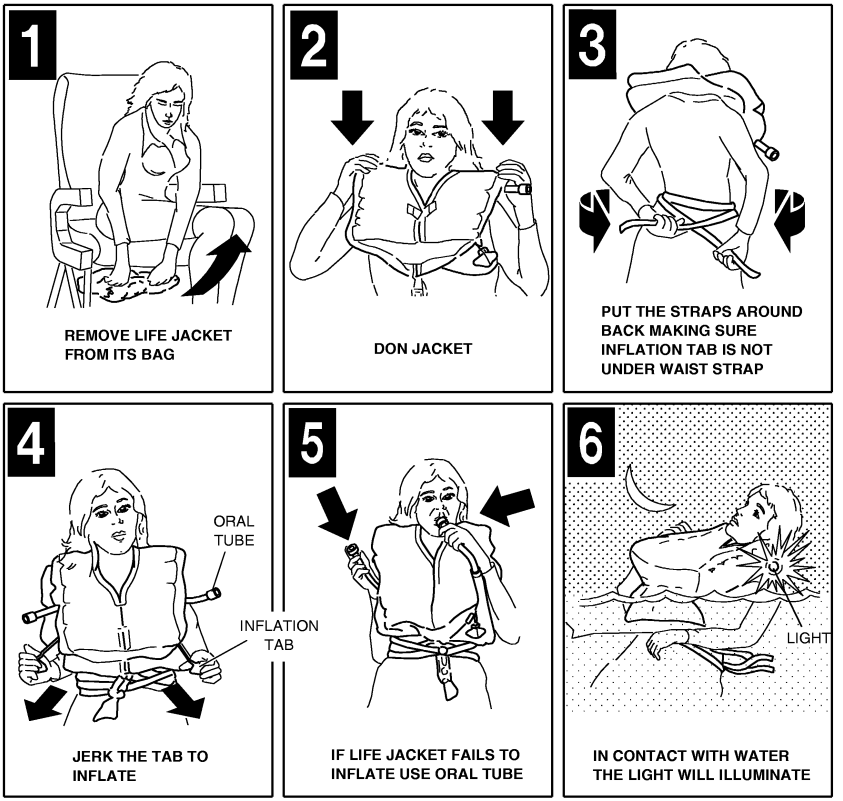
# LIFE JACKET OPERATION

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# FIRE EXTINGUISHER

## HALON FIRE EXTINGUISHER

The Halon fire extinguisher should be used on classes B (oils, greases, flammable liquids) and C (electrical or electronic equipment, live electrical) fire. It is also allowed to be used on class A (paper, wood, fabric, rubber) fires if the cabin configuration permits, according to the fire extinguisher cabin configuration table.

## WATER FIRE EXTINGUISHER

The water fire extinguisher is more effective than the Halon against class A (paper, wood, fabric, rubber) fire and should be used only on this class.

**CAUTION:** DO NOT USE ON ELECTRICAL OR GREASE TYPE FIRE.

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# FIRE EXTINGUISHER CABIN CONFIGURATION

| | QUANTITY | TYPE | WEIGHT | CLASS |
|---|---|---|---|---|
| **CONFIGURATION 1** | 2 | Halon 1211/1301 | 2.5 lb | B; C |
| | or | | | |
| | 2 | Halon 1211 | 2.5 lb | B; C |
| **CONFIGURATION 2** | 2 | Halon 1211/1301 | 2.5 lb | B; C |
| | and | | | |
| | 1 | water based | 3.5 lb | A |
| **CONFIGURATION 3** | 1 | Halon 1211/1301 | 2.5 lb | B; C |
| | and | | | |
| | 1 | Halon 1211 | 9.0 lb | A; B; C |
| **CONFIGURATION 4** | 2 | Halon 1211 | 3.3 lb | B; C |
| **CONFIGURATION 5** | 2 | Halon 1211 | 3.5 lb | A; B; C |
| **CONFIGURATION 6** | 1 | Halon 1211 | 2.5 lb | B; C |
| | and | | | |
| | 1 | Halon 1211 | 9.0 lb | A; B; C |

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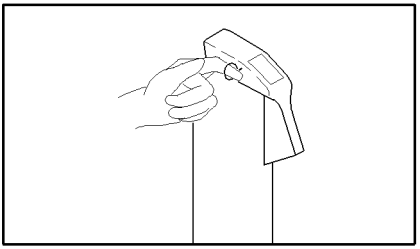
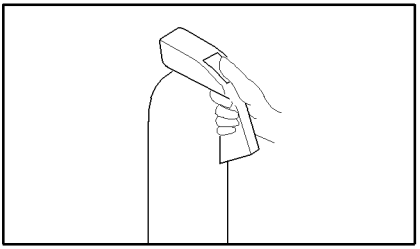
# FIRE EXTINGUISHER OPERATION

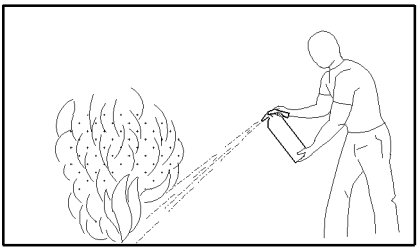


1. UNSNAP "QUICK RELEASE" MOUNTING STRAP AND REMOVE EXTINGUISHER.

2. HOLD UPRIGHT, PULL LOCKING PIN TO UNLOCK SPRAYING LEVER.



3. PRESS LEVER FOR DISCHARGE OPERATION



4. STAND APPROXIMATELLY 2 m (8 ft) AWAY FROM FIRE BEFORE DISCHARGING. AIM DISCHARGE NOZZLE AT FIRE BASE. SPRAY QUICKLY SIDE TO SIDE ACCROSS FIRE WIDTH. MOVE CLOSER AS FIRE IS BEING EXTINGUISHED. DIRECT ALL OF THE DISCHARGING AGENT ONTO THE FIRE AND MAKE SURE THE FIRE IS COMPLETELY EXTINGUISHED.

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Precautions after fire extinguishing:

- Look out for “flashback”;
- Ventilate the compartment as promptly as possible.

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# EMERGENCY LOCATOR TRANSMITTER (ELT)

## ELT 110-4 MODEL

The ELT 110-4 Model, when activated, transmits a radio signal on frequencies of 121.5 and 243.0 MHz, to facilitate airplane location during search and rescue operations.

The system comprises a transmitter with an ON/OFF switch and an impact switch installed in the lavatory right ceiling panel, an antenna located on the top rear and a remote panel located on the cockpit.

ELT may be manually or automatically activated. In both cases a red light flashes on the cockpit panel to indicate the ELT activation.

Manual activation may be performed when any switch is set to ON position.

Automatic activation occurs when the transmitter switch is set to OFF position, the cockpit switch is set to ARM position and the airplane suffers a deceleration greater than 5 g's.

In both cases (manual and automatic activation) the pilot may deactivate the ELT, performing the TEST/RESET function.

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## CONTROLS AND INDICATORS

## REMOTE PANEL

### 1 - ELT ALERT LIGHT (red)

– Flashes when the ELT is transmitting.

### 2 - ELT SWITCH (guarded)

ON - Activates the ELT.

ARM - Allows the ELT to be automatically activated.

**NOTE: -** The TEST/RESET function is provided by pressing ON, waiting 1 second and then pressing ARM.

**-** RESET function allows ELT deactivating, after a manual or automatic activation.

**-** During TEST/RESET function, the ELT alert light flashes to indicate that the system is transmitting.

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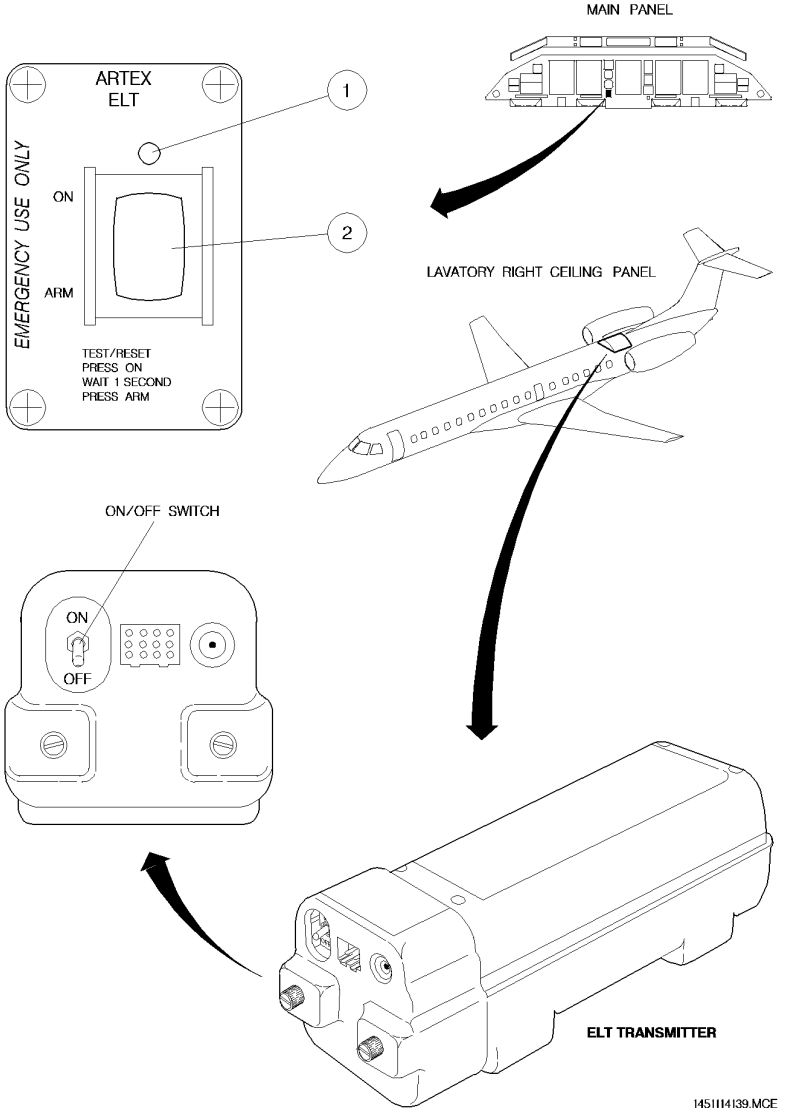


## ELT 110-4 MODEL

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# EMERGENCY LOCATOR TRANSMITTER (ELT)

## ELT 96 MODEL (OR ELT 97 MODEL)

The ELT 96 Model (or ELT 97 Model), when activated, transmits a radio signal on frequencies of 121.5 MHz, 243.0 MHz and 406.0 MHz, to facilitate airplane location during search and rescue operations.

The system comprises a transmitter, which also can be used in a portable mode, and an impact switch installed in the lavatory right ceiling panel, an antenna located on the top rear and a remote panel located on the cockpit.

ELT may be manually or automatically activated. In both cases a red light flashes on the cockpit panel to indicate the ELT activation, provided the portable mode is not removed for ground operation.

Manual activation may be performed either through the ELT front panel switch or remote switch in cockpit, in both cases setting the switch to MAN position.

Automatic activation occurs when the ELT switch and the remote control switch are set to AUTO position and airplane suffers a deceleration as a function of acceleration/time conditions.

In both cases (manual and automatic activation) the pilot may deactivate the ELT, performing the AUTO TEST/RESET function.

### PORTABLE MODE OPERATION

To operate the ELT 96 or the ELT 97 in portable mode, perform the following procedures:

- Release the quick-opening fireproof fasteners to remove the ELT from its compartment.
- Disconnect the fixed antenna coaxial plug from the ANT connector.
- Release the auxiliary antenna from its attaching clips and connect it to the ANT connector.
- Set the switch to MAN/RESET position.
- Hold or install the ELT vertically, preferably in a cleared area and as high as possible.

**NOTE:** When using in temperatures below freezing, keep ELT inside your jacket with antenna outside for longest operations life.

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## CONTROLS AND INDICATORS

## REMOTE PANEL

### 1 - ELT ALERT light (red)

– Flashes when the ELT is transmitting.

### 2 - ELT SWITCH

MAN - Activates the ELT.
AUTO - Allows the ELT to be automatically activated.

### 3 - AUTO TEST/RESET button

– When pressed allows the ELT to be checked.

**NOTE:** The ELT test must be performed only pressing the AUTO TEST/RESET Button.

– During AUTO TEST/RESET function, the ELT alert light illuminates during 2 seconds.
– If a failure is detected during the test, the ELT alert light flashes. For confirmation repeat the operation. If the failure persists set the ELT Switch on transmitter panel to OFF position and report to the maintenance personnel.
– Reset function allows deactivating the ELT, after a manual or automatic activation.

## TRANSMITTER PANEL

### 1 - ELT ALERT LIGHT (red)

– Flashes when the ELT is transmitting.

### 2 - ELT SWITCH

MAN/RESET - Activates the ELT. Reset function allows deactivating the ELT after a automatic activation.
AUTO - Enables the remote control to automatic operation.
OFF - Deactivates de ELT.

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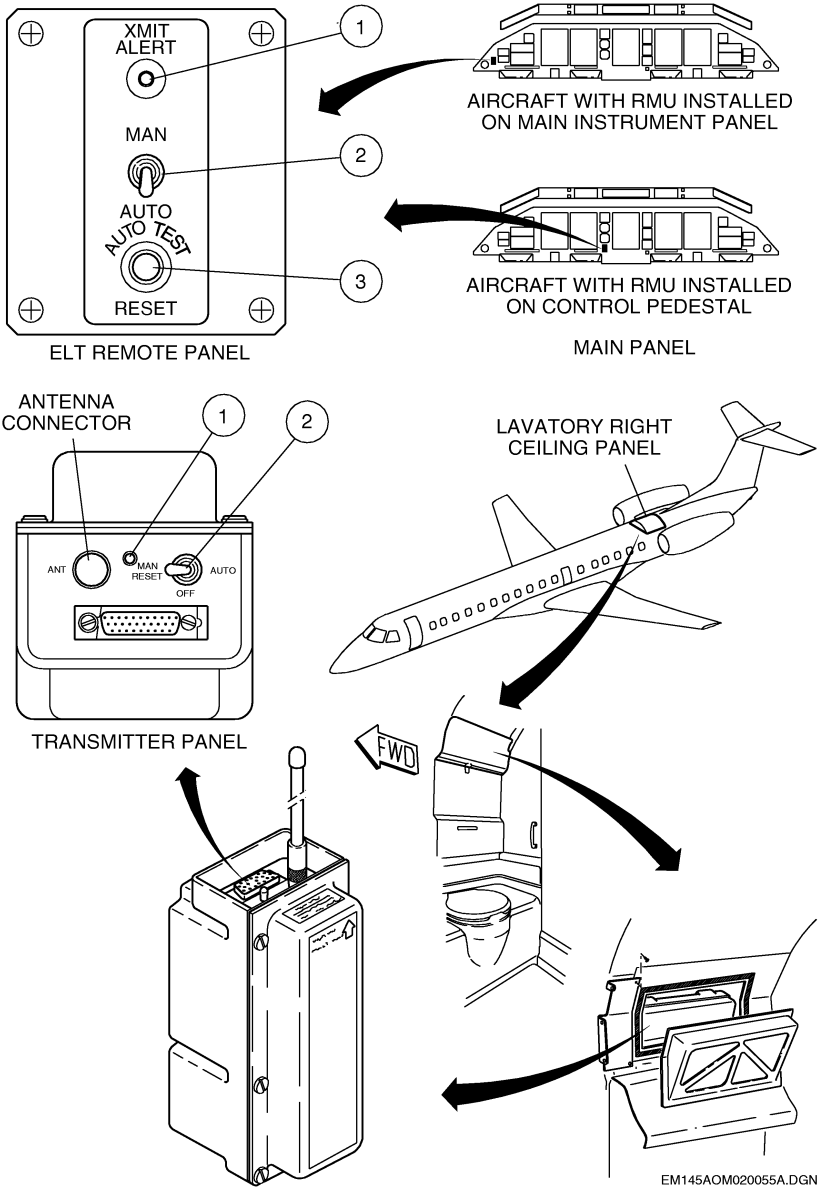


## ELT 96 AND 97 MODELS

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# EMERGENCY LOCATOR TRANSMITTER (ELT)

## ELT C406-2 MODEL

The ELT C406-2 Model, when activated, transmits a radio signal on frequencies of 121.5 and 243.0 MHz, and every 50 seconds, for 520 milliseconds (long message protocol), the transmitter turns on, using the 406.025 MHz frequency, to facilitate airplane location during search and rescue operations.

During 406.025 MHz time an encoded digital message is sent to the satellite. The information contained in that message is shown below:

- Serial number of the transmitter or aircraft ID;
- Country code;
- ID code;
- Position coordinates (when connected to an ARTEX ELT/NAV interface unit).

The system comprises a transmitter with an ON/OFF switch and an impact switch installed in the lavatory right ceiling panel, an antenna located on the top rear and a remote panel located on the cockpit.

ELT may be manually or automatically activated. In both cases a red light flashes on the cockpit panel to indicate the ELT activation.

Manual activation is performed by setting the ON/OFF switch to the ON position.

Automatic activation occurs when the transmitter switch is set to OFF position, the cockpit switch is set to ARM position and the airplane suffers a deceleration greater than 5 g's.

In both cases (manual and automatic activation) the pilot may deactivate the ELT by performing the TEST/RESET function.

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## CONTROLS AND INDICATORS

## REMOTE PANEL

### 1 - ELT ALERT LIGHT (RED)

– Flashes when the ELT is transmitting.

### 2 - ELT SWITCH (GUARDED)

ON - Activates the ELT.
ARM - Allows the ELT to be automatically activated.

**NOTE: -** The TEST/RESET function is provided by pressing ON, waiting 1 second and then pressing ARM.
- RESET function allows ELT deactivating, after a manual or automatic activation.
- During TEST/RESET function, the ELT alert light flashes to indicate that the system is transmitting.

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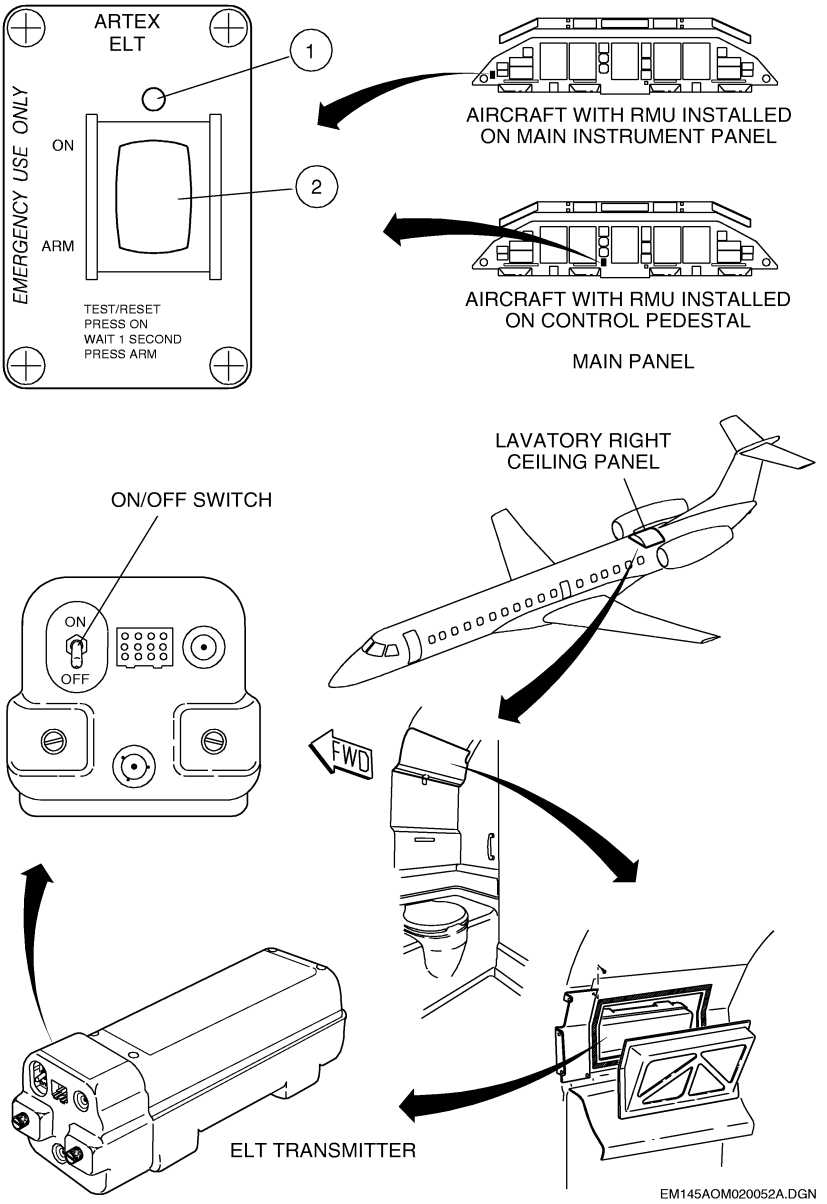


**ELT C406-2 MODEL**

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# LIGHTING

Refer to AOM - VOLUME 2 - Section 2-6 - LIGHTING.

# OXYGEN

Refer to AOM - VOLUME 2 - Section 2-16 - OXYGEN.

# NAVIGATION AND COMMUNICATION

Refer to AOM - VOLUME 2 - Section 2-18 - NAVIGATION AND COMMUNICATION.

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# LEAST RISK LOCATION

The place inside airplane cabin where structural or system damages are the least likely to jeopardize flight safety is the third overhead bin from front of the cabin. A noteworthy system located near this point is the chemical oxygen generator.

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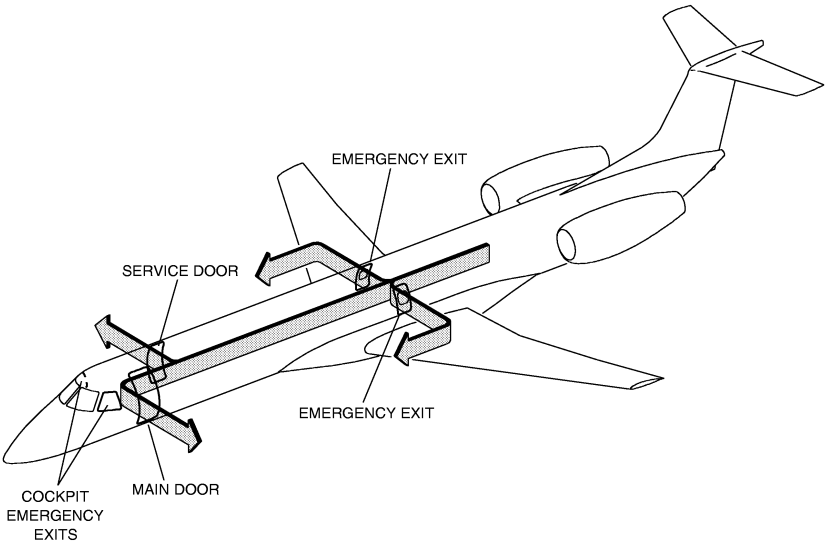
# EMERGENCY EXITS

There are two forward doors (main and service), two overwing exits and two cockpit windows, one each side, that can be used for emergency evacuation.




**DOORS AND EXITS LOCATION**

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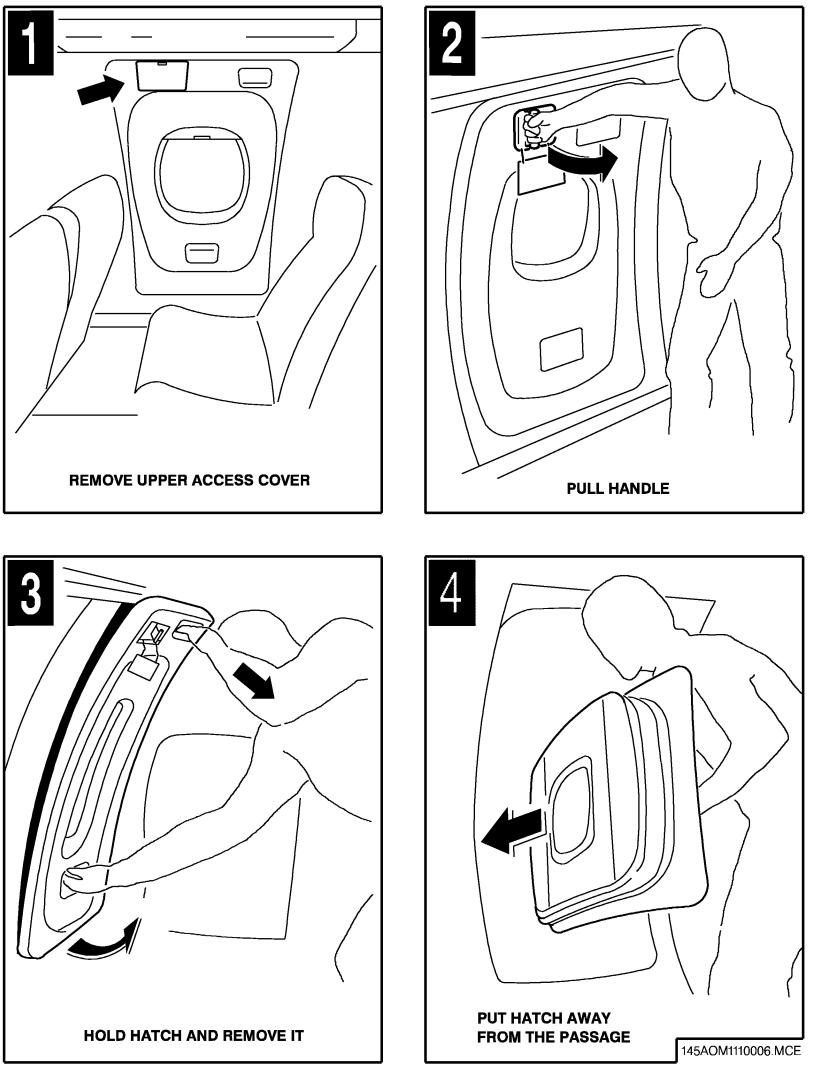
## EMERGENCY OVERWING EXITS

Two emergency exit hatches exist for passenger evacuation in the event of an emergency. They are located one on each side of the airplane, centered over the wings.




**EMERGENCY EXIT OPERATION (INSIDE CABIN)**

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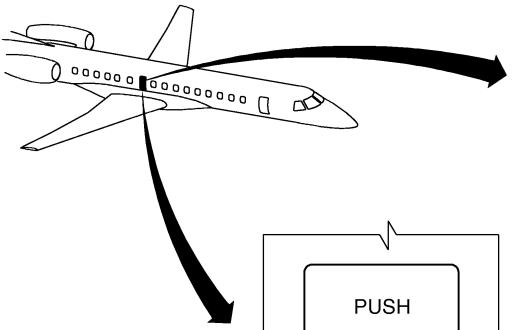
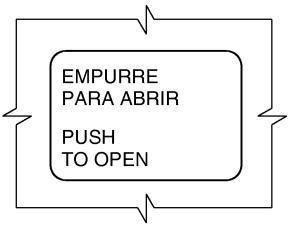
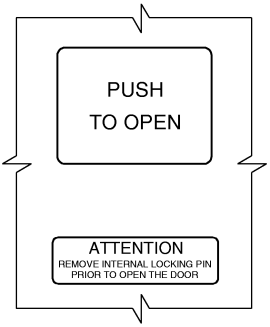





PRE–MOD SB 145–52–0040




POST–MOD SB 145–52–0040

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## EMERGENCY EXIT OPERATION (OUTSIDE CABIN)

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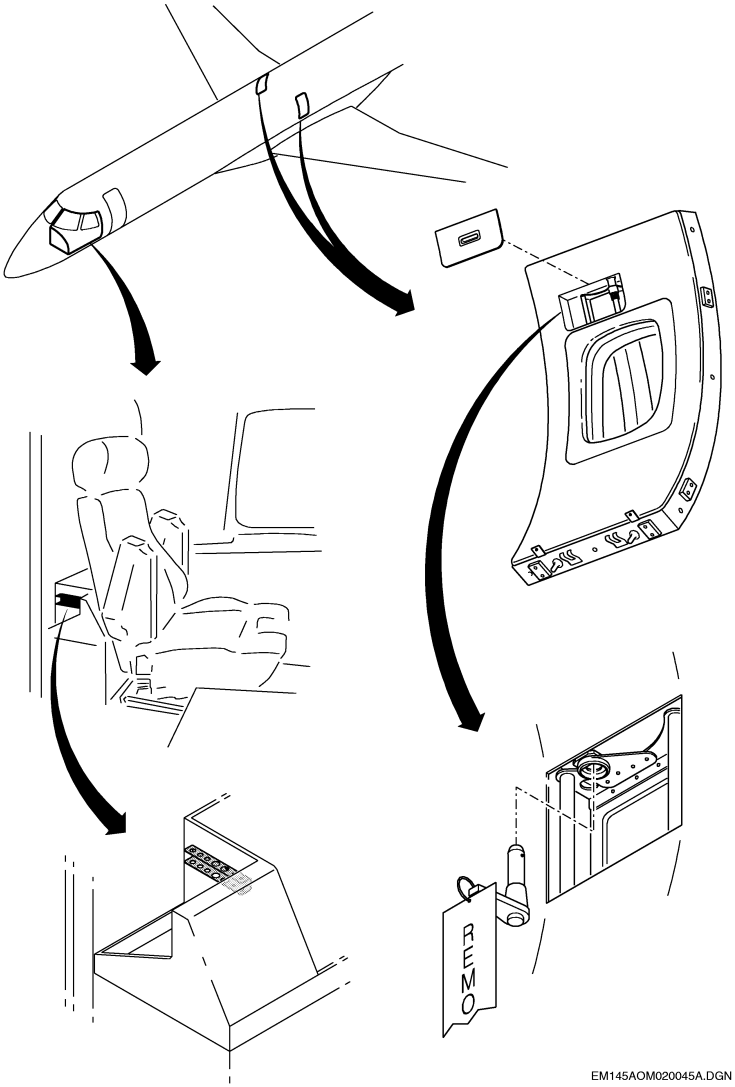
For airplanes Post-Mod. SB 145-52-0040, Part I and III, or equipped with an equivalent modification factory incorporated, the emergency exit hatches can be locked with locking pins.

On ground, at pilot discretion, the pins can be used but it must be removed and guarded in the quick-release pin support, in the LH cockpit rear console, behind the pilot seat, before any flight.

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**EMERGENCY EXIT OPERATION**

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# SECTION 1-11

# EMERGENCY EVACUATION

TABLE OF CONTENTS

Page Block
Emergency Evacuation Procedure..... 1-11-05
Doors and Exits..... 1-11-40
Emergency Rescue Charts ..... 1-11-45

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# INTRODUCTION

This Section presents information which may be used, at operators discretion, to develop customized evacuation procedures.

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# EMERGENCY EVACUATION PROCEDURE

## CAPTAIN

Parking Brake (if necessary) ..... APPLY
Cabin ..... DEPRESSURIZE
Fire Extinguishing Handles ..... PULL
APU Fuel Shutoff Valve ..... CLOSE
APU and Engine Fire Extinguishing
Bottles (if necessary) ..... DISCHARGE
Ventral Tank Transfer Knob (if applicable) ..... OFF
Electric Fuel Pumps ..... OFF
Electric Hydraulic Pumps ..... OFF
Cabin Crew ..... NOTIFY
Emergency Lighting ..... ON
Evacuation ..... INITIATE

**NOTE:** Cockpit door blow-out panels may be broken to be used as an alternative way to leave cockpit.

Before leaving the airplane:

Batteries ..... OFF

## FIRST OFFICER

ATC ..... NOTIFY

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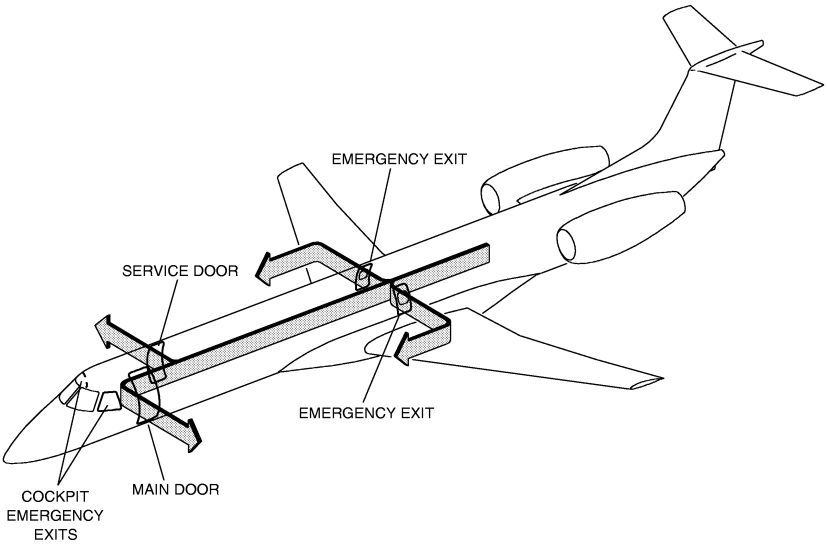
# DOORS AND EXITS

There are two forward doors (main and service), two overwing exits and two cockpit windows, one each side, that can be used for emergency evacuation.




**DOORS AND EXITS LOCATION**

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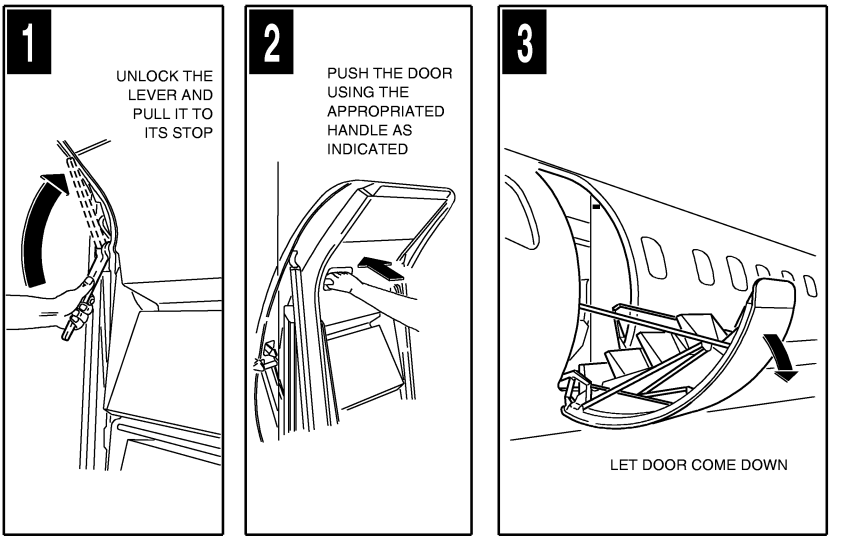
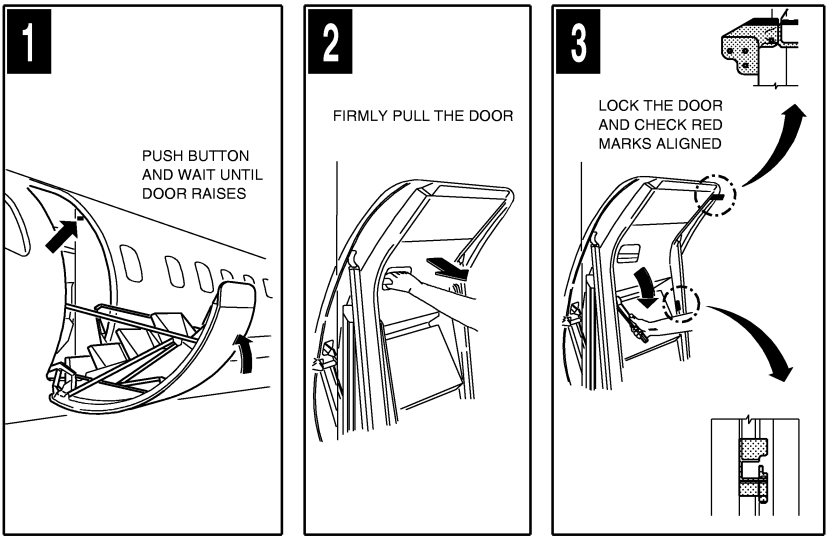
# MAIN DOOR

The main door (airstair or jetway type) is located at the fore left side of the fuselage.

**TO OPEN:**




**TO CLOSE:**

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**AIRSTAIR MAIN DOOR OPERATION (INSIDE CABIN)**

**NOTE:** Some airplanes may have only the upper right red mark.



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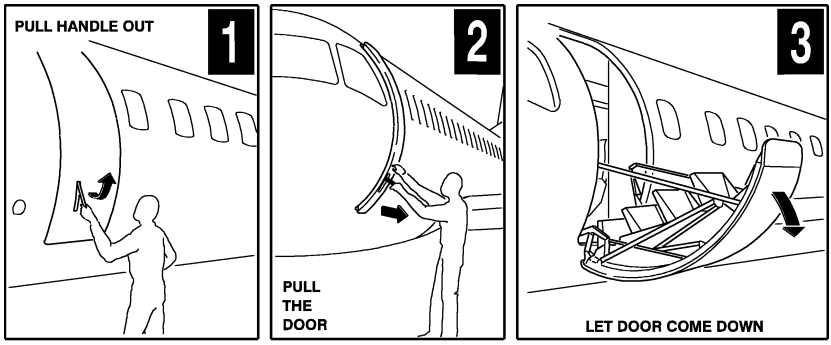
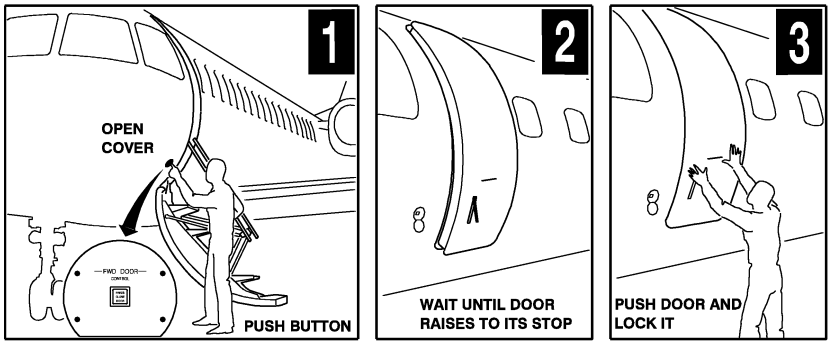
**TO OPEN:**




**TO CLOSE:**

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## AIRSTAIR MAIN DOOR OPERATION (OUTSIDE CABIN)

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## JETWAY MAIN DOOR OPERATION (INSIDE CABIN)

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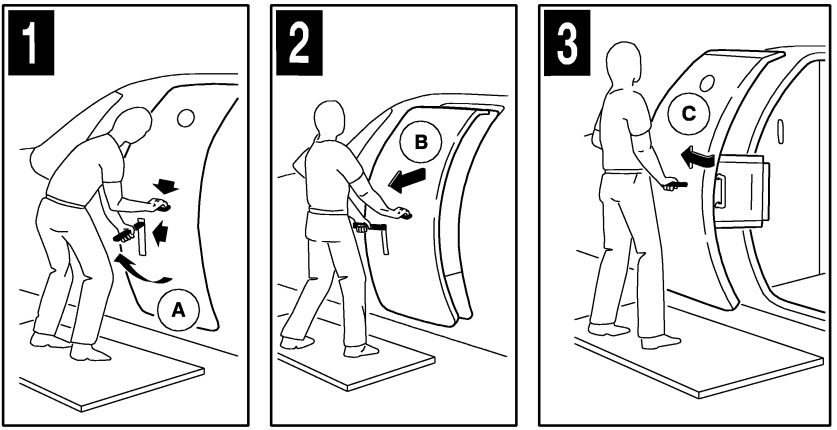
**TO OPEN:**

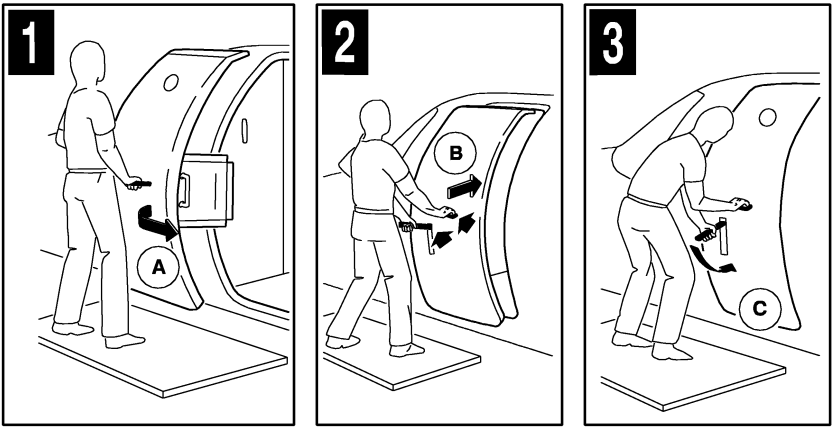



A LIFT THE LEVER TO UNLOCK THE DOOR

B PULL THE DOOR TO OPEN POSITION

C FULLY OPEN THE DOOR AND LOCK IT OPENED

**TO CLOSE:**




A HOLD THE DOOR HANDLE TO UNLOCK THE DOOR AND BRING IT TO CLOSURE POSITION

B PULL THE DOOR TO THE CLOSED POSITION

C LOWER THE LEVER TO LOCK THE DOOR CLOSED

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## JETWAY MAIN DOOR OPERATION (OUTSIDE CABIN)

## SERVICE DOOR

The service door, provided at the right side of the forward passenger cabin, is used for galley servicing and also as an emergency exit.

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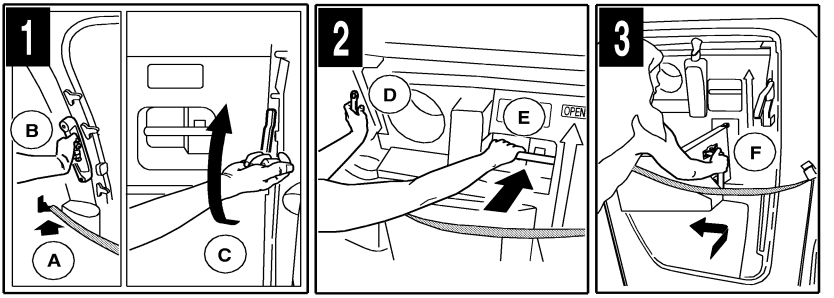
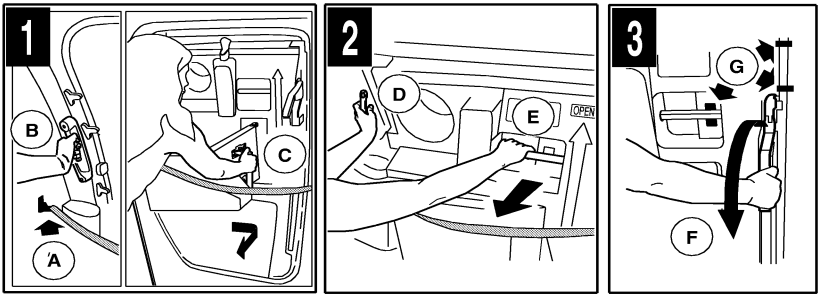
**TO OPEN:**




- A — MAKE SURE THAT THE SAFETY STRAP IS IN ITS CORRECT POSITION
- B — HOLD THE ASSISTANCE HANDLE
- C — LIFT THE LEVER TO UNLOCK THE DOOR
- D — KEEP HOLDING THE ASSISTANCE HANDLE
- E — PUSH THE DOOR TO OPEN
- F — MOVE THE DOOR UNTIL IT LOCKS IN THE OPEN POSITION

**TO CLOSE:**




- A — MAKE SURE THAT THE SAFETY STRAP IS IN ITS CORRECT POSITION
- B — HOLD THE ASSISTANCE HANDLE
- C — PULL THE LOWER HANDLE TO UNLOCK THE DOOR FROM THE OPEN POSITION AND BRING IT TO THE CLOSED POSITION
- D — KEEP HOLDING THE ASSISTANCE HANDLE
- E — FIRMLY PULL THE DOOR
- F — LOWER THE LEVER TO LOCK THE DOOR
- G — CHECK RED MARKS ALIGNED

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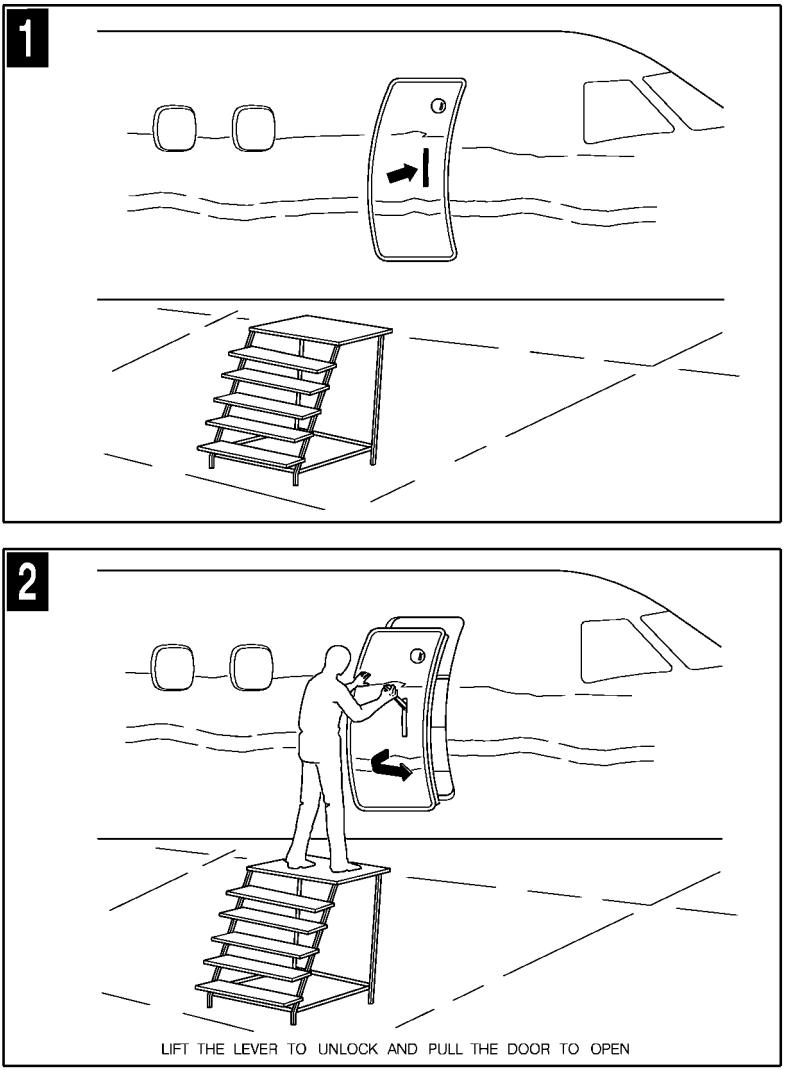
**SERVICE DOOR OPERATION (INSIDE CABIN)**

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## SERVICE DOOR OPERATION (OUTSIDE CABIN)

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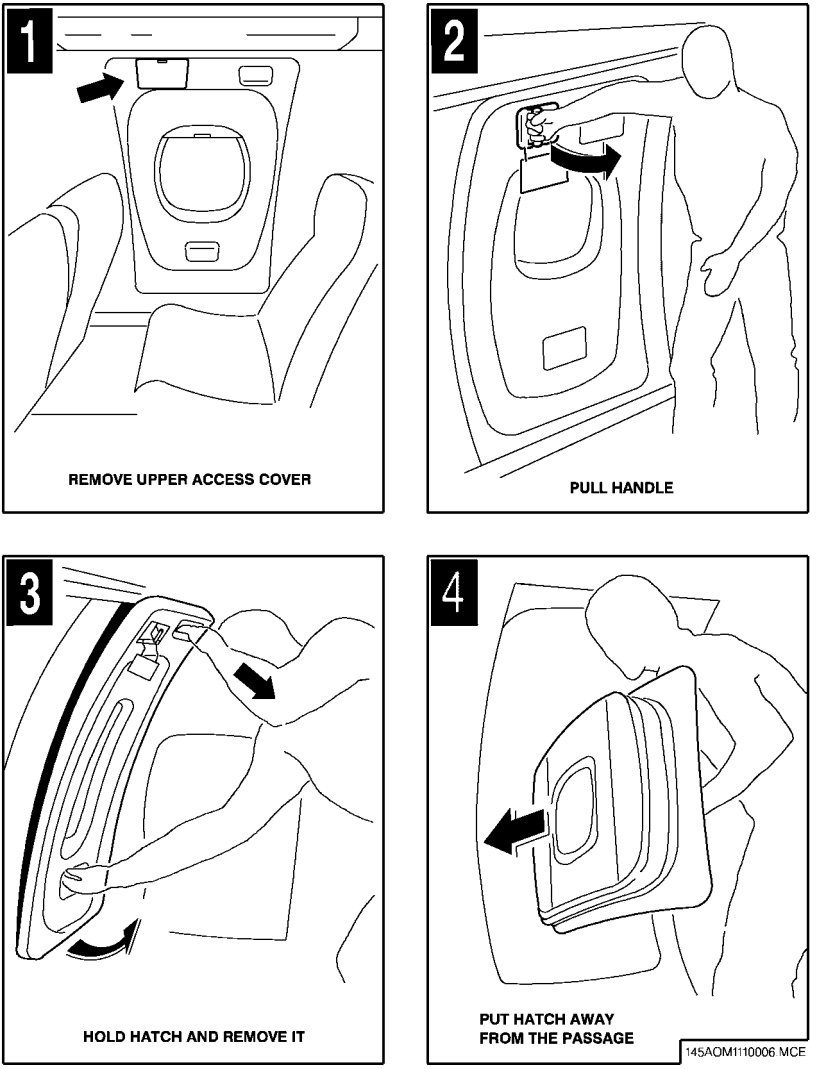
# EMERGENCY EXITS

## EMERGENCY OVERWING EXITS

Two emergency exit hatches exist for passenger evacuation in the event of an emergency. They are located one on each side of the aircraft, centered over the wings.




**EMERGENCY EXIT OPERATION (INSIDE CABIN)**

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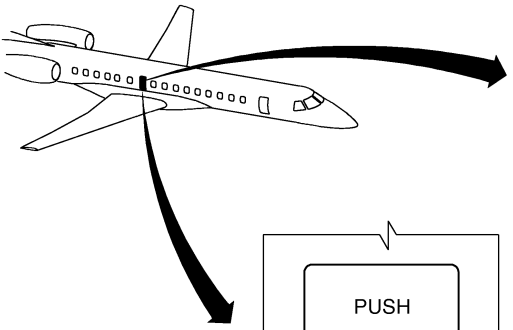
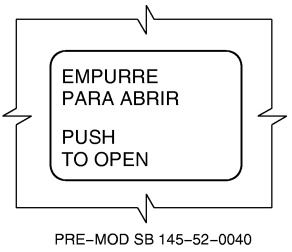
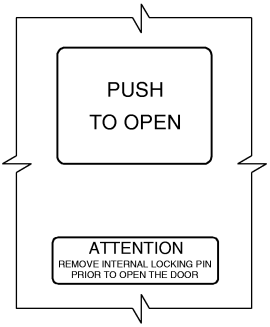





PRE–MOD SB 145–52–0040




POST–MOD SB 145–52–0040

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## EMERGENCY EXIT OPERATION (OUTSIDE CABIN)

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## COCKPIT EVACUATION

### COCKPIT WINDOWS

Cockpit windows may be partially open on the ground, and may be totally removed in case of loss of visibility through the windshield or for cockpit emergency evacuation.
If window removal is necessary, facilitate removal by moving the associated pilot seat backward.

**NOTE:** Windows can not be opened from outside.

A rope is positioned above each window to assist evacuation.

### COCKPIT DOOR

Cockpit door located between passengers cabin and cockpit is provided with an emergency exit. This emergency exit is accessible when the blow-out panel is removed.
The airplane is equipped with one of the two types of cockpit doors, the cockpit security door or the cockpit standard door. Each of them has a different emergency exit opening procedure.

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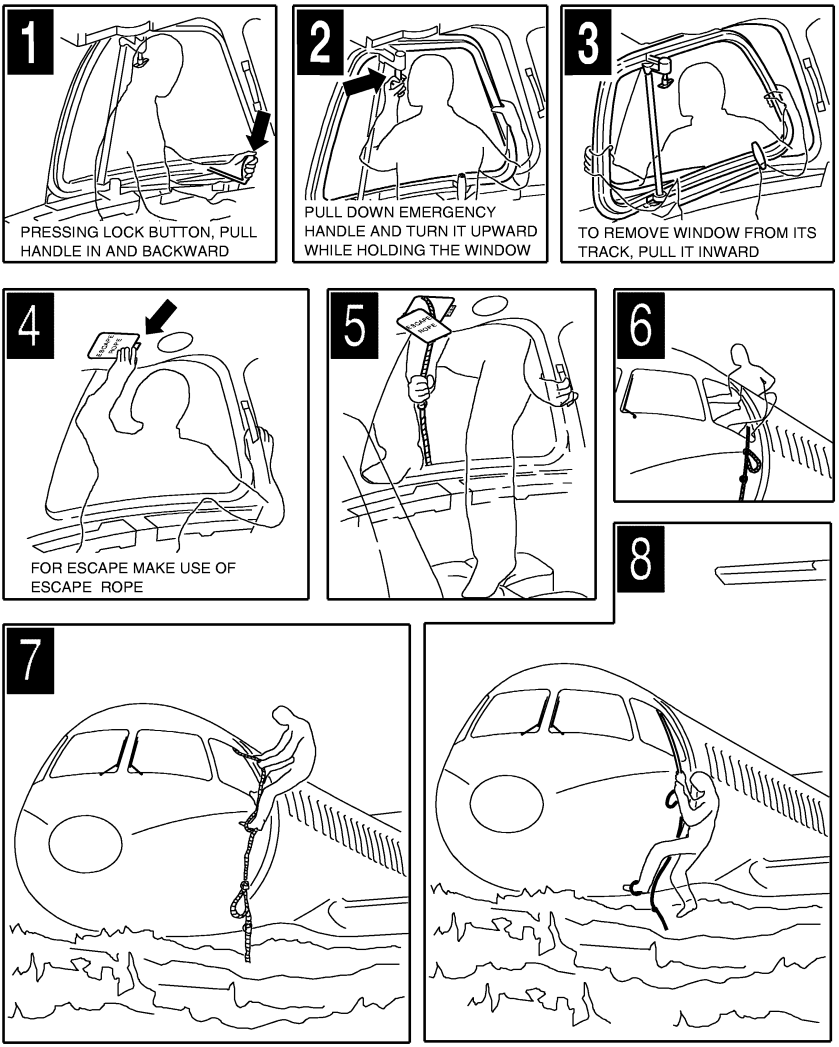


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## COCKPIT WINDOW REMOVAL AND EVACUATION PROCEDURE

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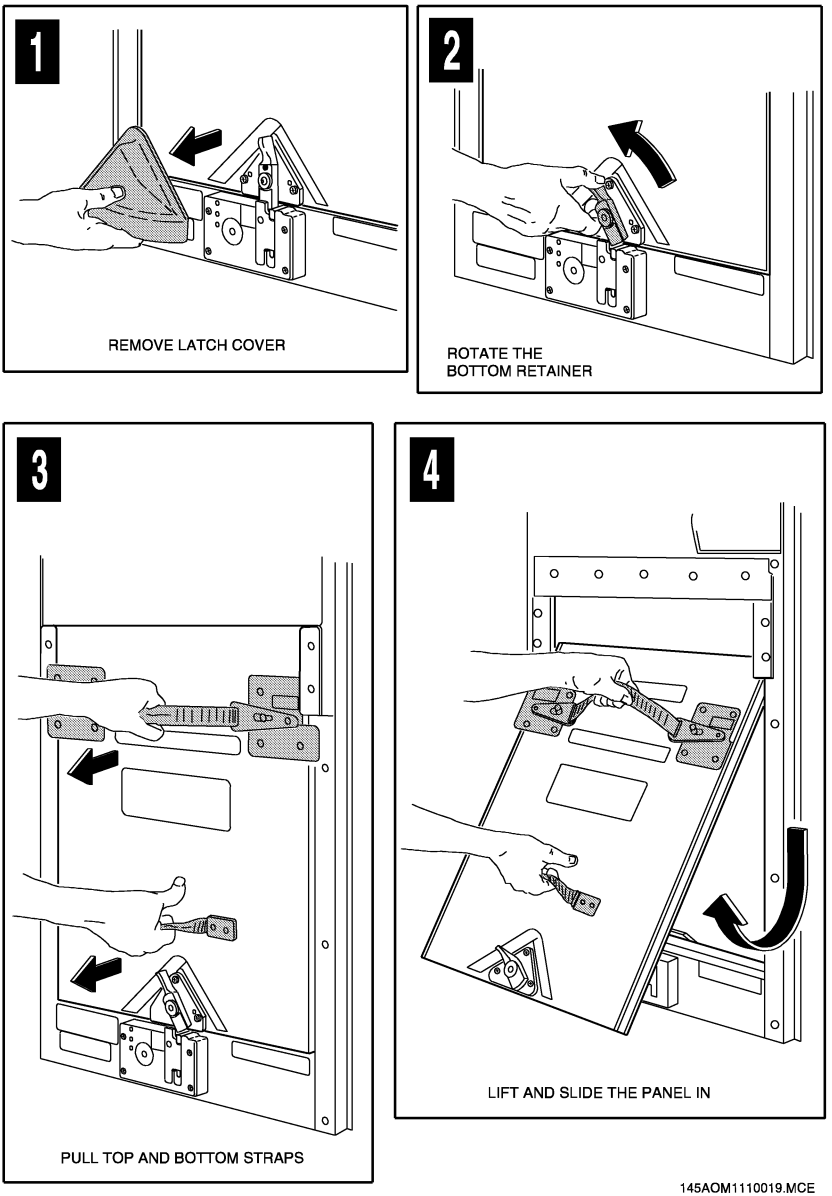


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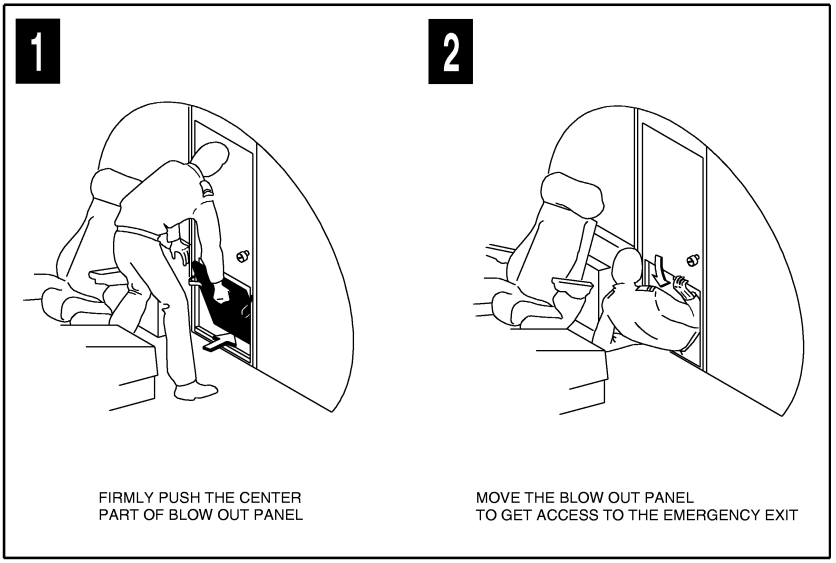
## SECURITY DOOR EMERGENCY EXIT PROCEDURE

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## STANDARD DOOR EMERGENCY EXIT PROCEDURE

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# EMERGENCY RESCUE CHARTS

The Emergency Rescue Charts present emergency equipment location as well as emergency evacuation schematic. These charts may be used, at operators discretion, to develop customized evacuation procedures.

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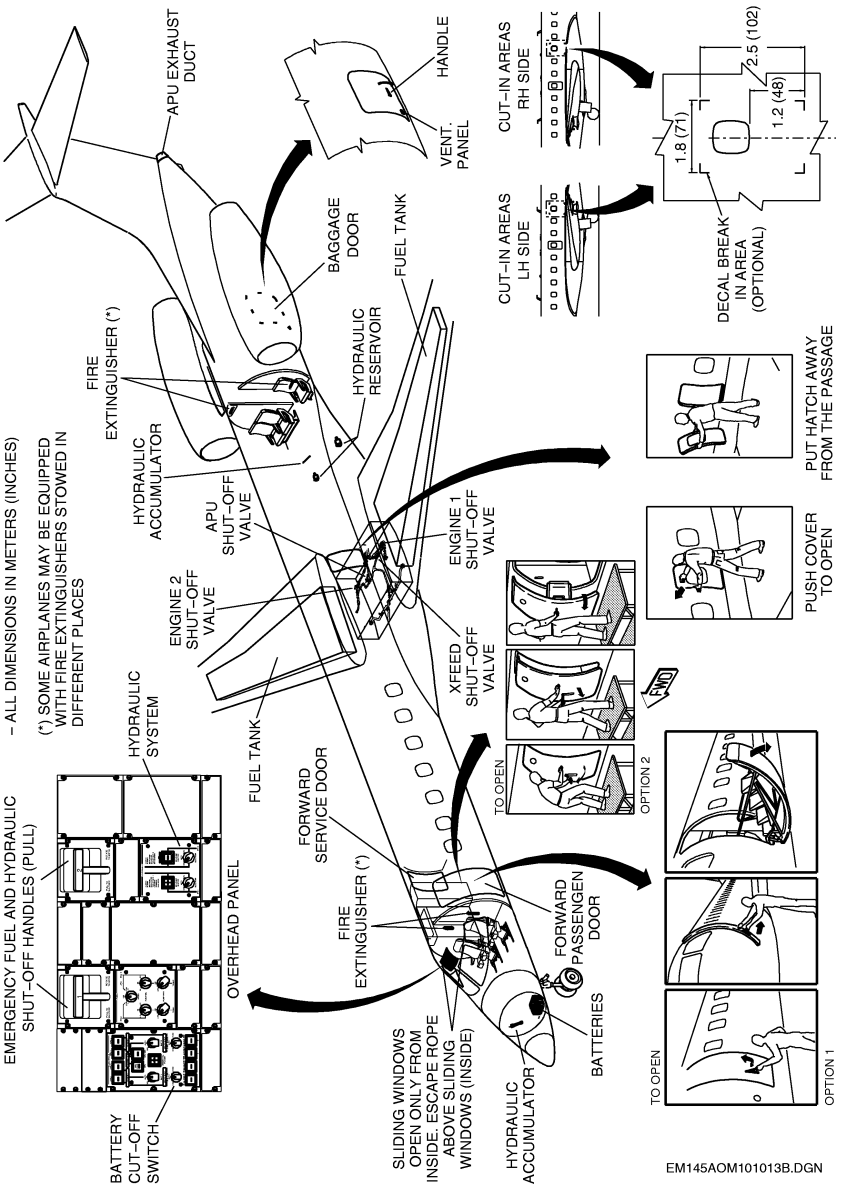
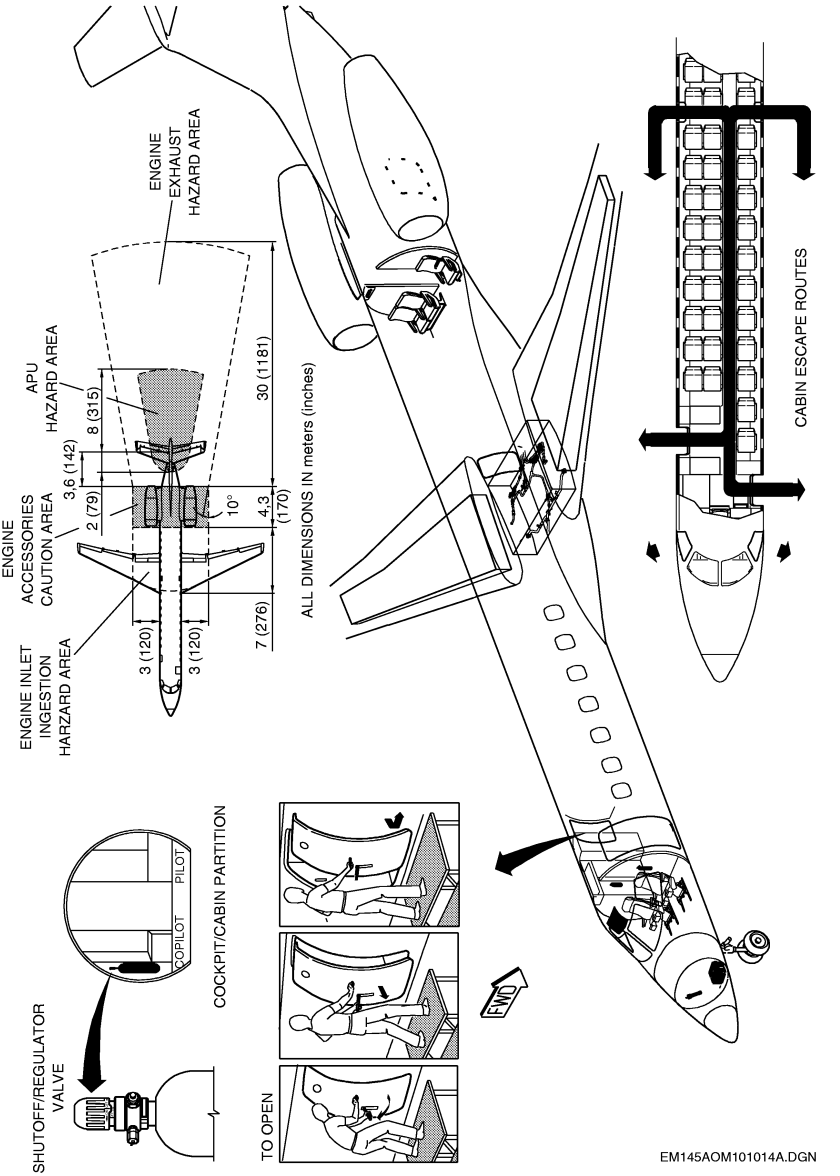



## EMERGENCY RESCUE CHART (1 OF 2)




## EMERGENCY RESCUE CHART (2 OF 2)

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# SECTION 1-12

# GROUND SERVICING

TABLE OF CONTENTS

Page Block

INTRODUCTION ..... 1-12-00
EXTERNAL CONNECTIONS ..... 1-12-05
TOWING ..... 1-12-10
PARKING/MOORING ..... 1-12-15
COLD WEATHER OPERATION ..... 1-12-20
FUEL SYSTEM SERVICING ..... 1-12-25
ENGINE OIL SERVICING ..... 1-12-30
APU OIL SERVICING ..... 1-12-35
HYDRAULIC/LANDING GEAR SERVICING ..... 1-12-40
OXYGEN SERVICING ..... 1-12-45
WATER/TOILET SERVICING ..... 1-12-50
GROUND RESETS ..... 1-12-60

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# INTRODUCTION

General guidelines are provided herein related to the ground handling and servicing of the airplane. They are intended to make flight crews familiar with the ordinary aspects of the subject, as those tasks described herein normally are the responsibility of the maintenance personnel.

For further instructions pertaining the subjects covered herein refer to the Aircraft Maintenance Manual.

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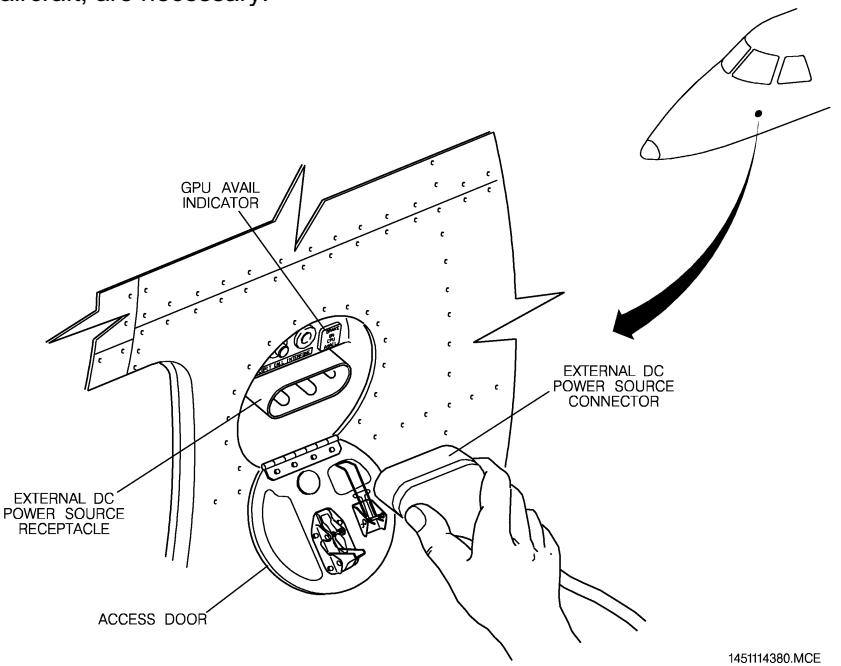
# EXTERNAL CONNECTIONS

## CONNECTING ELECTRICAL POWER SUPPLY

A 28 V DC external power supply source can be connected to the aircraft through the receptacle installed on the left side of the fuselage nose.

It is recommended that the external power source be capable of supplying at least 300 A, with maximal 1% steady-state voltage deviation. The voltage shown in the MFD electrical page should be 28.0 V (-2.0 V +1.0 V) DC when the GPU status is 'AVAILABLE'. The power source must be able to maintain the voltage within this range when the GPU status is 'IN USE'. Connecting a source out of these specifications may lead to electrical problems and therefore should be avoided.

Before energizing the aircraft, it must be assured that aircraft systems are in a safe condition, and that energizing will not cause any injury to persons or damage to equipment. When using an AC fed external power source, a ground connection between the hangar structure and the power source, and another one between the power source and the aircraft, are necessary.




**CONNECTING ELECTRICAL POWER SUPPLY**

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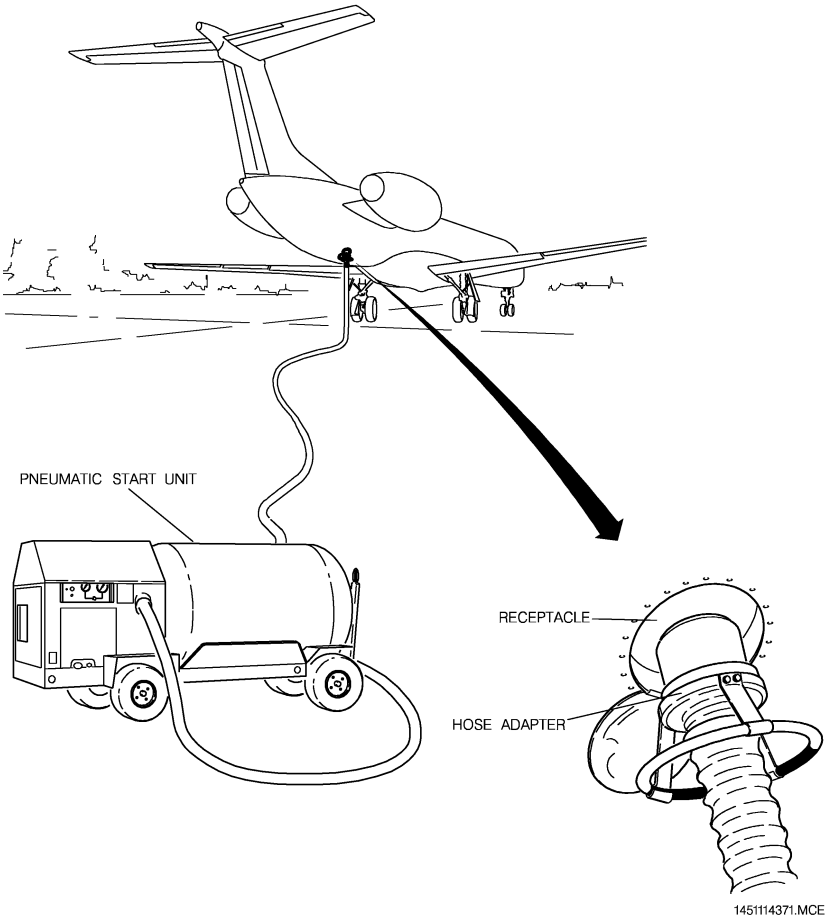
## CONNECTING THE PNEUMATIC START UNIT

The pneumatic start unit is connected to the aircraft through the receptacle on the right side of the rear fuselage. The output of the unit must be set between 40 and 45 psi. This pressure allows the opening of the valve to let external air in.




**PNEUMATIC START UNIT CONNECTION**

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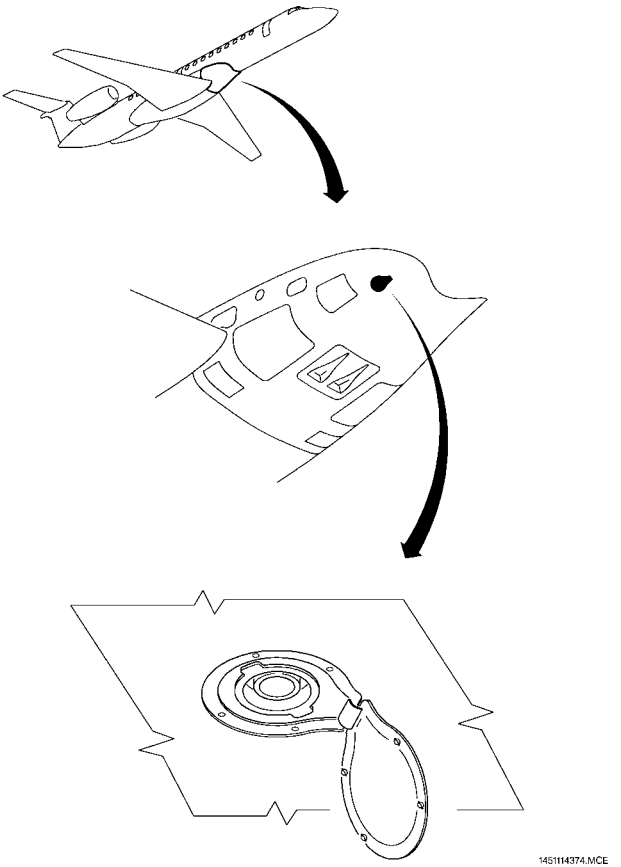
# AIR CONDITIONING GROUND CONNECTION

An external conditioned air-source can be connected to the airplane to supply hot or cold air directly into the cabin.

The operation consists of connecting the source and starting supply to the aircraft. Supplied air pressure must not exceed 127 mm $H_2O$ (5 in $H_2O$), maximum air temperature must not exceed 71°C (160°F) and maximum flow must not exceed 3,6 $m^3$/min (127 $ft^3$/min, 96 lbm/min). The source must be capable of supplying 50040 BTU/h.

The use of external conditioned air does not require any setting of the aircraft systems since the external conditioned air goes directly to the distribution ducts. However, it is recommended that the main door be left open when external air is being used, to prevent inadequate external source operation and to avoid cabin bump.



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**AIR CONDITIONING GROUND CONNECTION**

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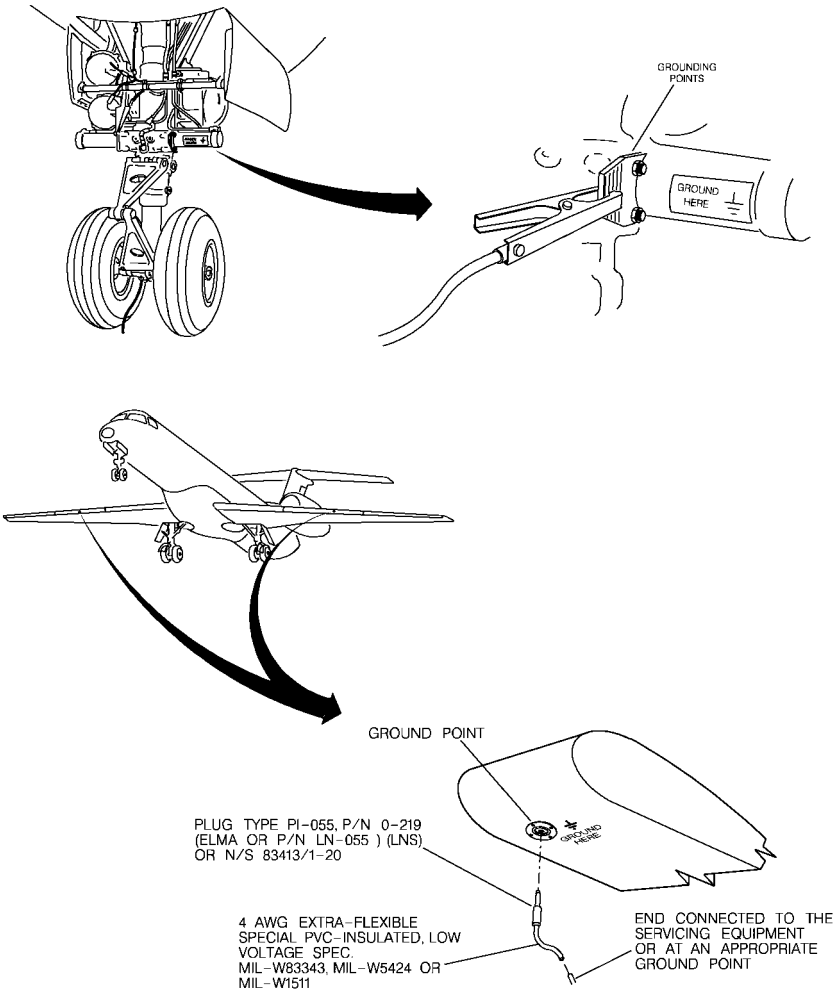
# STATIC GROUNDING

There are three grounding points on the aircraft. Two of them are installed on the lower surface of each wing leading edge and one is aft of the nose landing gear.




**STATIC GROUDING**

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To ground the aircraft properly, proceed as follow:

– Make sure that the aircraft is parked adjacent to an approved grounding point.

**NOTE: -** For general grounding, use a 4-AWG extra-flexible special PVC-insulated, low voltage cable, and a PL-055-type plug (specification MS 3493).

**-** To ground the refueling nozzle or the oxygen charger adapter, use a 3/32"-diameter steel cable (specification MIL-W-83343, MIL-W-5424 or MIL-W-1511) with plug (specification MIL-C-83413/4) and an alligator clip.

– Examine the static ground cable for damage and to make sure that the end-fittings are correctly attached.

**CAUTION:** USE THE GROUNDING POINTS SHOWN IN FIGURE ABOVE ONLY. THE USE OF OTHER POINTS MAY RESULT IN POOR GROUNDING.

– Connect the static ground cable plug to one of the grounding points on the lower surface of each wing leading edge and the other end to an earth grounding point.
– Connect the static grounding cable of the ground support equipment to an earth grounding point.
– Connect static grounding cable plug of ground support equipment to one of the aircraft grounding points.
– Connect the applicable ground support equipment.

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# TOWING

The towing operations are performed in compliance with the appropriate operational requirements using towbar or towbarless towing vehicles that are designed and operated to preclude damage to the airplane nose landing gear, steering system and associated fuselage structure.
Towbar and towbarless towing vehicles that are specifically accepted for this type of airplane are listed in the AMM Chapter 9.

**NOTE:** Towbarless towing is permitted only for airplanes Post-Mod. SB 145-32-0065 or SB 145-32-0086 or SB 145-32-0102 or equipped with an equivalent modification factory incorporated.

Maximum nosewheel displacement during towing is 170º to the left or to the right.
The maximum recommended wind speeds for airplane Towing, Pivoting, Turning and Taxi are:

- Dry Runways ..... 50 kts
- Wet Runways ..... 45 kts
- Snow Covered Runways .... 30 kts
- Ice Covered Runways ..... 10 kts

**NOTE:** For abnormal conditions such as soft mud and snow the main landing gear has hard points to attach winch or cables for towing the airplane fore and aft. For this specific procedure, IGFER (Instructions for Ground Fire Extinguishing and Rescue) must be consulted (only applicable to towbar towing).

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## TOWING PREPARATION

The following precautions apply when towing the airplane:

- During the towing operations, a properly trained person must stay in the cockpit to set the emergency/parking brake, if necessary.

**CAUTION:** EFFICIENT COMMUNICATION BETWEEN THE TOWING VEHICLE OPERATOR AND THE COCKPIT PERSON MUST BE ESTABLISHED BEFORE THE AIRPLANE IS TOWED.

- Turn on the anti-collision lights.

**CAUTION:** MAKE SURE THAT THE AIRPLANE WINGTIPS AND TAIL CAN BE SEEN CLEARLY.

- Close the main door (except for airplanes equipped with wheeled main door).
- If it is not necessary to tow the airplane with the hydraulic systems 1 and 2 pressurized:
  - Depressurize hydraulic systems 1 and 2.
  - Make sure that the emergency/parking brake accumulator is pressurized.

    If it is suspected that emergency/parking brake has no accumulator charge to supply power for an eventual actuation, turn electric hydraulic pump #2 on for a few seconds and then turn electric hydraulic pump off again.

    **NOTE:** Turning on an electric hydraulic pump using batteries only can discharge the batteries. The use of the APU generator to supply electrical power is recommended.

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- If it is necessary to tow the airplane with hydraulic systems 1 or 2 pressurized (e.g., engines running):
  - Keep hydraulic systems 1 and 2 pressurized.
  - Make sure that the emergency/parking brake accumulator is pressurized.

    **NOTE:** To prevent hydraulic fluid transference from system 1 to system 2 or vice versa, always apply brakes with the pedals before pulling and releasing the emergency/parking brake handle.
- Set the emergency/parking brake handle up. Check if emergency/parking brake light is ON.
- Disengage the steering system through the Steering Disengage Button located on the control wheel (pilot or copilot). The STEER INOP message is displayed on the EICAS.

**NOTE:** For airplanes Post-Mod. SB 145-32-0057 the steering system is disengaged alternatively by ground personnel setting the external steering disengagement switch to the “DISENGAGED” position.

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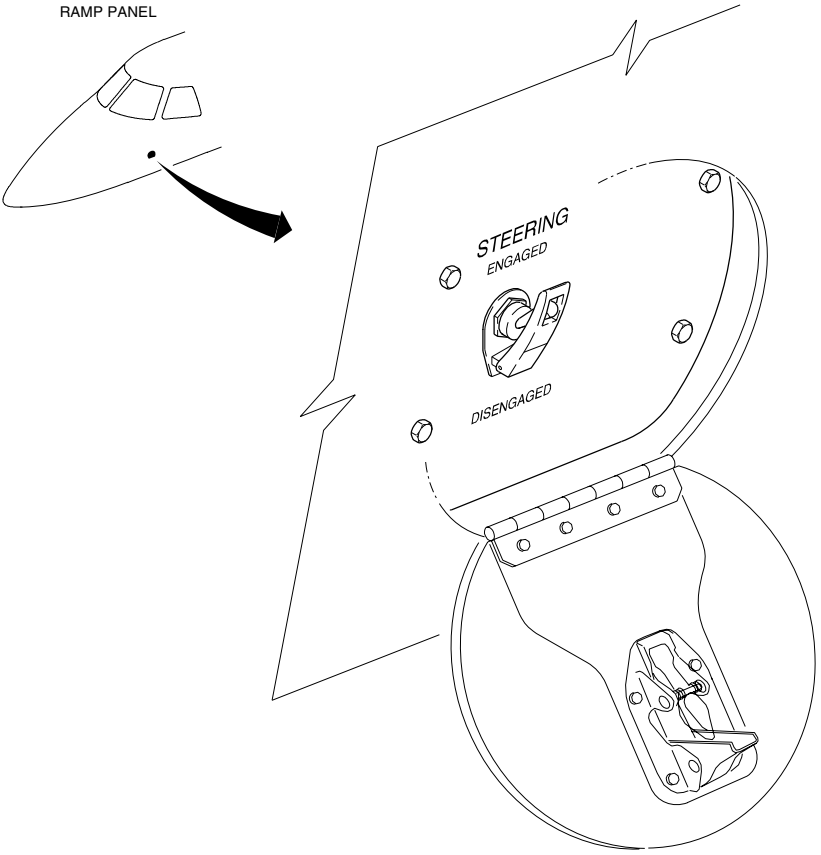


**STEERING DISENGAGEMENT SWITCH COMPARTMENT**

# TOWBAR TOWING

## EQUIPMENT

Ground towbar towing is normally accomplished by using ground support equipment P/N 01-1201-0000 (towbar) and 01-0582-0010 (towbar attachment) coupled to the nose landing gear.

The towbar incorporates breakable sections (fuse) with the purpose of causing the towbar to break in case of any towing abnormality, to protect the airplane structure or the nose landing gear from damage. Maximum towbar fuse push/pull design force is 4418 kgf (9740 lbf). Maximum design torque is 4300 N.m (3171.5 lbf.ft).

## PROCEDURES

Towbar Towing operation is accomplished following the steps below:

**WARNING: WHEN THE ENGINES AND APU ARE RUNNING DURING THE TOWING PROCEDURES MAKE SURE THAT ALL PERSONS ON THE GROUND STAY AWAY FROM HAZARDOUS AREAS.**

- Remove the lock pin from the guide pin on towbar assemblies.
- Install towbar on the nose landing gear.
- Put the guide pin into the towing point of the nose landing gear.
- Lock the guide pin with the lock pin.
- Install the other side of towbar assemblies to the tractor.
- Remove the wheel chocks.
- Release the emergency/parking brake. Check if the brake ON light goes off.

**NOTE: -** The person in cockpit must coordinate with ground personnel to release and apply the airplane emergency/parking brake.

**-** To prevent hydraulic fluid transference from system 1 to system 2 or vice versa, always apply brakes with the pedals before pulling and releasing the emergency/parking brake handle.

***CONTINUES ON NEXT PAGE***

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– Tow the airplane slowly straight ahead before turning. Complete the airplane towing in a straight line for a minimum of 3 m (10 ft) in order to align the steering as close as possible to the 0º position.

**NOTE:** Do not stop the airplane when turning if it is not necessary.

**CAUTION:**

- DO NOT OVERSTEER. THE MAXIMUM TOWING ANGLE IS 170º TO THE RIGHT AND 170º TO THE LEFT. IF THE MAXIMUM TOWING ANGLE IS EXCEEDED DAMAGE TO THE NOSE LANDING GEAR CAN OCCUR. TAKEOFF IS NOT ALLOWED WITH DAMAGED NOSE LANDING GEAR.
- DO NOT APPLY THE AIRPLANE BRAKES DURING THE TOWING PROCEDURE. REGARDLESS OF THE SPEED. USING BRAKES CAN CAUSE DAMAGE TO THE AIRPLANE STRUCTURE AND/OR TO THE NOSE LANDING GEAR. ONLY WHEN THERE IS A RISK OF COLLISION OR DAMAGE TO THE AIRPLANE AND IN ACCORDANCE TO THE TRACTOR OPERATOR, USE THE AIRPLANE BRAKES TO STOP THE AIRPLANE.

After towing operation is finished:

– Apply the emergency/parking brake or install the wheel chocks, as required.

**NOTE:** If hydraulic systems 1 and 2 are pressurized, always apply brakes with the pedals before pulling and releasing the emergency/parking brake handle to prevent hydraulic fluid transference from system 1 to system 2 or vice versa.

– Make sure that nose wheel displacements are below the maximum operational limit.

**NOTE:** Steering handle actuation with nose wheels beyond their operational limits may cause damage to the nose wheel steering system.

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***CONTINUED FROM PREVIOUS PAGE***

- Remove towbar.
- Remove the lock pin from the guide pin on the towbar assembly.
- Remove the guide pin from the towing point of the nose landing gear.
- Remove the towbar assembly from the nose landing gear.

**CAUTION:** CHECK WITH GROUND PERSONNEL IF THE NOSE WHEEL IS NEAR THE CENTER POSITION (CLOSE TO 0º) BEFORE PRESSURIZING THE HYDRAULIC SYSTEM.

- Pressurize the hydraulic system if it is depressurized.
- Engage the steering system through the steering handle. Check if the STEER OFF message is not displayed on EICAS.

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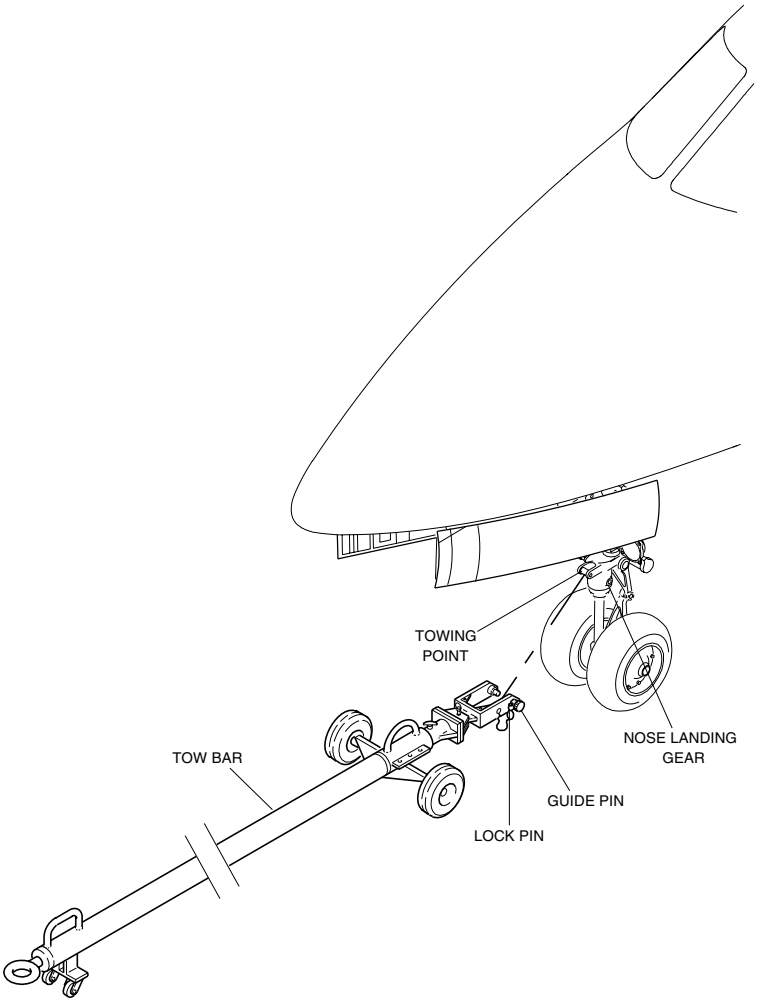


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## TOWBAR TOWING EQUIPMENT

# TOWBARLESS TOWING

## EQUIPMENT

Towbarless towing vehicles that are specifically accepted for this type of airplane are listed in the AMM Chapter 9.

## PROCEDURES

Towbarless Towing operation is accomplished following the steps below:

**WARNING: WHEN THE ENGINES AND APU ARE RUNNING DURING THE TOWING PROCEDURES MAKE SURE THAT ALL PERSONS ON THE GROUND STAY AWAY FROM HAZARDOUS AREAS.**

- Put the tug vehicle in the correct position near the nose wheels.
- Remove the wheel chocks from the main wheels.
- Connect the tug vehicle to the airplane.
- Release the emergency/parking brake. Check if the brake ON light goes off.

**NOTE:**
- Coordinate with ground personnel to release and apply the airplane emergency/parking brake.
- To prevent hydraulic fluid transference from system 1 to system 2 or vice versa, always apply brakes with the pedals before pulling and releasing the emergency/parking brake handle.

- Tow the airplane slowly straight ahead before turning. Complete the airplane towing in a straight line for a minimum of 3 m (10 ft) in order to align the steering as close as possible to the zero-degree position.

**NOTE:** Do not stop the airplane when turning if it is not necessary.

**CAUTION:**
- DO NOT OVERSTEER. THE MAXIMUM TOWING ANGLE IS 170º TO THE RIGHT AND 170º TO THE LEFT. IF THE MAXIMUM TOWING ANGLE IS EXCEEDED DAMAGE TO THE NOSE LANDING GEAR CAN OCCUR. TAKEOFF IS NOT ALLOWED WITH DAMAGED NOSE LANDING GEAR.

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- DO NOT APPLY THE AIRPLANE BRAKES DURING THE TOWING PROCEDURE. REGARDLESS OF THE SPEED. USING BRAKES CAN CAUSE DAMAGE TO THE AIRPLANE STRUCTURE AND/OR TO THE NOSE LANDING GEAR. ONLY WHEN THERE IS A RISK OF COLLISION OR DAMAGE TO THE AIRPLANE AND IN ACCORDANCE TO THE TRACTOR OPERATOR, USE THE AIRPLANE BRAKES TO STOP THE AIRPLANE.

After towing operation is finished:

– Set the emergency/parking brake and, with the airplane energized, make sure that the brake light is ON.

**NOTE:** To prevent hydraulic fluid transference from system 1 to system 2 or vice versa, always apply brakes with the pedals before pulling and releasing the emergency/parking brake handle.

– Make sure that nose wheel displacements are below the maximum operational limit.

**NOTE:** Steering handle actuation with nose wheels beyond their operational limits may cause damage to the nose wheel steering system.

– Install the chocks forward and aft of the left and right main landing gear wheels.

– Remove the airplane towing vehicle.

**CAUTION:** CHECK WITH GROUND PERSONNEL IF THE NOSE WHEEL IS NEAR THE CENTER POSITION (CLOSE TO 0º) BEFORE PRESSURIZING THE HYDRAULIC SYSTEM.

– Pressurize the hydraulic system if it is depressurized.

– Engage the steering system through the steering handle. Check if the STEER OFF message is not displayed on EICAS.

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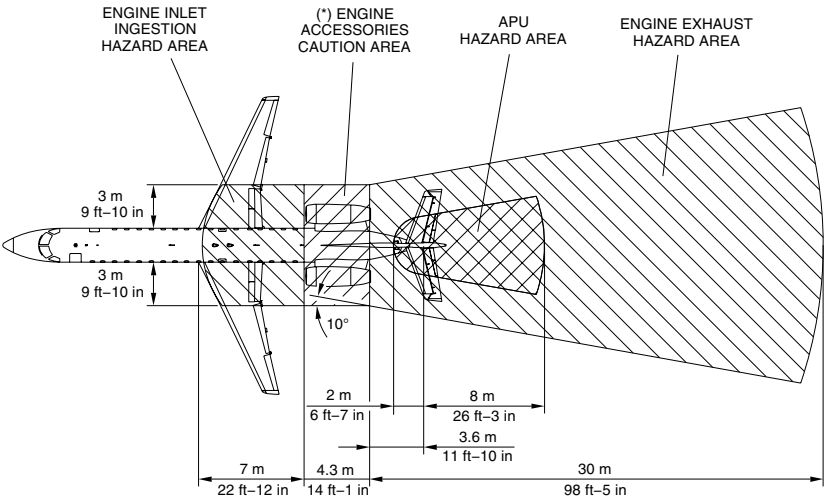
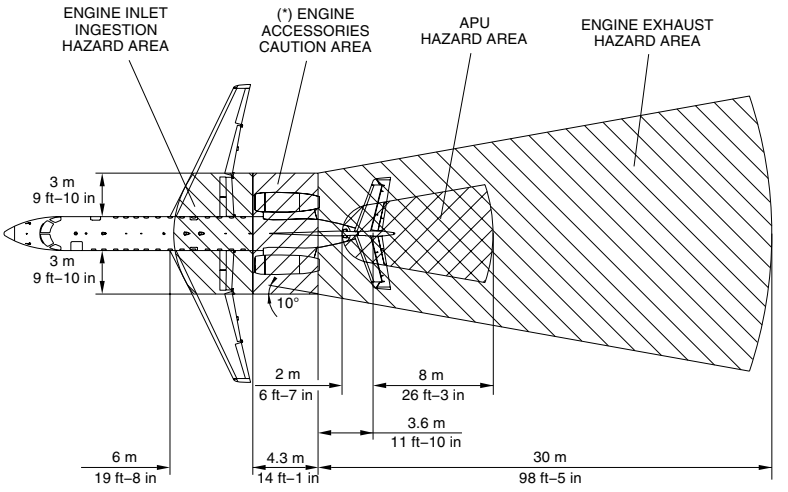
# HAZARD AREAS




**EMB–145 MODEL**




**EMB–135 MODEL**

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(*) Access to this area is permitted just with engine running in idle speed.

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# PARKING

The instructions contained herein cover only normal parking, i.e. parking between flights and the overnight stop. In case of prolonged parking, or parking under extremely adverse weather conditions, the assistance of a maintenance technician is required.

## PREPARATION

Make sure there is a minimum distance in relation to other parked airplane so as to permit airplane movement, further assuring that there is a minimum distance of 4.5 meters between the APU´s exhaust port and an adjacent airplane fuel tank vent.

The gust lock must be in the locked position whenever the airplane is on the ground, except for flight controls checks.

**NOTE: -** The airplane must be sheltered in a hangar when there are wind speeds higher than 50 knots (for the mechanical gust lock system) or above 65 knots (for the electromechanical gust lock system).

- If the airplane is exposed to wind gusts with the gust lock in the unlocked (FREE) position or the airplane is exposed to winds exceeding the limit specified for each gust lock system, an inspection according to TASK 05-50-04-200-802-A (AMM) should be performed.

## PARKING

Normal parking is performed according to the procedure below:

– Make sure that the safety pins are installed in each landing gear.

**CAUTION:** IF THE RELATED LANDING GEAR SAFETY PINS ARE NOT INSTALLED, INJURY TO PEOPLE AND/OR DAMAGE TO THE AIRPLANE/EQUIPMENT MAY OCCUR.

**NOTE:** Before parking the airplane, move it approximately three meters in a straight line to remove all torsional stresses applied to landing gear components and tires during a turn.

– Ground the airplane.
– If there is ice or snow in the parking area, put mat, thick sand or other applicable material under the tires, to prevent them from freezing.

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**CAUTION:** IF THE BRAKES ARE TOO HOT, DO NOT APPLY PARKING BRAKES UNTIL THEY ARE COOLER. THIS WILL PREVENT BRAKE DISCS FROM BONDING.

- Set the emergency/parking brake.
- Retract the flaps if they are extended.
- Set the gust lock lever.
- Put the chocks against the landing gear wheels.
- To prevent the courtesy light from discharging the battery, pull the COURTESY LIGHT (A22) circuit breaker.
- Install the covers to the pitot tubes, total-air-temperature (TAT) sensor, tail cone, nose cowl, ice detector, engine/APU air intakes and exhaust nozzles, and anemometrical static ports.

## RETURN TO SERVICE

- Remove the chocks from the landing gear wheels.
- Remove the covers from the pitot tubes, TAT sensor, tail cone, nose cowl, ice detector, engine/APU air intakes and exhaust nozzles, and anemometrical static ports.
- Make sure that the control handle of the landing gear is at the down position.
- Make sure that the safety pins are installed to each landing gear.

**CAUTION:** MAKE SURE THE SAFETY PINS ARE REMOVED BEFORE TAXYING THE AIRPLANE FOR TAKEOFF.

- Unground the airplane.

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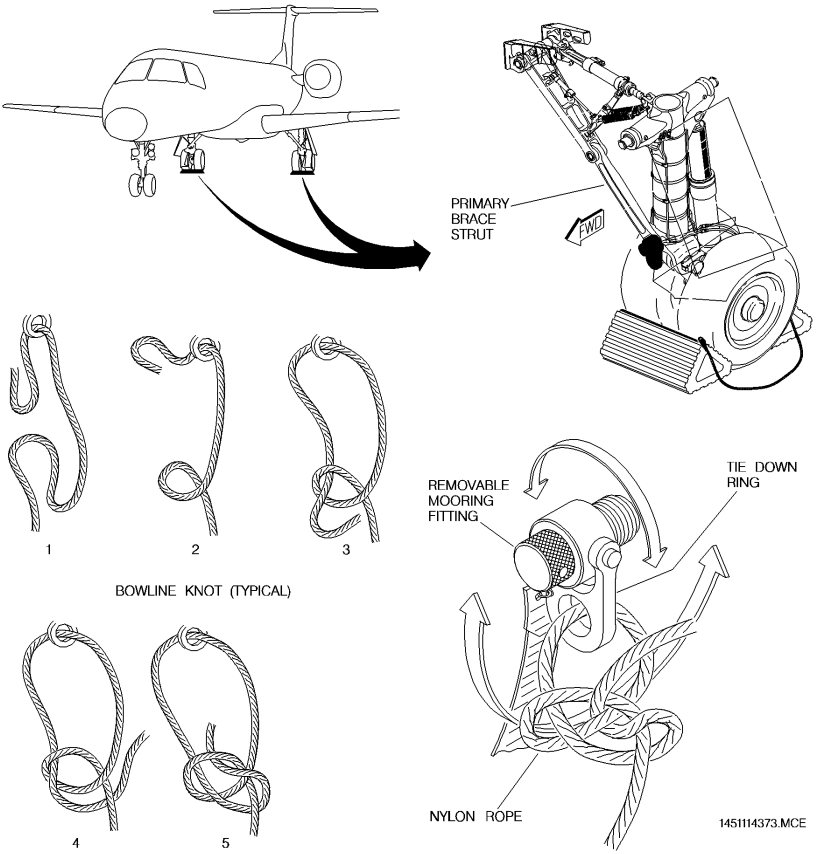
# MOORING

Mooring is necessary when the weather conditions are bad or unknown. The area where the aircraft is to be parked in and moored must be paved and level, with ground tiedown anchors available.




**MOORING THE AIRPLANE**

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The following table gives the surface conditions and wind velocities at which mooring is necessary;

Wind Limitation Table

| Surface Condition | Wind Velocity |
|---|---|
| Ice | 25 Kt |
| Snow | 40 Kt |
| Wet Concrete | 55 Kt |
| Dry Concrete | 60 Kt |

To moor the aircraft, proceed as follows:

- Tow the aircraft to a parking area where there are tiedown anchors available.
- Carry out the normal parking procedure.
- Install the tiedown rings (two), one in each primary brace strut of the main landing gear.
- Attach a nylon rope to the tiedown ring with a bowline knot, and then attach the other end of the rope to the tiedown anchor on the ground by knotting it with a bowline knot. See the corresponding illustration on the previous page.

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# COLD WEATHER OPERATION

## COLD SOAK PREPARATION

The procedures below should be applied in the event of extended airplane exposure at low temperatures. In the event that the airplane is off the maintenance base, the crew should ensure that all actions have been accomplished.

- Put the wheel chocks against the landing gear wheels.
- For an icy ramp, leave Emergency/Parking Brakes applied. Otherwise, Emergency/Parking Brakes must not be applied to avoid freezing of the brakes.
- Install protective covers on engines and APU inlets/outlets, pitot, TAT probes, and wheels.
- Drain water and waste from all water tanks, if cold soak temperature is expected to be below 0°C (32°F).
- Remove the batteries if temperatures are expected to be below -15°C (5°F). This protects the batteries and ensures their duration in case of electrical emergency.
- All doors and windows must be closed to avoid snow and humidity from entering into the airplane.

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# APPLICATION OF DEICING AND ANTI-ICING FLUIDS

## ANTI-ICING AND DEICING FLUIDS

When airplane surfaces are contaminated by frozen precipitation or frost before departure, they must be deiced. When the risk of freezing precipitation exists at dispatch or freezing precipitation is actually taking place, the airplane must be anti-iced. While deicing removes ice, anti-icing protects against additional icing for a certain period of time, called hold-over time. A combination of both anti-icing and deicing may be performed based on the judgment of the flight crew and procedures developed by the operator.

Deicing and anti-icing fluids lower the freezing point of frozen precipitation thus delaying the accumulation of contamination on the airplane. When applied to a clean surface, the fluid forms a thin layer that has a lower freezing point in precipitation. The fluid is highly soluble in water, thus the precipitation or ice melts on contact with fluid. These fluids also delay the onset of frost on airplane surfaces. As the ice melts, the fluid dilutes with the water, thereby causing the mixture to become less effective or to run off. Ice can begin to form again after enough dilution has occurred and freezing point begins to rise.

Deicing/anti-icing fluids are not intended to provide icing protection during flight. The fluid must flow-off the surface during takeoff, or they may cause undesirable performance effects. EMBRAER performed flight tests to investigate the effects of approved fluids on performance and handling characteristics. These tests demonstrated these fluids did not have a measurable effect on takeoff and climb performance.

Fluids are generally mixtures of glycol, water, inhibitors, thickening agents and wetting agents. Glycol lowers the freezing point and prevents the formation of ice contamination at temperatures below freezing. The wetting agent allows the fluid to conform to the airplane surfaces. The inhibitors prevent corrosion and increase the flash point. The thickening agent, normally propylene glycol with polymers, enables the coating of fluid to remain on airplane surfaces for longer periods.

Type I Fluid is unthickened, while fluids from Type II to IV are thickened.

Type I Fluid characteristically forms a thin wetting film which provides relatively limited holdover time, and provides protection against refreezing when no precipitation is present.

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A deicing fluid may be pure heated water, or a mixture of heated water and type I, II, III or IV fluids. Heating is applied to a minimum temperature of 60°C to assure maximum deicing efficiency.

Anti-icing fluids include types I, II, III or IV fluids in a mixture with water or undiluted.

Type I fluid is diluted with water to result in a freezing point approximately 10°C below ambient temperature. No additional holdover time is obtained by increasing the concentration of this fluid in the fluid/water mixture. However, increasing the concentration of fluids II, III and IV in a fluid/water mixture results in an additional holdover time.

The holdover time of the type IV fluid is greater than that of type II, which in its turn has a longer holdover time than type III fluid.

Type I fluid is normally pink or reddish orange in color, type II fluid is normally straw-colored, type III is bright yellow and type IV is green.

Type IV is an enhanced-performance fluid and offers significant operational advantages in terms of holdover times. However, thickened fluids may dry out during flight and residues may accumulate in aerodynamically quiet areas. The residues may turn to a gel which can freeze in flight, potentially restricting the movement of flight controls. Operators are reminded to frequently inspect control surfaces, gaps and tab hinges for signs of residual gel. If an approved fluid during actual use shows gelling, poor water wash off or unusual dry-out, EMBRAER should be notified.

**THE USE OF HOLDOVER TIMES**

Holdover times for the fluids are derived for each specific fluid brand, under various temperatures, fluid concentration and precipitation category. Note that the lower limit of the published holdover time is used to indicate the estimated time of protection during moderate precipitation, and the upper limit indicates the estimated time during light precipitation. Heavy conditions are not covered. Therefore, crew experience and airline orientation is required to clearly settle what is heavy, moderate or light. It is very important to determine the appropriate holdover time for the prevailing environmental conditions, and apply them on the line.

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Holdover times should be seen as rough approximations. They simply reflect the average, estimated time an anti-icing fluid should prevent the formation of frozen contaminants on the protected surfaces. Actual holdover times can be reduced or extended due to many factors influencing fluid effectiveness, such as high wind velocity, jet blast, heavy precipitation rates or high moisture content. Recommended practice is to use holdover times in conjunction with a pre-takeoff check to ascertain that frozen deposits have not started to accumulate on treated surfaces. This is a check normally conducted from inside the cockpit.

The pre-takeoff contamination check is normally accomplished from outside the airplane when the airplane cannot be effectively inspected by a pre-takeoff check or when the holdover times has been exceeded. The pilot-in-command must ask for the assistance of trained and qualified ground personnel to assist in the pre-takeoff contamination check, so that wing, empennage and fuselage, which are not visible from the cockpit or cabin, can also be inspected. If contamination is suspected, the airplane should be returned for additional deicing or anti-icing. For practical results, the holdover time must be equal to or greater than the estimated time from start of anti-icing to start of takeoff based on existing weather conditions.

Ensure that deicing and anti-icing are performed at the latest possible time before taxiing to the takeoff position. Always takeoff before hold-over time expires, so as to minimize the period when the airplane stays in line for takeoff and is exposed to contamination. Hold-over time should not be considered an exact figure. It is just an average time, which can be reduced by many factors affecting the fluid effectiveness. In the case of ice build-up after deicing/anti-icing fluid application, do not assume that ice will be blown off during takeoff roll. Ask for deicing/anti-icing fluid reapplication. If the hold-over time expires, carry out a pre-takeoff contamination check and another deicing/anti-icing fluid application is required.

No holdover time guidelines exist for the conditions of snow pellets, snow grains, ice pellets, moderate and heavy freezing rain and hail. In such, takeoffs in snow pellets, snow grains, ice pellets or hail must be preceded by a careful contamination check shortly before takeoff. Takeoff in conditions of moderate and heavy freezing rain is not approved.

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## DEICING AND ANTI-ICING PROCEDURES

Application of deicing and anti-icing fluid must be done by trained and qualified personnel. It is the pilot's responsibility to decide whether or not to accept the airplane for flight. Therefore, it is essential that pilots understand not only how the fluid works and how it is applied, but also the flight crew must be able to determine if the airplane is safe for flight following treatment.

Deicing is required to clean airplane surfaces contaminated by ice, snow, frost or slush. Anti-icing is required to prevent ice accumulation. If both anti-icing and deicing are required, the procedure may be performed in either one or two-step process depending on weather conditions, available equipment, available fluids and the holdover time. However, the frequent use of thickened de/anti-icing fluids in one-step process can result in the accumulation of fluid residues in aerodynamically quiet areas. These residues may re-hydrate when exposed to moisture (e.g., rain or humidity) and subsequently freeze at low temperatures, possibly restricting the movement of the airplane's control surfaces.

Thus, a two-step deicing/anti-icing fluid application is recommended to be performed so that the residues accumulation in the critical areas is minimized. The use of hot water or heated mix of type I fluid/water for the first step of a two step deicing/anti-icing process may also help to clean away residues of thickened fluids from previous applications.

In two separate steps, the airplane is first deiced using heated water only, or a heated mixture of deicing fluid and water. After completion of the deicing operation, anti-icing is performed with diluted or undiluted anti-icing fluid. The second step must be applied before residual liquids from the first deicing step freezes, typically within three minutes. This is especially important where only heated water is used to deicing. Mixing fluids in a two-step procedure may only be performed if approved by the fluid manufacturer.

It is important to keep in mind that in case of a one-step deicing/anti-icing procedure, holdover time starts to run from the beginning of the procedure. With a two-step procedure, the holdover time starts to run at the beginning of the second step.

Under no circumstances should an airplane that has been previously anti-iced receive a further spray of anti-icing fluid directly on top of the anti-icing contaminated film. If an additional protection is necessary before flight, a complete deicing/anti-icing procedure must be performed. Residues from previous treatment must be flushed off first.

All fluids must be used in accordance with the manufacturers' recommendations.

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## GROUND DEICING STRATEGY

The flight crew must understand the overall deicing and anti-icing strategies and insure that the procedures are performed properly to assure themselves that they have a safe airplane for flight.

All soft snow can be mechanically removed by blowing cold air across the airplane surface, using brooms, soft hand scrappers or rubber scrappers. Do not use tools to scrape or scratch compacted snow from the airframe surfaces or from the gaps between fixed or movable surfaces.

Flaps should be up and ailerons in neutral position, parking brake and gust lock should be applied. All doors should be closed.

For fluid applies, the following guidelines are recommended:

- Wings: Apply the fluid from the tip inboard to the root, sweeping from the leading edge in the aft direction. No frozen contamination is allowed on the wing upper surface. A 3 mm (1/8 in) frost layer is permitted on the underwing surfaces.
- Horizontal Stabilizer: It is recommended to set Pitch Trim to any position between 0° and full nose down to prevent APU soft Foreign Object Damage (FOD) ingestion. The best spray is straight in relation to the airplane centerline, in the aft direction (see figure). This is applicable when spraying either over or under the stabilizer surface. Straight spraying (cleaning from the stabilizer tip to the root), will make the fluid flow aft, away from the leading edge area. Spray angles up to 45° are acceptable (see figure), provided the stabilizer is set to full nose down. Back spraying (from trailing edge to leading edge - see figure) is not recommended as it will make spray flow forward and drip from the leading edge into the APU. Side spraying (90° in relation to airplane centerline) has also proved to flow fluid into the APU, either when cleaning the upper or the lower side of the stabilizer.

  Cross spraying the upper side of the stabilizer (truck positioned on the left side of the airplane, aiming the spray the right elevator/stabilizer - see figure) has been proven also to be very effective in removing contaminants and preventing fluids from flowing down into the APU.

  However, cross spray directs fluid to the stab/elevator gap. It may result in fluid accumulation and subsequent dry out in the quiet areas. Therefore, when cross spraying with fluids Type II, III or IV, additional care is required to comply with the requirements of the SNL 145-30-0006 that prescribes residues inspections on those areas.

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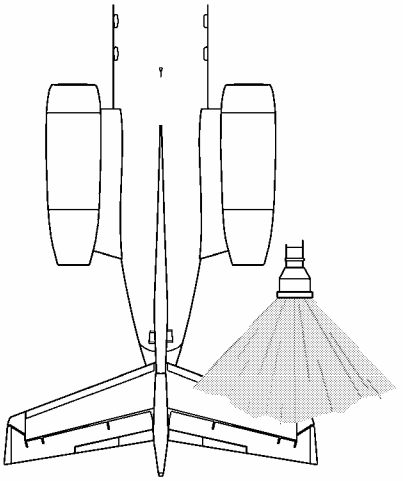

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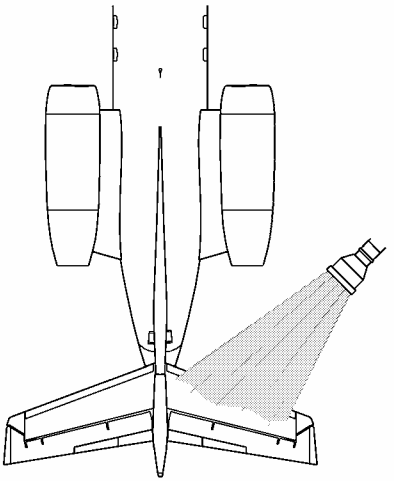
**STRAIGHT APPLICATION IN RELATION TO AIRPLANE CENTERLINE**



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**45° FLUID APPLICATION**

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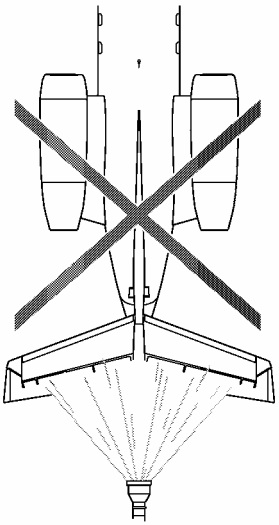

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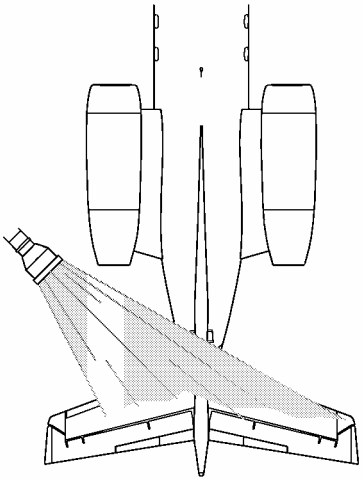
**BACK SPRAYING**



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**CROSS SPRAYING APPLICATION**

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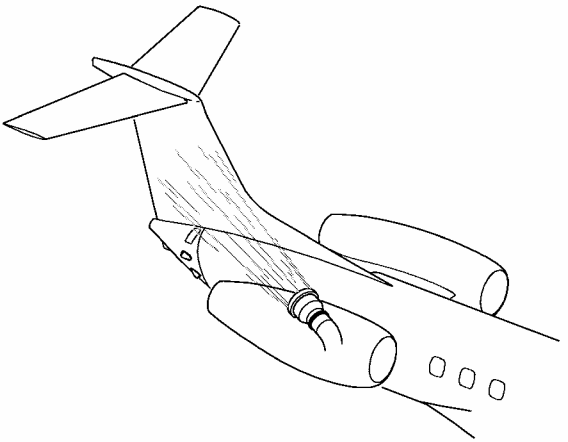
- Vertical Stabilizer and Rudder: Apply the fluid at a low, side angle (see figure), to prevent fluid spills into the APU. The rudder should be in the neutral position. Application on the rudder surface can also cause the fluid to be ingested by the APU. For the vertical surfaces the application should start at the top and then work down.



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**SPRAYING ON THE VERTICAL STABILIZER AND RUDDER**

– Fuselage – Remove all snow accumulated on the nose to avoid snow blowing back during takeoff and restricting pilot's visibility. Fluid should be sprayed along the top centerline of the fuselage and then outboard, letting the fluid cascade down and across the windows. Fluid must not be sprayed directly onto windows and window seals, doors and doors seals, air conditioning scoops or NACA air inlets. A thin layer of hoar frost on the fuselage is permitted, but only to the point you can still see the airplane markings. Check the APU air inlet and surrounding area to ensure that it is clear of ice or snow prior to APU starting. Fluid applied close to inlet area may be ingested and cause flameout and result in APU internal parts damage.

Landing gear and wheel bays – application of fluid in this area must be kept to a minimum. Do not allow water or fluid mixture spray on wheels and brakes to avoid damage to carbon brakes. For this part of the airplane, it is preferable to clear snow or slush using a brush.

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Engines – deposits of snow should be mechanically removed from engine intakes using either brooms, soft hand scrapers or rubber scrappers. Frozen deposits adhering to either the lower surface of the intake or to the fan blades should be removed by the applying hot air. To ensure the safety of ground personnel and passengers, this should be carefully coordinated with the flight crew.

It is also important to examine and remove all ice attached to the surface close to the pitot and static sensors, static ports, TAT probes, AOA sensors, and ice detectors. However, deicing or anti-icing fluid should not be applied directly to these devices. The fluids should be sprayed along the top of the sensors, allowing the fluid to cascade down across the sensor and de-ice it.

**GROUND ANTI-ICING STRATEGY**

Once the airplane has been fully deiced, then it is time to consider the prevention of any further ice contamination prior to takeoff by application of an anti-icing treatment. To prevent frozen contamination on airplane surfaces, the anti-icing operation requires that fluids be distributed uniformly over surfaces. In order to control uniformity, all horizontal surfaces must be visually checked during fluid application. The correct amount is indicated by fluid just beginning to drip off the leading edge. The following surfaces must be protected: wing upper surface and leading edge, horizontal stabilizer upper surface and leading edge, elevator upper surface, vertical stabilizer and rudder, fuselage upper surface.

On the wings, the best results are obtained by starting the spraying at the highest part of the wing section and proceeding towards the leading and trailing edges. On vertical surfaces, start at the top and work down.

A check for fluid coverage and residual ice is required immediately following application of the deicing/anti-icing fluids and should be accomplished by a qualified person. It is possible that fluid may not flow evenly over the protected surfaces. It is essential that the wings, horizontal and vertical stabilizer are properly coated with fluid. It is also important that the fluid be applied symmetrically to both wings so as to ensure that the aerodynamic effect of the fluid remaining is the same on both sides of the airplane.

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## APPROVED DEICING/ANTI-ICING FLUIDS

Only Deicing/Anti-icing fluids certified under specifications below are approved to be used in the EMB-145 airplane models:

| Deicing/Anti-icing Fluid | Specification |
|---|---|
| Type I | SAE AMS 1424 |
| Types II, III and IV | SAE AMS 1428 |

Refer to the fluid manufacturer's recommendations for fluid mixture, if applicable, and holdover times.

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# FORCED AIR DEICING

## GENERAL

Forced air deicing is other alternative process to ground deicing only.

Forced air uses an air stream to remove accumulations of frozen contamination from the airplane with or without fluid. Forced air could provide the option of injecting heated or unheated fluid into the air stream for removal of heavier frozen contamination.

Apply forced air according to the following instructions, considering the use of the pressure supply unit:

- From a distance of 1.5 m to 6 m (5 ft to20 ft).
- With a maximum pressure of 34.5 kPa (5 psi).
- At the minimum angle of the surface.

Additionally, adopt the following precautions:

- Forced air cannot remove adhering contaminants and therefore does not eliminate the need for deicing processes.
- Do not direct forced air into engines, auxiliary intakes/exhausts or the Pitot/Static/AOA sensors, Static Port and TAT.
- Do not use forced air in areas that made of rubber, plastic, or other soft material, because it is possible to damage these areas.
- Do not use forced air near windscreen wipers, because it is possible to damage these areas.
- Be careful to avoid damage to landing gear and wheel bays components when removing ice.
- Prevent ice, snow, or slush from entering and accumulating in aerodynamically quiet areas such as control surface hinge areas or from entering engine inlets.
- To ensure the safety of ground personnel and passengers, coordinate the forced air application carefully with the flight crew.
- It is possible that forced air applications do not eliminate the need for deicing or anti-icing processes.
- A subsequent inspection of the critical surfaces is required after the use of forced air.

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## FORCED AIR DEICING PROCEDURES

Application of deicing method must be done by trained and qualified personnel.

**Airplane Configuration**

- Doors and windows – CLOSED.
- THRUST LEVERS – IDLE.
- PARKING BRAKE – ON.
- FLAPS – UP.
- Pitch trim - full nose down to help in removing contaminants.
- Ailerons - neutral position.
- Rudder - neutral position.
- APU – is recommended to be OFF. If APU is required during the deicing procedure, do not apply hot air directly to or near the APU air inlet.
- APU Bleed - CLOSED.
- Engine Bleed – CLOSED.
- Air conditioning PACKS – OFF.

**Wing and Horizontal Stabilizers** – Apply the forced air from tip inboard to root, from the highest point of surface camber to the lowest. The hot air temperature must not be greater than 80°C (176°F) on these areas.

**Vertical Stabilizer, Dorsal Fin, Rudder, and Winglet** – Start at the top and then work down. The hot air temperature must not be greater than 80°C (176°F) on these areas.

**Fuselage** – Apply the hot air along the top centerline and then outboard, letting the melted ice cascade down and across the windows. The hot air temperature must not be greater than 80°C (176°F) on these areas.

**Nose Radome Area, Windows, and Windshields** – Do not apply hot air directly on cold windshields and windows. It is possible to damage the windows. The hot air temperature must not be greater than 80°C (176°F) on these areas.

Pitot/Static/AOA **Sensors, TAT probes, Pressurization Static Port, and Ice Detectors** – If ice cause blockage of the static port holes or Pitot/Static/AOA sensors, carefully apply hot air until the ice melts.

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**Landing Gear and Wheel Bay Areas** – Remove quantities of blown snow, applying hot air directly towards the wheels, wheel bays, brakes, or tires. Apply hot air also to remove the ice and to release the tires from the ground. The hot air temperature must not be greater than 85°C (194°F). The maximum airspeed must not be greater than 400 km/h (250 mph) on these areas.

**Engine and APU** – Do not direct forced air into engines and auxiliary intakes/exhausts, APU inlet/outlet, air/oil cooling intake, and rear fuselage door. Remove any frozen deposits that are bonded to either lower surface of the intake or the fan blades with the application of hot air. The hot air temperature must not be greater than 93°C (200°F) on these areas.

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# FUEL SYSTEM SERVICING

## PRESSURE REFUELING

Pressure refueling is done by accessing an adapter and a panel located on the right wing-to-fuselage fairing. The adapter is assembled with a valve operated by the opening movement of the fueling nozzle shut-off valve, which is manually controlled. Refer to the FUEL SYSTEM (Section 2-8) for detailed description of the system.

- Connect the ground cable to the airplane.
- Open refueling panel access door on the right side of the fuselage.
- Energize the airplane or set the Power Selection switch to BATTERY.
- Make sure that the refueling CLSD (closed) lights associated with LH and RH tanks are extinguished.
- Make sure that the DEFUELING light is extinguished.
- Make sure that the SELECTED fuel quantity indicator shows zero, select the desired fuel quantity for the airplane.
- Remove the protection cover from the pressure refueling adapter.
- Connect the refueling nozzle to the pressure refueling adapter.
- Pressurize the system (35 - 50 psig).
- Make sure that the refueling CLSD lights associated with LH and RH tanks illuminate and the refueling flow stops.
- Set the REFUELING switch to the OPEN position and make sure that the REFUELING lights associated with the LH and RH tanks extinguish.
- Make sure that the refueling CLSD lights related to LH and RH tanks illuminate, when the desired fuel level is reached.
- For airplanes with High Level Exceeding Indication System if the automatic refueling shutoff fails and the failed tank overfills, the “STOP RFL” red light will illuminate. Stop immediately the refueling operation and defuel the extra fuel of the affected tanks.
- Set the REFUELING switch to the CLOSED position.
- Disconnect the refueling nozzle from the pressure refueling adapter.
- Close the pressure refueling adapter with the protection cover.

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– Set the power selection switch to NORMAL position or deenergize the airplane.

**NOTE:** The power selection switch guard shall be manually closed.

– Disconnect the grounding cable.

**WARNING: MAKE SURE THAT ALL THE SWITCH GUARDS ON THE REFUELING PANEL ARE IN THE CLOSED POSITION.**

– Close access door.

## GRAVITY REFUELING

Wing tanks gravity refueling is accomplished through the filler caps installed on the upper wing surface. Prior to refueling, the refueling nozzle must be grounded through the grounding point at each wing lower surface. The operation consists in opening the filler cap and inserting the refueling nozzle into the filler port. Fuel quantity may be checked through the EICAS indication or through the magnetic measuring sticks in case of failure of the normal indication system.

## FUEL QUALITY CONTROL

Before accepting delivery from the fuel supplier, a check should be made with the purpose of ensuring that fuel intended for use in airplane is in a fit state for use. Fuel should be considered unsatisfactory for use if a sample shows:

– trace of sediments;
– globules of water;
– cloudiness; and
– positive reaction to water detector test.

A visual inspection to a sample should be accomplished to ensure that it does not contain excessive sediment. Generally, aviation turbine fuel is clean, and its color is appropriate to its grade (normally undyed and clear). Apart from cases where water is evidently present in the form of globules, only an appropriate check can be conclusive to indicate the presence of water in a fuel sample.

Both free and suspended water may be present in aviation jet fuel. The water finding paste or paper test method is used to show the presence of free water. The chemical water detector test method is designed to detect suspended water and should be used therefore in addition to the paste/paper method when checking fuels.

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## PRESSURE DEFUELING

- Connect the ground cable to the airplane.
- Energize the airplane.
- Open refueling panel access door on the right side of the fuselage and connect the fuel nozzle to the pressure refueling adapter.
- Set the defueling switch to the OPEN position and make sure that the defueling OPEN light illuminates.
- Apply suction (4 psig MAX) to the nozzle or set the Electric Fuel Pumps switches to the ON position.

  **NOTE:** To defuel the LH tank, set the cross-feed switch to the LOW 2 position.

- When the selected fuel quantity is reached, set the defueling switch to the CLOSED position and make sure its light is extinguished.

**CAUTION:** DO NOT PERMIT THE FUEL PUMPS TO RUN DRY DURING DEFUELING TO PREVENT DAMAGE.

- Set the Electric Fuel Pumps and X-FEED switches to the OFF position.
- Disconnect the refueling nozzle from the pressure refueling adapter.
- Close the pressure refueling adapter with the protection cover.
- Deenergize the airplane if necessary.

  **NOTE:** If Power Selection switch has been used at the BATTERY position, set it back to the NORMAL position and close the switch guard.

- Disconnect the grounding cable from the airplane.

  **WARNING: MAKE SURE ALL THE SWITCH GUARDS ARE AT THE CLOSED POSITION ON THE REFUELING PANEL.**

- Close access door.

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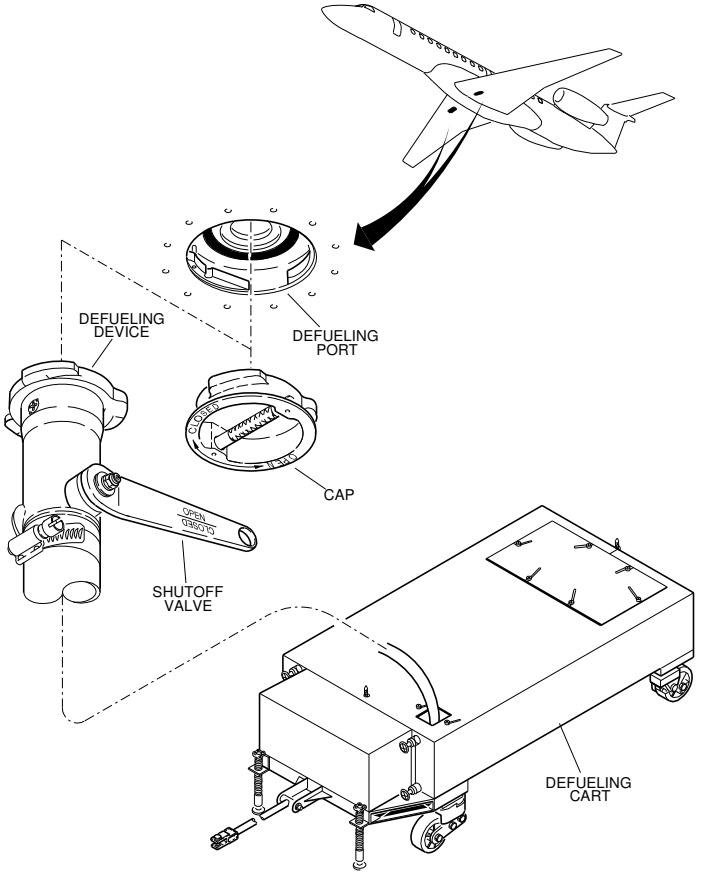
## GRAVITY DEFUELING

Gravity defueling is accomplished through the defueling port installed on the wing lower surface, next to the wing root.




**GRAVITY DEFUELING EQUIPMENT**

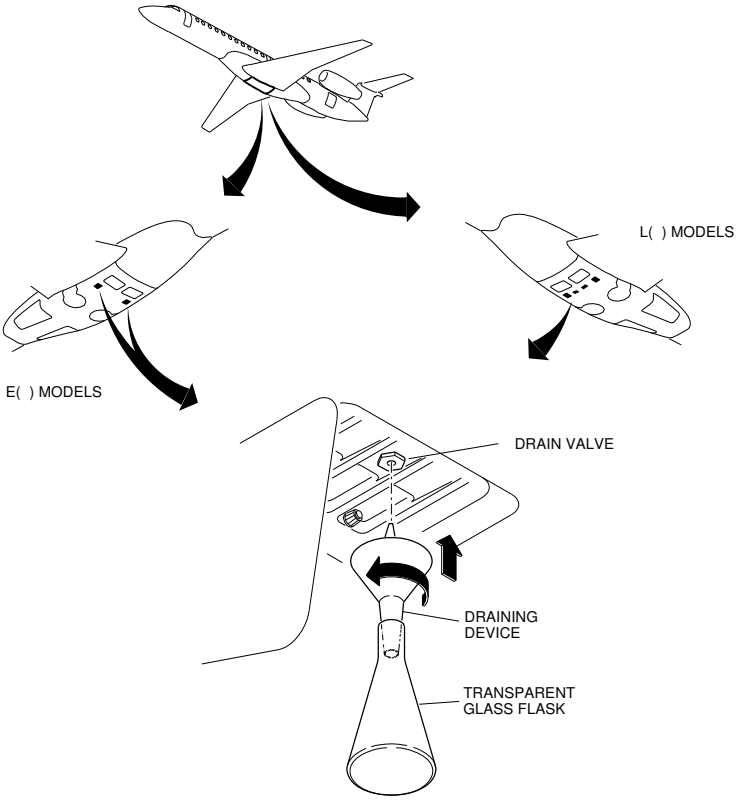
Gravity defueling is accomplished by installing the defueling valve to the defueling port and putting the other hose end into the defueling cart. The airplane must be previously grounded. Opening the shutoff valve will cause the defueling operation to initiate. When the selected remaining quantity is reached, closing the valve will stop defueling.

After the defueling operation is completed, the defueling valve must be removed from the defueling port, and the defueling cap must be closed.

## FUEL TANK DRAINING

Fuel tanks must be drained periodically to remove free water and contaminants from the tank bottom, on intervals no longer than 100 FH or 7 calendar days, whichever occurs first.

To drain, place a flask below the draining device. To open the drain valve, insert the draining device in the valve and turn it one-quarter of turn. Close the access panels after the draining is completed.




**FUEL DRAINING POINTS**

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## MEASURING STICK TABLES

To determine the fuel quantity, the airplane must be laterally leveled with roll angles between -1° to +1°and pitch angles between -2° to +2°. After refueling the airplane, start at the external measuring stick, closer to the wing tip. For airplanes without wing stub tank, between 1503 and 2131 liters (397 and 563 US gal), the external measuring stick provides a correct fuel level indication. Above 2131 liters (563 US gal), it is not possible to measure the fuel level through the measuring sticks. If the external measuring stick provides a zero indication, use the internal measuring stick to obtain the fuel level. It is also not possible to measure the fuel level through the measuring sticks, if it is below 448 liters (118 US gal).

For airplanes with wing stub tank, between 2163 and 2791 liters (571 and 737 US gal) the external measuring stick provides a correct fuel level indication. Above 2791 liters (737 US gal), it is not possible to measure the fuel level through the sticks. If the external measuring stick provides a zero indication, use the internal measuring stick to obtain the fuel level. Between 781 and 2168 liters (206 and 573 US gal) the internal measuring stick provides a correct fuel level indication. If the internal measuring stick provides a zero indication, use the wing stub stick to obtain the fuel level. It is also not possible to measure the fuel level through the measuring sticks, if it is below 7 liters (2 US gal).

Enter the measuring stick tables with the value read on the stick to obtain the fuel quantity (liters or US gal). To find the fuel mass in kg (lb) multiply the volume in liters (US gal) by the actual fuel density in kg/l (lb/US gal).

**NOTE: -** Do not add measuring sticks values.

- After the airplane refueling or after the fuel pumps are turned OFF, it is necessary to wait 10 minutes before reading the measuring sticks.

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| STICK POSITION | | AIRPLANES WITHOUT WING STUB TANK | | AIRPLANES WITH WING STUB TANK | |
|---|---|---|---|---|---|
| | | *LITERS* | *US GAL* | *LITERS* | *US GAL* |
| Wing Stub Tank | Min | -- | -- | 7 | 2 |
| | Max | -- | -- | 783 | 207 |
| Internal Point | Min | 448 | 118 | 781 | 206 |
| | Max | 1553 | 410 | 2168 | 573 |
| External Point | Min | 1503 | 397 | 2163 | 571 |
| | Max | 2131 | 563 | 2791 | 737 |

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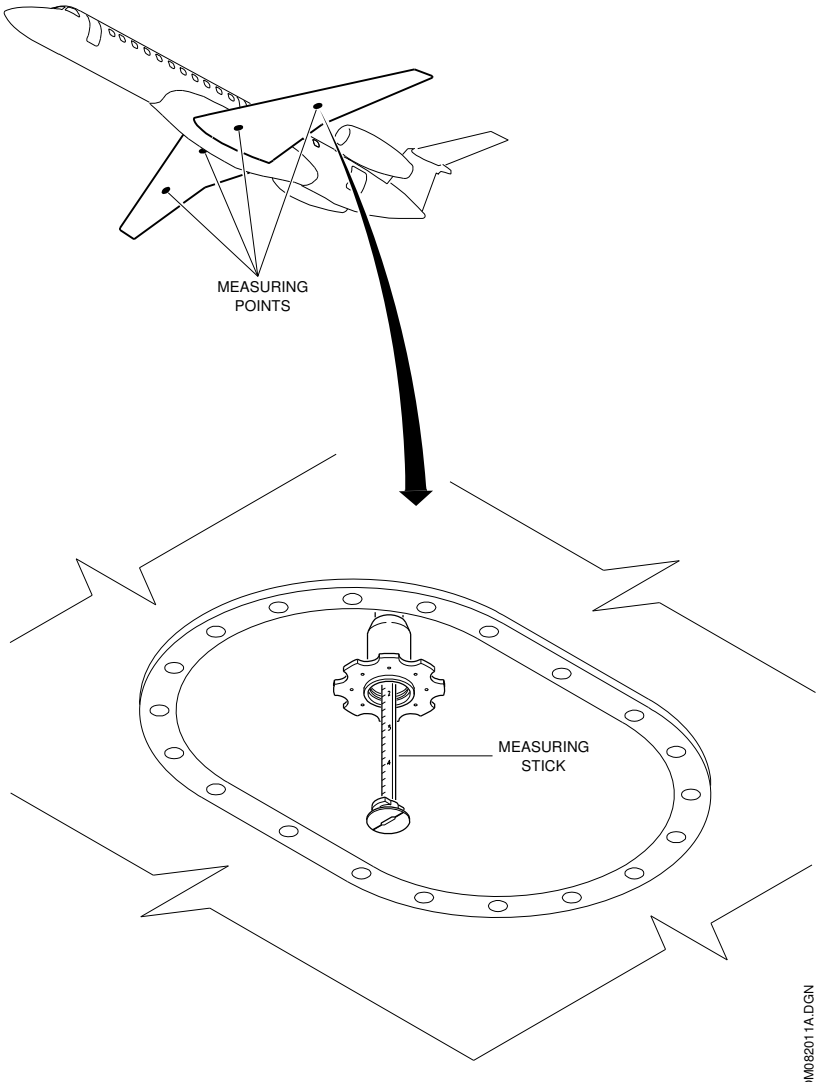
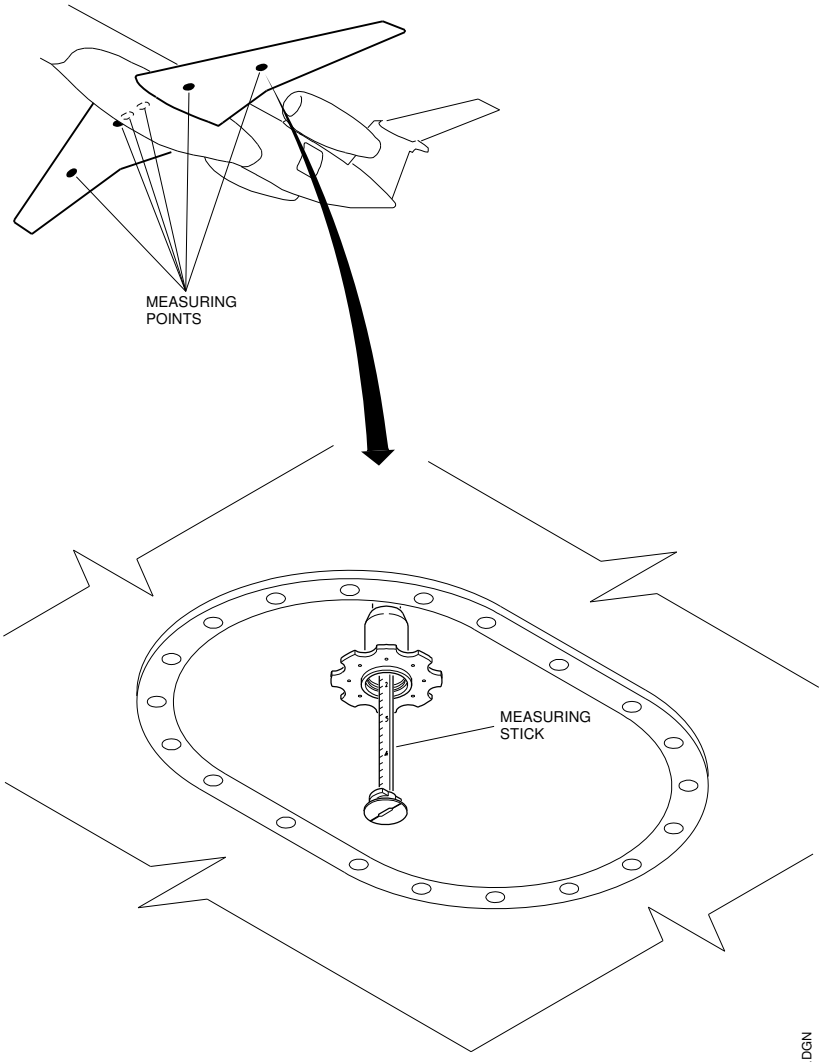



**MEASURING STICK POINTS**
**(AIRPLANES WITHOUT WING STUB TANK)**




## MEASURING STICK POINTS (AIRPLANES WITH WING STUB TANK)

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| STICK INDICATION | FUEL QUANTITY | | | |
|---|---|---|---|---|
| | INTERNAL STICK | | EXTERNAL STICK | |
| | *LITERS* | *US GAL* | *LITERS* | *US GAL* |
| 0.1 | 448 | 118 | 1503 | 397 |
| 0.2 | 455 | 120 | 1516 | 401 |
| 0.3 | 462 | 122 | 1530 | 404 |
| 0.4 | 469 | 124 | 1543 | 408 |
| 0.5 | 476 | 126 | 1556 | 411 |
| 0.6 | 483 | 128 | 1570 | 415 |
| 0.7 | 490 | 129 | 1583 | 418 |
| 0.8 | 497 | 131 | 1597 | 422 |
| 0.9 | 505 | 133 | 1610 | 425 |
| 1.0 | 512 | 135 | 1623 | 429 |
| 1.1 | 520 | 137 | 1637 | 432 |
| 1.2 | 527 | 139 | 1645 | 435 |
| 1.3 | 535 | 141 | 1663 | 439 |
| 1.4 | 543 | 143 | 1677 | 443 |
| 1.5 | 550 | 145 | 1690 | 447 |
| 1.6 | 558 | 148 | 1703 | 450 |
| 1.7 | 566 | 150 | 1717 | 454 |
| 1.8 | 574 | 152 | 1730 | 457 |
| 1.9 | 582 | 154 | 1744 | 461 |
| 2.0 | 591 | 156 | 1757 | 464 |
| 2.1 | 599 | 158 | 1770 | 468 |
| 2.2 | 607 | 160 | 1784 | 471 |
| 2.3 | 615 | 163 | 1797 | 475 |
| 2.4 | 624 | 165 | 1810 | 478 |
| 2.5 | 632 | 167 | 1824 | 482 |
| 2.6 | 641 | 169 | 1837 | 485 |
| 2.7 | 650 | 172 | 1851 | 489 |
| 2.8 | 658 | 174 | 1864 | 492 |

**MEASURING STICK TABLES (SHEET 1 OF 4)**
**(AIRPLANES WITHOUT WING STUB TANK)**

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| STICK INDICATION | FUEL QUANTITY | | | |
|---|---|---|---|---|
| | INTERNAL STICK | | EXTERNAL STICK | |
| | *LITERS* | *US GAL* | *LITERS* | *US GAL* |
| 2.9 | 667 | 176 | 1877 | 496 |
| 3.0 | 676 | 179 | 1891 | 499 |
| 3.1 | 685 | 181 | 1904 | 503 |
| 3.2 | 694 | 183 | 1917 | 507 |
| 3.3 | 703 | 186 | 1931 | 510 |
| 3.4 | 712 | 188 | 1944 | 514 |
| 3.5 | 721 | 191 | 1957 | 517 |
| 3.6 | 730 | 193 | 1971 | 521 |
| 3.7 | 740 | 195 | 1984 | 524 |
| 3.8 | 749 | 198 | 1998 | 528 |
| 3.9 | 759 | 200 | 2011 | 531 |
| 4.0 | 768 | 203 | 2024 | 535 |
| 4.1 | 778 | 205 | 2037 | 538 |
| 4.2 | 787 | 208 | 2051 | 542 |
| 4.3 | 797 | 211 | 2064 | 545 |
| 4.4 | 807 | 213 | 2078 | 549 |
| 4.5 | 817 | 216 | 2091 | 552 |
| 4.6 | 827 | 218 | 2104 | 556 |
| 4.7 | 837 | 221 | 2118 | 560 |
| 4.8 | 847 | 224 | 2131 | 563 |
| 4.9 | 857 | 226 | - | - |
| 5.0 | 868 | 229 | - | - |
| 5.1 | 878 | 232 | - | - |
| 5.2 | 888 | 235 | - | - |
| 5.3 | 899 | 237 | - | - |
| 5.4 | 909 | 240 | - | - |

**MEASURING STICK TABLES (SHEET 2 OF 4)**
**(AIRPLANES WITHOUT WING STUB TANK)**

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| STICK INDICATION | FUEL QUANTITY | |
|---|---|---|
| | INTERNAL STICK | |
| | *LITERS* | *US GAL* |
| 5.5 | 920 | 243 |
| 5.6 | 930 | 246 |
| 5.7 | 941 | 249 |
| 5.8 | 952 | 252 |
| 5.9 | 963 | 254 |
| 6.0 | 974 | 257 |
| 6.1 | 985 | 260 |
| 6.2 | 996 | 263 |
| 6.3 | 1007 | 266 |
| 6.4 | 1018 | 269 |
| 6.5 | 1030 | 272 |
| 6.6 | 1041 | 275 |
| 6.7 | 1052 | 278 |
| 6.8 | 1064 | 281 |
| 6.9 | 1076 | 284 |
| 7.0 | 1087 | 287 |
| 7.1 | 1099 | 290 |
| 7.2 | 1111 | 293 |
| 7.3 | 1123 | 297 |
| 7.4 | 1134 | 300 |
| 7.5 | 1146 | 303 |
| 7.6 | 1159 | 306 |
| 7.7 | 1171 | 309 |
| 7.8 | 1183 | 312 |
| 7.9 | 1195 | 316 |
| 8.0 | 1208 | 319 |
| 8.1 | 1220 | 322 |
| 8.2 | 1232 | 326 |

**MEASURING STICK TABLES (SHEET 3 OF 4)**
**(AIRPLANES WITHOUT WING STUB TANK)**

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

| STICK INDICATION | FUEL QUANTITY | |
|---|---|---|
| | INTERNAL STICK | |
| | *LITERS* | *US GAL* |
| 8.3 | 1245 | 329 |
| 8.4 | 1258 | 332 |
| 8.5 | 1270 | 336 |
| 8.6 | 1283 | 339 |
| 8.7 | 1296 | 342 |
| 8.8 | 1309 | 346 |
| 8.9 | 1322 | 349 |
| 9.0 | 1335 | 353 |
| 9.1 | 1348 | 356 |
| 9.2 | 1361 | 360 |
| 9.3 | 1374 | 363 |
| 9.4 | 1388 | 367 |
| 9.5 | 1401 | 370 |
| 9.6 | 1415 | 374 |
| 9.7 | 1428 | 377 |
| 9.8 | 1442 | 381 |
| 9.9 | 1455 | 385 |
| 10.0 | 1469 | 388 |
| 10.1 | 1483 | 392 |
| 10.2 | 1497 | 395 |
| 10.3 | 1511 | 399 |
| 10.4 | 1525 | 403 |
| 10.5 | 1539 | 407 |
| 10.6 | 1553 | 410 |

**MEASURING STICK TABLES (SHEET 4 OF 4)**
**(AIRPLANES WITHOUT WING STUB TANK)**

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

| STICK IND | FUEL QUANTITY | | | | | |
|---|---|---|---|---|---|---|
| | INTERNAL STICK | | EXTERNAL STICK | | WING STUB STICK | |
| | *LITERS* | *US GAL* | *LITERS* | *US GAL* | *LITERS* | *US GAL* |
| 0.1 | 781 | 206 | 2163 | 571 | 7 | 2 |
| 0.2 | 794 | 210 | 2184 | 577 | 14 | 4 |
| 0.3 | 805 | 213 | 2203 | 582 | 22 | 6 |
| 0.4 | 817 | 216 | 2220 | 586 | 29 | 8 |
| 0.5 | 827 | 219 | 2235 | 590 | 36 | 10 |
| 0.6 | 838 | 221 | 2249 | 594 | 43 | 11 |
| 0.7 | 848 | 224 | 2263 | 598 | 50 | 13 |
| 0.8 | 858 | 227 | 2276 | 601 | 56 | 15 |
| 0.9 | 868 | 229 | 2288 | 605 | 63 | 17 |
| 1.0 | 878 | 232 | 2301 | 608 | 69 | 18 |
| 1.1 | 888 | 235 | 2314 | 611 | 74 | 20 |
| 1.2 | 898 | 237 | 2327 | 615 | 80 | 21 |
| 1.3 | 907 | 240 | 2340 | 618 | 85 | 23 |
| 1.4 | 917 | 242 | 2354 | 622 | 90 | 24 |
| 1.5 | 927 | 245 | 2368 | 626 | 95 | 25 |
| 1.6 | 937 | 248 | 2383 | 630 | 100 | 26 |
| 1.7 | 947 | 250 | 2398 | 633 | 104 | 28 |
| 1.8 | 957 | 253 | 2413 | 638 | 109 | 29 |
| 1.9 | 968 | 256 | 2429 | 642 | 113 | 30 |
| 2.0 | 978 | 258 | 2445 | 646 | 116 | 31 |
| 2.1 | 989 | 261 | 2461 | 650 | 120 | 32 |
| 2.2 | 1000 | 264 | 2477 | 654 | 123 | 33 |
| 2.3 | 1011 | 267 | 2493 | 659 | 129 | 34 |
| 2.4 | 1022 | 270 | 2508 | 663 | 136 | 36 |
| 2.5 | 1034 | 273 | 2524 | 667 | 140 | 37 |
| 2.6 | 1045 | 276 | 2539 | 671 | 144 | 38 |
| 2.7 | 1057 | 279 | 2553 | 674 | 148 | 39 |

**MEASURING STICK TABLES (SHEET 1 OF 4)**
**(AIRPLANES WITH WING STUB TANK)**

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

| STICK IND | FUEL QUANTITY | | | | | |
|---|---|---|---|---|---|---|
| | INTERNAL STICK | | EXTERNAL STICK | | WING STUB STICK | |
| | *LITERS* | *US GAL* | *LITERS* | *US GAL* | *LITERS* | *US GAL* |
| 2.8 | 1069 | 282 | 2567 | 678 | 155 | 41 |
| 2.9 | 1081 | 286 | 2580 | 682 | 164 | 43 |
| 3.0 | 1093 | 289 | 2593 | 685 | 173 | 46 |
| 3.1 | 1105 | 292 | 2604 | 688 | 181 | 48 |
| 3.2 | 1118 | 295 | 2615 | 691 | 188 | 50 |
| 3.3 | 1130 | 299 | 2625 | 693 | 195 | 51 |
| 3.4 | 1143 | 302 | 2634 | 696 | 201 | 53 |
| 3.5 | 1156 | 305 | 2643 | 698 | 207 | 55 |
| 3.6 | 1169 | 309 | 2651 | 700 | 213 | 56 |
| 3.7 | 1182 | 312 | 2658 | 702 | 218 | 58 |
| 3.8 | 1194 | 316 | 2666 | 704 | 224 | 59 |
| 3.9 | 1208 | 319 | 2673 | 706 | 229 | 60 |
| 4.0 | 1221 | 322 | 2680 | 708 | 234 | 62 |
| 4.1 | 1234 | 326 | 2687 | 710 | 239 | 63 |
| 4.2 | 1247 | 329 | 2696 | 712 | 244 | 64 |
| 4.3 | 1260 | 333 | 2706 | 715 | 249 | 66 |
| 4.4 | 1273 | 336 | 2717 | 718 | 254 | 67 |
| 4.5 | 1286 | 340 | 2731 | 721 | 259 | 68 |
| 4.6 | 1300 | 343 | 2747 | 726 | 265 | 70 |
| 4.7 | 1313 | 347 | 2767 | 731 | 270 | 71 |
| 4.8 | 1326 | 350 | 2791 | 737 | 276 | 73 |

**MEASURING STICK TABLES (SHEET 2 OF 4)**
**(AIRPLANES WITH WING STUB TANK)**

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| STICK INDICATION | FUEL QUANTITY | | | |
|---|---|---|---|---|
| | INTERNAL STICK | | WING STUB STICK | |
| | *LITERS* | *US GAL* | *LITERS* | *US GAL* |
| 4.9 | 1339 | 354 | 281 | 74 |
| 5.0 | 1352 | 357 | 287 | 76 |
| 5.1 | 1365 | 361 | 293 | 78 |
| 5.2 | 1378 | 364 | 300 | 79 |
| 5.3 | 1391 | 368 | 306 | 81 |
| 5.4 | 1404 | 371 | 313 | 83 |
| 5.5 | 1418 | 374 | 320 | 85 |
| 5.6 | 1431 | 378 | 327 | 86 |
| 5.7 | 1444 | 381 | 334 | 88 |
| 5.8 | 1457 | 385 | 342 | 90 |
| 5.9 | 1470 | 388 | 350 | 92 |
| 6.0 | 1483 | 392 | 357 | 94 |
| 6.1 | 1496 | 395 | 365 | 97 |
| 6.2 | 1509 | 399 | 374 | 99 |
| 6.3 | 1522 | 402 | 382 | 101 |
| 6.4 | 1535 | 405 | 390 | 103 |
| 6.5 | 1548 | 409 | 399 | 105 |
| 6.6 | 1561 | 412 | 408 | 108 |
| 6.7 | 1574 | 416 | 416 | 110 |
| 6.8 | 1588 | 419 | 425 | 112 |
| 6.9 | 1601 | 423 | 434 | 115 |
| 7.0 | 1615 | 427 | 443 | 117 |
| 7.1 | 1629 | 430 | 452 | 119 |
| 7.2 | 1642 | 434 | 461 | 122 |
| 7.3 | 1656 | 438 | 470 | 124 |
| 7.4 | 1670 | 441 | 479 | 126 |
| 7.5 | 1685 | 445 | 488 | 129 |
| 7.6 | 1699 | 449 | 497 | 131 |

**MEASURING STICK TABLES (SHEET 3 OF 4)**
**(AIRPLANES WITH WING STUB TANK)**

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

| STICK INDICATION | FUEL QUANTITY | | | |
|---|---|---|---|---|
| | INTERNAL STICK | | WING STUB STICK | |
| | *LITERS* | *US GAL* | *LITERS* | *US GAL* |
| 7.7 | 1714 | 453 | 505 | 134 |
| 7.8 | 1729 | 457 | 514 | 136 |
| 7.9 | 1744 | 461 | 523 | 138 |
| 8.0 | 1759 | 465 | 532 | 141 |
| 8.1 | 1774 | 469 | 541 | 143 |
| 8.2 | 1790 | 473 | 550 | 145 |
| 8.3 | 1806 | 477 | 558 | 147 |
| 8.4 | 1822 | 481 | 567 | 150 |
| 8.5 | 1838 | 486 | 576 | 152 |
| 8.6 | 1855 | 490 | 585 | 154 |
| 8.7 | 1872 | 494 | 593 | 157 |
| 8.8 | 1889 | 499 | 602 | 159 |
| 8.9 | 1906 | 503 | 611 | 161 |
| 9.0 | 1923 | 508 | 620 | 164 |
| 9.1 | 1941 | 513 | 629 | 166 |
| 9.2 | 1958 | 517 | 639 | 169 |
| 9.3 | 1976 | 522 | 648 | 171 |
| 9.4 | 1994 | 527 | 658 | 174 |
| 9.5 | 2012 | 531 | 668 | 176 |
| 9.6 | 2030 | 536 | 679 | 179 |
| 9.7 | 2048 | 541 | 689 | 182 |
| 9.8 | 2065 | 546 | 701 | 185 |
| 9.9 | 2083 | 550 | 713 | 188 |
| 10.0 | 2101 | 555 | 725 | 192 |
| 10.1 | 2118 | 560 | 738 | 195 |
| 10.2 | 2135 | 564 | 752 | 199 |
| 10.3 | 2152 | 568 | 767 | 203 |
| 10.4 | 2168 | 573 | 783 | 207 |

**MEASURING STICK TABLES (SHEET 4 OF 4)**
**(AIRPLANES WITH WING STUB TANK)**

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## REFUELING WITH AN ENGINE RUNNING

Refueling the airplane with an engine running is not recommended. Apart from the risk of fire, there is the risk posed for the maintenance and other personnel who are required to move around the airplane.

There may be circumstances in which an Airport Authority agrees with a detailed procedure that offers an acceptable level of safety to all parts involved. This would, however, be a matter between the Airport Authority and the individual operator. Therefore, contact the Airport Authority prior to performing this operation and/or obtain the necessary approval from the operations inspector.

To refuel the airplane with an engine running, proceed as follows:

- Have the passengers disembarked (refer to the “Deplaning or Boarding with One Engine Running” procedure ahead).
- The airplane must be parked in an area designated by the Airport Authority, with free access to fire fighting equipment and personnel.
- Keep the main door open and the stairs deployed.
- Shut down the right engine.
- Set the left engine to idle power.
- At least one pilot must remain in the cockpit during the refueling. This pilot is responsible for informing all flight and ground crew that the airplane is being refueled and the engine is running.
- During the refueling procedure, do not turn on switches, except those required to operate the fuel system. Set all airplane systems before initiating refueling, in order to avoid moving controls during refueling. Sparks of any kind must be avoided. The use of mobile phones must not be allowed.
- Smoking is prohibited during the refueling, both inside and outside the cabin.
- Only pressure refueling is recommended and, to avoid the possibility of fuel spillage, fueling should be limited to 90% of the tank capacity.
- In the case of fuel spillage, shut down the operating engine.

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## DEPLANING OR BOARDING WITH ONE ENGINE RUNNING

The following precautions are recommended:

- At least one pilot must remain in the cockpit.
- Turn the left engine off.
- Set the right engine to idle power.
- Provide safety precautions for passengers on the ground. Isolate the right side of the airplane so that no passenger can get access to this area.

## REFUELING WITH PASSENGERS ON BOARD OR EMBARKING/DISEMBARKING

The following precautions are recommended:

- At least one pilot must remain in the cockpit during the refueling procedure. This pilot is responsible for informing all the flight and ground crew that the airplane is being refueled with passengers on board or embarking/disembarking.
- Engines must be off.
- Crew, staff, and passengers must be warned that refueling will take place;
- “Fasten Seat Belts” signs must be off;
- “No Smoking” signs must be on together with interior lights to enable the emergency exits to be noticed;
- Passengers must be instructed to unfasten their seat belts and refrain from smoking;
- Sufficient qualified personnel must be on board and be prepared for an immediate emergency evacuation;
- If the presence of fuel vapors is detected inside the airplane, or any other hazard arises during refueling, fueling must be interrupted immediately;
- Aisles and emergency doors must be kept unobstructed, as well as the ground area beneath the exits.

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## RECOMMENDATIONS FOR APU START AND OPERATION WHILE REFUELING

If the APU is operating during refueling:

- Respect APU limitations.
- APU start is allowed during refueling if the start is an initial start or a restart after a normal shutdown.
- APU shutdown is allowed during the refueling operations.

If the APU fails to start during refueling:

- Complete refueling prior to another start attempt.
- Do not attempt to start the APU before disconnection of the fuel hose.

In case of an APU fire:

- Stop the refueling operation
- Accomplish the APU FIRE procedure.

In case of fuel spillage:

- Stop the refueling operation.
- Shut down the APU.
- Do not start the APU until the spillage is removed.

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# ENGINE OIL SERVICING

The engine oil tank features an oil level sight gage and an oil level/low level warning sensor. To check oil level in the engine, open its access door and observe the sight glass. It must never exceed the FULL mark.

The engine oil consumption rate is considered high when it increases above the typical consumption rate for the engine, or is equal to or more than 10.1 ounces per hour (0.32 quarts per hour or 300cc per hour). Engine oil consumption rates may increase as engine hours/cycles increase.

High oil consumption indicates something is not functioning properly or possibly a leak which should be addressed by maintenance personnel when convenient. In the absence of other problems associated with the high oil consumption rate there is no mandatory action. Engine oil consumption rates can increase as engine hours/cycles increase.

To fill the tank with oil, proceed as follows:

– Remove the filler cap from the engine oil tank.
– There is an O-ring on the filler cap that must be checked for dents, cracks or breakage. Remove and visually inspect this O-ring.
– Replace the O-ring, if necessary.
– Prior to the first engine run of the day, pour oil through the filler neck observing that the one quart mark on the sight gauge is not exceeded.
– Prior to other flights of the day, if the quantity is below the three quart mark on the sight gauge, fill the oil tank until the oil reaches the two quart mark on the sight gauge.

**NOTE:** Servicing the oil tank to levels other than above could cause an indication of a high oil pressure condition during takeoff.

– After filling the tank, put the O-ring and the filler cap back in place and make sure that it is properly installed and tightened.

**NOTE:** Assure an adequate oil quantity to avoid low oil level indication in flight (8 quarts recommended).

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## APPROVED ENGINE OIL TYPES

| SPECIFICATION | COMMERCIAL PRODUCT | SUPPLIER |
|---|---|---|
| MIL-PRF 23699D STD | Aeroshell/Royco Turbine Oil 500 | Shell/Royal Lubricants |
| | BPTO 2380 | Air BP Lubricants |
| | Mobil Jet II | Mobil |
| MIL-PRF-23669 HTS | Mobil Jet Oil 254 | |
| | BPTO 2197 | Air BP Lubricants |
| MIL-PRF-7808 | Mobil RM 284A | Mobil |

**CAUTION:**

- IF MIXED WITH OTHER OILS, MOBIL JET OIL 254 CAN CAUSE WASHING OR SHEDDING OR CARBON DEPOSITS LEFT BY THOSE OILS. THIS CLEANING PROCESS CAN LEAD TO OIL SYSTEM PROBLEMS, SUCH AS BLOCKED PASSAGEWAYS AND SCREENS. CHANGING FROM BPTO 2380, MIL JET II OR AEROSHELL/ROYCO 500, TO MOBIL JET 254 SHOULD ONLY BE DONE WHEN THE ENGINE IS NEW OR OVERHAULED.
- USE OF NON-APPROVED OIL COULD RESULT IN DAMAGE AND PREMATURE ENGINE FAILURE.
- IF OIL BRANDS ARE CHANGED, IT SHOULD BE ACCOMPLISHED GRADUALLY USING THE “TOP OFF” METHOD.
- DO NOT MIX MIL-PRF-23669D STD AND MIL-PRF-7808.
- USE OF MIL-PRF-7808 TYPE OIL SHOULD BE LIMITED TO ONLY THOSE TIMES WHEN OPERATING IN EXTREME COLD WITHOUT PREHEAT CAPABILITY (-40°F TO -65°F) OR WHEN MIL-PRF-7808 IS THE ONLY TYPE OF OIL AVAILABLE.

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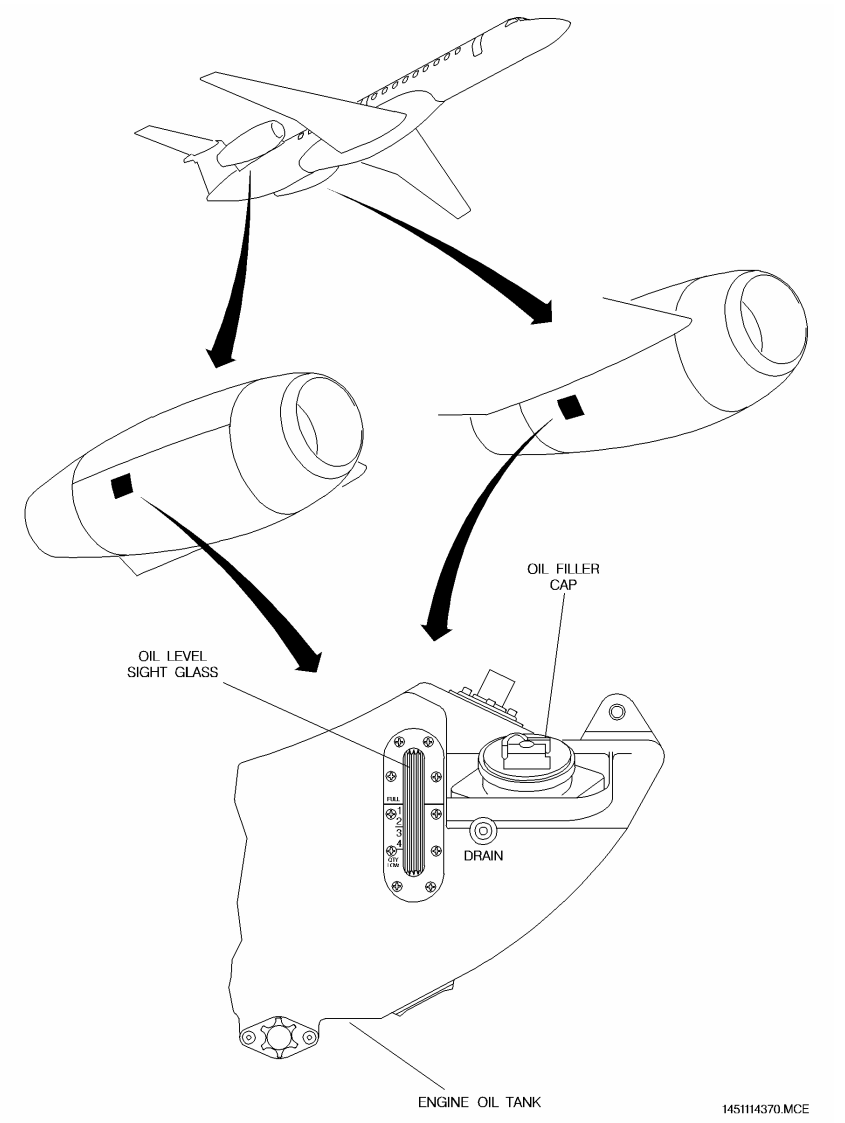


## ENGINE OIL FILLING AND OIL LEVEL CHECK

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# APU OIL SERVICING

APU oil tank servicing is done through the access at the airplane tail cone which, when open, provides access to a sight glass and an oil filler cap. The sight glass has a FULL indication which must never be exceeded.

## APPROVED APU OIL TYPES

| SPECIFICATION | COMMERCIAL PRODUCT | SUPPLIER |
|---|---|---|
| MIL-PRF-7808 | Aeroshell Turbine Oil 390 | Shell |
| | BPTO 2389 | Local supplier |
| | Castrol 325 | Castrol |
| | Mobil Avrex S Turbo 256 | Local supplier |
| MIL-PRF-23699 | Castrol 5000 | Castrol |
| | Castrol 5050 | Castrol |
| | Calstex Sato 5S | Local supplier |
| | BPTO 2197 | Air BP Lubricants |
| | BPTO 2380 | |
| | Hatcol 3211 | Local supplier |
| | Mobil Jet Oil II | Mobil |
| | Mobil Jet Oil 254 | Mobil |
| | Aeroshell/Royco Turbine Oil 500 | Royal Lubricants<br>Shell<br>Aeropia<br>Aero Hardware |
| | Aeroshell/Royco Turbine Oil 560 | Local supplier |
| | Total Aero Turbine Oil 535 | Local supplier |
| | Turbonycoil 525-2A | Nyco |
| | Turbonycoil TN 600 | Nyco |

**CAUTION:**
- DO NOT FILL THE APU OIL TANK WITH AN OIL OF A DIFFERENT BRAND FROM THAT WHICH IS IN THE TANK, EVEN IF THE SPECIFICATION IS THE SAME (REFER TO THE PLACARD ATTACHED TO THE ACCESS DOOR).
- DO NOT ALLOW THE OIL LEVEL TO EXCEED THE "FULL" MARK ON THE SIGHT PLUG. AN OVERFILLED TANK WILL RESULT IN OIL FOAMING, HIGH TEMPERATURE, AND LOW OIL PRESSURE.

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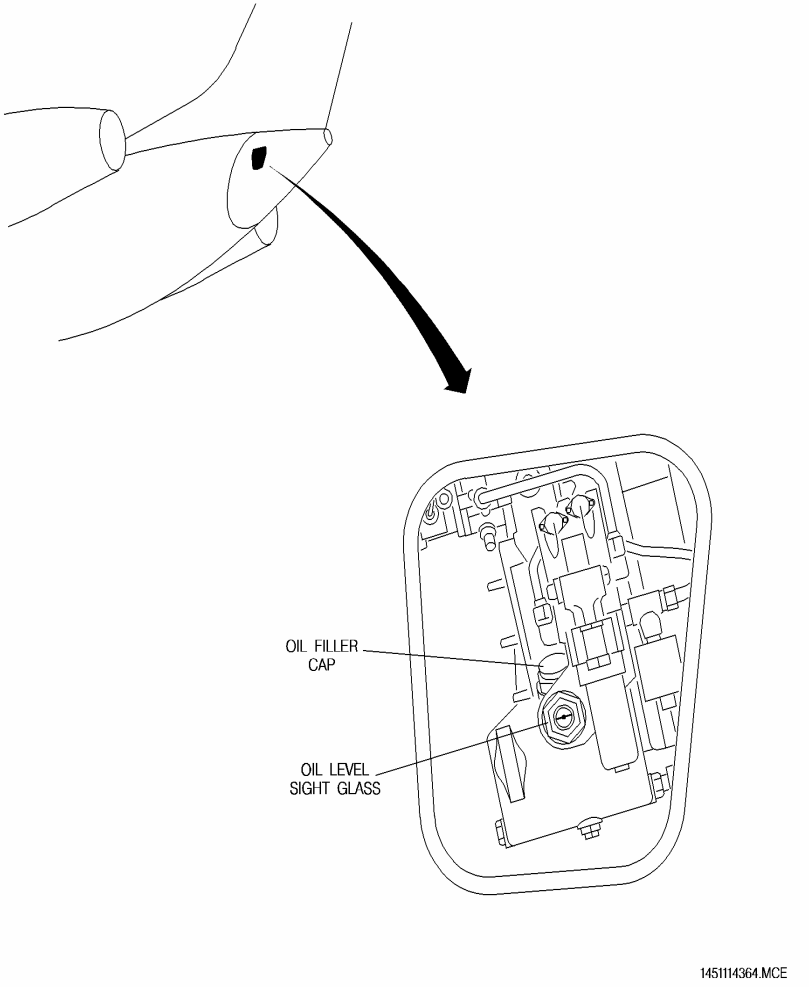


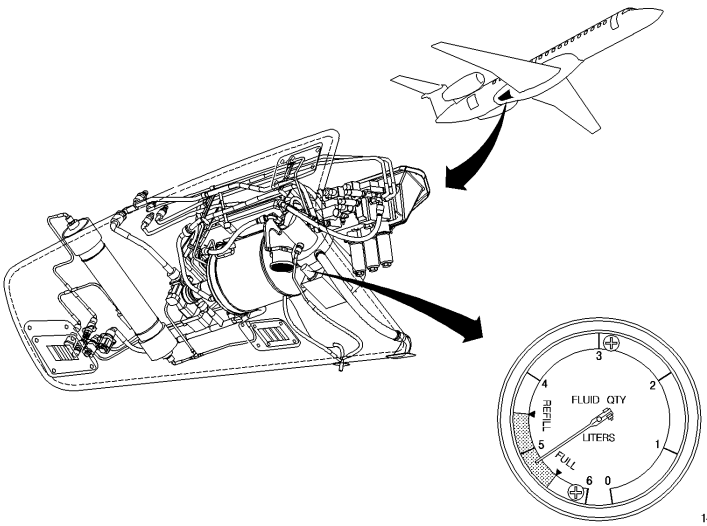

## APU OIL FILLING AND OIL LEVEL CHECK

# HYDRAULIC SYSTEM SERVICING

## HYDRAULIC FLUID LEVEL CHECK

Gain access through the panel located aft of the wing fairing (on both sides of the aircraft). On the hydraulic fluid level indicator, make sure the needle pointer is between the 4.5 and 5.5 liter marks (normal range). The shaded region is the dispatchability range. If the pointer is below the refill mark, fill the reservoir until you have the correct full level mark. Low oil level in the reservoir can be a sign that there is a leak in the system. After servicing the hydraulic system, close the related hydraulic fluid reservoir access panel.
If level indicator is inoperative, it is still possible to check fluid level, but a maintenance technician is required to do the job.

**CAUTION:** USE ADEQUATE GOGGLES AND RUBBER GLOVES WHILE SERVICING HYDRAULIC SYSTEM. IN CASE HYDRAULIC FLUID COMES IN CONTACT WITH THE SKIN, FLUSH THE AFFECTED AREA WITH WATER. IN CASE HYDRAULIC FLUID COMES IN CONTACT WITH THE EYES, FLUSH THEM WITH WATER AND SEEK MEDICAL ATTENTION.




**CHECK OF HYDRAULIC FLUID LEVEL**

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# LANDING GEAR SERVICING

## MAIN AND NOSE LANDING GEAR SHOCK ABSORBER PRESSURE

The main and nose landing gear shock absorber sometimes need nitrogen to be filled. Nitrogen is filled through a charging valve installed at the landing gear. Filling pressure is a function of the piston height, as checked in the charts below (there are separate charts for nose and main landing gears).

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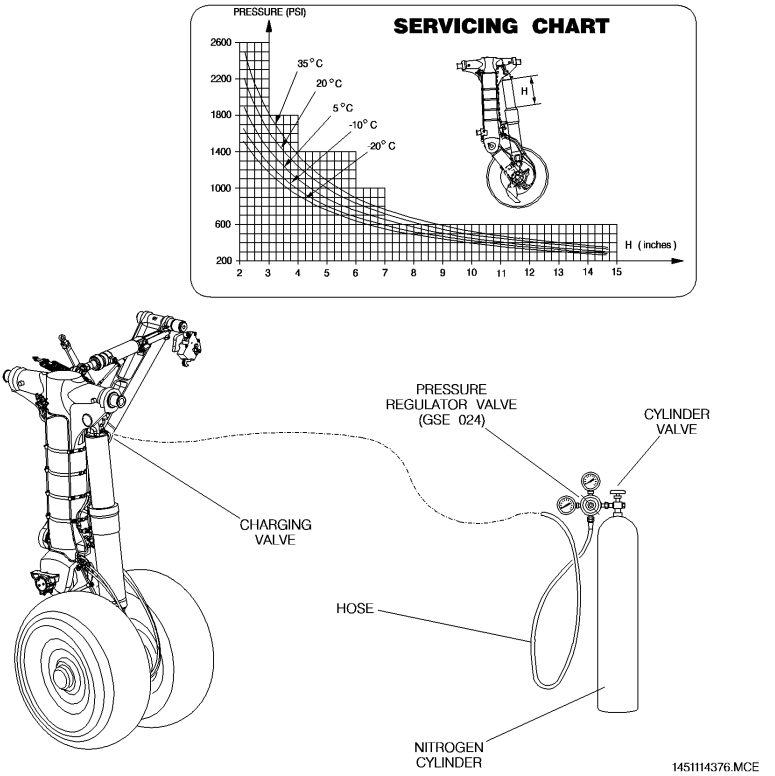
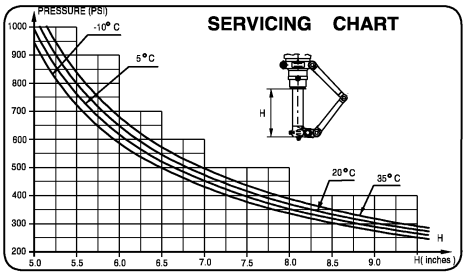
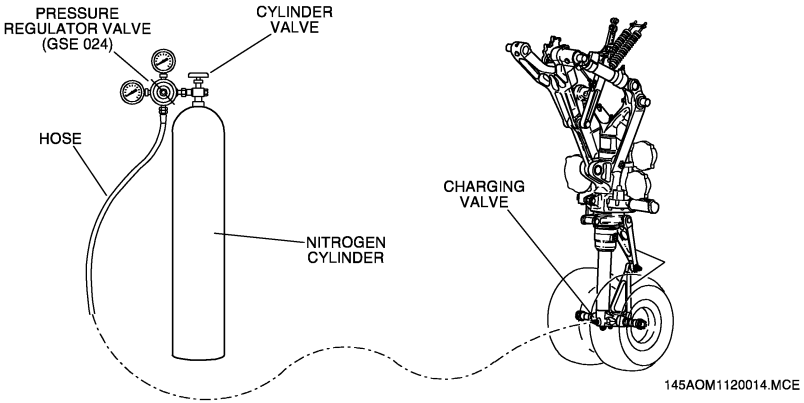



**MAIN LANDING GEAR SERVICING**




(TYPICAL)




## NOSE LANDING GEAR SERVICING

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# TIRE PRESSURE

| AIRPLANE VERSION | NOSE TIRE PRESSURE (PSI) (Loaded) | MAIN TIRE PRESSURE (PSI) (Loaded) |
|---|---|---|
| EMB-145 ER | 82 +4/-0 | 145 +5/-0 |
| EMB-145 EU | 82 +4/-0 | 145 +5/-0 |
| EMB-145 EP | 82 +4/-0 | 148 +5/-0 |
| EMB-145 MP/MK | 84 +2/-2 | 150 +3/-3 |
| EMB-145 LR/LU | 84 +2/-2 | 160 +4/-4 |
| EMB-135 ER | 84 +2/-2 | 134 +3/-3 |
| EMB-135 LR | 84 +2/-2 | 148 +3/-3 |
| ERJ-140 ER (EMB-135 KE) | 84 +2/-2 | 145 +3/-3 |
| ERJ-140 LR (EMB-135 KL) | 84 +2/-2 | 153 +3/-3 (*)<br>148 +3/-3 (**) |
| EMB-145 XR | 84 +2/-2 | 175 +4/-4 |

(*) Airplanes equipped with main tire dimension H30x9.5-16 16PR

(**) Airplanes equipped with main tire dimension 30x9.5-14 16PR

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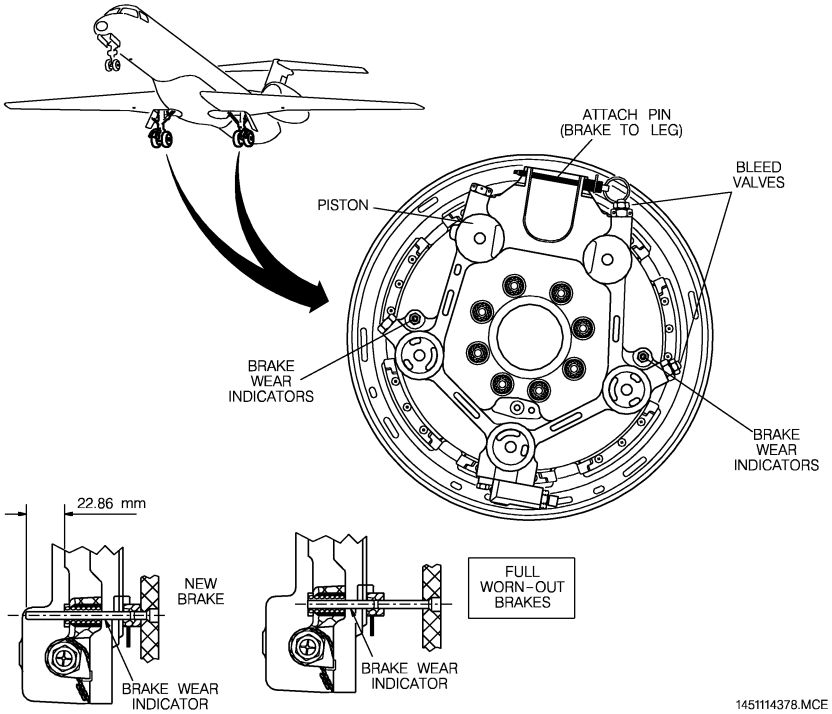
## BRAKE WEAR INDICATOR

Checking the brake wear indicators is required during walk-arounds, as prescribed in the approved Airplane Flight Manual, according to the following procedure:




- Operate the emergency/parking brake handle and visually verify all pistons (2) of the brake assembly for operation.
  Brake wear indicator positions must be inspected with brake pressurized (brake applied).
- Inspect the brake wear indicators for visible cracks.
- Inspect the brake wear indicators length. The length of the brake wear indicator for a new brake is 22.86 mm (0.90 in). When the indicator rod is flat with the hexagonal insert, the brakes are full worn out and should be replaced.
- If one or more of the brake wear indicators does not come out of the piston housing, the brake assembly must be replaced.

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# CREW OXYGEN MASK STOWAGE

## EROS OXYGEN MASK

Stowage box ..... OPEN

Supply hose ..... WIND AND PUT IN BOX

Before winding the supply hose, make sure it is not twisted.

Pneumatic Harness ..... FOLD INTO THE MASK

Crew Mask ..... PUT IN BOX

Make sure the pneumatic harness does not interfere with the retainers.

Make sure that the tabs in the front of the crew oxygen mask is on the top of the plastic stop in the stowage box assembly and the supply hose is at the center of the stowage box.

Left lid of the stowage box ..... CLOSE

Test/shut-off button ..... PUSH

OXY ON flag ..... CHECK

Make sure that the "OXY ON" flag cannot be seen.

Hole of the red plate ..... CONNECT TO DOOR PIN

Connect the hole of the red plate to the door pin in the stowage box assembly .

Right lid of the stowage box ..... CLOSE

Test/shut-off sliding control lever ..... PUSH

Push the lever in the indicated direction. A white band becomes visible beneath the lever. The oxygen is supplied to the mask regulator.

Blinker ..... CHECK

A yellow blinker is displayed for a short time indicating that there is no leak in the mask regulator assembly.

Test/shut-off sliding control lever ..... RELEASE

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## PURITAN OXYGEN MASK

Stowage box ..... OPEN

Supply hose ..... WIND AND PUT IN BOX

Before winding the supply hose, make sure it is not twisted.

Pneumatic Harness..... FOLD INTO THE MASK

Crew Mask ..... PUT IN BOX

Make sure the pneumatic harness does not interfere with the retainers. Make sure that the mask regulator is at the center of the stowage box.

Lids of the stowage box ..... CLOSE

OXY ON flag ..... CHECK

If the OXY ON flag is visible:

Test/reset button ..... PUSH

Test/reset button ..... PUSH

OXY ON flag ..... CHECK

The oxygen is supplied to the mask regulator.

Blinker ..... CHECK

A yellow blinker is displayed for a short time indicating that there is no leak in the mask regulator assembly.

Test/reset button ..... RELEASE

The OXY ON flag goes out of view.

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# OXYGEN SERVICING

A 50-cu.ft oxygen cylinder is installed on the right side of the cockpit/passenger cabin partition. This cylinder is designated for pilot, copilot and observer use during emergencies. Its pressure can be checked on the EICAS, inside the cockpit, and through an access panel located on the right side of the aiplane nose. Minimum pressure for dispatch of the main cylinder is:

- Crew made up of pilot and copilot: 1100 psi
- Crew made up of pilot, copilot and observer: 1500 psi

Portable oxygen cylinders are distributed along the cabin for passenger and flight attendant emergencies. For airplane dispatchability, the minimum pressure shown on the gauge of the portable oxygen cylinder must be in accordance with the minimum guideline set either for the airline or regulator authority.

Dispatching pressures were calculated for an ambient temperature of 21°C (70°F). For other temperatures, a correction chart is available at the Operations Manual.

**WARNING: HIGH-PRESSURE OXYGEN CAN CAUSE SUDDEN COMBUSTION BY CONTACT WITH OIL, GREASE, SOLVENTS, HYDROCARBONS IN GENERAL, CLOTH FIBERS, METAL CHIPS, ETC. QUALIFIED PERSONNEL ONLY MUST HANDLE AND SERVICE THE OXYGEN EQUIPMENT.**

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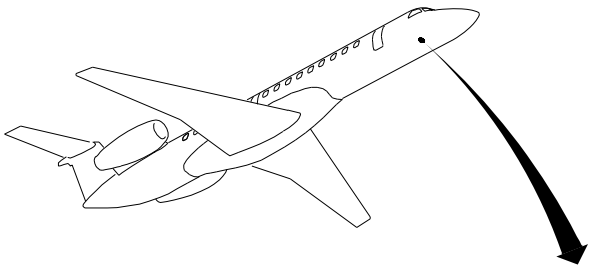

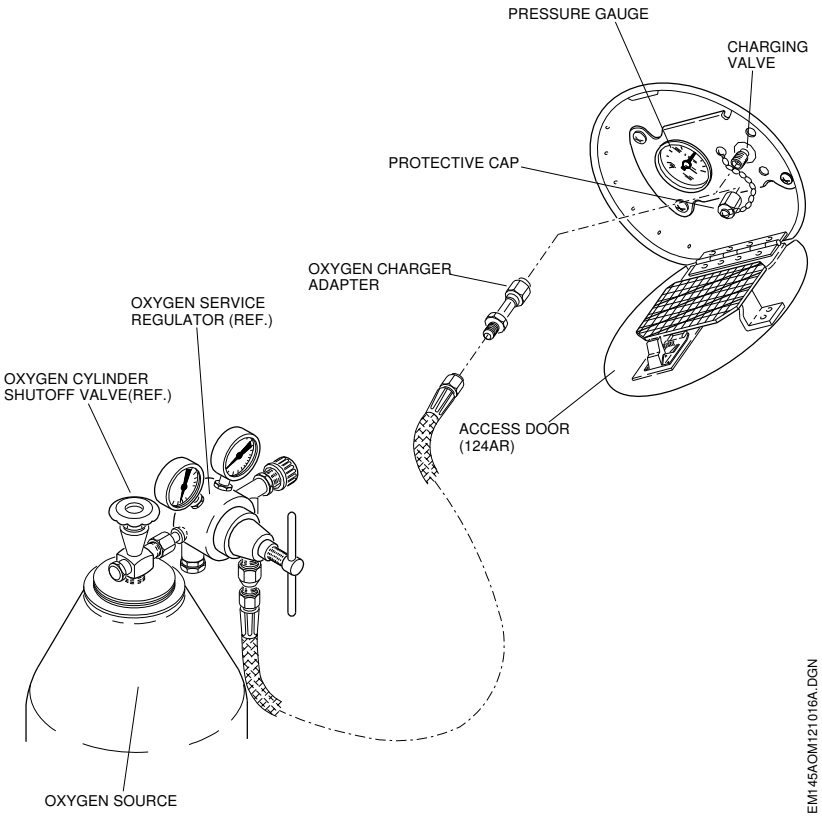


## OXYGEN SERVICING

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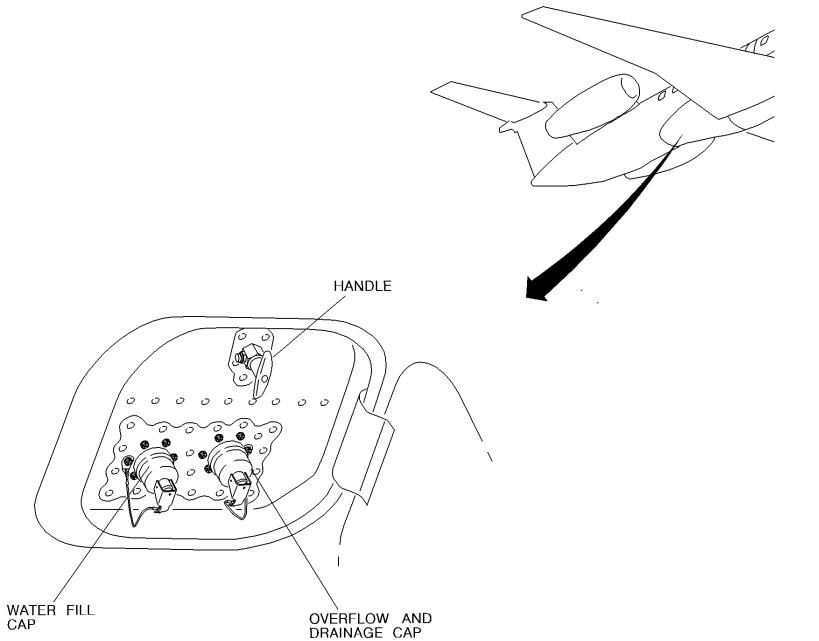
# WATER TANK SERVICING

Filling and draining of the water tank is done through a panel installed on the lower right side of the fuselage aft section.

The tank is drained through the water drain installed on the servicing panel, near its control handle. To drain the water tank, remove the cap and pull the handle.

Draining is recommended when freezing or icing conditions are forecast after the last flight and parking overnight.

To fill the tank (20 liters - 5.3 US gallons) of water, caps from the water filling connection and from the tank overflow must be removed. The tanks is full when water starts to flow through the overflow.




**WATER TANK DRAINING AND FILLING**

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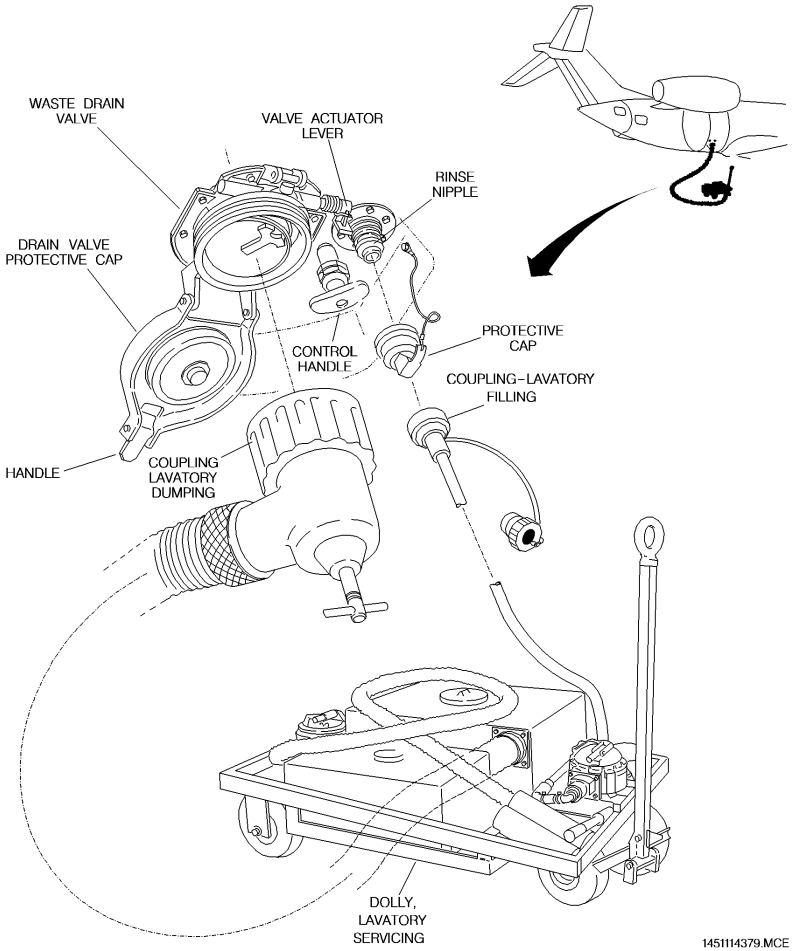
# TOILET SERVICING

Toilet waste disposal servicing is accomplished by accessing a panel at the rear right side of the fuselage. A sanitary service unit must be connected to the aircraft service panel.




**TOILET SERVICING**

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Servicing the toilet waste tank is accomplished as follows:

**NOTE:** Commercial deodorants and disinfectants can be added to the waste tank, but the tank definitive volume must not contain such material.

- Open waste-service-panel door.
- Remove the protective cap from the toilet rinse nipple.
- Release the handle and open the cap of the waste drain valve.
- Connect the lavatory dumping coupling of the lavatory servicing dolly to the waste drain valve.
- Connect the lavatory filling coupling to the rinse nipple.
- Push the lever of the waste drain-valve actuator to open its internal flapper valve. Do not operate the coupling handle; its operation is not necessary.
- Pull and lock the drain control handle to open the holding-tank drain valve.
- Continue the tank drainage until the waste flow stops.
- Flush with water through the rinse nipple for approximately 3 minutes.
- Release the control cable.
- Fill the waste holding tank with 15 liters (4 gal) of water.
- Pull and lock the drain control handle to open the holding-tank drain valve.
- Release the drain control handle after all liquid is drained.
- Fill the waste holding tank with a maximum of 7.5 liters (2 gal) of water and then add:
  - 57 grams (2 oz.) of Monogram MC-2000 germicidal deodorant, or;
  - 170 grams (6 oz.) of Mirabowl "Q" germicidal deodorant.
- Disconnect the lavatory dumping and filling couplings.
- Close the cap and latch the handle of the waste drain valve. The flapper valve will close automatically when the cap is closed.
- Install the cap on the toilet rinse nipple.

**NOTE:** The access door will close only if the waste drain valve is correctly closed.

- Close waste-service-panel door.

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# GROUND RESETS

The purpose of this chapter is to provide flight crew with information and procedures to clear nuisance EICAS messages and miscellaneous nuisance faults.

This chapter does not cover all messages or faults that may be detected on the airplane. Any message or fault not covered by this document must be reported to the maintenance personnel.

Standard procedures must be established to instruct the flight crew how to proceed when a nuisance message or fault is presented before starting to follow this chapter after dispatch. These procedures may vary for different airports.

This chapter is organized in a four-column table, as follows:

- ATA column: gives the ATA number for the related message or fault.
- MESSAGE or CONDITION column: provides the messages or fault condition, alphabetically ordered. Messages are referred in capital letters and conditions are referred in plain text.
- LOCATION column: indicates the location of the fault or annunciation.
- PROCEDURES column: provides the proper procedures required to clear the nuisance EICAS message or fault. It may also provide the effectivity of the procedure or Fault Condition in which the procedure applies.

**NOTE:** This chapter does not constitute an operational approval. If Local Regulatory Authority approval is required, it should be obtained by the operator.

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## LIMITATIONS

This chapter shall be used under the following condition:

- Airplane on the ground with parking brake set.
- Each procedure may be performed only once per flight leg. If the nuisance EICAS message or fault is not cleared, maintenance personnel must be notified to clear the condition.
- Effectivity and Fault Condition must be observed. Ground Resets Procedures should be accomplished only if the applicable effectivity and fault conditions are satisfied. Applicable effectivity and fault conditions are listed preceding the procedures. Those procedures that do not have effectivity and fault conditions listed preceding the procedures can be accomplished to every model and conditions, observing the preceding items.

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | Absence of ADF 1 bearing information on the RMU and on the PFD and MFD (Transitory condition of Integrated Navigation Unit 1) | ADF | (1) Set the cursor of RMU 1 to the ADF 1 window.<br>(2) Do the test of the frequency selection:<br>(a) Put the cursor on the selected frequency code.<br>(b) Turn the dual concentric knobs.<br>A frequency code can be set.<br>(3) Do the self-test:<br>(a) Set the RMU 1 to the ADF 1 window.<br>(b) Push and hold the RMU TST function key.<br>On the RMU, the ADF 1 window shows:<br>– TEST and ADF TEST (amber).<br>– TEST (amber) and ADF PASS (green), at the end of the test cycle.<br>**NOTE:** An ADF ERR (red) is the indication that the selected ADF is defective. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | Absence of ADF 2 bearing information on the RMU and on the PFD and MDF (Transitory condition of Integrated Navigation Unit 2) | ADF | (1) Set the cursor of RMU 2 to the ADF 2 window.<br>(2) Do the test of the frequency selection:<br>(a) Put the cursor on the selected frequency code.<br>(b) Turn the dual concentric knobs.<br>A frequency code can be set.<br>(3) Do the self-test:<br>(a) Set the RMU to the ADF 2 window.<br>(b) Push and hold the RMU TST function key.<br>On the RMU, the ADF 2 window shows:<br>– TEST and ADF TEST (amber).<br>– TEST (amber) and ADF PASS (green), at the end of the test cycle.<br>**NOTE:** An ADF ERR (red) is the indication that the selected ADF is defective. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | Absence of DME 1 distance information on the RMU and on the PFD and MFD (Transitory condition of Integrated Navigation Unit 1) | DME | (1) On RMU 1, push the DME function key.<br>(2) Move the cursor of RMU 1 to the DME 1 window.<br>(3) Do the test of frequency selection:<br>(a) Put the cursor on the selected frequency code.<br>(b) Turn the dual concentric knobs.<br>A frequency code can be set.<br>(4) Do the self-test:<br>(a) Set the RMU 1 to the DME 1 window.<br>(b) Push and hold the RMU TST function key.<br>On the RMU, the DME 1 window shows:<br>– TEST and DME TEST (amber).<br>– TEST (amber) and DME PASS (green), at the end of the test cycle.<br>**NOTE:** A DME ERR (red) is the indication that the selected DME is defective. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | Absence of DME 2 distance information on the RMU and on the PFD and MFD (Transitory condition of Integrated Navigation Unit 2) | DME | (1) On RMU 2, push the DME function key.<br>(2) Move the cursor of RMU 2 to the DME 2 window.<br>(3) Do the test of frequency selection:<br>(a) Put the cursor on the selected frequency code.<br>(b) Turn the dual concentric knobs.<br>A frequency code can be set.<br>(4) Do the self-test:<br>(a) Set the RMU 2 to the DME 2 window.<br>(b) Push and hold the RMU TST function key.<br>On the RMU, the DME 2 window shows:<br>– TEST and DME TEST (amber).<br>– TEST (amber) and DME PASS (green), at the end of the test cycle.<br>**NOTE:** A DME ERR (red) is the indication that the selected DME is defective. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 24 | Absence of electrical power at some buses (Transitory condition of the electrical circuit) | GPU | (1) Energize airplane with external DC power supply.<br>(2) Check that output voltage of external power is 28 ± 0.5 V DC.<br>(3) Check that BATT 1-2 switches, BUS TIE switch, and ESSENTIAL POWER pushbutton (pushbutton released), on the electrical panel, on the overhead panel, are set at the AUTO position.<br>(4) Check that GPU pushbutton, on the electrical panel, on the overhead panel, is set at ON (GPU pushbutton pushed).<br>(5) Set the ELEC PWR switch, on the maintenance panel, to RESET. |
| 23 | ACARS/ DMU failure message on FMS (Transitory condition of the CMU) | ACARS | Make sure the CMU ground service is active and ready to use.<br>Make sure the CMU is correctly installed.<br>Check if the fault occurred during the airplane power-up.<br>**NOTE:** The CMU takes approximately 1 minute or 2 minutes to restart. During this time, the CDU displays ACARS DMU FAILED. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 27 | Aileron – No roll control through the switch (Transitory condition of the roll trim electrical circuit) | AILERON | Make sure that the ROLL TRIM circuit breaker is closed.<br>Energize the airplane with hydraulic pressure.<br>Do a roll trim test through the roll trim switch:<br>(1) Push the roll trim switch to the LWD position for approximately 3 seconds. The roll trim system is automatically deactivated in 3 seconds.<br>(2) Push the roll trim switch to the RWD position for approximately 3 seconds. The roll trim system is automatically deactivated in 3 seconds. |
| 34 | ALT Flag on the ISIS (SMITHS and THALES) | ISIS | (1) On the circuit breaker panel, open and close the INTEG STBY circuit breaker.<br>**NOTE:** Before turning on the ISIS, make sure that there is no dynamic pressure applied to Pitot/Static 3. It must be equivalent to an airspeed equal to or greater than 60 knots.<br>The airplane must be maintained stationary during the ISIS initialization.<br>(2) The display shows an initialization page for 70 seconds (ISIS SMITHS) or for 90 seconds (ISIS THALES).<br>(3) Wait until the ISIS completes its initialization. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | ATT Flag on the ISIS (SMITHS and THALES) | ISIS | (1) On the circuit breaker panel, open and close the INTEG STBY circuit breaker.<br>**NOTE:** Before turning on the ISIS, make sure that there is no dynamic pressure applied to Pitot/Static 3. It must be equivalent to an airspeed equal to or greater than 60 knots.<br>The airplane must be maintained stationary during the ISIS initialization.<br>(2) The display shows an initialization page for 70 seconds (ISIS SMITHS) or for 90 seconds (ISIS THALES).<br>(3) Wait until the ISIS completes its initialization. |
| 34 | CAGE Flag on the ISIS (THALES) | ISIS | (1) Push the CAGE button to cage the Integrated Standby Instrument System (ISIS) and do not move the ISIS during this phase.<br>**NOTE:** The "ATT 10s" indication replaces the ATT CAGE flag to show that the ISIS is in the attitude reset (caging) phase.<br>In flight, the pilot must maintain the airplane in straight and level flight and at constant speed before pushing the CAGE button during this phase.<br>(2) Make sure that the attitude function has been set to the true value in stabilized condition. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 31 | CAS Message displayed on the PFD | IC-600 | On the copilot's reversionary panel, set the MFD selector to the EICAS position. To check which the discrepant message is, compare the messages on the copilot's MFD with the ones presented on the EICAS. In a discrepant message on the EICAS:<br>– Open the IC-600 1 circuit breaker, wait a few seconds, and close it back. Wait for the IC system initialization. Do the comparison again. |
| 27 | Directional Trim Locked (Rudder trim switch has to be pressed 3 times before the surface responds and the system operates at the fourth try) (Transitory condition of yaw trim electrical circuit) | Rudder Trim | Pressurize the hydraulic system.<br>Do the operational check of the yaw trim:<br>– Move the YAW TRIM switch to the LEFT position.<br>On the EICAS display, the arrow of the YAW TRIM indication moves to the left.<br>**NOTE:** The system cycle is limited in 3 seconds, after this time you must to release the switch and move it again to get another cycle.<br>– Release the YAW TRIM switch, it goes to neutral position by itself.<br>On the EICAS display, the arrow of the YAW TRIM indication remains at last position.<br>– Move the YAW TRIM switch to the RIGHT position.<br>On the EICAS display, the arrow of the YAW TRIM indication goes from LEFT to RIGHT position. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 27 | Directional Trim Locked (Yaw trim surface is locked at the RH position) (Transitory condition of the Yaw Trim electrical circuit) | Yaw Trim | Pressurize the hydraulic system.<br>Do the operational check of the yaw trim:<br>– Move the YAW TRIM switch to the LEFT position.<br>On the EICAS display, the arrow of the YAW TRIM indication moves to the left.<br>**NOTE:** The system cycle is limited in 3 seconds, after this time you must to release the switch and move it again to get another cycle.<br>– Release the YAW TRIM switch, it goes to neutral position by itself.<br>On the EICAS display, the arrow of the YAW TRIM indication remains at last position.<br>– Move the YAW TRIM switch to the RIGHT position.<br>On the EICAS display, the arrow of the YAW TRIM indication goes from LEFT to RIGHT position. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 28 | FCU L (R) ARINC 429 message appears on the repeater indicator panel | FCU | Do the electrical fuel quantity indication check.<br>On the repeater indicator panel, set the toggle switch to the TEST position and clear the fault message.<br>If passes the electrical fuel quantity indication check, reset is ok. |
| 28 | FCU L (R) FAIL message on the repeater indicator panel | FCU | Do the electrical fuel quantity indication check.<br>On the repeater indicator panel, set the toggle switch to the TEST position and clear the fault message.<br>If passes the electrical fuel quantity indication check, reset is ok. |
| 34 | HDG Flag on the ISIS (SMITHS and THALES) | ISIS | (1) On the circuit breaker panel, open and close the INTEG STBY circuit breaker.<br>**NOTE:** Before turning on the ISIS, make sure that there is no dynamic pressure applied to Pitot/Static 3. It must be equivalent to an airspeed equal to or greater than 60 knots.<br>The airplane must be maintained stationary during the ISIS initialization.<br>(2) The display shows an initialization page for 70 seconds (ISIS SMITHS) or for 90 seconds (ISIS THALES).<br>(3) Wait until the ISIS completes its initialization. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | M Flag on the ISIS | ISIS | (1) On the circuit breaker panel, open and close the INTEG STBY circuit breaker.<br>**NOTE:** Before turning on the ISIS, make sure that there is no dynamic pressure applied to Pitot/Static 3. It must be equivalent to an airspeed equal to or greater than 60 knots.<br>The airplane must be maintained stationary during the ISIS initialization.<br>(2) The display shows an initialization page for 90 seconds.<br>(3) Wait until the ISIS completes its initialization. |
| 34 | MAINT Indication on the ISIS | ISIS | (1) On the circuit breaker panel, open and close the INTEG STBY circuit breaker.<br>**NOTE:** Before turning on the ISIS, make sure that there is no dynamic pressure applied to Pitot/Static 3. It must be equivalent to an airspeed equal to or greater than 60 knots.<br>The airplane must be maintained stationary during the ISIS initialization.<br>(2) The display shows an initialization page for 90 seconds.<br>(3) Wait until the ISIS completes its initialization. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 28 | MFD shows dashes instead of wing fuel quantity | FCU | Get access to the maintenance panel. Set the fuel page on the MFD. Move the "FUEL QTY IND" toggle switch on the maintenance panel.<br>(1) The EICAS display shows these messages and indications:<br>– FUEL 1-2 LO LEVEL (WARNING).<br>– TANK 1-2 shows 1130 kg ± 10 kg (2500 lb).<br>(2) The MFD shows these indications:<br>– TANK 1 – 1130 kg ± 10 kg (2500 lb).<br>– TANK 2 – 1130 kg ± 10 kg (2500 lb).<br>– TOTAL – 2260 kg (5000 lb).<br>(3) The warning lights flash.<br>(4) The aural warning operates (bell).<br>**NOTE:** After 10 seconds, the preceding indications go back to the normal condition.<br>Press one of the master warning lights to stop the lights.<br>If passes the electrical fuel quantity indication check, reset is ok. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | SPD Flag on the ISIS | ISIS | (1) On the circuit breaker panel, open and close the INTEG STBY circuit breaker.<br>**NOTE:** Before turning on the ISIS, make sure that there is no dynamic pressure applied to Pitot/Static 3. It must be equivalent to an airspeed equal to or greater than 60 knots.<br>The airplane must be maintained stationary during the ISIS initialization.<br>(2) The display shows an initialization page for 90 seconds.<br>(3) Wait until the ISIS completes its initialization. |
| 34 | SSEC Annunciation on the ISIS | ISIS | (1) On the circuit breaker panel, open and close the INTEG STBY circuit breaker.<br>**NOTE:** Before turning on the ISIS, make sure that there is no dynamic pressure applied to Pitot/Static 3. It must be equivalent to an airspeed equal to or greater than 60 knots.<br>The airplane must be maintained stationary during the ISIS initialization.<br>(2) The display shows an initialization page for 90 seconds.<br>(3) Wait until the ISIS completes its initialization. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 22 | The rudder servo motor does not actuate (Transitory condition of Integrated Computer) | IC-600 | (1) Energize the airplane with the External DC Power supply.<br>(2) Pressurize the hydraulic system. Operational check of the Yaw trim:<br>(a) Move the YAW TRIM switch to the LEFT position. On the EICAS display, the arrow of the YAW TRIM indication moves to the left. **NOTE:** The system cycle time is limited in 3 seconds, after this time you must to release the switch and move it again to get another cycle.<br>(b) Release the YAW TRIM switch, it goes to neutral position by itself. On the EICAS display, the arrow of the YAW TRIM indication remains at last position.<br>(c) Move the YAW TRIM switch to the RIGHT position. On the EICAS display, the arrow of the YAW TRIM indication goes from LEFT to RIGHT position.<br>(3) Release the pressure of the hydraulic system. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | VMO/MMO Flag on the ISIS | ISIS | (1) On the circuit breaker panel, open and close the INTEG STBY circuit breaker.<br>**NOTE:** Before turning on the ISIS, make sure that there is no dynamic pressure applied to Pitot/Static 3. It must be equivalent to an airspeed equal to or greater than 60 knots.<br>The airplane must be maintained stationary during the ISIS initialization.<br>(2) The display shows an initialization page for 90 seconds.<br>(3) Wait until the ISIS completes its initialization. |
| | | | |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | AHRS 1 ATT MODE | EICAS | (1) After the airplane is brought to a stop at the ramp or hangar, power off the AHRS 1.<br>Open the circuit breaker AHRS 1.<br>(2) Reapply power and try to align the AHRS in a normal fashion. |
| 34 | AHRS 2 ATT MODE | EICAS | (1) After the airplane is brought to a stop at the ramp or hangar, power off the AHRS 2.<br>Open the circuit breaker AHRS 2.<br>(2) Reapply power and try to align the AHRS in a normal fashion. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | AHRS 1 FAIL | EICAS | (1) Enter the correct present position.<br>For airplanes with single or dual Honeywell FMS:<br>**NOTE:** Operator can use either the FMS CDU or the bezel pushbuttons of the pilot's MFD to enter the present position.<br>(a) FMS CDU:<br>Push the NAV mode key and the NEXT function key (NAV INDEX 2/2 page comes into view).<br>Push the POS INIT (3L) left line select key (POS INIT 1/1 page comes into view).<br>Push the LOAD (2R) right line select key to update the FMS position with the last saved position (FMS CDU shows the LOADED POSITION coordinates).<br>Bezel Pushbuttons:<br>Make sure that the airplane is in the ground configuration.<br>On main menu of the pilot's MFD, use the bezel pushbuttons to select the PPOS INIT option (pilot's MFD shows the present position initialization menu).<br>**NOTE:** From this menu operator can:<br>– Confirm that the EFIS stored present position (PPOS) is correct, and push the ENT pushbutton, or<br><br>(continued) |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | AHRS 1 FAIL (continued) | EICAS | (continued)<br>– Operator can change the present position coordinates via the bezel pushbuttons and the data set knob.<br>(b) After the present coordinates are set, push the ENT pushbutton to send the coordinates to the AH-900 computer.<br>For airplanes with single or dual Universal FMS:<br>**NOTE:** Operator can use either the FMS CDU or the bezel pushbuttons of the pilot's MFD to enter the present position.<br>(a) FMS CDU:<br>On the FMS CDU, on the INIT 1/1 page, push the ACCEPT line select key to update the FMS position.<br>Bezel pushbuttons:<br>Make sure that the airplane is in the ground configuration.<br>On main menu of the pilot's MFD, use the bezel pushbuttons to select the PPOS INIT option (pilot's MFD shows the present position initialization menu).<br>**NOTE:** From this menu operator can:<br>– Confirm that the EFIS stored present position (PPOS) is correct, and push the ENT pushbutton, or<br><br>(continued) |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | AHRS 1 FAIL (continued) | EICAS | (continued)<br>– Operator can change the present position coordinates via the bezel pushbuttons and the data set knob.<br>(b) After the present coordinates are set, push the ENT pushbutton to send the coordinates to the AH-900 computer.<br>**NOTE:** At the end of the alignment, the AHRU conducts an alignment-performance test on the entered latitude. If the entered does not pass the alignment-performance test, the AHRS 1 ALN FAULT message shows on the EICAS display. If a subsequent entry of the same latitude does not pass the alignment-performance test, the AHRS 1 FAIL message shows on the EICAS display. Under the preceding conditions, the AHRU still accepts latitude entries. If an entry passes the alignment-performance test:<br>– AHRS 1 FAIL message goes out of view, and<br>– AHRU clears the bits that were set to indicate the failure.<br>(2) Wait until the alignment is completed. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | AHRS 2 FAIL | EICAS | (1) Enter the correct present position. For airplanes with single or dual Honeywell FMS:<br>**NOTE:** Operator can use either the FMS CDU or the bezel pushbuttons of the pilot's MFD to enter the present position.<br>(a) FMS CDU:<br>Push the NAV mode key and the NEXT function key (NAV INDEX 2/2 page comes into view).<br>Push the POS INIT (3L) left line select key (POS INIT 1/1 page comes into view).<br>Push the LOAD (2R) right line select key to update the FMS position with the last saved position (FMS CDU shows the LOADED POSITION coordinates).<br>(b) Bezel Pushbuttons:<br>Make sure that the airplane is in the ground configuration.<br>On main menu of the pilot's MFD, use the bezel pushbuttons to select the PPOS INIT option (pilot's MFD shows the present position initialization menu).<br>**NOTE:** From this menu operator can:<br>– Confirm that the EFIS stored present position (PPOS) is correct, and push the ENT pushbutton, or<br><br>(continued) |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | AHRS 2 FAIL (continued) | EICAS | (continued)<br>– Operator can change the present position coordinates via the bezel pushbuttons and the data set knob.<br>(c) After the present coordinates are set, push the ENT pushbutton to send the coordinates to the AH-900 computer.<br>For airplanes with single or dual Universal FMS:<br>**NOTE:** Operator can use either the FMS CDU or the bezel pushbuttons of the pilot's MFD to enter the present position.<br>(a) FMS CDU:<br>On the FMS CDU, on the INIT 1/1 page, push the ACCEPT line select key to update the FMS position.<br>(b) Bezel pushbuttons:<br>Make sure that the airplane is in the ground configuration. On main menu of the pilot's MFD, use the bezel pushbuttons to select the PPOS INIT option (pilot's MFD shows the present position initialization menu).<br>**NOTE:** From this menu operator can:<br>– Confirm that the EFIS stored present position (PPOS) is correct, and push the ENT pushbutton, or<br><br>(continued) |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | AHRS 2 FAIL (continued) | EICAS | (continued)<br>– Operator can change the present position coordinates via the bezel pushbuttons and the data set knob.<br>(c) After the present coordinates are set, push the ENT pushbutton to send the coordinates to the AH-900 computer.<br>**NOTE:** At the end of the alignment, the AHRU conducts an alignment-performance test on the entered latitude. If the entered does not pass the alignment-performance test, the AHRS 1 ALN FAULT message shows on the EICAS display. If a subsequent entry of the same latitude does not pass the alignment-performance test, the AHRS 1 FAIL message shows on the EICAS display. Under the preceding conditions, the AHRU still accepts latitude entries. If an entry passes the alignment-performance test:<br>– AHRS 1 FAIL message goes out of view, and<br>– AHRU clears the bits that were set to indicate the failure.<br>(2) Wait until the alignment is completed. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 32 | BRAKE DEGRADED | EICAS | (1) On the circuit breaker panel, open the BRAKES OUTBD and BRAKES INBD circuit breakers.<br>(2) Close the BRAKES OUTBD and BRAKES INBD circuit breakers on the circuit breaker panel.<br>(3) Press both brake pedals and verify that the message remains extinguished. |
| 31 | CHECK IC 2 SW | EICAS | On the circuit breaker panel, open the IC 2 circuit breaker and close it after a few seconds. |
| 31 | DAU 1A FAIL (Transitory condition of IC) | EICAS | Check that EICAS DAU 1A and 1B, MFD 1, EICAS DISPLAY, DISPLAY CONTROL 1, IC 1 and IC 2 circuit breakers are closed.<br>Check the SG pushbutton on the pilot Reversionary Panel.<br>Is the SG pushbutton pressed when the DAU 1A FAIL message appears?<br>**YES**<br>–Open, and then, close the IC 2 circuit breaker on the overhead circuit breakers panel. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 31 | DAU 1B FAIL (Transitory condition of IC) | EICAS | Check that EICAS DAU 1A and 1B, MFD 1, EICAS DISPLAY, DISPLAY CONTROL 1, IC 1 and IC 2 circuit breakers are closed.<br>Check the SG pushbutton on the pilot Reversionary Panel.<br>Is the SG pushbutton pressed when the DAU 1B FAIL message appears?<br>**YES**<br>–Open, and then, close the IC 2 circuit breaker on the overhead circuit breakers panel. |
| 31 | DAU 2A FAIL (Transitory condition of IC) | EICAS | Check that EICAS DAU 2A and 2B, MFD 2, EICAS DISPLAY, DISPLAY CONTROL 2, IC 1 and IC 2 circuit breakers are closed.<br>Check the SG pushbutton on the pilot Reversionary Panel.<br>Is the SG pushbutton pressed when the DAU 2A FAIL message appears?<br>**YES**<br>–Open, and then, close the IC 2 circuit breaker on the overhead circuit breakers panel. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 31 | DAU 2B FAIL (Transitory condition of IC) | EICAS | Check that EICAS DAU 2A and 2B, MFD 2, EICAS DISPLAY, DISPLAY CONTROL 2, IC 1 and IC 2 circuit breakers are closed.<br>Check the SG pushbutton on the pilot Reversionary Panel.<br>Is the SG pushbutton pressed when the DAU 2B FAIL message appears?<br>**YES**<br>–Open, and then, close the IC 2 circuit breaker on the overhead circuit breakers panel. |
| 31 | DAU 1 WRN MISCOMP (Transitory condition of IC) | EICAS | Check that EICAS DAU 1A and 1B, MFD 1, EICAS DISPLAY, DISPLAY CONTROL 1, IC 1 and IC 2 circuit breakers are closed.<br>Check the SG pushbutton on the pilot Reversionary Panel.<br>Is the SG pushbutton pressed when the DAU 1 WRN MISCOMP message appears?<br>**YES**<br>–Open, and then, close the IC 2 circuit breaker on the overhead circuit breakers panel. |

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|---|---|---|---|
| 31 | DAU 2 WRN MISCOMP (Transitory condition of IC) | EICAS | Check that EICAS DAU 2A and 2B, MFD 2, EICAS DISPLAY, DISPLAY CONTROL 2, IC 1 and IC 2 circuit breakers are closed.<br>Check the SG pushbutton on the pilot Reversionary Panel.<br>Is the SG pushbutton pressed when the DAU 2 WRN MISCOMP message appears?<br>**YES**<br>–Open, and then, close the IC 2 circuit breaker on the overhead circuit breakers panel. |
| 34 | DU 1 FAN FAIL | EICAS | On the circuit breaker panel, open and close PFD 1 circuit breaker (D13). |
| 34 | DU 2 FAN FAIL | EICAS | On the circuit breaker panel, open and close MFD 1 circuit breaker (D23). |
| 34 | DU 3 FAN FAIL | EICAS | On the circuit breaker panel, open and close EICAS/DISPLAY circuit breaker (C9). |
| 34 | DU 4 FAN FAIL | EICAS | On the circuit breaker panel, open and close MFD 2 circuit breaker (D12). |
| 34 | DU 5 FAN FAIL | EICAS | On the circuit breaker panel, open and close PFD 2 circuit breaker (D22). |
| 34 | DU 1 OVHT | EICAS | Check if the DU 1 OVHT message appears for approximately 4 seconds on the EICAS and then disappears. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | DU 2 OVHT | EICAS | Check if the DU 2 OVHT message appears for approximately 4 seconds on the EICAS and then disappears. |
| 34 | DU 3 OVHT | EICAS | (1) On the pilot reversionary panel, rotate the MFD switch to the EICAS position.<br>The EICAS screen shows on the MFD 1 display (DU 2).<br>(2) Check if the DU 3 OVHT message appears for approximately 4 seconds on the EICAS (DU 2) and then disappears.<br>If yes, on the pilot reversionary panel, rotate the MFD switch to the normal position.<br>The EICAS screen shows on the EICAS display (DU 3). |
| 34 | DU 4 OVHT | EICAS | Check if the DU 4 OVHT message appears for approximately 4 seconds on the EICAS and then disappears. |
| 34 | DU 5 OVHT | EICAS | Check if the DU 5 OVHT message appears for approximately 4 seconds on the EICAS and then disappears. |
| 34 | HGS FAIL | EICAS | Open the following circuit breakers and, after approximately 5 seconds, close them:<br>– HCP (Location Tip: DC BUS 1/CAT III/HCP) CB H8<br>– HGC (Location Tip: DC BUS 1/CAT III/HCG) CB H6<br>– OHU (Location Tip: DC BUS 1/CAT III/OHU). CB H7 |
| 34 | IRS 1 ATT MODE | EICAS | (1) After the airplane is brought to a stop at the ramp or hangar, power off IRS 1.<br>(2) Reapply power and try to align IRS 1 in a normal fashion. |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | IRS 2 ATT MODE | EICAS | (1) After the airplane is brought to a stop at the ramp or hangar, power off IRS 2.<br>(2) Reapply power and try to align IRS 2 in a normal fashion. |
| 34 | IRS 1 FAIL | EICAS | (1) Set the MSU 1 rotary switch to ALIGN.<br>(2) Enter the correct present position.<br>**NOTE:** The airplane must be maintained stationary during the IRS 1 alignment.<br>(3) Wait until the alignment is complete.<br>In case of IRS 1 FAIL message does not disappear:<br>(a) Set the MSU 1 rotary switch to OFF.<br>(b) On the overhead electrical panel, push the BACKUP pushbutton (the stripped bar illuminates).<br>(c) On the overhead circuit breaker panel, open IRS 1 CB.<br>(d) On the overhead circuit breaker panel, open the following CBs:<br>For single FMS installed:<br>CDU, CMPTR, GPS.<br>For dual FMS installed:<br>CDU 1, CDU 2, FMC 1, FMC 2, GPS 1, and GPS 2.<br>(e) Wait at least 3 seconds.<br>(f) On the overhead electrical panel, push the BACKUP pushbutton again (the stripped bar extinguishes).<br>(continued) |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | IRS 1 FAIL (continued) | EICAS | (continued)<br>(g) On the overhead circuit breaker panel, close IRS 1 CB.<br>(h) On the overhead circuit breaker panel, close the following CBs:<br>For single FMS installed: CDU, CMPTR, GPS.<br>For dual FMS installed: CDU 1, CDU 2, FMC 1, FMC 2, GPS 1, and GPS 2.<br>(i) Set the MSU 1 rotary switch to ALIGN.<br>(j) Enter the correct present position.<br>**NOTE:** The airplane must be kept stationary during the IRS 1 alignment.<br>(k) Wait until the alignment is complete. |
| 34 | IRS 2 FAIL | EICAS | (1) Set the MSU 2 rotary switch to ALIGN.<br>(2) Enter the correct present position.<br>**NOTE:** The airplane must be maintained stationary during the IRS 2 alignment.<br>(3) Wait until the alignment is complete.<br>In case of IRS 2 FAIL message does not disappear:<br>(a) Set the MSU 2 rotary switch to OFF.<br>(b) On the overhead electrical panel, push the BACKUP pushbutton (the stripped bar illuminates).<br>(continued) |

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| ATA | EICAS MESSAGE or CONDITION | LOCATION | PROCEDURE |
|---|---|---|---|
| 34 | IRS 2 FAIL (continued) | EICAS | (continued)<br>(c) On the overhead circuit breaker panel, open IRS 2 CB.<br>(d) On the overhead circuit breaker panel, open the following CBs:<br>For single FMS installed:<br>CDU, CMPTR, GPS.<br>For dual FMS installed:<br>CDU 1, CDU 2, FMC 1, FMC 2, GPS 1 and GPS 2.<br>(e) Wait at least 3 seconds.<br>(f) On the overhead electrical panel, push the BACKUP pushbutton again (the stripped bar extinguishes).<br>(g) On the overhead circuit breaker panel, close IRS 2 CB.<br>(h) On the overhead circuit breaker panel, close the following CBs:<br>For single FMS installed:<br>CDU, CMPTR, GPS.<br>For dual FMS installed:<br>CDU 1, CDU 2, FMC 1, FMC 2, GPS 1 and GPS 2.<br>(i) Set the MSU 2 rotary switch to ALIGN.<br>(j) Enter the correct present position.<br>**NOTE:** The airplane must be kept stationary during the IRS 2 alignment.<br>(k) Wait until the alignment is complete. |
| 27 | RUD STOP DISAGREE | EICAS | Energize the airplane with the hydraulic power. |

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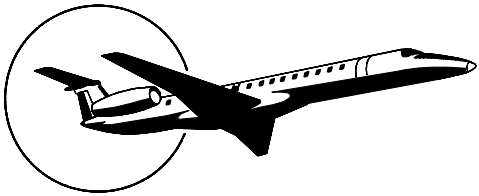

# AIRPLANE OPERATIONS MANUAL
# VOLUME 2

**EMBRAER S.A.**

THIS PUBLICATION IS INCOMPLETE WITHOUT AIRPLANE OPERATIONS MANUAL AOM–145/1114 VOLUME 1

**AOM–145/1114-105**
**OCTOBER 31, 1996**
**REVISION 46 – OCTOBER 28, 2024**

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**Airplane Operations Manual**
**AOM–145/1114**

Please use this Customer Comment Form to notify us of any discrepancies or problems you find in the Airplane Operations Manual. We would also welcome constructive suggestions on how we can further improve our documentation or service.

Your feedback will be acknowledged, and we will advise you of the action we intend to take.

Sincerely,
Flight Operations Engineering & Support

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Section/Page/Code: _____ Date of Page: _____ Revision: ____

Name: _____
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| Proposed date for implementation: _____ | Implemented: _____ |

# LIST OF EFFECTIVE PAGES

# (VOLUME 2)

| | | |
|---|---|---|
| ORIGINAL | 0 | OCT 31, 1996 |
| REVISION | 1 | FEB 14, 1997 |
| REVISION | 2 | MAR 10, 1997 |
| REVISION | 3 | APR 15, 1997 |
| REVISION | 4 | MAY 08, 1997 |
| REVISION | 5 | JUL 10, 1997 |
| REVISION | 6 | SEP 19, 1997 |
| REVISION | 7 | NOV 28, 1997 |
| REVISION | 8 | FEB 02, 1998 |
| REVISION | 9 | APR 03, 1998 |
| REVISION | 10 | AUG 31, 1998 |
| REVISION | 11 | JAN 12, 1999 |
| REVISION | 12 | JUN 01, 1999 |
| REVISION | 13 | SEP 20, 1999 |
| REVISION | 14 | DEC 15, 1999 |
| REVISION | 15 | APR 28, 2000 |
| REVISION | 16 | SEP 29, 2000 |
| REVISION | 17 | MAR 30, 2001 |
| REVISION | 18 | JUN 29, 2001 |
| REVISION | 19 | AUG 24, 2001 |
| REVISION | 20 | OCT 02, 2001 |
| REVISION | 21 | JAN 21, 2002 |
| REVISION | 22 | MAR 28, 2002 |
| REVISION | 23 | JUN 28, 2002 |
| REVISION | 24 | DEC 20, 2002 |
| REVISION | 25 | JUN 30, 2003 |
| REVISION | 26 | DEC 30, 2003 |
| REVISION | 27 | JUN 30, 2004 |
| REVISION | 28 | NOV 30, 2004 |
| REVISION | 29 | JUN 30, 2005 |
| REVISION | 30 | NOV 30, 2005 |
| REVISION | 31 | JUN 30, 2006 |
| REVISION | 32 | NOV 30, 2006 |
| REVISION | 33 | JUN 29, 2007 |
| REVISION | 34 | NOV 30, 2007 |
| REVISION | 35 | JUN 30, 2008 |
| REVISION | 36 | DEC 19, 2008 |
| REVISION | 37 | OCT 30, 2009 |
| REVISION | 38 | AUG 15, 2011 |
| REVISION | 39 | OCT 22, 2012 |

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44



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REVISION.....40 ..... NOV 14, 2013
REVISION.....41 ..... MAR 06, 2015
REVISION.....42 .....APR 05, 2017
REVISION.....43 .....APR 26, 2019
REVISION.....44 ..... AUG 14, 2020
REVISION.....45 ..... NOV 30, 2022
REVISION.....46 ..... OCT 28, 2024

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**NOTE:** The references to the deleted pages from the previous revisions (revision 45 and earlier) were removed from the LEP.



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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 2-LEP | **title** | 105 | * | REVISION 46 | AOM-145/1114-105 |
| 2-LEP | 1 | 105 | * | REVISION 46 | |
| 2-LEP | 2 | 105 | * | REVISION 46 | |
| 2-LEP | 3 | 105 | * | REVISION 46 | |
| 2-LEP | 4 | 105 | * | REVISION 46 | |
| 2-LEP | 5 | 105 | * | REVISION 46 | |
| 2-LEP | 6 | 105 | * | REVISION 46 | |
| 2-LEP | 7 | 105 | * | REVISION 46 | |
| 2-LEP | 8 | 105 | * | REVISION 46 | |
| 2-LEP | 9 | 105 | * | REVISION 46 | |
| 2-LEP | 10 | 105 | * | REVISION 46 | |
| 2-LEP | 11 | 105 | * | REVISION 46 | |
| 2-LEP | 12 | 105 | * | REVISION 46 | |
| 2-LEP | 13 | 105 | * | REVISION 46 | |
| 2-LEP | 14 | 105 | * | REVISION 46 | |
| 2-LEP | 15 | 105 | * | REVISION 46 | |
| 2-LEP | 16 | 105 | * | REVISION 46 | |
| 2-LEP | 17 | 105 | * | REVISION 46 | |
| 2-LEP | 18 | 105 | * | REVISION 46 | |
| 2-LEP | 19 | 105 | * | REVISION 46 | |
| 2-LEP | 20 | 105 | * | REVISION 46 | |
| 2-LEP | 21 | 105 | * | REVISION 46 | |
| 2-LEP | 22 | 105 | * | REVISION 46 | |
| 2-LEP | 23 | 105 | * | REVISION 46 | |
| 2-LEP | 24 | 105 | * | REVISION 46 | |
| 2-LEP | 25 | 105 | * | REVISION 46 | |
| 2-LEP | 26 | 105 | * | REVISION 46 | |
| 2-LEP | 27 | 105 | * | REVISION 46 | |
| 2-LEP | 28 | 105 | * | REVISION 46 | |

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User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 2-LEP | 29 | 105 | * | REVISION 46 | |
| 2-LEP | 30 | 105 | * | REVISION 46 | |
| 2-LEP | 31 | 105 | * | REVISION 46 | |
| 2-LEP | 32 | 105 | * | REVISION 46 | |
| 2-LEP | 33 | 105 | * | REVISION 46 | |
| 2-LEP | 34 | 105 | * | REVISION 46 | |
| 2-LEP | 35 | 105 | * | REVISION 46 | |
| 2-LEP | 36 | 105 | * | REVISION 46 | |
| 2-LEP | 37 | 105 | * | REVISION 46 | |
| 2-LEP | 38 | 105 | * | REVISION 46 | |
| 2-LEP | 39 | 105 | * | REVISION 46 | |
| 2-LEP | 40 | 105 | * | REVISION 46 | |
| 2-LEP | 41 | 105 | * | REVISION 46 | |
| 2-LEP | 42 | 105 | * | REVISION 46 | |
| 2-LEP | 43 | 105 | * | REVISION 46 | |
| 2-LEP | 44 | 105 | * | REVISION 46 | |
| 2-LEP | 45 | 105 | * | REVISION 46 | |
| 2-LEP | 46 | 105 | * | REVISION 46 | |
| 2-LEP | 47 | 105 | * | REVISION 46 | |
| 2-LEP | 48 | 105 | * | REVISION 46 | |
| 2-LEP | 49 | 105 | * | REVISION 46 | |
| 2-LEP | 50 | 105 | * | REVISION 46 | |
| 2-TOC | 1 | 01 | | JUN 28, 2002 | ALL |
| 2-TOC | 2 | 01 | | JUN 28, 2002 | |
| 2-01-00 | 1 | 01 | | SEP 29, 2000 | ALL |
| 2-01-00 | 2 | 01 | | DEC 20, 2002 | |
| 2-01-00 | 3 | 01 | | DEC 20, 2002 | |
| 2-01-00 | 4 | 01 | | JUN 28, 2002 | |
| 2-01-00 | 4A | 01 | | DEC 20, 2002 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-01-00 | 4B | 01 | DEC 20, 2002 | |
| 2-01-00 | 5 | 01 | JUN 28, 2002 | |
| 2-01-00 | 6 | 01 | JUN 28, 2002 | |
| 2-01-00 | 7 | 01 | JUN 28, 2002 | |
| 2-01-00 | 8 | 01 | JUN 28, 2002 | |
| 2-01-05 | 1 | 01 | SEP 29, 2000 | Panel Typical |
| 2-01-05 | 2 | 01 | SEP 29, 2000 | |
| 2-01-05 | 3 | 01 | SEP 29, 2000 | |
| 2-01-05 | 4 | 01 | JUN 28, 2002 | |
| 2-01-10 | 1 | 01 | SEP 29, 2000 | ALL except XR |
| 2-01-10 | 2 | 01 | SEP 29, 2000 | |
| 2-01-15 | 1 | 01 | SEP 29, 2000 | ALL |
| 2-01-15 | 2 | 01 | SEP 29, 2000 | |
| 2-02-00 | 1 | 01 | REVISION 45 | ALL |
| 2-02-00 | 2 | 01 | REVISION 45 | |
| 2-02-05 | 1 | 01 | OCT 02, 2001 | Cockpit |
| 2-02-05 | 2 | 01 | OCT 02, 2001 | |
| 2-02-05 | 3 | 01 | OCT 02, 2001 | |
| 2-02-05 | 4 | 01 | OCT 02, 2001 | |
| 2-02-05 | 5 | 01 | OCT 02, 2001 | |
| 2-02-05 | 6 | 01 | OCT 02, 2001 | |
| 2-02-05 | 7 | 01 | OCT 02, 2001 | |
| 2-02-05 | 8 | 01 | OCT 02, 2001 | |
| 2-02-10 | 1 | 01 | OCT 02, 2001 | Attendant stations |
| 2-02-10 | 2 | 01 | OCT 02, 2001 | |
| 2-02-15 | 1 | 01 | OCT 02, 2001 | Attendant's panel |
| 2-02-15 | 2 | 01 | OCT 02, 2001 | |
| 2-02-15 | 3 | 01 | OCT 02, 2001 | |
| 2-02-15 | 4 | 01 | OCT 02, 2001 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-02-15 | 5 | 01 | OCT 02, 2001 | |
| 2-02-15 | 6 | 01 | OCT 02, 2001 | |
| 2-02-15 | 7 | 01 | OCT 02, 2001 | |
| 2-02-15 | 8 | 01 | OCT 02, 2001 | |
| 2-02-15 | 9 | 01 | OCT 02, 2001 | |
| 2-02-15 | 10 | 01 | OCT 02, 2001 | |
| 2-02-20 | 1 | 01 | OCT 02, 2001 | Galley |
| 2-02-20 | 2 | 01 | OCT 02, 2001 | |
| 2-02-20 | 3 | 01 | OCT 02, 2001 | |
| 2-02-20 | 4 | 01 | OCT 02, 2001 | |
| 2-02-25 | 1 | 01 | OCT 02, 2001 | PSU |
| 2-02-25 | 2 | 01 | OCT 02, 2001 | |
| 2-02-25 | 3 | 01 | OCT 02, 2001 | |
| 2-02-25 | 4 | 01 | OCT 02, 2001 | |
| 2-02-27 | 1 | 01 | REVISION 38 | Cockpit Door |
| 2-02-27 | 2 | 01 | REVISION 38 | |
| 2-02-30 | 1 | 01 | REVISION 27 | Water and Waste |
| 2-02-30 | 2 | 01 | REVISION 27 | |
| 2-02-30 | 3 | 01 | OCT 02, 2001 | |
| 2-02-30 | 4 | 01 | OCT 02, 2001 | |
| 2-02-35 | 1 | 01 | REVISION 38 | Airstair main door |
| 2-02-35 | 2 | 01 | REVISION 38 | |
| 2-02-35 | 3 | 01 | REVISION 38 | |
| 2-02-35 | 4 | 01 | REVISION 38 | |
| 2-02-35 | 5 | 01 | REVISION 38 | |
| 2-02-35 | 6 | 01 | REVISION 38 | |
| 2-02-35 | 7 | 01 | REVISION 38 | |
| 2-02-35 | 8 | 01 | REVISION 38 | |
| 2-02-35 | 1 | 02 | REVISION 32 | Jetway main door |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-02-35 | 2 | 02 | REVISION 32 | |
| 2-02-35 | 3 | 02 | REVISION 20 | |
| 2-02-35 | 4 | 02 | REVISION 26 | |
| 2-02-35 | 5 | 02 | REVISION 26 | |
| 2-02-35 | 6 | 02 | REVISION 26 | |
| 2-02-40 | 1 | 01 | REVISION 37 | Access doors and hatches |
| 2-02-40 | 2 | 01 | REVISION 37 | |
| 2-02-40 | 3 | 01 | REVISION 37 | |
| 2-02-40 | 4 | 01 | REVISION 37 | |
| 2-02-40 | 5 | 01 | REVISION 37 | |
| 2-02-40 | 6 | 01 | REVISION 37 | |
| 2-02-40 | 7 | 01 | REVISION 37 | |
| 2-02-40 | 8 | 01 | REVISION 37 | |
| 2-02-40 | 9 | 01 | REVISION 37 | |
| 2-02-40 | 10 | 01 | REVISION 37 | |
| 2-02-40 | 11 | 01 | REVISION 37 | |
| 2-02-40 | 12 | 01 | REVISION 37 | |
| 2-02-50 | 1 | 01 | REVISION 38 | PC power system |
| 2-02-50 | 2 | 01 | REVISION 38 | |
| 2-02-55 | 1 | 01 | REVISION 38 | In-flight entertainment system |
| 2-02-55 | 2 | 01 | REVISION 38 | |
| 2-02-55 | 3 | 01 | REVISION 38 | |
| 2-02-55 | 4 | 01 | REVISION 38 | |
| 2-02-55 | 5 | 01 | REVISION 38 | |
| 2-02-55 | 6 | 01 | REVISION 38 | |
| 2-02-55 | 7 | 01 | REVISION 38 | |
| 2-02-55 | 8 | 01 | REVISION 38 | |
| 2-02-60 | 1 | 01 | REVISION 25 | AIR CEL |
| 2-02-60 | 2 | 01 | REVISION 20 | |

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User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-02-60 | 3 | 01 | OCT 02, 2001 | |
| 2-02-60 | 4 | 01 | OCT 02, 2001 | |
| 2-02-60 | 5 | 01 | OCT 02, 2001 | |
| 2-02-60 | 6 | 01 | OCT 02, 2001 | |
| 2-02-60 | 1 | 02 | REVISION 25 | MAGNASTAR |
| 2-02-60 | 2 | 02 | REVISION 25 | |
| 2-02-65 | 1 | 01 | REVISION 25 | Cockpit Security Door |
| 2-02-65 | 2 | 01 | REVISION 27 | |
| 2-02-65 | 3 | 01 | REVISION 25 | |
| 2-02-65 | 4 | 01 | REVISION 25 | |
| 2-02-65 | 5 | 01 | REVISION 25 | |
| 2-02-65 | 6 | 01 | REVISION 25 | |
| 2-02-67 | 1 | 01 | REVISION 33 | Video Surveillance System |
| 2-02-67 | 2 | 01 | REVISION 33 | |
| 2-02-67 | 3 | 01 | REVISION 33 | |
| 2-02-67 | 4 | 01 | REVISION 33 | |
| 2-02-70 | 1 | 01 | REVISION 31 | ALL |
| 2-02-70 | 2 | 01 | REVISION 31 | |
| 2-02-70 | 3 | 01 | REVISION 31 | |
| 2-02-70 | 4 | 01 | REVISION 31 | |
| 2-02-70 | 5 | 01 | REVISION 31 | |
| 2-02-70 | 6 | 01 | REVISION 31 | |
| 2-03-00 | 1 | 01 | DEC 20, 2002 | ALL |
| 2-03-00 | 2 | 01 | DEC 20, 2002 | |
| 2-04-00 | 1 | 01 | REVISION 45 | ALL |
| 2-04-00 | 2 | 01 | REVISION 45 | |
| 2-04-05 | 1 | 01 | JUN 28, 2002 | ALL |
| 2-04-05 | 2 | 01 | JUN 28, 2002 | |
| 2-04-05 | 3 | 01 | REVISION 23 | |

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User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-04-05 | 4 | 01 | REVISION 30 | |
| 2-04-05 | 5 | 01 | JUN 28, 2002 | |
| 2-04-05 | 6 | 01 | JUN 28, 2002 | |
| 2-04-05 | 7 | 01 | JUN 28, 2002 | |
| 2-04-05 | 8 | 01 | JUN 28, 2002 | |
| 2-04-05 | 9 | 01 | JUN 28, 2002 | |
| 2-04-05 | 10 | 01 | JUN 28, 2002 | |
| 2-04-05 | 11 | 01 | JUN 28, 2002 | |
| 2-04-05 | 12 | 01 | JUN 28, 2002 | |
| 2-04-05 | 13 | 01 | JUN 28, 2002 | |
| 2-04-05 | 14 | 01 | JUN 28, 2002 | |
| 2-04-05 | 15 | 01 | JUN 28, 2002 | |
| 2-04-05 | 16 | 01 | JUN 28, 2002 | |
| 2-04-05 | 17 | 01 | JUN 28, 2002 | |
| 2-04-05 | 18 | 01 | DEC 20, 2002 | |
| 2-04-05 | 19 | 01 | JUN 28, 2002 | |
| 2-04-05 | 20 | 01 | JUN 28, 2002 | |
| 2-04-05 | 21 | 01 | JUN 28, 2002 | |
| 2-04-05 | 22 | 01 | DEC 20, 2002 | |
| 2-04-05 | 23 | 01 | JUN 28, 2002 | |
| 2-04-05 | 24 | 01 | JUN 28, 2002 | |
| 2-04-05 | 25 | 01 | JUN 28, 2002 | |
| 2-04-05 | 26 | 01 | JUN 28, 2002 | |
| 2-04-05 | 27 | 01 | JUN 28, 2002 | |
| 2-04-05 | 28 | 01 | JUN 28, 2002 | |
| 2-04-05 | 29 | 01 | JUN 28, 2002 | |
| 2-04-05 | 30 | 01 | JUN 28, 2002 | |
| 2-04-05 | 31 | 01 | JUN 28, 2002 | |
| 2-04-05 | 32 | 01 | JUN 28, 2002 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-04-05 | 33 | 01 | JUN 28, 2002 | |
| 2-04-05 | 34 | 01 | JUN 28, 2002 | |
| 2-04-05 | 35 | 01 | JUN 28, 2002 | |
| 2-04-05 | 36 | 01 | JUN 28, 2002 | |
| 2-04-10 | 1 | 01 | REVISION 45 | ALL |
| 2-04-10 | 2 | 01 | REVISION 45 | |
| 2-04-10 | 3 | 01 | REVISION 45 | |
| 2-04-10 | 4 | 01 | REVISION 45 | |
| 2-04-10 | 5 | 01 | REVISION 45 | |
| 2-04-10 | 6 | 01 | REVISION 45 | |
| 2-04-10 | 7 | 01 | REVISION 45 | |
| 2-04-10 | 8 | 01 | REVISION 45 | |
| 2-04-10 | 9 | 01 | REVISION 45 | |
| 2-04-10 | 10 | 01 | REVISION 45 | |
| 2-04-10 | 11 | 01 | REVISION 45 | |
| 2-04-10 | 12 | 01 | REVISION 45 | |
| 2-04-10 | 13 | 01 | REVISION 45 | |
| 2-04-10 | 14 | 01 | REVISION 45 | |
| 2-04-10 | 15 | 01 | REVISION 45 | |
| 2-04-10 | 16 | 01 | REVISION 45 | |
| 2-04-13 | 1 | 01 | REVISION 44 | ALL |
| 2-04-13 | 2 | 01 | REVISION 44 | |
| 2-04-13 | 3 | 01 | REVISION 44 | |
| 2-04-13 | 4 | 01 | REVISION 45 | |
| 2-04-13 | 5 | 01 | REVISION 45 | |
| 2-04-13 | 6 | 01 | REVISION 44 | |
| 2-04-13 | 7 | 01 | REVISION 44 | |
| 2-04-13 | 8 | 01 | REVISION 44 | |
| 2-04-13 | 9 | 01 | REVISION 44 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-04-13 | 10 | 01 | REVISION 44 | |
| 2-04-13 | 11 | 01 | REVISION 44 | |
| 2-04-13 | 12 | 01 | REVISION 44 | |
| 2-04-13 | 13 | 01 | REVISION 44 | |
| 2-04-13 | 14 | 01 | REVISION 44 | |
| 2-04-13 | 15 | 01 | REVISION 44 | |
| 2-04-13 | 16 | 01 | REVISION 44 | |
| 2-04-13 | 17 | 01 | REVISION 44 | |
| 2-04-13 | 18 | 01 | REVISION 44 | |
| 2-04-13 | 19 | 01 | REVISION 44 | |
| 2-04-13 | 20 | 01 | REVISION 44 | |
| 2-04-13 | 21 | 01 | REVISION 44 | |
| 2-04-13 | 22 | 01 | REVISION 45 | |
| 2-04-13 | 23 | 01 | REVISION 45 | |
| 2-04-13 | 24 | 01 | REVISION 45 | |
| 2-04-15 | 1 | 01 | REVISION 37 | ALL |
| 2-04-15 | 2 | 01 | REVISION 37 | |
| 2-04-15 | 3 | 01 | REVISION 38 | |
| 2-04-15 | 4 | 01 | REVISION 37 | |
| 2-04-15 | 5 | 01 | REVISION 39 | |
| 2-04-15 | 6 | 01 | REVISION 39 | |
| 2-04-20 | 1 | 01 | REVISION 30 | ALL |
| 2-04-20 | 2 | 01 | REVISION 23 | |
| 2-04-25 | 1 | 01 | REVISION 43 | ALL |
| 2-04-25 | 2 | 01 | REVISION 43 | |
| 2-04-25 | 3 | 01 | REVISION 43 | |
| 2-04-25 | 4 | 01 | REVISION 43 | |
| 2-04-25 | 5 | 01 | REVISION 43 | |
| 2-04-25 | 6 | 01 | REVISION 43 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-04-25 | 7 | 01 | REVISION 43 | |
| 2-04-25 | 8 | 01 | REVISION 43 | |
| 2-04-30 | 1 | 01 | REVISION 42 | EGPWS + Steep Approach |
| 2-04-30 | 2 | 01 | REVISION 42 | |
| 2-04-30 | 3 | 01 | REVISION 42 | |
| 2-04-30 | 4 | 01 | REVISION 42 | |
| 2-04-30 | 5 | 01 | REVISION 42 | |
| 2-04-30 | 6 | 01 | REVISION 42 | |
| 2-04-30 | 7 | 01 | REVISION 42 | |
| 2-04-30 | 8 | 01 | REVISION 42 | |
| 2-04-30 | 9 | 01 | REVISION 42 | |
| 2-04-30 | 10 | 01 | REVISION 42 | |
| 2-04-30 | 11 | 01 | REVISION 42 | |
| 2-04-30 | 12 | 01 | REVISION 42 | |
| 2-04-30 | 13 | 01 | REVISION 42 | |
| 2-04-30 | 14 | 01 | REVISION 42 | |
| 2-04-30 | 15 | 01 | REVISION 42 | |
| 2-04-30 | 16 | 01 | REVISION 42 | |
| 2-04-30 | 17 | 01 | REVISION 42 | |
| 2-04-30 | 18 | 01 | REVISION 42 | |
| 2-04-30 | 19 | 01 | REVISION 42 | |
| 2-04-30 | 20 | 01 | REVISION 42 | |
| 2-04-30 | 21 | 01 | REVISION 42 | |
| 2-04-30 | 22 | 01 | REVISION 42 | |
| 2-04-30 | 23 | 01 | REVISION 42 | |
| 2-04-30 | 24 | 01 | REVISION 42 | |
| 2-04-30 | 25 | 01 | REVISION 42 | |
| 2-04-30 | 26 | 01 | REVISION 42 | |
| 2-04-30 | 27 | 01 | REVISION 42 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-04-30 | 28 | 01 | REVISION 42 | |
| 2-04-30 | 29 | 01 | REVISION 42 | |
| 2-04-30 | 30 | 01 | REVISION 42 | |
| 2-04-30 | 31 | 01 | REVISION 42 | |
| 2-04-30 | 32 | 01 | REVISION 42 | |
| 2-04-30 | 33 | 01 | REVISION 42 | |
| 2-04-30 | 34 | 01 | REVISION 42 | |
| 2-04-30 | 35 | 01 | REVISION 42 | |
| 2-04-30 | 36 | 01 | REVISION 42 | |
| 2-04-30 | 37 | 01 | REVISION 42 | |
| 2-04-30 | 38 | 01 | REVISION 42 | |
| 2-04-30 | 39 | 01 | REVISION 42 | |
| 2-04-30 | 40 | 01 | REVISION 42 | |
| 2-04-30 | 41 | 01 | REVISION 42 | |
| 2-04-30 | 42 | 01 | REVISION 42 | |
| 2-04-30 | 43 | 01 | REVISION 42 | |
| 2-04-30 | 44 | 01 | REVISION 42 | |
| 2-04-30 | 45 | 01 | REVISION 42 | |
| 2-04-30 | 46 | 01 | REVISION 42 | |
| 2-04-35 | 1 | 01 | REVISION 39 | ALL |
| 2-04-35 | 2 | 01 | REVISION 39 | |
| 2-04-35 | 3 | 01 | REVISION 39 | |
| 2-04-35 | 4 | 01 | REVISION 39 | |
| 2-04-35 | 5 | 01 | REVISION 39 | |
| 2-04-35 | 6 | 01 | REVISION 39 | |
| 2-04-35 | 7 | 01 | REVISION 39 | |
| 2-04-35 | 8 | 01 | REVISION 39 | |
| 2-04-35 | 9 | 01 | REVISION 39 | |
| 2-04-35 | 10 | 01 | REVISION 39 | |

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| Page Block | Page | Code | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|
| 2-04-35 | 11 | 01 | | REVISION 39 | |
| 2-04-35 | 12 | 01 | | REVISION 39 | |
| 2-04-40 | 1 | 01 | | REVISION 42 | ALL |
| 2-04-40 | 2 | 01 | | REVISION 42 | |
| 2-04-40 | 3 | 01 | | REVISION 42 | |
| 2-04-40 | 4 | 01 | | REVISION 42 | |
| 2-04-40 | 5 | 01 | | REVISION 42 | |
| 2-04-40 | 6 | 01 | | REVISION 42 | |
| 2-04-40 | 7 | 01 | | REVISION 42 | |
| 2-04-40 | 8 | 01 | * | REVISION 46 | |
| 2-04-40 | 9 | 01 | | REVISION 42 | |
| 2-04-40 | 10 | 01 | | REVISION 42 | |
| 2-04-40 | 11 | 01 | | REVISION 42 | |
| 2-04-40 | 12 | 01 | | REVISION 42 | |
| 2-04-40 | 13 | 01 | | REVISION 42 | |
| 2-04-40 | 14 | 01 | | REVISION 42 | |
| 2-04-40 | 15 | 01 | | REVISION 42 | |
| 2-04-40 | 16 | 01 | | REVISION 42 | |
| 2-04-40 | 17 | 01 | | REVISION 42 | |
| 2-04-40 | 18 | 01 | | REVISION 45 | |
| 2-04-40 | 19 | 01 | | REVISION 42 | |
| 2-04-40 | 20 | 01 | | REVISION 42 | |
| 2-05-00 | 1 | 01 | | MAR 28, 2002 | ALL |
| 2-05-00 | 2 | 01 | | MAR 28, 2002 | |
| 2-05-05 | 1 | 01 | | REVISION 36 | ALL |
| 2-05-05 | 2 | 01 | | REVISION 36 | |
| 2-05-05 | 3 | 01 | | REVISION 36 | |
| 2-05-05 | 4 | 01 | | REVISION 36 | |
| 2-05-05 | 5 | 01 | | REVISION 36 | |

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User: fnhernaof - Printed By myTechCare - Nov 21/24 - 00:45:44

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-05-05 | 6 | 01 | REVISION 36 | |
| 2-05-05 | 7 | 01 | REVISION 36 | |
| 2-05-05 | 8 | 01 | REVISION 36 | |
| 2-05-05 | 9 | 01 | REVISION 36 | |
| 2-05-05 | 10 | 01 | REVISION 36 | |
| 2-05-05 | 11 | 01 | REVISION 36 | |
| 2-05-05 | 12 | 01 | REVISION 36 | |
| 2-05-05 | 13 | 01 | REVISION 36 | |
| 2-05-05 | 14 | 01 | REVISION 36 | |
| 2-05-10 | 1 | 01 | REVISION 22 | ALL |
| 2-05-10 | 2 | 01 | REVISION 29 | |
| 2-05-10 | 3 | 01 | MAR 28, 2002 | |
| 2-05-10 | 4 | 01 | MAR 28, 2002 | |
| 2-05-10 | 5 | 01 | REVISION 22 | |
| 2-05-10 | 6 | 01 | REVISION 26 | |
| 2-05-10 | 6A | 01 | JUN 28, 2002 | |
| 2-05-10 | 6B | 01 | JUN 28, 2002 | |
| 2-05-10 | 6C | 01 | REVISION 23 | |
| 2-05-10 | 6D | 01 | REVISION 26 | |
| 2-05-10 | 7 | 01 | REVISION 26 | |
| 2-05-10 | 8 | 01 | REVISION 22 | |
| 2-05-10 | 9 | 01 | MAR 28, 2002 | |
| 2-05-10 | 10 | 01 | JUN 28, 2002 | |
| 2-05-10 | 11 | 01 | MAR 28, 2002 | |
| 2-05-10 | 12 | 01 | MAR 28, 2002 | |
| 2-05-10 | 13 | 01 | MAR 28, 2002 | |
| 2-05-10 | 14 | 01 | MAR 28, 2002 | |
| 2-05-10 | 15 | 01 | REVISION 22 | |
| 2-05-10 | 16 | 01 | REVISION 29 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-05-10 | 17 | 01 | REVISION 29 | |
| 2-05-10 | 18 | 01 | REVISION 22 | |
| 2-05-10 | 19 | 01 | MAR 28, 2002 | |
| 2-05-10 | 20 | 01 | MAR 28, 2002 | |
| 2-05-10 | 21 | 01 | REVISION 29 | |
| 2-05-10 | 22 | 01 | REVISION 22 | |
| 2-05-10 | 23 | 01 | REVISION 22 | |
| 2-05-10 | 24 | 01 | REVISION 26 | |
| 2-05-10 | 25 | 01 | REVISION 22 | |
| 2-05-10 | 26 | 01 | REVISION 29 | |
| 2-05-10 | 27 | 01 | REVISION 29 | |
| 2-05-10 | 28 | 01 | REVISION 29 | |
| 2-05-15 | 1 | 01 | MAR 28, 2002 | ALL |
| 2-05-15 | 2 | 01 | MAR 28, 2002 | |
| 2-05-15 | 3 | 01 | MAR 28, 2002 | |
| 2-05-15 | 4 | 01 | MAR 28, 2002 | |
| 2-05-15 | 5 | 01 | MAR 28, 2002 | |
| 2-05-15 | 6 | 01 | MAR 28, 2002 | |
| 2-05-15 | 7 | 01 | REVISION 29 | |
| 2-05-15 | 8 | 01 | REVISION 22 | |
| 2-05-20 | 1 | 01 | REVISION 41 | ALL |
| 2-05-20 | 2 | 01 | REVISION 41 | |
| 2-05-20 | 3 | 01 | REVISION 41 | |
| 2-05-20 | 4 | 01 | REVISION 41 | |
| 2-05-20 | 5 | 01 | REVISION 41 | |
| 2-05-20 | 6 | 01 | REVISION 41 | |
| 2-06-00 | 1 | 01 | JAN 21, 2002 | ALL |
| 2-06-00 | 2 | 01 | JAN 21, 2002 | |
| 2-06-05 | 1 | 01 | JAN 21, 2002 | Cockpit lighting |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-06-05 | 2 | 01 | JAN 21, 2002 | |
| 2-06-05 | 3 | 01 | JAN 21, 2002 | |
| 2-06-05 | 4 | 01 | JAN 21, 2002 | |
| 2-06-05 | 5 | 01 | JAN 21, 2002 | |
| 2-06-05 | 6 | 01 | JAN 21, 2002 | |
| 2-06-05 | 7 | 01 | JAN 21, 2002 | |
| 2-06-05 | 8 | 01 | JAN 21, 2002 | |
| 2-06-10 | 1 | 01 | REVISION 44 | Pax cab lighting |
| 2-06-10 | 2 | 01 | REVISION 44 | |
| 2-06-10 | 3 | 01 | REVISION 44 | |
| 2-06-10 | 4 | 01 | REVISION 44 | |
| 2-06-10 | 5 | 01 | REVISION 44 | |
| 2-06-10 | 6 | 01 | REVISION 44 | |
| 2-06-10 | 7 | 01 | REVISION 44 | |
| 2-06-10 | 8 | 01 | REVISION 44 | |
| 2-06-15 | 1 | 01 | DEC 20, 2002 | External lighting |
| 2-06-15 | 2 | 01 | DEC 20, 2002 | |
| 2-06-15 | 3 | 01 | DEC 20, 2002 | |
| 2-06-15 | 4 | 01 | DEC 20, 2002 | |
| 2-06-15 | 5 | 01 | JAN 21, 2002 | |
| 2-06-15 | 6 | 01 | JAN 21, 2002 | |
| 2-06-15 | 7 | 01 | JAN 21, 2002 | |
| 2-06-15 | 8 | 01 | JAN 21, 2002 | |
| 2-06-20 | 1 | 01 | REVISION 24 | Emergency lighting |
| 2-06-20 | 2 | 01 | REVISION 25 | |
| 2-06-20 | 3 | 01 | JAN 21, 2002 | |
| 2-06-20 | 4 | 01 | JAN 21, 2002 | |
| 2-06-20 | 5 | 01 | JAN 21, 2002 | |
| 2-06-20 | 6 | 01 | JAN 21, 2002 | |

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User: fnhernaof - Printed By myTechCare - Nov 21/24 - 00:45:44

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-07-00 | 1 | 01 | JAN 21, 2002 | ALL |
| 2-07-00 | 2 | 01 | JAN 21, 2002 | |
| 2-07-05 | 1 | 01 | JAN 21, 2002 | General |
| 2-07-05 | 2 | 01 | JAN 21, 2002 | |
| 2-07-10 | 1 | 01 | JAN 21, 2002 | Engine and APU fire protection |
| 2-07-10 | 2 | 01 | JAN 21, 2002 | |
| 2-07-10 | 3 | 01 | JAN 21, 2002 | |
| 2-07-10 | 4 | 01 | JAN 21, 2002 | |
| 2-07-10 | 5 | 01 | JAN 21, 2002 | |
| 2-07-10 | 6 | 01 | JAN 21, 2002 | |
| 2-07-10 | 7 | 01 | REVISION 30 | |
| 2-07-10 | 8 | 01 | REVISION 30 | |
| 2-07-10 | 9 | 01 | JAN 21, 2002 | |
| 2-07-10 | 10 | 01 | JAN 21, 2002 | |
| 2-07-15 | 1 | 01 | JAN 21, 2002 | Lavatory fire protection |
| 2-07-15 | 2 | 01 | JAN 21, 2002 | |
| 2-07-15 | 3 | 01 | JAN 21, 2002 | |
| 2-07-15 | 4 | 01 | JAN 21, 2002 | |
| 2-07-15 | 1 | 02 | REVISION 44 | 145 ALL |
| 2-07-15 | 2 | 02 | REVISION 44 | |
| 2-07-15 | 3 | 02 | REVISION 44 | |
| 2-07-15 | 4 | 02 | REVISION 44 | |
| 2-07-15 | 5 | 02 | REVISION 44 | |
| 2-07-15 | 6 | 02 | REVISION 44 | |
| 2-07-20 | 1 | 01 | REVISION 44 | Baggage compart protection |
| 2-07-20 | 2 | 01 | REVISION 44 | |
| 2-07-20 | 3 | 01 | REVISION 44 | |
| 2-07-20 | 4 | 01 | REVISION 44 | |
| 2-07-20 | 5 | 01 | REVISION 44 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-07-20 | 6 | 01 | REVISION 44 | |
| 2-07-20 | 7 | 01 | REVISION 44 | |
| 2-07-20 | 8 | 01 | REVISION 44 | |
| 2-08-00 | 1 | 01 | REVISION 31 | ALL except XR |
| 2-08-00 | 2 | 01 | REVISION 17 | |
| 2-08-05 | 1 | 01 | REVISION 39 | ALL except XR |
| 2-08-05 | 2 | 01 | REVISION 39 | |
| 2-08-05 | 3 | 01 | REVISION 39 | |
| 2-08-05 | 4 | 01 | REVISION 39 | |
| 2-08-05 | 5 | 01 | REVISION 39 | |
| 2-08-05 | 6 | 01 | REVISION 39 | |
| 2-08-05 | 7 | 01 | REVISION 39 | |
| 2-08-05 | 8 | 01 | REVISION 39 | |
| 2-08-05 | 9 | 01 | REVISION 39 | |
| 2-08-05 | 10 | 01 | REVISION 39 | |
| 2-08-05 | 11 | 01 | REVISION 39 | |
| 2-08-05 | 12 | 01 | REVISION 39 | |
| 2-08-05 | 13 | 01 | REVISION 39 | |
| 2-08-05 | 14 | 01 | REVISION 39 | |
| 2-08-10 | 1 | 01 | REVISION 38 | ALL except XR |
| 2-08-10 | 2 | 01 | REVISION 38 | |
| 2-08-10 | 3 | 01 | REVISION 38 | |
| 2-08-10 | 4 | 01 | REVISION 38 | |
| 2-08-10 | 5 | 01 | REVISION 38 | |
| 2-08-10 | 6 | 01 | REVISION 38 | |
| 2-08-15 | 1 | 01 | REVISION 31 | ALL |
| 2-08-15 | 2 | 01 | REVISION 31 | |
| 2-08-15 | 3 | 01 | REVISION 31 | |
| 2-08-15 | 4 | 01 | REVISION 31 | |

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-09-00 | 1 | 01 | JAN 21, 2002 | ALL |
| 2-09-00 | 2 | 01 | JAN 21, 2002 | |
| 2-09-05 | 1 | 01 | REVISION 37 | General |
| 2-09-05 | 2 | 01 | REVISION 37 | |
| 2-09-05 | 3 | 01 | REVISION 37 | |
| 2-09-05 | 4 | 01 | REVISION 37 | |
| 2-09-05 | 5 | 01 | REVISION 37 | |
| 2-09-05 | 6 | 01 | REVISION 37 | |
| 2-09-05 | 7 | 01 | REVISION 37 | |
| 2-09-05 | 8 | 01 | REVISION 37 | |
| 2-09-05 | 9 | 01 | REVISION 37 | |
| 2-09-05 | 10 | 01 | REVISION 37 | |
| 2-09-05 | 11 | 01 | REVISION 37 | |
| 2-09-05 | 12 | 01 | REVISION 37 | |
| 2-10-00 | 1 | 01 | REVISION 41 | All except China Eastern |
| 2-10-00 | 2 | 01 | REVISION 41 | |
| 2-10-00 | 3 | 01 | REVISION 41 | |
| 2-10-00 | 4 | 01 | REVISION 41 | |
| 2-10-05 | 1 | 01 | DEC 20, 2002 | ALL |
| 2-10-05 | 2 | 01 | DEC 20, 2002 | |
| 2-10-05 | 3 | 01 | DEC 20, 2002 | |
| 2-10-05 | 4 | 01 | DEC 20, 2002 | |
| 2-10-10 | 1 | 01 | DEC 20, 2002 | ALL |
| 2-10-10 | 2 | 01 | DEC 20, 2002 | |
| 2-10-10 | 3 | 01 | JUN 28, 2002 | |
| 2-10-10 | 4 | 01 | JUN 28, 2002 | |
| 2-10-15 | 1 | 01 | REVISION 30 | ALL |
| 2-10-15 | 2 | 01 | REVISION 24 | |
| 2-10-15 | 3 | 01 | DEC 20, 2002 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-10-15 | 4 | 01 | DEC 20, 2002 | |
| 2-10-20 | 1 | 01 | DEC 20, 2002 | ALL |
| 2-10-20 | 2 | 01 | JUN 28, 2002 | |
| 2-10-25 | 1 | 01 | DEC 20, 2002 | ALL |
| 2-10-25 | 2 | 01 | JUN 28, 2002 | |
| 2-10-30 | 1 | 01 | REVISION 37 | ALL |
| 2-10-30 | 2 | 01 | REVISION 37 | |
| 2-10-30 | 3 | 01 | REVISION 37 | |
| 2-10-30 | 4 | 01 | REVISION 37 | |
| 2-10-30 | 5 | 01 | REVISION 37 | |
| 2-10-30 | 6 | 01 | REVISION 37 | |
| 2-10-35 | 1 | 01 | REVISION 30 | ALL |
| 2-10-35 | 2 | 01 | REVISION 23 | |
| 2-10-40 | 1 | 01 | REVISION 41 | ALL |
| 2-10-40 | 2 | 01 | REVISION 42 | |
| 2-10-40 | 3 | 01 | REVISION 42 | |
| 2-10-40 | 4 | 01 | REVISION 42 | |
| 2-10-40 | 5 | 01 | REVISION 42 | |
| 2-10-40 | 6 | 01 | REVISION 42 | |
| 2-10-40 | 7 | 01 | REVISION 42 | |
| 2-10-40 | 8 | 01 | REVISION 42 | |
| 2-10-40 | 9 | 01 | REVISION 42 | |
| 2-10-40 | 10 | 01 | REVISION 42 | |
| 2-10-50 | 1 | 01 | REVISION 41 | ALL |
| 2-10-50 | 2 | 01 | REVISION 41 | |
| 2-10-50 | 3 | 01 | REVISION 41 | |
| 2-10-50 | 4 | 01 | REVISION 41 | |
| 2-10-50 | 5 | 01 | REVISION 41 | |
| 2-10-50 | 6 | 01 | REVISION 41 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-10-50 | 7 | 01 | REVISION 41 | |
| 2-10-50 | 8 | 01 | REVISION 41 | |
| 2-10-50 | 9 | 01 | REVISION 41 | |
| 2-10-50 | 10 | 01 | REVISION 41 | |
| 2-10-50 | 11 | 01 | REVISION 41 | |
| 2-10-50 | 12 | 01 | REVISION 41 | |
| 2-10-50 | 13 | 01 | REVISION 41 | |
| 2-10-50 | 14 | 01 | REVISION 41 | |
| 2-10-50 | 15 | 01 | REVISION 41 | |
| 2-10-50 | 16 | 01 | REVISION 41 | |
| 2-10-50 | 17 | 01 | REVISION 42 | |
| 2-10-50 | 18 | 01 | REVISION 41 | |
| 2-10-50 | 19 | 01 | REVISION 41 | |
| 2-10-50 | 20 | 01 | REVISION 41 | |
| 2-10-50 | 21 | 01 | REVISION 41 | |
| 2-10-50 | 22 | 01 | REVISION 41 | |
| 2-10-60 | 1 | 01 | REVISION 39 | ALL |
| 2-10-60 | 2 | 01 | REVISION 39 | |
| 2-10-60 | 3 | 01 | REVISION 39 | |
| 2-10-60 | 4 | 01 | REVISION 40 | |
| 2-10-60 | 5 | 01 | REVISION 39 | |
| 2-10-60 | 6 | 01 | REVISION 39 | |
| 2-10-60 | 7 | 01 | REVISION 39 | |
| 2-10-60 | 8 | 01 | REVISION 39 | |
| 2-10-60 | 9 | 01 | REVISION 39 | |
| 2-10-60 | 10 | 01 | REVISION 39 | |
| 2-10-60 | 11 | 01 | REVISION 39 | |
| 2-10-60 | 12 | 01 | REVISION 39 | |
| 2-10-70 | 1 | 01 | JUN 28, 2002 | ALL |

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AOM-145/1114

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-10-70 | 2 | 01 | JUN 28, 2002 | |
| 2-10-70 | 3 | 01 | JUN 28, 2002 | |
| 2-10-70 | 4 | 01 | JUN 28, 2002 | |
| 2-10-70 | 5 | 01 | JUN 28, 2002 | |
| 2-10-70 | 6 | 01 | JUN 28, 2002 | |
| 2-11-00 | 1 | 01 | JAN 21, 2002 | ALL |
| 2-11-00 | 2 | 01 | JAN 21, 2002 | |
| 2-11-05 | 1 | 01 | JAN 21, 2002 | General |
| 2-11-05 | 2 | 01 | JAN 21, 2002 | |
| 2-11-05 | 3 | 01 | JAN 21, 2002 | |
| 2-11-05 | 4 | 01 | JAN 21, 2002 | |
| 2-11-05 | 5 | 01 | REVISION 30 | |
| 2-11-05 | 6 | 01 | REVISION 21 | |
| 2-11-05 | 7 | 01 | JAN 21, 2002 | |
| 2-11-05 | 8 | 01 | JAN 21, 2002 | |
| 2-12-00 | 1 | 01 | REVISION 38 | All except China Eastern |
| 2-12-00 | 2 | 01 | REVISION 38 | |
| 2-12-05 | 1 | 01 | REVISION 45 | ALL |
| 2-12-05 | 2 | 01 | REVISION 45 | |
| 2-12-05 | 3 | 01 | REVISION 45 | |
| 2-12-05 | 4 | 01 | REVISION 45 | |
| 2-12-05 | 5 | 01 | REVISION 45 | |
| 2-12-05 | 6 | 01 | REVISION 45 | |
| 2-12-05 | 7 | 01 | REVISION 45 | |
| 2-12-05 | 8 | 01 | REVISION 45 | |
| 2-12-05 | 9 | 01 | REVISION 45 | |
| 2-12-05 | 10 | 01 | REVISION 45 | |
| 2-12-05 | 11 | 01 | REVISION 45 | |
| 2-12-05 | 12 | 01 | REVISION 45 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-12-05 | 13 | 01 | REVISION 45 | |
| 2-12-05 | 14 | 01 | REVISION 45 | |
| 2-12-05 | 15 | 01 | REVISION 45 | |
| 2-12-05 | 16 | 01 | REVISION 45 | |
| 2-12-10 | 1 | 01 | REVISION 40 | ALL |
| 2-12-10 | 2 | 01 | REVISION 40 | |
| 2-12-10 | 3 | 01 | REVISION 40 | |
| 2-12-10 | 4 | 01 | REVISION 40 | |
| 2-12-10 | 5 | 01 | REVISION 40 | |
| 2-12-10 | 6 | 01 | REVISION 40 | |
| 2-12-10 | 7 | 01 | REVISION 40 | |
| 2-12-10 | 8 | 01 | REVISION 40 | |
| 2-12-10 | 9 | 01 | REVISION 40 | |
| 2-12-10 | 10 | 01 | REVISION 40 | |
| 2-12-10 | 11 | 01 | REVISION 40 | |
| 2-12-10 | 12 | 01 | REVISION 40 | |
| 2-12-15 | 1 | 01 | REVISION 40 | ALL |
| 2-12-15 | 2 | 01 | REVISION 40 | |
| 2-12-15 | 3 | 01 | REVISION 40 | |
| 2-12-15 | 4 | 01 | REVISION 40 | |
| 2-12-15 | 5 | 01 | REVISION 40 | |
| 2-12-15 | 6 | 01 | REVISION 40 | |
| 2-12-15 | 7 | 01 | REVISION 40 | |
| 2-12-15 | 8 | 01 | REVISION 40 | |
| 2-12-15 | 9 | 01 | REVISION 40 | |
| 2-12-15 | 10 | 01 | REVISION 40 | |
| 2-12-15 | 11 | 01 | REVISION 40 | |
| 2-12-15 | 12 | 01 | REVISION 40 | |
| 2-13-00 | 1 | 01 | REVISION 38 | ALL except XR |

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AOM-145/1114

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-13-00 | 2 | 01 | REVISION 38 | |
| 2-13-05 | 1 | 01 | JUN 29, 2001 | ALL |
| 2-13-05 | 2 | 01 | JUN 29, 2001 | |
| 2-13-05 | 3 | 01 | JUN 29, 2001 | |
| 2-13-05 | 4 | 01 | JUN 29, 2001 | |
| 2-13-10 | 1 | 01 | REVISION 38 | ALL except XR |
| 2-13-10 | 2 | 01 | REVISION 38 | |
| 2-13-10 | 3 | 01 | REVISION 38 | |
| 2-13-10 | 4 | 01 | REVISION 38 | |
| 2-13-10 | 5 | 01 | REVISION 38 | |
| 2-13-10 | 6 | 01 | REVISION 38 | |
| 2-13-10 | 7 | 01 | REVISION 38 | |
| 2-13-10 | 8 | 01 | REVISION 38 | |
| 2-13-10 | 9 | 01 | REVISION 38 | |
| 2-13-10 | 10 | 01 | REVISION 38 | |
| 2-13-10 | 11 | 01 | REVISION 38 | |
| 2-13-10 | 12 | 01 | REVISION 38 | |
| 2-13-10 | 13 | 01 | REVISION 38 | |
| 2-13-10 | 14 | 01 | REVISION 38 | |
| 2-13-10 | 15 | 01 | REVISION 38 | |
| 2-13-10 | 16 | 01 | REVISION 38 | |
| 2-13-10 | 17 | 01 | REVISION 38 | |
| 2-13-10 | 18 | 01 | REVISION 38 | |
| 2-13-15 | 1 | 01 | JUN 29, 2001 | ALL |
| 2-13-15 | 2 | 01 | JUN 29, 2001 | |
| 2-13-15 | 3 | 01 | JUN 29, 2001 | |
| 2-13-15 | 4 | 01 | JUN 29, 2001 | |
| 2-13-15 | 5 | 01 | JUN 29, 2001 | |
| 2-13-15 | 6 | 01 | JUN 28, 2002 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-13-15 | 7 | 01 | JUN 29, 2001 | |
| 2-13-15 | 8 | 01 | JUN 29, 2001 | |
| 2-13-15 | 9 | 01 | AUG 24, 2001 | |
| 2-13-15 | 10 | 01 | JUN 29, 2001 | |
| 2-13-20 | 1 | 02 | REVISION 42 | ANAC/FAA |
| 2-13-20 | 2 | 02 | REVISION 42 | |
| 2-13-20 | 3 | 02 | REVISION 42 | |
| 2-13-20 | 4 | 02 | REVISION 42 | |
| 2-13-20 | 5 | 02 | REVISION 42 | |
| 2-13-20 | 6 | 02 | REVISION 42 | |
| 2-13-20 | 7 | 02 | REVISION 42 | |
| 2-13-20 | 8 | 02 | REVISION 42 | |
| 2-13-20 | 9 | 02 | REVISION 42 | |
| 2-13-20 | 10 | 02 | REVISION 42 | |
| 2-13-20 | 11 | 02 | REVISION 42 | |
| 2-13-20 | 12 | 02 | REVISION 42 | |
| 2-13-25 | 1 | 01 | REVISION 41 | ALL |
| 2-13-25 | 2 | 01 | REVISION 42 | |
| 2-13-25 | 3 | 01 | REVISION 41 | |
| 2-13-25 | 4 | 01 | REVISION 41 | |
| 2-13-25 | 5 | 01 | REVISION 41 | |
| 2-13-25 | 6 | 01 | REVISION 41 | |
| 2-13-25 | 7 | 01 | REVISION 41 | |
| 2-13-25 | 8 | 01 | REVISION 41 | |
| 2-13-30 | 1 | 01 | JUN 29, 2001 | ALL |
| 2-13-30 | 2 | 01 | JUN 29, 2001 | |
| 2-13-30 | 3 | 01 | REVISION 18 | |
| 2-13-30 | 4 | 01 | REVISION 32 | |
| 2-13-30 | 5 | 01 | JUN 29, 2001 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-13-30 | 6 | 01 | AUG 24, 2001 | |
| 2-13-35 | 1 | 01 | REVISION 18 | ALL |
| 2-13-35 | 2 | 01 | REVISION 27 | |
| 2-13-35 | 3 | 01 | REVISION 18 | |
| 2-13-35 | 4 | 01 | REVISION 30 | |
| 2-13-35 | 5 | 01 | JUN 29, 2001 | |
| 2-13-35 | 6 | 01 | AUG 24, 2001 | |
| 2-14-00 | 1 | 01 | REVISION 29 | ALL except XR |
| 2-14-00 | 2 | 01 | REVISION 18 | |
| 2-14-05 | 1 | 01 | REVISION 18 | ALL |
| 2-14-05 | 2 | 01 | REVISION 29 | |
| 2-14-05 | 2A | 01 | REVISION 29 | |
| 2-14-05 | 2B | 01 | REVISION 29 | |
| 2-14-05 | 3 | 01 | REVISION 23 | |
| 2-14-05 | 4 | 01 | REVISION 32 | |
| 2-14-05 | 5 | 01 | JUN 28, 2002 | |
| 2-14-05 | 6 | 01 | DEC 20, 2002 | |
| 2-14-05 | 6A | 01 | REVISION 29 | |
| 2-14-05 | 6B | 01 | REVISION 29 | |
| 2-14-05 | 7 | 01 | JUN 28, 2002 | |
| 2-14-05 | 8 | 01 | JUN 28, 2002 | |
| 2-14-10 | 1 | 01 | REVISION 43 | ALL |
| 2-14-10 | 2 | 01 | REVISION 43 | |
| 2-14-10 | 3 | 01 | REVISION 43 | |
| 2-14-10 | 4 | 01 | REVISION 43 | |
| 2-14-10 | 5 | 01 | REVISION 43 | |
| 2-14-10 | 6 | 01 | REVISION 43 | |
| 2-14-10 | 7 | 01 | REVISION 43 | |
| 2-14-10 | 8 | 01 | REVISION 43 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-14-10 | 9 | 01 | REVISION 43 | |
| 2-14-10 | 10 | 01 | REVISION 43 | |
| 2-14-10 | 11 | 01 | REVISION 43 | |
| 2-14-10 | 12 | 01 | REVISION 43 | |
| 2-14-10 | 13 | 01 | REVISION 43 | |
| 2-14-10 | 14 | 01 | REVISION 43 | |
| 2-14-10 | 15 | 01 | REVISION 43 | |
| 2-14-10 | 16 | 01 | REVISION 43 | |
| 2-14-10 | 17 | 01 | REVISION 43 | |
| 2-14-10 | 18 | 01 | REVISION 43 | |
| 2-14-15 | 1 | 01 | JAN 21, 2002 | ALL except High Alt |
| 2-14-15 | 2 | 01 | JUN 29, 2001 | |
| 2-14-15 | 3 | 01 | REVISION 19 | |
| 2-14-15 | 4 | 01 | REVISION 29 | |
| 2-14-15 | 5 | 01 | REVISION 19 | |
| 2-14-15 | 6 | 01 | REVISION 29 | |
| 2-14-15 | 7 | 01 | JUN 29, 2001 | |
| 2-14-15 | 8 | 01 | JUN 29, 2001 | |
| 2-14-15 | 9 | 01 | JAN 21, 2002 | |
| 2-14-15 | 10 | 01 | OCT 02, 2001 | |
| 2-14-15 | 1 | 02 | REVISION 41 | High Alt |
| 2-14-15 | 2 | 02 | REVISION 41 | |
| 2-14-15 | 3 | 02 | REVISION 41 | |
| 2-14-15 | 4 | 02 | REVISION 41 | |
| 2-14-15 | 5 | 02 | REVISION 41 | |
| 2-14-15 | 6 | 02 | REVISION 41 | |
| 2-14-15 | 7 | 02 | REVISION 41 | |
| 2-14-15 | 8 | 02 | REVISION 41 | |
| 2-14-15 | 9 | 02 | REVISION 41 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-14-15 | 10 | 02 | REVISION 41 | |
| 2-14-15 | 11 | 02 | REVISION 41 | |
| 2-14-15 | 12 | 02 | REVISION 41 | |
| 2-14-15 | 13 | 02 | REVISION 41 | |
| 2-14-15 | 14 | 02 | REVISION 41 | |
| 2-14-15 | 15 | 02 | REVISION 41 | |
| 2-14-15 | 16 | 02 | REVISION 41 | |
| 2-14-20 | 1 | 01 | JUN 29, 2001 | ALL |
| 2-14-20 | 2 | 01 | JUN 29, 2001 | |
| 2-14-20 | 3 | 01 | JUN 29, 2001 | |
| 2-14-20 | 4 | 01 | JUN 29, 2001 | |
| 2-14-25 | 1 | 01 | REVISION 29 | ALL |
| 2-14-25 | 2 | 01 | REVISION 18 | |
| 2-15-00 | 1 | 01 | REVISION 41 | ALL except XR |
| 2-15-00 | 2 | 01 | REVISION 41 | |
| 2-15-05 | 1 | 01 | REVISION 41 | ALL |
| 2-15-05 | 2 | 01 | REVISION 41 | |
| 2-15-10 | 1 | 01 | REVISION 43 | ALL |
| 2-15-10 | 2 | 01 | REVISION 43 | |
| 2-15-10 | 3 | 01 | REVISION 43 | |
| 2-15-10 | 4 | 01 | REVISION 43 | |
| 2-15-10 | 5 | 01 | REVISION 43 | |
| 2-15-10 | 6 | 01 | REVISION 43 | |
| 2-15-10 | 7 | 01 | REVISION 43 | |
| 2-15-10 | 8 | 01 | REVISION 43 | |
| 2-15-10 | 9 | 01 | REVISION 43 | |
| 2-15-10 | 10 | 01 | REVISION 43 | |
| 2-15-10 | 11 | 01 | REVISION 43 | |
| 2-15-10 | 12 | 01 | REVISION 43 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-15-10 | 13 | 01 | REVISION 43 | |
| 2-15-10 | 14 | 01 | REVISION 43 | |
| 2-15-10 | 15 | 01 | REVISION 43 | |
| 2-15-10 | 16 | 01 | REVISION 43 | |
| 2-15-10 | 17 | 01 | REVISION 43 | |
| 2-15-10 | 18 | 01 | REVISION 43 | |
| 2-15-15 | 1 | 01 | REVISION 42 | ALL except XR |
| 2-15-15 | 2 | 01 | REVISION 41 | |
| 2-15-15 | 3 | 01 | REVISION 42 | |
| 2-15-15 | 4 | 01 | REVISION 41 | |
| 2-16-00 | 1 | 01 | OCT 02, 2001 | ALL except shuttle 135 |
| 2-16-00 | 2 | 01 | OCT 02, 2001 | |
| 2-16-05 | 1 | 01 | REVISION 44 | ALL except Shuttle 135 |
| 2-16-05 | 2 | 01 | REVISION 44 | |
| 2-16-10 | 1 | 01 | REVISION 26 | ALL except shuttle 135 |
| 2-16-10 | 2 | 01 | REVISION 20 | |
| 2-16-10 | 3 | 01 | OCT 02, 2001 | |
| 2-16-10 | 4 | 01 | OCT 02, 2001 | |
| 2-16-10 | 5 | 01 | OCT 02, 2001 | |
| 2-16-10 | 6 | 01 | OCT 02, 2001 | |
| 2-16-10 | 7 | 01 | OCT 02, 2001 | |
| 2-16-10 | 8 | 01 | OCT 02, 2001 | |
| 2-16-10 | 9 | 01 | OCT 02, 2001 | |
| 2-16-10 | 10 | 01 | OCT 02, 2001 | |
| 2-16-10 | 11 | 01 | OCT 02, 2001 | |
| 2-16-10 | 12 | 01 | OCT 02, 2001 | |
| 2-16-15 | 1 | 01 | REVISION 41 | ALL except Shuttle 135 |
| 2-16-15 | 2 | 01 | REVISION 41 | |

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AOM-145/1114

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-16-15 | 3 | 01 | REVISION 41 | |
| 2-16-15 | 4 | 01 | REVISION 41 | |
| 2-16-15 | 5 | 01 | REVISION 41 | |
| 2-16-15 | 6 | 01 | REVISION 41 | |
| 2-16-20 | 1 | 01 | REVISION 31 | ALL |
| 2-16-20 | 2 | 01 | REVISION 20 | |
| 2-16-25 | 1 | 01 | OCT 02, 2001 | ALL |
| 2-16-25 | 2 | 01 | OCT 02, 2001 | |
| 2-16-25 | 3 | 01 | OCT 02, 2001 | |
| 2-16-25 | 4 | 01 | OCT 02, 2001 | |
| 2-16-25 | 5 | 01 | OCT 02, 2001 | |
| 2-16-25 | 6 | 01 | OCT 02, 2001 | |
| 2-16-30 | 1 | 01 | REVISION 38 | ALL except Shuttle 135 |
| 2-16-30 | 2 | 01 | REVISION 36 | |
| 2-16-30 | 3 | 01 | REVISION 36 | |
| 2-16-30 | 4 | 01 | REVISION 36 | |
| 2-16-30 | 5 | 01 | REVISION 36 | |
| 2-16-30 | 6 | 01 | REVISION 36 | |
| 2-17-00 | 1 | 01 | JUN 29, 2001 | ALL |
| 2-17-00 | 2 | 01 | JUN 29, 2001 | |
| 2-17-05 | 1 | 01 | JUN 29, 2001 | ALL |
| 2-17-05 | 2 | 01 | JUN 29, 2001 | |
| 2-17-10 | 1 | 01 | REVISION 28 | ALL |
| 2-17-10 | 2 | 01 | REVISION 18 | |
| 2-17-10 | 3 | 01 | REVISION 28 | |
| 2-17-10 | 4 | 01 | REVISION 18 | |
| 2-17-10 | 5 | 01 | JUN 29, 2001 | |
| 2-17-10 | 6 | 01 | JUN 29, 2001 | |
| 2-17-10 | 7 | 01 | JUN 29, 2001 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-17-10 | 8 | 01 | JUN 29, 2001 | |
| 2-17-15 | 1 | 01 | REVISION 39 | ALL |
| 2-17-15 | 2 | 01 | REVISION 39 | |
| 2-17-15 | 3 | 01 | REVISION 39 | |
| 2-17-15 | 4 | 01 | REVISION 39 | |
| 2-17-15 | 5 | 01 | REVISION 39 | |
| 2-17-15 | 6 | 01 | REVISION 39 | |
| 2-17-15 | 7 | 01 | REVISION 39 | |
| 2-17-15 | 8 | 01 | REVISION 39 | |
| 2-17-15 | 9 | 01 | REVISION 39 | |
| 2-17-15 | 10 | 01 | REVISION 39 | |
| 2-17-15 | 11 | 01 | REVISION 39 | |
| 2-17-15 | 12 | 01 | REVISION 39 | |
| 2-17-20 | 1 | 01 | REVISION 43 | ISIS THALES |
| 2-17-20 | 2 | 01 | REVISION 43 | |
| 2-17-20 | 3 | 01 | REVISION 43 | |
| 2-17-20 | 4 | 01 | REVISION 43 | |
| 2-17-20 | 5 | 01 | REVISION 43 | |
| 2-17-20 | 6 | 01 | REVISION 43 | |
| 2-17-20 | 7 | 01 | REVISION 43 | |
| 2-17-20 | 8 | 01 | REVISION 43 | |
| 2-17-20 | 9 | 01 | REVISION 43 | |
| 2-17-20 | 10 | 01 | REVISION 43 | |
| 2-17-20 | 11 | 01 | REVISION 43 | |
| 2-17-20 | 12 | 01 | REVISION 43 | |
| 2-17-20 | 13 | 01 | REVISION 43 | |
| 2-17-20 | 14 | 01 | REVISION 43 | |
| 2-17-20 | 15 | 01 | REVISION 43 | |
| 2-17-20 | 16 | 01 | REVISION 43 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-17-25 | 1 | 01 | REVISION 37 | ALL |
| 2-17-25 | 2 | 01 | REVISION 38 | |
| 2-17-25 | 3 | 01 | REVISION 38 | |
| 2-17-25 | 4 | 01 | REVISION 39 | |
| 2-17-25 | 5 | 01 | REVISION 39 | |
| 2-17-25 | 6 | 01 | REVISION 37 | |
| 2-17-25 | 7 | 01 | REVISION 37 | |
| 2-17-25 | 8 | 01 | REVISION 37 | |
| 2-17-30 | 1 | 01 | REVISION 38 | ALL |
| 2-17-30 | 2 | 01 | REVISION 38 | |
| 2-17-30 | 3 | 01 | REVISION 38 | |
| 2-17-30 | 4 | 01 | REVISION 38 | |
| 2-17-30 | 5 | 01 | REVISION 38 | |
| 2-17-30 | 6 | 01 | REVISION 38 | |
| 2-17-35 | 1 | 01 | REVISION 33 | ALL but MFDAU |
| 2-17-35 | 2 | 01 | REVISION 22 | |
| 2-17-35 | 3 | 01 | REVISION 33 | |
| 2-17-35 | 4 | 01 | REVISION 33 | |
| 2-18-00 | 1 | 01 | REVISION 45 | ALL |
| 2-18-00 | 2 | 01 | REVISION 45 | |
| 2-18-00 | 3 | 01 | REVISION 45 | |
| 2-18-00 | 4 | 01 | REVISION 45 | |
| 2-18-00 | 5 | 01 | REVISION 45 | |
| 2-18-00 | 6 | 01 | REVISION 45 | |
| 2-18-01 | 1 | 01 | MAR 30, 2001 | ALL |
| 2-18-01 | 2 | 01 | MAR 30, 2001 | |
| 2-18-05 | 1 | 01 | MAR 30, 2001 | RMS |
| 2-18-05 | 2 | 01 | AUG 24, 2001 | |
| 2-18-07 | 1 | 01 | REVISION 29 | Integrated Com. Unit |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-07 | 2 | 01 | REVISION 17 | |
| 2-18-09 | 1 | 01 | MAR 30, 2001 | Integrated Nav. Unit |
| 2-18-09 | 2 | 01 | MAR 30, 2001 | |
| 2-18-11 | 1 | 01 | REVISION 43 | ALL RMU |
| 2-18-11 | 2 | 01 | REVISION 43 | |
| 2-18-11 | 3 | 01 | REVISION 43 | |
| 2-18-11 | 4 | 01 | REVISION 43 | |
| 2-18-11 | 5 | 01 | REVISION 43 | |
| 2-18-11 | 6 | 01 | REVISION 43 | |
| 2-18-11 | 7 | 01 | REVISION 43 | |
| 2-18-11 | 8 | 01 | REVISION 43 | |
| 2-18-11 | 9 | 01 | REVISION 43 | |
| 2-18-11 | 10 | 01 | REVISION 43 | |
| 2-18-11 | 11 | 01 | REVISION 43 | |
| 2-18-11 | 12 | 01 | REVISION 43 | |
| 2-18-11 | 13 | 01 | REVISION 43 | |
| 2-18-11 | 14 | 01 | REVISION 43 | |
| 2-18-11 | 15 | 01 | REVISION 43 | |
| 2-18-11 | 16 | 01 | REVISION 43 | |
| 2-18-11 | 17 | 01 | REVISION 43 | |
| 2-18-11 | 18 | 01 | REVISION 43 | |
| 2-18-11 | 19 | 01 | REVISION 43 | |
| 2-18-11 | 20 | 01 | REVISION 43 | |
| 2-18-11 | 21 | 01 | REVISION 43 | |
| 2-18-11 | 22 | 01 | REVISION 43 | |
| 2-18-11 | 23 | 01 | REVISION 43 | |
| 2-18-11 | 24 | 01 | REVISION 43 | |
| 2-18-11 | 25 | 01 | REVISION 43 | |
| 2-18-11 | 26 | 01 | REVISION 43 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-11 | 27 | 01 | REVISION 43 | |
| 2-18-11 | 28 | 01 | REVISION 43 | |
| 2-18-11 | 29 | 01 | REVISION 43 | |
| 2-18-11 | 30 | 01 | REVISION 43 | |
| 2-18-11 | 31 | 01 | REVISION 43 | |
| 2-18-11 | 32 | 01 | REVISION 43 | |
| 2-18-11 | 33 | 01 | REVISION 43 | |
| 2-18-11 | 34 | 01 | REVISION 43 | |
| 2-18-11 | 35 | 01 | REVISION 43 | |
| 2-18-11 | 36 | 01 | REVISION 43 | |
| 2-18-11 | 37 | 01 | REVISION 43 | |
| 2-18-11 | 38 | 01 | REVISION 43 | |
| 2-18-11 | 39 | 01 | REVISION 43 | |
| 2-18-11 | 40 | 01 | REVISION 43 | |
| 2-18-11 | 41 | 01 | REVISION 43 | |
| 2-18-11 | 42 | 01 | REVISION 43 | |
| 2-18-11 | 43 | 01 | REVISION 43 | |
| 2-18-11 | 44 | 01 | REVISION 43 | |
| 2-18-11 | 45 | 01 | REVISION 43 | |
| 2-18-11 | 46 | 01 | REVISION 43 | |
| 2-18-11 | 47 | 01 | REVISION 43 | |
| 2-18-11 | 48 | 01 | REVISION 43 | |
| 2-18-11 | 49 | 01 | REVISION 43 | |
| 2-18-11 | 50 | 01 | REVISION 43 | |
| 2-18-11 | 51 | 01 | REVISION 43 | |
| 2-18-11 | 52 | 01 | REVISION 43 | |
| 2-18-11 | 53 | 01 | REVISION 43 | |
| 2-18-11 | 54 | 01 | REVISION 43 | |
| 2-18-11 | 55 | 01 | REVISION 43 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-11 | 56 | 01 | REVISION 43 | |
| 2-18-13 | 1 | 01 | MAR 30, 2001 | Tuning Backup Control |
| 2-18-13 | 2 | 01 | MAR 30, 2001 | |
| 2-18-13 | 3 | 01 | MAR 30, 2001 | |
| 2-18-13 | 4 | 01 | MAR 30, 2001 | |
| 2-18-13 | 5 | 01 | AUG 24, 2001 | |
| 2-18-13 | 6 | 01 | MAR 30, 2001 | |
| 2-18-15 | 1 | 01 | REVISION 36 | Digital Audio Panel |
| 2-18-15 | 2 | 01 | REVISION 36 | |
| 2-18-15 | 3 | 01 | REVISION 36 | |
| 2-18-15 | 4 | 01 | REVISION 36 | |
| 2-18-15 | 5 | 01 | REVISION 36 | |
| 2-18-15 | 6 | 01 | REVISION 36 | |
| 2-18-19 | 1 | 01 | REVISION 45 | EICAS messages |
| 2-18-19 | 2 | 01 | REVISION 45 | |
| 2-18-20 | 1 | 01 | REVISION 27 | Communication Control |
| 2-18-20 | 2 | 01 | REVISION 19 | |
| 2-18-20 | 3 | 01 | AUG 24, 2001 | |
| 2-18-20 | 4 | 01 | JUN 28, 2002 | |
| 2-18-20 | 5 | 01 | JUN 28, 2002 | |
| 2-18-20 | 6 | 01 | JUN 28, 2002 | |
| 2-18-20 | 7 | 01 | JUN 28, 2002 | |
| 2-18-20 | 8 | 01 | MAR 30, 2001 | |
| 2-18-20 | 9 | 01 | MAR 30, 2001 | |
| 2-18-20 | 10 | 01 | MAR 30, 2001 | |
| 2-18-21 | 1 | 01 | JUN 29, 2001 | HF-230 |
| 2-18-21 | 2 | 01 | MAR 30, 2001 | |
| 2-18-21 | 3 | 01 | MAR 30, 2001 | |
| 2-18-21 | 4 | 01 | MAR 30, 2001 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-21 | 5 | 01 | MAR 30, 2001 | |
| 2-18-21 | 6 | 01 | MAR 30, 2001 | |
| 2-18-21 | 7 | 01 | MAR 30, 2001 | |
| 2-18-21 | 8 | 01 | MAR 30, 2001 | |
| 2-18-21 | 9 | 01 | MAR 30, 2001 | |
| 2-18-21 | 10 | 01 | MAR 30, 2001 | |
| 2-18-21 | 11 | 01 | MAR 30, 2001 | |
| 2-18-21 | 12 | 01 | MAR 30, 2001 | |
| 2-18-21 | 13 | 01 | MAR 30, 2001 | |
| 2-18-21 | 14 | 01 | MAR 30, 2001 | |
| 2-18-21 | 15 | 01 | MAR 30, 2001 | |
| 2-18-21 | 16 | 01 | MAR 30, 2001 | |
| 2-18-21 | 1 | 02 | REVISION 31 | KHF-950 and ref. to KHF-1050 |
| 2-18-21 | 2 | 02 | REVISION 18 | |
| 2-18-21 | 3 | 02 | JUN 29, 2001 | |
| 2-18-21 | 4 | 02 | JUN 29, 2001 | |
| 2-18-21 | 5 | 02 | JUN 29, 2001 | |
| 2-18-21 | 6 | 02 | JUN 29, 2001 | |
| 2-18-21 | 7 | 02 | JUN 29, 2001 | |
| 2-18-21 | 8 | 02 | JUN 29, 2001 | |
| 2-18-21 | 9 | 02 | JUN 29, 2001 | |
| 2-18-21 | 10 | 02 | JUN 29, 2001 | |
| 2-18-21 | 11 | 02 | JUN 29, 2001 | |
| 2-18-21 | 12 | 02 | JUN 29, 2001 | |
| 2-18-21 | 1 | 03 | REVISION 33 | KHF-1050 |
| 2-18-21 | 2 | 03 | REVISION 33 | |
| 2-18-22 | 1 | 01 | MAR 30, 2001 | 3rd VHF COM |
| 2-18-22 | 2 | 01 | MAR 30, 2001 | |
| 2-18-22 | 3 | 01 | MAR 30, 2001 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-22 | 4 | 01 | MAR 30, 2001 | |
| 2-18-22 | 5 | 01 | AUG 24, 2001 | |
| 2-18-22 | 6 | 01 | MAR 30, 2001 | |
| 2-18-22 | 1 | 02 | MAR 30, 2001 | 3rd VHF NAV/COM |
| 2-18-22 | 2 | 02 | MAR 30, 2001 | |
| 2-18-22 | 3 | 02 | MAR 30, 2001 | |
| 2-18-22 | 4 | 02 | MAR 30, 2001 | |
| 2-18-22 | 1 | 03 | MAR 30, 2001 | 3rd VHF NAV |
| 2-18-22 | 2 | 03 | MAR 30, 2001 | |
| 2-18-22 | 3 | 03 | MAR 30, 2001 | |
| 2-18-22 | 4 | 03 | MAR 30, 2001 | |
| 2-18-22 | 5 | 03 | MAR 30, 2001 | |
| 2-18-22 | 6 | 03 | MAR 30, 2001 | |
| 2-18-22 | 1 | 04 | JUN 28, 2002 | 3rd VHF COM/CMU |
| 2-18-22 | 2 | 04 | MAR 28, 2002 | |
| 2-18-22 | 3 | 04 | MAR 28, 2002 | |
| 2-18-22 | 4 | 04 | MAR 28, 2002 | |
| 2-18-22 | 5 | 04 | MAR 28, 2002 | |
| 2-18-22 | 6 | 04 | MAR 28, 2002 | |
| 2-18-23 | 1 | 01 | REVISION 17 | SELCAL |
| 2-18-23 | 2 | 01 | REVISION 33 | |
| 2-18-24 | 1 | 01 | MAR 30, 2001 | ACARS |
| 2-18-24 | 2 | 01 | MAR 30, 2001 | |
| 2-18-24 | 3 | 01 | MAR 30, 2001 | |
| 2-18-24 | 4 | 01 | MAR 30, 2001 | |
| 2-18-24 | 5 | 01 | MAR 30, 2001 | |
| 2-18-24 | 6 | 01 | MAR 30, 2001 | |
| 2-18-24 | 7 | 01 | AUG 24, 2001 | |
| 2-18-24 | 8 | 01 | MAR 30, 2001 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-24 | 9 | 01 | MAR 28, 2002 | |
| 2-18-24 | 10 | 01 | MAR 30, 2001 | |
| 2-18-24 | 1 | 02 | OCT 02, 2001 | CMU mark III |
| 2-18-24 | 2 | 02 | JAN 21, 2002 | |
| 2-18-24 | 3 | 02 | OCT 02, 2001 | |
| 2-18-24 | 4 | 02 | OCT 02, 2001 | |
| 2-18-24 | 5 | 02 | OCT 02, 2001 | |
| 2-18-24 | 6 | 02 | OCT 02, 2001 | |
| 2-18-24 | 7 | 02 | OCT 02, 2001 | |
| 2-18-24 | 8 | 02 | OCT 02, 2001 | |
| 2-18-24 | 9 | 02 | MAR 28, 2002 | |
| 2-18-24 | 10 | 02 | OCT 02, 2001 | |
| 2-18-25 | 1 | 01 | REVISION 29 | CVR |
| 2-18-25 | 2 | 01 | REVISION 29 | |
| 2-18-25 | 3 | 01 | REVISION 29 | |
| 2-18-25 | 4 | 01 | REVISION 29 | |
| 2-18-27 | 1 | 01 | REVISION 17 | Passenger Address |
| 2-18-27 | 2 | 01 | REVISION 31 | |
| 2-18-27 | 3 | 01 | MAR 30, 2001 | |
| 2-18-27 | 4 | 01 | MAR 30, 2001 | |
| 2-18-27 | 5 | 01 | AUG 24, 2001 | |
| 2-18-27 | 6 | 01 | MAR 30, 2001 | |
| 2-18-27 | 7 | 01 | REVISION 31 | |
| 2-18-27 | 8 | 01 | REVISION 17 | |
| 2-18-28 | 1 | 01 | JUN 29, 2001 | satcom system |
| 2-18-28 | 2 | 01 | JUN 29, 2001 | |
| 2-18-28 | 3 | 01 | JUN 29, 2001 | |
| 2-18-28 | 4 | 01 | JUN 29, 2001 | |
| 2-18-28 | 5 | 01 | JUN 29, 2001 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-28 | 6 | 01 | JUN 29, 2001 | |
| 2-18-28 | 7 | 01 | JUN 29, 2001 | |
| 2-18-28 | 8 | 01 | JUN 29, 2001 | |
| 2-18-28 | 9 | 01 | JUN 29, 2001 | |
| 2-18-28 | 10 | 01 | JUN 29, 2001 | |
| 2-18-28 | 11 | 01 | JUN 29, 2001 | |
| 2-18-28 | 12 | 01 | JUN 29, 2001 | |
| 2-18-28 | 13 | 01 | JUN 29, 2001 | |
| 2-18-28 | 14 | 01 | JUN 29, 2001 | |
| 2-18-30 | 1 | 01 | MAR 30, 2001 | AHRS |
| 2-18-30 | 2 | 01 | MAR 30, 2001 | |
| 2-18-30 | 3 | 01 | MAR 30, 2001 | |
| 2-18-30 | 4 | 01 | DEC 20, 2002 | |
| 2-18-30 | 5 | 01 | MAR 30, 2001 | |
| 2-18-30 | 6 | 01 | MAR 30, 2001 | |
| 2-18-30 | 7 | 01 | MAR 30, 2001 | |
| 2-18-30 | 8 | 01 | MAR 30, 2001 | |
| 2-18-30 | 9 | 01 | REVISION 17 | |
| 2-18-30 | 10 | 01 | REVISION 25 | |
| 2-18-30 | 11 | 01 | REVISION 25 | |
| 2-18-30 | 12 | 01 | REVISION 25 | |
| 2-18-30 | 13 | 01 | MAR 28, 2002 | |
| 2-18-30 | 14 | 01 | MAR 28, 2002 | |
| 2-18-30 | 15 | 01 | MAR 30, 2001 | |
| 2-18-30 | 16 | 01 | MAR 30, 2001 | |
| 2-18-30 | 17 | 01 | AUG 24, 2001 | |
| 2-18-30 | 18 | 01 | MAR 30, 2001 | |
| 2-18-30 | 19 | 01 | MAR 30, 2001 | |
| 2-18-30 | 20 | 01 | MAR 30, 2001 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-30 | 21 | 01 | MAR 30, 2001 | |
| 2-18-30 | 22 | 01 | MAR 30, 2001 | |
| 2-18-30 | 23 | 01 | MAR 30, 2001 | |
| 2-18-30 | 24 | 01 | MAR 30, 2001 | |
| 2-18-30 | 25 | 01 | AUG 24, 2001 | |
| 2-18-30 | 26 | 01 | MAR 30, 2001 | |
| 2-18-30 | 1 | 02 | JUN 28, 2002 | IRS |
| 2-18-30 | 2 | 02 | MAR 30, 2001 | |
| 2-18-30 | 3 | 02 | MAR 30, 2001 | |
| 2-18-30 | 4 | 02 | DEC 20, 2002 | |
| 2-18-30 | 5 | 02 | JUN 28, 2002 | |
| 2-18-30 | 6 | 02 | MAR 30, 2001 | |
| 2-18-30 | 7 | 02 | MAR 30, 2001 | |
| 2-18-30 | 8 | 02 | MAR 30, 2001 | |
| 2-18-30 | 9 | 02 | MAR 30, 2001 | |
| 2-18-30 | 10 | 02 | MAR 30, 2001 | |
| 2-18-30 | 11 | 02 | MAR 30, 2001 | |
| 2-18-30 | 12 | 02 | DEC 20, 2002 | |
| 2-18-30 | 13 | 02 | MAR 30, 2001 | |
| 2-18-30 | 14 | 02 | MAR 30, 2001 | |
| 2-18-30 | 15 | 02 | AUG 24, 2001 | |
| 2-18-30 | 16 | 02 | MAR 30, 2001 | |
| 2-18-30 | 17 | 02 | AUG 24, 2001 | |
| 2-18-30 | 18 | 02 | MAR 30, 2001 | |
| 2-18-30 | 19 | 02 | MAR 30, 2001 | |
| 2-18-30 | 20 | 02 | MAR 30, 2001 | |
| 2-18-30 | 21 | 02 | MAR 30, 2001 | |
| 2-18-30 | 22 | 02 | MAR 30, 2001 | |
| 2-18-30 | 23 | 02 | MAR 30, 2001 | |

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

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| Page Block | Page | Code | | | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|---|---|
| 2-18-30 | 24 | 02 | | | MAR 30, 2001 | |
| 2-18-30 | 25 | 02 | | | AUG 24, 2001 | |
| 2-18-30 | 26 | 02 | | | MAR 30, 2001 | |
| 2-18-35 | 1 | 01 | * | | REVISION 46 | FMZ 2000 FMS |
| 2-18-35 | 2 | 01 | * | | REVISION 46 | |
| 2-18-35 | 3 | 01 | * | | REVISION 46 | |
| 2-18-35 | 4 | 01 | * | | REVISION 46 | |
| 2-18-35 | 5 | 01 | * | | REVISION 46 | |
| 2-18-35 | 6 | 01 | * | | REVISION 46 | |
| 2-18-35 | 7 | 01 | * | | REVISION 46 | |
| 2-18-35 | 8 | 01 | * | | REVISION 46 | |
| 2-18-35 | 9 | 01 | * | | REVISION 46 | |
| 2-18-35 | 10 | 01 | * | | REVISION 46 | |
| 2-18-35 | 11 | 01 | * | | REVISION 46 | |
| 2-18-35 | 12 | 01 | * | | REVISION 46 | |
| 2-18-35 | 13 | 01 | * | | REVISION 46 | |
| 2-18-35 | 14 | 01 | * | | REVISION 46 | |
| 2-18-35 | 15 | 01 | * | | REVISION 46 | |
| 2-18-35 | 16 | 01 | * | | REVISION 46 | |
| 2-18-35 | 17 | 01 | * | new | REVISION 46 | |
| 2-18-35 | 18 | 01 | * | new | REVISION 46 | |
| 2-18-35 | 1 | 02 | | | REVISION 26 | UNS 1K FMS |
| 2-18-35 | 2 | 02 | | | REVISION 17 | |
| 2-18-35 | 3 | 02 | | | REVISION 18 | |
| 2-18-35 | 4 | 02 | | | REVISION 35 | |
| 2-18-35 | 4A | 02 | | | REVISION 35 | |
| 2-18-35 | 4B | 02 | | | REVISION 35 | |
| 2-18-35 | 4C | 02 | | | REVISION 35 | |
| 2-18-35 | 4D | 02 | | | REVISION 35 | |

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User: fnhernaof - Printed By myTechCare - Nov 21/24 - 00:45:44

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-35 | 5 | 02 | REVISION 34 | |
| 2-18-35 | 6 | 02 | REVISION 17 | |
| 2-18-35 | 7 | 02 | MAR 30, 2001 | |
| 2-18-35 | 8 | 02 | MAR 30, 2001 | |
| 2-18-35 | 9 | 02 | AUG 24, 2001 | |
| 2-18-35 | 10 | 02 | JUN 28, 2002 | |
| 2-18-35 | 11 | 02 | REVISION 19 | |
| 2-18-35 | 12 | 02 | REVISION 27 | |
| 2-18-35 | 13 | 02 | REVISION 29 | |
| 2-18-35 | 14 | 02 | REVISION 23 | |
| 2-18-35 | 1 | 04 | REVISION 45 | ANAC/FAA FMZ 2010 FMS (NZ 6.1.1) |
| 2-18-35 | 2 | 04 | REVISION 45 | |
| 2-18-35 | 3 | 04 | REVISION 45 | |
| 2-18-35 | 4 | 04 | REVISION 45 | |
| 2-18-35 | 5 | 04 | REVISION 45 | |
| 2-18-35 | 6 | 04 | REVISION 45 | |
| 2-18-35 | 7 | 04 | REVISION 45 | |
| 2-18-35 | 8 | 04 | REVISION 45 | |
| 2-18-35 | 9 | 04 | REVISION 45 | |
| 2-18-35 | 10 | 04 | REVISION 45 | |
| 2-18-35 | 11 | 04 | REVISION 45 | |
| 2-18-35 | 12 | 04 | REVISION 45 | |
| 2-18-35 | 13 | 04 | REVISION 45 | |
| 2-18-35 | 14 | 04 | REVISION 45 | |
| 2-18-35 | 15 | 04 | REVISION 45 | |
| 2-18-35 | 16 | 04 | REVISION 45 | |
| 2-18-35 | 17 | 04 | REVISION 45 | |
| 2-18-35 | 18 | 04 | REVISION 45 | |
| 2-18-35 | 19 | 04 | REVISION 45 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-35 | 20 | 04 | REVISION 45 | |
| 2-18-35 | 21 | 04 | REVISION 45 | |
| 2-18-35 | 22 | 04 | REVISION 45 | |
| 2-18-35 | 23 | 04 | REVISION 45 | |
| 2-18-35 | 24 | 04 | REVISION 45 | |
| 2-18-40 | 1 | 01 | MAR 30, 2001 | Navigation Display |
| 2-18-40 | 2 | 01 | MAR 30, 2001 | |
| 2-18-40 | 3 | 01 | MAR 30, 2001 | |
| 2-18-40 | 4 | 01 | MAR 30, 2001 | |
| 2-18-40 | 5 | 01 | AUG 24, 2001 | |
| 2-18-40 | 6 | 01 | MAR 30, 2001 | |
| 2-18-40 | 7 | 01 | MAR 30, 2001 | |
| 2-18-40 | 8 | 01 | MAR 30, 2001 | |
| 2-18-40 | 9 | 01 | MAR 30, 2001 | |
| 2-18-40 | 10 | 01 | MAR 30, 2001 | |
| 2-18-40 | 11 | 01 | MAR 30, 2001 | |
| 2-18-40 | 12 | 01 | MAR 30, 2001 | |
| 2-18-40 | 13 | 01 | MAR 30, 2001 | |
| 2-18-40 | 14 | 01 | MAR 30, 2001 | |
| 2-18-40 | 15 | 01 | MAR 30, 2001 | |
| 2-18-40 | 16 | 01 | MAR 30, 2001 | |
| 2-18-40 | 17 | 01 | MAR 30, 2001 | |
| 2-18-40 | 18 | 01 | MAR 30, 2001 | |
| 2-18-40 | 19 | 01 | AUG 24, 2001 | |
| 2-18-40 | 20 | 01 | MAR 30, 2001 | |
| 2-18-40 | 21 | 01 | MAR 30, 2001 | |
| 2-18-40 | 22 | 01 | MAR 30, 2001 | |
| 2-18-40 | 23 | 01 | AUG 24, 2001 | |
| 2-18-40 | 24 | 01 | MAR 30, 2001 | |

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User: fnhernaof - Printed By myTechCare - Nov 21/24 - 00:45:44

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-45 | 1 | 01 | REVISION 38 | Weather Radar |
| 2-18-45 | 2 | 01 | REVISION 38 | |
| 2-18-45 | 3 | 01 | REVISION 38 | |
| 2-18-45 | 4 | 01 | REVISION 38 | |
| 2-18-45 | 5 | 01 | REVISION 38 | |
| 2-18-45 | 6 | 01 | REVISION 38 | |
| 2-18-45 | 7 | 01 | REVISION 38 | |
| 2-18-45 | 8 | 01 | REVISION 38 | |
| 2-18-45 | 9 | 01 | REVISION 38 | |
| 2-18-45 | 10 | 01 | REVISION 38 | |
| 2-18-45 | 11 | 01 | REVISION 38 | |
| 2-18-45 | 12 | 01 | REVISION 38 | |
| 2-18-45 | 13 | 01 | REVISION 38 | |
| 2-18-45 | 14 | 01 | REVISION 38 | |
| 2-18-45 | 15 | 01 | REVISION 38 | |
| 2-18-45 | 16 | 01 | REVISION 38 | |
| 2-18-45 | 17 | 01 | REVISION 38 | |
| 2-18-45 | 18 | 01 | REVISION 38 | |
| 2-18-45 | 19 | 01 | REVISION 38 | |
| 2-18-45 | 20 | 01 | REVISION 38 | |
| 2-18-45 | 21 | 01 | REVISION 38 | |
| 2-18-45 | 22 | 01 | REVISION 38 | |
| 2-18-45 | 23 | 01 | REVISION 38 | |
| 2-18-45 | 24 | 01 | REVISION 38 | |
| 2-18-45 | 25 | 01 | REVISION 38 | |
| 2-18-45 | 26 | 01 | REVISION 38 | |
| 2-18-45 | 27 | 01 | REVISION 38 | |
| 2-18-45 | 28 | 01 | REVISION 38 | |
| 2-18-45 | 29 | 01 | REVISION 38 | |

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-45 | 30 | 01 | REVISION 38 | |
| 2-18-50 | 1 | 01 | AUG 24, 2001 | Lightning Sensor |
| 2-18-50 | 2 | 01 | MAR 30, 2001 | |
| 2-18-50 | 3 | 01 | MAR 30, 2001 | |
| 2-18-50 | 4 | 01 | MAR 30, 2001 | |
| 2-18-50 | 5 | 01 | MAR 30, 2001 | |
| 2-18-50 | 6 | 01 | MAR 30, 2001 | |
| 2-18-50 | 7 | 01 | MAR 30, 2001 | |
| 2-18-50 | 8 | 01 | MAR 30, 2001 | |
| 2-18-60 | 1 | 02 | REVISION 45 | ANAC/FAA FMZ 2010 BARO-VNAV (FMS 6.1.1) |
| 2-18-60 | 2 | 02 | REVISION 45 | |
| 2-18-60 | 3 | 02 | REVISION 45 | |
| 2-18-60 | 4 | 02 | REVISION 45 | |
| 2-18-60 | 5 | 02 | REVISION 45 | |
| 2-18-60 | 6 | 02 | REVISION 45 | |
| 2-18-60 | 7 | 02 | REVISION 45 | |
| 2-18-60 | 8 | 02 | REVISION 45 | |
| 2-18-60 | 9 | 02 | REVISION 45 | |
| 2-18-60 | 10 | 02 | REVISION 45 | |
| 2-18-60 | 11 | 02 | REVISION 45 | |
| 2-18-60 | 12 | 02 | REVISION 45 | |
| 2-18-60 | 13 | 02 | REVISION 45 | |
| 2-18-60 | 14 | 02 | REVISION 45 | |
| 2-18-60 | 15 | 02 | REVISION 45 | |
| 2-18-60 | 16 | 02 | REVISION 45 | |
| 2-18-60 | 17 | 02 | REVISION 45 | |
| 2-18-60 | 18 | 02 | REVISION 45 | |
| 2-18-60 | 19 | 02 | REVISION 45 | |
| 2-18-60 | 20 | 02 | REVISION 45 | |

* Asterisk indicates pages revised, added or deleted by the current revision.



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User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-60 | 21 | 02 | REVISION 45 | |
| 2-18-60 | 22 | 02 | REVISION 45 | |
| 2-18-60 | 23 | 02 | REVISION 45 | |
| 2-18-60 | 24 | 02 | REVISION 45 | |
| 2-18-60 | 25 | 02 | REVISION 45 | |
| 2-18-60 | 26 | 02 | REVISION 45 | |
| 2-18-65 | 1 | 02 | REVISION 45 | ANAC/FAA FMZ 2010 RNP (FMS 6.1.1) |
| 2-18-65 | 2 | 02 | REVISION 45 | |
| 2-18-65 | 3 | 02 | REVISION 45 | |
| 2-18-65 | 4 | 02 | REVISION 45 | |
| 2-18-65 | 5 | 02 | REVISION 45 | |
| 2-18-65 | 6 | 02 | REVISION 45 | |
| 2-18-65 | 7 | 02 | REVISION 45 | |
| 2-18-65 | 8 | 02 | REVISION 45 | |
| 2-18-70 | 1 | 02 | REVISION 45 | FMZ 2010 LPV (FMS 6.1.1) |
| 2-18-70 | 2 | 02 | REVISION 45 | |
| 2-18-70 | 3 | 02 | REVISION 45 | |
| 2-18-70 | 4 | 02 | REVISION 45 | |
| 2-18-70 | 5 | 02 | REVISION 45 | |
| 2-18-70 | 6 | 02 | REVISION 45 | |
| 2-18-70 | 7 | 02 | REVISION 45 | |
| 2-18-70 | 8 | 02 | REVISION 45 | |
| 2-18-70 | 9 | 02 | REVISION 45 | |
| 2-18-70 | 10 | 02 | REVISION 45 | |
| 2-18-75 | 1 | 01 | REVISION 39 | HGS |
| 2-18-75 | 2 | 01 | REVISION 39 | |
| 2-18-75 | 3 | 01 | REVISION 39 | |
| 2-18-75 | 4 | 01 | REVISION 39 | |
| 2-18-75 | 5 | 01 | REVISION 39 | |

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-75 | 6 | 01 | REVISION 39 | |
| 2-18-75 | 7 | 01 | REVISION 39 | |
| 2-18-75 | 8 | 01 | REVISION 39 | |
| 2-18-75 | 9 | 01 | REVISION 39 | |
| 2-18-75 | 10 | 01 | REVISION 39 | |
| 2-18-75 | 11 | 01 | REVISION 39 | |
| 2-18-75 | 12 | 01 | REVISION 39 | |
| 2-18-75 | 13 | 01 | REVISION 39 | |
| 2-18-75 | 14 | 01 | REVISION 39 | |
| 2-18-75 | 15 | 01 | REVISION 39 | |
| 2-18-75 | 16 | 01 | REVISION 39 | |
| 2-18-75 | 17 | 01 | REVISION 39 | |
| 2-18-75 | 18 | 01 | REVISION 39 | |
| 2-18-75 | 19 | 01 | REVISION 39 | |
| 2-18-75 | 20 | 01 | REVISION 39 | |
| 2-18-80 | 1 | 01 | REVISION 38 | IFF |
| 2-18-80 | 2 | 01 | REVISION 38 | |
| 2-18-80 | 3 | 01 | REVISION 38 | |
| 2-18-80 | 4 | 01 | REVISION 38 | |
| 2-18-80 | 5 | 01 | REVISION 38 | |
| 2-18-80 | 6 | 01 | REVISION 38 | |
| 2-18-80 | 7 | 01 | REVISION 38 | |
| 2-18-80 | 8 | 01 | REVISION 38 | |
| 2-18-80 | 9 | 01 | REVISION 38 | |
| 2-18-80 | 10 | 01 | REVISION 38 | |
| 2-18-95 | 1 | 01 | REVISION 45 | ALL |
| 2-18-95 | 2 | 01 | REVISION 43 | |
| 2-18-95 | 3 | 01 | REVISION 43 | |
| 2-18-95 | 4 | 01 | REVISION 43 | |

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

AOM-145/1114

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-18-95 | 5 | 01 | REVISION 43 | |
| 2-18-95 | 6 | 01 | REVISION 43 | |
| 2-19-00 | 1 | 01 | REVISION 40 | ALL |
| 2-19-00 | 2 | 01 | REVISION 36 | |
| 2-19-05 | 1 | 01 | JUN 28, 2002 | ALL |
| 2-19-05 | 2 | 01 | JUN 28, 2002 | |
| 2-19-05 | 3 | 01 | REVISION 29 | |
| 2-19-05 | 4 | 01 | REVISION 23 | |
| 2-19-05 | 5 | 01 | JUN 28, 2002 | |
| 2-19-05 | 6 | 01 | JUN 28, 2002 | |
| 2-19-10 | 1 | 01 | REVISION 43 | ALL |
| 2-19-10 | 2 | 01 | REVISION 43 | |
| 2-19-10 | 3 | 01 | REVISION 43 | |
| 2-19-10 | 4 | 01 | REVISION 43 | |
| 2-19-10 | 5 | 01 | REVISION 43 | |
| 2-19-10 | 6 | 01 | REVISION 43 | |
| 2-19-10 | 7 | 01 | REVISION 43 | |
| 2-19-10 | 8 | 01 | REVISION 43 | |
| 2-19-10 | 9 | 01 | REVISION 43 | |
| 2-19-10 | 10 | 01 | REVISION 43 | |
| 2-19-10 | 11 | 01 | REVISION 43 | |
| 2-19-10 | 12 | 01 | REVISION 43 | |
| 2-19-10 | 13 | 01 | REVISION 43 | |
| 2-19-10 | 14 | 01 | REVISION 43 | |
| 2-19-10 | 15 | 01 | REVISION 43 | |
| 2-19-10 | 16 | 01 | REVISION 43 | |
| 2-19-15 | 1 | 01 | REVISION 36 | ALL |
| 2-19-15 | 2 | 01 | REVISION 36 | |
| 2-19-15 | 3 | 01 | REVISION 36 | |

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| Page Block | Page | Code | Change | Applicability (model, engine, certification, other) |
|---|---|---|---|---|
| 2-19-15 | 4 | 01 | REVISION 36 | |
| 2-19-15 | 5 | 01 | REVISION 36 | |
| 2-19-15 | 6 | 01 | REVISION 36 | |
| 2-19-15 | 7 | 01 | REVISION 36 | |
| 2-19-15 | 8 | 01 | REVISION 36 | |
| 2-19-15 | 9 | 01 | REVISION 36 | |
| 2-19-15 | 10 | 01 | REVISION 36 | |
| 2-19-15 | 11 | 01 | REVISION 36 | |
| 2-19-15 | 12 | 01 | REVISION 36 | |
| 2-19-15 | 13 | 01 | REVISION 36 | |
| 2-19-15 | 14 | 01 | REVISION 36 | |
| 2-19-15 | 15 | 01 | REVISION 36 | |
| 2-19-15 | 16 | 01 | REVISION 36 | |
| 2-19-15 | 17 | 01 | REVISION 36 | |
| 2-19-15 | 18 | 01 | REVISION 36 | |
| 2-19-15 | 19 | 01 | REVISION 36 | |
| 2-19-15 | 20 | 01 | REVISION 36 | |
| 2-19-20 | 1 | 01 | REVISION 40 | ANAC/FAA |
| 2-19-20 | 2 | 01 | REVISION 40 | |
| 2-19-20 | 3 | 01 | REVISION 40 | |
| 2-19-20 | 4 | 01 | REVISION 40 | |

User: fnhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44



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# TABLE OF CONTENTS

**AOM - VOLUME 2 - SYSTEMS DESCRIPTION**

**2-1 - AIRPLANE DESCRIPTION**

**2-2 - EQUIPMENT AND FURNISHINGS**

**2-3 - EMERGENCY EQUIPMENT (DELETED)**

**2-4 - CREW AWARENESS**

**2-5 - ELECTRICAL**

**2-6 - LIGHTING**

**2-7 - FIRE PROTECTION**

**2-8 - FUEL**

**2-9 - AUXILIARY POWER UNIT**

**2-10 - POWERPLANT**

**2-11 - HYDRAULIC**

**2-12 - LANDING GEAR AND BRAKES**

**2-13 - FLIGHT CONTROLS**

**2-14 - PNEUMATICS, AIR CONDITIONING AND PRESSURIZATION**

**2-15 - ICE AND RAIN PROTECTION**

**2-16 - OXYGEN**

**2-17 - FLIGHT INSTRUMENTS**

**2-18 - NAVIGATION AND COMMUNICATION**

**2-19 - AUTOPILOT**

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

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# SECTION 2-01

# AIRPLANE DESCRIPTION

TABLE OF CONTENTS

Page Block

Introduction ..... 2-01-00
Airplane Description ..... 2-01-00
Cockpit Arrangement ..... 2-01-00
Interior Arrangement ..... 2-01-00
Main/Glareshield Panels ..... 2-01-05
Control Pedestal ..... 2-01-05
Overhead Panel ..... 2-01-10
Cockpit Partition ..... 2-01-15

User: fhherna0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# INTRODUCTION

This Section is intended to present a general overview of the airplane, thus initiating the reader to the EMB-145, which may, then, go through the Sections searching more detailed information on each system.

# AIRPLANE DESCRIPTION

The EMB-145 and EMB-135 models are a low wing, T-tail pressurized airplanes, powered by two high by-pass ratio rear mounted turbofan engines. The tricycle landing gear is all retractable, with twin tires in each leg.

A glass cockpit panel has been developed with highly integrated on-board avionics, thus allowing pilots to better monitor airplane general operation.

The typical passenger configuration consists of three seats abreast, with front galley and rear toilet, permitting to carry up to 50 passengers for the EMB-145 model, up to 44 passengers for the ERJ 140 model and up to 37 passengers for the EMB-135 model. Convenient accommodation is provided for the flight crew.

For detailed information on each system, refer to the appropriate Section in this manual.

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The airplane is presented in the following models:

| Model | MTOW kg (lb) | MLW kg (lb) | MZFW kg (lb) | FUEL (wing) (*) kg (lb) | FUEL (ventral) (*) kg (lb) |
|---|---|---|---|---|---|
| 135ER | 19000 (41888) | 18500 (40785) | 15600 (34392) | 4174 (9200) | - |
| 135LR | 20000 (44092) | 18500 (40785) | 16000 (35274) | 5187 (11435) | - |
| 140ER | 20100 (44313) | 18700 (41226) | 17100 (37698) | 4173 (9200) | - |
| 140LR | 21100 (46517) | 18700 (41226) | 17100 (37698) | 5187 (11435) | - |
| 145STD | 19200 (42328) | 18700 (41226) | 17100 (37698) | 4174 (9200) | - |
| 145EU | 19990 (44070) | 18700 (41226) | 17100 (37698) | 4174 (9200) | - |
| 145ER | 20600 (45414) | 18700 (41226) | 17100 (37698) | 4174 (9200) | - |
| 145EP | 20990 (46275) | 18700 (41226) | 17100 (37698) | 4174 (9200) | - |
| 145LR | 22000 (48501) | 19300 (42549) | 17900 (39462) | 5187 (11435) | - |
| 145LU | 21990 (48479) | 19300 (42549) | 17900 (39462) | 5187 (11435) | - |
| 145MK | 19990 (44070) | 18700 (41226) | 17700 (39021) | 4174 (9200) | - |
| 145MP | 20990 (46275) | 19300 (42549) | 17900 (39462) | 4174 (9200) | - |
| 145XR | 24100 (53131) | 20000 (44092) | 18500 (40785) | 5187 (11435) | 845 (1863) |

**NOTE:** (*) The values for fuel capacity above have been determined for an adopted fuel density of 0.811 kg/l (6.767 lb/US Gal).

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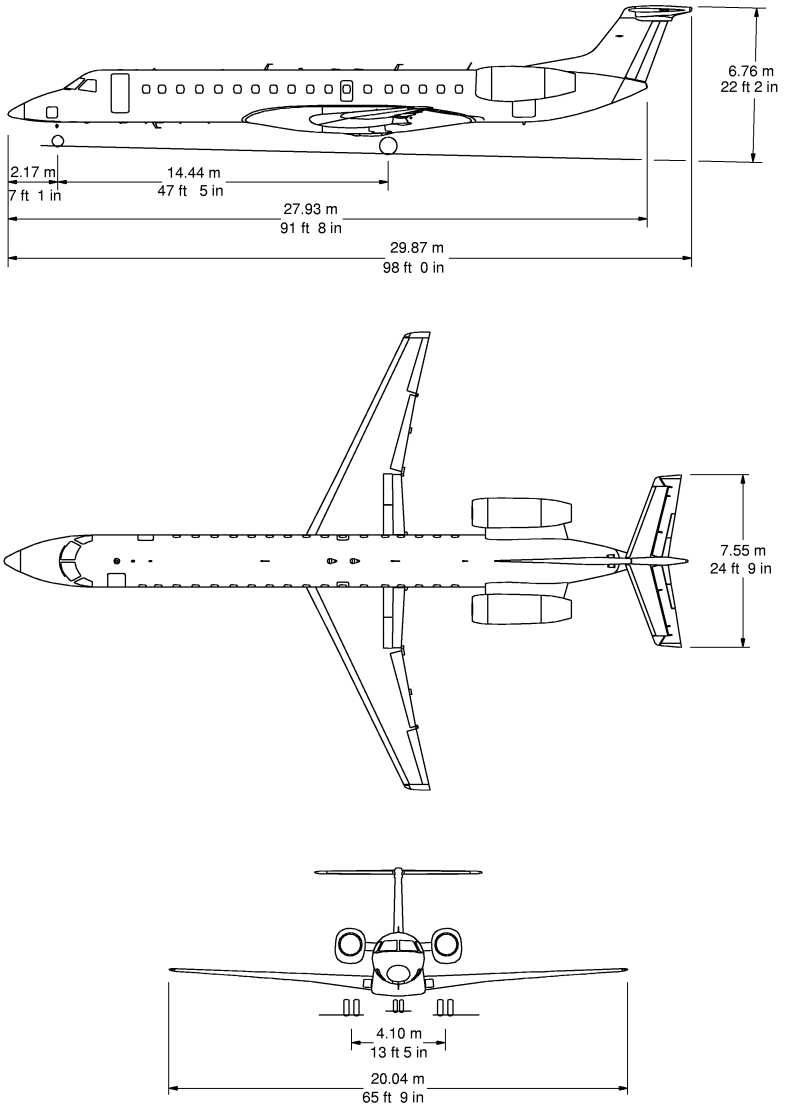


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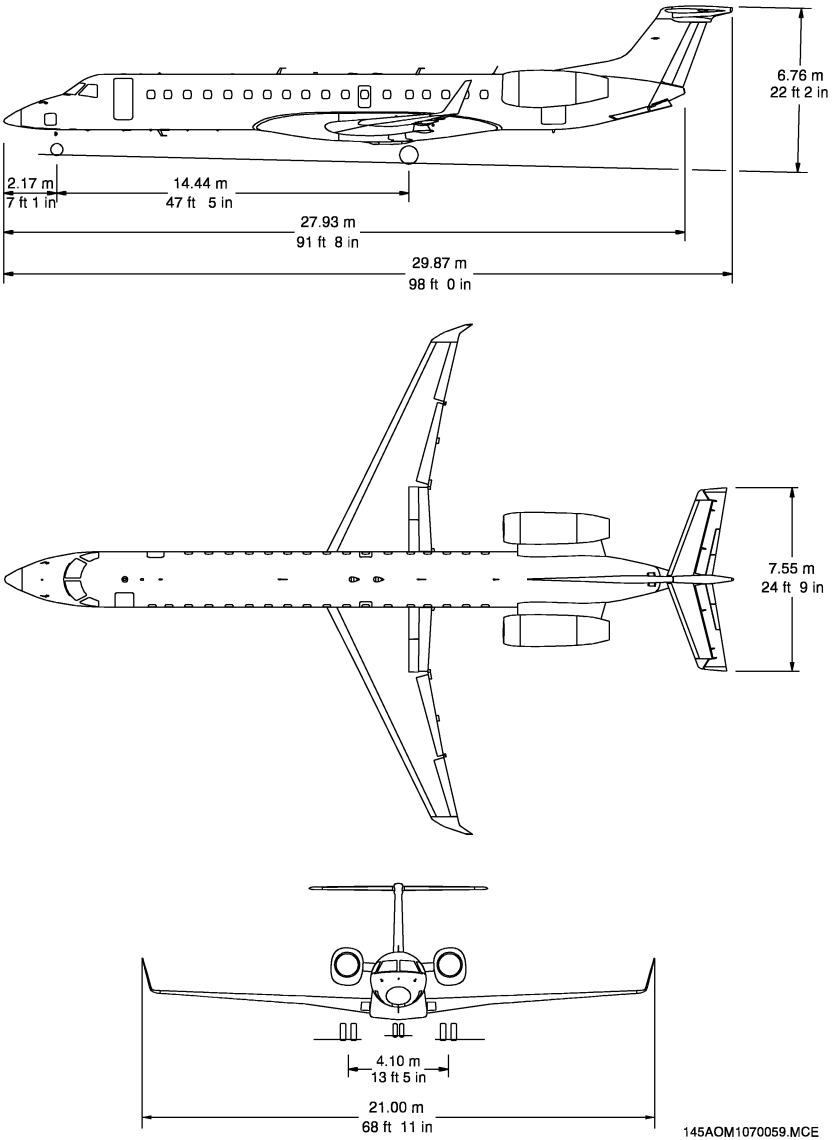


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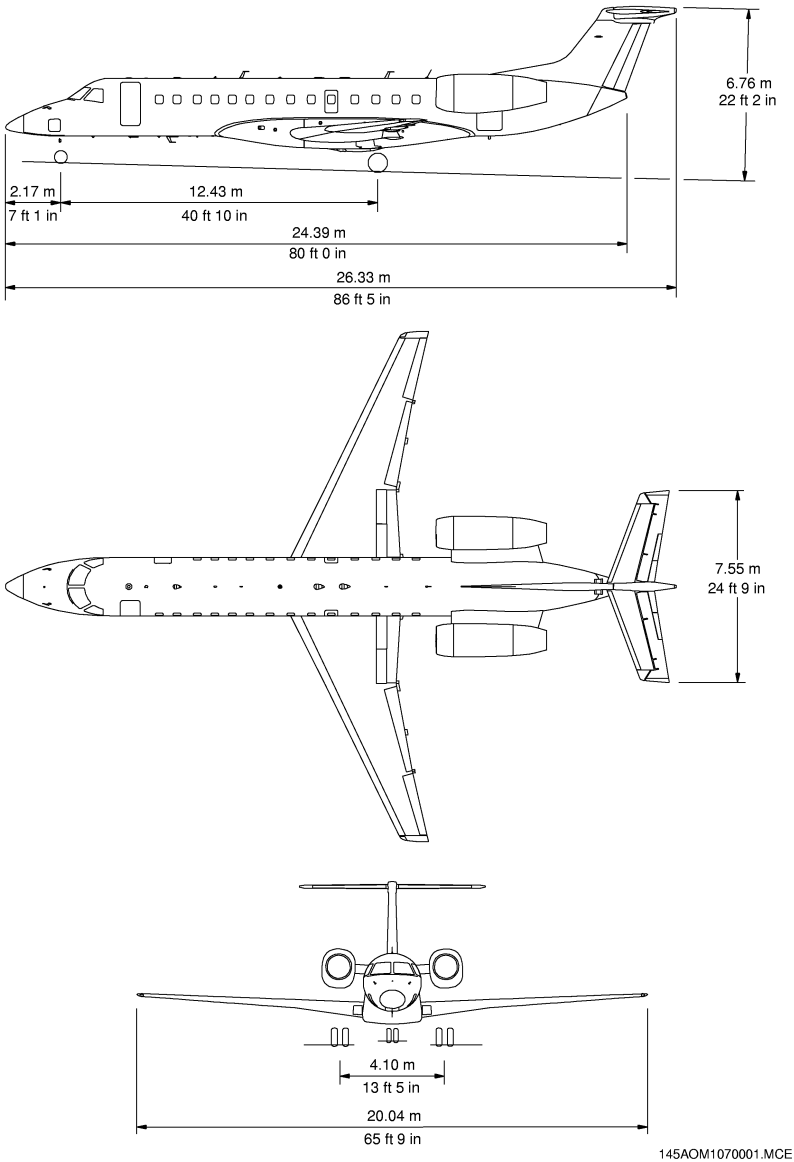
# THREE VIEW DRAWING (EMB-135 MODELS)

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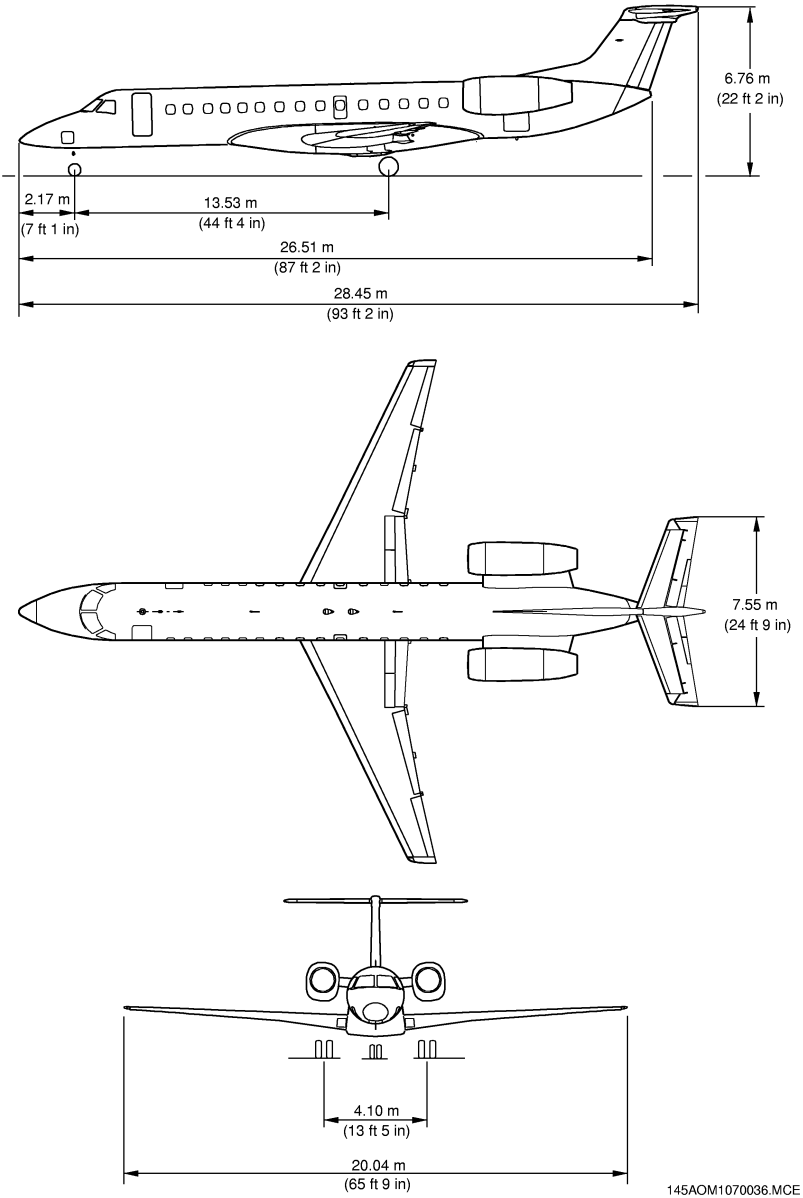


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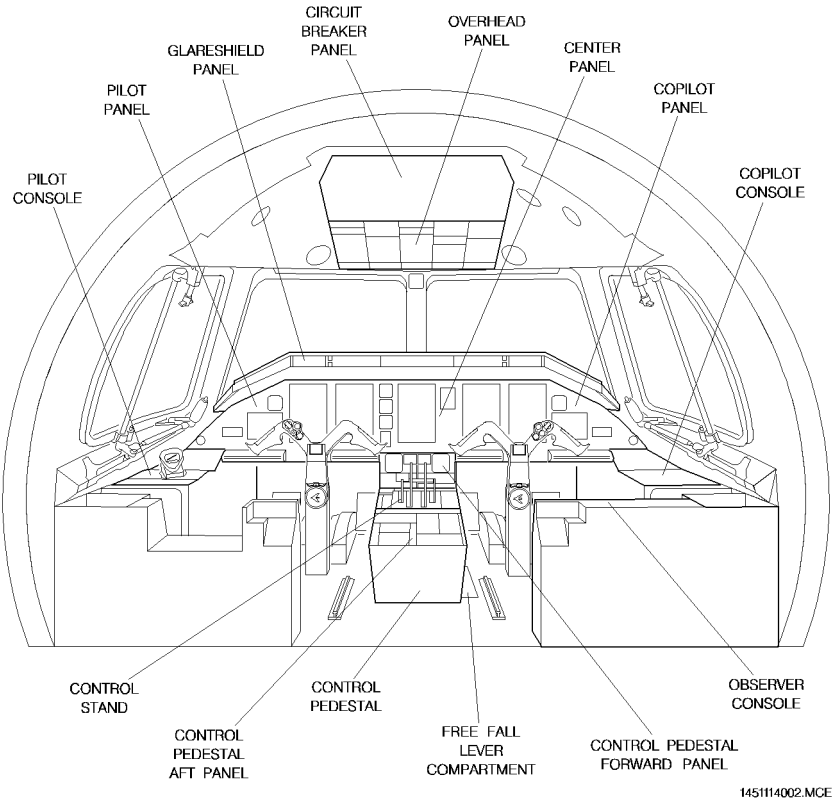
# COCKPIT ARRANGEMENT

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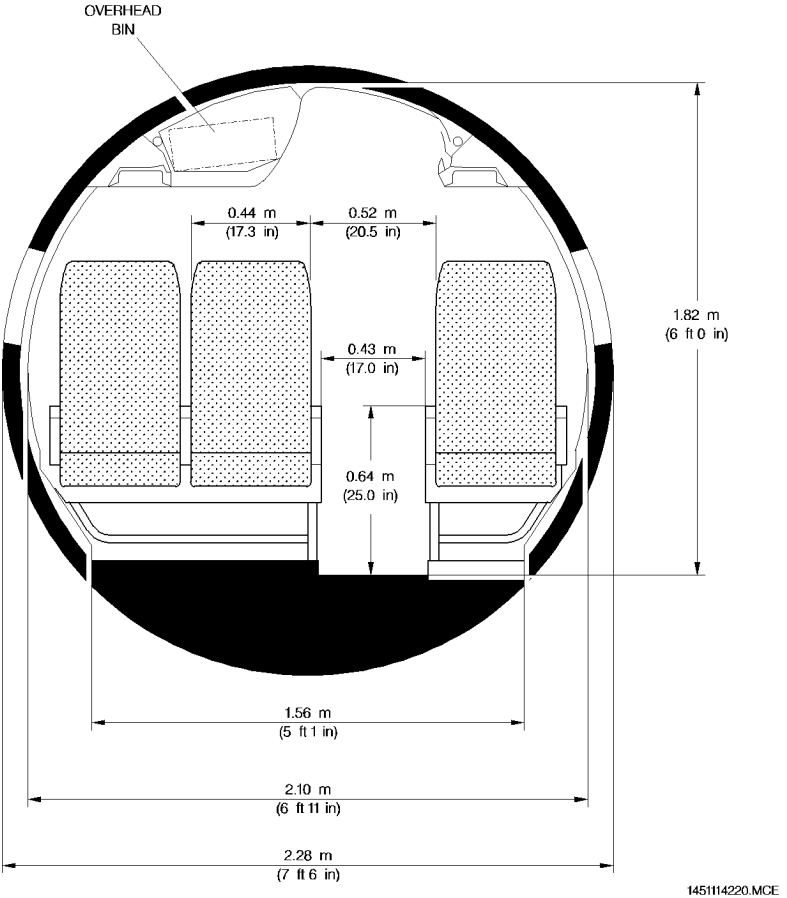
# INTERIOR ARRANGEMENT

## CROSS SECTION (TYPICAL)

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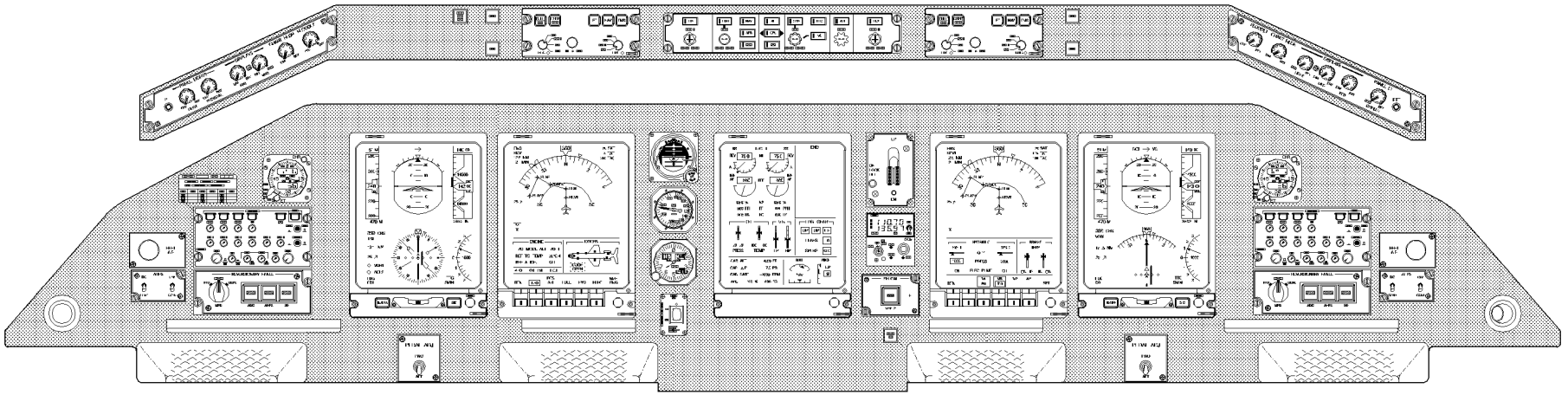
# MAIN/GLARESHIELD PANELS (TYPICAL I)



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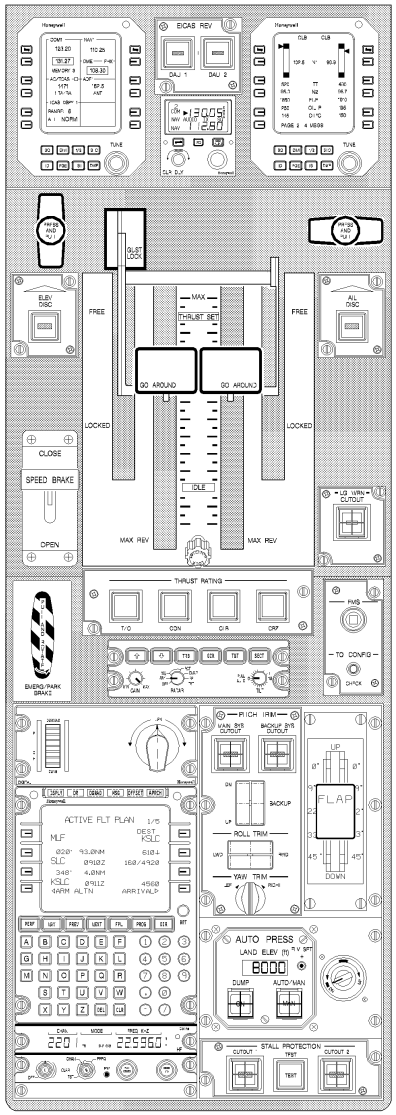
# CONTROL PEDESTAL (TYPICAL I)



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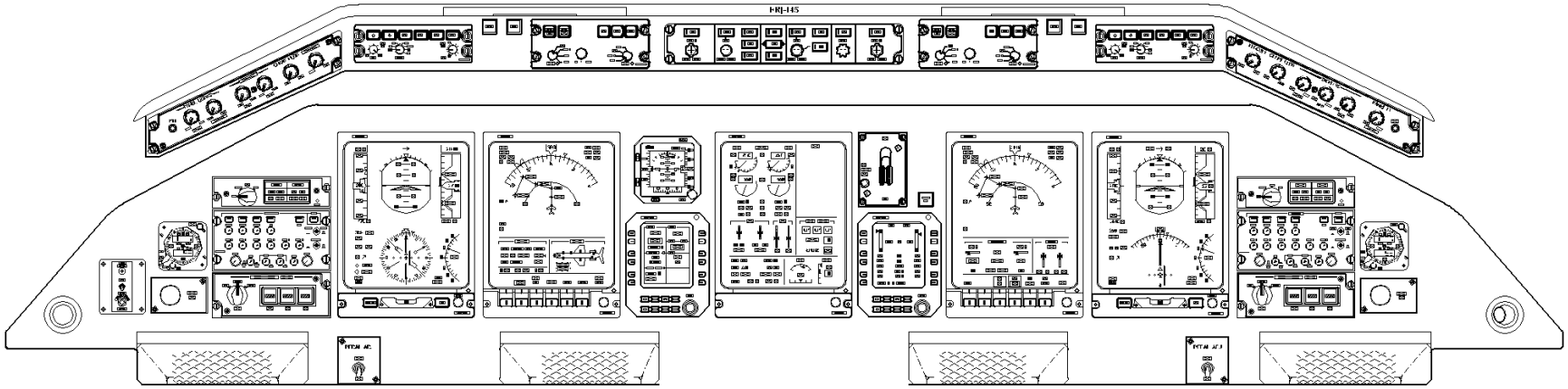
# MAIN/GLARESHIELD PANELS (TYPICAL II)



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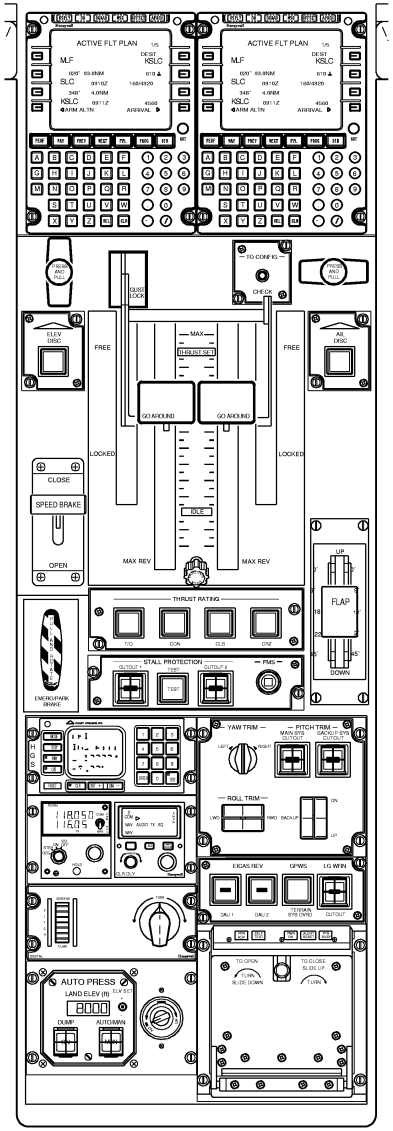
# CONTROL PEDESTAL (TYPICAL II)

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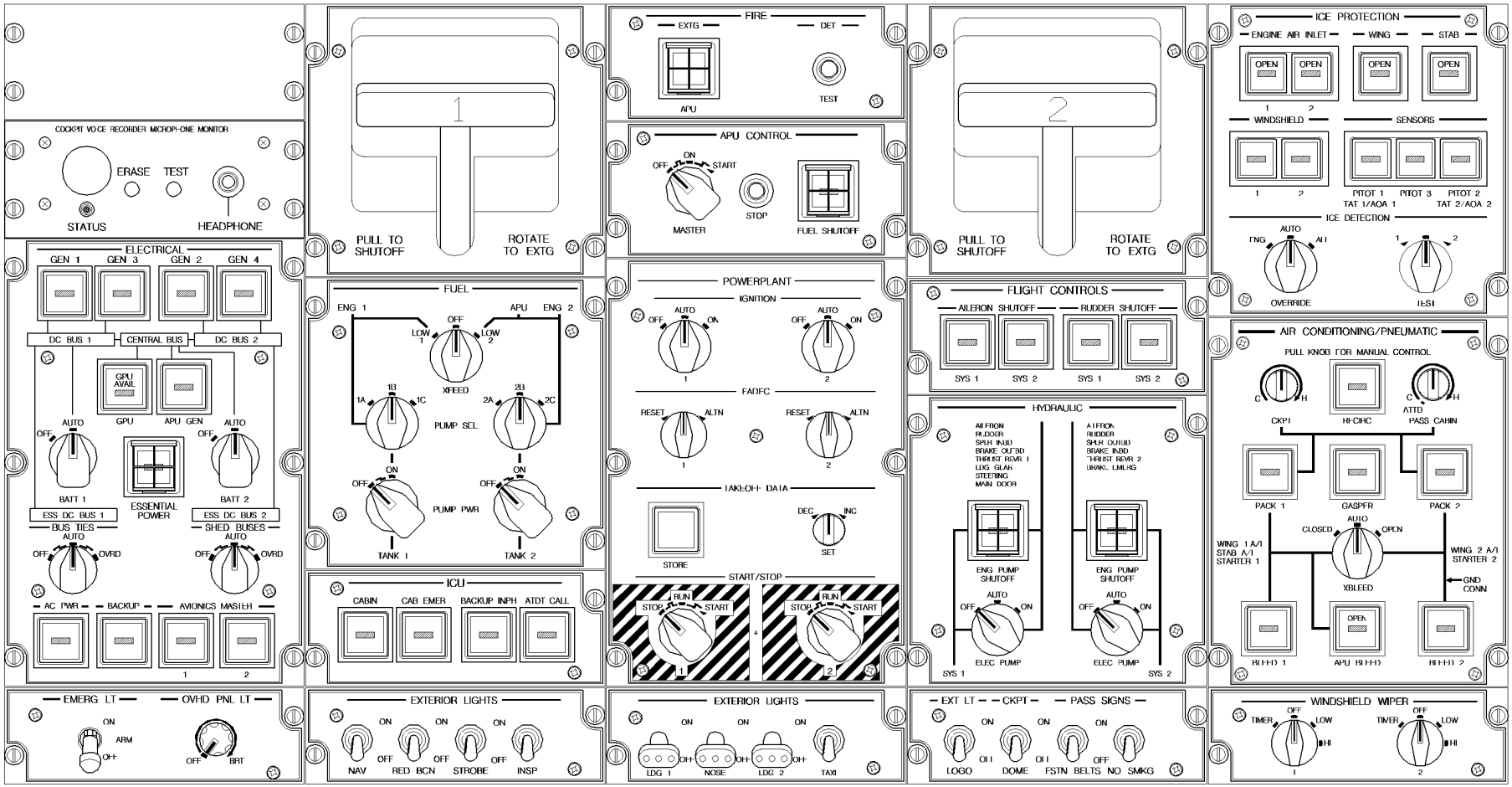
# OVERHEAD PANEL (TYPICAL)

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AOM-145/1114

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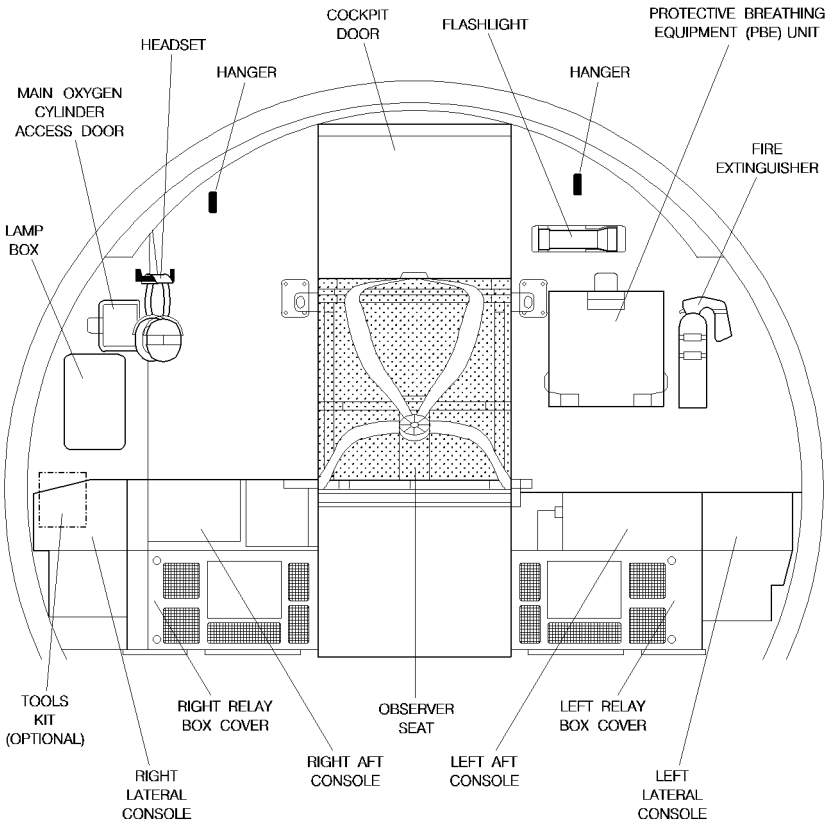
# COCKPIT PARTITION (TYPICAL)

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User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

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# SECTION 2-02
# EQUIPMENT AND FURNISHINGS

TABLE OF CONTENTS


| | Block | Page |
|---|---|---|
| Cockpit | 2-02-05 | 01 |
| Pilot Seats | 2-02-05 | 01 |
| Pilot Seat Controls | 2-02-05 | 02 |
| Pilot Seat Adjustment | 2-02-05 | 04 |
| Pedal Adjustment | 2-02-05 | 05 |
| Observer Seat | 2-02-05 | 06 |
| Direct Vision Windows | 2-02-05 | 08 |
| Attendant Stations and Seats | 2-02-10 | 01 |
| Attendant's Control Panels | 2-02-15 | 01 |
| Galley | 2-02-20 | 01 |
| Controls and Indicators | 2-02-20 | 03 |
| Passenger Service Unit | 2-02-25 | 01 |
| Controls and Indicators | 2-02-25 | 02 |
| Cockpit/Passenger Cabin Partition | 2-02-27 | 01 |
| Water and Waste | 2-02-30 | 01 |
| Water | 2-02-30 | 01 |
| Waste | 2-02-30 | 01 |
| Airstair Main Door (*) | 2-02-35 | 01 |
| EICAS Message | 2-02-35 | 01 |
| Controls and Indicators | 2-02-35 | 02 |
| Main Door Acoustic Curtain | 2-02-35 | 06 |
| Jetway Main Door (*) | 2-02-35 | 01 |
| EICAS Message | 2-02-35 | 01 |
| Main Door Acoustic Curtain | 2-02-35 | 04 |
| Access Doors and Hatches | 2-02-40 | 01 |
| Service Door | 2-02-40 | 01 |
| Baggage Door | 2-02-40 | 05 |
| Compartment Hatches | 2-02-40 | 07 |
| Refueling Panel Access Door | 2-02-40 | 08 |
| Emergency Exit Hatches | 2-02-40 | 10 |
| Doors and Hatches Indication on MFD | 2-02-40 | 10 |


**NOTE:** Optional equipment are marked with an asterisk (*) and its description may not be present in this manual.

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PC Power System (*) ..... 2-02-50 ...01
Controls and Indicators ..... 2-02-50 ...02
In-Flight Entertainment System (*) ..... 2-02-55 ...01
Controls and Indicators ..... 2-02-55 ...02
Audio System ..... 2-02-55 ...08
Telephone System (*) ..... 2-02-60 ...01
Cockpit Security Door (*) ..... 2-02-65 ...01
Door Description ..... 2-02-65 ...02
Security Door Placards ..... 2-02-65 ...04
Video Surveillance System (VSS) (*) ..... 2-02-67 ...01
General ..... 2-02-67 ...01
Video Unit ..... 2-02-67 ...01
Video Cameras ..... 2-02-67 ...03
Controls and Indicators ..... 2-02-67 ...04
Lavatory Door ..... 2-02-70 ...01

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**NOTE:** Optional equipment are marked with an asterisk (*) and its description may not be present in this manual.



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# COCKPIT

## PILOT SEATS

The pilot seats are fixed to slide rails that permits fore and aft adjustments. When the seats are in their aftmost position, a lateral movement is also available, in order to ease crew access to the seat. Each seat is equipped with adjustable armrests, seat backs, thigh support and lumbar position, and can also be adjusted for height. Backrest inclination, thigh support and lumbar positions are hydromechanically adjusted. Seat aft, fore and lateral adjustments are mechanically actuated, the same applying to armrest adjustments.

The pilot and copilot seats are identical, except for the symmetrical arrangement of the controls. Controls on the pilot's seat are on the opposite side from those on the copilot's seat.

A switch installed in the seat allows height adjustment, which is performed by an electrical actuator. In case of electrical actuator malfunction height adjustment may also be accomplished manually by attaching a crank to the actuator and rotating it. Extension or retraction of the actuator rod connected to the seat structure permits vertical displacement.

The crew seat belts consist of five straps. The left (for the pilot seat) and right (for the copilot seat) lap belt straps are permanently fixed to a rotary buckle, provided with quick-release latch locks that are operated by turning the existing rotary device on the buckle face. The two upper straps are connected to an inertia reel attached to the seat backrest, which allows the pilot to bend forward in normal, slow movements. Abrupt movements or high acceleration locks the upper straps, preventing the pilot from impacting against the instrument panel. The inertia reel can be mechanically locked through a lever installed on the seat.

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# PILOT SEAT CONTROLS

**1 - SEAT FORE/AFT AND LATERAL ADJUSTMENT LEVER**

- Pulling the lever up, the seat is free to slide along its rails. Lateral movement is allowed only when the seat is at the aft stop.
- Releasing the lever, the seat is locked. Fore/aft movement has predetermined fixed positions. Lateral movement has only the left and right stops.

**2 - SEAT HEIGHT ADJUSTMENT BUTTON (spring loaded, center off rocker button)**

- Pressing the button up or down causes the seat to raise or to lower respectively, provided the airplane is energized.

**3 - BACKREST INCLINATION ADJUSTMENT BUTTON**

- Pressing the button allows the occupant to select the required inclination by pressure exerted upon the backrest.
- Releasing the button, backrest is retained in the desired position.

**4 - LUMBAR ADJUSTMENT WHEEL**

- When rotated, provides in and out lumbar adjustment.

**5 - THIGH SUPPORT ADJUSTMENT WHEEL**

- When rotated, provides thigh support height adjustment.

**6 - ARMREST ANGLE ADJUSTMENT WHEEL**

- When rotated, allows armrest adjustment to the desired angle.

**7 - INERTIA REEL LOCK LEVER**

LOCK - Locks the inertia reel in the current position.

UNLOCK - Unlocks the inertia reel, permitting normal belt movement.

**8 - HEIGHT ADJUSTMENT LEVER BACK-UP**

- When attached to the height adjustment actuator and rotated, it causes the seat to raise or to lower.

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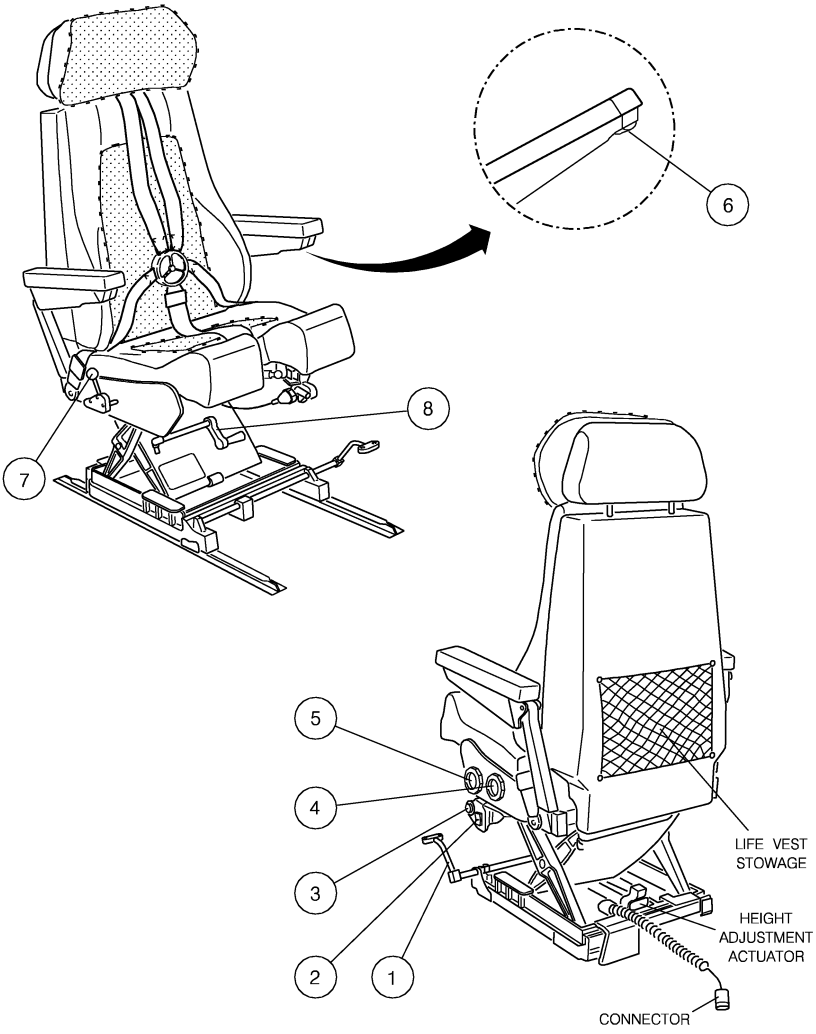


**NOTE**

Pilot's seat shown. Copilot's seat controls are on the opposite side.

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## PILOT SEAT CONTROLS

## PILOT SEAT ADJUSTMENT

Seat adjustment should be accomplished to accommodate the pilot's eye level and position best suited for control column actuation. The seat should be moved up or down until the pilot's line of sight reaches the same horizontal plane of a sight device made up of two white spheres and a black sphere. Then, move the seat fore or aft until the opposite white sphere is aligned with the black one. The seat should not be moved anymore. To adjust the rudder pedals, refer to PEDAL ADJUSTMENT.

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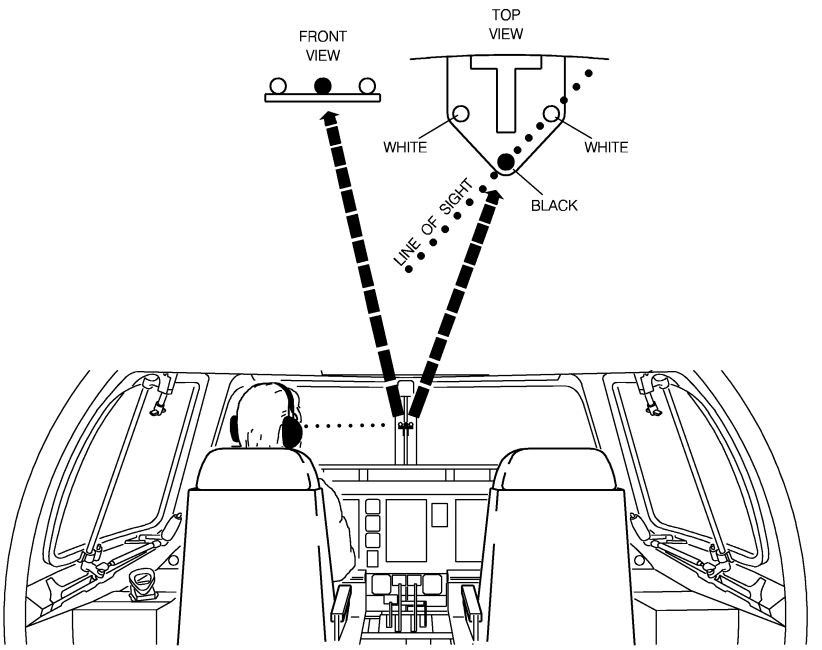


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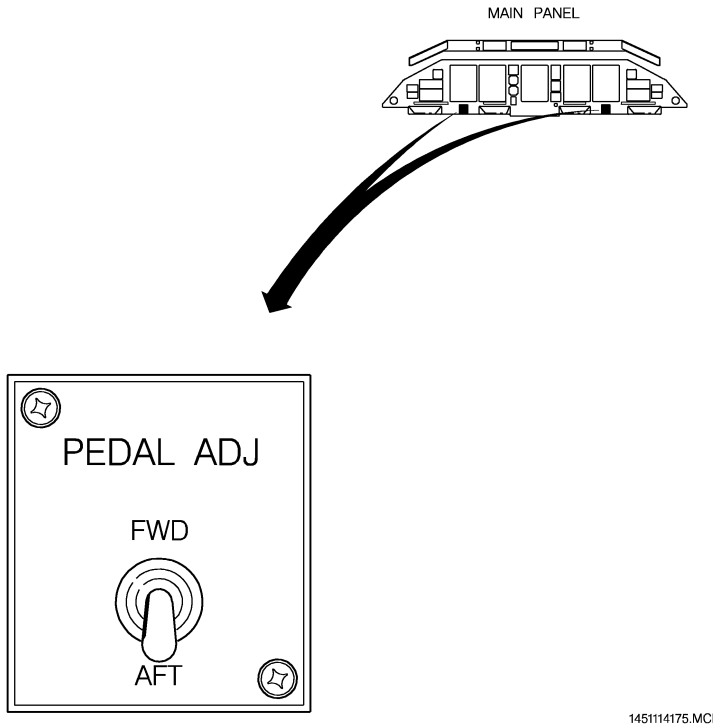
## PEDAL ADJUSTMENT

Toggle switches installed on the pilot and copilot's panels allows rudder pedals adjustment, which is performed by electric actuators. Setting the switch up or down signals the actuator to move the pedals fore or aft, to assure the pilot's comfort and a full rudder throw from the adjusted seat position.

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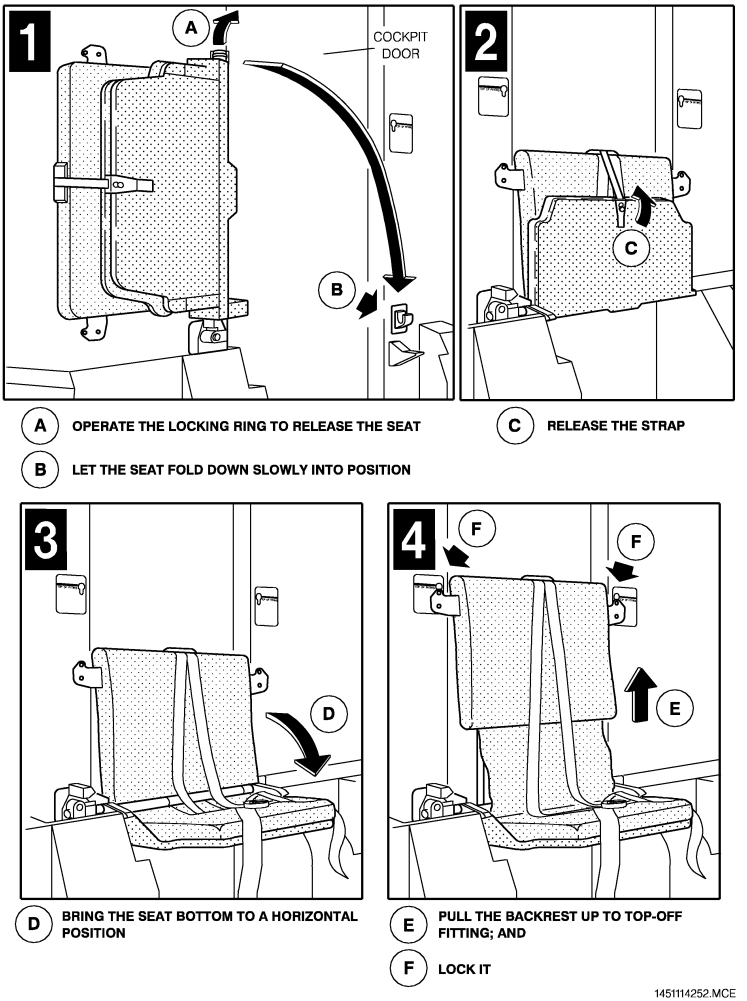
# OBSERVER SEAT

The observer seat is located behind and between the pilot seats. When in use, it lies in front of the cockpit door. Stow it by folding and rotating away from the door area against the right side of the cockpit partition, behind the copilot's seat.

The cockpit door can be opened or closed with either the observer seat in use or stowed.

**TO FOLD OUT:**




A OPERATE THE LOCKING RING TO RELEASE THE SEAT

B LET THE SEAT FOLD DOWN SLOWLY INTO POSITION

C RELEASE THE STRAP

D BRING THE SEAT BOTTOM TO A HORIZONTAL POSITION

E PULL THE BACKREST UP TO TOP-OFF FITTING; AND

F LOCK IT

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**OBSERVER SEAT**

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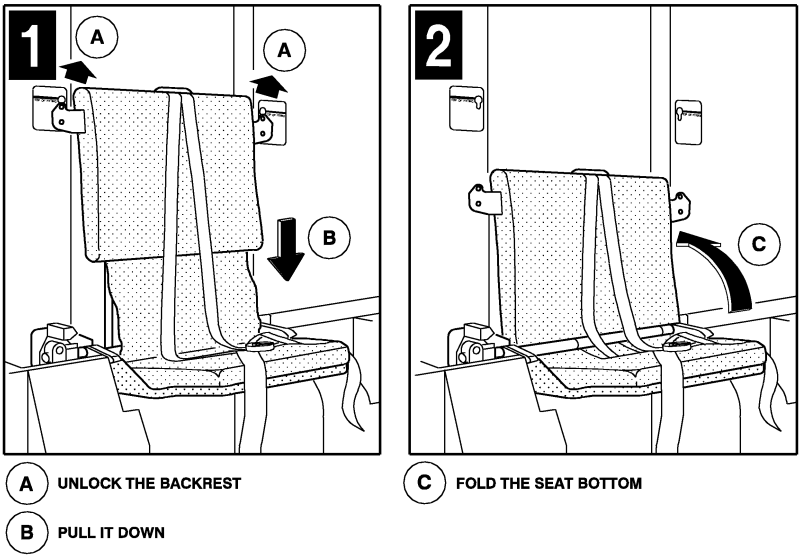
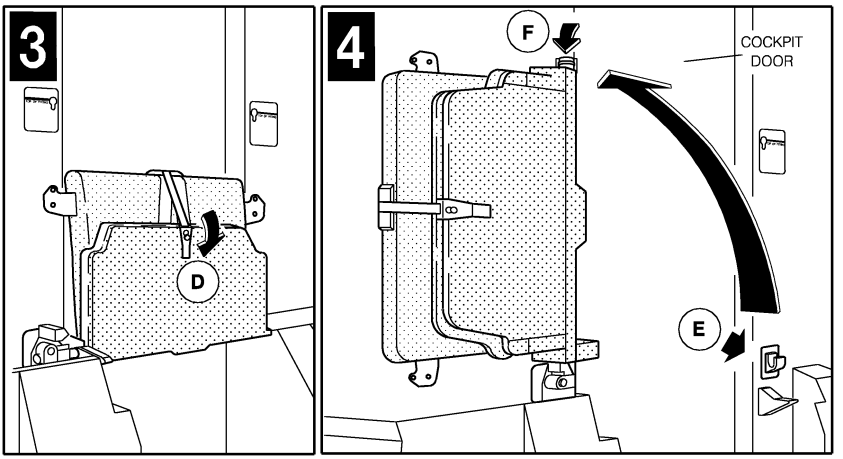
**TO FOLD IN:**




A UNLOCK THE BACKREST

B PULL IT DOWN

C FOLD THE SEAT BOTTOM




D STRAP THE SEAT

E ROTATE SEAT INTO STOWED POSITION

F LOCK THE RING

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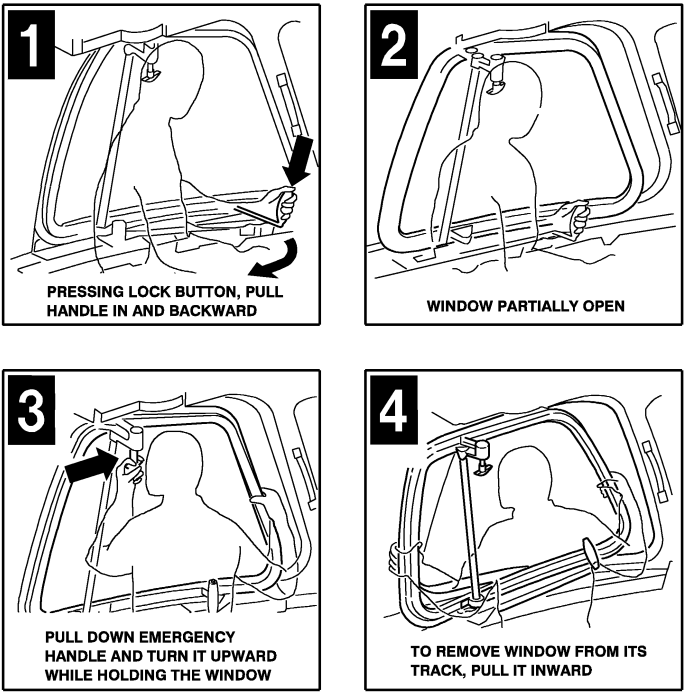
## OBSERVER SEAT

## DIRECT VISION WINDOWS

The normal position for the direct vision windows is closed. However, they may be partially opened on the ground, and may be totally removed in case of loss of visibility through the windshield or for cockpit emergency evacuation. Placing respective pilot seat to the aftmost position makes for easier window removal.

A yellow pin protrudes near the opening handle when the window is not properly locked in the closed position, indicating the unlocked condition.

A WINDOW NOT CLOSED inscription on the window front frame will be visible when the window is not properly closed.

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**DIRECT VISION WINDOW REMOVAL**

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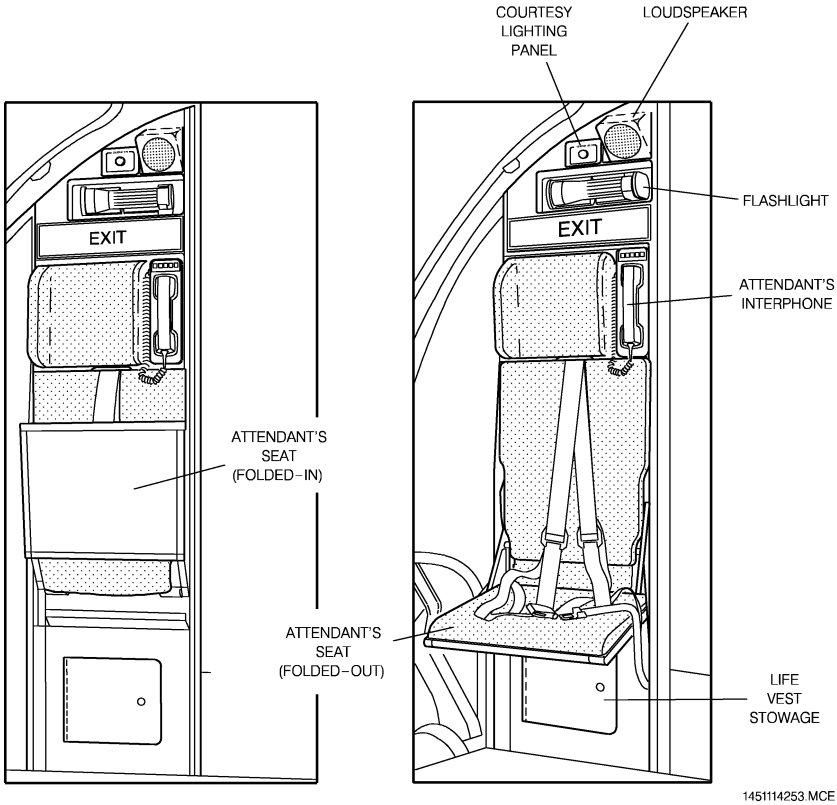
# ATTENDANT STATIONS AND SEATS

The standard flight attendant station is positioned at the cockpit partition, close to the main door. The seat is of the fold-away type, to prevent passageway blockage.

An optional second flight attendant seat is available at the aft end of the aisle in front of the lavatory door. When not in use, an adequate mechanism allows its sliding against the lavatory wall, behind the last double seat row.




**FORWARD FLIGHT ATTENDANT STATION**

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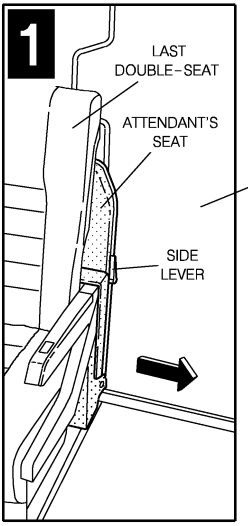
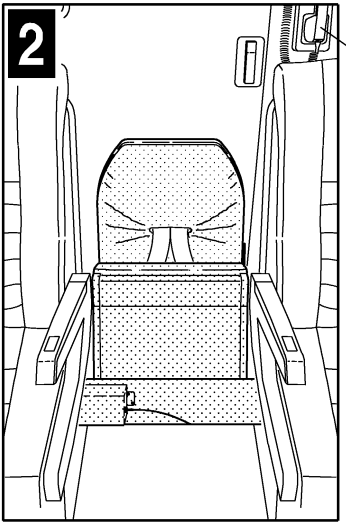
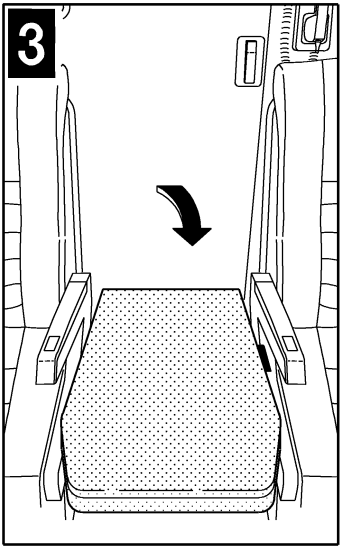


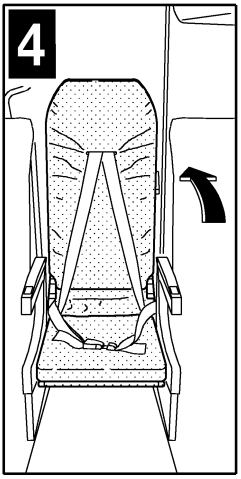

OPERATE THE SIDE LEVER
TO RELEASE THE SEAT




LET THE SEAT LOCK IN POSITION




OPERATE THE SIDE LEVER AND BRING
THE SEAT TO A HORIZONTAL POSITION




OPERATE THE SIDE LEVER AND MOVE
THE BACKREST UNTIL IT LOCKS IN POSITION

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## AFT FLIGHT ATTENDANT SEAT

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# ATTENDANT'S CONTROL PANELS

The Forward Attendant Control Panel is located on the passenger cabin divider opposite the forward attendant seat, in the entry area. This panel provides controls and indications for some functions of the Lighting System, Air Conditioning temperature control, Attendant Call System and Passenger Service Unit (PSU).

The Aft Attendant Call Panel is located on the left face of the lavatory wall and consists of four attendant call indication lights.

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# FORWARD ATTENDANT CONTROL PANEL (OPTION 1)

### 1 - ATTENDANT CALL INDICATION LIGHTS

LAV (Amber) - Illuminates when the call is from the lavatory.

PA (Green) - Illuminates when the call is from the passenger cabin.

### 2 - PSU TEST BUTTON

- When pressed, provides PSU test, illuminating all the PSU's reading lights and attendant call lights. The associated attendant call chimes are also activated.

### 3 - PSU RESET BUTTON

- When pressed after test, allows resetting all PSUs to the initial state.

### 4 - CALL RESET BUTTON

- When pressed, clears all attendant call signals.

# AFT ATTENDANT CALL PANEL

### 1 - ATTENDANT CALL INDICATION LIGHTS

LAV (Amber) - Illuminates when the call is from the lavatory.

PA (Green) - Illuminates when the call is from the passenger cabin.

PILOT (Green) - Illuminates when the call is from the cockpit.

PILOT EMERG (Red) - Illuminates when an emergency call to the attendant is from the cockpit.

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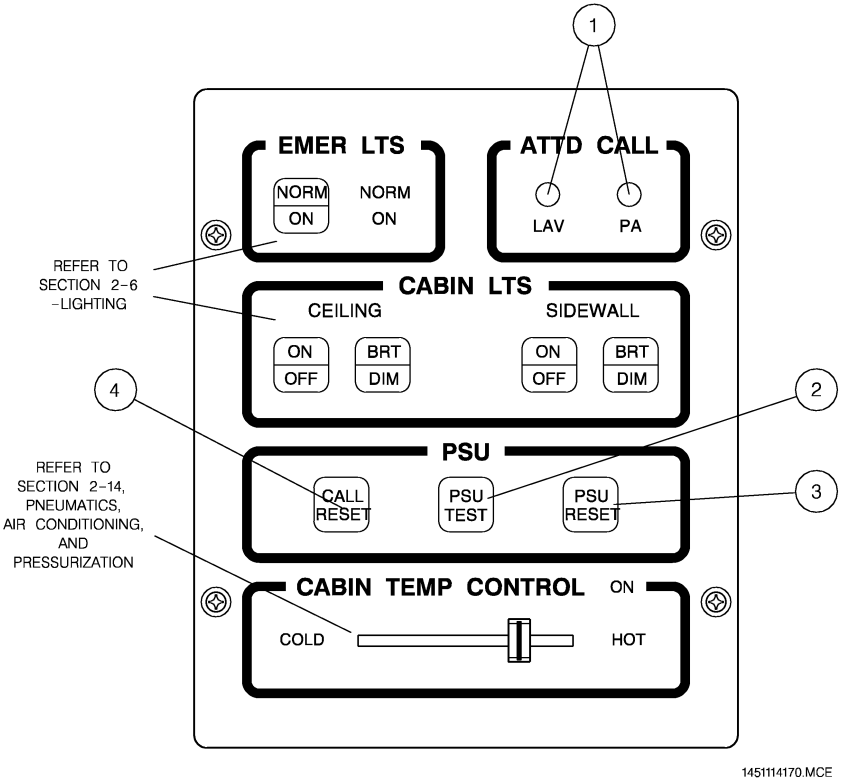
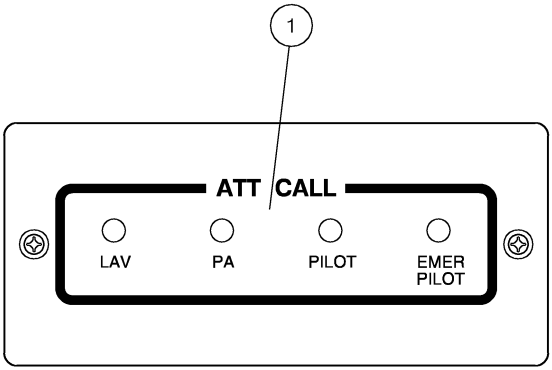



**FORWARD ATTENDANT CONTROL PANEL (OPTION 1)**




**AFT ATTENDANT CALL PANEL**

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# FORWARD ATTENDANT CONTROL PANEL (OPTION 2)

### 1 - ATTENDANT CALL INDICATION LIGHTS

LAV (Red) - Illuminates when the call is from the lavatory.

PAX (Amber) - Illuminates when the call is from the passenger cabin.

### 2 - PSU TEST BUTTON

– When pressed, provides PSU test, illuminating all the PSU's reading lights and attendant call lights. The associated attendant call chimes are also activated.

### 3 - PSU RESET BUTTON

– When pressed after test, allows reseting all PSUs to the initial state.

### 4 - CALL RESET BUTTON

– When pressed, clears all attendant call signals.

# AFT ATTENDANT CALL PANEL

### 1 - ATTENDANT CALL INDICATION LIGHTS

LAV (Red) - Illuminates when the call is from the lavatory.

PAX (Amber) - Illuminates when the call is from the passenger cabin.

PILOT (Green) - Illuminates when the call is from the cockpit.

PILOT EMERG (Red) - Illuminates when an emergency call to the attendant is from the cockpit.

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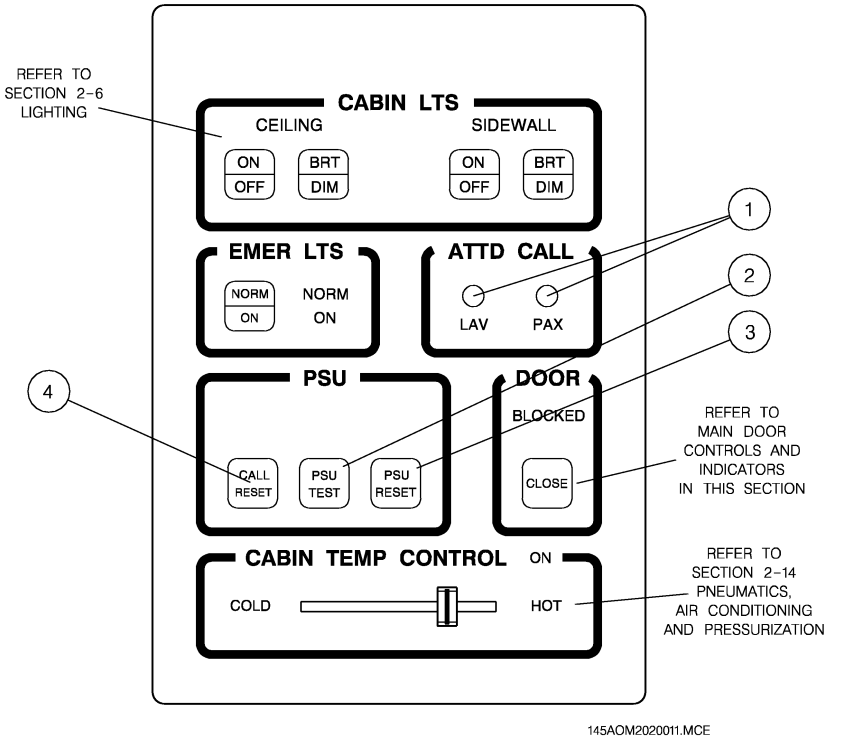
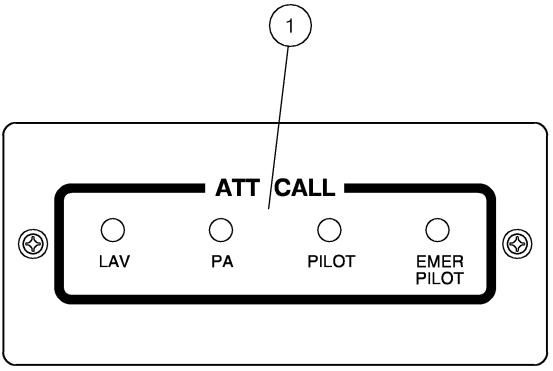



**FORWARD ATTENDANT CONTROL PANEL (OPTION 2)**




**AFT ATTENDANT CALL PANEL**

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# FORWARD ATTENDANT CONTROL PANEL (OPTION 3)

### 1 - ATTENDANT CALL INDICATION LIGHTS

LAV (Red) - Illuminates when the call is from the lavatory.

PAX (Amber) - Illuminates when the call is from the passenger cabin.

### 2 - PSU TEST BUTTON

– When pressed, provides PSU test, illuminating all the PSU's reading lights and attendant call lights. The associated attendant call chimes are also activated.

### 3 - PSU RESET BUTTON

– When pressed after test, allows reseting all PSUs to the initial state.

### 4 - CALL RESET BUTTON

– When pressed, clears all attendant call signals.

# AFT ATTENDANT CALL PANEL

### 1 - ATTENDANT CALL INDICATION LIGHTS

LAV (Red) - Illuminates when the call is from the lavatory.

PAX (Amber) - Illuminates when the call is from the passenger cabin.

PILOT (Green) - Illuminates when the call is from the cockpit.

PILOT EMERG (Red) - Illuminates when an emergency call to the attendant is from the cockpit.

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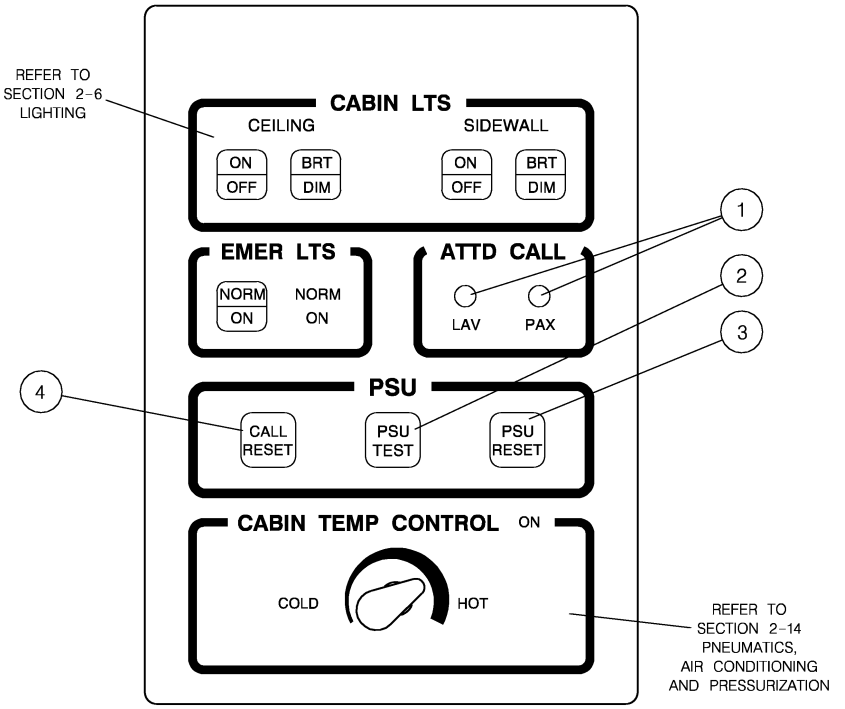
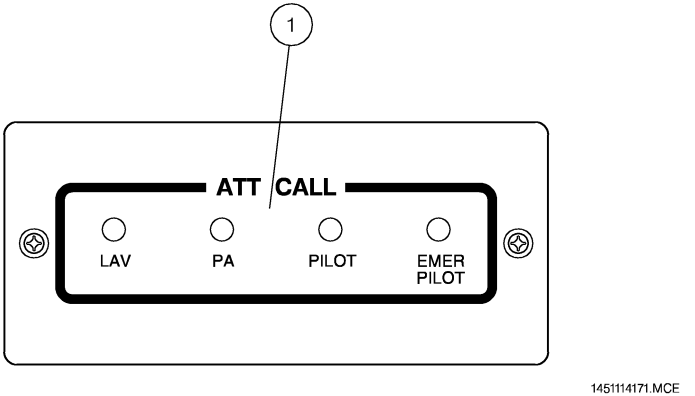



**FORWARD ATTENDANT CONTROL PANEL (OPTION 3)**




**AFT ATTENDANT CALL PANEL**

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# FORWARD ATTENDANT CONTROL PANEL (OPTION 4)

### 1 - ATTENDANT CALL INDICATION LIGHTS

LAV (Red) - Illuminates when the call is from the lavatory.

PAX (Amber) - Illuminates when the call is from the passenger cabin.

### 2 - PSU TEST BUTTON

– When pressed, provides PSU test, illuminating all the PSU's reading lights and attendant call lights. The associated attendant call chimes are also activated.

### 3 - PSU RESET BUTTON

– When pressed after test, allows reseting all PSUs to the initial state.

### 4 - CALL RESET BUTTON

– When pressed, clears all attendant call signals.

# AFT ATTENDANT CALL PANEL

### 1 - ATTENDANT CALL INDICATION LIGHTS

LAV (Red) - Illuminates when the call is from the lavatory.

PAX (Amber) - Illuminates when the call is from the passenger cabin.

PILOT (Green) - Illuminates when the call is from the cockpit.

PILOT EMERG (Red) - Illuminates when an emergency call to the attendant is from the cockpit.

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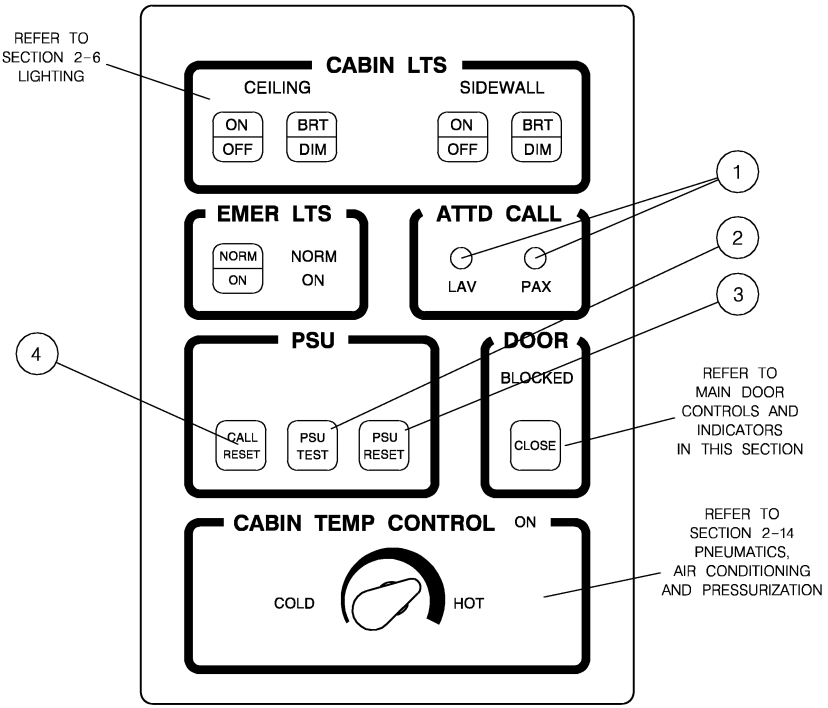
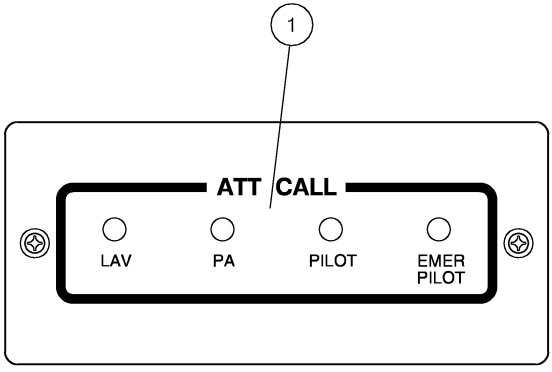



**FORWARD ATTENDANT CONTROL PANEL (OPTION 4)**




**AFT ATTENDANT CALL PANEL**

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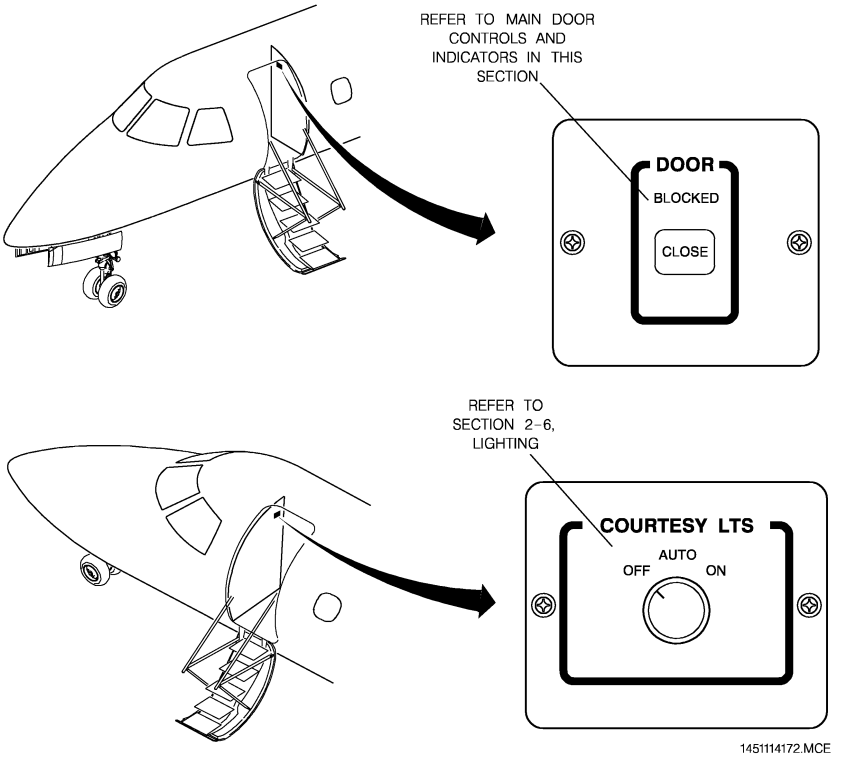
## ENTRANCE PANELS

The Entrance Panels are located in the entry area, and provides main door control and indication and courtesy lights control.




**NOTE: -** The Interior Main Door Control Button is available only to airplanes equipped with Airstar door.

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# GALLEY

The galley can be positioned in different locations of the forward area in passenger cabin.

The galley has many compartments that can be configured in different ways and can be equipped with different optional equipment to facilitate and provide an appropriate flight service to the passengers.

The following items can equip the galley:

- Switches and Circuit Breaker Panel (Galley Control Panel);
- CD player;
- Toilet Smoke Detector Panel;
- Pre-Recorded Messages Control Panel;
- Half Trolleys;
- Waste Compartment;
- Ice Box;
- Hot Jugs;
- Pull-out Working Table;
- Stowage Compartment;
- Miscellaneous Compartment;
- Literature Pocket.

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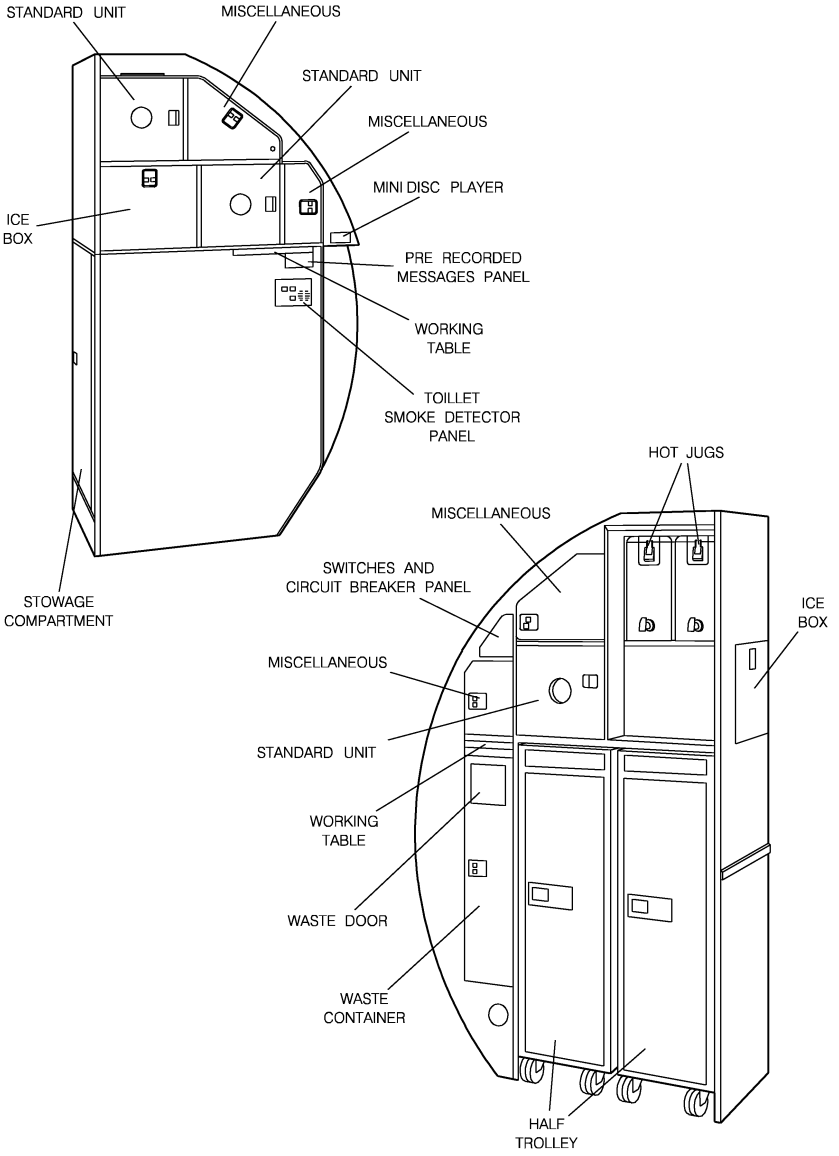


## GALLEY (STANDARD)

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# CONTROLS AND INDICATORS

## GALLEY CONTROL PANEL

### 1 - AREA LIGHTING BUTTON

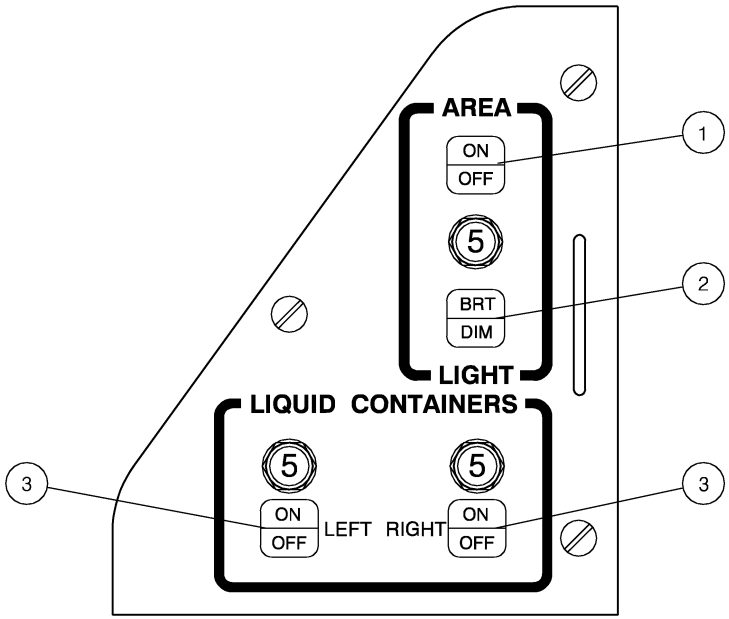
- When alternately pressed, turns on or off the galley area lighting.

### 2 - AREA LIGHTING BRIGHT/DIM BUTTON

- When alternately pressed, selects the bright or dim mode for galley area lighting.

### 3 - LEFT AND RIGHT LIQUID CONTAINER BUTTON

- When alternately pressed turns on or off heating for the associated liquid container.
- When the heating is turned on, the respective left or right indication is lit.

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**GALLEY CONTROL PANEL**

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# PASSENGER SERVICE UNIT

The Passenger Service Unit (PSU) provides the following services:

- Reading light with associated control button at each passenger seat.
- Passenger information sign informing the passenger of NO SMOKING and FASTEN SEAT BELTS instructions.
- Pushbutton and indicator for attendant call.
- Air gasper for each individual passenger seat (refer to Section 2-14 – Pneumatics, Air Conditioning and Pressurization).
- Oxygen Masks Dispensing unit (refer to Section 2-16 – Oxygen).
- Loudspeaker for internal communication.

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# CONTROLS AND INDICATORS

## 1 - ATTENDANT CALL INDICATOR LIGHT (amber)

- It also illuminates whenever the associated Attendant Call Button is pressed (attendant call is activated), for quick identification of the passenger by the flight attendant.

## 2 - INDIVIDUAL READING LIGHT CONTROL BUTTON

- Turns on/off the associated individual reading light.

## 3 - ATTENDANT CALL BUTTON

- When pressed, it activates the attendant call.
- When pressed again, it deactivates the attendant call.
- When the attendant call is activated:
  - An associated chime will be heard in all cabin loudspeakers.
  - The PA indication, located on the Attendant Control Panel, will illuminate.
  - The associated zone attendant call annunciator will illuminate to provide easy identification to the flight attendant. There are four zone attendant call annunciators distributed in the passenger cabin ceiling.

## 4 - NO SMOKING/FASTEN SEAT BELT SIGNS

- These passenger-warning signs are commanded by two separate switches, located on the Overhead Panel. Refer to Section 2-6 – Lighting.
- An associated chime, activated by the passenger address system, will be heard whenever any passenger warning signs is turned on or off by the pilot.
- The signs may also be activated by the automatic oxygen relay activation whenever sudden cabin depressurization occurs above 14000 ft cabin altitude.

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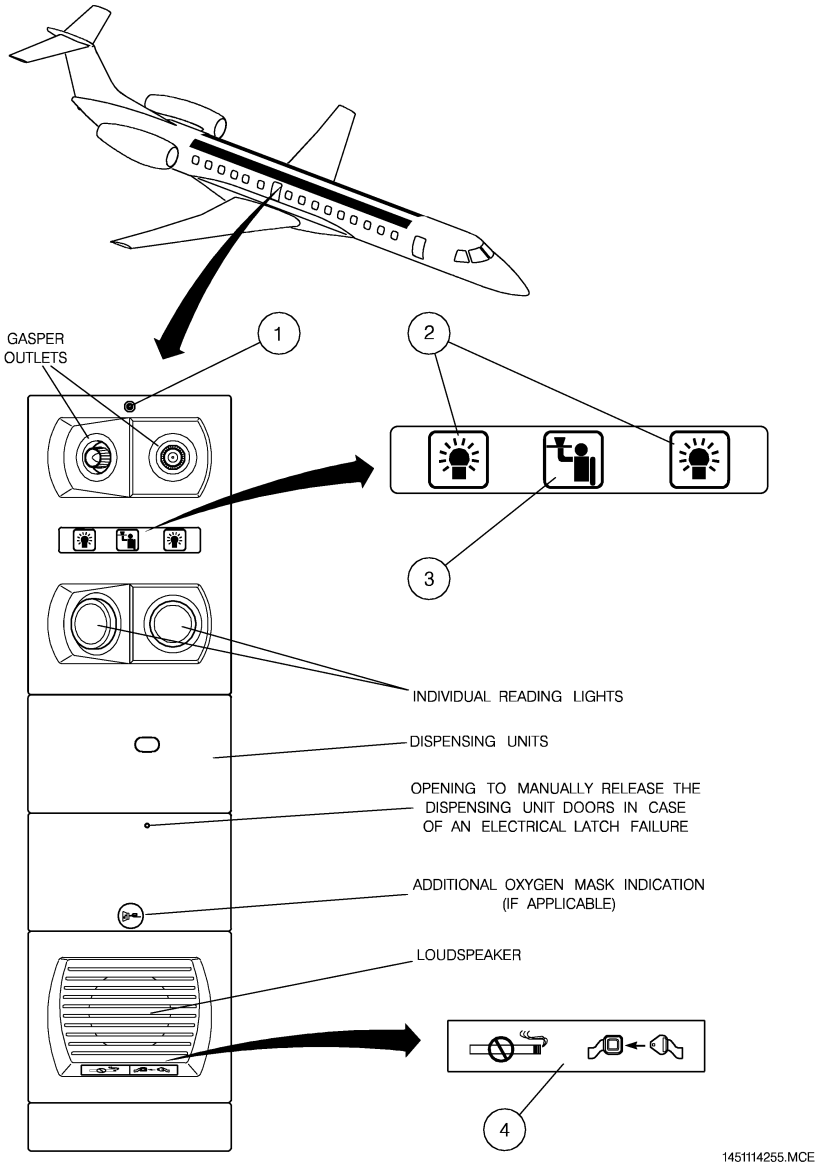


**PASSENGER SERVICE UNIT**

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# COCKPIT/PASSENGER CABIN PARTITION

The cockpit/passenger cabin partition possesses a cockpit door, LH and RH partitions.

The cockpit door assembly is composed of a blowout panel assembly and a door assembly. The door assembly contains a locking latch assembly and a viewer. Two strap assemblies keep the blowout panel assembly attached to the door in the event of a significant pressure increase or decrease in the airplane. The peephole (optional) allows the cockpit occupants to see through the door assembly. The locking latch assembly engages a striker on the LH partition to secure the door when it is closed.

The cockpit/passenger cabin LH partition contains a striker and an electrical installation. The electrical installation possesses a harness assembly.

The cockpit/passenger cabin RH partition is provided with an access panel assembly that gives access to the relay box.

One blue light can be provided above the cockpit door to advise when the cockpit is to be shut out. This light is commanded through the STERILE light switch located at the overhead panel.

The figure on the next page presents the location of the cockpit/passenger cabin partition components.

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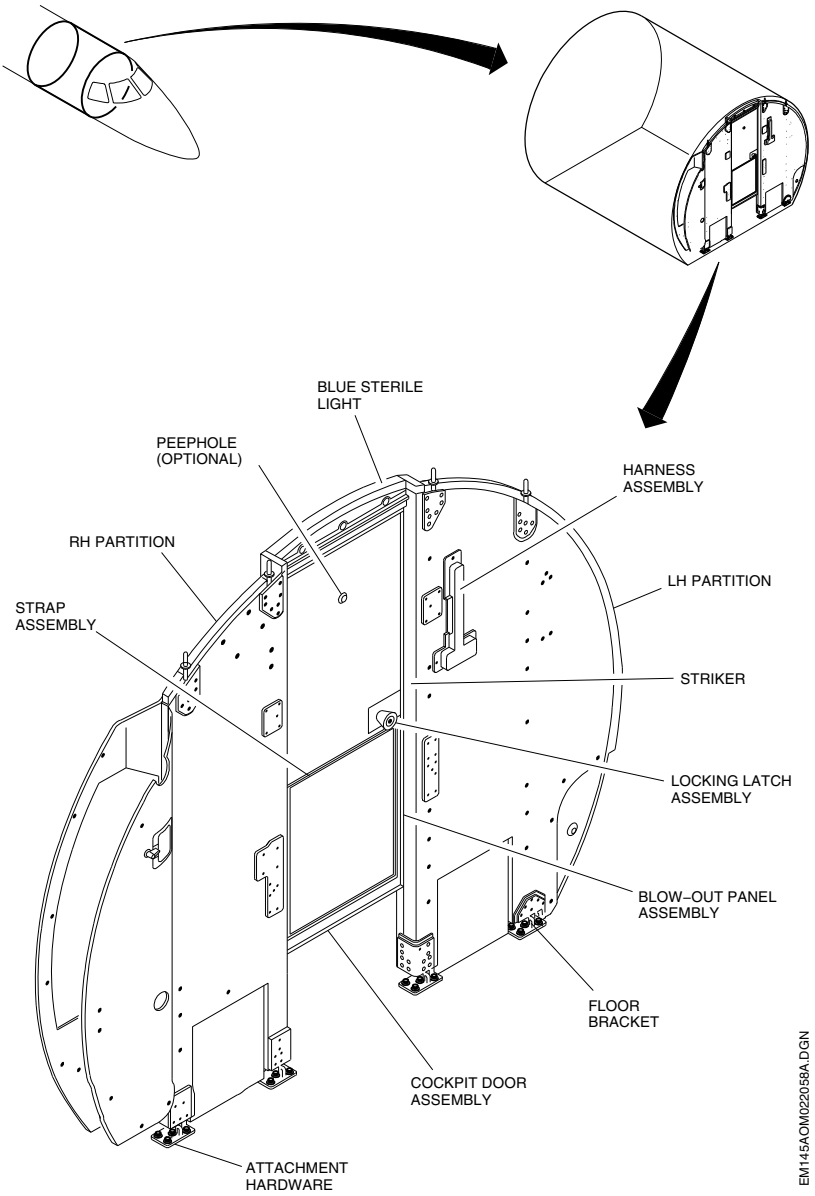


## COCKPIT/PASSENGER CABIN PARTITION COMPONENTS LOCATION

# WATER AND WASTE

Water service is provided to the washbasin for crew members and passenger hygiene.

The waste system consists of a self-contained recirculating flushing toilet.

## WATER

The water supply consists of a tank, a faucet, drain valves and required tubing.

The faucet is installed on the washbasin and supplies water from the tank when the valve is pressed.

A lever beside the faucet actuates a valve to drain accumulated washbasin water into the atmosphere. Draining is performed by gravity on the ground or by differential pressure while in flight. A heater at the end of the drain line prevents its obstruction by ice formation. The heater is activated whenever the DC BUS 1 is energized.

The wash basin drain line is also connected to the exterior by a muffler providing ventilation of the lavatory.

A water service control panel on the lower rear right side of the wing-to-fuselage fairing allows the supply of water to the tank and to draining it, if necessary.

## WASTE

The waste system consists of an electrically-operated self-contained recirculation toilet unit, which collects and stores human waste in an internal holding tank. Adequate chemical products are used to disinfect and deodorize the waste holding tank.

A vent line connecting the waste holding tank to the exterior performs its ventilation (odors exhaust) by means of differential pressure.

Toilet flushing is initiated by pressing and releasing the flush button adjacent to the toilet. This button actuates a motor-driven pump and filter, which delivers flushing fluid for a pre-timed interval.

A restrictor at the bowl bottom prevents waste material return when it is carried directly to the tank.

A waste service panel on the lower rear right side of the fuselage is equipped with a control cable, a waste drain valve and a rinse nipple with cap, and allows the waste system to be serviced.

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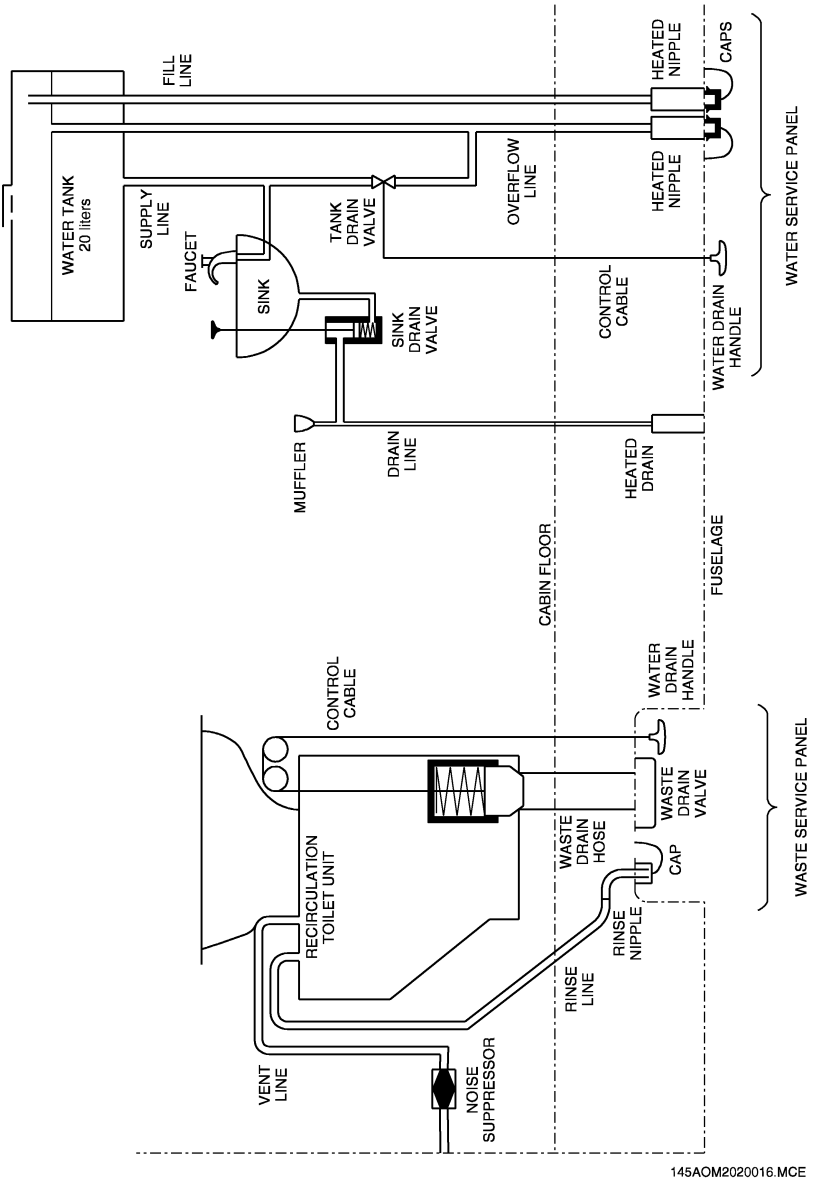
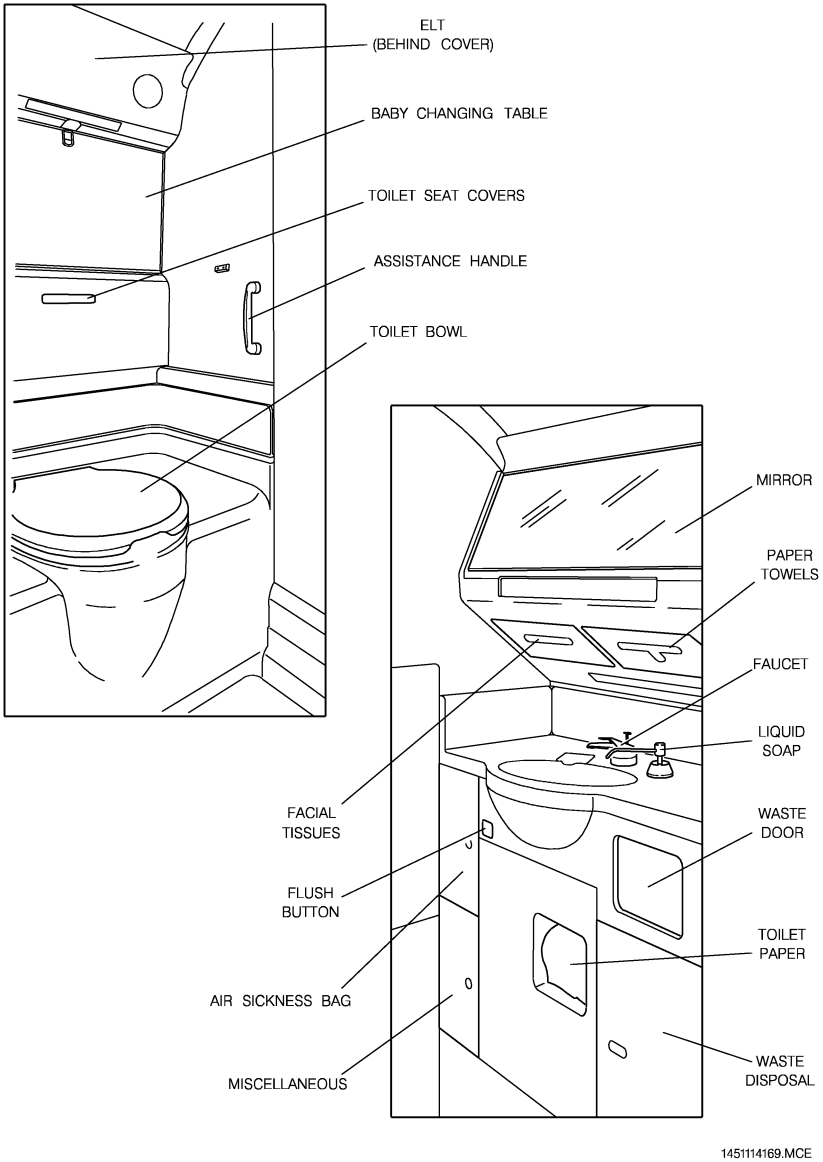



## WASTE AND WATER SYSTEM SCHEMATIC




## LAVATORY

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# AIRSTAIR MAIN DOOR

The airplane is provided with one main entry door located on the left forward fuselage section and is designed as type I door.

The main door, incorporating folding air stairs, is hinged at its lower edge. The door is raised in normal operation by two hydraulic door actuators powered by hydraulic system 1 or by an accumulator with sufficient capacity for four complete door operation cycle.

The door opening operation is manual. The hydraulic circuit damping function allows a smooth operation when the door is lowered.

The system may be controlled from inside or outside, through the entrance panel or through the exterior main door control panel, respectively.

The door may also be closed and locked raising it manually, by an outside ground attendant, and actuating either the inner or the outer handle.

An alternative opening valve is provided in the cockpit to allow the main door to be lowered if it is blocked by hydraulic system pressure (solenoid valve failure).

**NOTE: -** No more than three persons should be standing on the doorsteps simultaneously.
- If the need arises, a person may be carried into and out of the airplane by two people provided there is at least one load-free step between the carriers and the sum of the weight of the three people is no more than 231 kg (509 lb). If at least one of the carriers weighs more than 77 kg (169 lb), the heavier one should be the first to step onto the stair when getting in the airplane, and the last one when getting out.

## EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | MAIN DOOR OPN | Main door is open or not properly locked either on the ground with engine 1 running or in flight. |

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# CONTROLS AND INDICATORS

## 1 - EXTERIOR MAIN DOOR CONTROL BUTTON

- When pressed, a solenoid valve is energized, allowing hydraulic power to raise the main door.

## 2 - INTERIOR MAIN DOOR CONTROL BUTTON

- When pressed, a solenoid valve is energized, allowing hydraulic power to raise the main door.
- A BLOCKED inscription illuminates when the main door actuator hydraulic line remains pressurized after door closing. In this case the main door is hydraulically blocked.

**NOTE:** The BLOCKED inscription may momentary illuminate when the main door is commanded to close, which does not mean that the main door is hydraulically blocked. The blockage is only characterized when the inscription remains illuminated.

## 3 - MAIN DOOR ALTERNATIVE OPENING VALVE

- When actuated for 2 minutes, it depressurizes the door close line, allowing the main door to be lowered when blocked by hydraulic system pressure, provided Hydraulic System 1 is depressurized.

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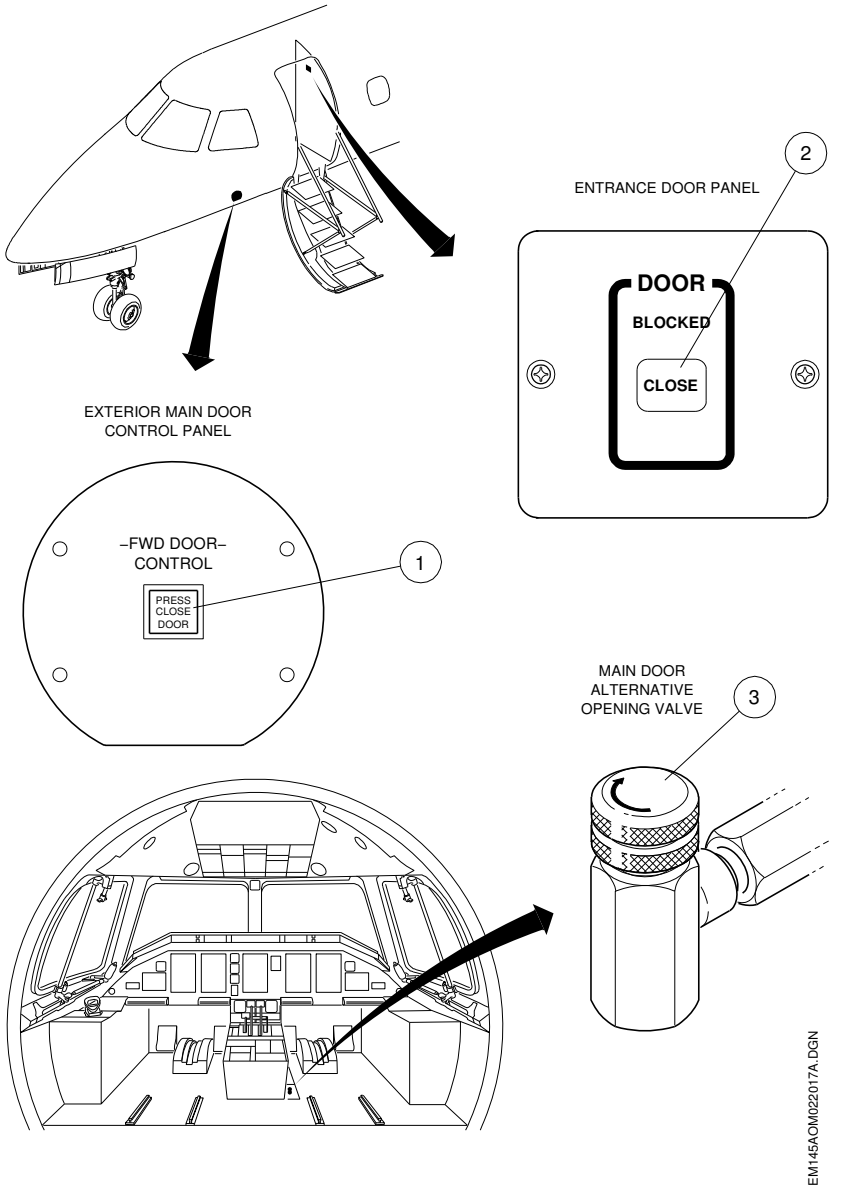


## AIRSTAIR MAIN DOOR CONTROLS AND INDICATORS

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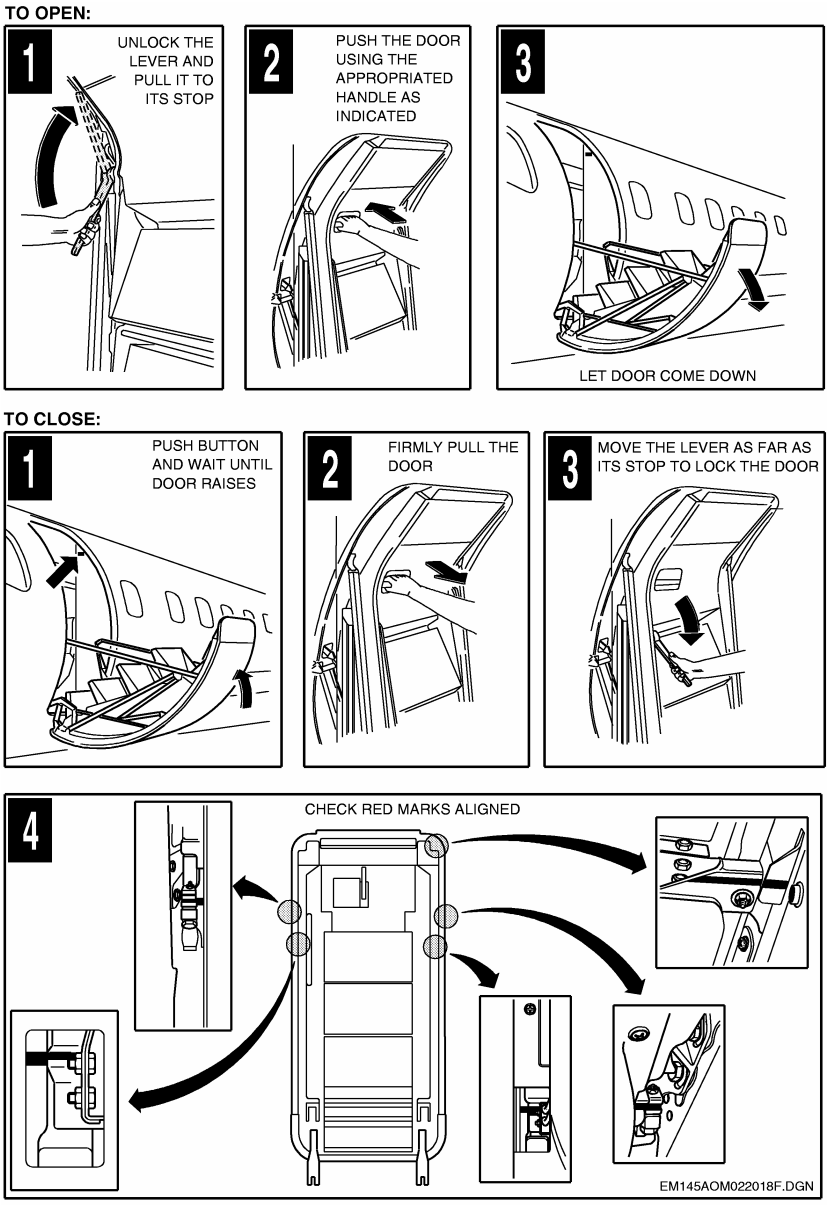


**AIRSTAIR DOOR OPERATION (INSIDE CABIN)**

**NOTE:** The number of red marks may vary with the airplane configuration.

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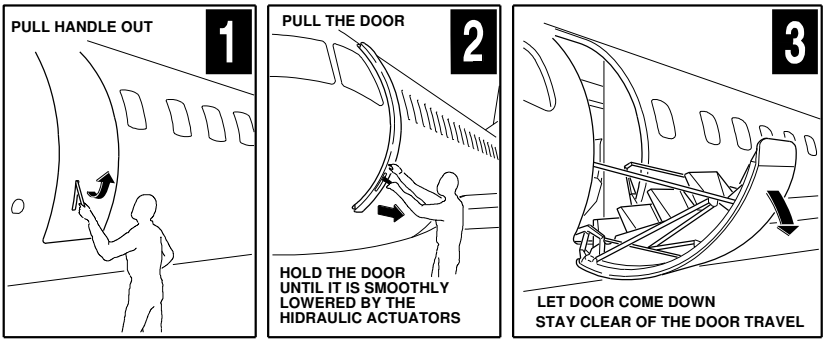
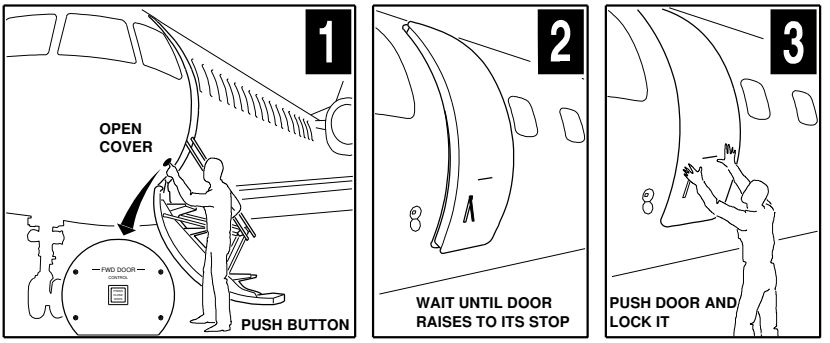
**TO OPEN:**




**TO CLOSE:**

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## AIRSTAIR DOOR OPERATION (OUTSIDE CABIN)

## MAIN DOOR ACOUSTIC CURTAIN

The airplane is equipped with an acoustic curtain at the main door area. The acoustic curtain reduces noise level in the forward passenger cabin area when it is installed.

**NOTE: -** The acoustic curtain must be stowed for takeoff and landing.

- The acoustic curtain should be installed during flights for passenger comfort.
- The acoustic curtain should be rolled-up with the ultra-leather facing outward. Thus, in case of rain, snow, wind or other weather conditions, the ultra-leather will be the exposed material.

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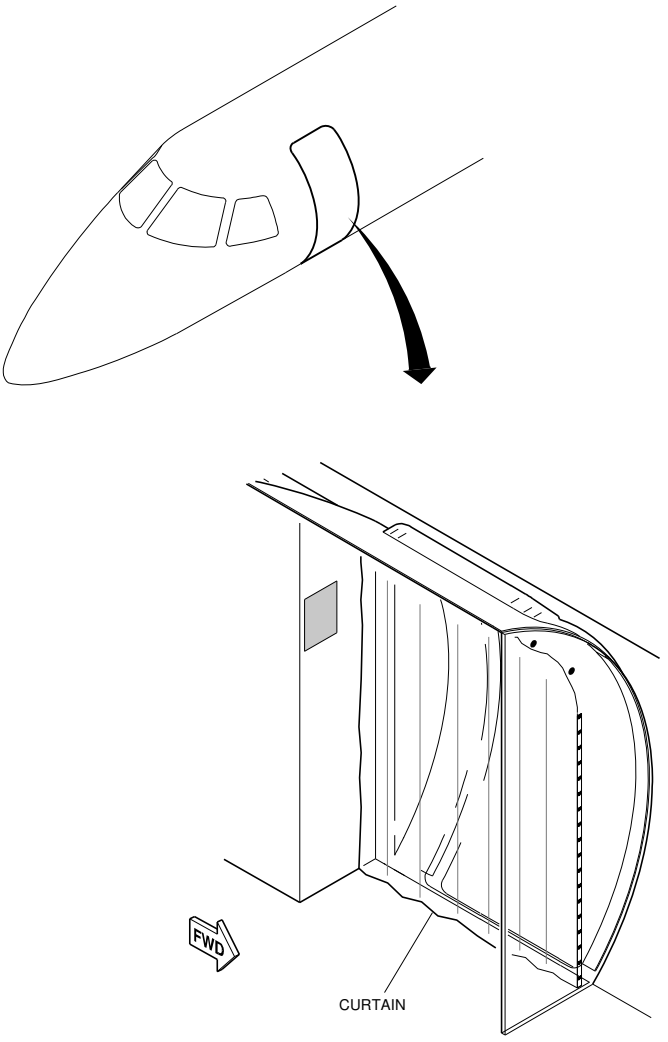


**MAIN DOOR ACOUSTIC CURTAIN**

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# JETWAY MAIN DOOR

The airplane is provided with one main entry door located on the left forward fuselage section and is designed as type I door.

Some airplanes may be optionally equipped with a main door without handrails and stairs. This door will allow docking at jetway terminals. The door opening operation is manual. The system is mechanical and the door swings opens laterally and toward the airplane's front end.

The door movement is operated by internal and external handles. The door remains against the airplane fuselage when fully open, leaving the entrance completely free for the airport's jetway.

## EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | MAIN DOOR OPN | Main door is open or not properly locked either on the ground with engine 1 running or in flight. |

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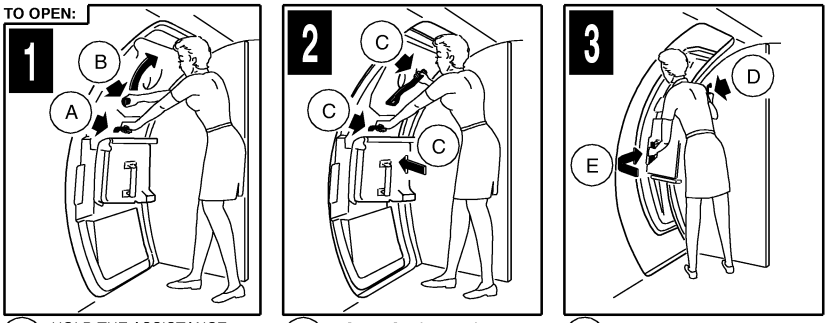


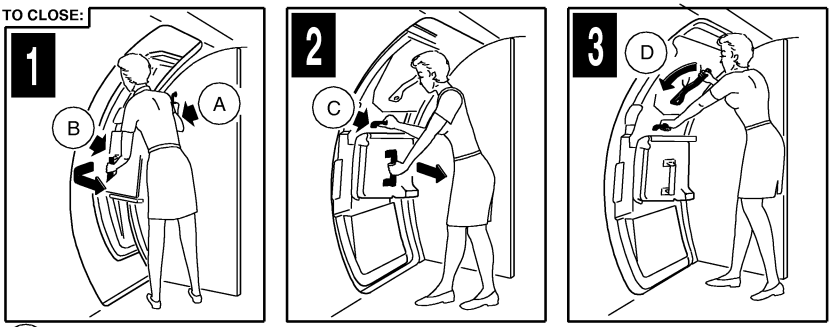

A HOLD THE ASSISTANCE HANDLE

B TURN THE LEVER CLOCKWISE TO UNLOCK THE DOOR

C HOLDING HANDLE AND LEVER, PUSH THE DOOR

D HOLD THE PARTITION HANDLE

E PUSH THE DOOR HANDLE UNTIL THE DOOR LOCKS IN THE OPEN POSITION

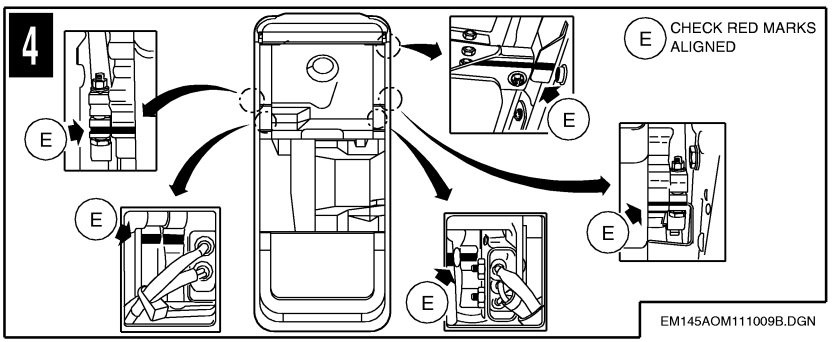



A HOLD THE PARTITION HANDLE

B PULL THE DOOR HANDLE TO UNLOCK THE DOOR AND BRING IT TO CLOSURE POSITION

C HOLDING THE HANDLES, PULL THE DOOR TO THE CLOSURE POSITION

D TURN THE LEVER COUNTERCLOCKWISE TO LOCK THE DOOR CLOSED




## JETWAY DOOR OPERATION (INSIDE CABIN)

**NOTE:** The number of red marks may vary with the airplane configuration.

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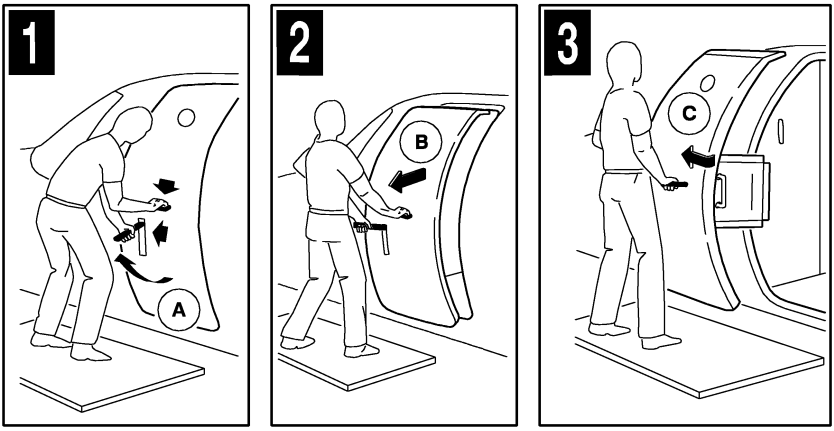
**TO OPEN:**

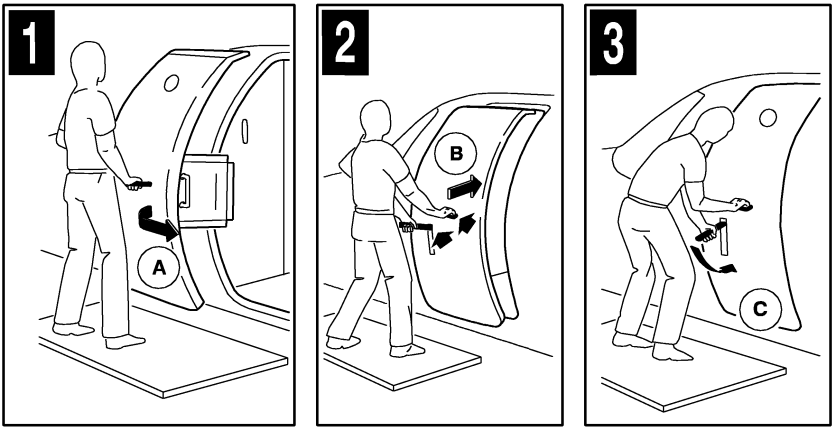



A LIFT THE LEVER TO UNLOCK THE DOOR

B PULL THE DOOR TO OPEN POSITION

C FULLY OPEN THE DOOR AND LOCK IT OPENED

**TO CLOSE:**




A HOLD THE DOOR HANDLE TO UNLOCK THE DOOR AND BRING IT TO CLOSURE POSITION

B PULL THE DOOR TO THE CLOSED POSITION

C LOWER THE LEVER TO LOCK THE DOOR CLOSED

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## JETWAY DOOR OPERATION (OUTSIDE CABIN)

## MAIN DOOR ACOUSTIC CURTAIN

The airplane is equipped with an acoustic curtain at the main door area. The acoustic curtain reduces noise level in the forward passenger cabin area when it is installed.

**NOTE: -** The acoustic curtain must be stowed for takeoff and landing.

- The acoustic curtain should be installed during flights for passenger comfort.
- The acoustic curtain should be rolled-up with the ultra-leather facing outward. Thus, in case of rain, snow, wind or other weather conditions, the ultra-leather will be the exposed material.

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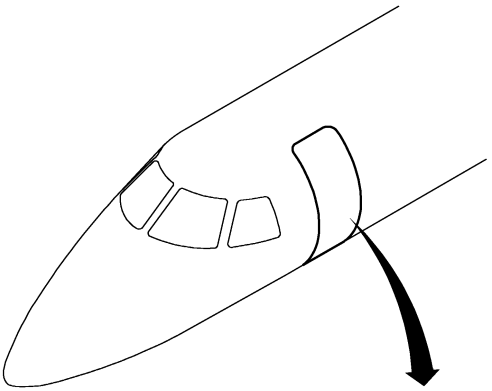

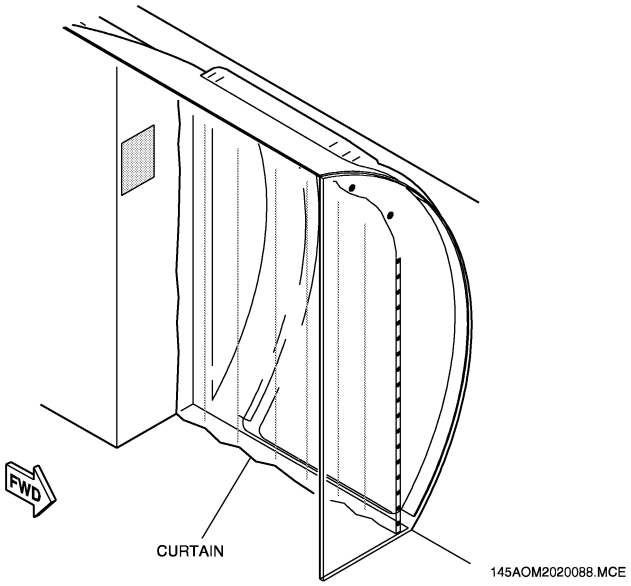


## MAIN DOOR ACOUSTIC CURTAIN

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# ACCESS DOORS AND HATCHES

The airplane is provided with one service door on the right side. Two passenger cabin emergency escape hatches are located over the wings. Finally, a number of access doors and hatches for different airplane systems can be found along the fuselage.

## SERVICE DOOR

The service door on the right side of the forward fuselage section is used for galley servicing and cabin cleaning between flights. It may also be used as an emergency exit.

The door is manually operated by internal and external handles. Open the service door by lifting the handle and moving the door outward, followed by a forward rotation.

### EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | SERVICE DOOR OPN | Service door is open or not properly locked either on the ground with engine 1 running or in flight. |

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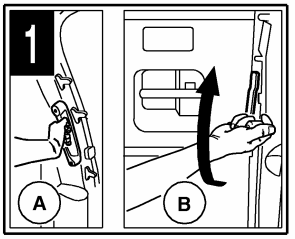
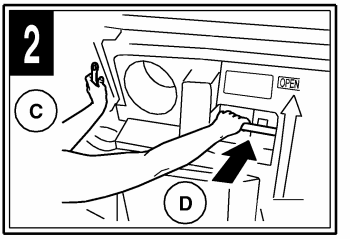
**TO OPEN:**



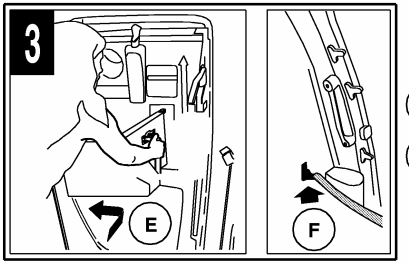




A HOLD THE ASSISTANCE HANDLE

B LIFT THE LEVER TO UNLOCK THE DOOR

C KEEP HOLDING THE ASSISTANCE HANDLE

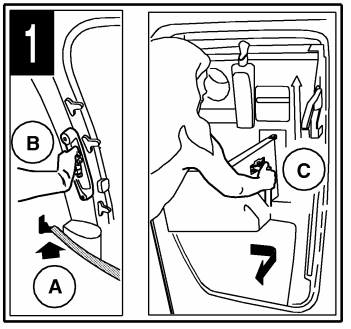
D PUSH THE DOOR TO OPEN

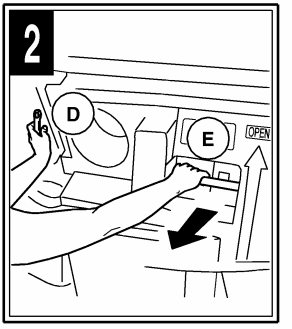


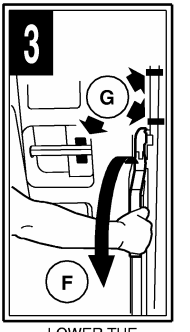

E MOVE THE DOOR UNTIL IT LOCKS IN THE OPEN POSITION

F MAKE SURE THAT THE SAFETY STRAP IS IN ITS CORRECT POSITION

**TO CLOSE:**




A REMOVE THE SAFETY STRAP

B HOLD THE ASSISTANCE HANDLE

C PULL THE LOWER HANDLE TO UNLOCK THE DOOR FROM THE OPEN POSITION AND BRING IT TO THE CLOSED POSITION

D KEEP HOLDING THE ASSISTANCE HANDLE

E FIRMLY PULL THE DOOR

F LOWER THE LEVER TO LOCK THE DOOR

G CHECK RED MARKS ALIGNED

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## SERVICE DOOR OPERATION

For airplanes Post-Mod. SB 145-52-0040, Part II and Part III, or equipped with an equivalent modification factory incorporated, the service door can be locked with a locking pin.

On ground, at pilot discretion, the pin can be used but must be removed and guarded in the quick-release pin support, in the LH cockpit rear console, behind the pilot seat, before any flight.

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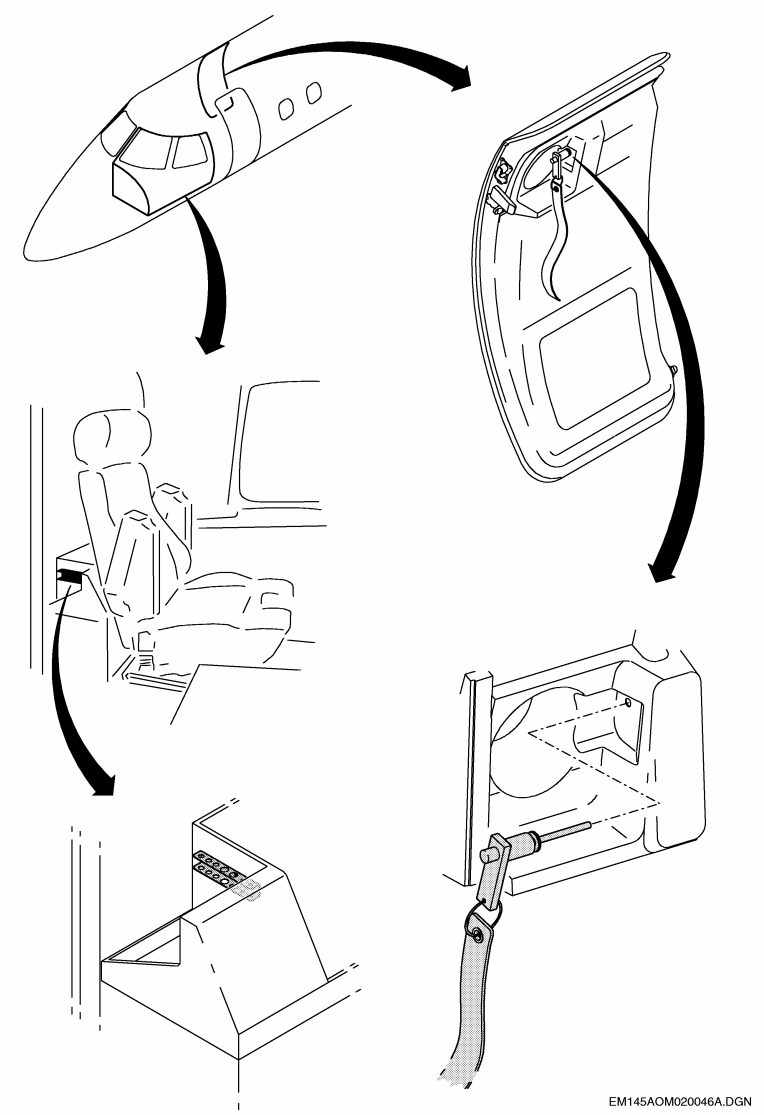


**SERVICE DOOR LOCKING PIN**

## BAGGAGE DOOR

The baggage door on the rear left side of the fuselage is manually operated from the outside. It is provided by a locking mechanism controlled by an external handle, stowed in the lower half of the door. The door is provided by depressurization vent that allows the opening operation.

### EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | BAGGAGE DOOR OPN | Baggage door open or not properly locked. |

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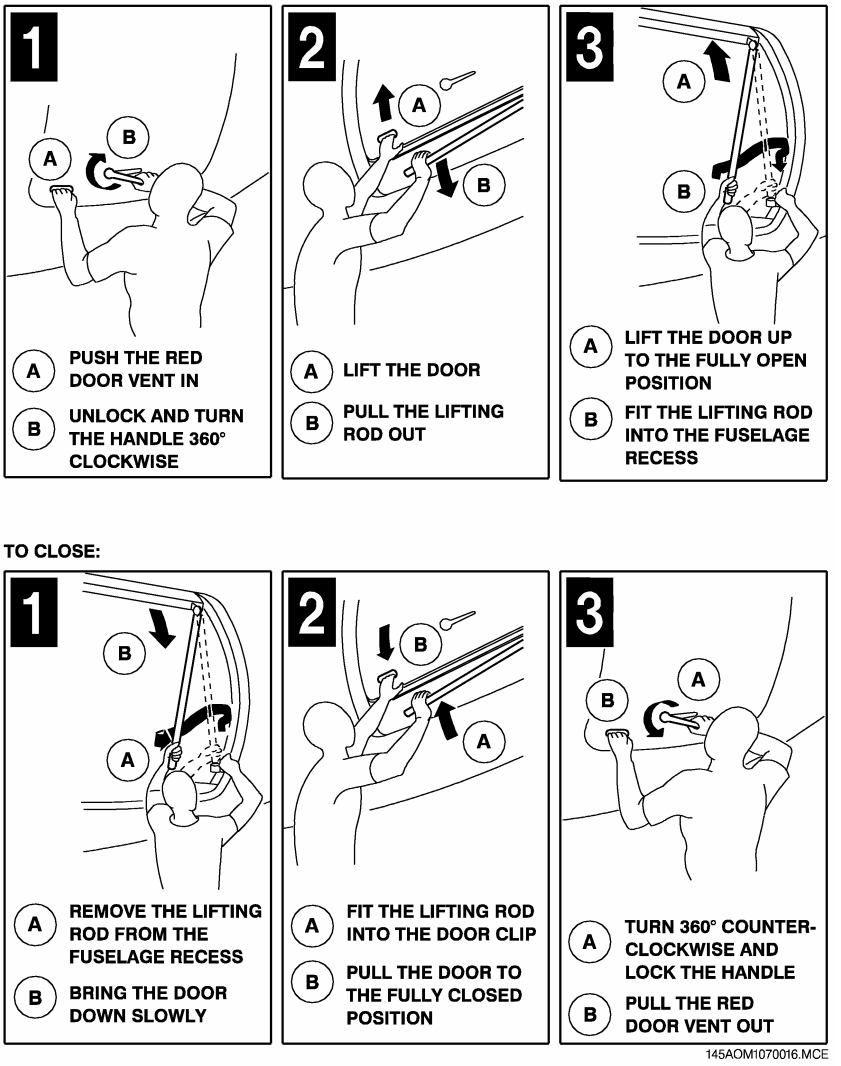


## BAGGAGE DOOR OPERATION

## COMPARTMENT HATCHES

A number of access doors and hatches for different airplane systems can be found along the fuselage.

The compartment hatches provide access for servicing the airplane systems and equipment.

The under cockpit access hatch is located under the fuselage, providing access to the fuselage pressurized compartment.

The forward electronic compartment access hatch is inside the nose landing gear wheel well.

The rear electronic compartment access hatch is located on the rear right side of the fuselage. This hatch provides access to the airplane pressurized area containing the rear electronic compartment, rudder autopilot servo, rudder control cables and electrical harness, stabilizer electrical harness and elevators control cables.

A unlocked condition of any compartment hatch causes a single caution message on Eicas. In addition, the MFD indicates the open-hatch(es) condition in a graphical representation.

### EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | ACCESS DOORS OPN | At least one compartment access hatch open or not properly locked. |

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## REFUELING PANEL ACCESS DOOR

The refueling panel access door is located on the forward right side of the wing-to-fuselage fairing (refer to Section 2-8 – Fuel System).

The opening of the fueling panel access door causes a caution message on Eicas. In addition, the MFD indicates the open-door condition in a graphical representation.

### EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | FUELING DOOR OPN | Refueling panel access door open or not properly closed. |

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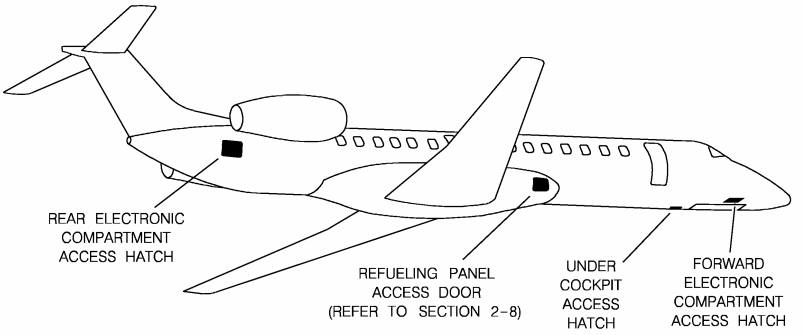


## ACCESS DOORS AND HATCHES

## EMERGENCY EXIT HATCHES

Two passenger cabin emergency escape hatches are located over the wings. Refer to Section 1-10 – Emergency Information.

## DOORS AND HATCHES INDICATION ON MFD

The doors section of the Takeoff System Page on MFD consists of a graphical representation of the airplane (white) with squares located along the fuselage to denote the various doors and hatches to be monitored.

If a door or hatch is ajar, the associated graphical square will change from green to red and a red DOOR OPEN inscription will be presented, boxed in red, in the lower left corner of the DOORS section.

The following doors and hatches are monitored for status:

- Main door;
- Service door;
- Baggage door;
- Fueling panel access door;
- Rear electronic compartment access hatch;
- Forward electronic compartment access hatch;
- Under cockpit access hatch;
- Emergency exits hatches.

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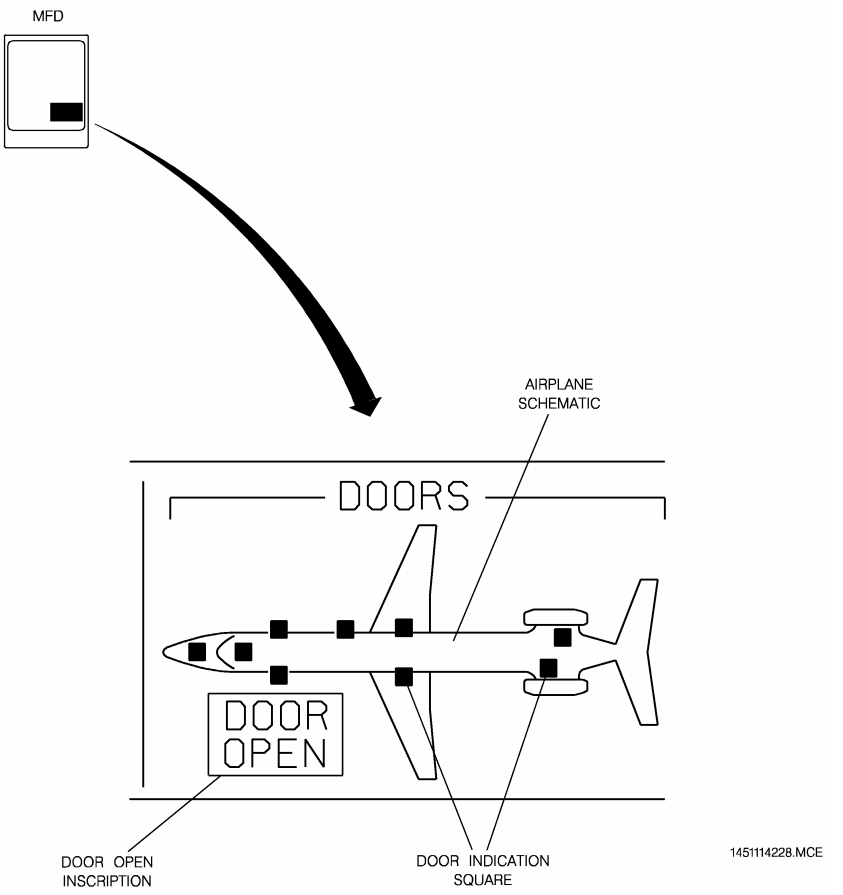


**DOORS AND HATCHES INDICATION ON MFD**

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# PC POWER SYSTEM

The PC Power system is designed to supply aircraft seats with 110V/60Hz AC-power for Personal Electronic Devices (PED) such as laptop computers and other passenger equipment.

A control switch in the In-flight Entertainment Panel (IFE), installed in the Cockpit Overhead Panel, controls the PC Power System.

The Master Control Unit (MCU) controls the power available to the AC Outlet Units in the seat armrest. The MCU has power programming capability, which monitors the total electrical current in use at the Outlet Units and, if necessary, disables or enables the available power outlets.

If any cabin decompression occurs during the flight, the MCU is deactivated by a ground signal from the pressurization system.

Each outlet incorporates a LED, that is visible to the passenger and indicates that AC power is available. The green color indicates the power supply, the yellow color indicates power not available at the moment, and the red color indicates that AC outlet unit out of service.

A blue color LED on the aisle seats indicates if the In-Seat Power Converter is providing power.

**NOTE**: The PC Power System may be turned off during take-off and landing conditions or when operating below 10000 ft.

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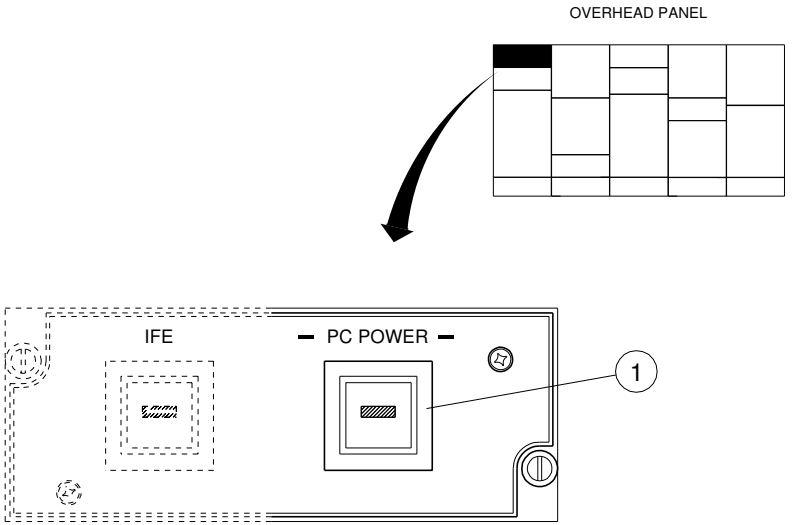
# CONTROLS AND INDICATORS

## IN-FLIGHT ENTERTAINMENT PANEL

The PC Power System is only activated or deactivated by releasing or pressing the PC Power Button on the IFE Panel.

### 1 - PC POWER BUTTON

- Enables (pushed in) or disables (pushed out) the power supply to the AC-outlet units.
- A striped bar illuminates in the button to indicate that it is pushed out.

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**PC POWER SYSTEM BUTTON ON THE IFE PANEL**

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# IN-FLIGHT ENTERTAINMENT SYSTEM

The In-Flight Entertainment System provides the passengers with real-time flight information through the Airshow system and video/audio entertainment through a DVD player, a VHS video cassette player and a CD changer.

An In-Flight Entertainment (IFE) control switch on the IFE Panel, installed in the Cockpit Overhead Panel, controls the In-Flight Entertainment System.

The DVD Player and the Video Cassette Player are independent units and both are connected to the Video System Control Unit. These two units are controlled by basic commands such as: play, rewind, forward and stop. A controller selects and controls the Airshow system exhibition mode.

The Video signal is exhibited on 10” monitors and on 6.4” monitors distributed in the passenger cabin. The Video System Control Unit (VSCU) selects the signal, and allows image viewing on the Preview Unit before the selected video signal is distributed to the monitors. The video and audio outputs will be determined by an operator command, from a switch located on the VSCU front panel.

The flight attendant defines the selection, composition and sequence of the video pictures and audio briefing at the time the Air Show is ordered. These can include:

- Geographic Maps of flight routes that show in real time the airplane position, previous flight path and planned route;
- Multi-language location names and interest points on the map;
- Multi-language flight information (e.g., ground speed, altitude, temperature, distance and times);
- Customized graphics, including customized logos and announcements;
- Audio briefings for safety and/or personal announcements.

A discrete signal from the Passenger Address mutes the Airshow Audio during announcements. A discrete signal from the No Smoking and Fasten Seat belts switches in the cockpit causes the Airshow to display an appropriate message.

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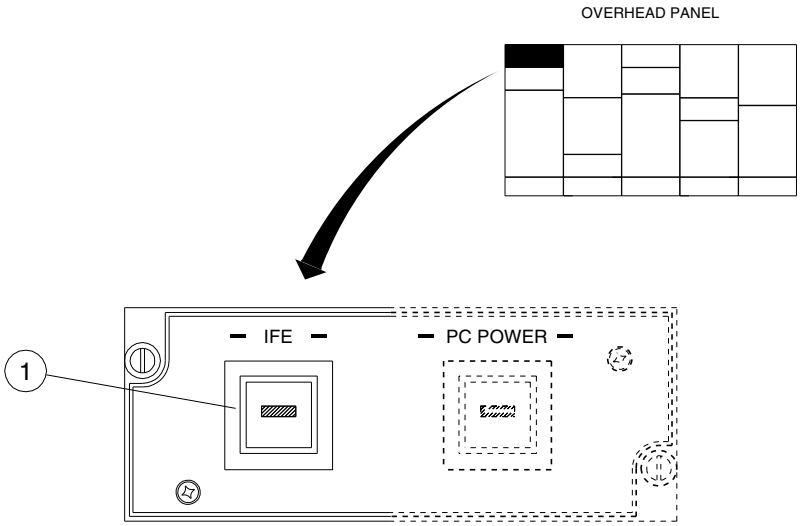
# CONTROLS AND INDICATORS

## IN-FLIGHT ENTERTAINMENT PANEL

The In-Flight Entertainment System should be activated or deactivated by releasing or pressing the IFE Button on the IFE Panel.

### 1 - IN-FLIGHT ENTERTAINMENT BUTTON (IFE)

- Enables (pushed in) or disables (pushed out) the power supply to the In-Flight Entertainment System.
- A striped bar illuminates in the button to indicate that it is pushed out.

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**IN-FLIGHT ENTERTAINMENT BUTTON ON THE IFE PANE**

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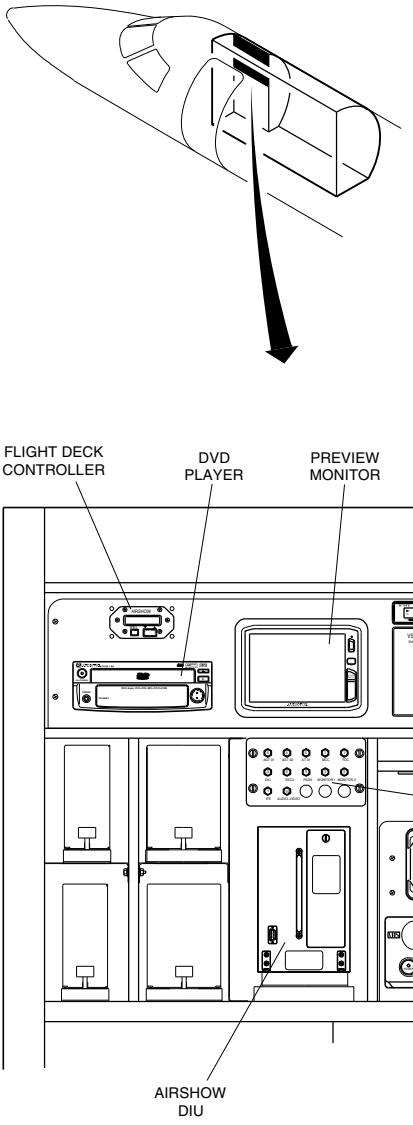


**IN-FLIGHT ENTERTAINMENT PANEL**

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## VIDEO SYSTEM CONTROL UNIT (VSCU)

The VSCU is responsible for collecting Video signals from the DVD Player, Video Cassette Player and Airshow, and Audio signals from the DVD Player, CD Player, Video Cassette Player and Airshow.

### 1 - VSCU DISPLAY

- Shows the video and audio channels to be selected and displayed on the forward galley preview monitor and heard on the headphone connected to the VSCU Panel headphone jack.

### 2 - POWER KEY BUTTON

- When pressed, turns on the VSCU.

### 3 - SELECT RIGHT KEY

- Selects the subsequent channel to be displayed on the preview monitor.

### 4 - VOLUME UP KEY

- Increases the volume on the headphone.

### 5 - ENTER KEY

- Selects the video signal that will be displayed on passenger monitors, and which audio signal will be sent to passenger loudspeakers.

### 6 - HEADPHONE JACK

- To connect a headphone and allow the flight attendant to hear the audio signal associated with the video displayed on the preview monitor.

### 7 - VOLUME DOWN KEY

- Decreases the volume on the headphone.

### 8 - SELECT LEFT KEY

- Selects the previous channels to be displayed on the preview monitor

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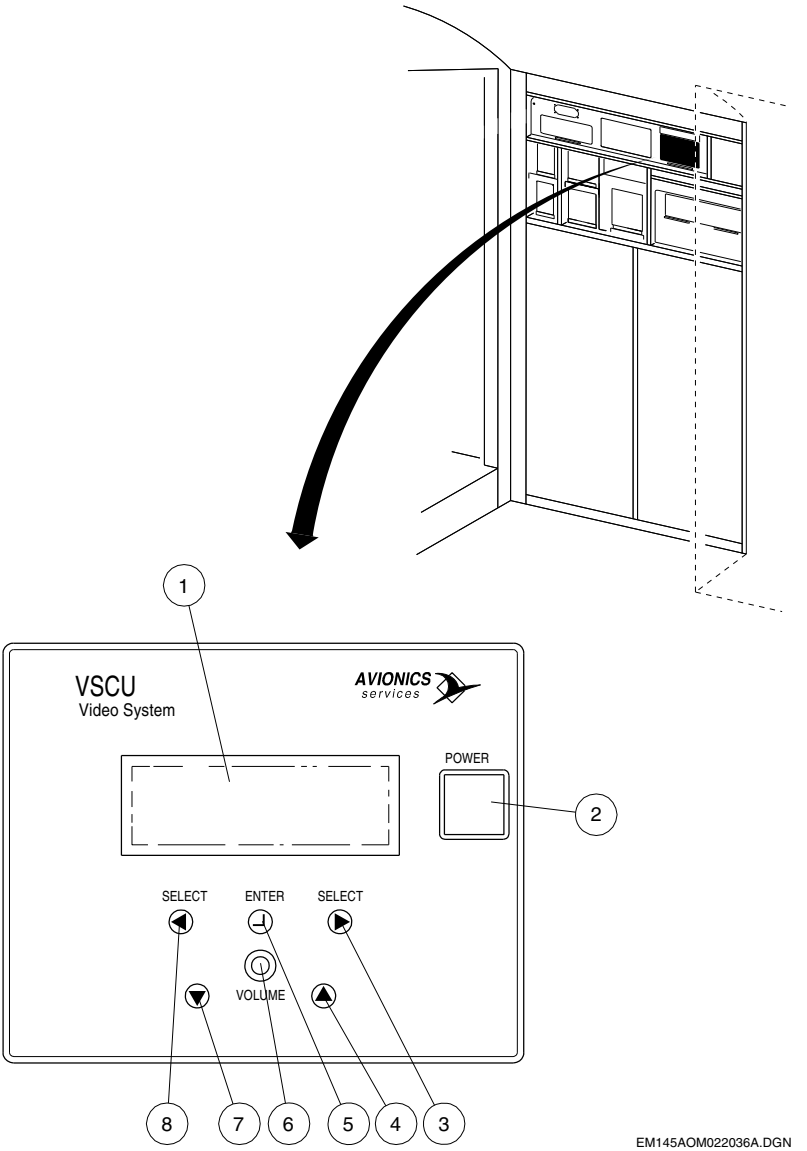


**VIDEO SYSTEM CONTROL UNIT PANEL**

## FLIGHT DECK CONTROLLER PANEL

The Flight Deck Controller is used to monitor and change various customer-requested features in the Airshow Digital Interface Unit, including:

- Time to destination;
- Greenwich Mean Time;
- Destination Airport;
- Mode display;
- Graphic display (multiple logos);
- Languages;
- Audio Briefing/announcements.

When the ground speed reaches 100 knots, the FDC automatically begins to count down the time to destination and displays the time remaining on the Air Show info page.

After the system is powered, to access the cursor control on the main menu, press the “SELECT” button on the Cockpit Controller and the “asterisk” will stop flashing. Use the “SCROLL” knob to scroll up or down the menu. Press “SELECT” to access your choice.

### 1 - SEL KEY

- When pressed, sets the function pre-selected by the operator through the UP and DOWN selection keys.

### 2 - UP AND DOWN SELECTION KEY

- Moves up and down the active cursor on the active screen to enable the subsequent selection.

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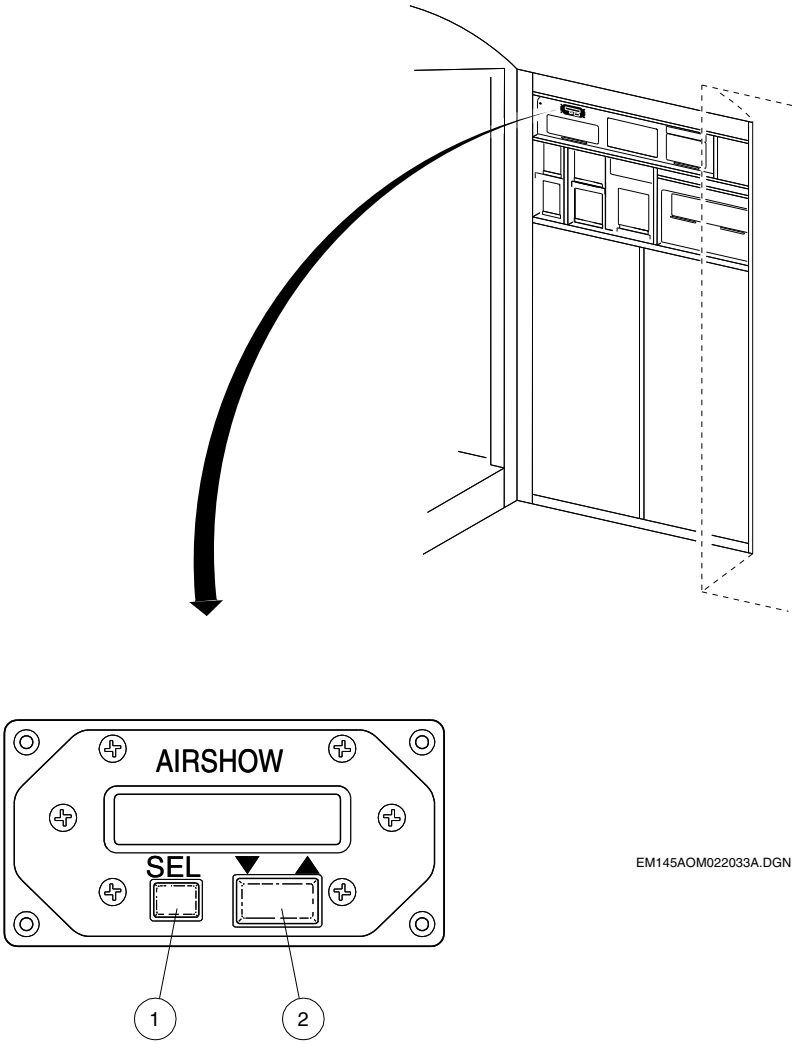


**FLIGHT DECK CONTROLLER PANEL**

## AUDIO SYSTEM

The Audio system provides selectable audio entertainment at each passenger seat location, from three different sources: CD Player, DVD Player and Video Cassette Player. The controls to command the CD Changer are located on the CD Changer Control Unit. The system also provides priority interruption capability that enables a passenger address to simultaneously override all audio channels.

The Audio System has four stereo channels. These four channels are distributed as follows: CD Changer, DVD Player, Video Cassette Player and one channel for Airshow. The Digital Passenger Entertainment Control Unit (DPECU) selects the desired channel.

There is one DPECU installed in the armrest of each passenger seat. The DPECU buttons provide channel selection and volume control. A display indicates the channel selected and it is also used as a status indicator during the self-test. A jack for the passenger's headset is provided to listen to the current passenger selection.

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# TELEPHONE SYSTEM

## AIR-CELL SYSTEM

The air-cell telephone system is designed to provide air and air/ground telephone connection capability using existing ground based cellphone networks.

There are three telephone lines and four telephone handsets. Three handsets are located in the passenger cabin and one in the cockpit. An additional input/output data port is provided on every handset cradle for a fax machine or other analog device. Only one device can be used at a time (fax or phone).

The telephone handsets located in the cockpit and on the right forward bulkhead cannot be used simultaneously, since they are connected to the same telephone line.

**NOTE:** The telephone system will be turned off when the In-Flight Entertainment (IFE) Button is pressed.

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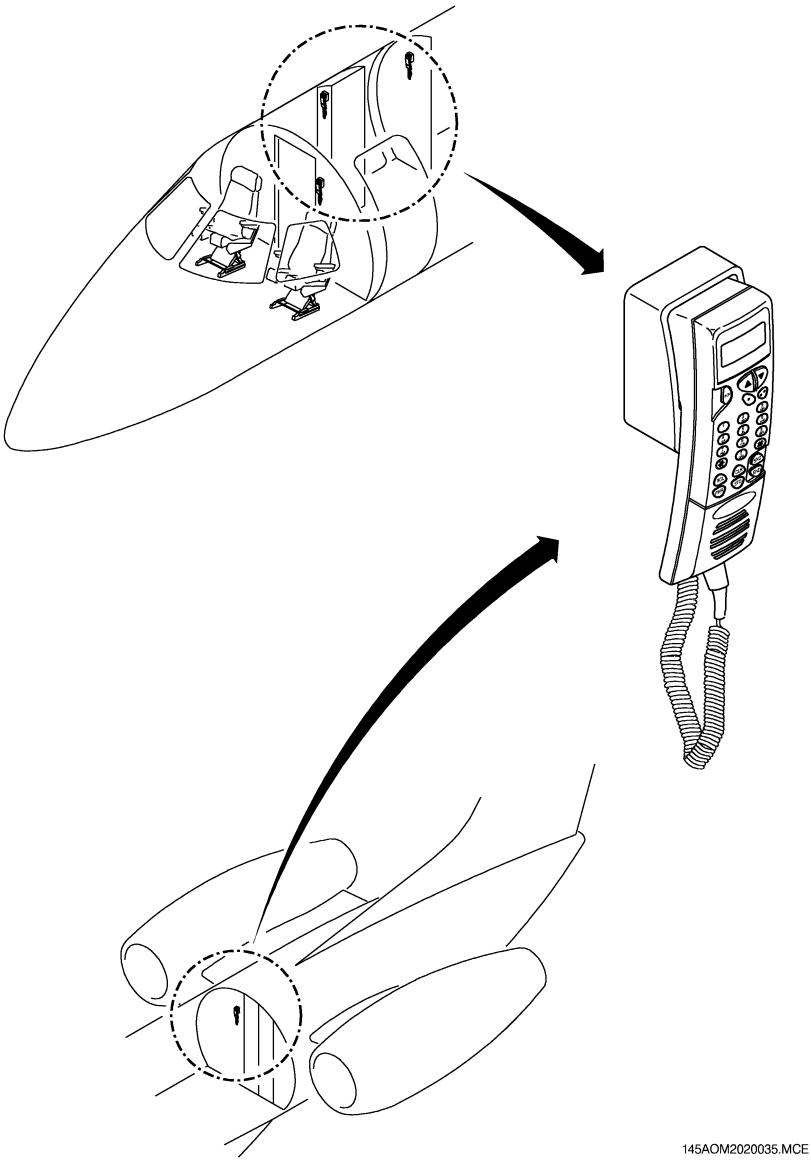

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## TELEPHONE HANDSET LOCATIONS

# CONTROLS AND INDICATORS

## TELEPHONE HANDSET

The handsets provide voice communication control and programming of the system. A handset cradle provides secure storage of the handset when it is not in use. The cradle features a connection for the handset and a standard RJ-11 telephone jack for a fax or modem device.

The operation of the telephone system is similar to a cellphone:
– Press “PWR” to turn the power on or off;
– To place a call, enter the phone number and press “SND”;
– To receive a call, press “SND” or lift the handset and press “SND”;
– To end a call, press “END”.

**1 - OPERATING DISPLAY AND STATUS INDICATOR**
- Provides a visual indication of telephone numbers and mobile phone service messages.

**2 - DOT MARK**
- The dot in the lower left corner of the display is illuminated when the phone is on.

**3 - IN USE MESSAGE**
- Lights when the phone is in use.

**4 - NO SRV MESSAGE**
- Lights when the telephone is out of service range of an AirCell cell site.

**5 - ROAM MESSAGE**
- Lights when the unit is in range of an AirCell site that is not in your home system.

**6 - ONE TOUCH DIALING KEY**
- Calls a phone number stored in the phone memory.

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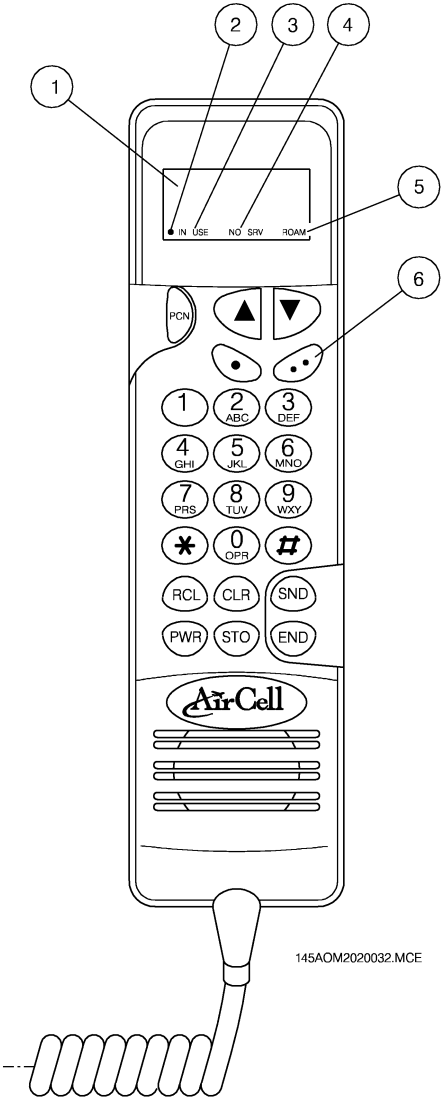


**TELEPHONE HANDSET**

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# TELEPHONE SYSTEM

## MAGNASTAR SYSTEM

The MagnaStar™ C-2000 digital airborne telephone system transmits and receives both voice and fax/modem type data to and from the aircraft, using an exclusive cellular-linked technology.

The telephone system has two air-ground voice/fax/data communications channels that can be used simultaneously. The digital airborne telephone system operates over the “GenStar” satellite system, which offers continuous coverage throughout the United States of America, southern section of Canada and most section of Mexico.

The frequency range of operation to transmit is 894 to 896 MHz and to receive is 849 to 851 MHz.

The telephone handsets contain noise-canceling microphones to overcome the aircraft noise environment, and the audio is digitized at the handset to further ensure clear communication. Special function keys and a liquid crystal display (LCD) allow easy use of all options. The handset has an adjustable audio volume, telephone call styles, and selects various options. The LCD display presents useful information and menu style selections.

There is a fax machine with fax/scanner/printer and copier functions installed in the credenza.

The operation of the telephone system is similar to a cellular phone. When in normal operation, the handset works as a normal telephone. To place a call, it is necessary to pick up the handset and dial the desired phone number with all prefix and country codes.

The figure on the next page presents the telephone handset and fax locations.

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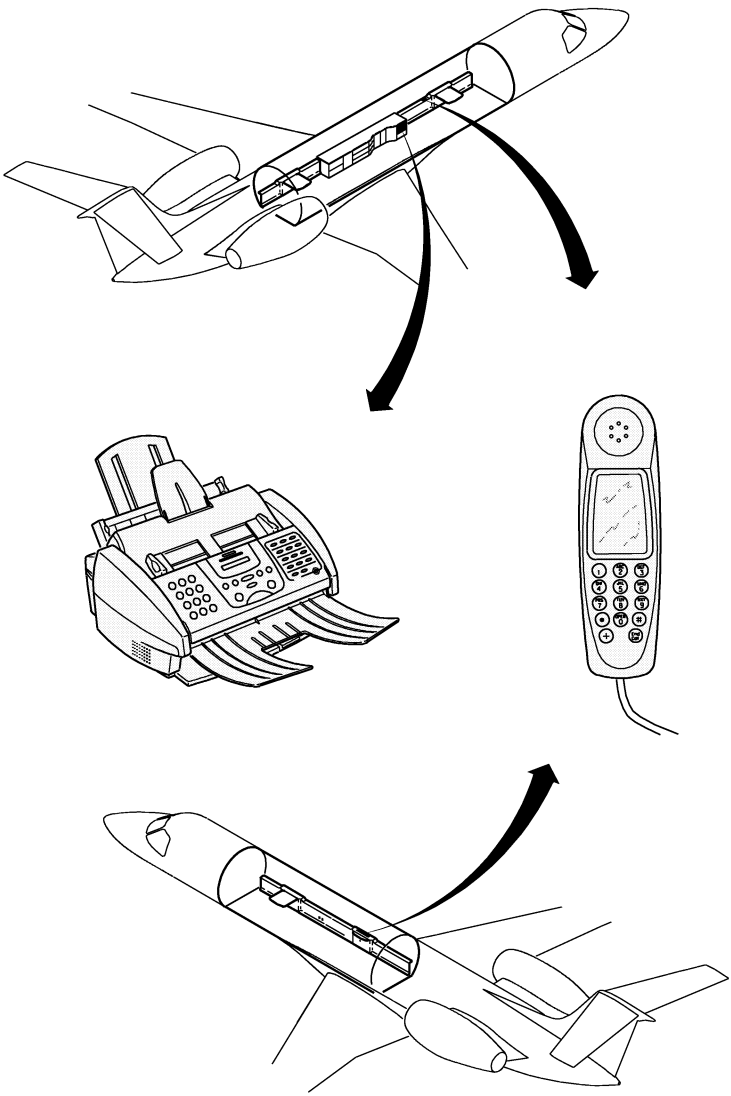

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## TELEPHONE HANDSET AND FAX LOCATIONS

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# COCKPIT SECURITY DOOR

The Cockpit Security Door is a bullet proof reinforced door that isolates the cockpit from the cabin passengers, avoiding non authorized people to enter in the cockpit.

In addition, the intrusion resistant cockpit door system has been shown to comply with all other applicable regulations, including but not limited to:

– Static strength,
– Rapid decompression,
– Smoke evacuation and penetration,
– Required airflow, and
– Emergency ingress and egress.

Components of the intrusion resistant cockpit door system include:

– Cockpit door latch/striker/handle,
– Mechanical deadbolt,
– View Lens,
– Decompression Panel, and
– Decompression Latch.

**NOTE: -** The security cockpit door must be kept closed and locked at all times during flight except to permit access and egress according to the operator's procedures for opening, closing and locking the door.

- Two crewmembers must be in the cockpit during all flight phases. If one of the pilots leaves the flight deck, he must be replaced in the cockpit by another crewmember.

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# DOOR DESCRIPTION

**1. FIXED VENTING LOUVER**

The fixed venting louver has movable horizontal slats for admitting air to the cockpit. The vent cover should normally be open. In smoke conditions, to close the louver vent, push the two spring clips through the vent holes and carefully pull the sliding panel away from the vent and slide the panel up to the closed position.

**2. DEADBOLT ASSEMBLY**

Deadbolt assembly has three positions.

– UNLOCKED position: Deadbolt is unlocked.
– LOCKED KEY OPERABLE position: Deadbolt is locked and it can be unlocked with maintenance deadbolt key. This position must be used only on ground by maintenance personnel.
– LOCKED KEY INOPERABLE position: Used by pilots to lock the door only if the main door slide latch is inoperative.

**3. MAIN DOOR SLIDE LATCH**

LOCKED position: Main door slide latch is locked.
UNLOCKED position: Main door slide latch is unlocked.

**NOTE:** If the slide latch is inoperative then pilots must lock the deadbolt at LOCKED KEY INOPERABLE position.

**4. TOP STRAP ASSEMBLY**

Top strap assembly is used only in case of emergency exit procedure. Pulling the top strap will disengage the pins.

**NOTE:** The pins must be fully engaged at all times to avoid intrusion through emergency exit.

**5. BOTTOM STRAP ASSEMBLY**

Bottom strap assembly is used only in case of emergency exit procedure.

**6. PRESSURE SENSITIVE LATCH COVER**

It covers the pressure sensitive latch and must be removed in an emergency exit procedure.

**7. PRESSURE SENSITIVE LATCH**

Pressure sensitive latch is partially and automatically released when the cockpit pressure is lower than the passengers cabin pressure.

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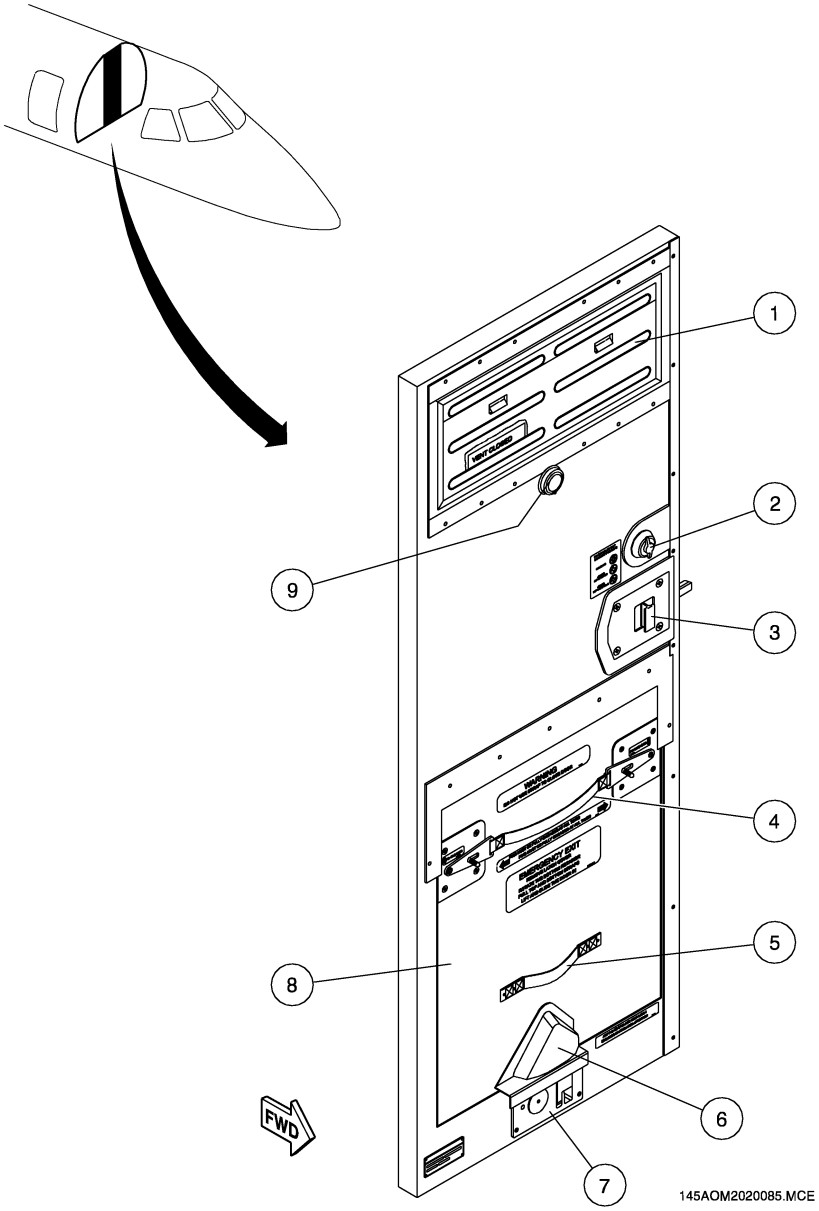


**SECURITY DOOR**

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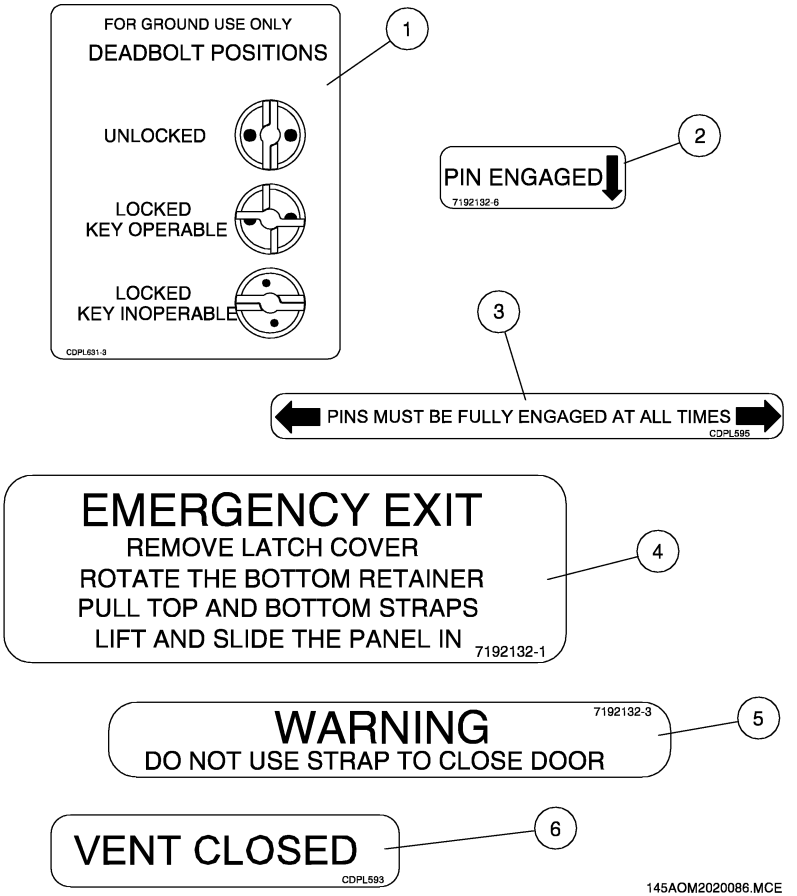
### 8. DECOMPRESSION PANEL

It is a blow out panel that is partially opened when the pressure sensitive latch is automatically released may be used as a cockpit emergency exit.

### 9. PEEPHOLE

Peephole allows crew members to observe passengers cabin side before open the door.

## SECURITY DOOR PLACARDS

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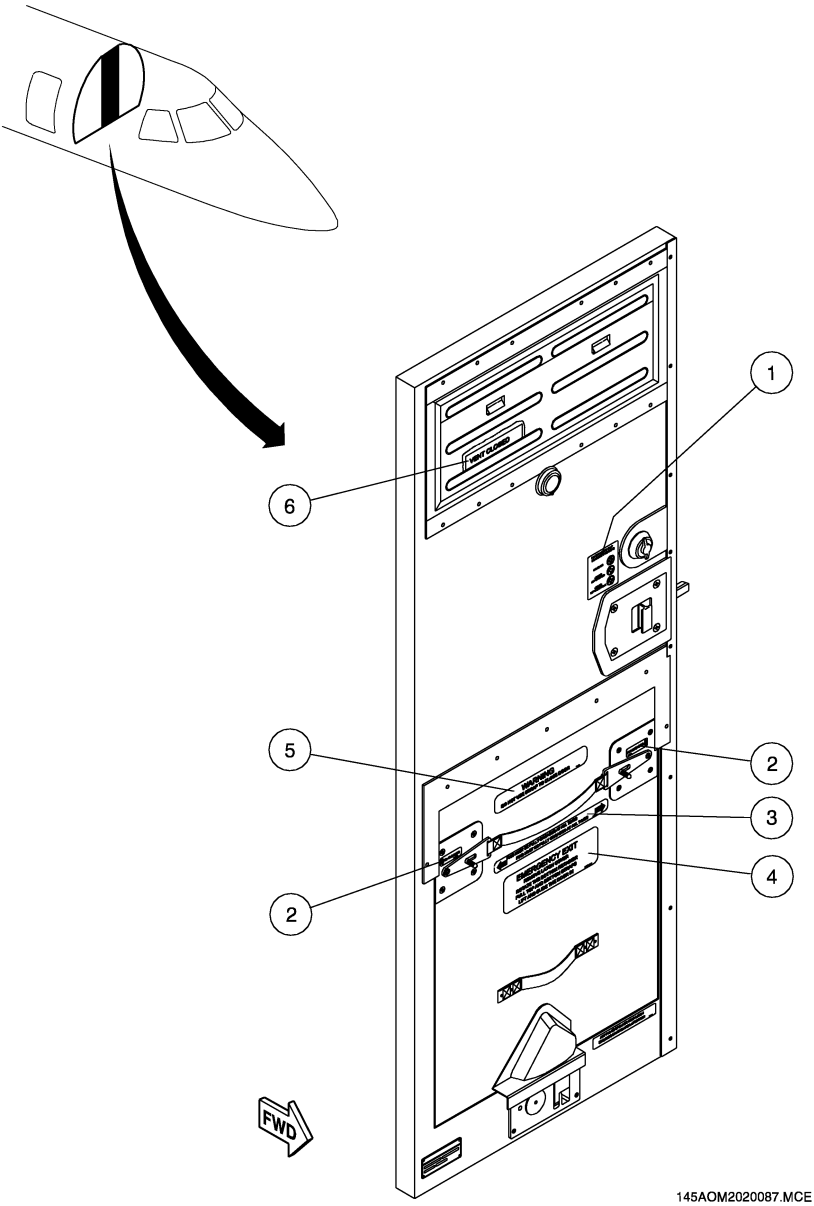


## SECURITY DOOR PLACARDS

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# VIDEO SURVEILLANCE SYSTEM (VSS)

## GENERAL

The Video Surveillance System (VSS) provides the means to monitor the entire door area outside the cockpit from either pilot's seats. It aids the flight crew with the identification of persons requesting entry to the cockpit and the detection of suspicious behavior or a potential threat.
The VSS is comprised of three video cameras and one video unit, installed in the control pedestal. The DC BUS 1 powers the VSS.

## VIDEO UNIT

Video display is achievable under all operational lighting conditions and provides sufficient resolution to clearly identify persons requesting entry into the cockpit. The images transmitted to the video display are not recorded.
The system is turned on by switching the BRT/OFF knob on the VSS video unit. The other knob selects the video camera that will transmit the image.

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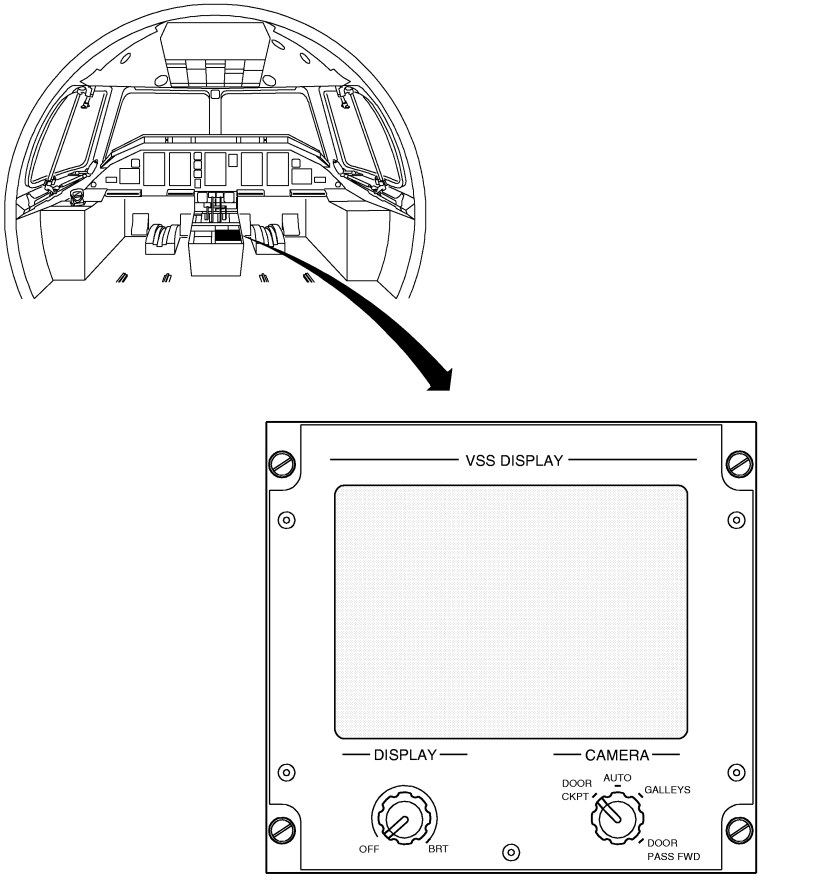


**VSS VIDEO UNIT**

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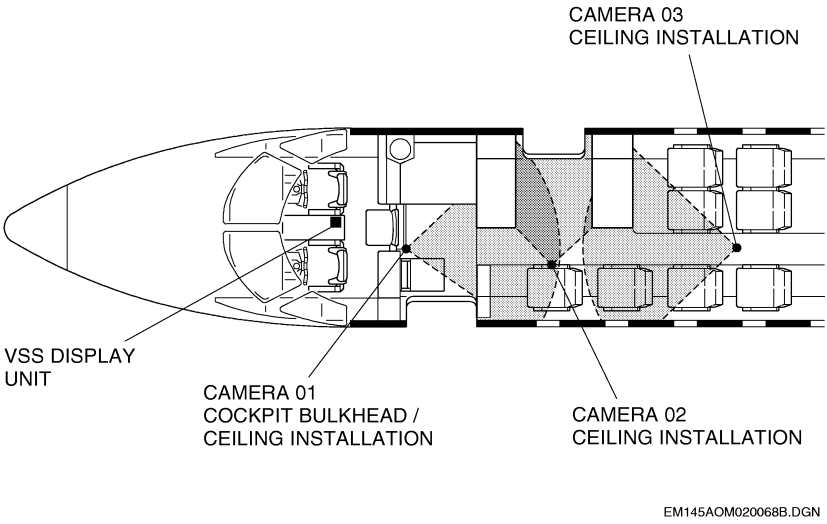
## VIDEO CAMERAS

One video camera provides images of the cockpit door area. A second video camera covers the galleys area, and a third video camera furnishes images of the forward pax doors area. The passenger seats area are not monitored.




**VSS VIDEO CAMERAS LOCATION**

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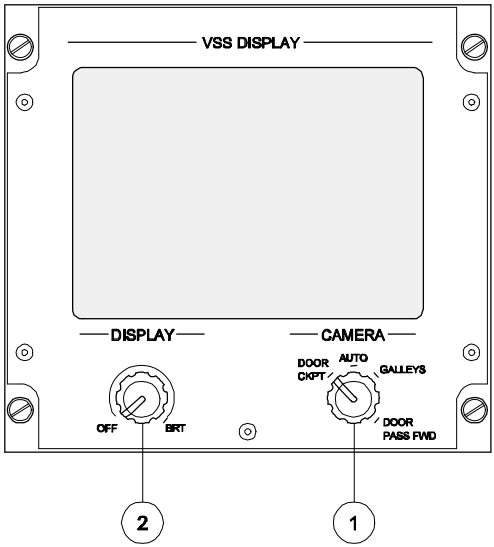
# CONTROLS AND INDICATORS

## VIDEO SURVEILLANCE SYSTEM (VSS)




### 1 – VIDEO CAMERA SELECTOR KNOB

- DOOR CKPT: furnishes images of cockpit door area.
- AUTO: automatically switches the image from one video camera to another with an interval of 3 seconds.
- GALLEYS: furnishes images of the galleys area.
- DOOR PAX FWD: furnishes images of the forward pax doors area.

### 2 – OFF/BRIGHT SELECTOR KNOB

- OFF: turns off the VSS.
- BRT: turns on the VSS and adjusts the brightness intensity.

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# LAVATORY DOOR

When the lavatory door becomes jammed or hard to open, the procedures that should followed by the cabin crew to open it from outside the lavatory can be:

– **Using the slide latch:**

Under the LAVATORY placard, which is located on the lavatory door just above the “OCCUPIED/VACANT” display, there is an alternative mechanism to unlock the door in case of difficulty to open it from inside the lavatory.

To unlock the door, the Flight Attendant must lift this placard and, holding the placard lifted, slide the latch to the left position, until the display inscription changes from “OCCUPIED” to “VACANT” (see figure on the next page). Then, the door should be opened normally.

This mechanism is the same for both Slide and Bi-fold doors.

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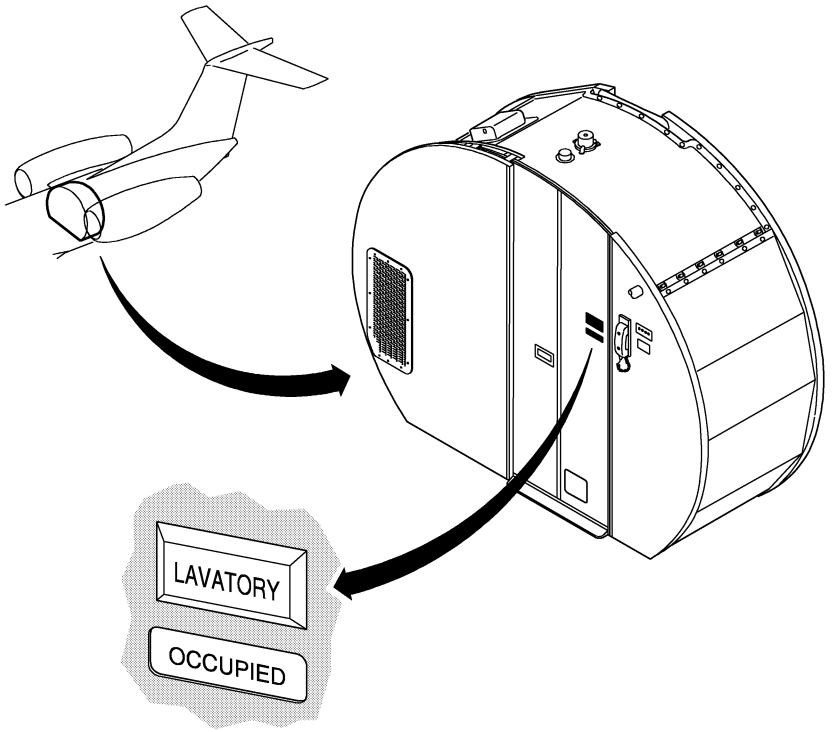


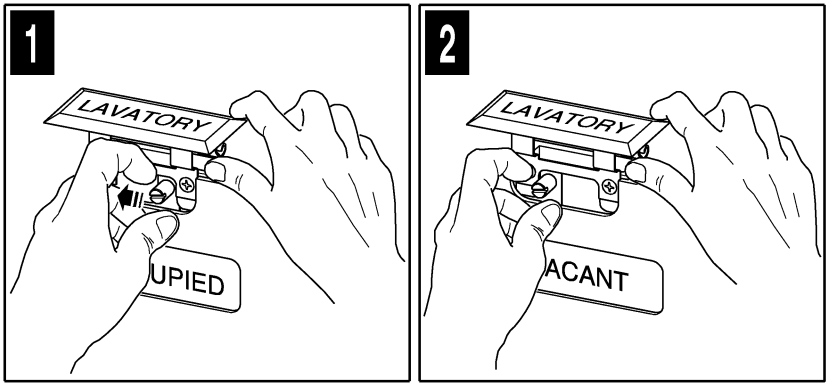


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**SLIDE LATCH**

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– **Using the cut-out access:**

For airplanes Post-Mod. SB 145-25-0287 (Slide Door) or Post-Mod. SB 145-25-0302 (Bi-fold Door) or equipped with an equivalent modification factory incorporated, there is an access box that can be used to unlock the door from outside the Lavatory.

To unlock the door, the flight attendant must remove the cover and move the rod upward and downward repeatedly.

In case of difficulty to move the rod, the flight attendant should hold the lavatory handle and move the door up and down or side to side with quick short movements, at the same time that moves the rod up and downward repeatedly until the door is unlocked (see figures on the next pages).

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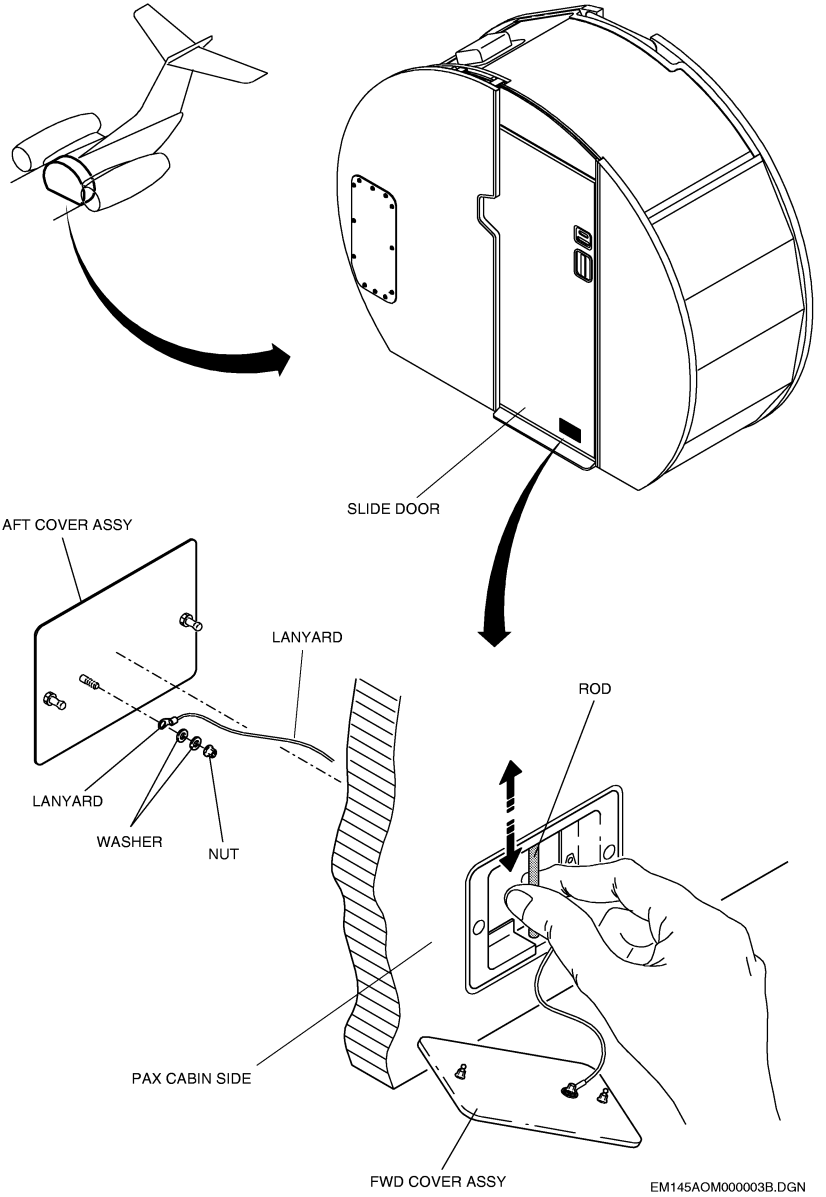


## LAVATORY SLIDE DOOR (POST-MOD. SB 145-25-0287)

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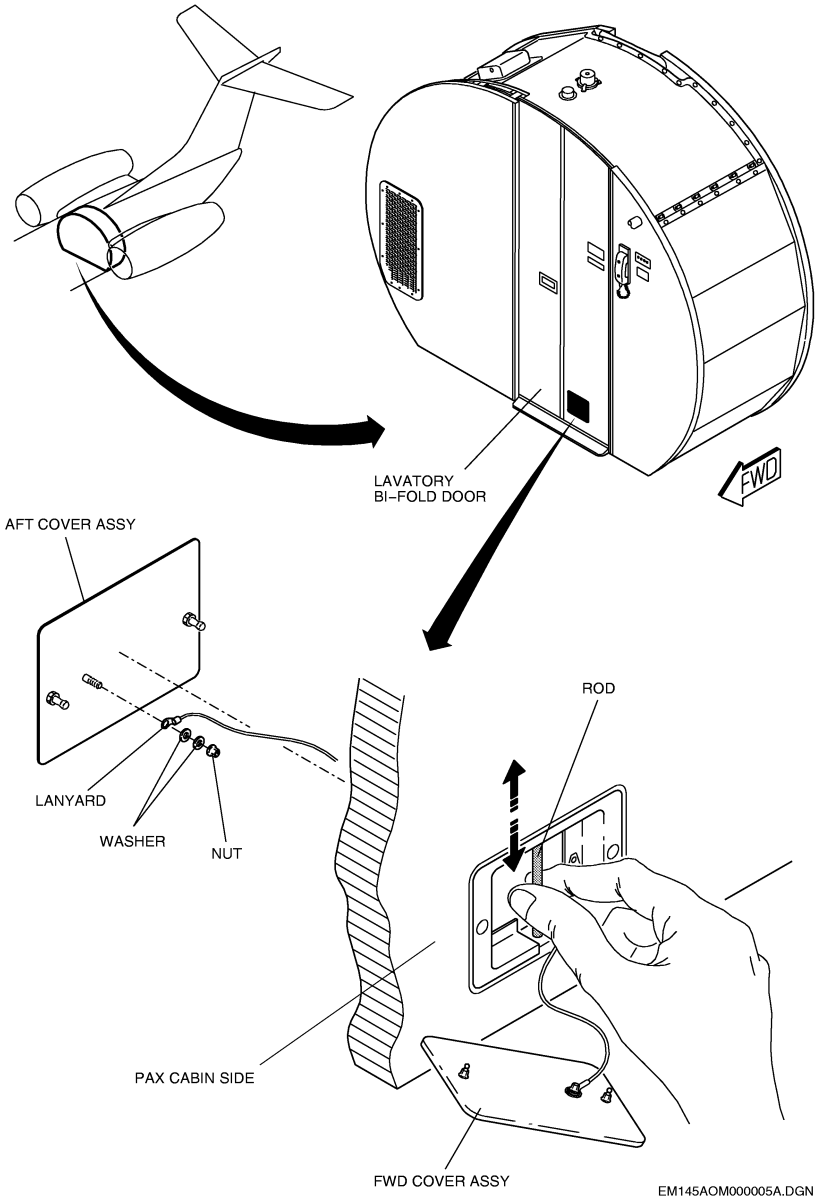


## LAVATORY BIFOLD DOOR (POST-MOD. SB 145-25-0302)

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# SECTION 2-03
# EMERGENCY EQUIPMENT

This section has been removed from this volume. For emergency information, refer to Section 1-10 in Volume 1.

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# SECTION 2-04
# CREW AWARENESS

TABLE OF CONTENTS


| | Block | Page |
|---|---|---|
| Index | 2-04-00 | 01 |
| General | 2-04-05 | 01 |
| Avionics Integration | 2-04-05 | 01 |
| Displays | 2-04-05 | 06 |
| EICAS Messages | 2-04-05 | 18 |
| Controls and Indicators | 2-04-05 | 20 |
| Built-in Test | 2-04-05 | 29 |
| Visual Warnings | 2-04-10 | 01 |
| Warning Lights | 2-04-10 | 01 |
| EICAS Messages | 2-04-10 | 02 |
| EICAS Message Dictionary | 2-04-10 | 03 |
| Displays Indications | 2-04-10 | 10 |
| Controls and Indicators | 2-04-10 | 11 |
| PFD Presentations | 2-04-13 | 01 |
| Comparison Monitors | 2-04-13 | 01 |
| Caution Annunciators | 2-04-13 | 04 |
| Warning Annunciators | 2-04-13 | 08 |
| PFD Additional Annunciators | 2-04-13 | 10 |
| Aural Warnings | 2-04-15 | 01 |
| Aural Warning Unit | 2-04-15 | 01 |
| EICAS Message | 2-04-15 | 06 |
| Takeoff Configuration Warning | 2-04-20 | 01 |
| EICAS Message | 2-04-20 | 01 |
| Controls and Indicators | 2-04-20 | 02 |
| Stall Protection System | 2-04-25 | 01 |
| General | 2-04-25 | 01 |
| EICAS Messages | 2-04-25 | 04 |
| Controls and Indicators | 2-04-25 | 05 |


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Ground Proximity Warning System ..... 2-04-30 ...01
Modes and Messages ..... 2-04-30 ...06
EGPWS Features ..... 2-04-30 ...26
Warning Priorities ..... 2-04-30 ...36
EICAS Messages ..... 2-04-30 ...37
Controls and Indicators ..... 2-04-30 ...38
Steep Approach Operation ..... 2-04-30 ...43
Windshear Detection and Escape Guidance System ..... 2-04-35 ...01
Windshear General Information ..... 2-04-35 ...01
Windshear Detection ..... 2-04-35 ...04
Windshear Escape Guidance Mode ..... 2-04-35 ...06
EICAS Message ..... 2-04-35 ...10
Controls and Indicators ..... 2-04-35 ...10
Traffic and Collision Avoidance System ..... 2-04-40 ...01
General ..... 2-04-40 ...01
System Description ..... 2-04-40 ...02
TCAS Voice Messages ..... 2-04-40 ...08
Controls and Indicators ..... 2-04-40 ...10
TCAS Test ..... 2-04-40 ...15

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# GENERAL

The EMB-145 is provided with a variety of visual, aural, and sensitive warnings to notify crew regarding systems status, malfunctions, and abnormal airplane configurations.

Alarm lights provide indication whether there is an abnormal situation. Some systems also provide indicating lights, for system status indication.

An Engine Indication and Crew Alerting System (EICAS) provides the flight crew with a three-level alerting and indications messages system: warning, caution and advisory. A fourth level is provided exclusively for maintenance purposes. Besides the five displays on the main panel, two back up displays are provided through the RMUs (Radio Management Unit). Some of the more critical messages also generate an aural warning.

Sensitive warning is available through the Stall Protection System (SPS), which shakes the control column, if an imminent stall is detected.

To aid in navigation and approach procedures, the airplane is also provided with a Ground Proximity Warning System (GPWS/EGPWS), a Traffic and Collision Avoidance System (TCAS), and a Windshear Detection and Escape Guidance System.

## AVIONICS INTEGRATION

The EMB-145 is equipped with a variety of highly integrated computers and displays, so as to reduce pilots workload while providing high reliability and redundancy. This feature is achieved by providing different paths to each type of data, thus minimizing the possibility of losing information due to failure in one computer.

The system is composed of:
- Two Integrated Computers (IC-600);
- Two Integrated Computer Configuration Modules (IM-600) (If installed);
- Two Data Acquisition Units (DAU);
- One Central Maintenance Computer (CMC);
- One Horizontal Stabilizer Control Unit (HSCU);
- Two Primary Flight Displays (PFD), two Multi-Function Display (MFD) and one Engine Indications and Crew Alerting System (EICAS) display;
- Two Radio Management Units (RMU);

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– One Tuning Backup Control Head;
– Independent Standby Instruments or one Integrated Standby Instruments System (ISIS);
– Two Integrated Navigation Computers;
– Two Integrated Communication Computers;
– Three Digital Audio Panels (DAP);
– Two Attitude and Heading Reference System (AHRS) or Two Inertial Reference System (IRS);
– Two Air Data Computers (ADC);
– One Ground Proximity Warning System (GPWS) or Enhanced Ground Proximity Warning System (EGPWS);
– One Aural Warning Unit (AWU);
– One Cockpit Voice Recorder (CVR);
– One Flight Data Recorder System (FDR);
– One or two Flight Management Systems (FMS);
– One Traffic and Collision Avoidance System (TCAS);
– One Radar System;
– One Stall Protection System (SPS).

The primary components of such integration are the IC-600 units, which exchange information with all the other components, either directly or through auxiliary computers. The IC-600s are responsible for the interface among the many airplane systems, besides managing information presented on the displays. Each IC-600 computes the received data and sends the appropriate information to the displays.

The DAUs are the central data collection points for the EICAS. DAU 1 is dedicated to collect data from the forward airplane systems and left engine. DAU 2 collects data from the aft airplane systems and right engine. Engine data is sent to the DAUs through the FADECs and directly from the engine sensors.
The discrete signals collected by the DAUs are converted into digital signals and sent to the Integrated Computer (IC-600). In the IC 600 there is a symbol generator which provides images to Display Units.
Each DAU is a dual (A and B) channel unit. Channels B on both DAUs are kept as a standby source, which must be manually selected, through the DAU reversionary button in case of a channel A DAU failure. Both IC-600s use channel A of on-side DAU as the primary source of information.

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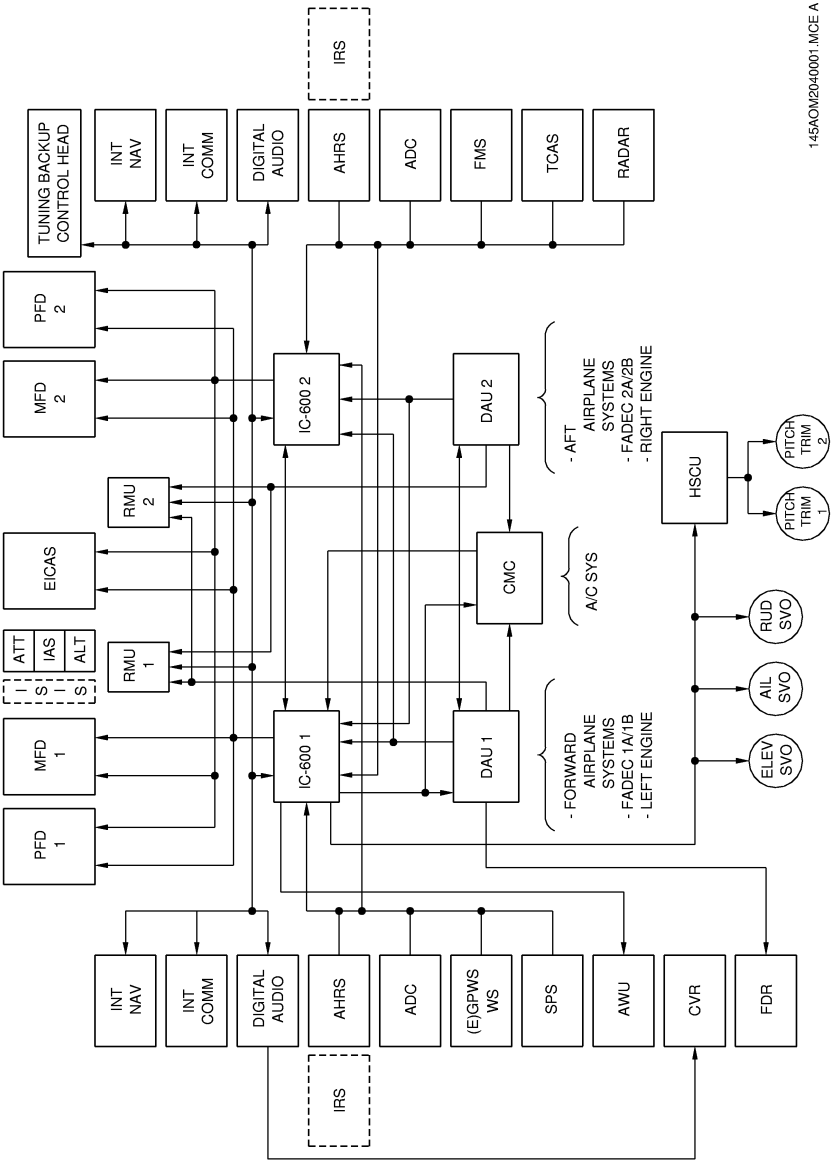


**AVIONICS INTEGRATION SCHEMATIC**

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During normal operation, information contained on PFD 1, MFD 1 and EICAS displays is provided by IC 600 # 1, while IC 600 # 2 provides images for MFD 2 and PFD 2.
Both computers interact with each other and send outputs to the Aural Warning unit to generate a tone indicating a caution or warning message when there is an abnormal situation.

If IC 600 # 1 fails, RMU # 1 displays engine backup page 1 automatically and a red X is presented on displays PFD 1, MFD 1 and EICAS. After the IC 600 # 1 failure, IC 600 # 2 can control the five displays if the Symbol Generator ("SG") button on the left reversionary panel is pressed. In this case, RMU # 1 goes back to the normal mode.

If IC 600 # 2 fails, a red X is displayed on PFD 2 and MFD 2. After the IC 600 # 2 failure, IC 600 # 1 can control the five displays if the Symbol Generator ("SG") button on the right reversionary panel is pressed. RMU # 1 remains operating normally.

If both ICs fail, besides all displays presenting a red X, RMU # 1 automatically displays engine backup page 1.

Usually, airplane configuration options are set on IC-600 through straps. If the number of installed options exceeds the maximum adjustable through the IC-600 wiring, a configuration module (IM-600) is installed. IM-600 can be installed only on airplanes equipped with EICAS 16 or later. It stores information for several airplane configurations.

On EICAS 16, an advisory CONFIG MISMATCH message appears if there is a discrepancy between the configuration information of both IM-600s in relation to both IC-600s.

On EICAS 16.5 or later, an amber CHK IC CONFIG message appears in case of discrepancy between the following data: EMB-135 or EMB 145 models, engine type, Long Range configuration, or English/Metric units. The CONFIG MISMATCH message is also active in case of discrepancy of the other parameters that do not trigger off the CHK IC CONFIG message .

On EICAS 19, the message DAU AC ID MISCMP was incorporated to inform a mismatch between the DAU 1 and DAU 2 configuration inputs regarding airplane type.

If a IM-600 failure occurs, the IC-600 will use the last data read from that source (when it was still working), and an advisory IC CONFIG FAIL message will appear.

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## DISPLAYS

Five Cathode Ray Tube (CRT) displays are provided to present information to the flight crew, as follows:

- Two Primary Flight Displays (PFD) on the pilot and copilot panel.
- Two Multi-Function Displays (MFD) on the pilot and copilot panel.
- One EICAS display on the center panel.

In addition, the Radio Management Unit (RMU) displays on the control pedestal forward panel may be used as a back-up for the main panel displays.

The displays themselves are identical and interchangeable. The control panel installed just below each display, except for the RMUs, allows controlling some of the associated display features.

In case of failure of one display, its information may be presented in one of the remaining operative displays.

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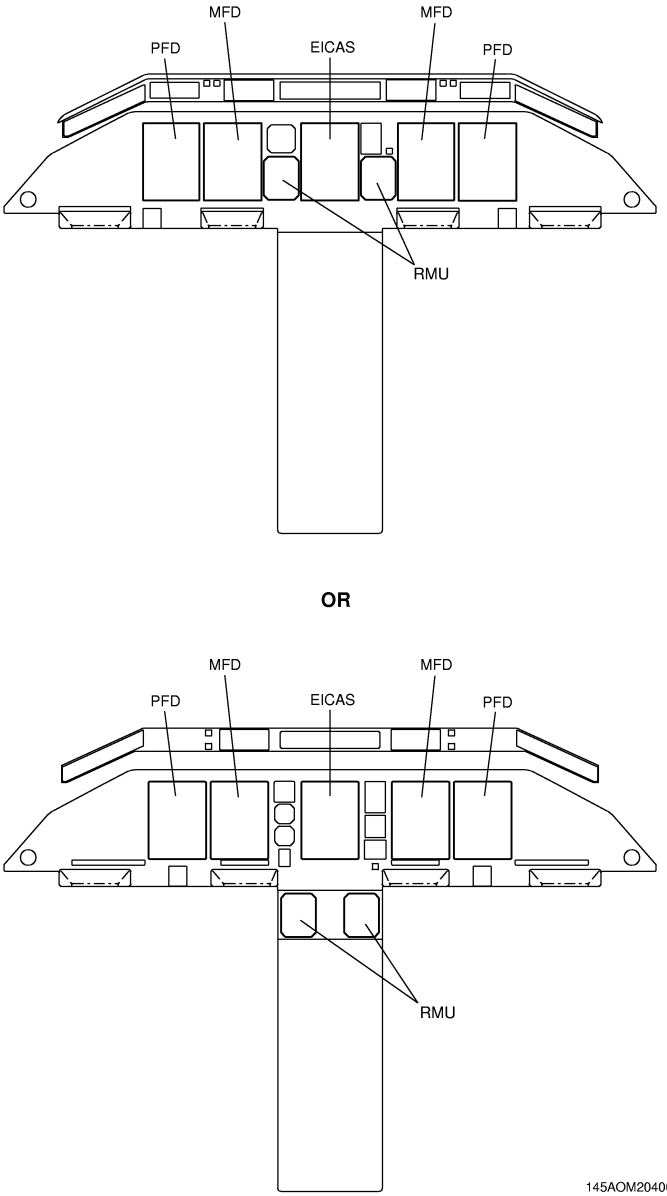


## AIRPLANE DISPLAYS

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## PRIMARY FLIGHT DISPLAY (PFD)

The PFD is the primary pilots instrument. It presents the information formerly presented in a variety of instruments such as airspeed indicator, altitude indicator, ADI, HSI, vertical speed indicator. The PFD further provides radio aids, autopilot, flight director, yaw damper and radio altitude information. For further information on these parameters, refer to Sections 2-17 – Flight Instruments, 2-18 – Navigation and Communication, and 2-19 – Autopilot.

The PFD is divided into sections, each one presenting one group of information.

The PFD bezel incorporates an inclinometer, buttons and a knob for barometric settings.

In case of a display failure, information may be presented on the MFD by appropriately setting the MFD selector knob on the reversionary panel.

The RMU is also able to present PFD information (refer to Section 2-18 - Navigation and Communication for further details about this feature).

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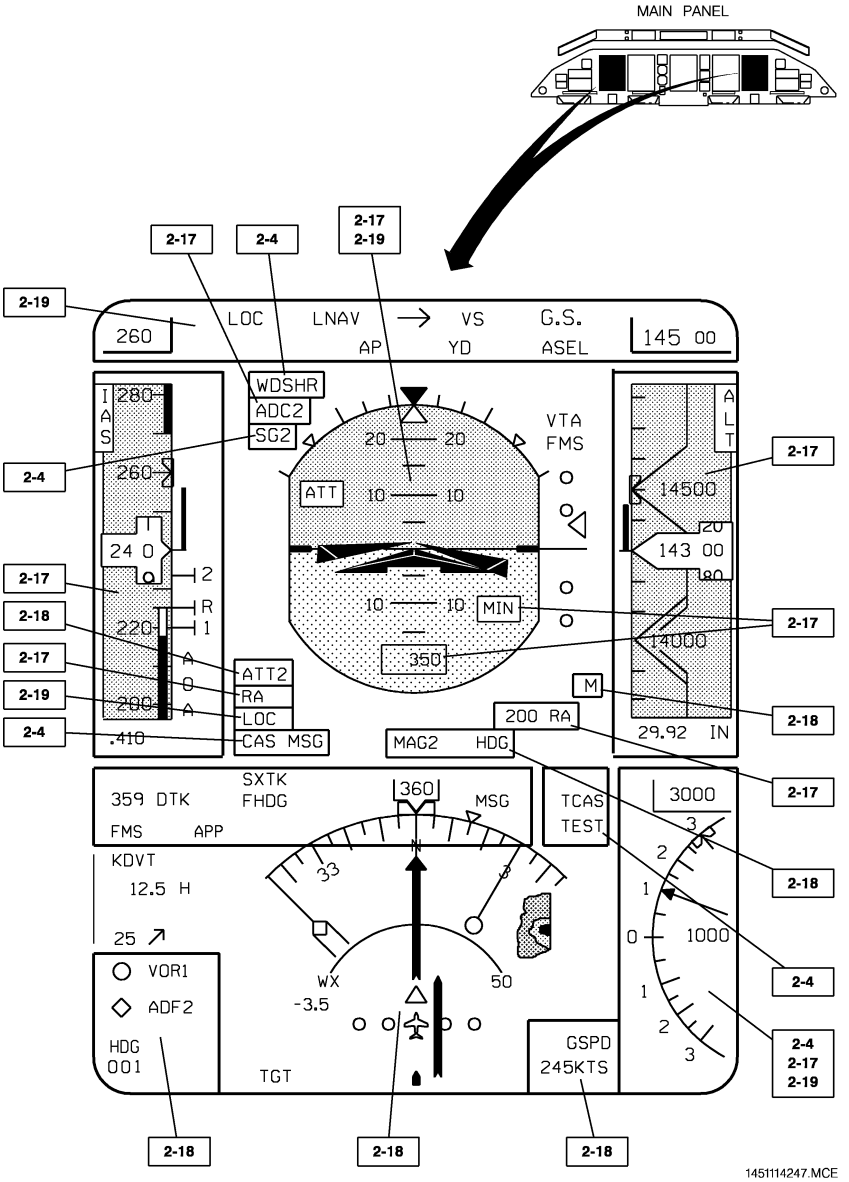


**NOTE:** Number inside boxes refer to Operations Manual Section where information concerning the associated item can be found.

**PFD DISPLAY SCHEMATIC**

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## MULTI FUNCTION DISPLAY (MFD)

The Multi Function Display (MFD) presents radar, TCAS, FMS, CMC and other navigation information and systems pages. There are five system pages available:

- Fuel: provides fuel system parameters and status.
- Electrical: provides electrical system parameters and status.
- Environmental and Ice Protection: provides air conditioning, pneumatics, oxygen, and ice and rain protection systems parameters and status.
- Hydraulic and Brakes: provides hydraulic and brakes systems and status.
- Takeoff: provides takeoff temperature settings, oil level and doors status.

For further information on system pages, refer to each associated system description.

The MFD may operate in three different presentation modes, besides the reversionary ones. The Map and Plan modes present navigation information. For further information on these, refer to Section 2-18 - Navigation and Communication. The maintenance mode permits access to maintenance messages, but is available only on the left MFD for maintenance personnel when the airplane is on ground.

Selection of the different modes and pages may be made by using the controls located on the display bezel. Button functions are indicated in the menus presented in the lower part of the display, just above each button. Each button function changes, depending on which menu has been selected. Menu selection is made by using the buttons themselves. If required, radar modes and TCAS information may be shown.

The MFD also operates as a back-up display for either PFD or EICAS, in case of such displays failure. Appropriate selections may be made through the reversionary panel.

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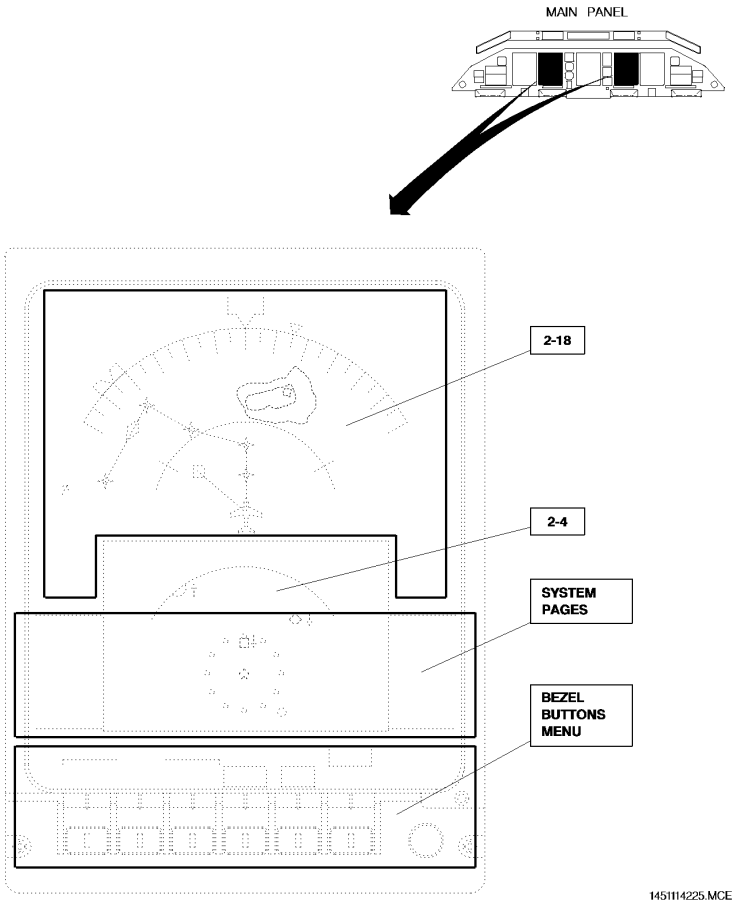


**NOTE:** Number inside boxes refer to Operations Manual Section where information concerning the associated item can be found.

**MFD DISPLAY SCHEMATIC**

## EICAS DISPLAY

The EICAS display presents analogic engine indications and some systems parameters like flaps, landing gear, spoilers and trim positions, total fuel quantity, APU and environmental information.

In the upper right corner, the EICAS display presents crew awareness messages:

- Warning messages, red colored and always presented on the top of the list.
- Caution messages, amber colored and presented after warning messages.
- Advisory messages, cyan colored and presented after caution messages.

For further information on engine indications presented in the upper left corner, refer to Section 2-10 – Powerplant. For information on EICAS Messages, refer to the item Visual Warnings (Section 2-04-10).

In case of failure in the EICAS display, its information may be presented on the MFD, by appropriately setting the MFD selector knob on the reversionary panel. The RMU is also capable of presenting some EICAS information, should the need arise.

The EICAS bezel is provided with a knob to scroll messages if the system generates more messages than the display can present at once.

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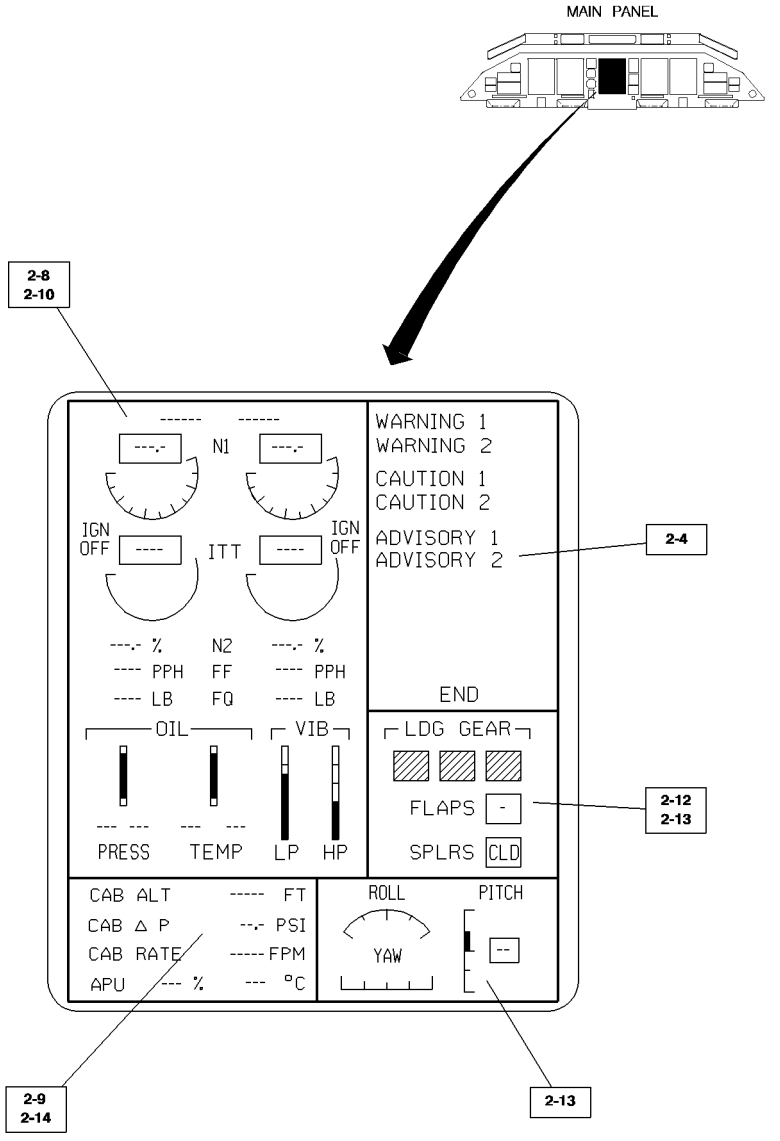


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**NOTE:** Number inside boxes refer to Operations Manual Section where information concerning associated item can be found.

**EICAS DISPLAY SCHEMATIC**

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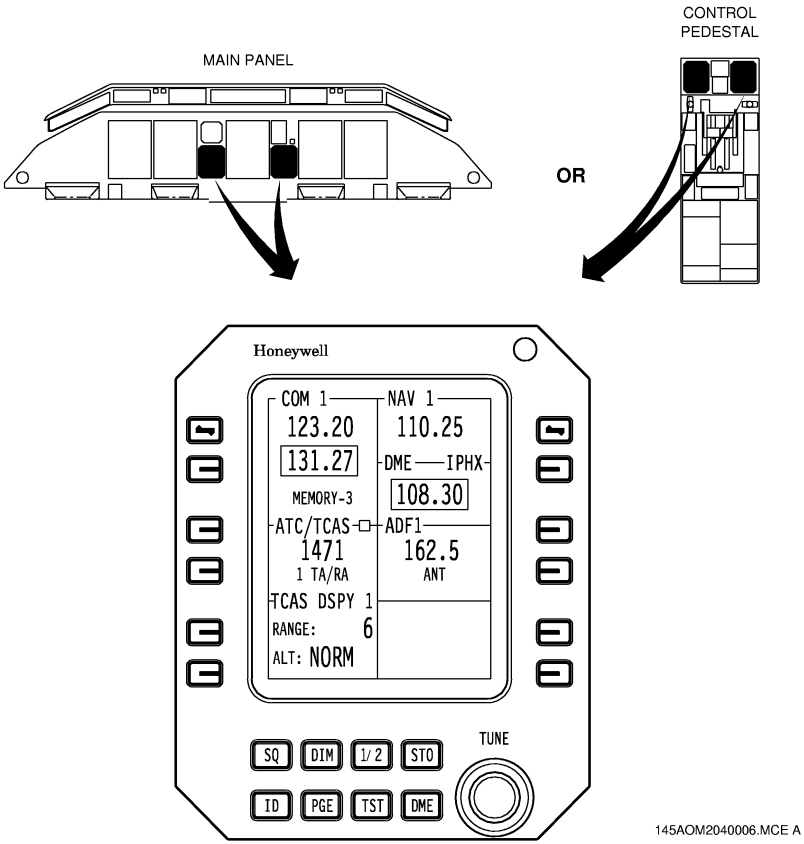
## RADIO MANAGEMENT UNIT

The Radio Management Unit (RMU) is provided for radio controlling purposes, but may be used as a back-up for PFDs, MFDs and EICAS. The RMU display presents settings and modes for each radio (NAV and COMM), transponder, and TCAS. In case of failure of the main panel displays, the RMU may be selected to present navigation, engine or systems information, as well as some EICAS messages. The information presentation however may change, due to the size of the RMU display. Also, some items of information may not be presented to avoid display overload. For further information on RMU features, refer to Section 2-18 – Navigation and Communication.




**RMU DISPLAY EXAMPLE**

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## NORMAL OPERATION

When the airplane is first energized, the system performs a self-test to check abnormal conditions in the displays.

On power up, the displays default information are the following:

- PFD: presents EADI, EHSI, airspeed, altitude, radio altitude, vertical speed scales, flight director mode, autopilot and yaw damper status.
- MFD: presents takeoff page, system menu and navigation data in Map format. This information is supplied as follows:
  - MFD 1: supplied by channel A of both DAUs through IC-600 # 1.
  - MFD 2: supplied by channel A of both DAUs through IC-600 # 2.
- EICAS: presents engine and fuel indications, crew awareness messages (if any), landing gear, flaps, spoilers, pressurization, APU and trims status. This information is supplied by channel A of both DAUs through IC-600 # 1.

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## FAILURE MODES

The system is developed to avoid absence of information in most of the failure combinations.

The failures that may affect the crew awareness system are associated with electrical power supply or computer malfunctions. In both cases, the system architecture is such that only major failures will lead to loss of information presentation. Even in this condition, crew will still have essential data available to safely continue the flight, using standby instruments.

### ELECTRICAL SYSTEM FAILURES

Each display is supplied in such a way that in case of failure in one or more electric buses, the remaining buses will still be supplying one or more displays.
This feature is achieved by supplying all displays with four different buses (two DC Buses and two Essential buses). Furthermore, each pair of duplicated displays (PFDs, MFDs, and RMUs) are supplied by different buses, one for each display.

### COMPUTER FAILURES

Since both IC-600s receive data from duplicated sources, a single failure will not lead to loss of information addressed to the flight crew. In case of any source failure, the reversionary panel permits shifting between existing sources, thus using cross side information. This feature may be used only when the system is not capable of providing information through normal means.

### DISPLAYS FAILURES

In case of any failure in the PFD or EICAS displays, the corresponding information may be presented in one of the remaining displays, by using the reversionary panel. The MFD may present other display information, but its data may not be presented in the remaining displays.

If all displays are lost, the RMU is capable of providing essential flight data.

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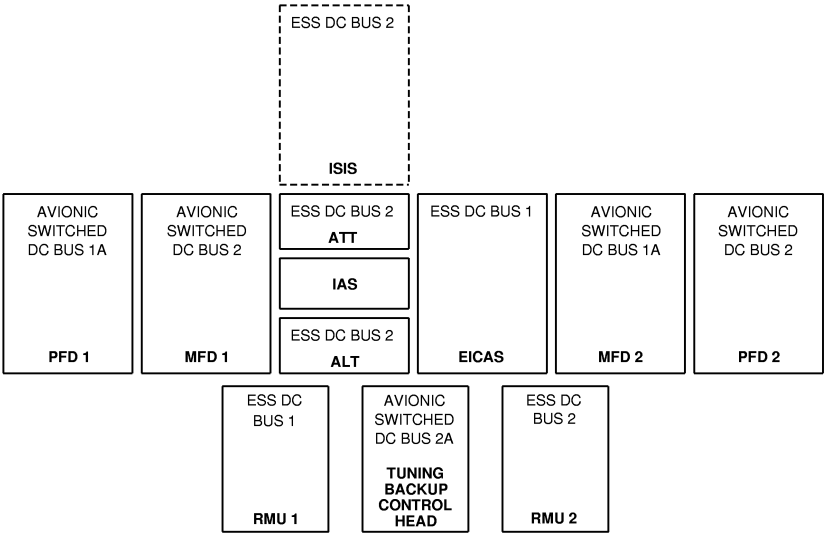


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## DISPLAYS SUPPLYING SCHEMATIC

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## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | DAU 1 (2) ENG MISCOMP | N1, N2, ITT engine parameters read from both engines are not matching. |
| | DAU 1 (2) SYS MISCOMP | Systems parameters for system pages generation are not matching. |
| | DAU 1 (2) WRN MISCOMP | Discrete signals for warning messages generation read from the many systems are not matching. |
| | DAU 1 (2) A FAIL | Associated DAU channel A has failed. |
| | DAU AC ID MISCMP | Mismatch between DAU 1 and DAU 2 configuration inputs regarding aircraft type. |
| | IC 1 (2) OVERHEAT | Associated temperature of the IC-600 is too high. |
| | IC BUS FAIL | A failure in the Interconnection Bus has been detected. |
| | IC 1 (2) WOW INOP | ICs/Weight - On - Wheels interface not working properly. |
| | CHECK PFD 1 (2) | A miscomparison on the associated PFD bus has been detected. |
| | CHECK IC 1 (2) SW | Updating error on IC-600. |
| | CHK IC CONFIG | Configuration module mismatch (airplane model, engine type, LR version, and units). |

(Continued)

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(Continued)

| TYPE | MESSAGE | MEANING |
|---|---|---|
| ADVISORY | CONFIG MISMATCH (if applicable) | For EICAS 16, means mismatch of any configuration between both IM-600s. For EICAS 16.5 or later, means mismatch of any of the configurations stored in the IM-600 modules except those considered in the CHK IC CONFIG logic. |
| | DAU 1 (2) B FAIL | Associated DAU channel B has failed. |
| | DAU 1 (2) REVERSION | Associated DAU has been commanded to operate with channel B mode. |
| | CMC FAIL | CMC has failed. |
| | IC 1 (2) CONFIG FAIL | A failure in the configuration module of the IC has been detected. |
| | DU 1 (2, 3, 4, 5) FAN FAIL | Associated display fan has failed. |
| | DU 1 (2, 3, 4, 5) OVHT | Associated display unit temperature is too high. |
| | IC 1 (2) FAN FAIL | Associated IC fan has failed. |

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# CONTROLS AND INDICATORS

## PFD BEZEL

Provides controls that allow barometric settings in the PFD. For further information, refer to Section 2-17 - Flight Instruments.

## MFD BEZEL

MAIN MENU

1 - SYSTEM BUTTON
- Selects system menu.
- If TCAS window is being displayed, it will be replaced by the previously selected system page.

2 - MFD BUTTON
- Selects MFD menu.

3 - CHECKLIST BUTTON
- This function is not enabled.

4 - TCAS BUTTON
- Selects TCAS information to be presented on the MFD. For further information refer to item TCAS presented in this section.
- If TCAS is already selected, pressing the button restores the previously selected system page.

5 - WEATHER RADAR BUTTON
- Selects weather radar information to be presented on the MFD. For further information on weather radar, refer to Section 2-18 - Navigation and Communication.

6 - MAP PLAN BUTTON
- When the radar is being displayed, enables the Map format for radar presentation. For further information on weather radar, refer to Section 2-18 – Navigation and Communication.

7 - MAP/PLAN RANGE KNOB
- Allows setting the Map format range that is displayed on the MFD. For further information on this feature, refer to Section 2-18 – Navigation and Communication.
- Except for the SPDS menu, this knob function is available in all menus.

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SYS SUBMENU

1 - RETURN BUTTON
- Returns to the main menu.

2 - TAKEOFF PAGE BUTTON
- Selects the takeoff page to be presented on the MFD. For further information on this page refer to Section 2-2 – Equipment and Furnishings and Section 2-10 – Powerplant.

3 - ENVIRONMENTAL CONTROL SYSTEM AND PNEUMATIC PAGE BUTTON
- Selects the environmental control system and pneumatic page to be presented on the MFD. For further information on this page refer to Sections 2-14 – Pneumatics, Air Conditioning and Pressurization and Section 2-16 – Oxygen.

4 - FUEL SYSTEM PAGE BUTTON
- Selects the fuel system page to be presented on the MFD.
- When fuel system page is being displayed, button function changes.
- For further information on this page refer to Section 2-8 – Fuel.

5 - HYDRAULIC PAGE BUTTON
- Selects the hydraulic page to be presented on the MFD. For further information on this page refer to Section 2-11– Hydraulic.

6 - ELECTRICAL SYSTEM PAGE BUTTON
- Selects the electrical system page to be presented on the MFD. For further information on this page refer to Section 2-5 – Electrical.

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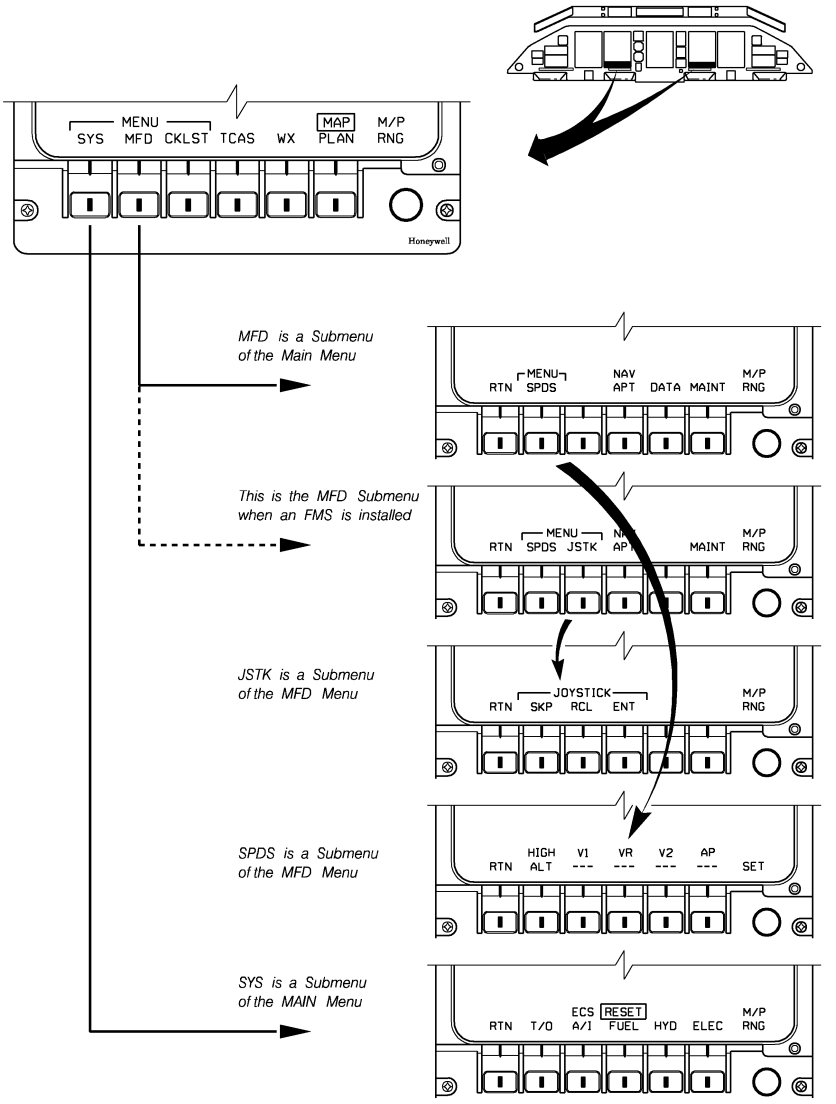


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## MFD BEZEL BUTTON MENU TREE

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MFD SUBMENU

1 - RETURN BUTTON
- Returns to the main menu.

2 - REFERENCE SPEEDS BUTTON
- Selects SPDS menu. For further information on this menu, refer to Section 2-17 – Flight Instruments.

3 - JOYSTICK BUTTON
- **NOTE**: This function is available only when the FMS is installed.
- Selects JSTK menu. For further information on this menu, refer to Section 2-18 – Navigation and Communication.

4 - AIRPORT AND NAVIGATION AIDS BUTTON
- Provides selection and toggling of airport and navigation aids displays on the MFD. For further information on this feature, refer to Section 2-18 – Navigation and Communication.

5 - DATA BUTTON
- Provides selection and toggling of waypoint identifier displays on the MFD. For further information on this feature, refer to Section 2-18 – Navigation and Communication.

6 - MAINTENANCE SELECTION BUTTON (LEFT MFD ONLY)
- Presents maintenance messages on MFD.
- Function is available only on the ground.

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## EICAS BEZEL

Provides a knob to allow EICAS messages scrolling. For further information, refer to Visual Warnings in this Section.

## REVERSIONARY PANEL

### 1 - MFD SELECTOR KNOB

PFD - presents on the MFD the information normally presented on the PFD. The PFD bezel button remains their normal function.

NORMAL - Normal MFD operation mode.

EICAS - presents on the MFD the information normally presented on the EICAS.

### 2 - ADC BUTTON

- Changes the ADC information from the on-side ADC to the cross-side ADC.
- A striped bar illuminates inside the button to indicate that it is pressed.

### 3 - AHRS/IRS BUTTON

- Changes the attitude and heading source from the on-side AHRS/IRS to the cross-side AHRS/IRS.
- A striped bar illuminates inside the button to indicate that it is pressed.

### 4 - SYMBOL GENERATOR BUTTON

- Changes the symbol generator from the on-side SG to the cross-side Symbol Generator as well ADC and AHRS.
- A striped bar illuminates inside the button to indicate that it is pressed.

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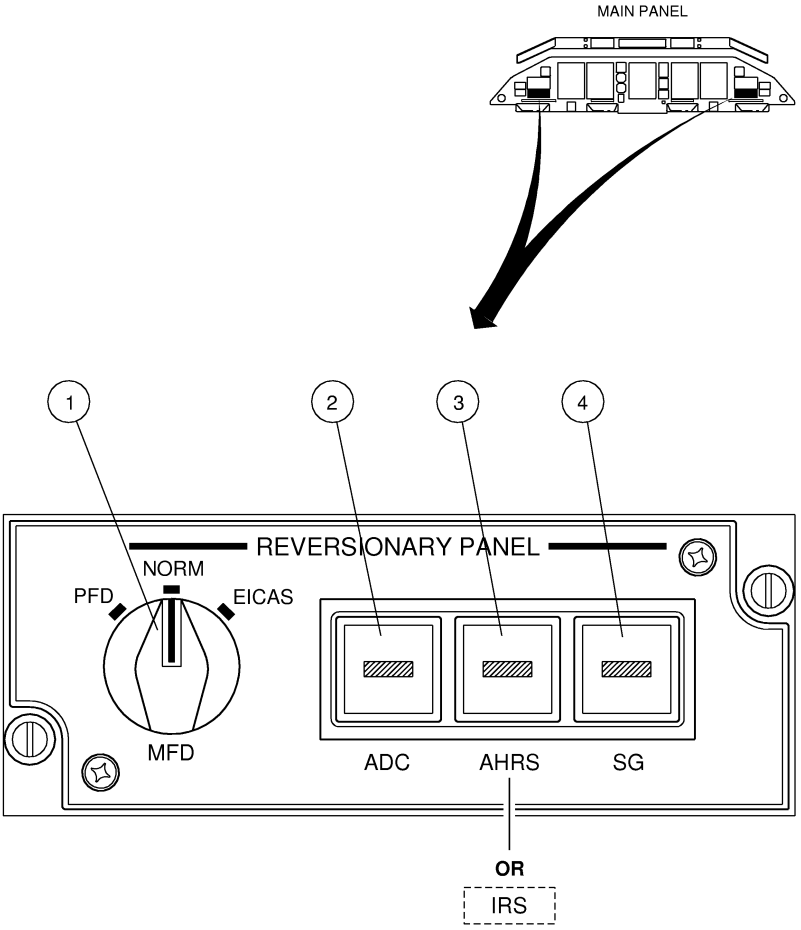


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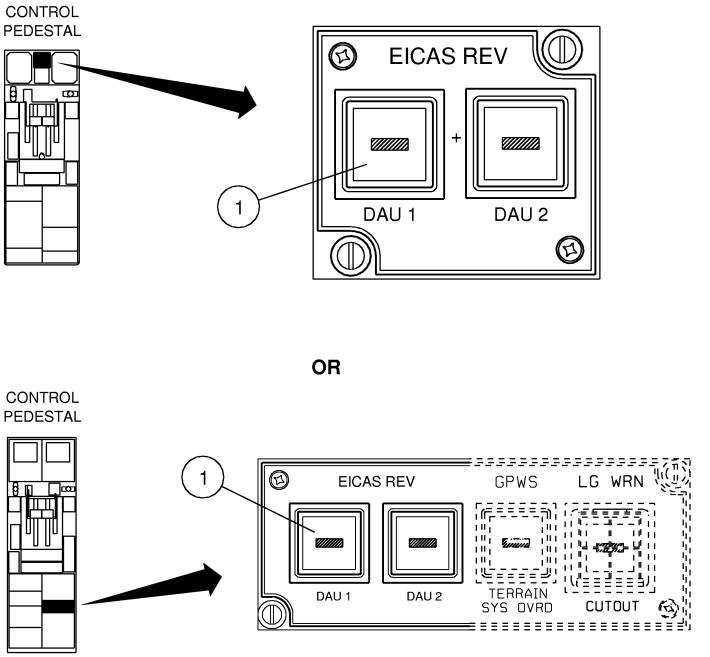
## REVERSIONARY PANEL

## EICAS REVERSIONARY PANEL

### 1 - DAU REVERSIONARY BUTTON

- Allows channel B of associated DAU to supply both IC-600s.
- A striped bar is illuminated inside the button to indicate that it is pressed and that channel B is the current data source.

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**EICAS REVERSIONARY PANEL**

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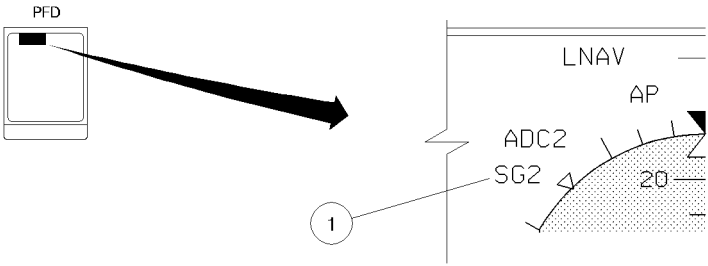
## PRIMARY FLIGHT DISPLAY

### 1 - SYMBOL GENERATOR REVERSION ANNUNCIATION

- Indicates that a symbol generator reversion has been selected on the reversionary panel.
- Presented on both PFDs.
- Labels: SG1 for IC-600 # 1 and SG2 for IC-600 # 2.
- Color: amber

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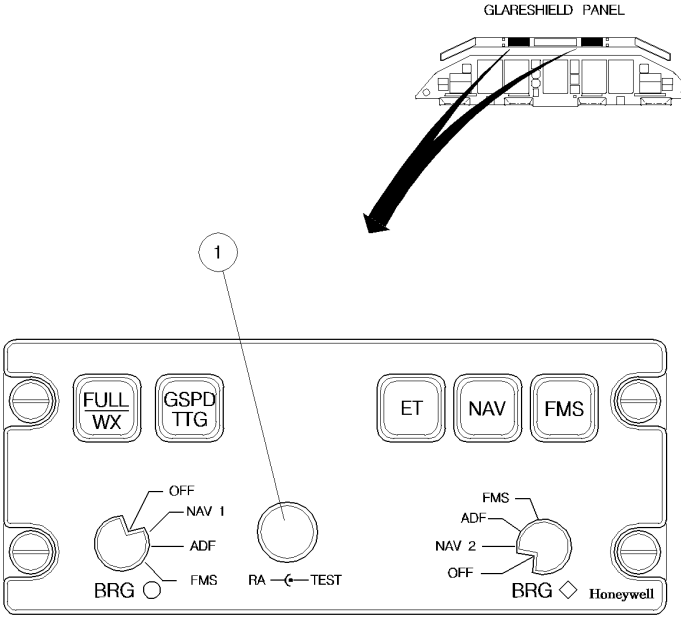
## DISPLAYS CONTROL PANEL

**NOTE:** For further information on displays control panel, refer to Sections 2-17 – Flight Instruments and 2-18 – Navigation and Communication .

### 1 - TEST BUTTON

- On the ground:
  - When pressed, activates the IC-600s first level test.
  - When pressed for more than 6 seconds activates the IC 600s second level test.
  - When released, normal operation of IC-600s is resumed.

- In flight:
  Refer to Radio Altimeter description on Section 2-17 – Flight Instruments.

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## BUILT-IN TEST

There are 3 kinds of Built-In-Tests (BIT) that the IC-600 may perform: power up BIT, continuous BIT and pilot initiated BIT. All of them check the software and hardware integrity and operation.

### POWER UP BIT

The power up BIT checks the power supply, IC-600 interfaces, memories, autopilot engagement and disengagement, and autopilot servos.

### CONTINUOUS BIT

Memories and processors tests are continuously performed after the power up BIT, as well as autopilot functions.

### PILOT INITIATED BIT

A pilot initiated BIT may be commanded by pressing the TEST button in the displays control panel. This test may be commanded on the ground only and is divided into two levels. The first level is indicated on airplane displays, which present the failure mode annunciations.
The second level is activated if the TEST button is held pressed, and checks the IC-600 internal interfaces. The test results are displayed on the PFD, which alternates every 10 seconds between internal and external test results pages.
To perform the IC-600 test is necessary to press the TEST button at co-localized display control panel.

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The PFD first level test indications are as follows:

- A magenta TEST is displayed in upper left center of the PFD.
- Indications removed: all bugs, flight director information, all pointers, low airspeed awareness, take-off speed bugs and digital readouts, $V_{MO}/M_{MO}$, and trend vectors.
- Indications forced: all comparison monitors, all marker beacons, and windshear annunciation.
- Indications presented as invalid: pitch and roll, vertical and lateral deviations, baro correction, vertical speed set digital readout, altitude preselect, heading, distance digital readout, ground speed (or time to go or elapsed time), selected heading and course (or desired track), Mach, airspeed, airspeed set digital readout, altitude.
- If heading is valid upon test activation, its source annunciation will remain valid (DG1 or 2 or MAG1 or 2). If heading is invalid, its source annunciation will change to HDG1 or HDG2.

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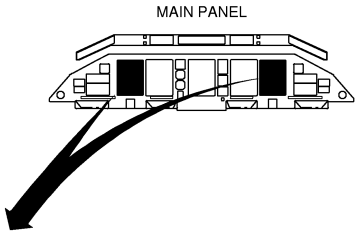


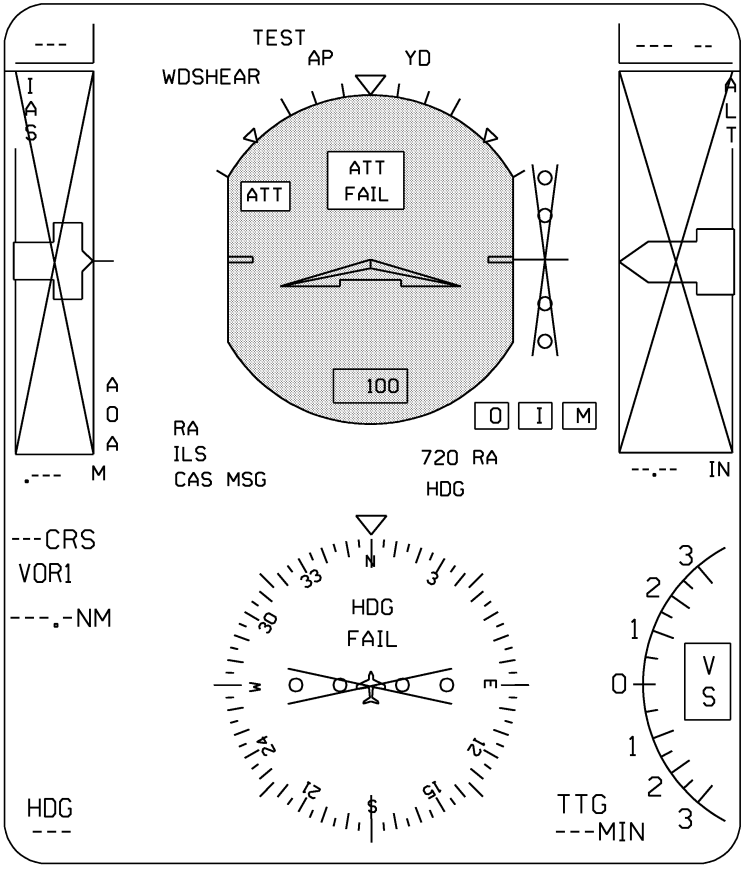


145AOM2040014.MCE

## PFD TEST INDICATIONS - FIRST LEVEL

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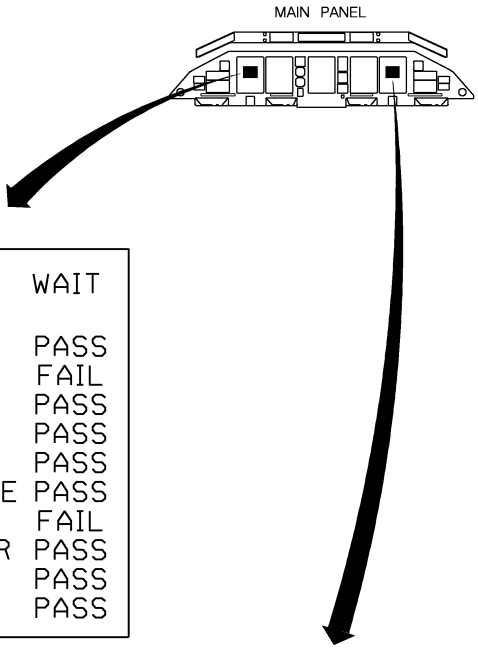


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**PFD TEST INDICATIONS - SECOND LEVEL**

The MFD test indications are as follows:

- Indications removed: heading source, TCAS, weather patch, drift bug, wind vector, heading select bug, flight plan data, airports, navaids, designator information.
- Indications forced: TERRAIN FAIL, EICAS CHK, WX TERRAIN, MENU INOP, HDG FAIL.
- Indications presented as invalid: heading, weather radar tilt, SAT, true airspeed, ground speed, distance and time to waypoint.

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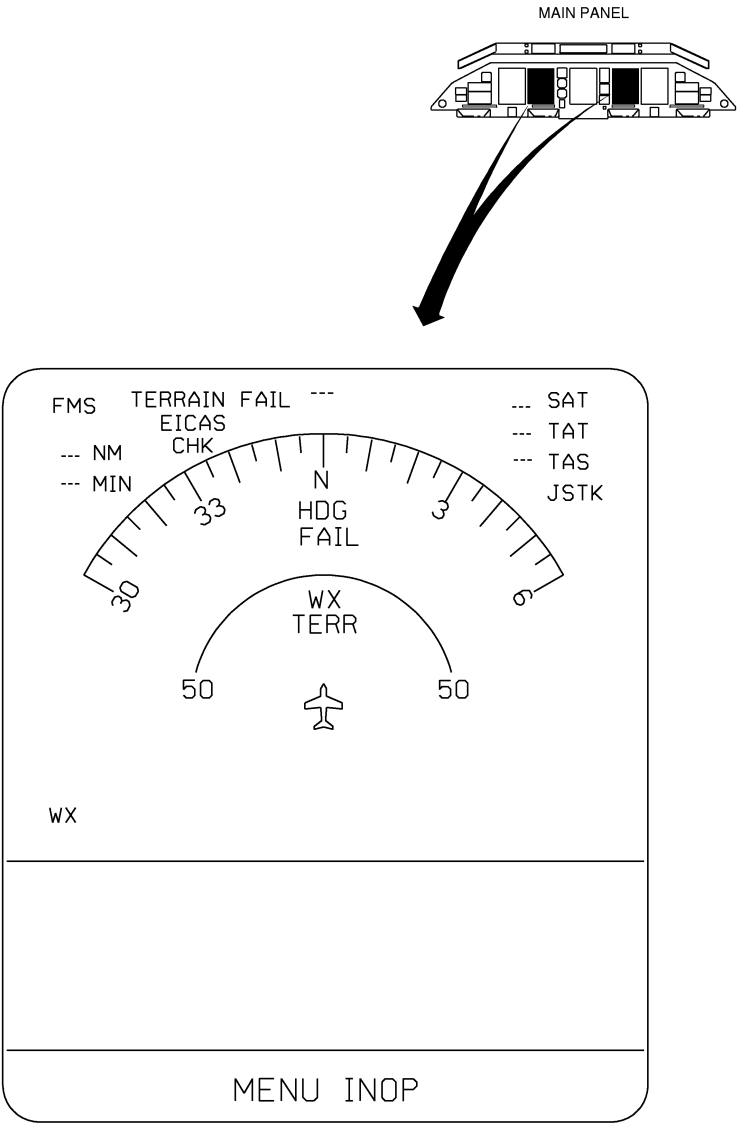


145AOM2040016.MCE A

**MFD TEST INDICATIONS**

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The EICAS test is commanded only from the pilot's panel, and its indications are as follows:

- Indications removed: reversion, ignition, FADEC in control, all engine and trim bugs.
- Indications forced: the crew awareness field will be filled with a "X".
- Indications presented as invalid: landing gear status, N1, N2, ITT, fuel flow and quantity, oil pressure, temperature and quantity, vibration for LP and HP, flaps, spoilers, all cabin and APU parameters, all trim values.

During IC-600 # 1 first level pilot initiated BIT, RMU 1 will display the first page of standby engine indication. The RMU 2 is not included in the IC-600 # 2 first level pilot initiated BIT.

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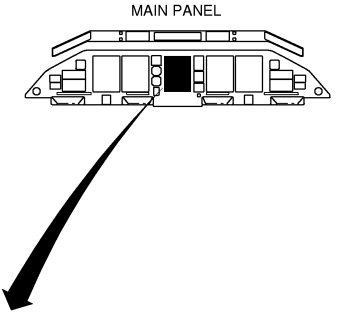


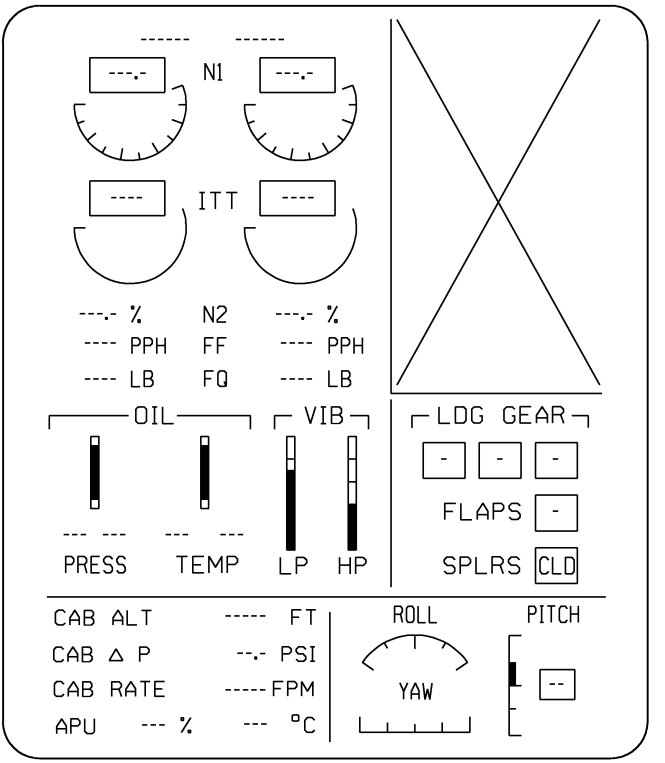


145AOM2040078.MCE

## EICAS TEST INDICATIONS

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# VISUAL WARNINGS

Visual warnings are provided through lights, illuminated buttons, EICAS messages and displays indications.

## WARNING LIGHTS

Some of the airplane systems are actuated by illuminated buttons. When under normal operating conditions, such buttons are not illuminated. If the pilot has commanded the button to a position that requires crew attention, a striped bar is illuminated inside the button. There are some exceptions such as the windshield heating, the GPU, the ice protection wing and stab, and the APU bleed buttons, which are illuminated under normal operating conditions.

Some systems also provide indicating lights, for system status indication. Further details on such lights are provided in the associated systems description section.

Master warning and caution lights are installed on each pilot glareshield panel. Such lights blink when any warning or caution message is presented on the EICAS or generated in the Aural Warning Unit (AWU). To stop blinking, pilots must press the associated light. To find information on illuminated buttons and any specific warning light, refer to the associated system's description.

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# EICAS MESSAGES

EICAS messages are presented in the upper right corner of the EICAS display. In case of a simultaneous failure in the EICAS and MFD displays, the RMUs are capable of presenting some messages.

## EICAS MESSAGES LEVELS

There are three message levels: warning, caution, and advisory:

- **Warning** messages are red colored and require immediate crew action. Warning messages are always presented on the top of the list, in the same order they are generated.
- **Caution** messages are amber colored and require immediate crew awareness. They follow warning in criticality level and in display presentation.
- **Advisory** messages are cyan and are dedicated to minor failures or system status. Advisory messages are displayed below caution messages.

A fourth level is provided for maintenance purposes, but it is not presented to the flight crew, and its access can only be made on the ground.

When the message is generated, it is displayed blinking at the top of the associated group. To stop blinking, press the associated master button on the glareshield. Advisory messages will stop blinking after 5 seconds.

## EICAS MESSAGES PRIORITY LOGIC

If more than one message is simultaneously presented, warning will precede caution messages, which will precede advisories. The space is provided for the simultaneous display of up to 15 messages. An END label is provided after the last message, to indicate end of message listing. If more than 15 messages are being generated, a knob in the display bezel permits paging through the remaining messages. In this case, a status line is provided in the sixteenth line, to indicate how many messages are not being currently presented and where they are (above or below the currently presented messages). END label and warning messages can not be scrolled out of the display. Due to this characteristic, caution and advisory messages will be scrolled in the area left blank below the warning messages. If a new message is generated during a scrolling, it will be automatically displayed at the top of the associated group.

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### INHIBITION LOGIC

To avoid its nuisance effect upon the flight crew, inhibition logic is provided to prevent some messages from being displayed during takeoff and approach/landing phases. The inhibition logic is as follows:

Takeoff Phase:

Inhibition is valid when the airplane crosses $V_1$ –15 kt. The inhibition is deactivated when one of the following conditions is accomplished:

- radio altitude is greater than 400 ft or;
- calibrated airspeed is less than 60 kt or;
- after 1 minute.

Approach/landing Phase:

Inhibition is valid from the point when airplane crosses 200 ft radio altitude. The inhibition is deactivated when one of the following conditions is accomplished:

- airplane is on the ground for 3 seconds or more;
- after 1 minute.

### IC-600 RESULTS SELF-CHECK

The results of both IC-600 computations are continuously compared to check for any inconsistency between both sides. A dedicated amber annunciation, “CAS MSG”, is provided on the PFDs to indicate whenever a difference between both IC-600s has been found, thus leading to possible unreliable messages.

## EICAS MESSAGE DICTIONARY

The following table presents all the EICAS messages. Type column indicates whether the message’s nature is Warning (W), Caution (C), or Advisory (A).
The number in column INHIBITION indicates the following:
- (1) Message is inhibited during takeoff;
- (2) Message is inhibited during takeoff and approach/landing;
- (3) Message is not inhibited;
- (4) Message is inhibited during approach/landing;
- (5) Message is inhibited on the ground and on all flight phases excluding takeoff.

For further information regarding each message’s logic, refer to the associated system’s description.

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| SECTION | TYPE | MESSAGE | INHIBITION |
|---|---|---|---|
| 2-2 EQUIPMENT AND FURNISHINGS | W | MAIN DOOR OPN | 2 |
| | W | SERVICE DOOR OPN | 2 |
| | C | ACCESS DOORS OPN | 2 |
| | C | BAGGAGE DOOR OPN | 2 |
| | C | EMERG EXIT OPN | 2 |
| | C | FUELING DOOR OPN | 2 |
| 2-4 CREW AWARENESS | W | GPWS | 3 |
| | W | NO TAKEOFF CONFIG | 4 |
| | W | SPS 1 (2) INOP | 3 |
| | C | AURAL WARN FAIL | 2 |
| | C | CHECK IC 1 (2) SW | 2 |
| | C | CHECK PFD 1 (2) | 2 |
| | C | CHK IC CONFIG | 2 |
| | C | DAU AC ID MISCMP | 2 |
| | C | DAU 1 (2) A FAIL | 2 |
| | C | DAU 1 (2) ENG MISCOMP | 2 |
| | C | DAU 1 (2) SYS MISCOMP | 2 |
| | C | DAU 1 (2) WRN MISCOMP | 2 |
| | C | GPWS INOP | 3 |
| | C | IC BUS FAIL | 2 |
| | C | IC 1 (2) OVERHEAT | 2 |
| | C | IC 1 (2) WOW INOP | 2 |
| | C | SPS ADVANCED | 3 |
| | C | STICK PUSHER FAIL | 3 |
| | C | TERR INOP | 3 |
| | C | WINDSHEAR INOP | 3 |
| | A | CHECKLIST MISMATCH | 2 |
| | A | CMC FAIL | 2 |
| | A | CONFIG MISMATCH | 2 |
| | A | IC 1 (2) CONFIG FAIL | 2 |
| | A | IC 1 (2) FAN FAIL | 2 |
| | A | DAU 1 (2) B FAIL | 2 |
| | A | DAU 1 (2) REVERSION | 2 |
| | A | DU 1 (2, 3, 4, 5) FAN FAIL | 2 |
| | A | DU 1 (2, 3, 4, 5) OVHT | 2 |
| | A | SPS/ICE SPEEDS | 1 |

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| SECTION | TYPE | MESSAGE | INHIBITION |
|---|---|---|---|
| 2-5 ELECTRICAL | W | BATT 1 (2) OVTEMP | 3 |
| | W | ELEC ESS XFR FAIL | 3 |
| | C | 115 VAC BUS OFF | 2 |
| | C | APU CNTOR CLSD | 2 |
| | C | APU GEN OFF BUS | 2 |
| | C | APU GEN OVLD | 2 |
| | C | BATT 1 (2) OFF BUS | 2 |
| | C | BKUP BATT OFF BUS | 2 |
| | C | DC BUS 1 (2) OFF | 2 |
| | C | ELEC EMERG ABNORM | 2 |
| | C | ESS BUS 1 (2) OFF | 2 |
| | C | GEN 1 (2, 3, 4) OFF BUS | 2 |
| | C | GEN 1 (2, 3, 4) OVLD | 2 |
| | C | SHED BUS 1 (2) OFF | 2 |
| | A | GEN 1 (2, 3, 4) BRG FAIL | 2 |
| 2-6 LIGHTING | C | EMERG LT NOT ARMD | 2 |
| 2-7 FIRE PROTECTION | W | APU FIRE | 3 |
| | W | BAGG SMOKE | 2 |
| | W | ENG 1 (2) FIRE | 3 |
| | W | LAV SMOKE | 2 |
| | C | APU EXTBTL INOP | 2 |
| | C | APU FIREDET FAIL | 2 |
| | C | BAGG EXT BTL INOP | 2 |
| | C | E1 (2) EXTBTLA (B) INOP | 2 |
| | C | E1 (2) FIREDET FAIL | 2 |
| 2-8 FUEL | W | FUEL 1 (2) LO LEVEL | 2 |
| | W | FUEL XFER CRITICAL | 2 |
| | C | APU FUEL LO PRESS | 2 |
| | C | APU FUEL SOV INOP | 2 |
| | C | E1 (2) FUEL LO PRESS | 2 |
| | C | E1 (2) FUEL SOV INOP | 2 |
| | C | FUEL IMBALANCE | 2 |
| | C | FUEL TANK LO TEMP | 2 |
| | C | FUEL XFEED FAIL | 2 |
| | C | FUELING DOOR OPN | 2 |
| | C | FUEL EQ XFEED OPN | 2 |
| | C | FUEL CONFIG DISAG | 2 |

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| SECTION | TYPE | MESSAGE | INHIBITION |
|---|---|---|---|
| 2-8 FUEL | C | FUEL VENT OPEN | 2 |
| | C | FUEL XFER INOP | 2 |
| | C | FUEL XFER OVFLOW | 2 |
| | C | XFER ISOL FAIL | 2 |
| | C | DEFUEL NOT CLOSED | 2 |
| | A | APU FUEL SOV CLSD | 2 |
| | A | E 1(2) FUELSOV CLSD | 2 |
| | A | FUEL XFEED OPEN | 2 |
| | A | FUEL LR CONFIG | 2 |
| 2-9 APU | C | APU FAIL | 2 |
| | C | APU OIL HI TEMP | 2 |
| | C | APU OIL LO PRESS | 2 |
| 2-10 POWERPLANT | W | ATTCS FAIL | 5 |
| | W | E1 (2) ATTCS NO MRGN | 2 |
| | W | E1 (2) OIL LOW PRESS | 2 |
| | W | E1 (2) LOW N1 | 2 |
| | W | ENG 1-2 OUT | 1 |
| | C | E1 (2) ATS SOV OPN | 2 |
| | C | E1 (2) CTL A (B) FAIL | 2 |
| | C | E1 (2) CTL FAIL | 2 |
| | C | E1 (2) EXCEEDANCE | 2 |
| | C | E1 (2) FPMU NO DISP | 2 |
| | C | E1 (2) FUEL LO TEMP | 2 |
| | C | ENG NO TO DATA | 2 |
| | C | ENG REF A/I DISAG | 2 |
| | C | ENG1 (2) REV DISAGREE | 2 |
| | C | E1 (2) NO DISP | 2 |
| | C | ENG 1 (2) OUT | 1 |
| | C | FADEC ID NO DISP | 2 |
| | C | ENG 1 (2) REV FAIL | 2 |
| | C | ENG 1 (2) TLA FAIL | 2 |
| | A | CHECK XXX PERF (XXX = A, A1, A1P, A3, A1/3, A1E) | 2 |
| | A | E1 (2) SHORT DISP | 2 |
| | A | E1 (2) ADC DATA FAIL | 2 |
| | A | E1 (2) FUEL IMP BYP | 2 |
| | A | E1 (2) OIL IMP BYP | 2 |

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| SECTION | TYPE | MESSAGE | INHIBITION |
|---|---|---|---|
| 2-10 POWERPLANT | A | E1 (2) IDL STP FAIL | 2 |
| | A | E1 (2) CTL A (B) DEGRAD | 2 |
| 2-11 HYDRAULIC | C | HYD SYS 1 (2) FAIL | 2 |
| | C | HYD SYS 1 (2) OVHT | 2 |
| | A | E1 (2) HYD PUMP FAIL | 2 |
| | A | E1 (2) HYDSOV CLSD | 2 |
| | A | HYD PUMP SELEC OFF | 2 |
| | A | HYD1 (2) LO QTY | 2 |
| 2-12 LANDING GEAR AND BRAKES | W | LG/LEVER DISAGREE | 3 |
| | C | BRAKE OVERHEAT | 3 |
| | C | BRK INBD INOP | 1 |
| | C | BRK OUTBD INOP | 1 |
| | C | EMRG BRK LO PRES | 1 |
| | C | LG AIR/GND FAIL | 3 |
| | C | STEER INOP | 2 |
| | C | NLG/UPDOOR OPN | 2 |
| | C | BRAKE DEGRADED | 1 |
| 2-13 FLIGHT CONTROLS | W | PIT TRIM 1 (2) INOP | 2 |
| | W | PTRIM MAIN INOP | 2 |
| | W | PTRIM BACKUP INOP | 2 |
| | C | AIL SYS 1 (2) INOP | 2 |
| | C | FLAP FAIL | 2 |
| | C | PTRIM CPT SW FAIL | 3 |
| | C | PTRIM F/O SW FAIL | 3 |
| | C | PTRIM BKP SW FAIL | 3 |
| | C | RUDDER OVERBOOST | 2 |
| | C | RUDDER SYS 1 (2) INOP | 2 |
| | C | RUD HDOV PROT FAIL | 2** |
| | C | SPBK LVR DISAGREE | 2 |
| | C | SPOILER FAIL | 2 |
| | A | FLAP LOW SPEED | 2 |
| 2-14 PNEUMATICS, AIR CONDITIONING AND PRESSURIZATION | W | BLD 1 (2) LEAK | 2 |
| | W | BLD APU LEAK | 2 |
| | W | BLD 1 (2) OVTEMP | 2 |
| | C | APU BLD VLV FAIL | 2 |
| | C | BLD 1 (2) LOW TEMP | 2 |
| | C | BLD 1 (2) VLV FAIL | 2 |

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| SECTION | TYPE | MESSAGE | INHIBITION |
|---|---|---|---|
| 2-14 PNEUMATICS, AIR CONDITIONING AND PRESSURIZATION | C | CROSS BLD FAIL | 2 |
| | C | CROSS BLD SW OFF | 2 |
| | C | ELEKBAY OVTEMP | 2 |
| | C | HS VLV 1 (2) FAIL | 2 |
| | C | PACK 1 (2) OVHT | 2 |
| | C | PACK 1 (2) OVLD | 2 |
| | C | PACK 1 (2) VLV FAIL | 2 |
| | C | PRESN AUTO FAIL | 2 |
| | C | RAM AIR VLV FAIL | 2 |
| | A | BLD 1 (2) VLV CLSD | 2 |
| | A | HI ALT LDG-T/O | 2 |
| | A | CROSS BLD OPEN | 2 |
| | A | PACK 1 (2) VLV CLSD | 2 |
| 2-15 ICE AND RAIN PROTECTION | W | ICE COND-A/I INOP | 2 |
| | C | A/ICE LOW CAPACITY | 3 |
| | C | A/ICE SWITCH OFF | 2 |
| | C | AOA 1 (2) HEAT INOP | 2 |
| | C | E1 (2) A/ICE FAIL | 2 |
| | C | ICE DET1 (2) FAIL | 2 |
| | C | ICE DETECTORS FAIL | 2 |
| | C | NO ICE-A/ICE ON | 2 |
| | C | PITOT 1 (2, 3) INOP | 2 |
| | C | STAB A/ICE FAIL | 2 |
| | C | TAT 1 (2) HEAT INOP | 2 |
| | C | W/S 1 (2) HEAT FAIL | 2 |
| | C | WG A/ICE FAIL | 3 |
| | A | ENG A/ICE OVERPRES | 3 |
| | A | ICE CONDITION | 2 |
| 2-16 OXYGEN | C | OXYGEN LO PRESS | 2 |
| 2-17 FLIGHT INSTRUMENTS | C | DFDR FAIL | 2 |
| | A | FDAU FAIL | 2 |
| | A | RAD ALT 1 (2) FAIL | 1 |
| | A | RAD ALT FAIL | 1 |

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| SECTION | TYPE | MESSAGE | INHIBITION |
|---|---|---|---|
| 2-18 NAVIGATION AND COMMUNICATION | C | AHRS 1 (2) ALN FAULT | 2 |
| | C | AHRS 1 (2) FAIL | 2 |
| | C | AHRS 1 (2) OVERHEAT | 2 |
| | C | CHECK XPDR | 2 |
| | C | HGS FAIL | 3 |
| | C | IRS 1 (2) ALN FAULT | 2 |
| | C | IRS 1 (2) FAIL | 2 |
| | C | IRS 1 (2) OVERHEAT | 2 |
| | A | A III NOT AVAIL | 3 |
| | A | AHRS 1 (2) ALN | 2 |
| | A | AHRS 1 (2) ATT MODE | 2 |
| | A | AHRS 1 (2) BASIC MODE | 2 |
| | A | AHRS 1 (2) EXC MOTION | 2 |
| | A | AHRS 1 (2) NO MAG HDG | 4 |
| | A | AHRS 1 (2) NO PPOS | 1 |
| | A | AHRS 1 (2) ON BATT | 2 |
| | A | IRS 1 (2) ALN | 2 |
| | A | IRS 1 (2) ATT MODE | 2 |
| | A | IRS 1 (2) EXC MOTION | 2 |
| | A | IRS 1 (2) ON BATT | 2 |
| 2-19 AUTOPILOT | W | AUTOPILOT FAIL | 2 |
| | C | AUTO TRIM FAIL | 2 |
| | C | AP ELEV MISTRIM | 2 |
| | C | AP AIL MISTRIM | 2 |
| | C | LATERAL MODE OFF | 3 |
| | C | VERTICAL MODE OFF | 3 |
| | C | YAW DAMPER FAIL | 2 |

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# DISPLAYS INDICATIONS

Many of the airplane's parameters are indicated on one of the displays, in analogic or digital format.

## ANALOGIC INDICATIONS

Analogic indications are provided as pointers moving over a scale, which may be graduated or not. In both cases, if the pointer indicates a value out of the normal range for that parameter, both pointer and scale become amber or red, if the parameter goes deeply into the out of range area. Pointers are removed if the parameter signal becomes invalid. For some parameters, scale may also be removed in this condition. Scale and pointer are not presented for some parameters, when they are not required, as for EADI chevrons, $V_1$, $V_R$, $V_2$ speed bugs, trend vectors, etc.

## DIGITAL INDICATIONS

Digital indications are provided as green characters for normal values. If the associated parameter goes outside its normal range, digits become amber, with an amber box surrounding them. Both digits and box become red if the parameter goes deeply into the out of range area. If the parameter signal becomes invalid, digits are replaced by amber dashes, without boxes.

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# CONTROLS AND INDICATORS

## GLARESHIELD PANEL

### 1 - MASTER WARNING BUTTON

- Acknowledges the warning messages and stops the associated blinking when pressed.
- A red light blinks inside the button when a new warning message is displayed on the EICAS.

### 2 - MASTER CAUTION BUTTON

- Acknowledges the caution messages and stops the associated blinking when pressed.
- An amber light blinks inside the button when a new caution message is displayed on the EICAS.

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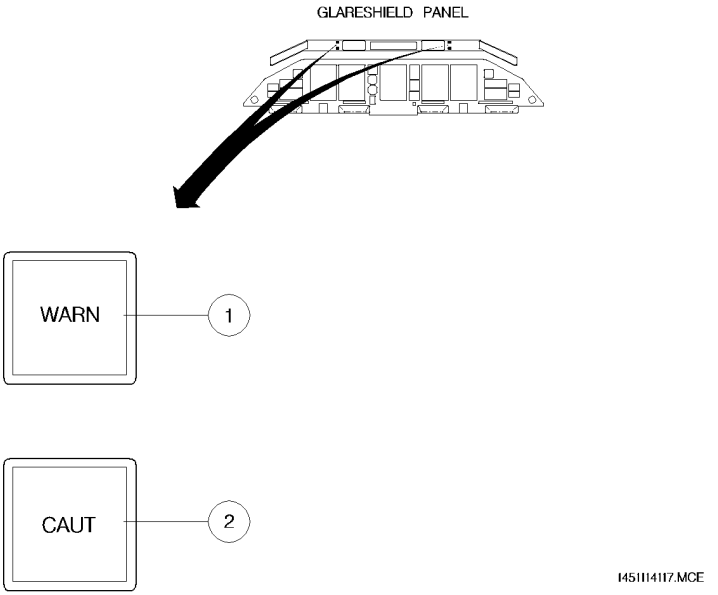
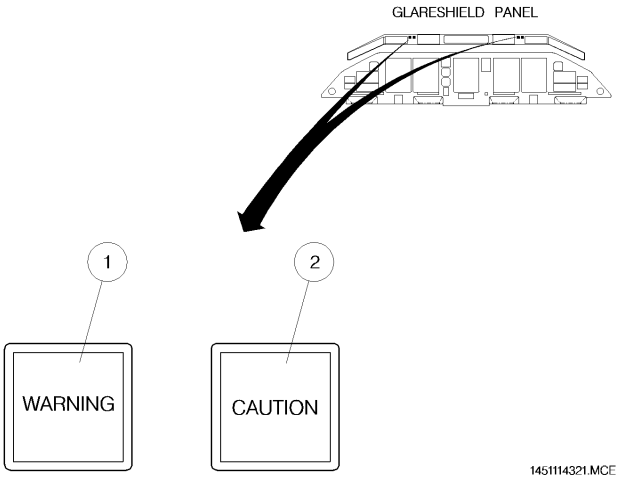



## GLARESHIELD PANEL




## GLARESHIELD PANEL (OPTIONAL)

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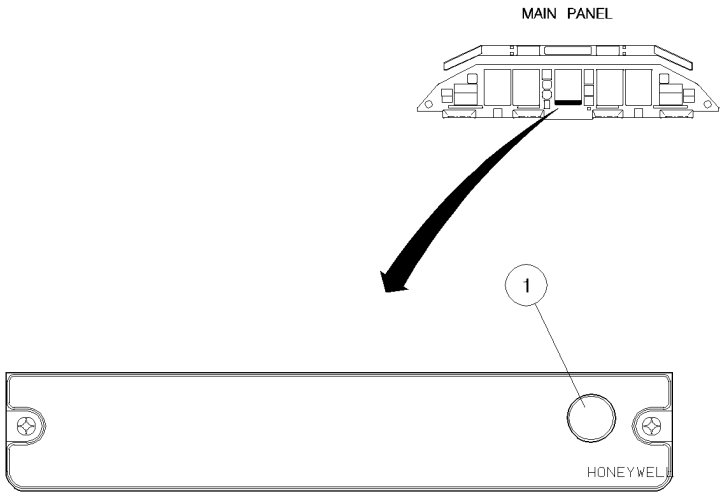
## EICAS BEZEL

### 1 - MESSAGE SCROLLING KNOB

- To be used when displayed EICAS messages can not be presented at once.
- By rotating the knob clockwise, advances through EICAS messages. Rotated counterclockwise moves backward through EICAS messages.

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**EICAS BEZEL**

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## PRIMARY FLIGHT DISPLAY

### 1 - EICAS CHECK SUM FAIL COMPARISON MONITOR DISPLAY

- Color: amber.
- Label: CAS MSG.
- Displayed when the number of active EICAS messages in each IC-600 is found to be different.

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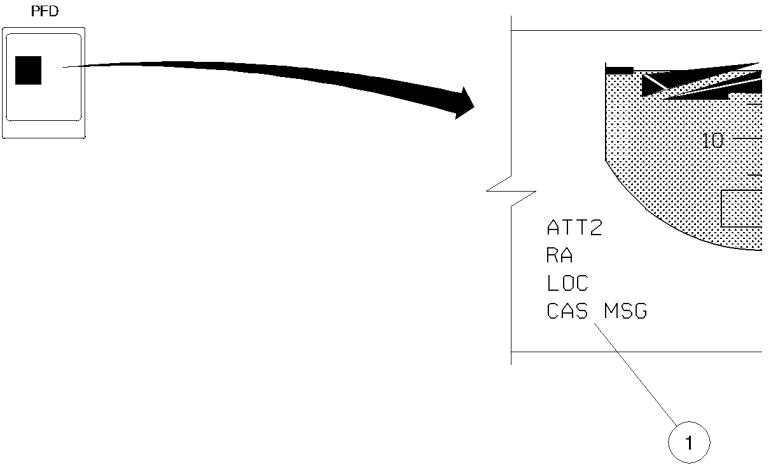


**PRIMARY FLIGHT DISPLAY**



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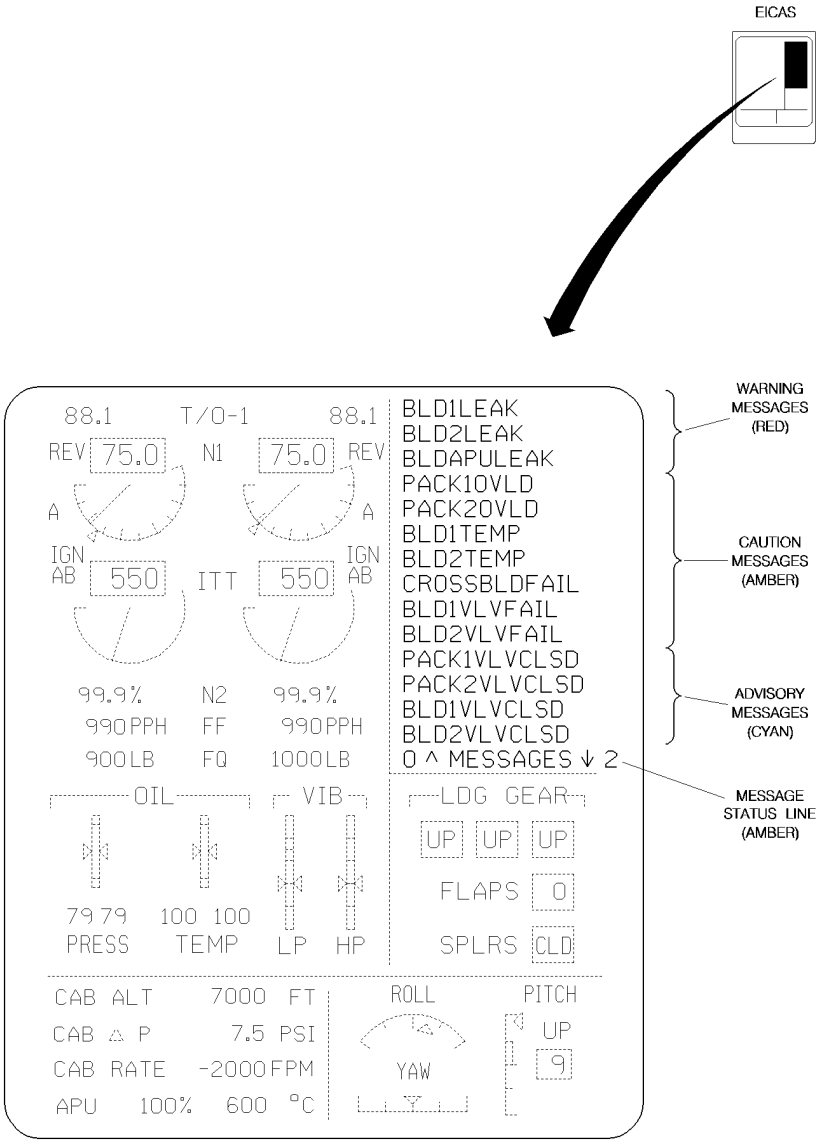
## EICAS DISPLAY




## EICAS MESSAGES EXAMPLE

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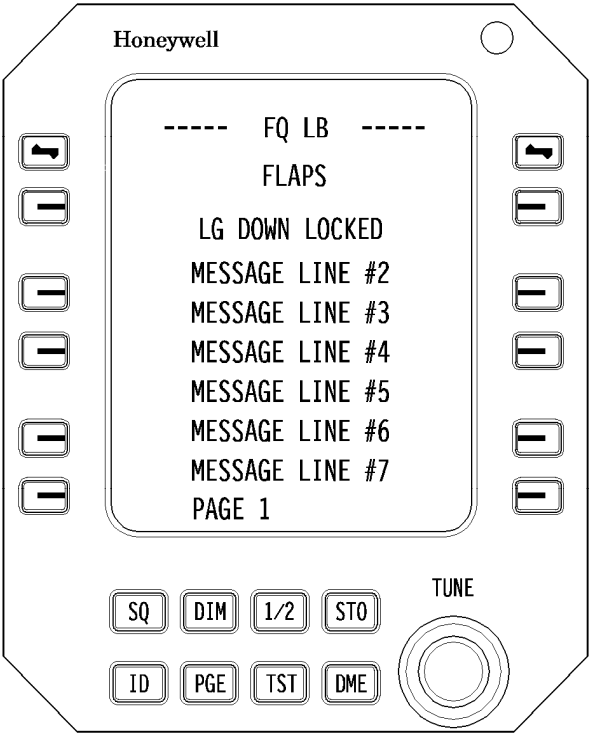
## RMU DISPLAY




## RMU MESSAGES EXAMPLE

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# PFD PRESENTATIONS

## COMPARISON MONITORS

The left and right side area for several critical parameters is monitored by the system. If an excessive difference is detected between left and right side information, a comparison monitor annunciator for data is displayed on the PFD.

Active messages are cleared when the miscompare situation has been corrected.

Comparison monitor annunciators are displayed as follows:

**1 - PIT (PITCH ATTITUDE)**

- Displayed in the upper left corner of the attitude sphere when pitch attitude data differs by more than ±5º.

**2 - ALT (ALTITUDE)**

- Displayed in the upper right corner of the altitude tape when altitude data differs by more than ±200 ft.

**3 - HDG (HEADING)**

- Displayed to the upper right of the HSI compass when heading data differs by more than ±6º (level flight).

**4 - LOC (LOCALIZER)**

- Displayed to the lower left of the attitude sphere when localizer deviation differs by more than approximately ½ dot (below 1200 ft AGL).

**5 - CAS MSG (CAS MESSAGE)**

- Displayed to the lower left of the attitude sphere when a red or amber CAS message has been triggered by the on-side IAC but not the cross-side IAC.

**6 - ILS (INSTRUMENT LANDING SYSTEM)**

- Displayed to the lower left of the attitude sphere when both localizer and glideslope comparison monitors have been tripped.

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**7 - GS (GLIDESLOPE)**

- Displayed to the lower left of the attitude sphere when glideslope deviation differs by more than approximately 2/3 dot (below 1200 ft AGL).

**8 - RA (RADIO ALTITUDE)**

- Displayed to the lower left of the attitude sphere when radio altitude data differs by more than the amount calculated by the formula [(RA1+RA2)x0.0625]+10. Available only with two radio altimeters installed.
- An amber RA1 is displayed in the event of Radio Altimeter 2 failure. Radio Altitude source is RA1.
- An amber RA2 is displayed in the event of Radio Altimeter 1 failure. Radio Altitude source is RA2.

**9 - IAS (AIRSPEED)**

- If the on-side and cross-side calibrated airspeed differ by 5 kt or more for longer than 2 seconds, it is displayed in the upper left corner of the airspeed tape first flashing, for 10 seconds, and then steady.

**10 - ROL (ROLL ATTITUDE)**

- Displayed in the upper left corner of the attitude sphere when roll attitude data differs by more than ±6º.

**11 - ATT (ATTITUDE)**

- Displayed in the upper left corner of the attitude sphere when both pitch and roll comparison monitors have been tripped.

**NOTE:** The comparison monitor is active when the pilot and copilot have the same type of data, but different sources selected for display. For example, if the pilot and copilot both have ILS 1 selected (amber source annunciator), no comparison monitor is active on that data (localizer and glideslope).

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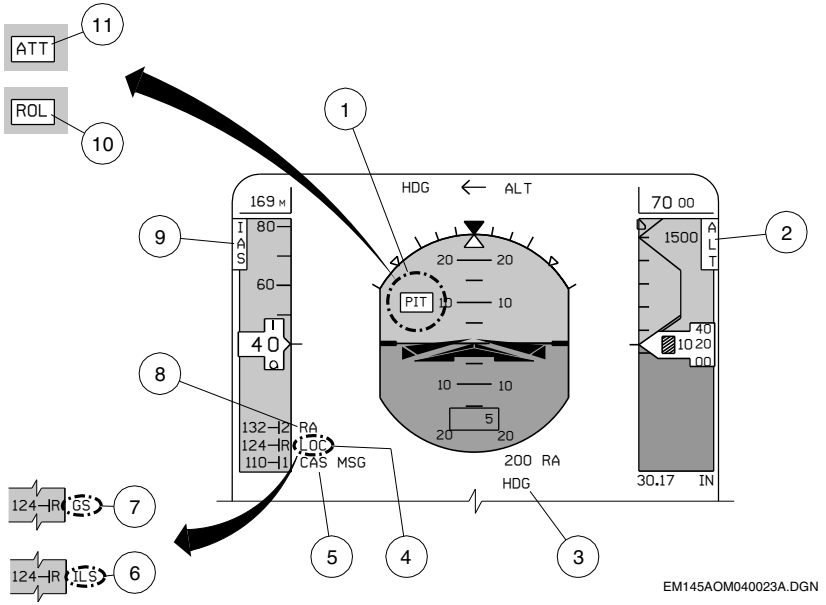


## COMPARISON MONITOR ANNUNCIATORS

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## CAUTION ANNUNCIATORS

The amber caution annunciators are described as follows:

**1 - FD FAIL**

- If a flight director fails, **FD FAIL** is displayed in the lateral mode annunciator box, and the flight director mode annunciators and command cue are removed.

**2 - AP/YD**

- Autopilot and yaw damper caution annunciators. **AP/YD** are displayed above the attitude sphere, below the flight director mode annunciators. Refer to PFD Additional Annunciators for more information.

**3 - GND PROX**

- When the EGPWS indicates a caution conditions **GND PROX** is displayed in the upper right of the ADI sphere. The following aural alerts are considered cautionary:
  - "SINK RATE";
  - "DON'T SINK";
  - "TOO LOW TERRAIN";
  - "TOO LOW FLAPS";
  - "TOO LOW GEAR";
  - "GLIDESLOPE";
  - "CAUTION TERRAIN";
  - "CAUTION OBSTACLE".

**4 - MSG**

- The FMS message annunciator (**MSG**) is displayed to the upper right of the HSI compass. The **MSG** annunciator flashes until the FMS message is cleared from the scratchpad.

**5 - TCAS FAIL**

- Amber **TCAS FAIL** caution annunciator is displayed to the upper left on the vertical speed display.
- For airplanes Post-Mod. SB 145-34-0125, the **TCAS FAIL** caution annunciator flashes for 10 s and remain steady displayed as long as the condition persists.

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**6 - DISTANCE DISPLAY FAILURES**

- If the DME or FMS distance signal fails, the digital readout is replaced with amber dashes.

**7 - COURSE SELECT FAILURE**

- If the course select signal fails, the digital readout is replaced with amber dashes and the course pointer is removed from the display. This indication is also given for an invalid heading display or FMS source.

**8 - AOA**

- Angle of attack information (and calibrated airspeed) are used to calculate stall speed for low speed awareness. If the angle of attack information or indicated airspeed information is invalid, AOA is displayed to the lower right of the airspeed tape.

**9 - ATT1 OR ATT2**

- If the pilot and copilot are using their normal onside attitude source, there is no attitude source annunciator. If the pilot and copilot have selected the same attitude source, that attitude source (**ATT1** or **ATT2**) is annunciated to the lower left of the attitude sphere on both PFDs.

**10 - RA**

- If a radio altimeter fails, **RA** is displayed in the digital radio window.

**11 - MAX/MIN SPD**

- These annunciators are displayed to the left of the attitude sphere. **MIN SPD** is displayed when the vertical speed or airspeed hold mode is engaged and the indicated airspeed drops below 80 kt. **MAX SPD** is displayed anytime indicated airspeed exceeds $V_{MO}/M_{MO}$.

**12 - SG1 OR SG2**

- When the symbol generator reversion is selected and one symbol generator is driving both pilot's and copilot's displays, that symbol generator is annunciated (**SG1** or **SG2**) to the upper left of the attitude sphere on both PFDs.

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**13 - ADC1 OR ADC2**

- If the pilot and copilot are using their normal onside air data source, there is no air data annunciator. If the pilot and copilot have selected the same air data source (**ADC1** or **ADC2**) is annunciated to the upper left of the attitude sphere on both PFDs.

**14 - WDSHEAR**

- When the windshear detection system detects windshear, **WDSHEAR** is displayed to the upper left of the attitude sphere. The annunciator flashes for 10 seconds and then goes on steady. The annunciator is **amber** (caution) if the performance is being increased, and **red** (warning) if the performance is being decreased. If the go-around button is pushed during a windshear caution or warning, the flight director vertical flight director guidance directs the airplane.

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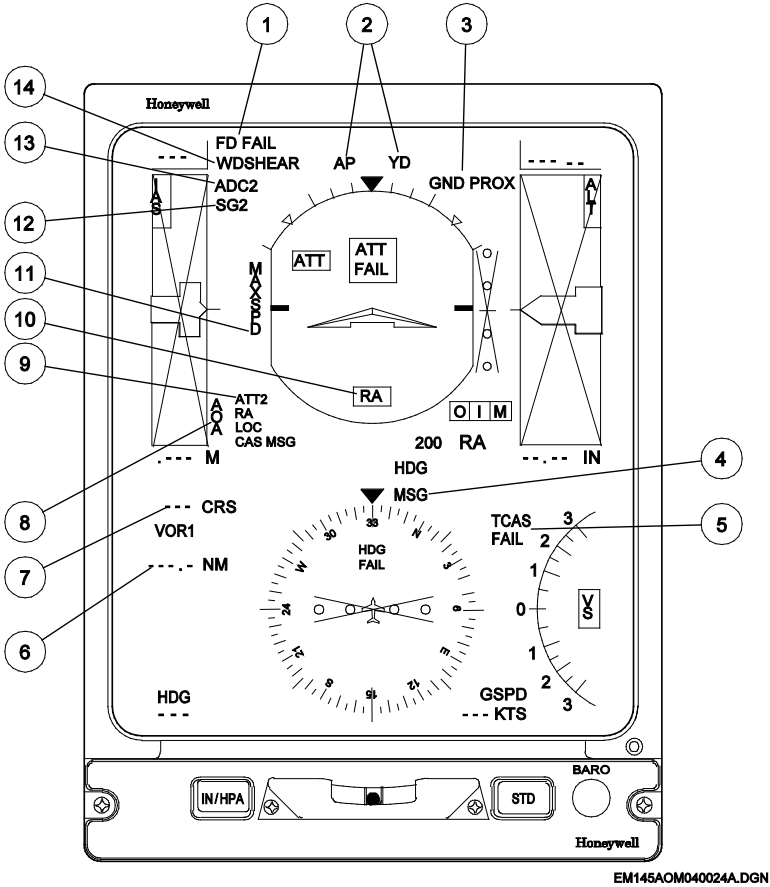


**PFD WITH CAUTION ANNUNCIATORS**

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# WARNING ANNUNCIATORS

The red warning annunciators are described as follows:

**1 - ATT FAIL**

- If either the pitch or roll data fails, the pitch scale marking are removed, the attitude sphere turns cyan, and **ATT FAIL** is displayed in the attitude sphere.

**2 - PULL UP**

- When the EGPWS indicates a warning condition, **PULL UP** is displayed boxed in the upper right corner of the ADI sphere.

**3 - AIR DATA COMPUTER FAILURE**

- If the ADC fails, the rolling digit displays of airspeed and altitude are removed, the scale marking are removed and an "**X**" is drawn through the scales. If the digital Mach display fails, the digital readout is replaced with amber dashes.
- In the case of the vertical speed, the current value pointer is removed, a boxed **VS** is displayed inside the scale.

**4 - VERTICAL DEVIATION FAILURE**

- If the radio source driving the vertical navigation scale fails, the deviation pointer is removed and a red "**X**" is drawn through the scale. The scale and pointer are removed for invalid FMS data.

**5 - COURSE DEVIATION FAILURE**

- If the course deviation data fails, the CDI is removed and a red "**X**" is drawn through the scale. The course digital readout is replaced with amber dashes.

**6 - HDG FAIL**

- If the heading select signal fails, the heading bug is removed from the display and **HDG FAIL** is displayed inside the HSI compass. This indication is also given in the event of an invalid heading display.

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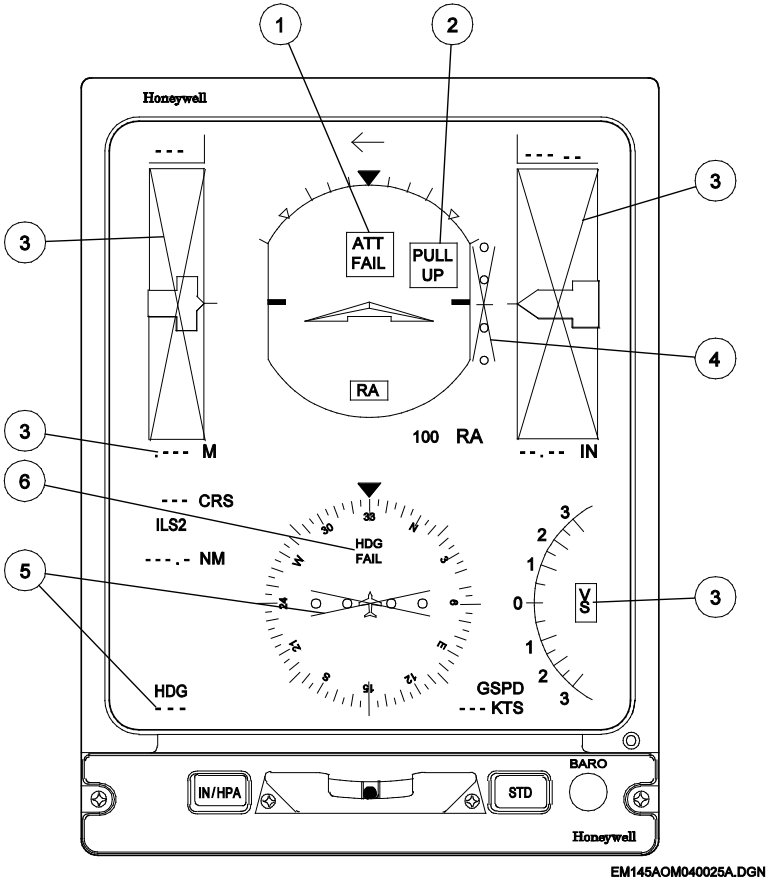


**PFD WITH WARNING ANNUNCIATORS**

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# PFD ADDITIONAL ANNUNCIATORS

## ATTITUDE DIRECTOR INDICATOR (ADI) DISPLAY AND MODE ANNUNCIATORS

### 1 - LATERAL FLIGHT DIRECTOR MODE ANNUNCIATORS

- The **HDG**, **VAPP**, **VOR**, **ROL**, **LOC**, **BC** and **LNAV** mode annunciators are displayed. Armed modes are displayed in white, captured modes are displayed in green and boxed in white for 7 seconds after the transition from armed to captured.

### 2 - VERTICAL FLIGHT DIRECTOR MODE ANNUNCIATORS

- The **VS**, **MACH**, **PIT**, **ASEL**, **TO**, **CLB**, **ALT**, **WSHR**, **SPD**, **DES**, **GS**, **IAS** and **GA** mode annunciators are displayed. Armed modes are displayed in white, while captured modes are displayed in green and boxed in white for 7 seconds after the transition from armed to captured.

### 3 - VERTICAL DEVIATION DISPLAY

- A **GS** in white is displayed above the vertical deviation scale when the vertical deviation is from an ILS glideslope, and a **FMS** in white is displayed when the vertical deviation is from an FMS.
- If the glideslope data is invalid, the pointer is removed and a red "X" is displayed through the scale. If the FMS data is invalid, the scale, label and pointer are removed.

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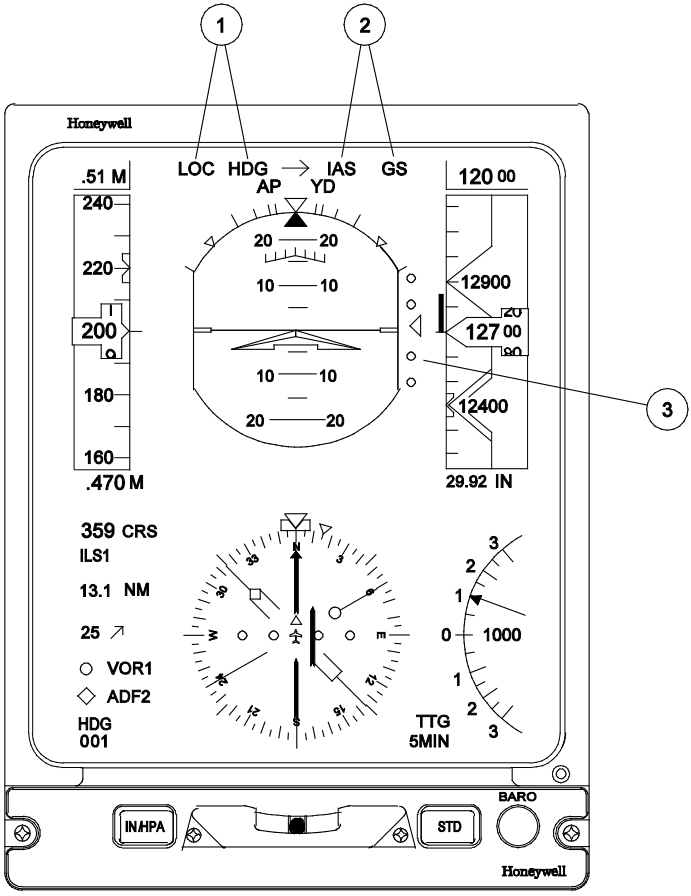


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## ADI DISPLAY ON THE PFD



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## 1 - AUTOPILOT ANNUNCIATORS

| MESSAGE | COLOR | TYPE | STATUS |
|---|---|---|---|
| AP | Green | Steady | Engaged |
| AP Test | Amber | Steady | Autopilot Test |
| AP | Amber | Flashes for 5s | Normal AP disconnect |
| AP | Red | Flashes for 5s then steady | Abnormal AP disconnect |
| AP | Red | Flashes for 5s | Abnormal AP disconnect in CAT II |
| TCS | White | Steady while TCS switch is pushed | Touch control steering |
| TKNB | Amber | Steady | TURN knob is out of detent |

## 2 - YAW DAMPER ANNUNCIATORS

| MESSAGE | COLOR | TYPE | STATUS |
|---|---|---|---|
| YD | Green | Steady | Engaged |
| YD | Amber | Flashes for 5s | Normal yaw damper disconnect |
| YD | Amber | Flashes for 5s then steady | Abnormal yaw damper disconnect |

## 3 - FMS VERTICAL TRACK ALERT (VTA) ANNUNCIATOR

- For Universal FMS, the annunciator **VTA** is displayed in magenta flashing then steady when the FMS advisory VNAV is selected and the airplane is approaching the top of descent point.

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### 4 - RADIO ALTITUDE MINIMUM ALTITUDE ANNUNCIATOR

- When actual radio altitude decreases to within 100 ft of the set Decision Height value, a white box is displayed. When the actual radio altitude is equal to or less than the set value, **MIN** is displayed in amber (inside the box) and it flashes for 10s.

### 5 - MARKER BEACON ANNUNCIATOR

- A cyan **O** represents the outer, an amber **M** represents the middle, and a white **I** represents the inner marker. They appear inside a white box, flashing.

### 6 - RADIO ALTITUDE MINIMUM ALTITUDE ANNUNCIATOR

- An amber **MIN** is displayed (boxed) and flashes for 10 seconds when the actual radio altitude is equal to or less than the set value.

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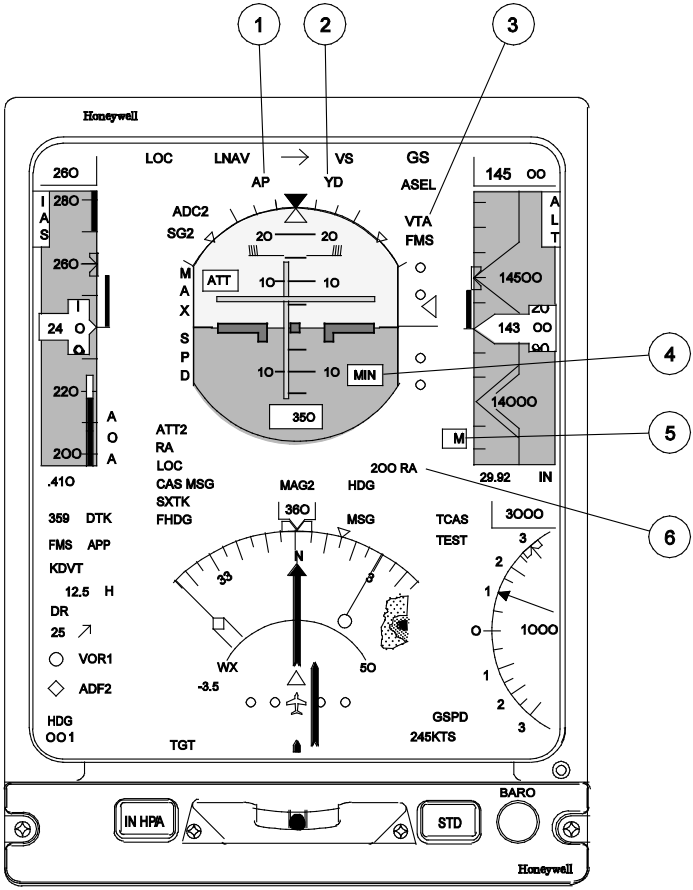


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## ADI DISPLAY ON THE PFD



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## 1 - CAT II ANNUNCIATOR

– **CAT2** is displayed in green when the conditions for a CAT II approach are satisfied. If these conditions are met, but after lost, **CAT2** in amber flashes for 10 seconds and then goes on steady. If the localizer deviation exceeds the CAT II requirements with radio altitude less than 500 ft, the green **CAT2** turns amber and flashes.

## HORIZONTAL SITUATION INDICATOR (HSI) DISPLAY

FULL COMPASS DISPLAY

The color of the course pointer, distance display, groundspeed, lateral deviation, and navigation source annunciator are green when the source selected is Short Range Navigation, magenta when FMS is selected as navigation source and yellow when the same navigation source on both sides or secondary NAV source is selected.

## 2 - MEASUREMENTS

– One of the annunciators **TTG** in white, **ET** in green or **GSPD** in green is displayed.

## 3 - BEARING POINTER ANNUNCIATORS (COPILOT)

– The **OFF**, **NAV2**, **ADF2**, **FMS** or **VOR2** bearing pointer annunciators may be displayed. If the on-side display controler fails, the default sources is VOR2 for the "◊" pointer (copilot's).

## 4 - BEARING POINTER ANNUNCIATORS (PILOT)

– The **OFF**, **NAV1**, **ADF1**, **FMS** or **VOR1** bearing pointer annunciators may be displayed. If the on-side display controler fails, the default sources is VOR1 for the "O" pointer (pilot's).

## 5 - DISTANCE DISPLAY

– The display is distance to the station for a short-range NAV and the distance to the TO waypoint for the FMS. The display range is from 0 to 409.5 NM for DME and 0 to 4096 NM for FMS. If DME hold is selected when VOR is displayed, an amber **H** is displayed.

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## 6 - NAVIGATION SOURCE ANNUNCIATORS

- One of the Navigation Source Annunciators **VOR1**, **VOR2**, **ILS1**, **ILS2** or **FMS** is displayed.

## 7 - COURSE POINTER AND DIGITAL DISPLAY

- If short range NAV is selected, the annunciator **CRS** (Course) is displayed. If long range NAV is selected, the annunciator **DTK** (Desired Track) appears.

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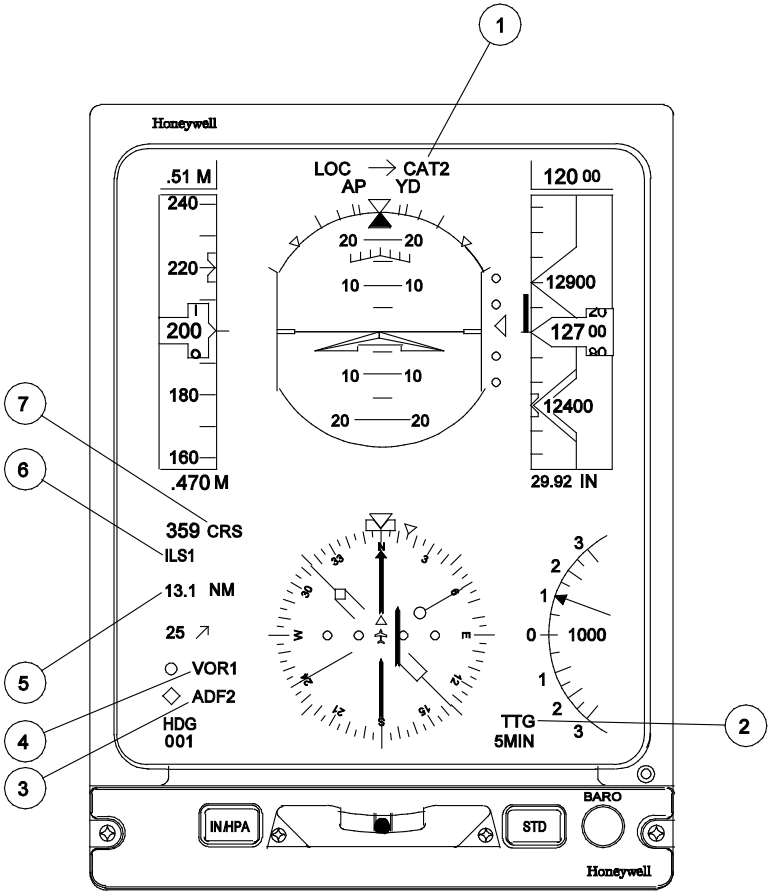


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## HSI DISPLAY ON THE PFD



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COMPASS ARC DISPLAY

## 1 - HEADING SOURCE ANNUNCIATOR

- When the cross-side heading source is selected, or when the AHRS is in DG mode, the heading source annunciator (**FHDG**) is displayed.
- When the AHRS is in DG mode, the on-side heading source annunciators are **DG1** or **DG2** (in white). When the magnetic heading is invalid, the source annunciator is **HDG1** or **HDG2** (in amber).

## 2 - FMS MESSAGE AND STATUS ANNUNCIATORS

- The FMS message annunciator (**MSG**, in amber) is displayed in amber and flashes until the FMS condition is cleared.

## 3 - WEATHER RADAR MODE ANNUNCIATOR

The mode annunciators are described below:

| ANNUNCIATOR | COLOR | R/T MODE |
|---|---|---|
| FPLN | green | Flight plan mode. |
| FSBY | green | Forced standby. |
| GMAP | green | Ground mapping mode. |
| R/T | green | RCT and turbulence (1). |
| RCT | green | REACT Mode. |
| STBY | green | Standby. |
| TEST | green | Test mode and no faults. |
| TGT | green | Target alert enabled (2). |
| TX | green | WX is transmitting but not selected for display, or in STBY or FSTBY (3). |
| WAIT | green | RTA in warm-up (4). |
| WX | green | Weather mode (1). |
| WX/T | green | Weather and turbulence (5). |
| FAIL | amber | RTA Fail - test mode and faults (6). |
| GCR | amber | Normal WX with ground clutter reduction. |
| STAB | amber | Stabilization off. |
| VAR | amber | Variable gain. |

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**NOTE: 1)** Turbulence detection is only available on the PRIMUS® 880.

**2)** When target alert is enabled and a level 3 weather return is detected in the forward 15° antenna scan, **TGT** in amber is displayed.

**3)** **TX** is displayed in amber when the airplane is on ground and WX is transmitting, but not selected for display, or in STBY and FSTBY.

**4)** Early version of the P1000 annunciates **TX** in amber when the radar is in the warm up mode. In later versions the warm up is indicated by **WAIT** in green.

**5)** When weather radar is invalid **WX** in amber is displayed.

**6)** When on the ground and the weather test display is selected, weather failures are indicated by fault codes in the tilt angle field.

### 4 - WEATHER RADAR TGT/VAR ANNUNCIATORS

– When the target alert mode is armed, the message **TGT** in green appears. It turns amber when a potentially dangerous target is detected. This indicates that the pilot should select a higher range on the weather radar to view the target. When variable radar gain is selected, **VAR** in amber is displayed.

### 5 - DME HOLD ANNUNCIATOR

– If DME hold is selected when VOR is displayed, **H** in amber is displayed.

### 6 - FMS HEADING (FHDG) ANNUNCIATOR

– When heading guidance is supplied from the FMS, **FHDG** in magenta is displayed.

### 7 - FMS STATUS ANNUNCIATOR

The following FMS status annunciators are displayed in amber:

– **INTEG** (Integrity) - The GPS sensor does not meet the required integrity calculations for the current phase of flight.
– **WPT** (Waypoint) - The airplane is approaching a flightplan waypoint.
– **DR** (Dead reckoning) - The FMS is in dead reckoning mode.
– **DGR** (Degrade) - The ability of the FMS to accurately calculate airplane position is degraded.

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The following FMS status annunciators are displayed in cyan:

- **SXTK** (Crosstrack) - The airplane is off track.
- **TERM** (Terminal) - The FMS is in the terminal phase of the flightplan.
- **APP** (Approach) - the FMS is in the approach phase of the flightplan. For RNAV (FMS) approaches, the annunciator is displayed steady and for GPS approaches, the annunciator flashes for ten seconds.

The table below shows the Full-scale Deviation for FMS Terminal and Approach Modes:

| ANNUNCIATOR (IN CYAN) | MODE | FULL-SCALE LATERAL DEVIATION | FULL-SCALE VERTICAL DEVIATION |
|---|---|---|---|
| APP | GPS Approach | 0.3 NM | 150 ft |
| APP (steady) | RNAV Approach | 1.25 NM | 150 ft |
| TERM | GPS Terminal | 1.0 NM | 500 ft |

AIRSPEED DISPLAY

When the FGS enters the MAX SPEED mode, the annunciator **MAX SPEED** is displayed in amber to the left of the ADI sphere.

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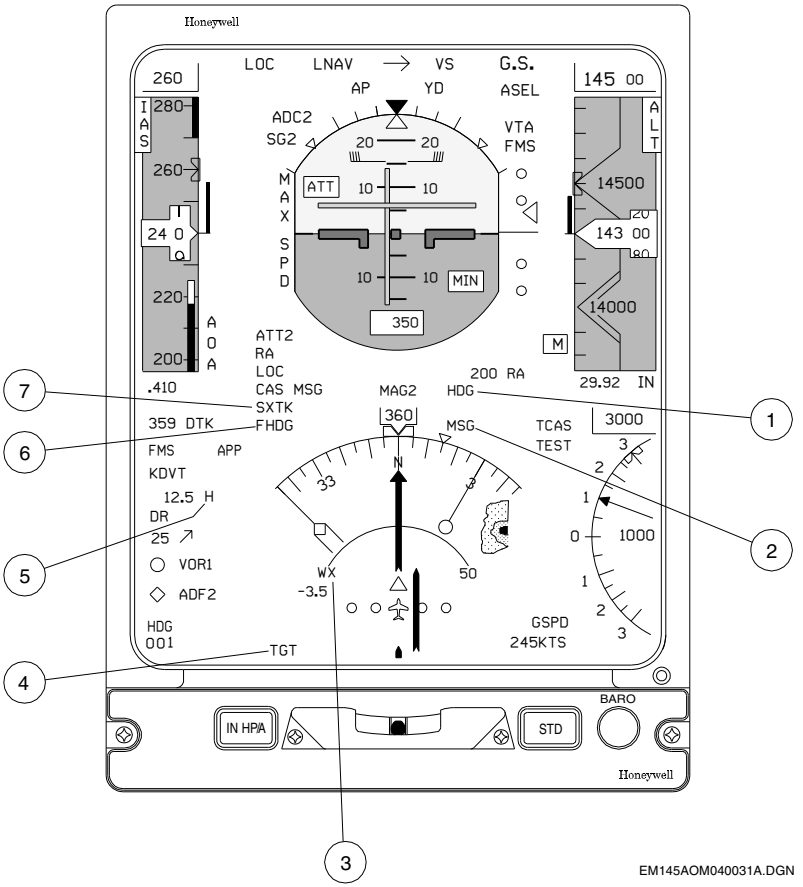


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## MESSAGES ON THE PFD



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**VERTICAL SPEED DISPLAY**

The picture above shows the location of the annunciator described below:

**1 - TCAS STATUS ANNUNCIATOR**

| Annunciator | Color | TCAS Status |
|---|---|---|
| TA ONLY | white | TCAS is in traffic advisory mode only. |
| TCAS OFF (1) | white | TCAS is off. |
| TCAS TEST | white | TCAS is in self-test. |
| TCAS FAIL (2) | amber | TCAS data is invalid. |
| RA FAIL | red | Resolution advisories are not available. |

**NOTE: 1)** For airplanes Post-Mod. SB 145-34-0125, the TCAS OFF annunciator flashes for 10 s and remain steady displayed as long as the condition persists.

**2)** For airplanes Post-Mod. SB 145-34-0125, the TCAS FAIL annunciator flashes for 10 s and remain steady displayed as long as the condition persists.

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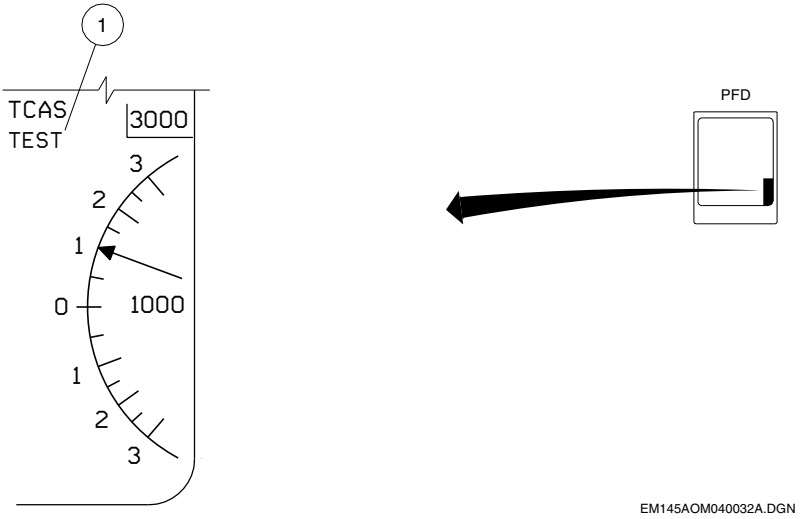


**VERTICAL SPEED DISPLAY ON THE PFD**

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## PFD SELF-TEST DISPLAY

To run the EFIS self-test, push and hold the TEST button on the display controller. The PFD displays the following:

- Course select, heading select, radio altitude set, distance, and groundspeed/time-to-go digital displays are replaced with amber (horizontal) dashes.
- Attitude and heading displays are flagged.
- All pointers/scales are flagged.
- All heading bugs/pointers are removed.
- Flight director command cue is removed.
- Radio altimeter digital readout displays radio altimeter self-test value.
- The comparison monitor annunciators are displayed (in amber) **ATT**, **HDG**, and **ILS** (if ILS sources are selected on both sides).
- **TEST** in magenta is annunciated to the upper left of the ADI.
- The annunciator **WDSHEAR** in red is displayed.
- Flight director mode annunciators are removed.
- Radio altitude minimum is displayed at the last set value.

**NOTE:** The amber annunciator **FD FAIL** is not displayed during the self test.

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# AURAL WARNINGS

There are two kinds of aural warnings: voice messages and tones.

Voice messages are normally associated with warning messages on EICAS or other warning systems. They are generated whenever a potentially dangerous condition exists, as determined by the GPWS, TCAS and windshear detection system. There are some voice messages that can be cancelled, but others can only be cancelled when the cause that triggered them has been eliminated.

Tones have different forms and indicate some notable airplane events, sometimes in unison with voice messages.

## AURAL WARNING UNIT

In order to generate messages and tones, the Aural Warning Unit (AWU) receives signals from the following airplane systems:

– TCAS;
– Windshear detection system;
– GPWS;
– IC-600;
– Fire detection system;
– Stall protection system;
– Trims;
– Flaps;
– Brakes;
– Spoilers;
– Radio altimeter;
– Autopilot;
– Landing gear;
– ADC;
– Pressurization;
– SELCAL.

The AWU sends the appropriate audio signal to an audio digital system, which routes the messages to the appropriate speakers.

### AWU POWER SOURCE

The AWU is supplied by one DC bus and one Essential DC bus, and is provided with two channels, A and B. Channel B is kept as a backup for channel A, and is automatically activated should channel A fail.

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## AWU POWER-UP TEST

An AWU power-up test is performed and generates aural warnings for one or both channels operating normally. If both channels have failed, the caution message AURAL WARN FAIL is displayed on EICAS.

## AURAL WARNINGS LEVELS

The aural warnings are classified into four levels, presented below in a decreasing level order:

– **Emergency** - Associated with situations that may be hazardous. AWU generates a master warning tone (triple chime) before the warning and voice message may be generated. In any case, the aural warning is repeated every second until deactivated through the master warning button or until the condition that generated the warning has been eliminated.

– **Abnormal** - Associated with malfunctions or failures. AWU generates a master caution tone (single chime) every five seconds, until it is removed, canceled or replaced by a higher priority aural warning. Voice messages are generated after each tone.

– **Advisory** - Associated with minor malfunctions or failures that lead to loss of redundancy or degradation of the affected system's performance.

– **Information** - A remarkable event has occurred.

## AURAL WARNINGS ANNUNCIATION PRIORITY

When multiple aural warnings are active, aural warnings among the highest level alert groups shall be sounded first in order and repeated. Once all alerts in the higher group are cancelled or removed, then the second tier group alerts are sounded and repeated.

An alert in process shall be immediately interrupted when an alert of a higher priority needs to be generated.

EXCEPTIONS TO AURAL WARNINGS PRIORITY

When an internal voice message is being annunciated, it shall be completed before another alert, even of a higher priority, is annunciated. This does not apply to internally generated tones which shall be interrupted within 1 second.

If an emergency arises together with a warning that generates continuous sounds, such as a fire or stall, the sound volume is reduced to avoid misunderstanding of the remaining messages, although being loud enough to still warn pilots.

The master warning tone is inhibited when any other emergency alert (internal or external) is occurring at the same time.

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| LEVEL | ASSOCIATED CONDITION/EICAS MESSAGE | PRIORITY | TONE | VOICE MESSAGE | CANCEL |
|---|---|---|---|---|---|
| EMERGENCY | Stall condition. | 1 | Clacker | None | NO |
| | Windshear condition (1). | 2 | None | WINDSHEAR | NO |
| | Ground proximity condition (1). | 3 | (1) | (1) | NO |
| | Traffic proximity condition (1). | 4 | None (3) | (1) | NO (2) |
| | Fire in engine or APU.<br>ENG 1 (2) FIRE ,<br>APU FIRE. | 5 | Bell | None | YES |
| | Airspeed above $V_{MO}$ or $M_{MO}$. | 6 | Attenson 3 | HIGH SPEED | NO |
| | Landing gear not locked down for landing. | 7 | Attenson 3 | LANDING GEAR | NO |
| | Cabin altitude above 10000 ft (Normal Mode Operation).<br>or<br>Cabin altitude above 14500 ft (HI ALT Mode Operation - only for airplanes equipped with HI ALT system). | 8 | Attenson 3 | CABIN | YES |
| | Associated with takeoff configuration warning. | 9 | Attenson 3 | TAKEOFF<br>plus one of the following:<br>-FLAPS<br>-TRIM<br>-SPOILER<br>-BRAKES | NO |
| | Associated with emergency failures. | 10 | Attenson 3 | None | NO |
| ABNORMAL | Associated with glide slope deviation. | None | None | GLIDE SLOPE | YES |
| | Traffic proximity condition. | None | None (3) | TRAFFIC | YES |
| | Associated with abnormal failures. | None | Master Caution Tone | None | YES |

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**NOTE: 1)** Messages are generated outside the AWU. For further details, refer to the associated system description.

**2)** TCAS resolution advisory warning can not be canceled.

**3)** For airplanes Post-Mod. SB 145-34-0046 and Post-Mod. SB 145-31-0028 or with an equivalent modification factory incorporated.

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| LEVEL | ASSOCIATED CONDITION/EICAS MESSAGE | PRIORITY | TONE | VOICE MESSAGE | CANCEL |
|---|---|---|---|---|---|
| ADVISORY | Autopilot disengagement during approach. | None | None | AUTOPILOT | NO (1) |
| | Associated with decision height crossing. | None | None | MINIMUM | NO |
| | Airplane is crossing or has reached a preselected altitude. | None | (4) | None | NO |
| | Airplane altitude more than 200 ft above or below the selected. | 1 | Horn | None | Not applicable |
| INFORMATION | Power up test detected a failure in one channel of AWU. | Not applicable | None | AURAL UNIT ONE CHANNEL | NO |
| | Associated with incorrect command of pitch trim main or backup channel switches. | None | Single chime | TRIM (2) | NO |
| | Associated with SELCAL callings. | None | None | SELCAL | NO |
| | Both AWU channels are operating normally on power up test. | None | None | AURAL UNIT OK | NO |
| | Takeoff configuration test successful. | None | None | TAKEOFF OK | NO |
| | Power 1 or 2 fail. | None | None | AURAL UNIT ONE POWER | Not applicable |
| | When CMU receives a new message. | None | None | INCOMING CALL (3) | NO |

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**NOTE: 1)** For Post-Mod. SB 145-22-0001 airplanes or S/N 145001 through 145003, 145041 and on, the voice message can be cancelled (refer to Section 2-19 Autopilot for further information).

**2)** Applicable to airplanes equipped with HSCU-1009 or -5009 and AWU-5.

**3)** For airplanes Post-Mod. SB 145-23-0028.

**4)** For airplanes equipped with AWU-5, the altitude alerter is three 2900 Hz tones.

For airplanes Post-Mod. SB 145-31-0051 (equipped with AWU-6) or with an equivalent modification factory incorporated, the tone is a single C CHORD.

## EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | AURAL WARN FAIL | Both AWU channels are inoperative. |

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# TAKEOFF CONFIGURATION WARNING

A dedicated aural warning sounds to indicate that airplane configuration is unsuitable for takeoff. Such aural warning is activated whenever the airplane is on the ground, any thrust lever angle is above 60° and at least one of the following conditions is met:

- Flaps are not in takeoff position.
- Parking brakes are applied.
- Pitch trim is out of the green range.
- Any spoiler panel is deployed.

More than one aural warning may be generated, if more than one condition are met.

### TEST BUTTON

A test button is provided to allow checking the takeoff configuration warning integrity, by simulating power levers advanced. A voice message is generated after successful tests. Unsuccessful tests will generate an EICAS message and a voice message associated with the out-of-configuration item.

## EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | NO TAKEOFF CONFIG | Airplane is not in takeoff configuration. |

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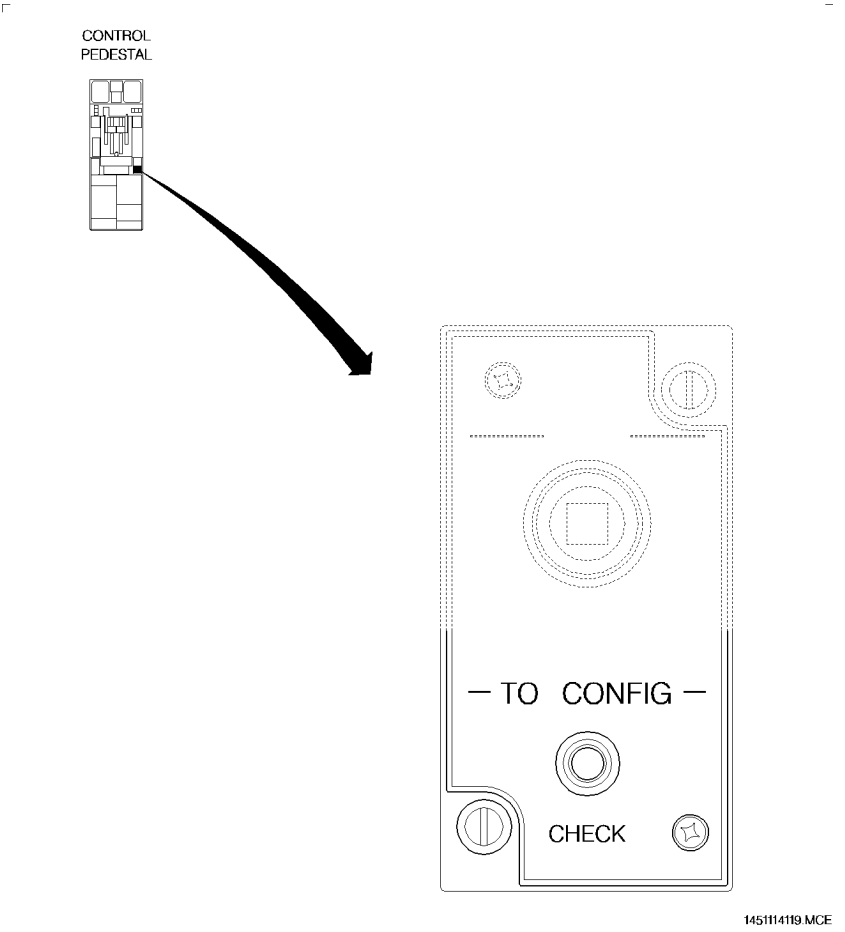
# CONTROLS AND INDICATORS

## 1 - TAKEOFF CONFIGURATION CHECK BUTTON

– Allows checking the takeoff configuration warning.




**TAKEOFF CONFIGURATION CHECK BUTTON**

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# STALL PROTECTION SYSTEM

## GENERAL

To help detect imminent stalls and to avoid stalling the airplane, the EMB-145 is provided with a Stall Protection System (SPS). The SPS is composed of one computer box with two independent channels, the SPS panel, two Angle of Attack (AOA) sensors, two stick shaker actuators, and one stick pusher actuator. The system provides sensitive, visual and aural indications of an impending stall. To avoid spurious actuation, the SPS receives signals from many airplane systems, thus correcting its set point according to flaps and landing gear position, icing and windshear conditions and Mach number.

At higher altitudes, the stall protection system advances its set point to cope with compressibility effects. Therefore, the stall is always defined by the pusher activation, regardless of the altitude. The basic difference between lower and higher levels is that at higher altitudes the pusher and the shaker speeds are higher due to above mentioned stall protection set point advance, preserving the stall margin.

### INTERFACES

Each channel receives data from the following on-side airplane systems: AHRS or IRS, ADC, flaps, landing gear, air/ground, windshear detection, ice detection and radio altimeter. Each Stall Protection Computer (SPC) channel receives information from its associated AOA sensor and sends it to the opposite channel in order to compensate side slip influence on angle of attack measurements. A locked AOA sensor signal is not considered in stall calculations and in this case the channel will be deactivated. If a stall condition is imminent, the system first actuates the stick shaker and disengages the autopilot. If no corrective action is taken and the airplane is on the verge of entering a stall, the stick pusher is actuated, which pitches the nose down. Simultaneously, a clacker is generated in the aural warning system.

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A bug in the airspeed scale on the PFD indicates the stall speed for the associated condition and a pitch limit indicator is presented on EADI to indicate the current margin to the stick shaker angle. When the airplane reaches 0.5 g, the stick pusher is inhibited, stopping its actuation over the control column. A quick disconnect button is provided in the control wheel to permit pilots to cut the system if the need arises. To disconnect the system in case of failure, the SPS panel provides one cutout button for each channel. An EICAS message is presented to indicate that the system has failed or is cutout.

EICAS displays the SPS/ICE SPEEDS message to indicate that the Ice Detection/SPS interface logic (Ice Compensation) is active, and consequently the SPS will actuate at reduced angle of attack values for flaps 9°, 18° and 22°.

**NOTE:** The first in-flight ice detection, by any ice detector, activates the ice compensation.

- The ice compensation is inhibited during 5 minutes after takeoff.
- The ice compensation is reset only on the ground, by pressing the SPS Test Button.

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## SYSTEM INHIBITION

The stick pusher does not actuate in the following conditions:

- On the ground (except during test).
- Below 0.5 g.
- If the quick disconnect button is pressed (except for JAA certification).
- Below 200 ft AGL. If radio altimeter has failed, this condition reverts to a 10-second delay after takeoff.
- If any cutout buttons are released.
- Above 200 KIAS.
- If at least one channel is inoperative.

## SYSTEM TEST

A test button is provided to test the system on the ground. The system operates normally if not tested. Test button remains illuminated if the system has not been tested or after unsuccessful tests. It is not possible to test the system in flight. This inhibition is valid for 30 seconds after landing, above 70 KIAS or with landing gear not downlocked.

**NOTE:** Test button remains illuminated if quick disconnect button is pressed during test.



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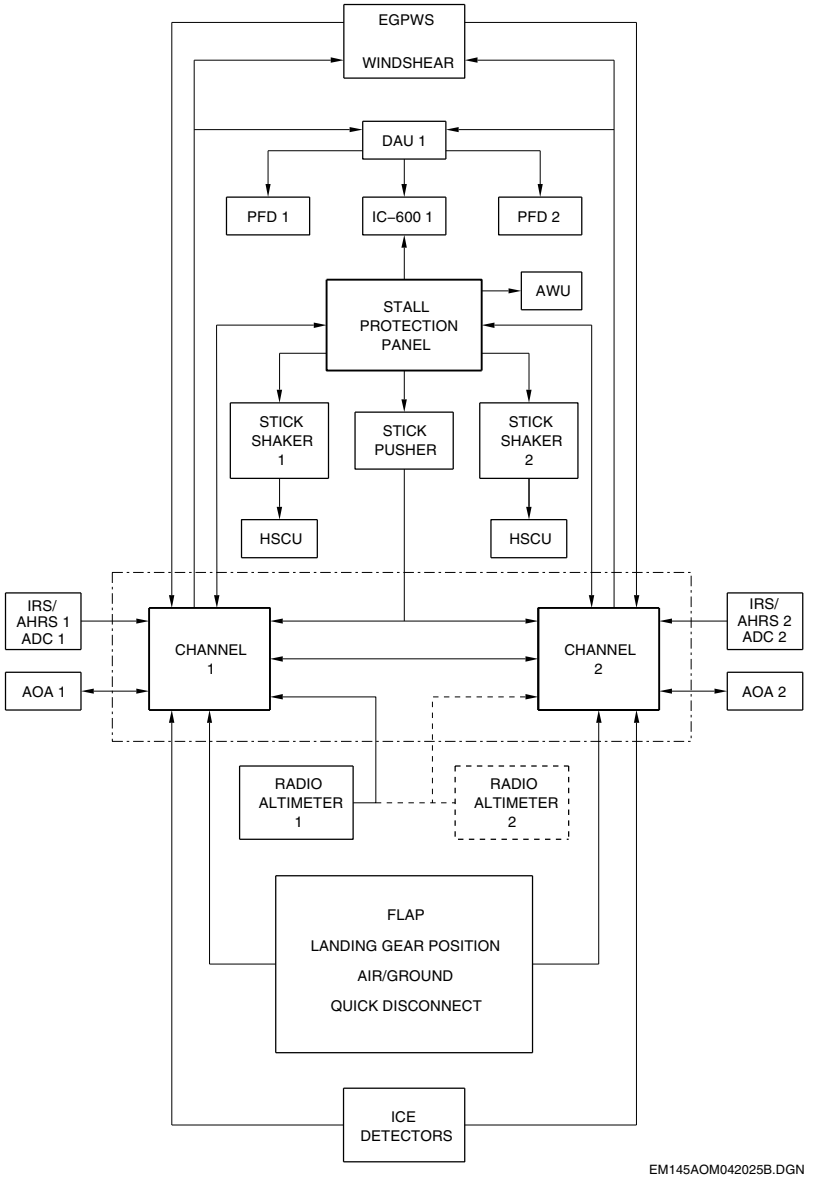


## STALL PROTECTION SYSTEM SCHEMATIC

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## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | SPS 1(2) INOP | Associated SPS computer channel has failed or AOA vane failed. |
| | SPS 1-2 INOP | Both SPS computer channels have failed or both AOA vanes have failed or stick pusher has failed or is cutout. |
| CAUTION | SPS ADVANCED | Stick shaker and pusher actuation is set to higher speeds due to:<br>– Flap signal disagreement.<br>– Failure in at least one SPS channel.<br>– AHRS or ADC parameters disagree.<br>– Air/Ground signs disagree.<br>– Landing gear down and locked indications disagree. |
| | STICK PUSHER FAIL | Stick pusher actuator has been commanded but has not moved. |
| ADVISORY | SPS/ICE SPEEDS | SPS actuation angle is advanced for flaps 9°, 18° and 22°. |

**NOTE:** Advisory SPS/ICE SPEEDS messages are inhibited for the first 5 minutes after takeoff.

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# CONTROLS AND INDICATORS

## STALL PROTECTION SYSTEM PANEL

### 1 - CUTOUT BUTTON (GUARDED)

- Cuts out the associated channel.
- A striped bar illuminates inside the button to indicate that it is in the cutout position.

### 2 - TEST BUTTON

- Starts the test sequence, as follows:
  - Button illuminates.
  - Both stick shakers actuate.
  - Pusher actuates.
  - Button illumination extinguishes.

  **NOTE: -** Test sequence is completed within a maximum of 5 seconds.
  - The TEST button must be released at the first sign of stick shaker actuation.
- Button is kept illuminated after an unsuccessful test or if the system has not been tested.

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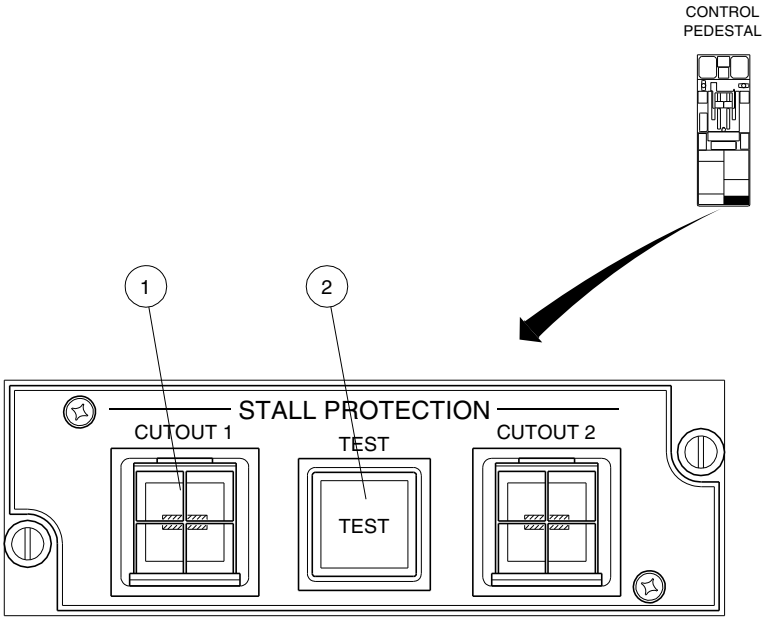


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## STALL PROTECTION SYSTEM PANEL

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## PFD INDICATIONS

### 1 – PITCH LIMIT INDICATOR

- Displayed on the EADI parallel to the airplane symbol.
- Indicates the remaining margin left for the stick shaker angle of attack set point.
- Indication is presented whenever the margin reaches 10°.
- Color:
  - green for margin from 10° up to 5°.
  - amber for margin between 5° and 2°.
  - red for margin below 2°.

Pitch Limit Indicator as well as the pusher and shaker firing angles are corrected for mach compensation at higher altitudes or excessive AOA rate.

### 2 - LOW AIRSPEED AWARENESS

- Displayed in the airspeed scale when airspeed is near stall speed for the current configuration.
- For further details on Low Airspeed Awareness, refer to Section 2-17–Flight Instruments.

Low speed awareness cue computation is not corrected for mach compensation at higher altitudes or excessive AOA rate.

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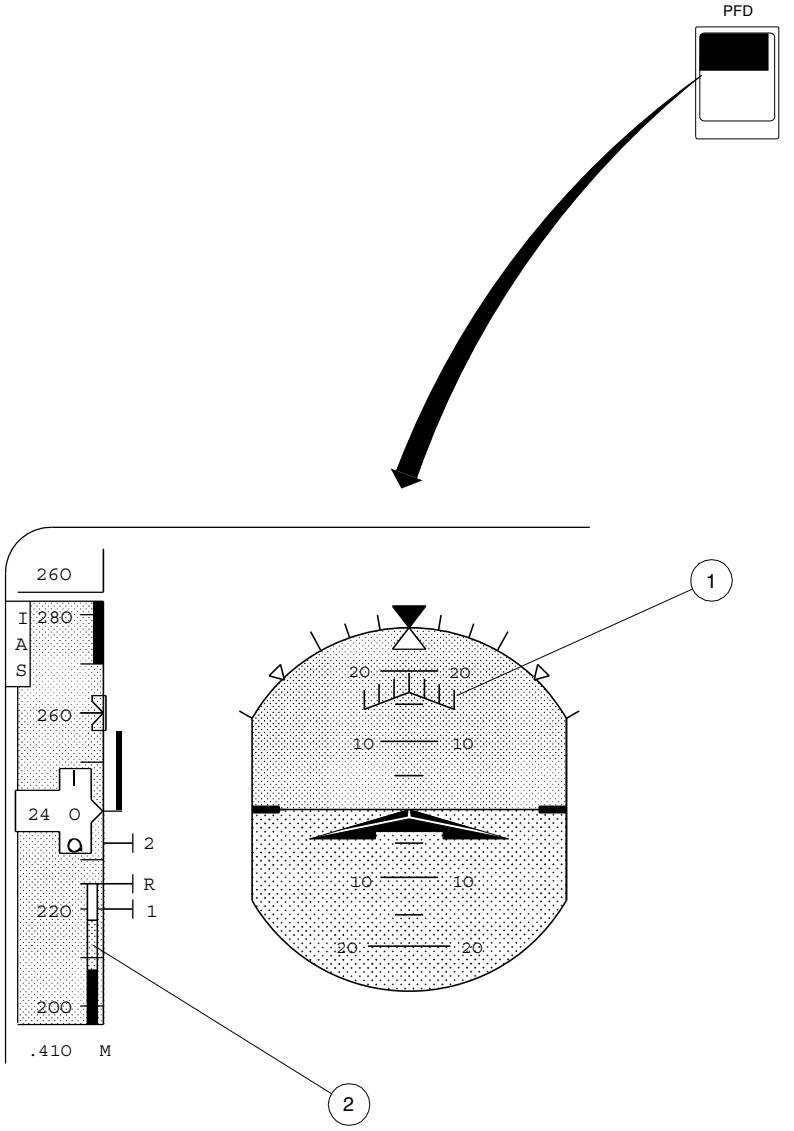


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**PRIMARY FLIGHT DISPLAY**



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# GROUND PROXIMITY WARNING SYSTEM

The purpose of the Ground Proximity Warning System (GPWS) is to avoid accidents caused by Controlled Flight Into Terrain (CFIT) and also severe windshear.

The GPWS is based on radio altitude (“look down”) information. Some airplanes may be optionally equipped with the Enhanced Ground Proximity Warning System (EGPWS). The EGPWS incorporates GPWS functions with additional features like Terrain Clearance Floor, Terrain Look Ahead Alerting and Terrain Awareness Display. These functions use airplane geographic position, airplane altitude and an internal terrain database to predict potential conflicts between the airplane's flight path and terrain, and to provide graphic displays of the conflicting terrain.

**NOTE:**
- Unless otherwise indicated, the system description below is applicable to the GPWS and to the EGPWS.
- Airplanes equipped with EGPWS version 216 and on incorporates additional features like Peaks Mode, Runway Field Clearance Floor, Obstacle Alerting and Geometric Altitude.

The GPWS/EGPWS is a useful navigation aids when flying at low altitude, generally within 2500 ft above terrain. It provides voice messages, EICAS message and PFD indication (EGPWS only) to alert the flight crew, so that they may take appropriate action.

The GPWS/EGPWS interfaces with the followings systems and equipment:

- Radio Altimeter - The radio altimeter provides altitude above ground, how fast the altitude decreases as a result of airplane sinkage or ground profile change and the validity signal.
- IC-600s - The IC-600s provide glideslope deviation, localizer deviation, selected decision height, selected course, packed discrete and selected terrain range.
- ADCs - The ADCs provide uncorrected barometric altitude, corrected barometric altitude, computed airspeed, true airspeed, barometric altitude rate and static air temperature.
- AHRSs/IRS - The AHRSs/IRS provide magnetic heading, pitch and roll angle, longitudinal and normal acceleration.

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– FMS - The FMS provides latitude, longitude, ground speed, true tracking, true heading and NAV mode. The same is applicable when the airplane is equipped with dual FMS.
– GPS - The GPS provides latitude, longitude and altitude.
– Landing gear - The landing gear provides a discrete signal that indicates gear down/locked condition.
– Flap - The Flap Control Unit provides one discrete signal that indicates whether or not flaps are in landing position.
– AWU - The AWU receives the aural messages to be enunciated. It also provides a discrete signal to indicate that the glideslope advisory alert may be canceled without any restriction.
– Terrain Inhibit Switch - It is used in approach mode, in airports not covered by an EGPWS database, assuring protection against unwanted terrain alerts.

Some modes may have their associated envelopes shifted, so as to suit particular airport requirements or to avoid nuisance warnings under some flight situations. This feature is achieved either with calculations or data provided by the FMS, if installed.

The GPWS/EGPWS provides alerts associated with the following flight conditions:

– Mode 1 - Excessive descent rate.
– Mode 2 - Excessive closure rate to terrain.
– Mode 3 - Altitude loss after takeoff.
– Mode 4 - Insufficient terrain clearance.
– Mode 5 - Excessive deviation below glideslope beam.
– Mode 6 - Callouts.
– Mode 7 - Windshear (refer to Section 2-04-35).
– Terrain Awareness Alerting and Warning (EGPWS mode only).
– Terrain Clearance Floor (EGPWS mode only).

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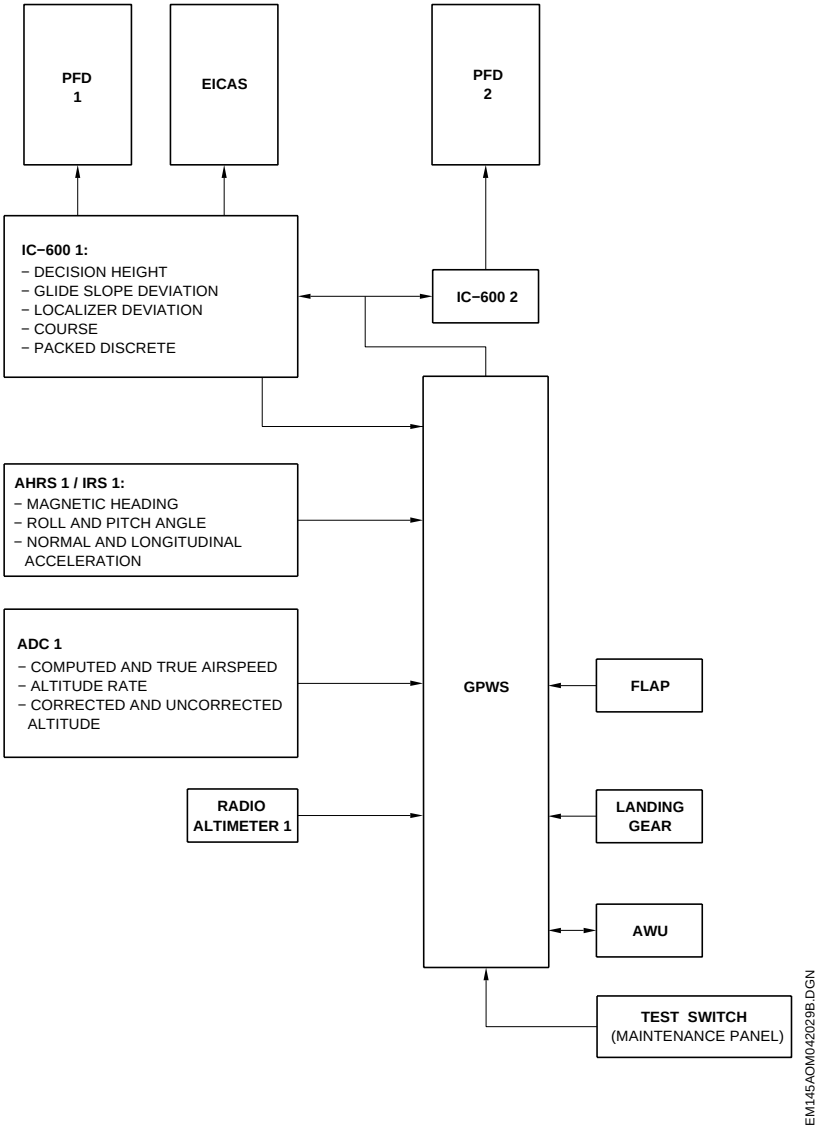


## GPWS SCHEMATIC



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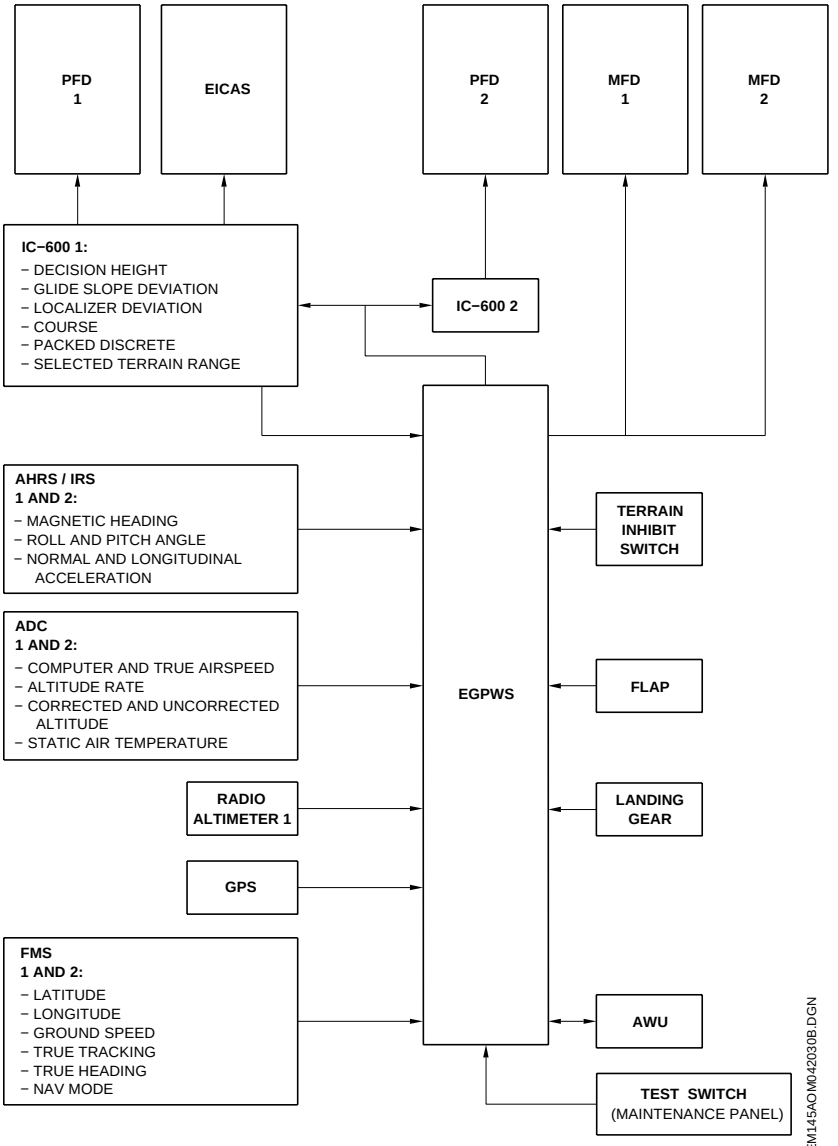


## EGPWS SCHEMATIC



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# MODES AND MESSAGES

## MODE 1 - EXCESSIVE DESCENT RATE

Mode 1 provides alerts and warnings when the airplane has attained an excessive descent rate in respect to altitude above ground level (AGL) during the descent and approach phases of flight.

This mode has outer (sink rate) and inner (pull up) alert/warning boundaries:

Minimum Terrain Clearance (MTC) for “SINK RATE” message triggering:

- Minimum: 30 ft at 1000 ft/min of descent Altitude Rate.
- Maximum: 2450 ft at 5007 ft/min or greater of descent Altitude Rate.

Minimum Terrain Clearance (MTC) for “WHOOP WHOOP PULL UP” or “PULL UP” message triggering:

- Minimum: 30 ft at 1710 ft/min of descent Altitude Rate.
- Maximum: 2450 ft at 7125 ft/min or greater of descent Altitude Rate.

Penetration of the outer (sinkrate) boundary will result in:

- Aural message “**SINK RATE**”. The message will be repeated as long as the penetration increases; and
- "**GPWS**" warning message on EICAS for airplane equipped with GPWS; or
- Amber "**GND PROX**" indication on the PFD for airplane equipped with EGPWS.

Penetration of the inner (pull up) boundary causes the repeated aural message until the condition is cleared, as follows:

- Aural message “**WHOOP WHOOP PULL UP**” and "**GPWS"** warning message on EICAS for airplanes equipped with GPWS; or
- Aural message “**PULL UP**” and red "**PULL UP**" indication on the PFD for airplanes equipped with EGPWS.

If a valid ILS Glideslope front course signal is received and the airplane is above the glideslope centerline, the sinkrate boundary is adjusted to prevent unwanted alerts when the airplane is safely capturing the glideslope.

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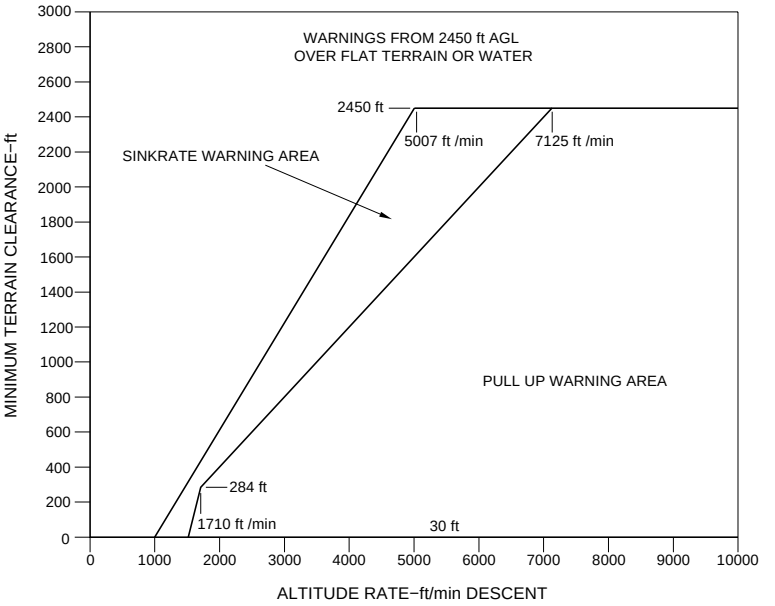
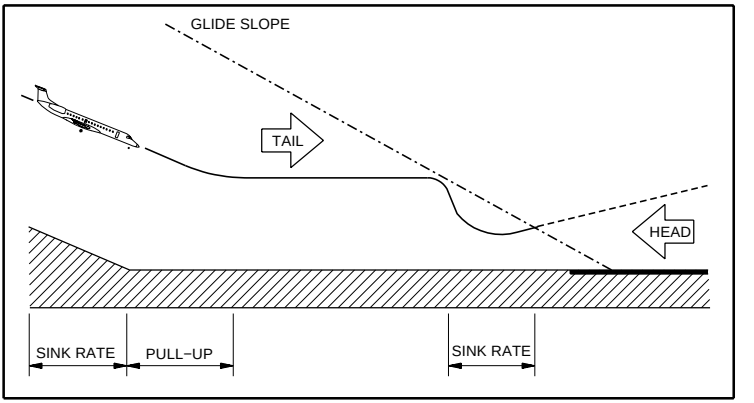
**MODE 1 EXCESSIVE DESCENT RATE**




**GPWS/EGPWS MODE 1 SCHEMATIC**



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## MODE 2 - EXCESSIVE CLOSURE RATE TO TERRAIN

Mode 2 provides alerts and warnings based on airspeed, airplane gear/flap configuration, radio altitude, and excessive closure rate to terrain. Mode 2 exists in two forms: 2A and 2B.

### MODE 2A

Mode 2A is selected when the flaps are not in landing configuration and the airplane is not on the glide slope beam.

Minimum Terrain Clearance (MTC) for "**TERRAIN TERRAIN"** message triggering:

- Minimum: 30 ft at 2038 ft/min of Closure Rate.
- Maximum:
  - 1650 ft at 5733 ft/min or greater of Closure Rate, for an airspeed equal or below 220 KIAS.
  - 2450 ft at 9800 ft/min or greater of Closure Rate for an airspeed equal or above 310 KIAS.

If the airplane penetrates the Mode 2A envelope, the situation results in:

- Aural message "**TERRAIN, TERRAIN**" ; and
- "**GPWS**" warning message on EICAS for airplanes equipped with GPWS; or
- Amber "**GND PROX**" indication on the PFD for airplanes equipped with EGPWS.

If the airplane continues to penetrate the envelope, the aural message switches to messages described below, until the condition is cleared:

- Aural message "**WHOOP WHOOP PULL UP**" and "**GPWS**" warning message on EICAS for airplanes equipped with GPWS; or
- Aural message "**PULL UP**" and red "**PULL UP**" indication on the PFD for airplanes equipped with EGPWS.

The visual and aural messages will remain on until the airplane has gained 300 ft of barometric altitude.

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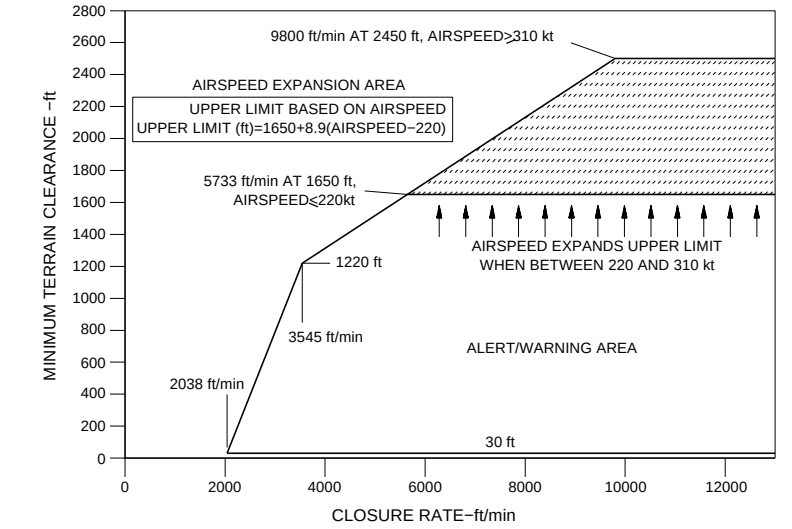


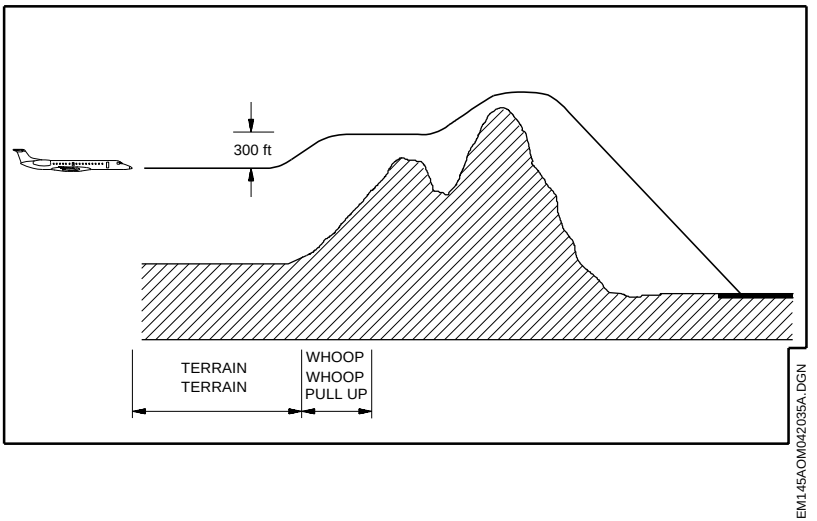


## GPWS/EGPWS MODE 2A SCHEMATIC



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**MODE 2B**

Mode 2B is selected when the flaps are in landing configuration or when making an ILS approach with glide slope and localizer deviations below 2 dots.

Minimum Terrain Clearance (MTC) for "**TERRAIN TERRAIN"** message triggering:

- Minimum: 30 ft at 2038 ft/min of closure rate.
- Maximum:
  - 789 ft at 3000 ft/min or greater of closure rate. This steady value can also vary from 200 ft up to 600 ft for flaps set to landing configuration.

If the airplane penetrates the Mode 2B envelope with both gear and flaps in the landing configuration, the message "**TERRAIN**" is sounded.

If the airplane penetrates the mode 2B envelope with either the landing gear UP or flaps not in landing configuration will result in:

- Aural message "**TERRAIN, TERRAIN**" ; and
- "**GPWS**" warning message on EICAS for airplanes equipped with GPWS; or
- Amber "**GND PROX**" indication on the PFD for airplanes equipped with EGPWS.

If the airplane continues to penetrate the envelope, the aural message switches to messages described below, until the condition is cleared:

- Aural message "**WHOOP WHOOP PULL UP**" and "**GPWS**" warning messageon EICAS for airplanes equipped with GPWS; or
- Aural message "**PULL UP**" and red "**PULL UP**" indication on the PFD for airplanes equipped with EGPWS.

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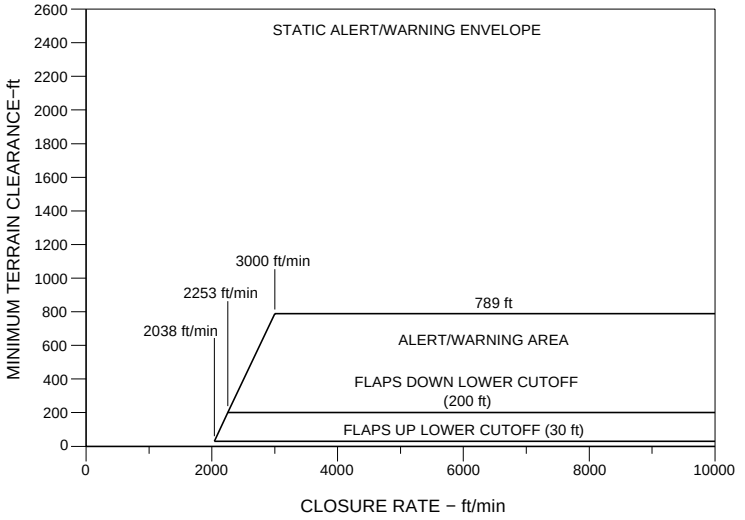
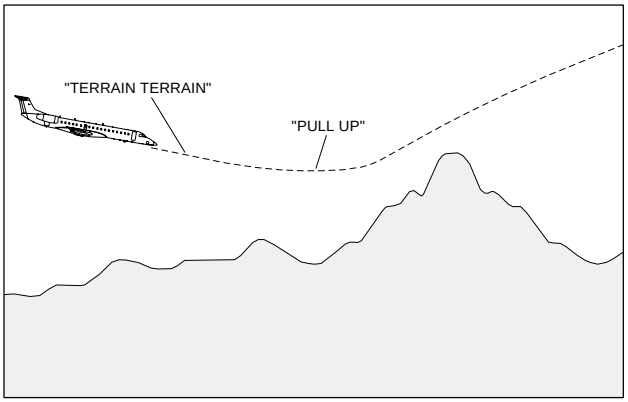
**MODE 2B TERRAIN CLOSURE RATE**

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**GPWS/EGPWS MODE 2B SCHEMATIC**



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## MODE 3 - ALTITUDE LOSS AFTER TAKEOFF

Mode 3 provides alerts and warnings for a significant altitude loss after takeoff with landing gear UP or flaps in other than landing configuration. The amount of altitude loss required to trigger the warning depends on the height of the airplane above the terrain.

Minimum Terrain Clearance (MTC) for "**DON'T SINK, DON'T SINK**" message triggering:

- Minimum: 30 ft at 5 ft of altitude loss.
- Maximum: 1500 ft at 143 ft or greater of altitude loss.

Significant altitude loss after takeoff or during a low altitude go-around activates the aural message "**DON'T SINK, DON'T SINK**" and:

- "**GPWS**" warning message on EICAS for airplanes equipped with GPWS; or
- Amber "**GND PROX**" indication on the PFD for airplanes equipped with EGPWS.

The audio message is only annunciated twice, unless excessive altitude loss continues to accumulate.

Once triggered, the visual message can only be cancelled achieving a positive rate of climb relative to the original altitude. Therefore, as long as the original altitude is not crossed, any descent will trigger the aural and visual messages again. After crossing the original altitude, a new altitude value is set every moment.

**NOTE:** For airplanes Post-Mod. SB 145-34-0088 or equipped with an equivalent modification factory incorporated, there is a time-delay of 10 seconds to inhibit the generation of the "**DON'T SINK, DON'T SINK**" aural message in the transition from landing to take-off configuration, during a go-around maneuver.

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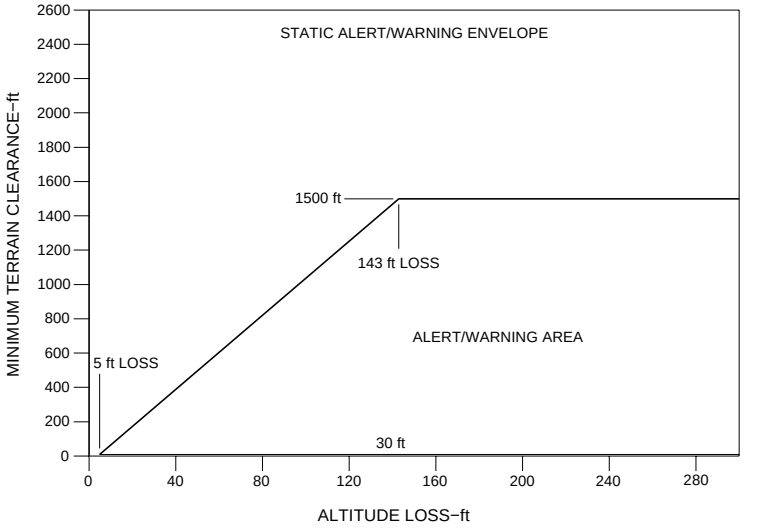
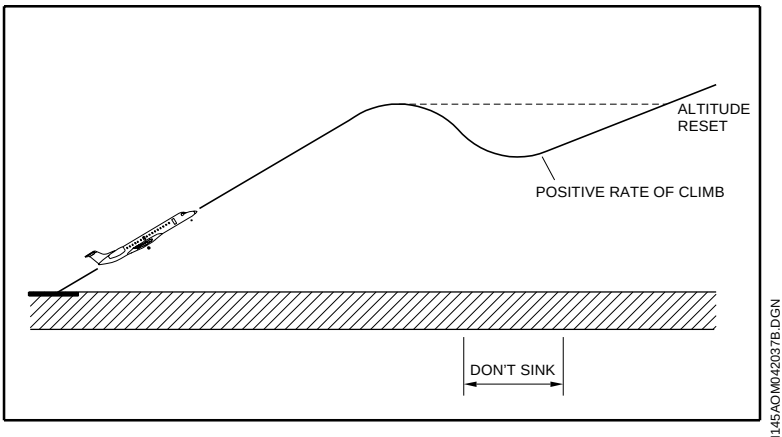
**MODE 3 ALTITUDE LOSS AFTER TAKEOFF**




**GPWS/EGPWS MODE 3 SCHEMATIC**



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## MODE 4 - INSUFFICIENT TERRAIN CLEARANCE

Mode 4 provides alerts for insufficient terrain clearance with respect to phase of flight and speed. Mode 4 exists in three forms, 4A, 4B and 4C.

### MODE 4A

Mode 4A is active during cruise and approach with the landing gear UP.

Minimum Terrain Clearance (MTC) for "**TOO LOW GEAR**" message triggering:

- Minimum: 30 ft.
- Maximum: 500 ft for an airspeed equal or less than 190 KIAS.

Minimum Terrain Clearance (MTC) for "**TOO LOW TERRAIN"** message triggering:

- Minimum: 30 ft.
- Maximum: 1000 ft for an airspeed equal or higher than 250 KIAS.

If during cruise the ground is slowly getting closer and the airplane is not in the landing configuration or during approach with an unintentional gear up landing, the aural message "**TOO LOW TERRAIN**" will be sounded. Once the message has been issued, an additional 20% altitude loss is required for the issuing of a new message.

The "**GPWS"** warning message is displayed on EICAS for airplanes equipped with GPWS and the amber "**GND PROX"** indication on the PFD for airplanes equipped with EGPWS.

If the airplane penetrates below the 500 ft AGL boundary with the landing gear still up, the aural message will be **"TOO LOW GEAR".** Once a message is issued, an additional 20% altitude loss is required for the issuing of a new message.

The visual and aural messages cease when the mode 4A is exited.

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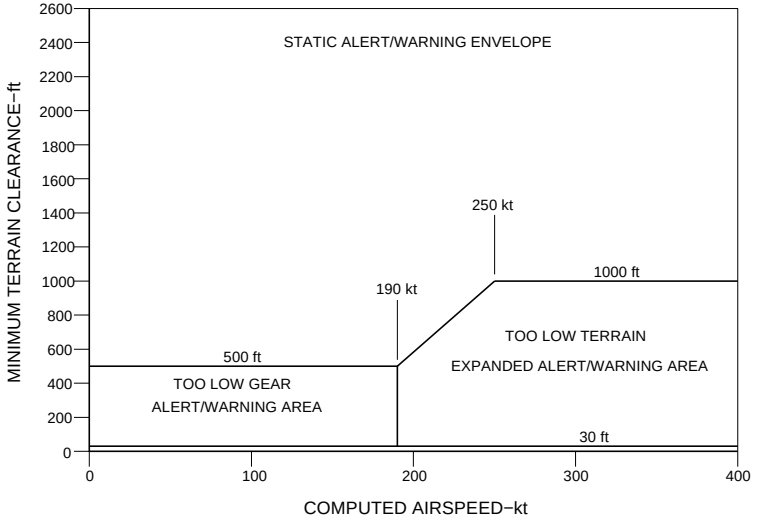
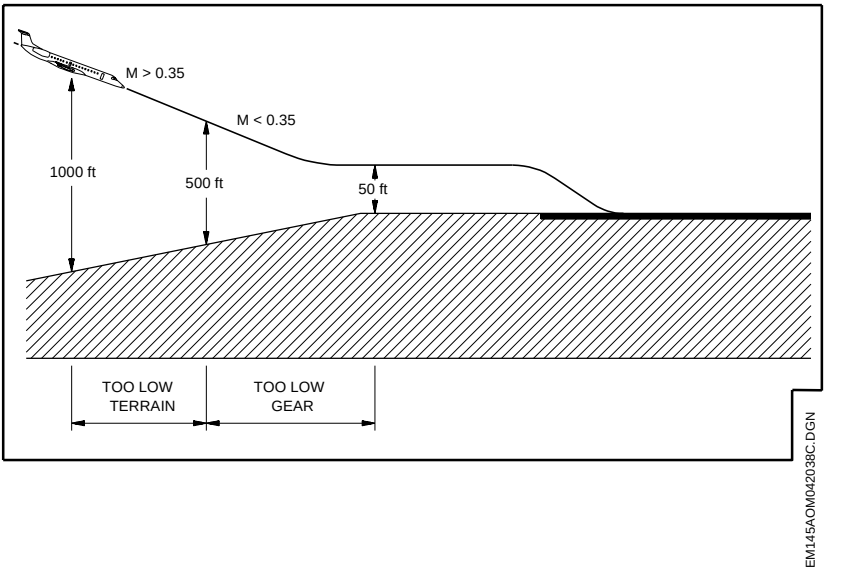
**MODE 4A MINIMUM TERRAIN CLEARANCE**




**GPWS/EGPWS MODE 4A SCHEMATIC**



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**MODE 4B**

Mode 4B is active during cruise and approach with the landing gear down and flaps in other than landing configuration.

Minimum Terrain Clearance (MTC) for "**TOO LOW FLAPS**" message triggering:

- Minimum: 30 ft.
- Maximum: 245 ft for an airspeed equal or less than 159 KIAS.

Minimum Terrain Clearance (MTC) for "**TOO LOW TERRAIN"** message triggering:

- Minimum: 30 ft.
- Maximum: 1000 ft for an airspeed equal or higher than 250 KIAS.

If during cruise the ground is slowly getting closer and the airplane is not in the landing configuration, or during approach with an unintentional gear up landing, the aural message "**TOO LOW TERRAIN**" will be sounded. Once the message is issued, an additional 20% altitude loss is required for the issuing of a new message.

The "**GPWS"** warning message is displayed on EICAS for airplanes equipped with GPWS and the amber "**GND PROX"** indication on the PFD for airplanes equipped with EGPWS.

If the airplane penetrates below the 245 ft AGL boundary with the landing gear down and flaps in other than landing configuration, the aural message will be **"TOO LOW FLAPS".** Once message is issued, an additional 20% altitude loss is required for the issuing of a new message.

The visual and aural messages cease when the mode 4B is exited.

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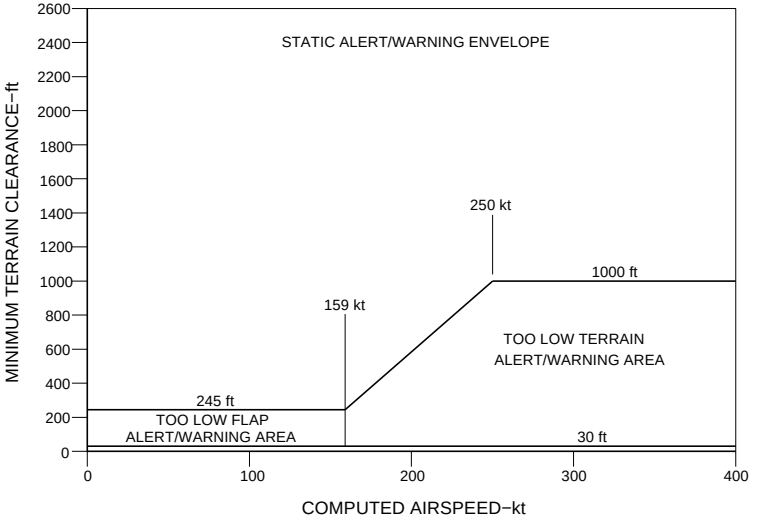
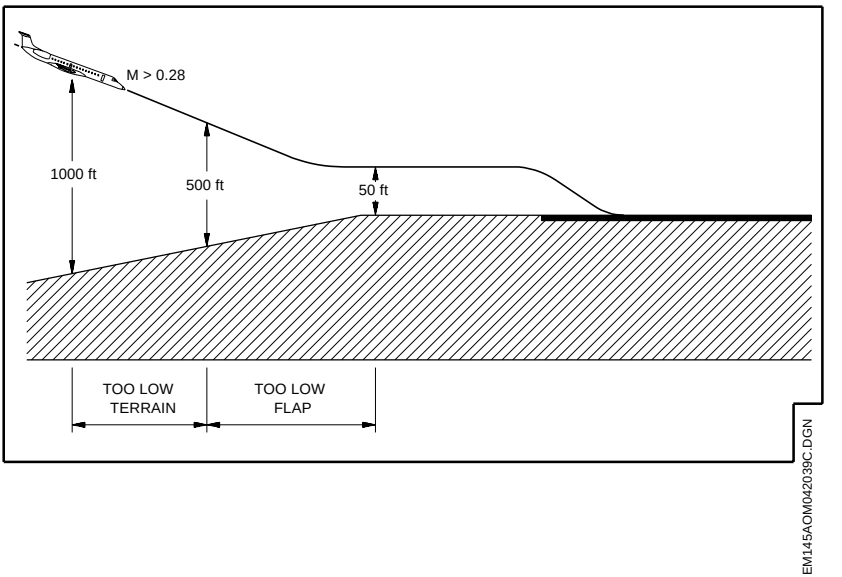
**MODE 4B MINIMUM TERRAIN CLEARANCE**




**GPWS/EGPWS MODE 4B SCHEMATIC**



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**MODE 4C**

Mode 4C is active during takeoff phase or low altitude go-around with either the landing gear or flaps in other than landing configuration, when the terrain is rising closer than the airplane is climbing.

Only in this case, the Minimum Terrain Clearance is a function of the Radio Altitude of the airplane.

Minimum Terrain Clearance (MTC) for "**TOO LOW TERRAIN**" message triggering:

- Minimum: 30 ft.
- Maximum:
  - 500 ft at 667 ft or greater of radio altitude for an airspeed less or equal or less than 190 KIAS.
  - 1000 ft at 1333 ft or greater of radio altitude for an airspeed equal or above 250 KIAS.

If during takeoff or low altitude go-around with either the landing gear or flaps in other than landing configuration, when the terrain is rising more steeply than the airplane is climbing, the aural message "**TOO LOW TERRAIN**" will be sounded.

The "**GPWS"** warning message is displayed on EICAS for airplanes equipped with GPWS and the amber "**GND PROX"** indication on the PFD for airplanes equipped with EGPWS.

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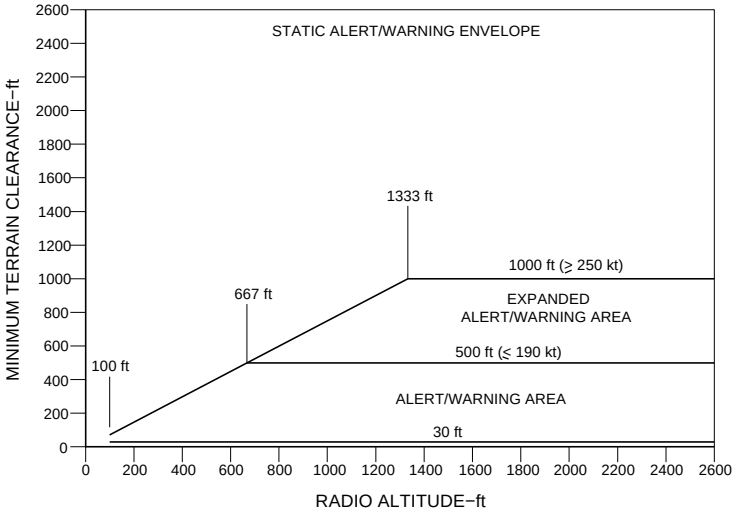
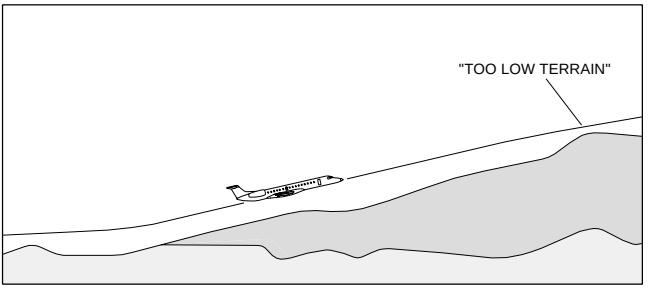
**MODE 4C MINIMUM TERRAIN CLEARANCE**

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## GPWS/EGPWS MODE 4C SCHEMATIC



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## MODE 5 - EXCESSIVE DEVIATION BELOW GLIDESLOPE BEAM

Mode 5 provides two levels of alerting if the airplane's flight path descends below the glideslope on ILS approaches.

Minimum Terrain Clearance (MTC) for "**GLIDESLOPE**" message triggering:

- Minimum:
  - For the Soft Alert Area, 30 ft at 2.98 dots of glideslope deviation.
  - For the Hard Alert Area, 30 ft at 3.68 dots of glideslope deviation.
- Maximum:
  - For the Soft Alert Area 1000 ft.
  - For the Hard Alert Area 300 ft.

The first alert occurs whenever the airplane is more than 1.3 dots below the beam and is called a "soft alert" because the volume level is reduced. A second alert occurs below 300 ft radio altitude with greater than 2 dots deviation from glideslope and is louder or "hard".

The aural message "**GLIDESLOPE**" is sounded once. Follow-on alerts are only allowed when the airplane descends lower on the glideslope beam by approximately 20%. Aural messages are sounded continuously once the airplane exceeds 2 dots.

The "**GPWS"** warning message is displayed on EICAS for airplanes equipped with GPWS and the amber "**GND PROX"** indication on the PFD for airplanes equipped with EGPWS.

The glideslope warning can be canceled by pressing the Master Caution Button.

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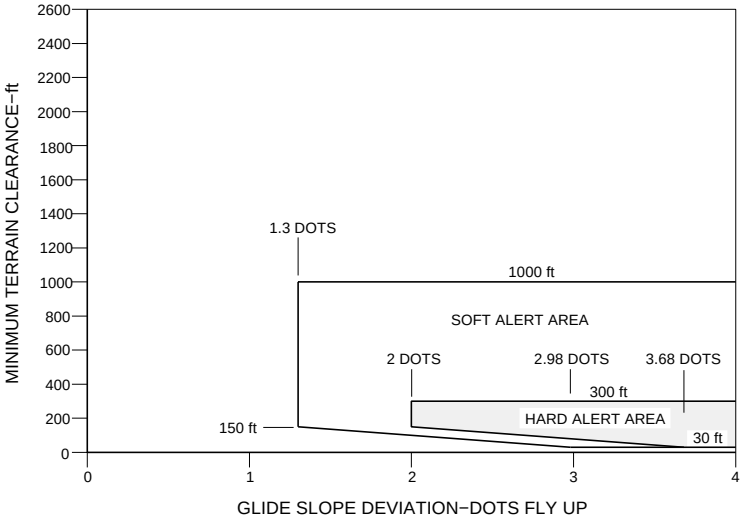
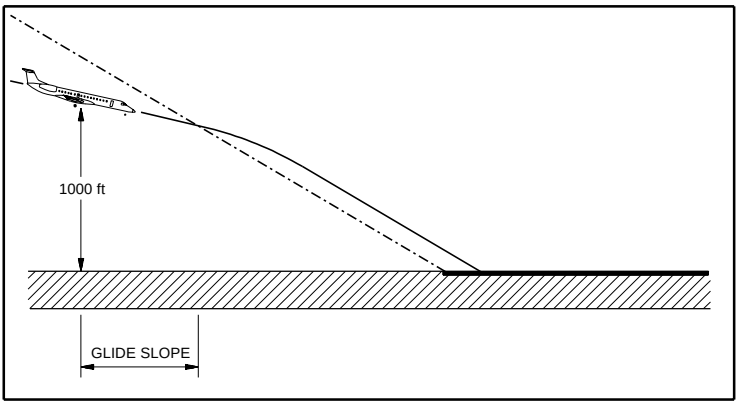
**MODE 5 EXCESSIVE GLIDE SLOPE DEVIATION**

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## GPWS/EGPWS MODE 5 SCHEMATIC



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## MODE 6 - CALLOUTS

Mode 6 provides aural messages for descent below predefined altitudes, decision height, a minimums setting and approaching minimums. Alerts for excessive roll or bank angle are also provided.

There are two configurations of EGPWS callouts certified for the EMB-145 family.

| | MINIMUMS CALLOUTS | ALTITUDE CALLOUTS |
|---|---|---|
| **CONFIGURATION 1** | "APPROACHING MINIMUMS"<br>"MINIMUMS MINIMUMS" | "FIVE HUNDRED"<br>"TWO HUNDRED"<br>"ONE HUNDRED" |
| **CONFIGURATION 2** | "APPROACHING MINIMUMS"<br>"MINIMUMS" | "ONE THOUSAND"<br>"FIVE HUNDRED"<br>"FOUR HUNDRED"<br>"THREE HUNDRED"<br>"TWO HUNDRED"<br>"ONE HUNDRED"<br>"FIFTY"<br>"FORTY"<br>"THIRTY"<br>"TWENTY"<br>"TEN" |

**NOTE:** Any altitude callout above 200 ft is inhibited when the absolute value of DH or MDA is set within 30 ft from the subject callout altitude.

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**MINIMUMS CALLOUTS**

The message "**APPROACHING MINIMUMS**" is sounded only once when the airplane is 80 ft above the decision height or another target has been reached, with the landing gear down.

- Radio altitude for message triggering:
  - Minimum: 90 ft.
  - Maximum: 1000 ft.

The message "**MINIMUMS MINIMUMS**" or "**MINIMUMS**" is sounded only once when the airplane is at decision height or another target has been reached, with the landing gear down.

- Radio altitude for message triggering:
  - Minimum: 10 ft.
  - Maximum: 1000 ft.

Visual indication of minimum target is presented on PFD.

**ALTITUDE CALLOUTS**

The messages will be sounded when associated radio altitude has been reached, with the landing gear down.

For the Configuration 1, the "**FIVE HUNDRED**" message will only be sounded whether one or more of the following conditions are satisfied:

- ILS is not tuned or not available.
- ILS is tuned in a valid signal, but with a deviation greater than 2 dots of localizer or glideslope.
- If a backcourse approach is detected.

Radio altitude for message activation:

- Minimum: 50 ft.
- Maximum: 1000 ft.

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**BANK ANGLE CALLOUT**

Minimum Terrain Clearance (MTC) for message triggering for GPWS:

– Minimum: 0 ft.

– Maximum: Increases linearly from 30 ft at 10° of bank angle to 150 ft at 40° then from 150 ft at 40° up to 2450 ft at 40°.

Minimum Terrain Clearance (MTC) for message triggering for EGPWS:

– Minimum: 5 ft.

– Maximum: Increases linearly from 30 ft at 10° of bank angle to 150 ft at 40° then from 150 ft at 40° up to 2450 ft at 55°, remaining constant at 55° above 2450 ft.

The aural message "**BANK ANGLE, BANK ANGLE**" is sounded when the airplane bank angle is too high or roll rate exceeds 1°/sec during all phases of flight.

The message is generated again if bank angle increases by 20%.

For airplanes equipped with EGPWS, when roll attitude increases to 40% above the initial callout angle, the callout will repeat continuously.

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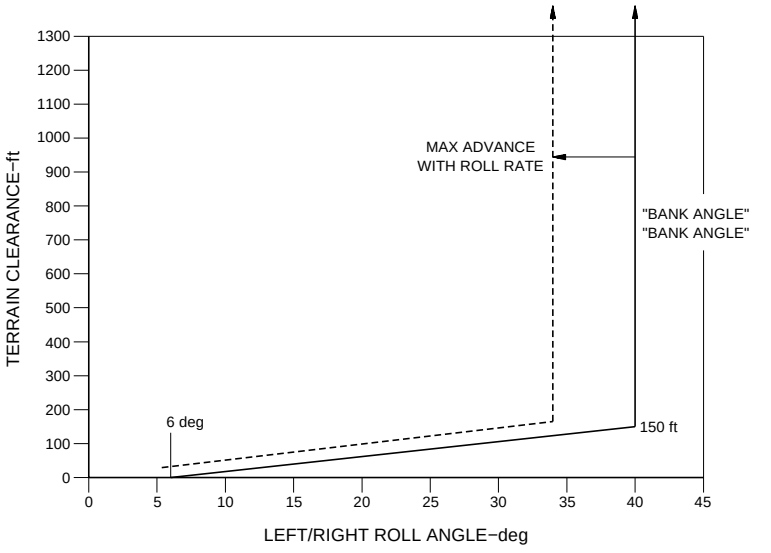
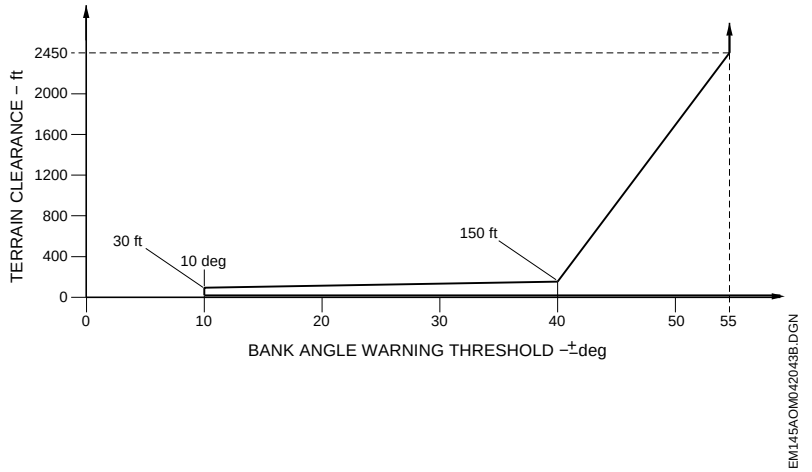



**GPWS MODE 6 - SCHEMATIC**
**BANK ANGLE CALLOUT**




**EGPWS MODE 6 - SCHEMATIC**
**BANK ANGLE CALLOUT**

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# EGPWS FEATURES

The EGPWS incorporates GPWS functions with added features including the Terrain Clearance Floor, Terrain Look Ahead Alerting and Terrain Awareness Display. Airplanes equipped with EGPWS version 216 incorporates additional features like Peaks Mode, Runway Field Clearance Floor, Obstacle Alerting and Geometric Altitude.

## TERRAIN CLEARANCE FLOOR

The Terrain Clearance Floor (TCF) provides a terrain clearance circular envelope around the airport runway, alerting the pilot of a possible premature descent for non-precision approaches regardless of the airplane's configuration. The TCF is active during takeoff, cruise and final approach and is based on current airplane position, nearest runway and radio altitude.

This alert mode complements the Mode 4 by providing an alert based on insufficient terrain clearance even when the airplane is in the landing configuration.

TCF alerts display "**GRND PROX**" on the PFD and the aural message "**TOO LOW TERRAIN**" sounds. This message sounds once when initial envelope penetration occurs and will repeat at every additional 20% decrease in radio altitude. The "**GRND PROX**" annunciator remains on until the TCF envelope is exited.

In the EGPWS version 216, the TCF alert provides an envelope extension for runway sides, which is limited to a minimum value of 245 ft beside the runway, within 1 NM to 2.5 NM from runway end. This feature provides improved alerting when it is determined that the airplane is landing to the side of the runway.

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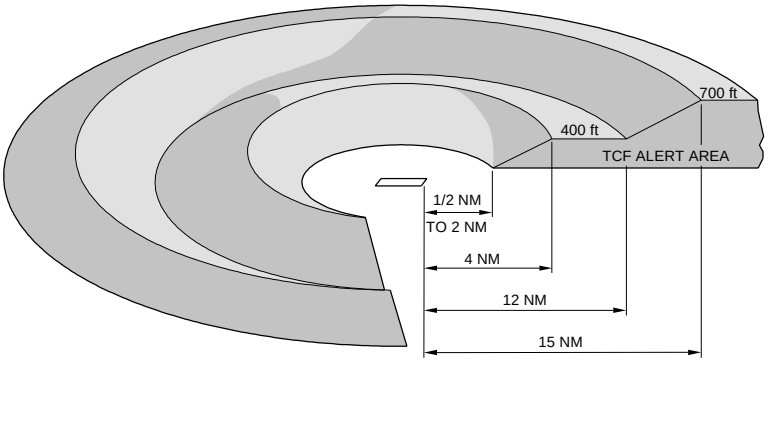


## TCF ALERT ENVELOPE

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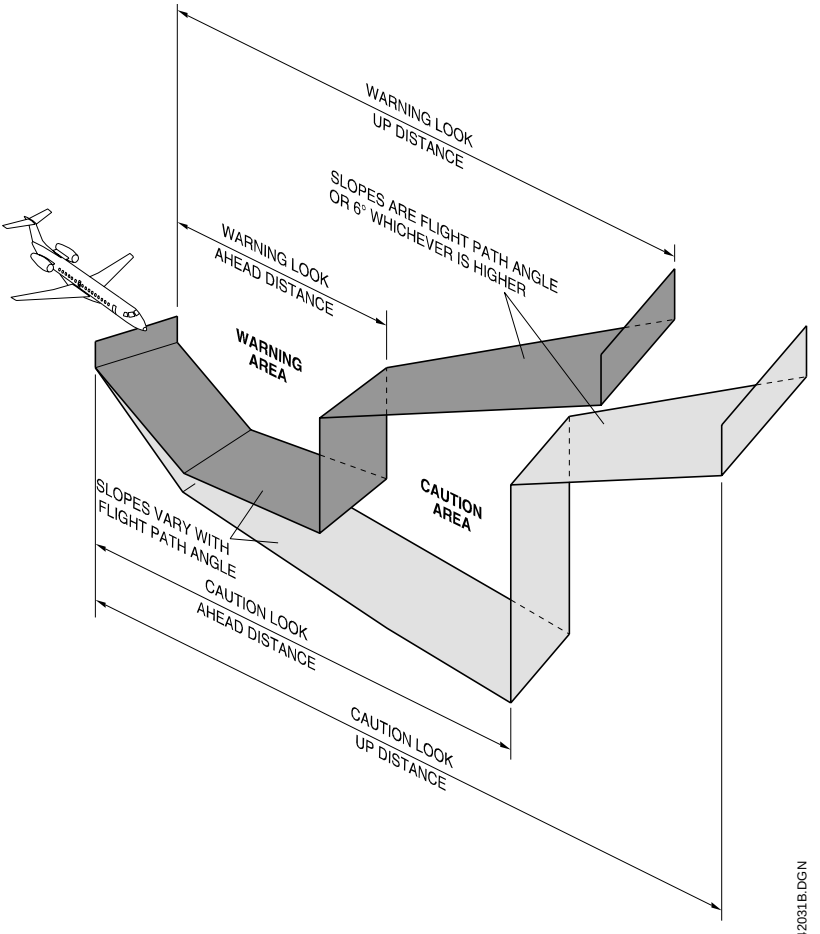
## TERRAIN LOOK AHEAD ALERTING

The Terrain Look Ahead Alerting provides a caution/warning level to alert the flight crew about potential terrain conflicts. The alerts are based mainly on the airplane's current position and barometric altitude information. In the event of terrain caution or warning conditions, a specific audio alert and visual alert are triggered and the terrain display image is enhanced to highlight each of the types of terrain threats.

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**TERRAIN WARNING AND CAUTION AREAS**



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When conditions are such as to generate a Terrain Caution alert (approximately 60 seconds prior to potential terrain conflict), the aural message "**CAUTION TERRAIN, CAUTION TERRAIN**" is sounded and the amber "**GND PROX"** indication is displayed on the PFD. This is repeated every seven seconds as long as the airplane is still in the caution envelope.

When conditions have been met to generate a Terrain Warning alert (approximately 30 seconds prior to potential terrain conflict), the aural message "**TERRAIN, TERRAIN, PULL UP**" is sounded and the red "**PULL UP"** indication is displayed on the PFD.

The terrain image will appear automatically on the MFD when a terrain threat event occurs.

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**TERRAIN AWARENESS DISPLAY**

The EGPWS terrain display is designed to increase flight crew awareness of the surrounding terrain in varying density dots patterns of green, yellow and red. These dot patterns represent specific terrain separation with respect to the airplane. The following table relates the color that the terrain is displayed with its meaning:

| COLOR | MEANING |
|---|---|
| Solid red | Warning Terrain (Approximately 30 sec from impact). |
| Solid yellow | Caution Terrain (Approximately 60 sec from impact). |
| High density red dots | Terrain that is more than 2000 ft above airplane altitude. |
| High density yellow dots | Terrain that is between 1000 and 2000 ft above airplane altitude. |
| Medium density yellow dots | Terrain that is between 500 ft (250 ft with gear down) below and 1000 ft above airplane altitude. |
| Medium density green dots | Terrain that is between 500 ft (250 ft with gear down) to 1000 ft below airplane altitude. |
| Light density green dots | Terrain that is 1000 to 2000 ft below airplane altitude. |
| Black | Terrain below 2000 ft. |

**NOTE: -** Terrain is not shown if its elevation is within 400 ft of runway elevation of the nearest airport.

- To reduce clutter on the display, any terrain more than 2000 ft below the airplane is not displayed.
- Terrain that is not covered in the EGPWS database will be displayed in magenta.

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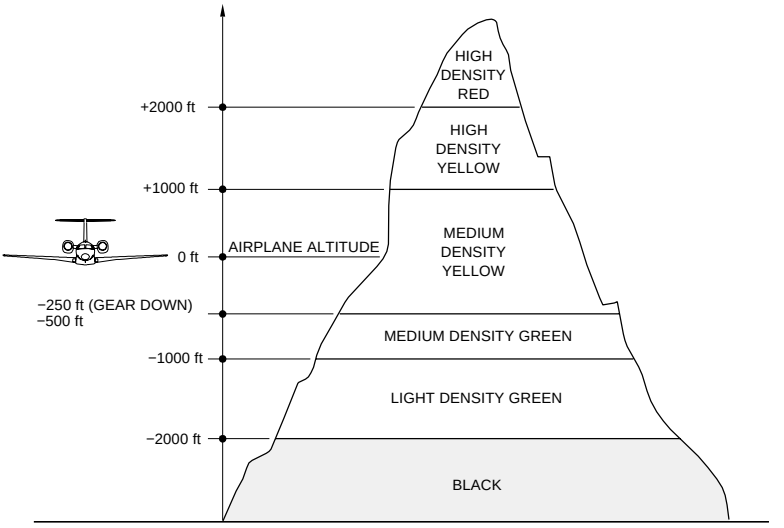
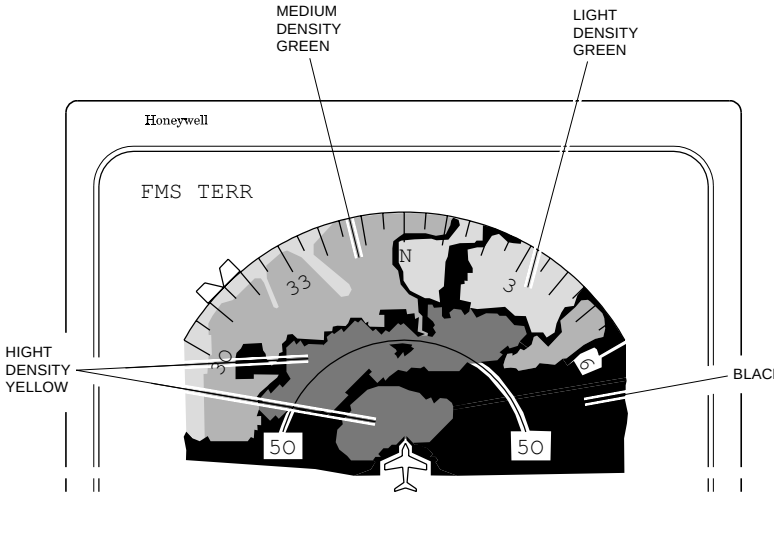



## EGPWS DISPLAY COLOR CODING




## EXAMPLE OF EGPWS DISPLAY ON MFD

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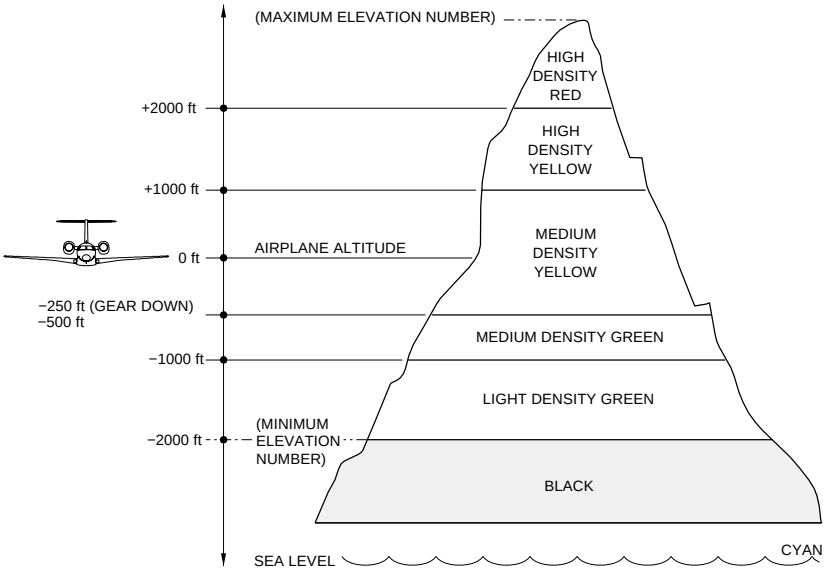
## PEAKS MODE

This is a feature provided only by EGPWS version 216 and, when selected, adds additional density patterns and level thresholds to the standard mode display levels and allows the terrain to be displayed during the cruise phase even if it is more than 2000 ft below the airplane.

When the Peaks display is on, elevation numbers indicating the highest and lowest terrain/obstacle currently being displayed are shown on the display. These elevations are expressed in hundreds of feet above sea level (MSL) with the highest elevation on top and the lowest on the bottom. In the event that there is no appreciable difference in the terrain/obstacle elevations, only the highest value is displayed.

The color of the elevation value displayed matches the color of the terrain displayed.

If the airplane is 500 ft (250 ft with landing gear down) or less above the terrain in the displayed range, the peaks color displayed will be identical to the terrain awareness display mode, with the exception of sea level displayed as cyan.




**PEAKS PROFILE AT A LOW RELATIVE ALTITUDE**

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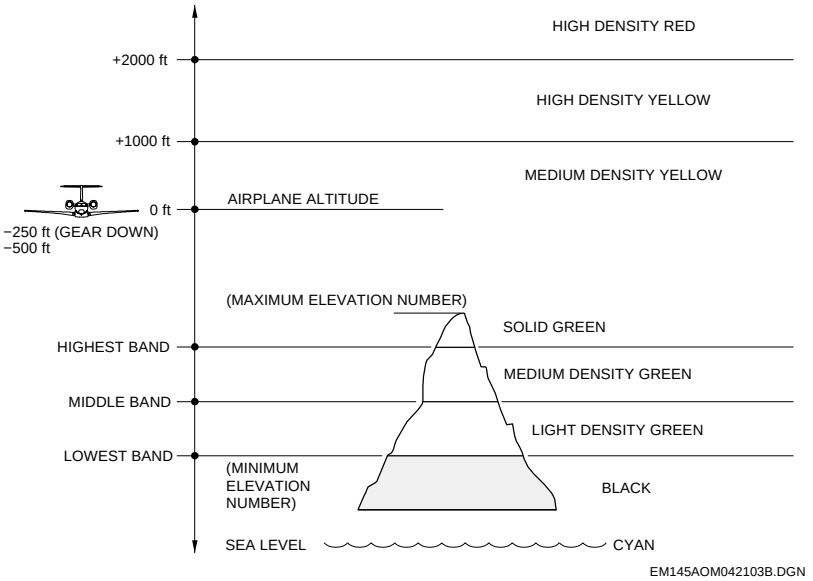
When the airplane is greater than 500 ft (250 ft with landing gear down) above all terrain in the displayed range, no yellow or red bands are displayed and low density green, medium density green and solid green will be displayed as a function of the highest and lowest elevations in view. Moreover, sea level elevations can be displayed as cyan to simulate water.




**PEAKS PROFILE AT A HIGH RELATIVE ALTITUDE**

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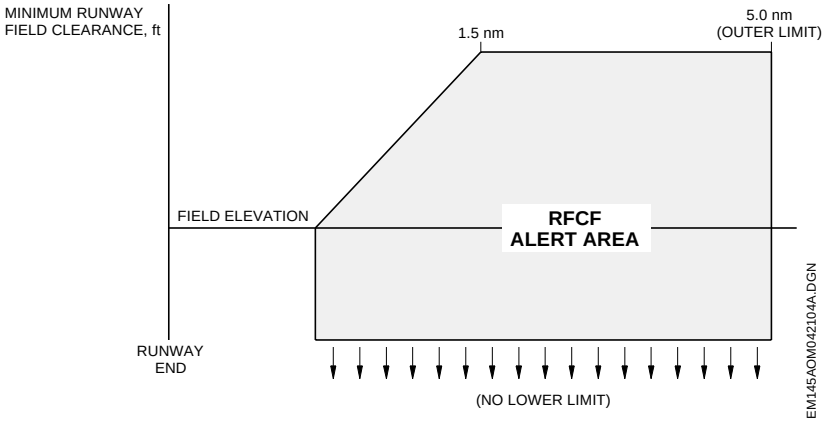
## RUNWAY FIELD CLEARANCE FLOOR

Runway Field Clearance Floor (RFCF) is a second clearance floor in addition to TCF in EGPWS version 216. While TCF uses radio altitude, RFCF determines the airplane height above the runway using geometric altitude by subtracting the elevation of the selected destination runway from the current altitude (MSL). This feature provides improved alerting for cases where the runway is at a high elevation compared to the terrain below the approach path.




**RFCF ALERT ENVELOPE**

RFCF alerts display “**GRND PROX**” on the PFD and the aural message "**TOO LOW TERRAIN**" sounds. This message sounds once when initial envelope penetration occurs and will repeat at every additional 20% decrease in radio altitude.

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## OBSTACLE ALERTING

A database of man-made obstacles is stored internal to the EGPWS version 216. The terrain "cell" on which the obstacle resides is coded as an obstacle with an elevation equal to the obstacles MSL height.
The same software algorithms that detect and display terrain conflict are used to detect and display obstacle conflict. If any obstacle is "seen" in the database by the algorithms, annunciators are illuminated and voice "**CAUTION OBSTACLE**" sounds approximately 45 seconds prior to potencial terrain conflict and the aural "**OBSTACLE OBSTACLE PULL UP**" sounds approximately 30 seconds prior to potencial terrain conflict.

## GEOMETRIC ALTITUDE

EGPWS version 216 and on uses Geometric Altitude algorithm to determine airplane altitude. The Geometric Altitude computation uses an improved pressure altitude calculation, GPS altitude, radio altitude, terrain and runway elevation data to reduce or eliminate errors potentially induced in corrected barometric altitude by temperature extremes, non-standard altitude conditions and altimeter miss-sets. Geometric Altitude also allows continuous EGPWS operations in QFE environments without custom inputs or special operational procedures.

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## WARNING PRIORITIES

The GPWS/EGPWS warning priorities are listed below. Messages at the top will start before or override a lower priority message even if it is already in progress.

| MESSAGE | MODE |
|---|---|
| PULL UP | 1 and 2 |
| TERRAIN TERRAIN | 2 and Terrain Look-Ahead |
| PULL UP | Terrain Look-Ahead |
| TERRAIN | 2 |
| MINIMUMS MINIMUMS | 6 |
| CAUTION TERRAIN | Terrain-Look Ahead |
| TOO LOW TERRAIN | 4 and Terrain Clearance Floor |
| ALTITUDE CALLOUTS | 6 |
| TOO LOW GEAR | 4 |
| TOO LOW FLAPS | 4 |
| SINKRATE | 1 |
| DON'T SINK | 3 |
| GLIDESLOPE | 5 |
| APPROACHING MINIMUMS | 6 |
| BANK ANGLE | 6 |

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# EICAS MESSAGES

## GPWS

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | GPWS | One GPWS envelope, associated to Modes 1 to 4, has been penetrated. |
| CAUTION | GPWS INOP | GPWS monitor has detected an internal failure. |

## EGPWS

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | GPWS | One GPWS envelope, associated to Modes 1 to 4, has been penetrated. |
| CAUTION | GPWS INOP | GPWS monitor has detected an internal failure. |
| | TERR INOP | Terrain mode is not available. |

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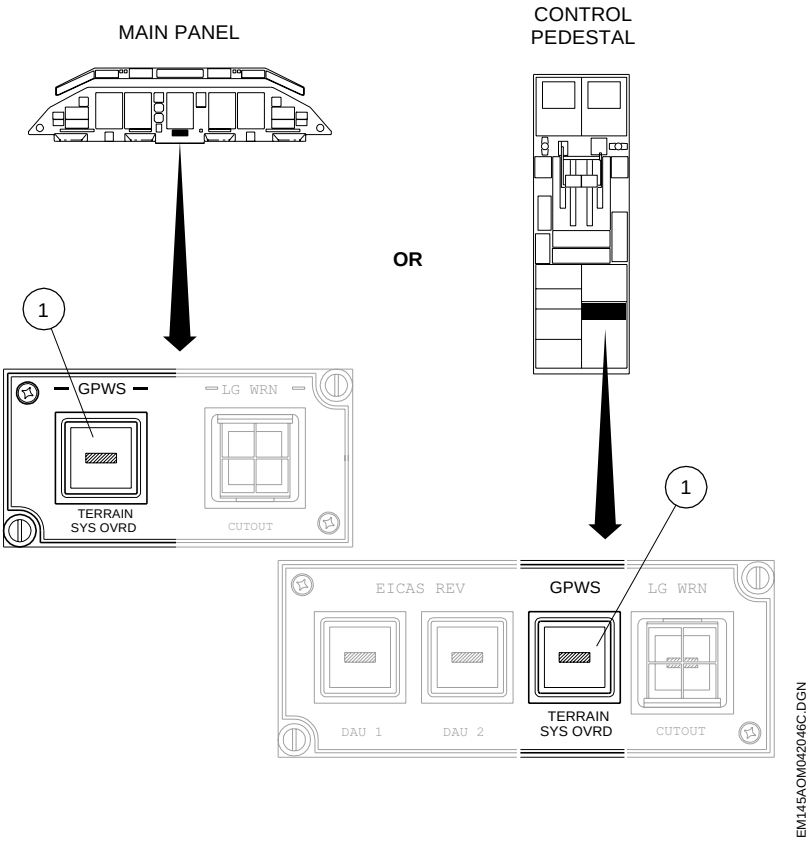
# CONTROLS AND INDICATORS

## 1 - EGPWS TERRAIN SYSTEM OVERRIDE BUTTON

– When pressed, inhibits EGPWS in approach mode, thus avoiding unwanted terrain alerts in airports not covered by EGPWS database.




**EGPWS TERRAIN SYSTEM OVERRIDE BUTTON**

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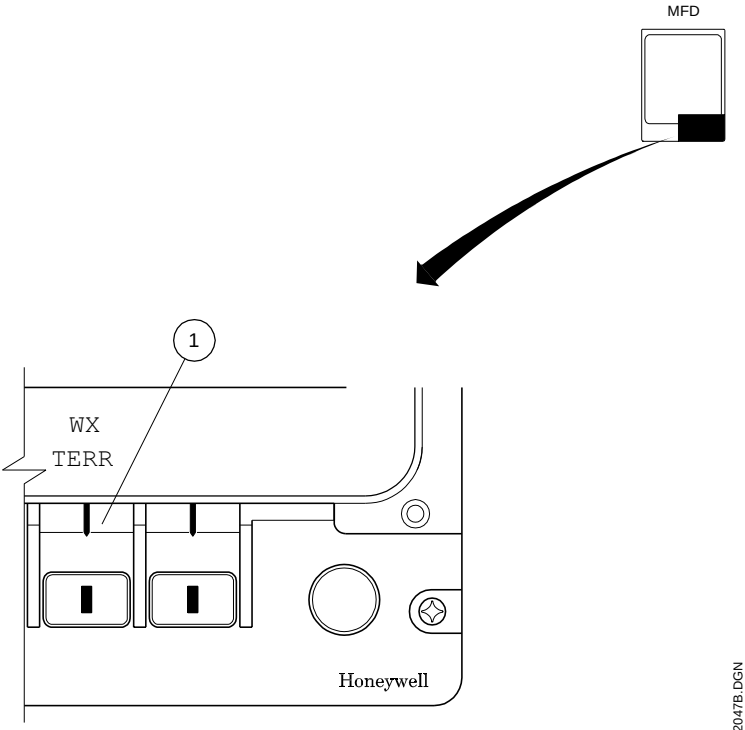
## MFD BEZEL PANEL

### 1 - EGPWS DISPLAY SELECTOR BUTTON

- Alternate pressing will cause the MFD to toggle between the weather radar or terrain to be displayed.
- The ranges allowed are: 5 NM, 10 NM, 25 NM, 50 NM, 100 NM, 200 NM, 300 NM, 500 NM and 1000 NM.
- When a terrain warning/caution condition exists and the terrain is not selected on the MFD, the terrain will be automatically displayed on the MFD with a range of 10 NM.

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**MFD BEZEL PANEL**

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## EGPWS DISPLAY ON MFD

### 1 - TERRAIN ANNUNCIATIONS

| LABEL | COLOR | CONDITION |
|---|---|---|
| TERR<br>(Upper left corner) | Cyan | Lit when terrain mode is selected. |
| TERR FAIL | Amber | Lit when terrain mode is inoperative. |
| TERR INHIB for Terrain Inhibition | White | Lit when the EGPWS terrain system override button is pressed in approach mode. |
| TERR N/A | Amber | Lit when EGPWS is uncertain of the airplane's position. |
| TERR TEST | Red | Lit when the self test is activated. |
| TERR<br>(Center) | Amber | Lit when terrain picture bus fails (Airplanes equipped with EICAS version 15). |

### 2 - TERRAIN INDICATION

– Displays an image of surrounding terrain in varying density dot patterns of green, yellow and red. These dot patterns represent specific terrain separation with respect to the airplane. The display is generated from airplane altitude compared to terrain data.

### 3 - TERRAIN ALERT INDICATION

– Indicates a terrain warning or caution condition.

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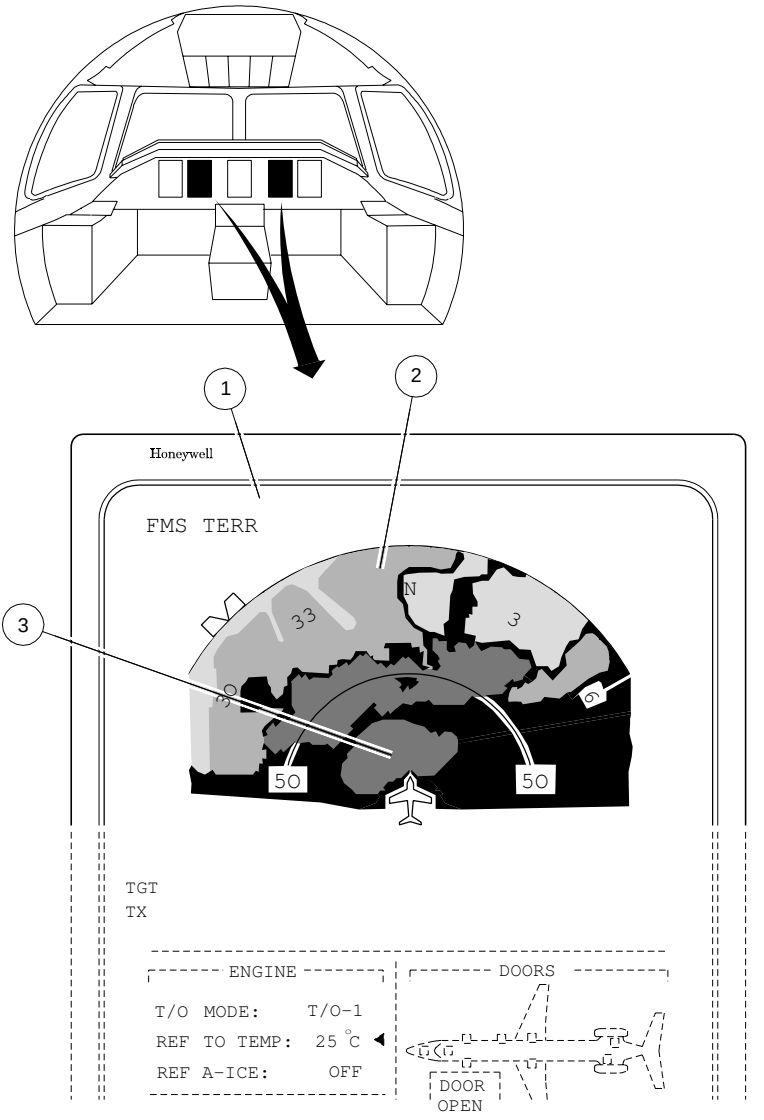


**EGPWS DISPLAY ON MFD**

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## DISPLAY ON PFD

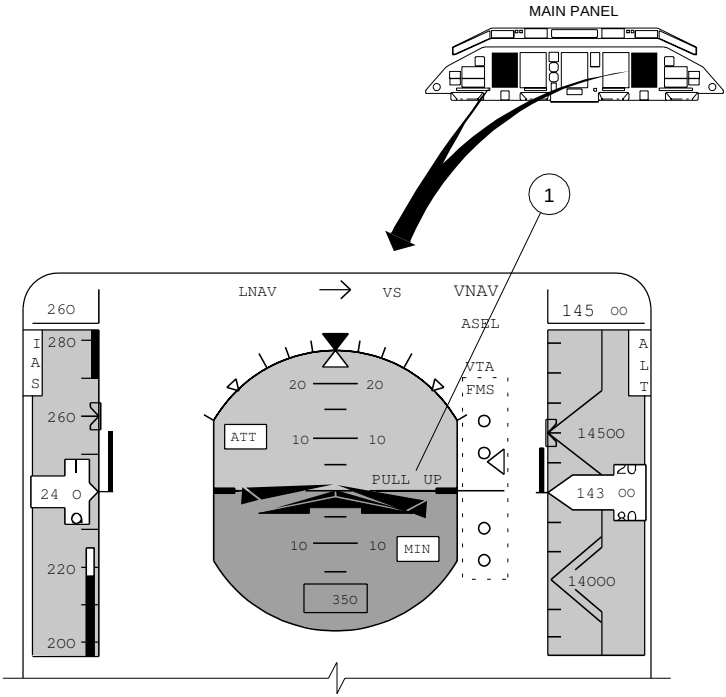
### GPWS

Refer to Section 2-17 - Flight Instruments.

### EGPWS

### 1 - PULL UP/GROUND PROXIMITY ANNUNCIATIONS

- Label: PULL UP (red)
  GND PROX for Ground Proximity (amber).
- PULL UP is lit when either modes 1 or 2 have been activated in their more critical situation.
- GND PROX is lit when ground is getting closer too fast.

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**EGPWS DISPLAY ON PFD**



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## STEEP APPROACH OPERATION

Some airplanes may be optionally equipped with Steep Approach function. Steep approaches are approach operations performed with glide slope angle equals to or above 4.5°. This kind of operation implies to the airplane a vertical speed higher than the normal, requiring means to change the range of the EGPWS Mode 1 envelope in order to avoid nuisance messages.

The Steep Approach mode is selected by means of two pushbuttons installed on the glareshield panel, one at each side. When either pushbutton is pressed, an internally preset mode of the EGPWS changes the references to sound the SINK RATE and PULL UP aural warnings.

When the airplane is in flight and the flaps are selected to 45°, the STEEP white light illuminates on the Steep Approach pushbutton indicating that the Steep Approach mode is available. When either the flaps are retracted to a position other than 45° or airplane lands, the STEEP white light extinguishes indicating that the Steep Approach mode is no longer available.

The pushbutton lower portion has two status lights, amber and green. The green light indicates that the Steep Approach mode is engaged and the amber light indicates a failure condition.

If the amber light turns on, it indicates that the Steep Approach mode is failed and steep approach operations must not be performed. In this situation, the Steep Approach mode is not engaged and the airplane must land in an airport that does not require steep approach operation.

In flight, with the STEEP inscription illuminated, if the Steep Approach pushbutton is pressed, the green light illuminates to indicate that the Steep Approach mode is engaged. If the green light does not illuminate, the Steep Approach mode is not engaged and the steep approach operation must not be performed.

The Steep Approach mode is deselected pressing the pushbutton or through automatic deselection. An automatic deselection of the Steep Approach mode is performed when:

– Airplane is on the ground;

– Flaps are set to a position other than 45°.

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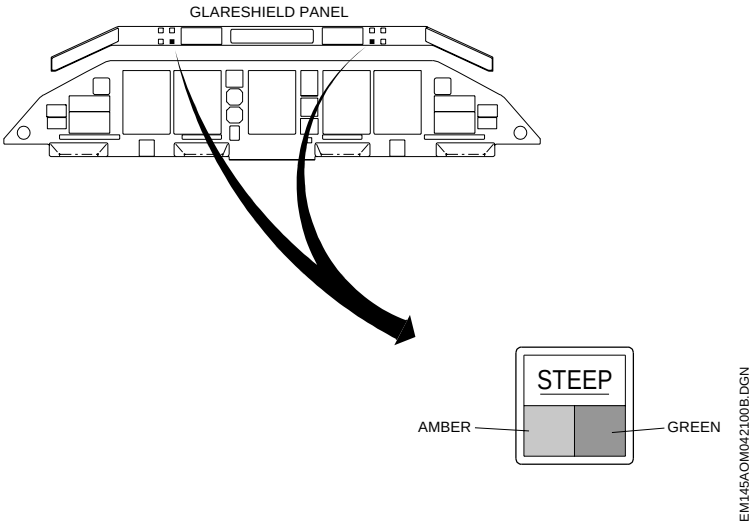


**STEEP APPROACH MODE PUSHBUTTON**

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## CONTROLS AND INDICATORS

### STEEP APPROACH PUSHBUTTON

| LIGHT INDICATION | MODE DESCRIPTION |
|---|---|
| STEEP | Illuminates in white color when the airplane is in the air and the flaps are in 45°. This means that the Steep Approach mode is available. |
| GREEN LIGHT | Illuminates when the button is pressed with the STEEP light illuminated. This means that the Steep Approach mode is engaged.<br><br>With the STEEP light illuminated, if the green light does not illuminates when the pushbutton is pressed, means that the Steep Approach is not engaged; in this case, do not perform Steep Approach operations. |
| AMBER LIGHT | The Steep Approach mode is failed. Do not perform Steep Approach operations. In this situation, the Steep Approach mode is not engaged and the airplane must land in an airport that not requires steep approach operation. |

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# WINDSHEAR DETECTION AND ESCAPE GUIDANCE SYSTEM

The EMB-145 is equipped with an additional warning system dedicated to windshear detection. The system provides visual and aural alarms to warn pilots of a windshear occurrence, as well as the most appropriate maneuver to recover from such phenomenon.

The Windshear Detection function is performed by the EGPWS computer, which also performs ground proximity warning functions. The Windshear Escape Guidance is a Flight Director mode provided by the avionics package.

## WINDSHEAR GENERAL INFORMATION

Windshear is a sudden change in wind direction or speed, normally caused by thunderstorms, frontal systems or any topographical feature that may affect the wind flow (e.g. hills, mountains, lakes, seas etc...).

Due to ground proximity, the most hazardous phases of flight regarding windshear encounters are takeoff, approach and landing. On a windshear, wind may shift from a tailwind to a headwind or to a downdraft or updraft. The consequences may be an abrupt change in airspeed, lift and altitude, upwards or downwards, according to shifting direction. Although quick, windshear is not instantaneous, which may lead pilots to correction attempts in the wrong manner. For instance, an airplane facing a headwind after takeoff, appears to have good performance, characterized by high airspeed, which drives the pilot into rotating the airplane to a pitch higher than usual. When the thunderstorm core is reached, wind shifts to a downdraft and airspeed decreases, as well as vertical speed. The pilot's natural reaction is to lower the airplane's nose in an attempt to maintain airspeed. Further ahead, wind shifts to tailwind component, resulting in a dramatic airspeed reduction with the nose already down. Under such scenario, it is very difficult to maintain a positive rate of climb.
If the takeoff or landing can not be delayed, the correct action is to increase airspeed before being subjected to windshear encounter and to consider flying near stall speeds with high angle of attack if necessary to regain altitude.

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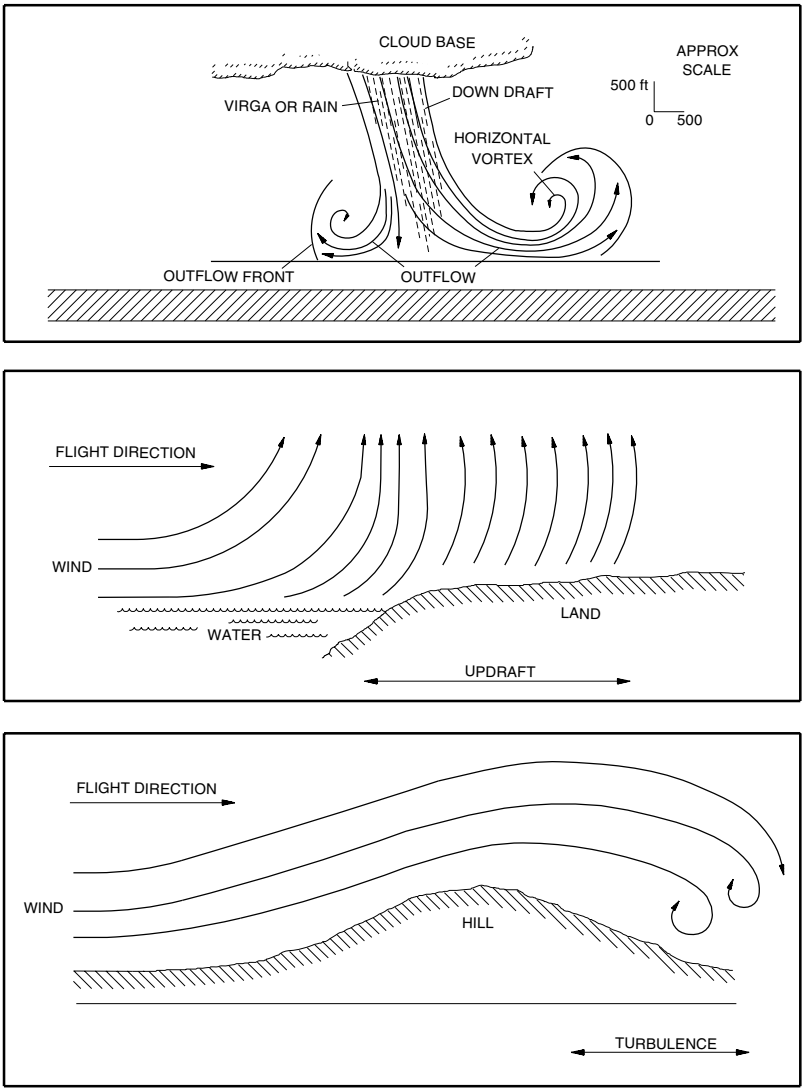


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**KINDS OF WINDSHEAR**

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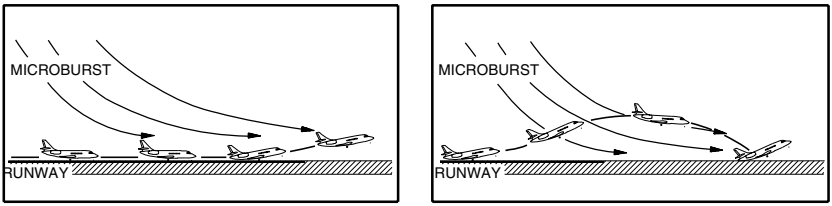
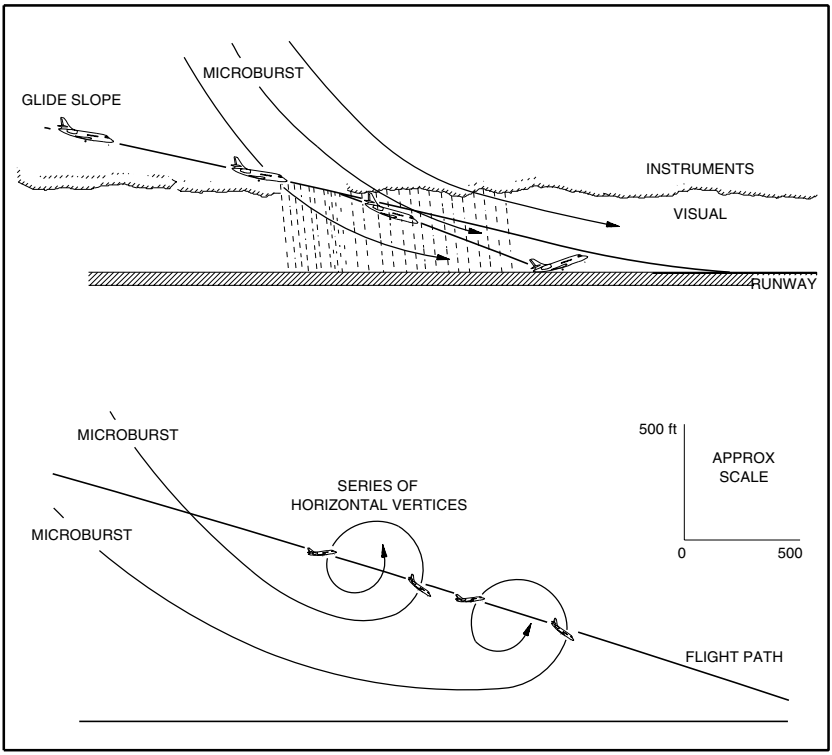



**WINDSHEAR EFFECT DURING TAKEOFF**




**WINDSHEAR EFFECT DURING LANDING**

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## WINDSHEAR EFFECTS

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## WINDSHEAR DETECTION

The windshear detection system is designed to identify the presence of severe windshear phenomenon and to provide timely warnings and adequate flight guidance for approach, missed approach, takeoff and climb out.

The windshear computer exchanges data with AHRS, ADC, SPS, Radio Altimeter and IC-600s. The system continuously searches for any windshear clue, and then signals the PFD and aural warning unit to provide the appropriate indications.

Windshear Caution alerts are given if the windshear consists of an increasing headwind (or decreasing tailwind) and/or severe updraft, which may precede an encounter with a microburst. Windshear cautions activate the Windshear Caution (WDSHEAR) amber indications on the upper left corner of both PFDs. On airplanes equipped with EGPWS, an aural message “CAUTION WINDSHEAR” is also triggered. Windshear Caution indications remain on for as long as the airplane remains exposed to an increasing headwind and/or updraft condition in excess of the alert threshold.

Windshear Warnings are given if the windshear consists of a decreasing headwind (or increasing tailwind) and/or severe downdraft. Windshear warnings activate the Windshear Warning (WDSHEAR) red indication on both PFDs and trigger an aural message “WINDSHEAR, WINDSHEAR, WINDSHEAR”. This message will not be repeated unless another, separate, severe windshear event is encountered. Windshear Warning indications remain on for as long as the airplane remains exposed to a decreasing headwind and/or downdraft in excess of the alert threshold. The threshold is adjusted in function of available climb performance, flight path angle, airspeeds significantly different from normal approach speeds and unusual fluctuations in Static Air Temperature (typically associated with the leading edges of microbursts).

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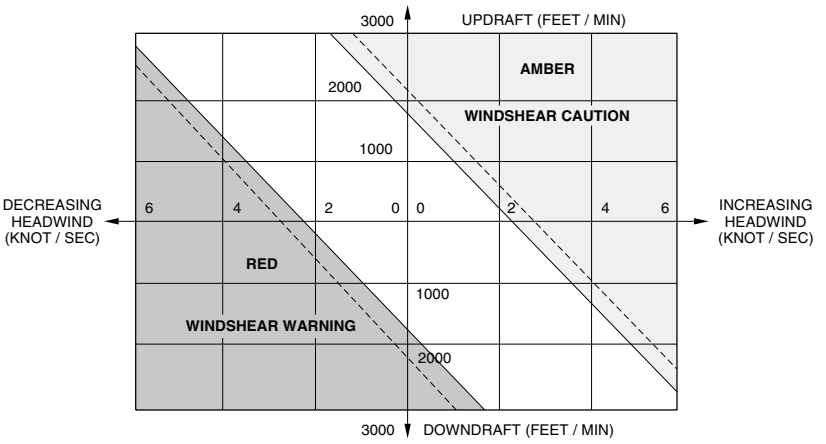


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## WINDSHEAR DETECTION

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## WINDSHEAR ESCAPE GUIDANCE MODE

The Windshear Escape Guidance mode is used to minimize altitude and speed loss during a windshear encounter. The strategy is to keep the airplane airborne until the windshear conditions subside or are exited.
The Windshear Escape Guidance Mode provides pitch command to recover from a windshear encounter. The amplitude of the pitch command will depend upon the airplane's performance and windshear severity and phase.

The Windshear Escape Guidance is a Flight Director mode engaged under the following conditions:

- Manually, by pressing the Go Around Button while a windshear condition (increasing/decreasing performance) is detected;
- Automatically, when in Go Around or Takeoff Mode and a windshear condition (increasing/decreasing performance) is detected;
- Automatically, when Thrust Levers Angle is above 78° and a decreasing performance windshear is detected (windshear warning).

When the windshear escape guidance mode is engaged a green "WSHR" indication is displayed on both PFDs in the Vertical Mode field and a "ROLL" indication is displayed in the Lateral Mode field. Whenever the Windshear Escape Guidance mode is engaged, the Pitch Limit Indicator (PLI) symbol is drawn directly on the Attitude Display Indicator portion of the PFD. The PLI represents the remaining angle of attack margin before Stick Shaker triggering.

All other Flight Director modes are canceled and the following vertical modes are inhibited when a caution or warning windshear condition is presented:

- Altitude Preselect Mode, Go Around and Takeoff.

No lateral modes are inhibited while in the vertical mode of WSHR.

The Windshear Escape Guidance mode is designed to meet the following requirements, in the listed order of priorities:

- Prevent the airplane from stalling;
- Prevent the airplane from descending;
- Prevent the airplane from exceeding $V_{MO}$.

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The Windshear Escape Guidance Mode incorporates three control sub-modes:

- Alpha Sub-mode - The airplane can be commanded to descend in order to maintain airspeed when approaching stall conditions. If the flight path angle control results in an angle of attack beyond the stick shaker triggering angle, the windshear control law can keep the airplane angle of attack below the stick shaker threshold.
- Gamma Sub-mode - The airplane can be prevented from descending by commanding a positive flight path angle. A nominal flight path angle is used to allow an airspeed raise during an increasing performance windshear, in anticipation of a decreasing performance windshear, and also to minimize altitude loss during a decreasing performance windshear.
- Speed Target Sub-mode - The airplane is allowed to climb in order to exchange excessive kinetic energy for potential energy. If the control of the flight path angle results in an excessive speed increase, the windshear control law maintains the airplane indicated airspeed at the target speed.

The Windshear Escape Guidance mode will be canceled if any of the following conditions occur:

- FLC, VS, SPD or ALT Mode is selected;
- Invalid AHRS data;
- Invalid ADC data;
- Invalid Stall Protection Computer (SPC);
- Radio Altitude greater than 1500 ft.

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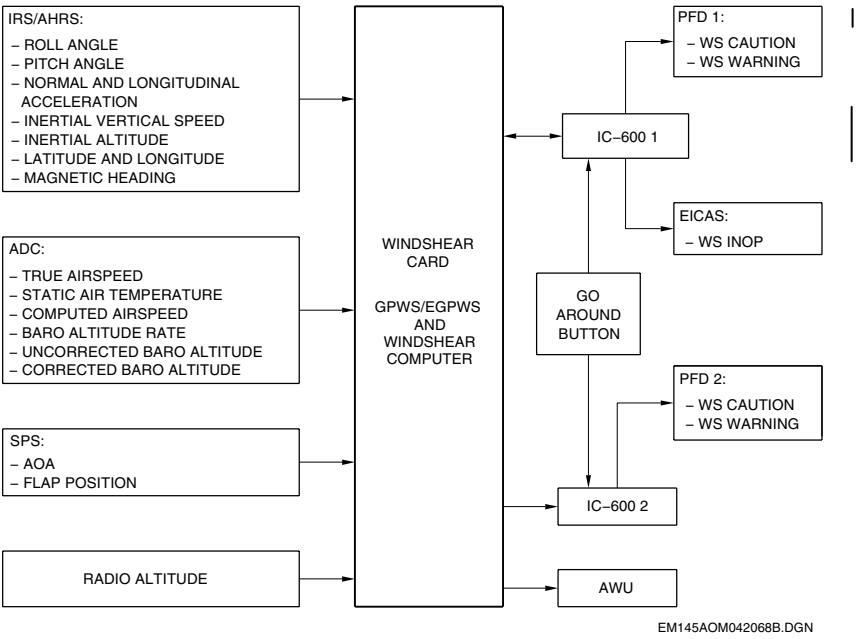


## WINDSHEAR DETECTION AND ESCAPE GUIDANCE SYSTEM SCHEMATIC

**NOTE:** Inertial vertical speed, inertial altitude, latitude and longitude are provided only for airplanes equipped with EGPWS.

## EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | WINDSHEAR INOP | Windshear detection and escape guidance system is inoperative. |

## CONTROLS AND INDICATORS

### PRIMARY FLIGHT DISPLAY

**1 - WINDSHEAR INDICATION**

- Indicates that a windshear has been detected.
- Color: amber or red depending on windshear severity.

**2 - ESCAPE GUIDANCE MODE ENGAGEMENT ANNUNCIATION**

- Indicates the Windshear Flight Guidance Escape Mode engagement.

**3 - PITCH LIMIT INDICATOR**

- Refer to Stall Protection System indicators in section 2-04-25.

**4 - FLIGHT GUIDANCE INDICATION**

- Indicates the appropriate pitch to be attained, during a windshear occurrence.

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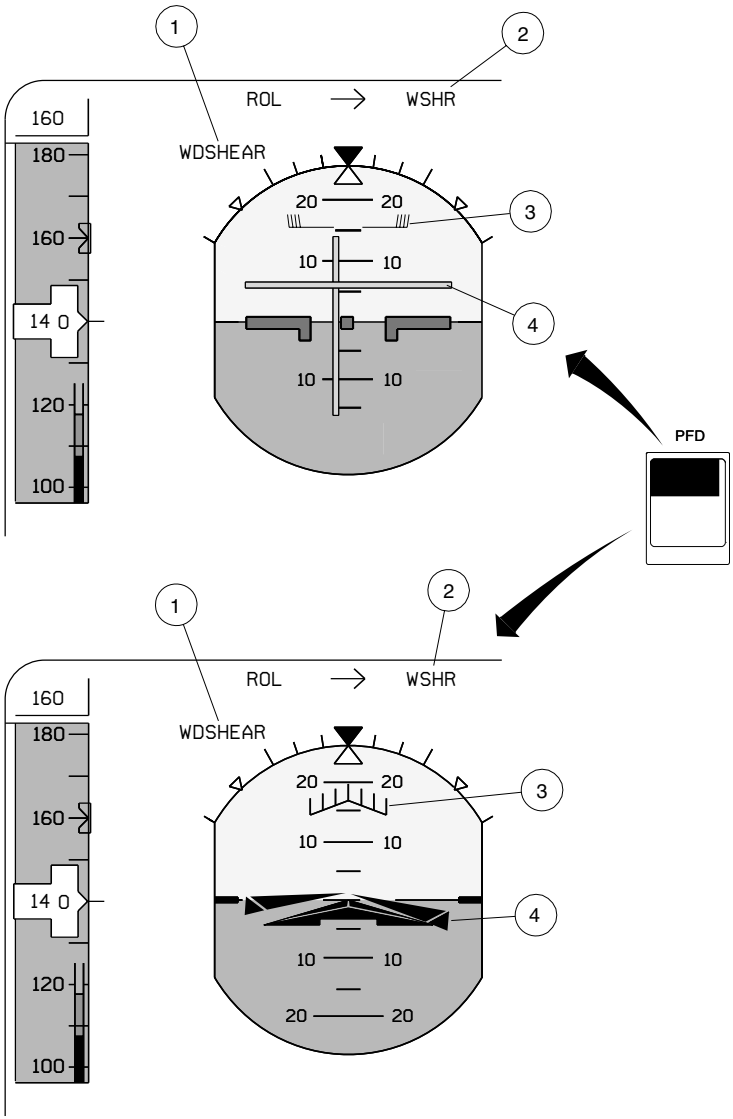


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## PRIMARY FLIGHT DISPLAY (CROSS-BAR AND V-BAR FORMAT)

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# TRAFFIC AND COLLISION AVOIDANCE SYSTEM

## GENERAL

The EMB-145 is equipped with a Traffic and Collision Avoidance System (TCAS), which provides the flight crew with an indication of possible in-flight traffic conflict. The system is based upon transponder signals and provides visual and aural warnings, as well as recommended evasive action.

The EMB-145 may be equipped with TCAS software version 6.04A, with TCAS software version 7.0 or with TCAS software version 7.1.

The TCAS 2000 presents the same operational characteristics of the TCAS II.

The TCAS software version 7.0 presents the following differences when compared to the TCAS software version 6.04:

- The altitude separation thresholds for issuing Traffic Advisory (TA) and Resolution Advisory (RA) between FL300 and FL420 are reduced for compatibility with RVSM flight operations.
- The thresholds for issuing RA for airplanes closing in altitude are reduced between the FL200 and FL420.
- Reduction in the numbers of RA eliminating those airplanes that are expected to pass with sufficient horizontal range separation.
- Allows RA direction reversion, i.e., change a CLIMB to a DESCENT and vice-versa in coordination with another TCAS equipped airplane.
- Introduction of three additional RA.
- Different set points and range of actuation, as presented in the following text.

The difference presented by TCAS software version 7.1 when compared to the TCAS software version 7.0 is the replacement of the corrective RA voice message “Adjust Vertical Speed, Adjust” with a single “Level Off, Level Off” RA.

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## SYSTEM DESCRIPTION

The TCAS was developed to provide crew awareness regarding possible conflicting air traffic situations. Besides providing awareness, TCAS also displays to the flight crew the recommended vertical maneuver to avoid conflicting traffic. TCAS does not provide recommendations for horizontal maneuvers.

**CAUTION:** PRIMARY RESPONSIBILITY FOR EVASIVE ACTION LIES WITH THE FLIGHT CREW AND ANY ACTION MUST ALWAYS BE PRECEDED BY A VERY CAREFUL EVALUATION OF THE SITUATION.

The TCAS computer receives data from the installed transponders, radio altimeters and air-ground sensor. The signals transmitted by surrounding airplanes inform their altitude, bearing and identification, thus making it possible to track any traffic that could enter the airplane's protection zone. Based on such data, the TCAS calculates the predicted path of each intruder airplane, determining whether or not it may become a target. To determine that, an alert zone is established, based on separation and speeds of both airplanes. The size of the alert zone is not distance-based but, rather, is based on time. Therefore, the caution area corresponds to the volume in space where a conflict is expected to occur in 35 to 45 seconds, if no action is taken. A warning area corresponds to an imminent conflict in the following 20 to 30 seconds. Such time is calculated by dividing distance between airplanes by their closure rate.

To inhibit the issuing of undesired warnings that constitute a nuisance effect, the system incorporates a series of protections. These apply during approaches to crowded airports, to increase protection against slow closure rates, and to prevent airplanes below 180 ft (380 ft for TCAS software version 7.0), which are about to land or have just taken-off, from creating a nuisance.

When an airplane is tracked by the TCAS, the system periodically interrogates the intruder's transponder. The exchange of data between two subsequent transmissions makes it possible to obtain the distance to the intruder and its altitude, and to predict its path.

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If the predicted path of the intruder enters the airplane's alert area, two kinds of alerts may be generated. If the area to be penetrated is the caution area, a Traffic Advisory (TA) is generated. Pilots are then requested to visually locate the intruder and perform the required preventive action.

If the warning area is penetrated a Resolution Advisory (RA) is generated, as well as the corrective action that must be taken to permit the greatest possible separation at the Closest Point of Approach (CPA). Sometimes, the recommended action may lead to crossing of the intruder's flight level or may change during the maneuver. This situation may occur when the calculation indicates that this is the best way to achieve the greatest possible separation at the CPA. For both advisory cases, a symbol is presented in the MFD to indicate the intruder's relative position, altitude and danger level. A voice message is generated to help the pilots in taking the most suitable action. The PFD provides indication of the recommended vertical speed to clear the conflict. A voice message may be generated to warn the pilot into monitoring the VSI on the PFD. When TCAS computations indicate that the traffic has been cleared, a voice message advises pilots that there is no longer a conflicting situation. In this condition, if no other TA or RA is on course, the intruder's indication changes, indicating that it is a safe nearby traffic.

If the intruder is also equipped with a TCAS, maneuvers are coordinated between both airplanes. If the intruder is only equipped with a transponder, the system may still indicate its position, provided its transponder is at least mode C. For airplanes equipped with mode A transponder, only Traffic Advisories may be generated.

**NOTE:** For airplanes Post-Mod SB 145-34-0106 the TCAS will send a "CLIMB" command in RA condition only up to 36000 ft. Above this altitude the TCAS will not send a "CLIMB" command in RA condition.

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**CAUTION:** THE TCAS CAN ONLY GENERATE RESOLUTION ADVISORIES FOR INTRUDERS EQUIPPED WITH RESPONDING MODE S OR MODE C TRANSPONDERS. TRAFFIC ADVISORIES CAN BE GENERATED FOR AIRPLANE WITH OPERATIVE MODE S, MODE C OR MODE A TRANSPONDERS. THE TCAS PROVIDES NO INDICATION OF AIRPLANE WITHOUT OPERATING TRANSPONDERS.

System options may be monitored and set through the RMU. A dedicated window is provided, presenting which TCAS display is being controlled, its range and altitude band. A RMU page permits toggling between options. Controls allow selection of different ranges, either horizontal and vertically, as well as changing the way some parameters are presented.

For airplanes Post-Mod. SB 145-34-0089 or Post-Mod. SB 145BAF-34-0006 or equipped with an equivalent modification factory incorporated, the Mode S Elementary Surveillance Transponder transmits the following parameters:

- Airplane Identification (Call Sign);
- Capability Report;
- Flight Status (airborne/on the ground);
- Pressure Altitude with 25 ft of resolution.

For airplanes equipped with Mode S Enhanced Surveillance Transponder (Post-Mod. SB 145-34-0096 or Post-Mod. SB 145BAF-34-0007 or equipped with an equivalent modification factory incorporated), in addition to the characteristics of the Mode S Elementary, the following Downlink Airplane Parameters (DAP) are transmitted automatically to be used by the ground Air Traffic Management:

- Magnetic Heading;
- Indicated Airspeed and/or Mach Number;
- Vertical Rate;
- Roll Angle;
- True Airspeed;
- True Track Angle;
- Ground Speed;
- Selected Altitude.

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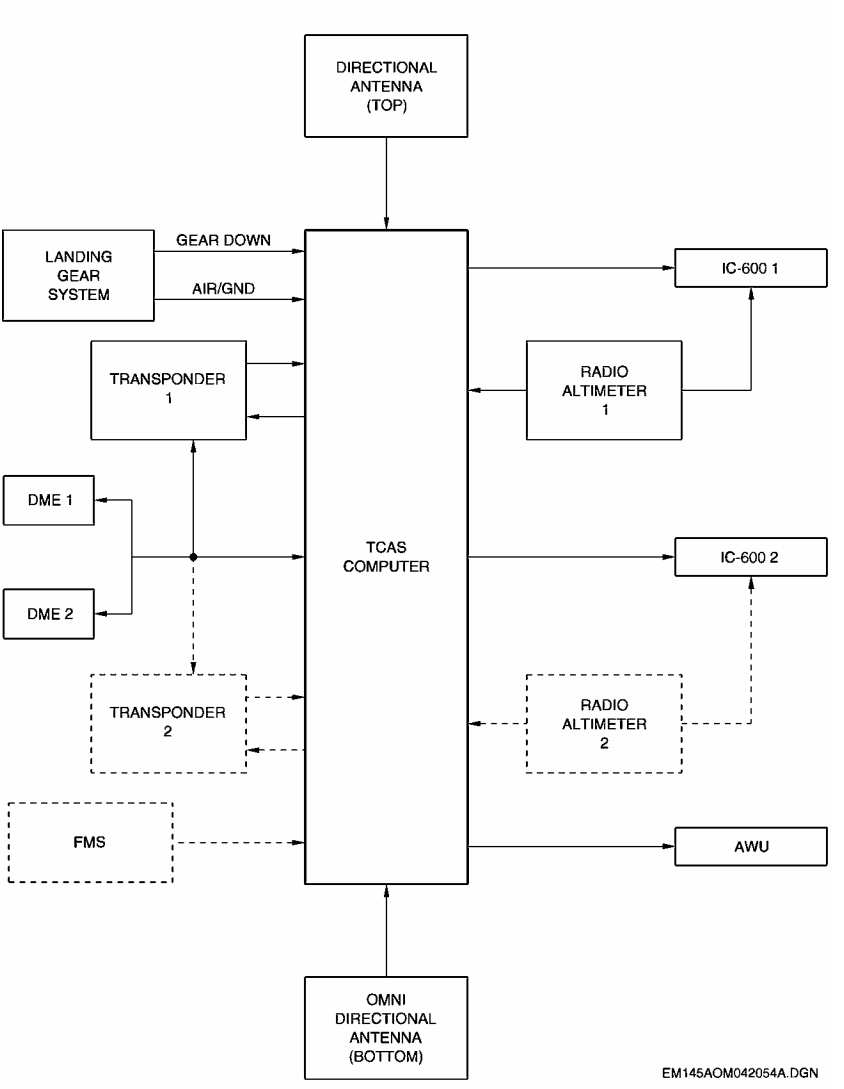


## TCAS SCHEMATIC



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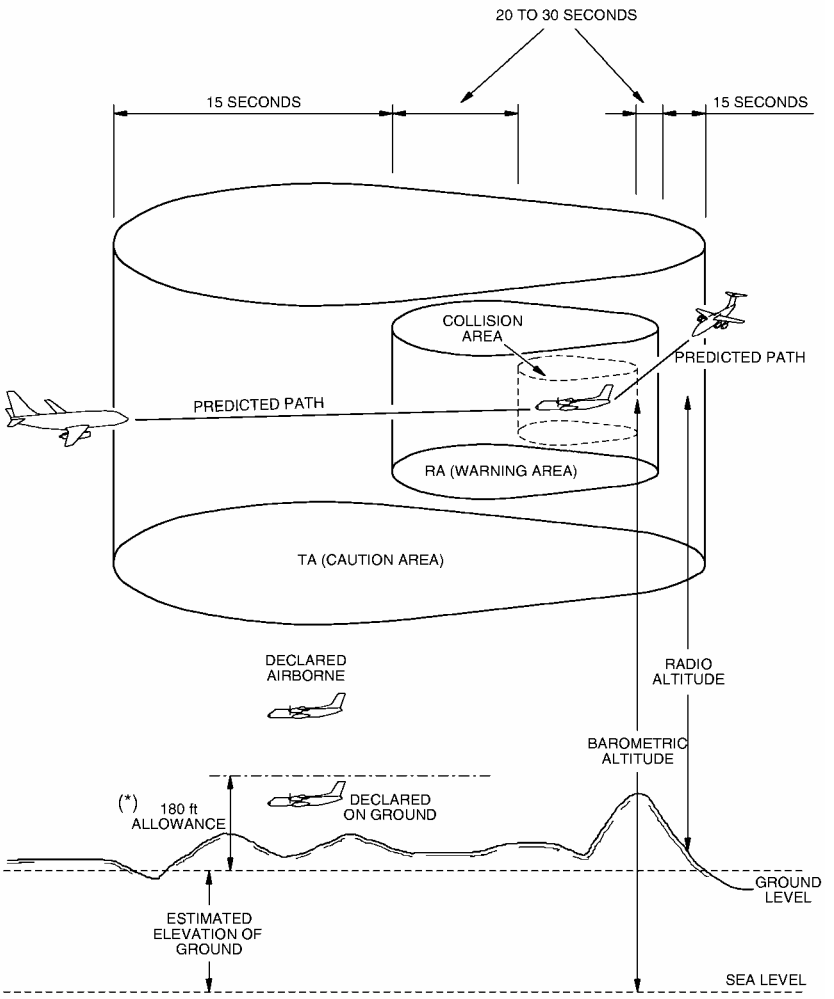


(*) 380 ft FOR TCAS SOFTWARE VERSION 7.0 .

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## TCAS PROTECTED AREAS



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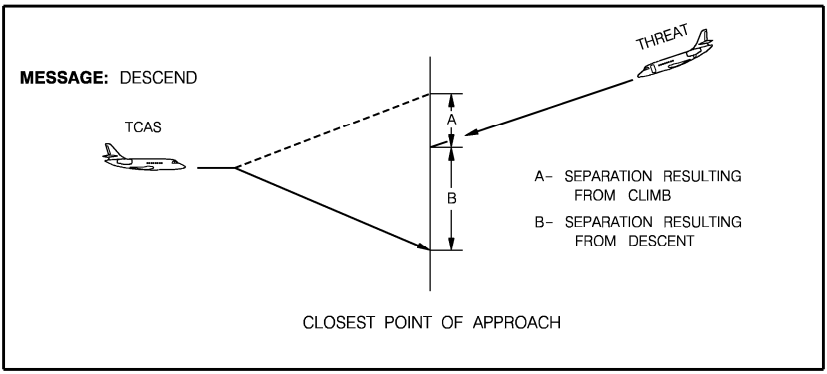


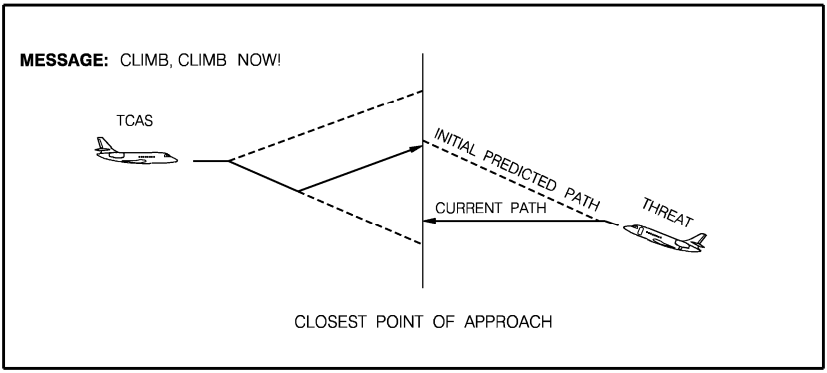


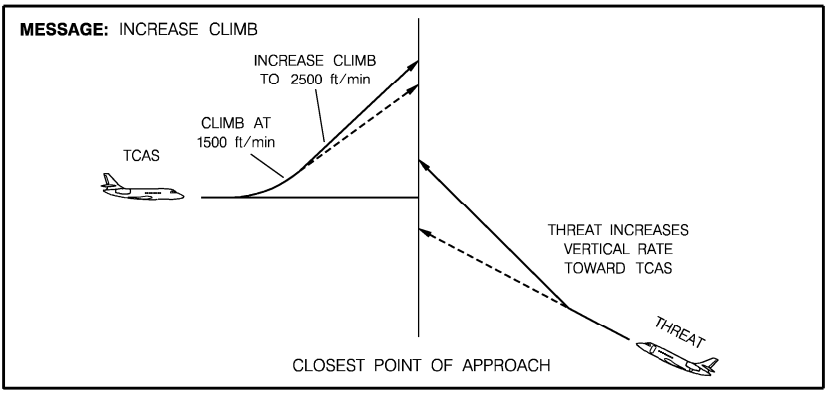


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## TCAS SITUATIONS

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# TCAS VOICE MESSAGES

**NOTE:** For airplanes Post-Mod. SB 145-34-0046 and Post-Mod. SB 145-31-0028, or with an equivalent modification factory incorporated, the Master Warning and Master Caution lights illumination associated to a TA/RA are not presented.

| TYPE | MESSAGE | MEANING | REMARKS |
|---|---|---|---|
| TA | TRAFFIC, TRAFFIC | An intruder is expected to enter the collision area in 35 to 45 seconds. An indication of it has just been displayed on the MFD. | – For TCAS software version 6.04, see NOTE 1.<br>– For TCAS software version 7.0, all TA are inhibited below 500 ft AGL. |
| PREVENTIVE RA | MONITOR VERTICAL SPEED | Vertical speed is changing to a non-recommended value. | – |
| CORRECTIVE RA | ADJUST VERTICAL SPEED, ADJUST | Vertical speed has to be adjusted to the recommended value indicated on the VSI. | TCAS software version 7.0 only. |
| | MAINTAIN VERTICAL SPEED, MAINTAIN | Maintain the vertical speed indicated on the VSI. | TCAS software version 7.0 and 7.1. |
| | MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN | Maintain the vertical speed indicated on the VSI. During climb or descent, airplane will cross intruder's flight level. | TCAS software version 7.0 and 7.1. |
| | LEVEL OFF, LEVEL OFF | Vertical speed has to be reduced to 0 fpm. | TCAS software version 7.1 only. |
| | CLIMB | Climb at the vertical speed indicated on the VSI to clear the possible conflict. | – |
| | DESCEND | Descend at the vertical speed indicated on the VSI to clear the possible conflict. Vertical Speed will be 1500 ft/min or greater. | See NOTE 1. |
| | REDUCE CLIMB | Reduce climb speed to clear the possible conflict. | Not valid for TCAS software versions 7.0 and 7.1. |
| | REDUCE DESCENT | Reduce descent speed to clear the possible conflict. | – See NOTE 1.<br>– Not valid for TCAS software versions 7.0 and 7.1. |
| | CLIMB, CROSSING CLIMB | Climb at the indicated vertical speed on the VSI to clear possible conflict. During climb, airplane will cross intruder's flight level. | – |

(Continued)



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| TYPE | MESSAGE | MEANING | REMARKS |
|---|---|---|---|
| CORRECTIVE RA | DESCEND, CROSSING DESCEND | Descend at the indicated vertical speed on the VSI to clear possible conflict. During descend, airplane will cross intruder's flight level. | See NOTE 1. |
| | INCREASE CLIMB | Climb speed has to be increased to the recommended value to clear the possible conflict. | Vertical Speed must be 2500 ft/min or greater. |
| | INCREASE DESCENT | Descent speed has to be increased to the recommended value to clear the possible conflict. Vertical Speed must be 2500 ft/min or greater. | – For TCAS software version 6.04, this message is inhibited below 1450 ft AGL.<br>– For TCAS software version 7.0, this message is inhibited below 1450 ft AGL while descending and below 1650 ft AGL while climbing. |
| | CLIMB, CLIMB NOW! | After a descent advisory, TCAS detected a changing situation that requires the need to climb. | – |
| | DESCEND, DESCEND NOW! | After a climb advisory, TCAS detected a changing in situation that requires the need to descend. | See NOTE 1. |
| | CLEAR OF CONFLICT | The possible conflict has been cleared. Message is presented only if intruder's transponder signal is valid. | Not presented if the intruder track or altitude information is lost. |

**NOTE:** 1) Inhibited below 1000 ft AGL while descending and below 1200 ft AGL while climbing.
2) All RAs are inhibited below 400 ft AGL while descending and below 600 ft AGL while climbing.
3) For TCAS software version 6.04, RA messages are repeated three times (one-word messages) and twice (two-word messages).
For TCAS software version 7.0, all RAs are repeated twice.
4) TA message sounds once.
5) The bearing indication on the TCAS display does not affect the TA/RA triggering logic.

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# CONTROLS AND INDICATORS

## RMU RADIO PAGE - ATC/TCAS WINDOW

Refer to Section 2-18 - Navigation and Communication for further details on RMU controls.

Refer to RMU ATC/TCAS Control Page in this Section for further details on TCAS controls.

### 1 - TRANSPONDER OPERATING MODE

- Allows selection of TCAS modes:
  - TA ONLY - TCAS traffic advisory mode is selected.
  - TA/RA - TCAS traffic advisory and resolution advisory modes are selected.
- Refer to Section 2-18 - Navigation and Communication for further details.

### 2 - TCAS CONTROL SIDE IDENTIFICATION

- Indicates which TCAS display (MFD 1 or 2) is being controlled through that RMU. The selection of TCAS DSPY 1 or 2 is accomplished through the cross-side transfer button when the yellow cursor box is placed on this field.
- Color: white for on-side TCAS display and magenta for cross-side.

### 3 - TCAS RANGE DISPLAY

- Displays the selected TCAS range value.
- Color: green
- Possible selections are 6, 12, 20, 40 NM. Airplanes equipped with TCAS software version 7.0 also allow 80 and 100 NM selection.

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## 4 - TCAS ALTITUDE BAND INDICATION

- Indicates the TCAS altitude band according to selected TCAS mode.
  - NORMAL (green) - With the TA display set to AUTO the operational TCAS altitude band will be from 1200 ft below to 1200 ft above the airplane. With the TA display set to MANUAL the operational TCAS altitude band will be from 2700 ft below to 2700 ft above the airplane.
  - ABOVE - The operational TCAS altitude band will be –2700 ft to +7000 ft.
  - BELOW - The operational TCAS altitude band will be –7000 ft to +2700 ft.

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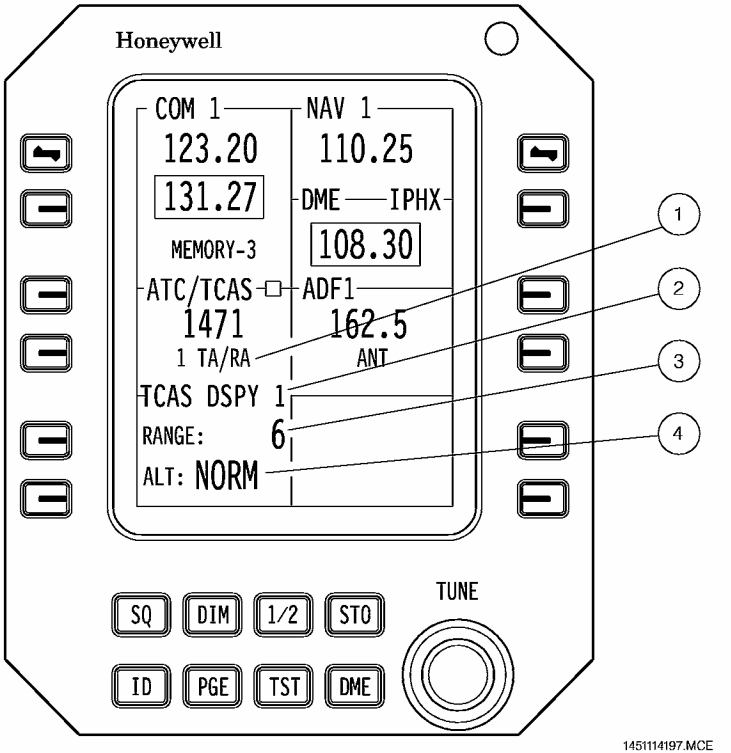


**RMU RADIO PAGE**



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## RMU ATC/TCAS CONTROL PAGE

### 1 - INTRUDER ALTITUDE

REL (green) - Intruder's altitude is displayed as a relative altitude to the airplane. Value is preceded by a plus or a minus signal, depending on whether the intruder is above or below the airplane.

FL (cyan) - Intruder's altitude is displayed as its flight level. This selection automatically reverts to REL after 20 seconds.

### 2 - TA DISPLAY

AUTO - Traffic is displayed only when a TA or RA condition exists.

MANUAL - All traffic detected by the system is displayed.

### 3 - FLIGHT LEVEL 1/2

– Displays the transponder-encoded altitude and the air data source.
Refer to transponder description (Section 2-18 – Navigation and Communication).

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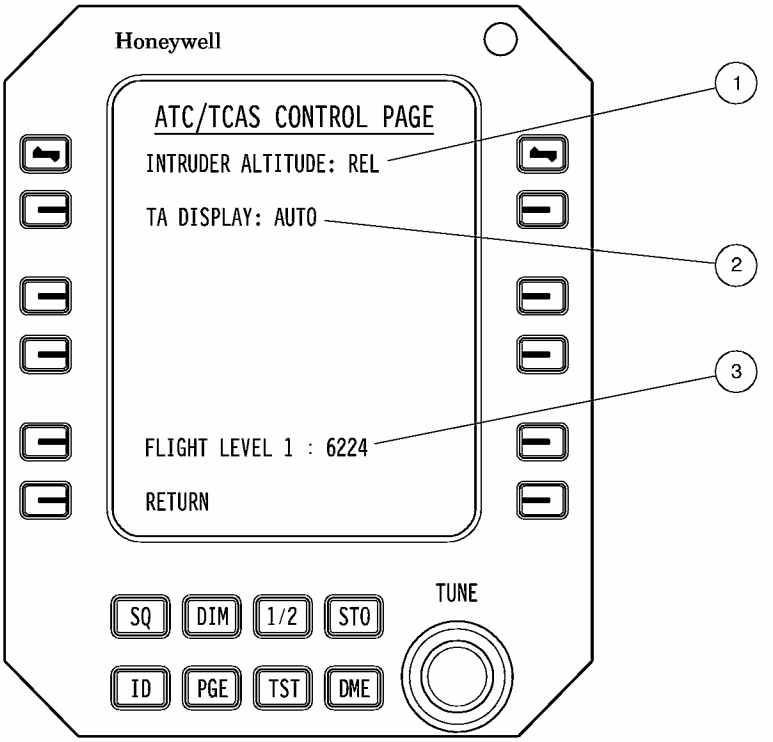


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**RMU ATC/TCAS CONTROL PAGE**



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## TCAS TEST

The TCAS self-test is activated through the RMU TST button and may be performed on the ground or in flight. TCAS operates normally if not tested.

To test the system proceed as follows:

- On the RMU radio page, place the yellow cursor box in the ATC/TCAS window. On the MFD, set TCAS mode.
- Press and hold for 7 seconds the RMU TST button.
- A white TCAS TEST message is presented on the MFDs and PFDs.
- A TCAS TEST aural warning sounds.
- The Master Warning lights flash.

  **NOTE:** Some airplanes don't have the Master Warning light flashing during the test.
- The MFDs show a traffic test pattern, which permits the checking of each of the existing intruder symbols, i.e., a hollow blue diamond, a solid blue diamond, a solid amber circle and a solid red square.
- On the PFDs, the VSI shows red and green arc zones.
- At the end of the test, the RMU shows a green TCAS PASS message and a TCAS TEST PASS aural warning will sound.

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## MULTI FUNCTION DISPLAY

### 1 - INNER RANGE RING

- Displayed around airplane symbol to indicate a 2 NM range.
- Removed if outer range indicates distance above 20 NM.

### 2 - OUTER RANGE RING

- May be selected up to 40 NM. Airplanes equipped with TCAS software version 7.0 allow selection up to 100 NM.

### 3 - NO BEARING ADVISORIES INDICATION

- Indicates data related to a detected intruder, whose bearing cannot be determined.
- Up to two lines may be displayed indicating the kind of advisory, its distance, relative altitude and whether it is climbing or descending in excess of 500 ft/min.
- Colors:
  - No bearings RAs: red.
  - No bearings TAs: amber.

### 4 - PROXIMATE TRAFFIC INDICATION

- Indicated by a solid cyan diamond.
- Represents any airplane within 6.5 NM horizontally and 1200 ft vertically, but whose path is not predicted to penetrate the Collision Area.

### 5 - INTRUDER'S VERTICAL MOVEMENT

- Indicated by an arrow next to the symbol that indicates if the intruder is climbing or descending in excess of 500 ft.
- Color: Same as of the associated symbol.

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## 6 - INTRUDER'S ALTITUDE

- Indicated by a solid two-digit number below or above the intruder's symbol.
- Color: Same as of the associated symbol.
- Normal presentation is relative altitude, which displays the intruder's relative altitude in hundreds of feet. A plus or minus signal indicates if the intruder is above (+) or below (–) the airplane.
- Two question marks ("??") are displayed if the intruder's relative altitude is greater than 9900 ft, below or above.
- If intruder is below the airplane, intruder's altitude is displayed below its symbol.
- If intruder is above the airplane, intruder's altitude is displayed above its symbol.

## 7 - RESOLUTION ADVISORY INDICATION

- Indicated by a solid red square.

## 8 - TRAFFIC ADVISORY INDICATION

- Indicated by a solid amber circle.

## 9 - OTHER TRANSPONDER REPLYING TRAFFIC INDICATION

- Indicated by a hollow cyan diamond.
- Indicates other airplanes equipped with transponder within the specified range and 2700 ft of vertical separation.
- Not displayed if a TA or RA is in process.

## 10 - OUT OF RANGE INTRUDER

- Indicates detected intruders that are out of display range.
- Indicated as half the associated symbol.

## 11 - INTRUDER'S ALTITUDE MODE INDICATION

- Indicates whether the selected intruder's altitude is relative or flight level.

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## 12 - TCAS BAND SELECTED

- Indicates whether the selected band for TCAS is below or above.

## 13 - TCAS MODE ANNUNCIATIONS

- Indicates current TCAS mode.
- Colors and labels are as follows, in the order of priority:
  - TCAS TEST - white
  - TCAS OFF (1) - white
  - TCAS FAIL (2) - amber
  - TA ONLY - white
  - TCAS - white
  - TCAS AUTO - white

**NOTE: 1)** For airplanes Post-Mod. SB 145-34-0125, the TCAS OFF annunciator flashes for 10 s and remain steady displayed as long as the condition persists.

**2)** For airplanes Post-Mod. SB 145-34-0125, the TCAS FAIL annunciator flashes for 10 s and remain steady displayed as long as the condition persists.

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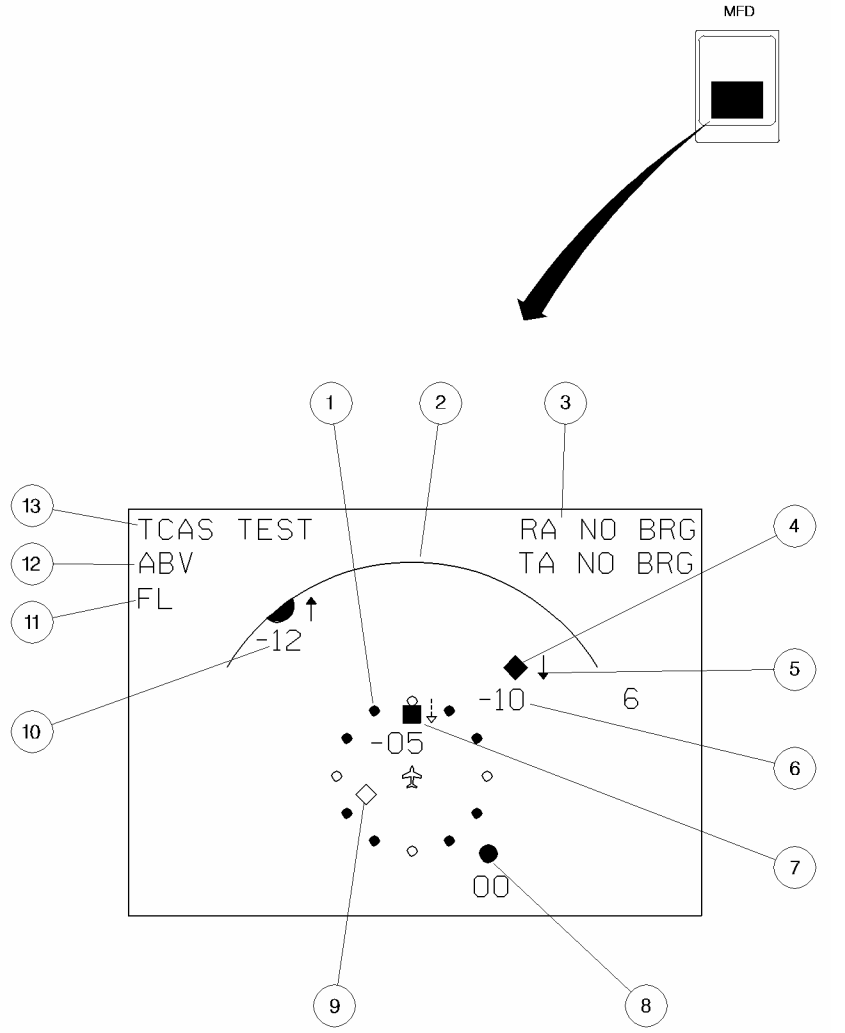


**MULTI FUNCTION DISPLAY**

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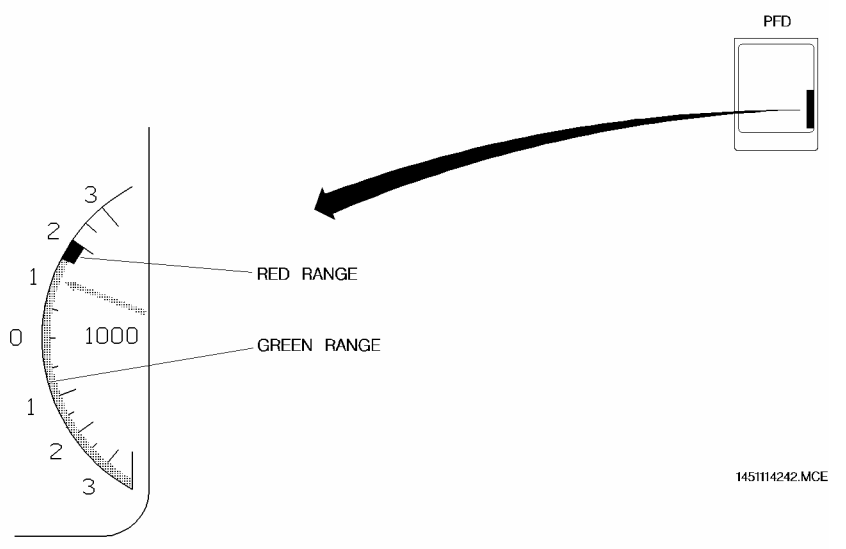
## PRIMARY FLIGHT DISPLAY

For further information on Vertical Speed Indicator, refer to Section 2-17 – Flight Instruments.

### VSI

- Indicates the recommended vertical speed to avoid a possible conflict.
- Green range - displayed along the scale, indicates the range of vertical speeds to be attained to avoid a conflict situation.
- Red range - displayed along the scale, indicates the range of vertical speeds prohibited for the current situation.
- Green range may be displayed together with the red range or split in two parts, depending on situation.
- Red range may be displayed alone, together with the green range, or split in two parts, depending on the situation.




**PRIMARY FLIGHT DISPLAY**

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# SECTION 2-05

# ELECTRICAL

TABLE OF CONTENTS

Block Page

General ..... 2-05-05...01
DC System ..... 2-05-05...02
DC System Protection ..... 2-05-05...04
External Power Source ..... 2-05-05...05
Batteries ..... 2-05-05...06
Backup Battery ..... 2-05-05...07
Generators ..... 2-05-05...07
APU Starter-Generator ..... 2-05-05...08
Electrical Distribution Logic ..... 2-05-05...09
Ground Service Bus ..... 2-05-05...10
Avionics Master ..... 2-05-05...11
AC System ..... 2-05-05...12
EDL Configurations and Diagrams ..... 2-05-10...01
Abnormal Operation Configurations ..... 2-05-10...01
Normal, Abnormal and Emergency Operation Diagrams ..... 2-05-10...13
EICAS Messages ..... 2-05-15...01
Controls and Indicators ..... 2-05-15...03
Electrical System Panel ..... 2-05-15...03
MFD Electrical Page ..... 2-05-15...06
Circuit Braker Panel and Load Distribution ..... 2-05-20...01
Circuit Breaker Panel ..... 2-05-20...01
DC Bus Load Distribution ..... 2-05-20...04

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# GENERAL

The electrical power system supplies AC and DC voltage for all loads during normal or emergency operation.

Two different types of sources provide electrical power supply:

- DC Power
- AC Power

The DC power system supplies 28 V DC for all airplane electrical loads and recharges the batteries. It is the primary electrical power supply system. The DC power system is comprised of:

- Four independent generators (28 V DC/400 A/engine driven).
- One APU starter-generator (28 V DC/400 A).
- Two Nickel-Cadmium batteries (24 V DC/44 Ah/1 hour rate).
- One lead-acid backup battery (24 V DC/5 Ah/10 hour rate).
- External power source.

AC power is supplied by one 250 VA/400 Hz single-phase static inverter, which converts 28 V DC into 115 V AC.

A dedicated page on the MFD (electrical page) provides, on request, information regarding system configuration, load and voltage conditions as well as battery temperatures. Furthermore, warning and caution messages are presented on the EICAS to indicate an electrical system failure.

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# DC SYSTEM

The 28 V DC electrical power system automatically controls power contactors, fault protection, load shedding and emergency system operation. This reduces pilot workload during normal operation, external power supply or system failures. The Electrical Distribution Logic (EDL) and Generator Control Units (GCU) perform system management. Detected system failures are automatically isolated, causing some bus(es) to be deenergized.

Under normal operation, the electrical DC system is divided into isolated left and right electrical networks. The left network includes generators 1 and 3, driven by engine 1. Operated in parallel, generators 1 and 3 are connected to DC BUS 1 to supply ESSENTIAL DC BUS 1, SHED DC BUS 1 and HOT BUS 1. Battery 1 is charged by the generators connected to DC BUS 1. Similarly, generators 2 and 4 power the right network and are driven by engine 2.

Both networks are interconnected through Bus Tie Contactors (BTC) in case of operation with less than four generators. APU generator may replace any inoperative generator, or may be used before engine starting when the APU generator or Ground Power Unit (GPU) may supply the electrical system.

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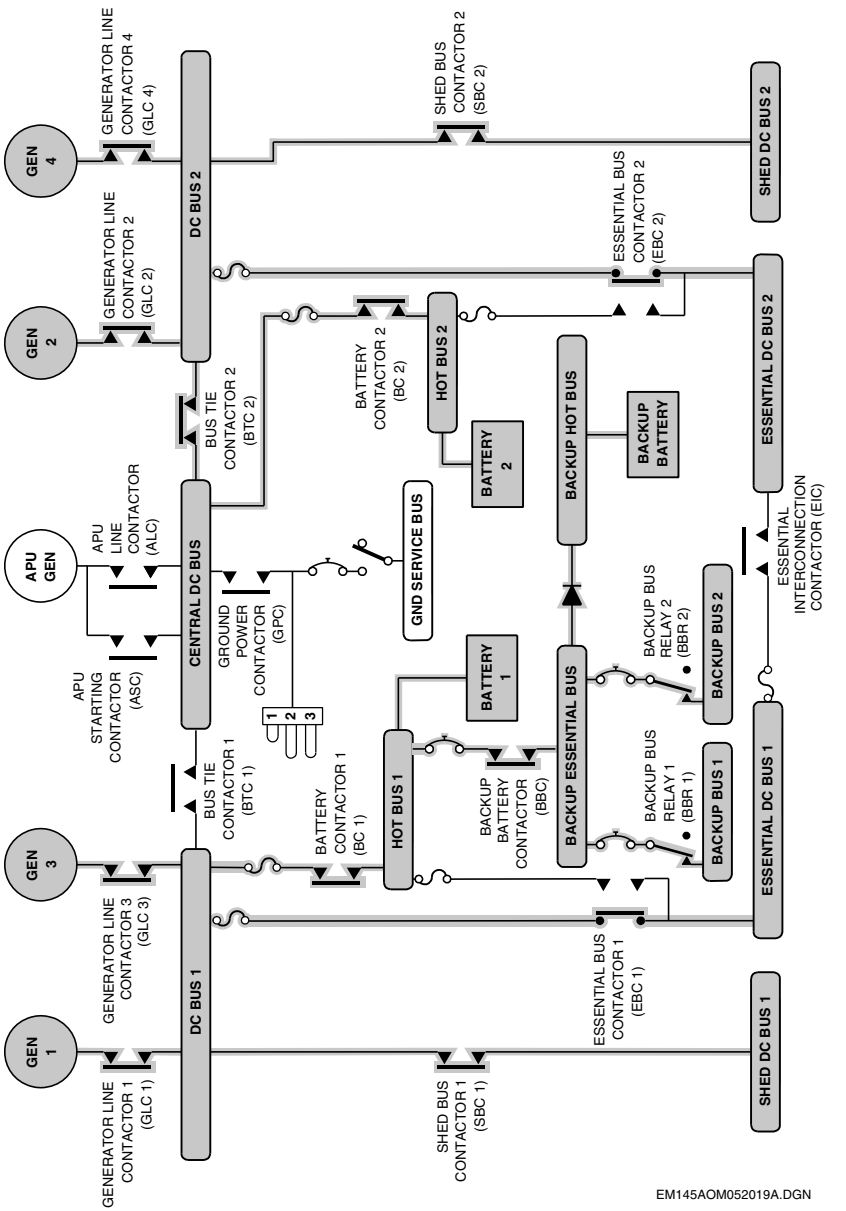


## DC ELECTRICAL DISTRIBUTION SYSTEM SCHEMATIC

## DC SYSTEM PROTECTION

The system monitors generators current and voltage to the electrically supplied equipment to protect it from a control unit failure, such as an overvoltage or a bus failure. If an overvoltage is detected, the associated GCU deenergizes the generator, disconnecting it from the bus.

A bus failure produces an overcurrent condition to one or more generators. Upon sensing this overcurrent, the GCU isolates the system networks, opening the BTCs. If any generator remains overloaded due to the failure, it is then deenergized and disconnected from the bus.

As long as the generator current exceeds 400 A, a caution message is presented on the EICAS, indicating that manual load shedding is required. If no action is taken, the system will be isolated and some buses may be deenergized.

System protections are designed so that normal transients will not cause generators to be disconnected from the bus inadvertently.

Resetting of the generator after a failure is accomplished by releasing the associated Generator Button and then pressing it again.

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## EXTERNAL POWER SOURCE

The Ground Power Unit (GPU) is connected to the airplane through an external receptacle. The GPU supplies 28 V DC to the load buses for ground operation and APU starting, independently of the internal batteries.

The GPU has priority over any battery and generator when energizing the airplane. Thus, the generators and the batteries cannot operate in parallel with the GPU.

The GPU Button, located on the overhead panel, controls the External power supply. As soon as the Ground Power Unit is energized, properly connected to the airplane receptacle, ready to supply power but not connected to the buses, the GPU AVAIL inscription illuminates on the GPU Button. An identical inscription above the GPU receptacle simultaneously illuminates.

When GPU AVAIL is illuminated and the batteries are not connected to the buses, only the GROUND SERVICE BUS is supplied through the external power supply. When the GPU Button is pressed, the Ground Power Contactor (GPC) will close, allowing the external power to feed the load buses. When the external power comes on line, the GPU AVAIL inscription on the GPU Button extinguishes itself and the white stripe on the button lower half illuminates.

An overvoltage circuit isolates the GPU from the airplane's electrical buses if the GPU voltage is incorrect. External power inverse polarity protection is also provided. To reset the system, release the GPU button and then press it again. If the GPU overvoltage persists, GPC will be kept open.

The external power voltage can be monitored through the electrical page, on the MFD. The electrical system page shows the GPU box and its voltage. The GPU voltage indication is removed in flight.

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# BATTERIES

Two 24 V DC, 44 Ampere-hour, nickel-cadmium batteries supply essential loads in case of an in-flight failure of all generators or if both engines are shut down simultaneously and the APU is not available. Both batteries can supply at least 40 minutes of power for essential loads in an all-generator-failure condition.

During normal operation, Battery 1 is connected in parallel with generators 1 and 3 (network 1). Battery 2 is connected in parallel with generators 2 and 4 (network 2). Battery 2 also supplies power for APU starting.

During APU starting, battery 1 is isolated from the load buses. While battery 2 provides power for APU start, battery 1 provides stable electrical power to the equipment that can be adversely affected by voltage transients.

A selector switch on the overhead panel controls each battery. When set to the AUTO position, battery contactors (BC 1 or BC 2) actuation is controlled according to the Electrical Distribution Logic (EDL). When the GPU is connected, the battery contactors open so that only the GPU can supply the load buses. When on the ground, with the batteries as the only electrical power source, EDL deenergizes the shed buses for battery conservation. When the battery selector knob is switched to the OFF position, the battery contactor opens, isolating the battery from the system.

The batteries are installed in the battery compartment, on the left side of the airplane nose section. They are ventilated in flight by forced airflow to prevent overheating. Temperature sensors installed in each battery provide temperature indication to the MFD. If battery internal temperature rises above 70°C, a warning message is presented on the EICAS. If a battery is isolated from the load buses, a caution message is displayed on the EICAS.

In case of Loss of All Generators battery duration is 40 minutes, considering three APU start attempts. However, be attentive to the following condition: On ground, after starting the APU, batteries voltage must be checked with all Generators disconnected. If batteries voltage is below 24.0V, they must be recharged. The minimum time for battery recharging is 30 minutes. Be aware that while GPU is ON, batteries will not be recharged.

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## BACKUP BATTERY

A 24 V DC, 5 Ampere-hour sealed lead-acid battery provides stabilized power for operation of the GCUs protective function, even in case of short-circuit, when system voltage may drop near zero volts.

The Backup Battery Button, on the overhead panel controls the backup battery. Pressing the button when the Battery 1 or 2 Selector Knob is set to the AUTO position connects the backup battery to the electrical system for charging. If the Backup Battery Button is released, a caution message is displayed on the EICAS.

## GENERATORS

The primary source of electrical power are the four 28 V DC, 400 Amperes, independent engine-driven brushless generators, two installed on each engine accessory gearbox.

Each generator is automatically controlled and protected by a dedicated Generator Control Unit (GCU), provided the Generator Control Button on the overhead panel is pressed.

The generators will come on line when engine speed stabilizes above 56.4% N2. If a failure occurs and the Generator Line Contactor (GLC) opens, a reset may be attempted once by releasing the associated Generator Control Button and then pressing it again.

Anytime the Generator Line Contactor is inadvertently opened or generator current is above 400 A, a caution message is displayed on the EICAS. The generator voltage and current can be monitored through the electrical page, on the MFD.

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## APU STARTER-GENERATOR

A 28 V DC, 400 Amperes, APU-driven starter-generator supplies electrical power during ground operation or in flight, as an alternative source of electrical power. The APU starter generator is controlled and protected by its dedicated GCU.

The APU Generator Button, on the Electrical System Panel, must be pressed for normal operation. The APU line contactor is actuated on and off by APU speed. If a failure occurs on the APU generator, a reset may be attempted releasing the APU Generator Button and pressing it again. Only one reset may be attempted.

The APU generator, when operating, is connected in parallel with the generators supplying DC Bus 2. If needed, the APU generator can replace an inoperative left network generator. After starting, and with an engine driven generator inoperative, the APU generator automatically replaces the inoperative generator.

Three electrical sources may be used to power an APU start: ground power unit, battery 2 or battery 2 assisted by the main generators. Battery 1 cannot be used for APU starting. Instead, it is isolated from the load buses to provide stable electrical power to supply equipment that may be affected by voltage fluctuation.

During starting, the APU Starting Contactor (ASC) is closed, allowing the APU starter-generator to operate as a starter, energized through the Central DC Bus. When the APU starting cycle is completed, the ASC opens. A caution message is displayed on the EICAS if the ASC does not open.

At 95% RPM plus seven seconds, the APU starter generator is available to supply electrical power to the system. In this condition, the APU Line Contactor (ALC) is closed, connecting the APU starter generator to the load buses. If the ALC does not close due to contactor failure or button not pressed, a caution message is displayed on the EICAS.

The APU starter generator voltage and current may be monitored on the MFD.

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# ELECTRICAL DISTRIBUTION LOGIC

Many different configurations are available in the Electrical Distribution Logic (EDL) to suit any particular situation. The EDL's architecture is symmetrical and the operational logic sequence for EDL 1 is the same as for EDL 2. EDL 1 is composed of DC Bus 1, Shed DC Bus 1, Essential DC Bus 1 and Hot Bus 1. The EDL 2 is composed of DC Bus 2, Shed DC Bus 2, Essential DC Bus 2 and Hot Bus 2.

The Central DC Bus primary function is to connect the APU generator or GPU to the load buses through the Bus Tie Contactors (BTC). The Central DC Bus also provides bus interconnections in case of asymmetrical configuration, such as generators failure or engine shutdown.

The Electrical Distribution Logic (EDL) differs depending on whether the airplane is on the ground or in flight. In flight, some buses are deenergized, depending on the power source available.

On the ground, all the DC buses are energized if at least one of the following conditions occurs:
- At least three generators are on.
- The GPU is on and connected to the airplane.
- At least one generator is on, and the Shed Buses Selector Knob is set to OVRD position.

The DC distribution table below shows the Electrical Distribution Logic configuration according to the conditions of the generators.

**DC DISTRIBUTION TABLE**

| CONDITION | RESULTS |
|---|---|
| 4 or 5 Generators On | Two isolated left and right electrical networks with all buses energized. |
| 3 Generators On | Both electrical networks interconnected through Bus Tie Contactors with all buses energized. |
| 1 or 2 Generators On | Both electrical networks interconnected through Bus Tie Contactors with shed buses deenergized. |
| Loss of all Generators | Batteries to supply the Essential Buses (in-flight condition only). |

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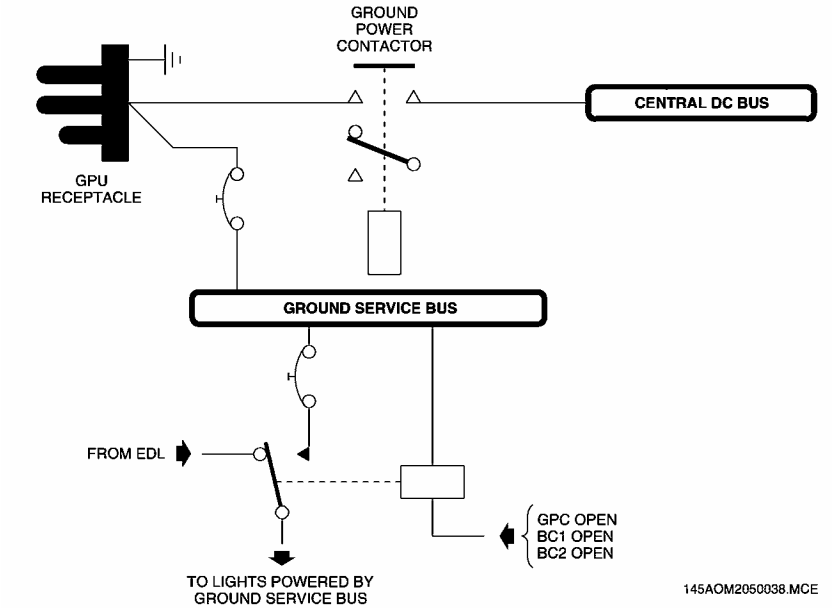
# GROUND SERVICE BUS

The Ground Service Bus is energized by connecting the GPU connector to the airplane receptacle, provided the batteries and generators are not connected to the buses (GPC, BC 1 and BC 2 are open).

The Ground Service Bus supplies electrical power for airplane servicing and maintenance while on the ground. It functions independently of the Electrical Distribution Logic and does not energize all electrical distribution buses.

The following lights will be powered by the Ground Service Bus:

- Passenger cabin lights;
- Lavatory lights;
- Galley lights;
- Courtesy/stairs lights;
- Cockpit dome lights;
- Baggage/service compartment lights.




**GROUND SERVICE SCHEMATIC**

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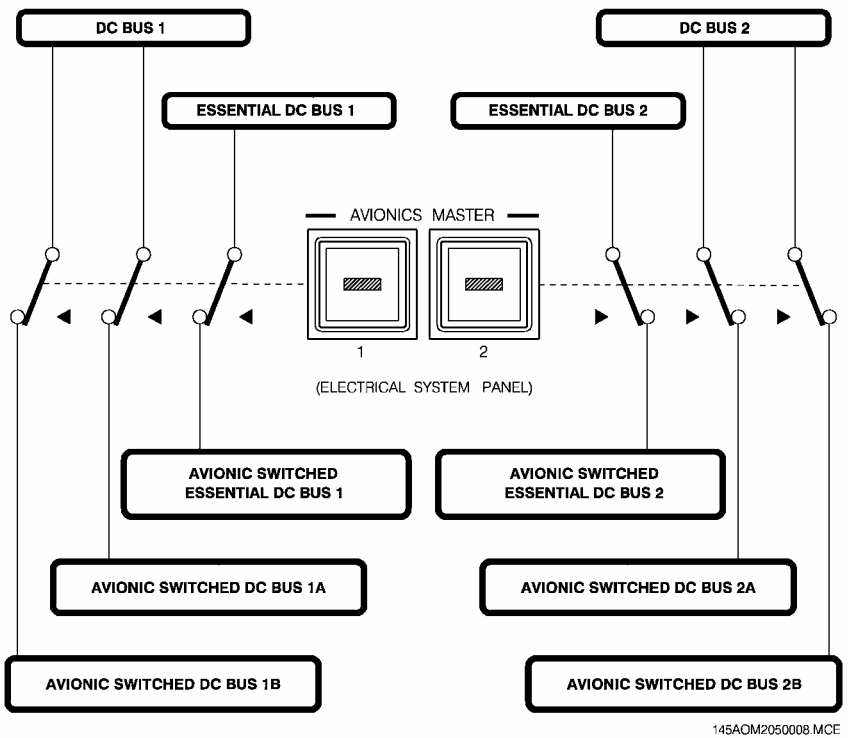
# AVIONICS MASTER

The avionics master system allows manual disconnection of some navigation and communication equipment from the load buses. This prevents undesirable voltage transients during APU starting on the ground.

The avionics master system consists of six buses: Avionics Switched DC Buses 1A, 1B, 2A, 2B and Avionics Switched Essential DC Buses 1 and 2. These buses are supplied by their associated DC buses. Two Avionics Master Buttons, located on the overhead panel, control switching the buses.




**AVIONICS MASTER SCHEMATIC**

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## AC SYSTEM

One 250 VA/400 Hz single phase static inverter converts 28 V DC electrical power into 115 V AC for airplane systems requiring AC power. The avionics system is the primary user of AC power.

The inverter is power supplied by the DC Bus 1 and controlled by the AC Power Button, on the overhead panel. If DC Bus 1 is energized and the AC Power Button is pressed, the 115 V AC BUS is automatically energized. If the DC Bus 1 is deenergized, the inverter becomes inoperative.

To reduce pilot workload, the AC Power Button should remain pressed, even after engine shutdown. If the AC Power Button is released, a striped bar illuminates to indicate that the button is out of normal operating condition.

During normal airplane operation, if 115 V AC BUS is deenergized, a caution message is displayed on the EICAS. An inverter reset may be attempted through the AC Power Button, by releasing and then pressing it again.

Under electrical emergency conditions the inverter stops the operation.

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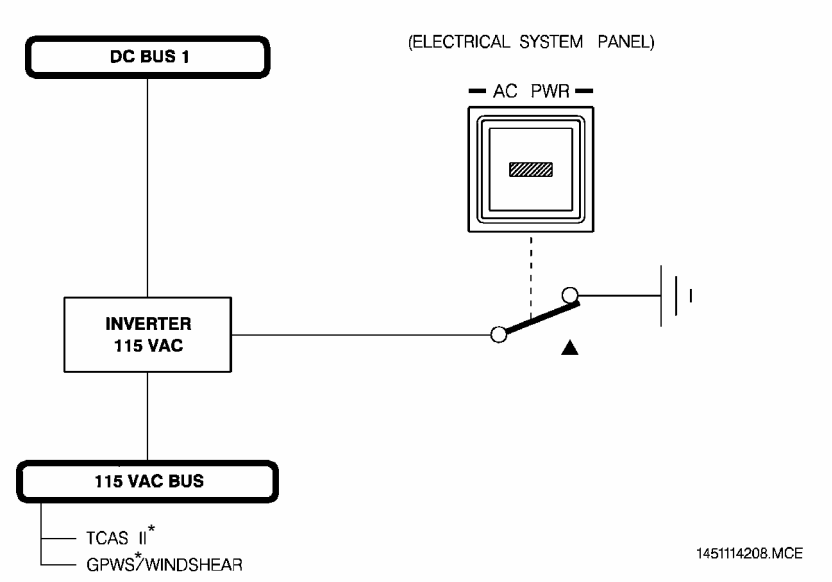


*If installed

## AC GENERATION AND DISTRIBUTION SCHEMATICS

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# ELECTRICAL DISTRIBUTION LOGIC (EDL) CONFIGURATIONS AND DIAGRAMS

## ABNORMAL OPERATION CONFIGURATIONS

For the Electrical Distribution Logic configurations presented here, the initial control positions on the Electrical System Panel are the following:

– Generator Buttons pressed;
– GPU Button released;
– Battery Selector Knobs set to AUTO position;
– Essential Power Button released;
– Bus Tie Selector Knob set to AUTO position;
– Shed Buses Selector Knob set to AUTO position;
– Backup Battery Button pressed;
– Avionics Master Buttons pressed.

**NOTE: -** All abnormal conditions considered below are in-flight conditions.
**-** In the schematic configurations, the continuous boxes indicate energized buses while dashed boxes indicate deenergized buses.

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**CONFIGURATION 1**

**Loss of one left side generator (network 1):**

- **Without APU generator available:**
  - GLC 1 or 3 is open.
  - ALC is open.
  - BTC 1 is closed.
- **With APU generator available:**
  - GLC 1 or 3 is open.
  - ALC is closed.
  - BTC 1 is closed and BTC 2 is open.

**Loss of one right side generator (network 2):**

- **Without APU generator available:**
  - GLC 2 or 4 is open.
  - ALC is open.
  - BTC 2 is closed.
- **With APU generator available:**
  - GLC 2 or 4 is open.
  - ALC is closed.
  - BTC 2 is closed and BTC 1 is open.

**Loss of two generators with APU generator available:**

- GLCs from affected generators are open.
- ALC is closed.
- BTC 1 and BTC 2 are closed.

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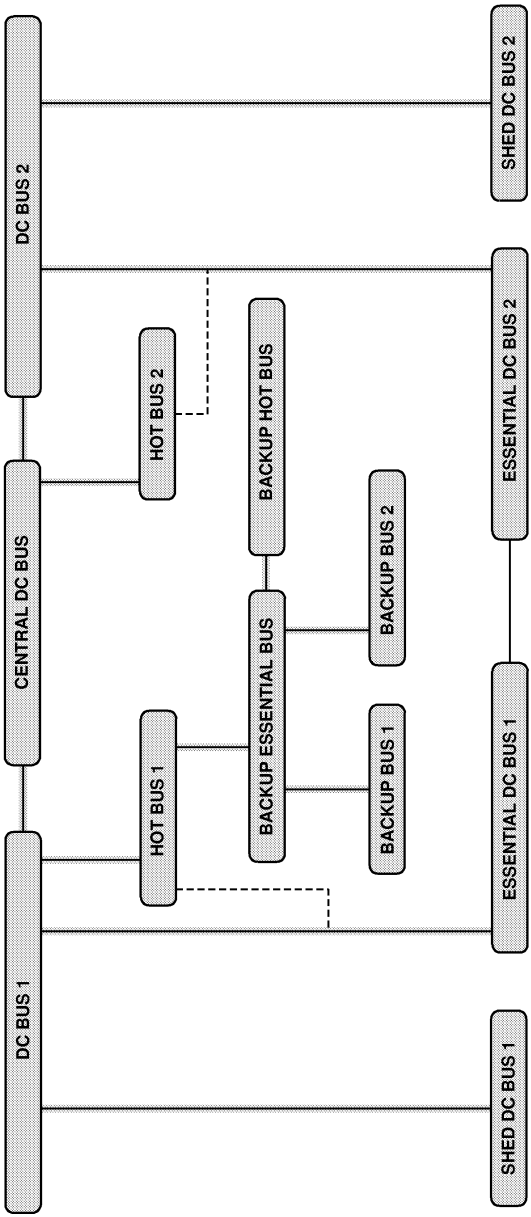


**CONFIGURATION 1**

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**CONFIGURATION 2**

**Loss of two generators without APU generator available:**

- GLCs from affected generators are open.
- ALC is open.
- BTC 1 and BTC 2 are closed.
- SBC 1 and SBC 2 are open.

**Loss of three generators without APU generator available:**

- GLCs from affected generators are open.
- ALC is open.
- BTC 1 and BTC 2 are closed.
- SBC 1 and SBC 2 are open.

**NOTE**: Depending on the amount of load on the remaining buses, an overload condition may occur. In this case, the pilot are required to perform an additional load shedding.

**Loss of three generators with APU generator available**:

- GLCs from affected generators are open
- ALC is closed.
- BTC 1 and BTC 2 are closed.
- SBC 1 and SBC 2 are open.

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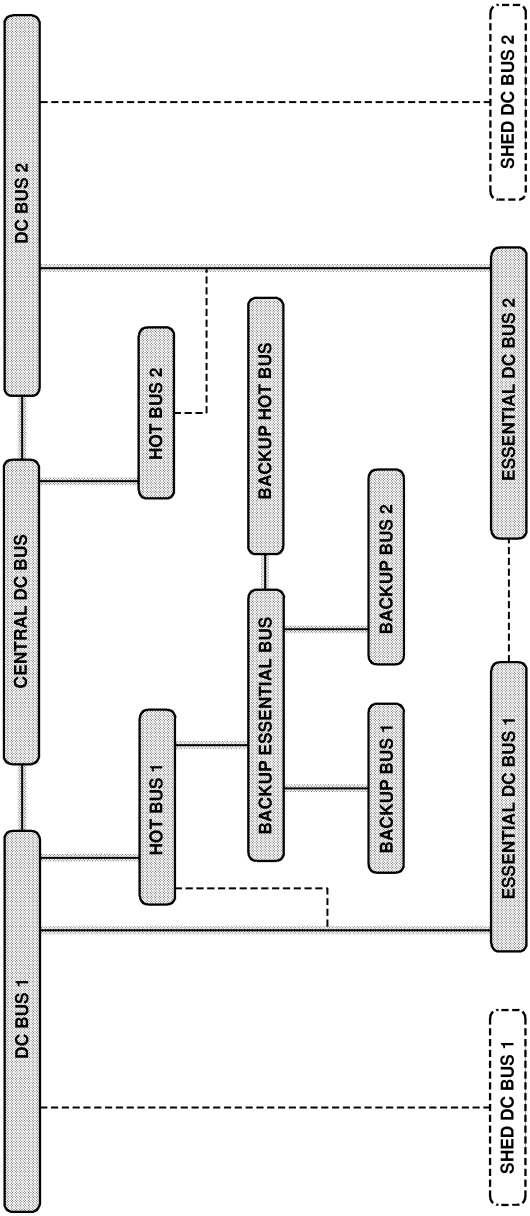


**CONFIGURATION 2**

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**CONFIGURATION 3**

**Loss of all generators:**

- When the last generator fails, the operational logic configures the system to dedicate the batteries to supply the Essential Buses only (electrical emergency condition). In this configuration, the Central DC Bus is also powered to allow the APU to be started.
- BTC 1, BTC 2, BC 1, SBC 1, SBC 2, BBR 1 and BBR 2 are open.
- EIC, EBC 1, EBC 2 and BC 2 are closed.

**NOTE**:- This operational mode is activated for in-flight condition only.
- A 1-second time delay is provided to avoid inadvertent switching to emergency configuration due to electrical transients.
- If the automatic transfer fails, perform this function manually by pressing the Essential Power Button.
- While In-flight, the electrical system is automatically reset if at least one generator is reset and supplying its associated bus.
- On the ground, the system can be reset by switching both Battery Selector Knobs from AUTO to OFF and then back to AUTO.

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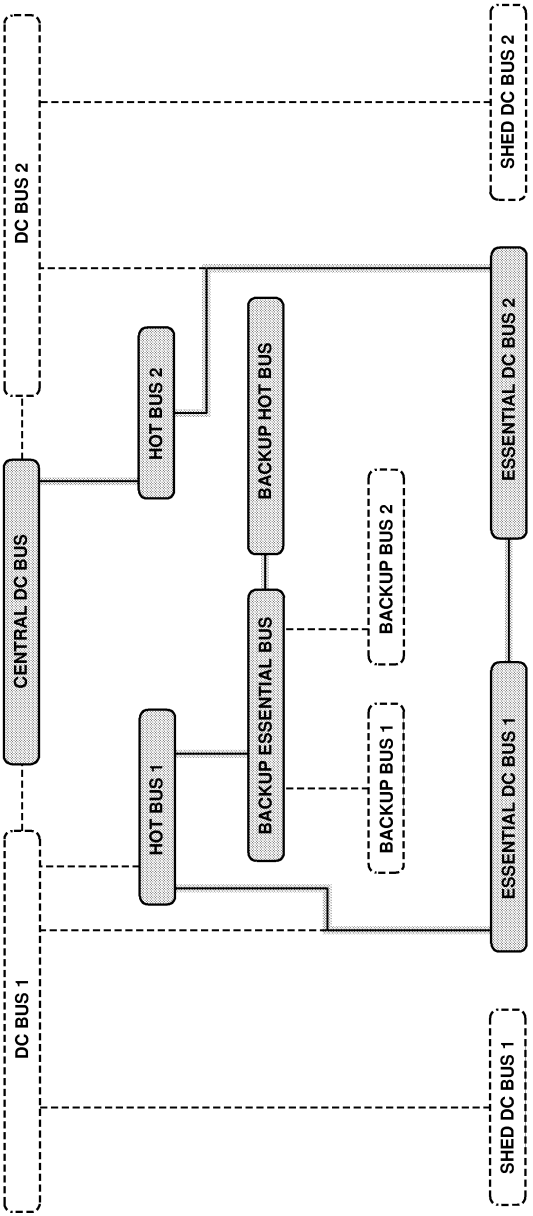


**CONFIGURATION 3**
**(Electrical Emergency Condition)**

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## ABNORMAL OPERATION - CONFIGURATION 3A

**Improper transfer to electrical emergency condition:**

If during normal operation an improper transfer to electrical emergency condition occurs, the following modification will take place:

- ELEC EMERG ABNORM caution message on the EICAS.
- EBC 1, EBC 2, EIC and BC 2 are closed.
- BTC 1, BTC 2 and BC 1 are open.
- GLCs from operating generators are closed.
- SBC 1 and SBC 2 are closed if at least three generators are on.

**NOTE**: - BC 2 remains closed to keep the CENTRAL DC BUS energized and making it possible to perform an APU start.
- In case APU generator is not available, the batteries will feed the essential buses for at least 40 minutes.
- DC BUS 1 and DC BUS 2 remain energized by the respective engine generators, but isolated from the CENTRAL DC BUS.

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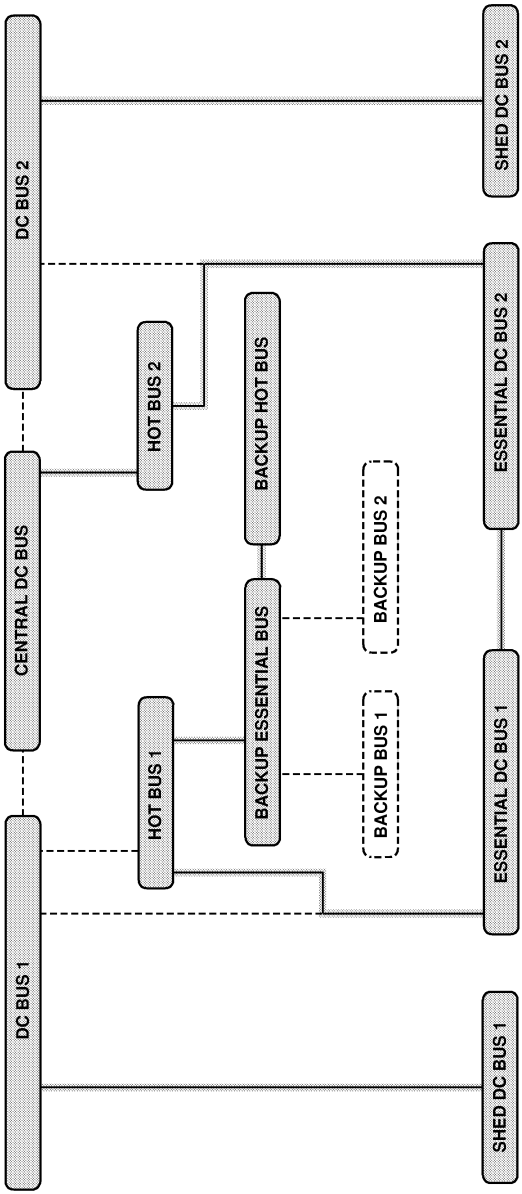


**CONFIGURATION 3A**

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## ABNORMAL OPERATION - CONFIGURATION 3B

**Electrical essential transfer failure:**

An electrical essential transfer failure will occur when all GLCs and ALC are open (loss of all generators) and DC BUS 1 and/or DC BUS 2 remain energized.

The DC BUS 1 may remain energized because:

- BTC 1 fails to open.
- BC 1 fails to open or;
- EBC 1 fails to close.

The DC BUS 2 may remain energized because:

- BTC 2 fails to open or;
- EBC 2 fails to close.

**Case 1 - Loss of all generators and BTC 1 is closed (DC BUS 1 is energized):**

- ELEC ESS XFR FAIL warning message on the EICAS.
- All GLCs and ALC are open.
- BTC 2, BC 1, SBC 1 and SBC 2 are open.
- EBC 1, EBC 2, BTC 1, BC 2, BBC and EIC are closed.

**NOTE**: BC 2 remains closed to keep the CENTRAL DC BUS energized and making it possible to perform an APU start.

**Case 2 - Loss of all generators and BTC 2 is closed (DC BUS 2 is energized):**

- ELEC ESS XFR FAIL warning message on the EICAS.
- All GLCs and ALC are open.
- BTC 1, BC 1, SBC 1 and SBC 2 are open.
- EBC 1, EBC 2, BTC 2, EIC and BC 2 are closed.

**NOTE**: BC 2 remains closed to keep the CENTRAL DC BUS energized and making it possible to perform an APU start.

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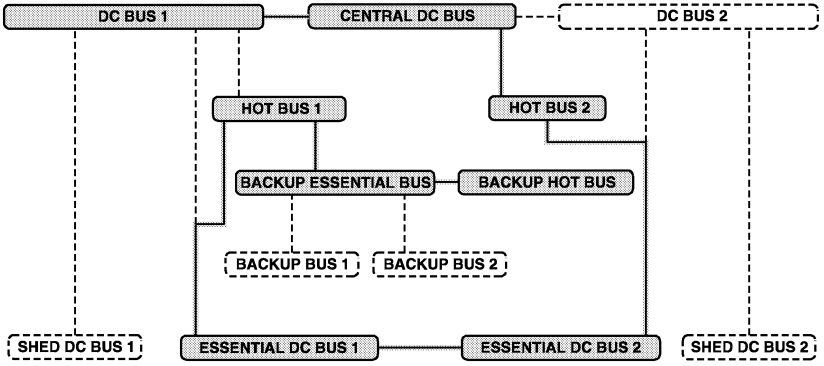
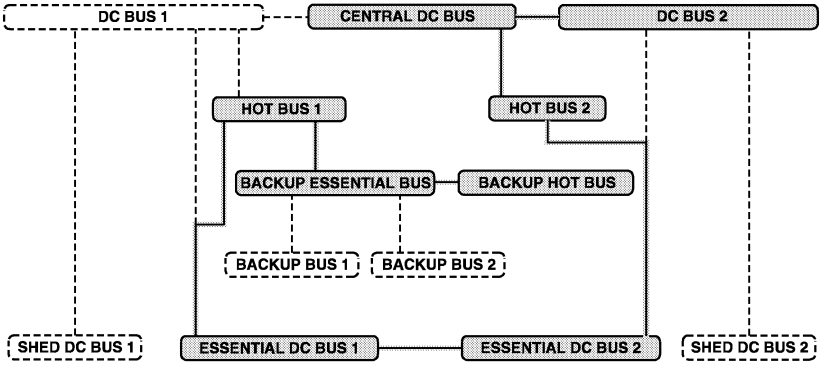



**CASE 1**




**CASE 2**

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## CONFIGURATION 3B

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**CONFIGURATION 4**

**Short circuit at one DC Bus with all generators on:**

- Associated battery is removed from affected DC bus through a fuse.
- BTC 1 and BTC 2 are open.
- Both GLCs of the affected DC Bus are open, isolating the bus.
- Cross-side BTC and EIC are closed and affected side EBC is energized to maintain both Essential DC Buses energized and batteries charged.

**Short circuit at one DC Bus with loss of one associated generator and with APU generator:**

- Associated battery is removed from the affected DC bus through a fuse.
- BTC 1 and BTC 2 are open.
- Remaining GLC of the affected DC Bus opens, isolating the bus.
- Cross-side BTC and EIC are closed, and affected side EBC is energized to maintain both Essential DC Buses energized and batteries charged.

**Short circuit at one DC Bus with loss of associated generators and with APU generator:**

- Both batteries are removed from the affected DC bus through the fuses.
- BTC 1 and BTC 2 are open.
- EIC closes and EBC of affected side is energized to maintain the associated Essential DC Bus energized and associated battery charged.

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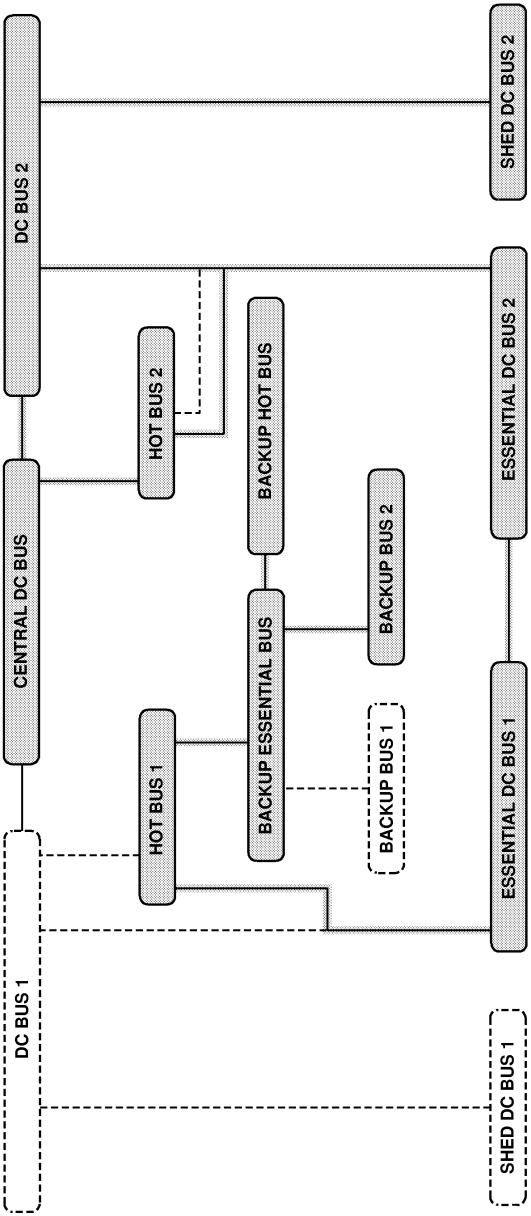


**CONFIGURATION 4**
**(Only EDL 1 Failure Shown)**

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**CONFIGURATION 5**

**Short circuit at one DC Bus with loss of one associated generator and without APU generator:**

- Both batteries are removed from the affected DC bus through the fuses.
- BTC 1 and BTC 2 are open.
- Remaining GLC of the affected DC Bus opens, isolating the bus.
- Cross-side BTC and EIC close, and EBC of the affected side is energized to maintain both Essential DC Buses energized and associated battery charged.
- Both SBCs are open.

**Short circuit at one DC Bus with loss of associated generators and without APU generator:**

- Both batteries are removed from the affected DC bus through the fuses.
- BTC 1 and BTC 2 are open.
- EIC closes and EBC of the affected side is energized to maintain the associated Essential DC Bus energized and associated battery charged.
- Both SBCs are open.

**Short circuit at one DC Bus with loss of associated generators plus one generator of the other side, with or without APU generator:**

- The EDL operational sequence is the same as in the previous condition.

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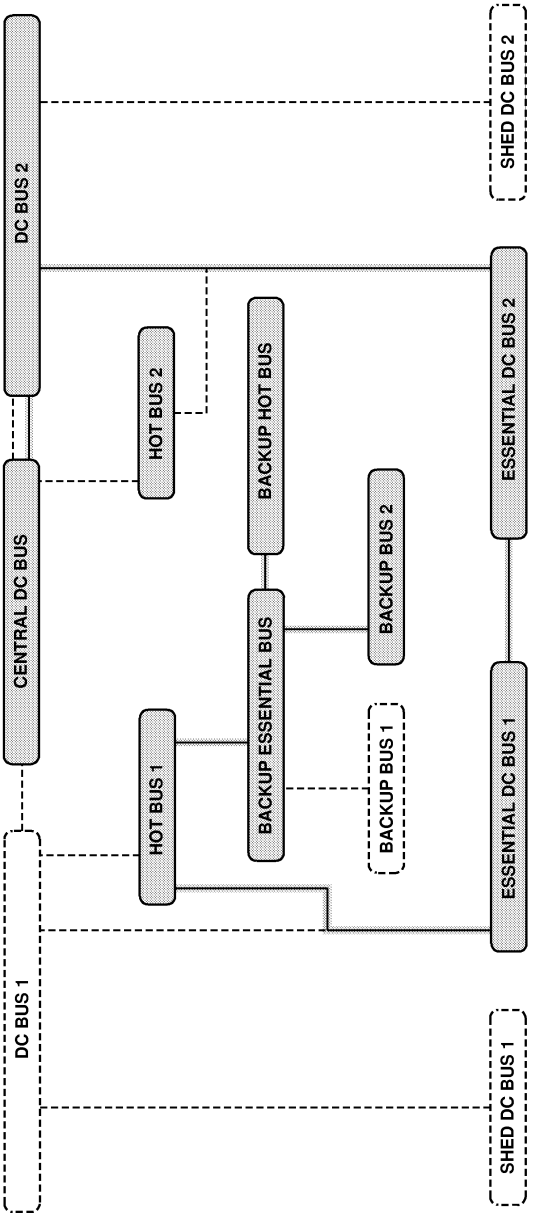


**CONFIGURATION 5**
**(Only EDL 1 Failure Shown)**

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## NORMAL, ABNORMAL AND EMERGENCY OPERATION DIAGRAMS

The following diagrams present the Electrical System layout when operating in normal, abnormal and emergency condition.

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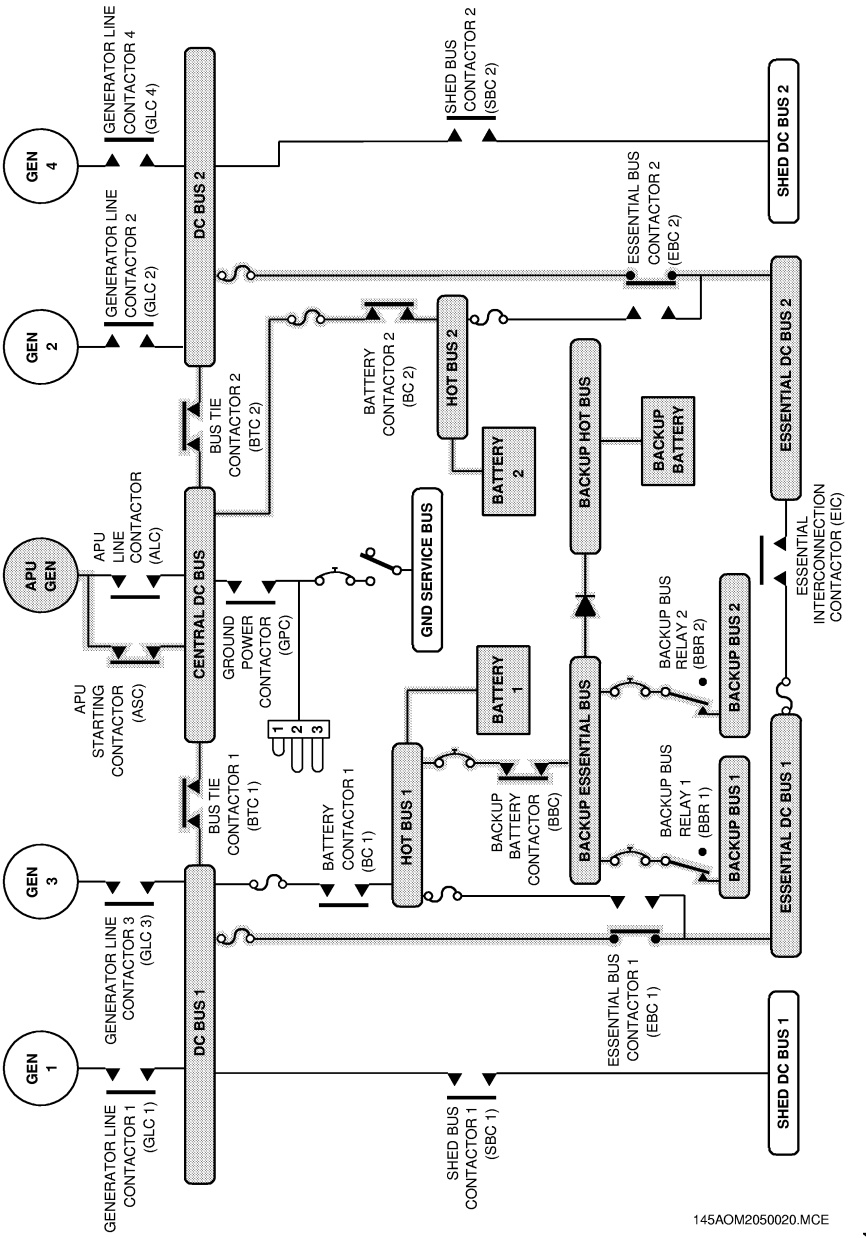


## EDL STATUS DURING APU STARTING WITH BATTERIES

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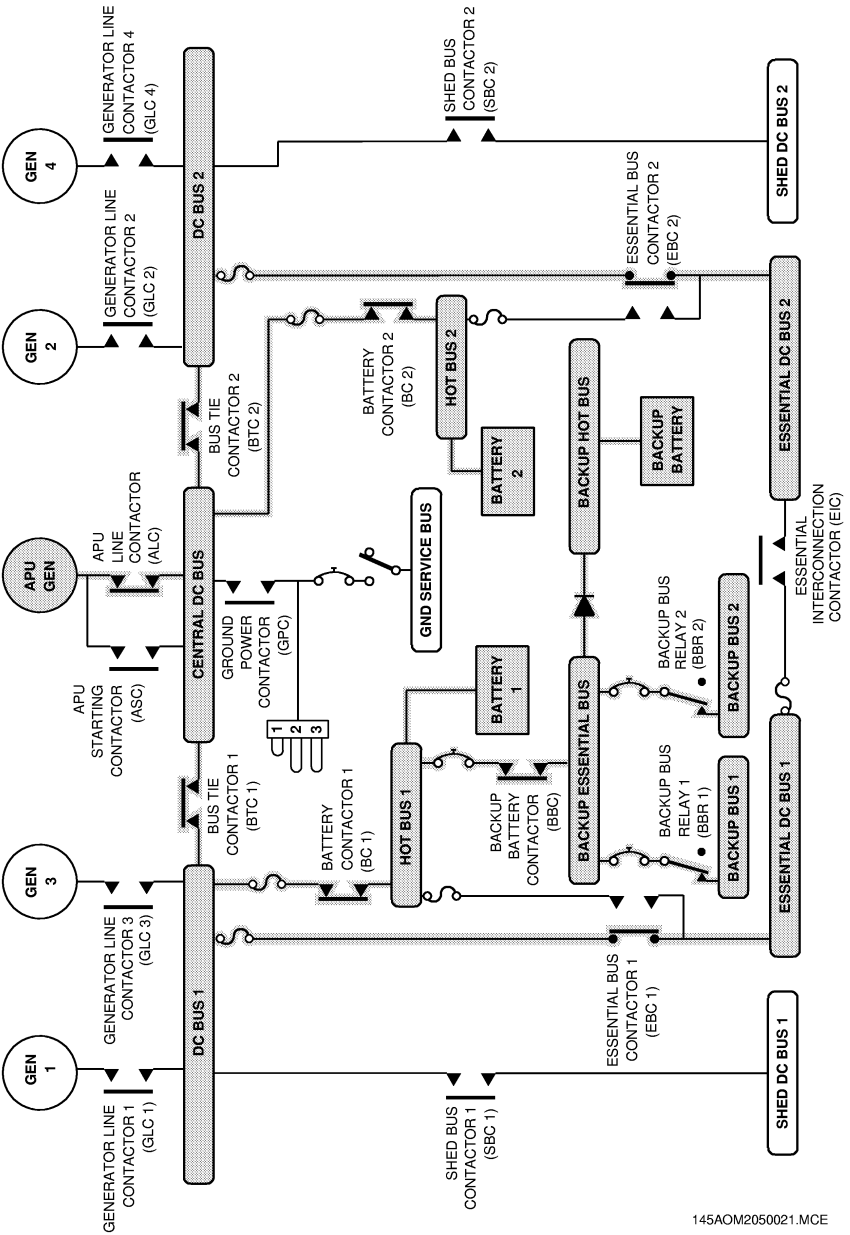


## EDL STATUS AFTER APU STARTING WITH BATTERIES

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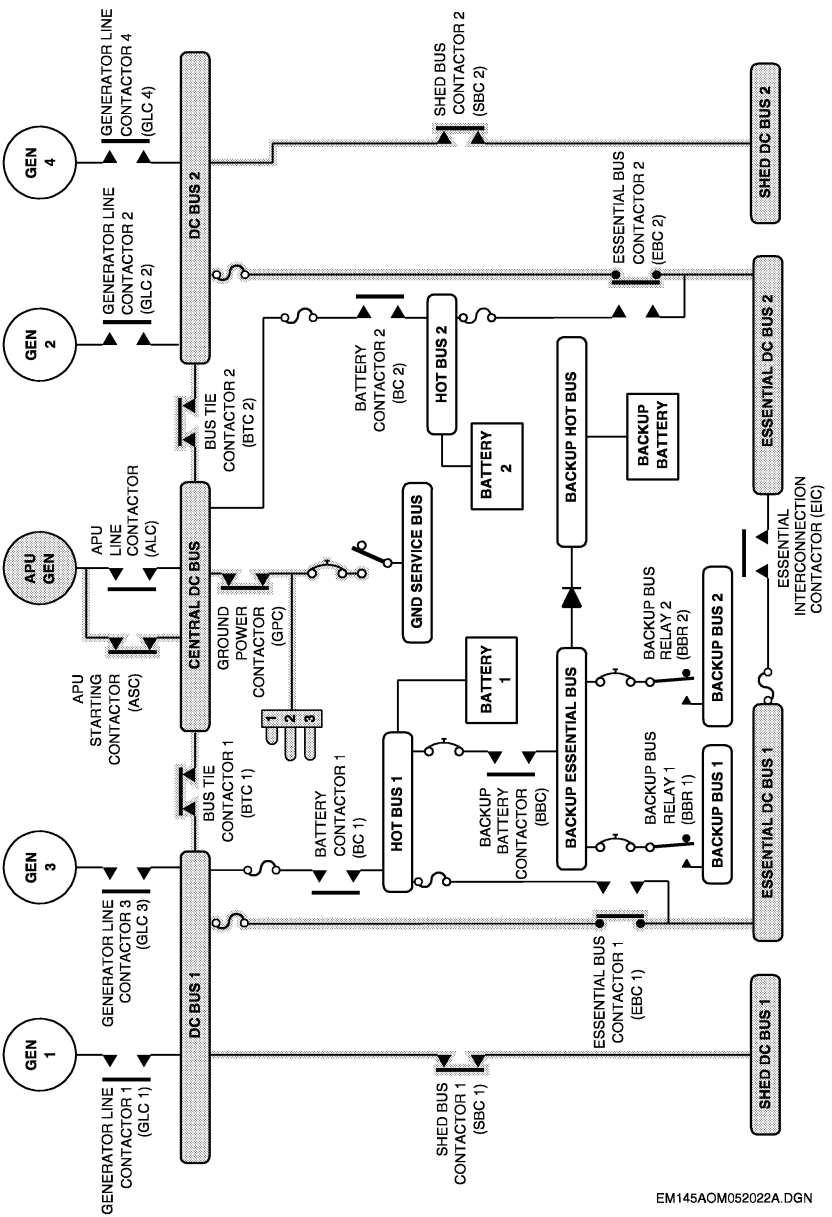


## EDL STATUS DURING APU STARTING WITH GPU

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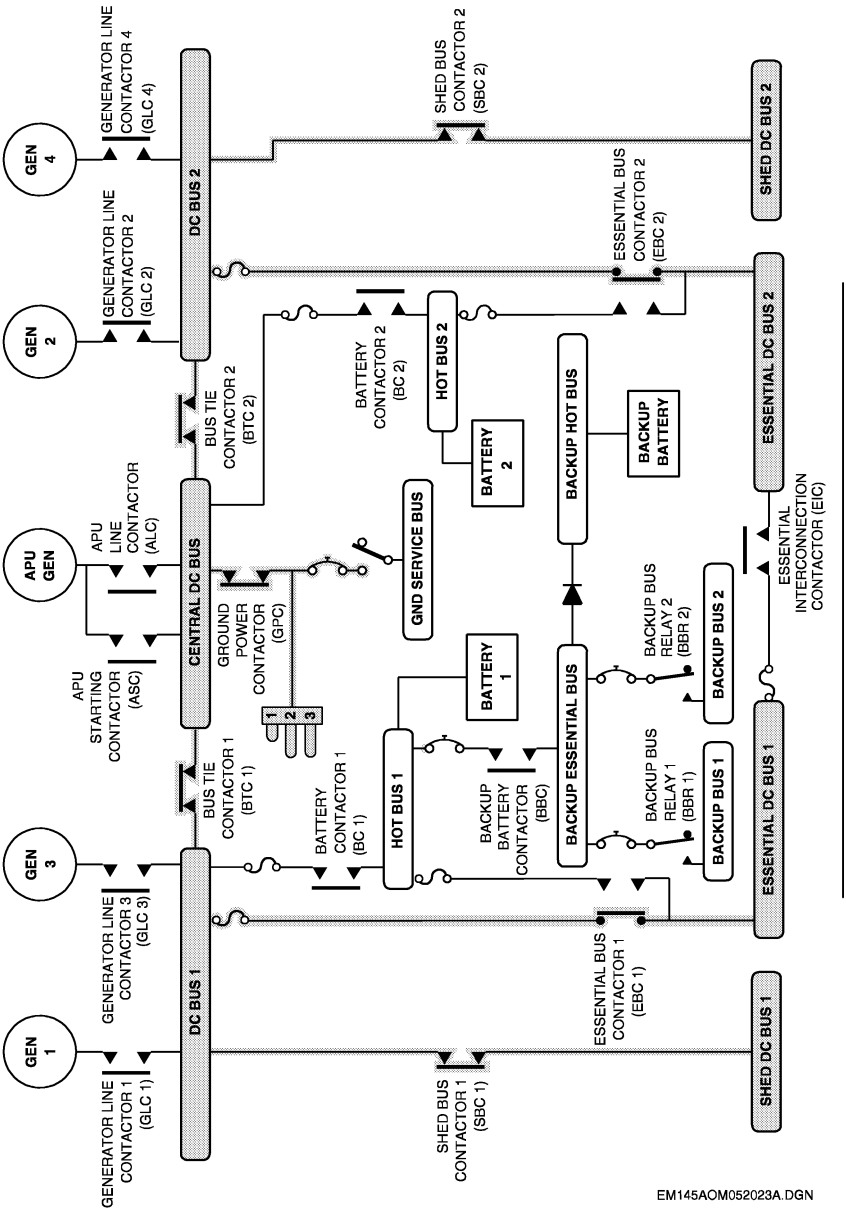


## EDL STATUS AFTER APU STARTING WITH GPU

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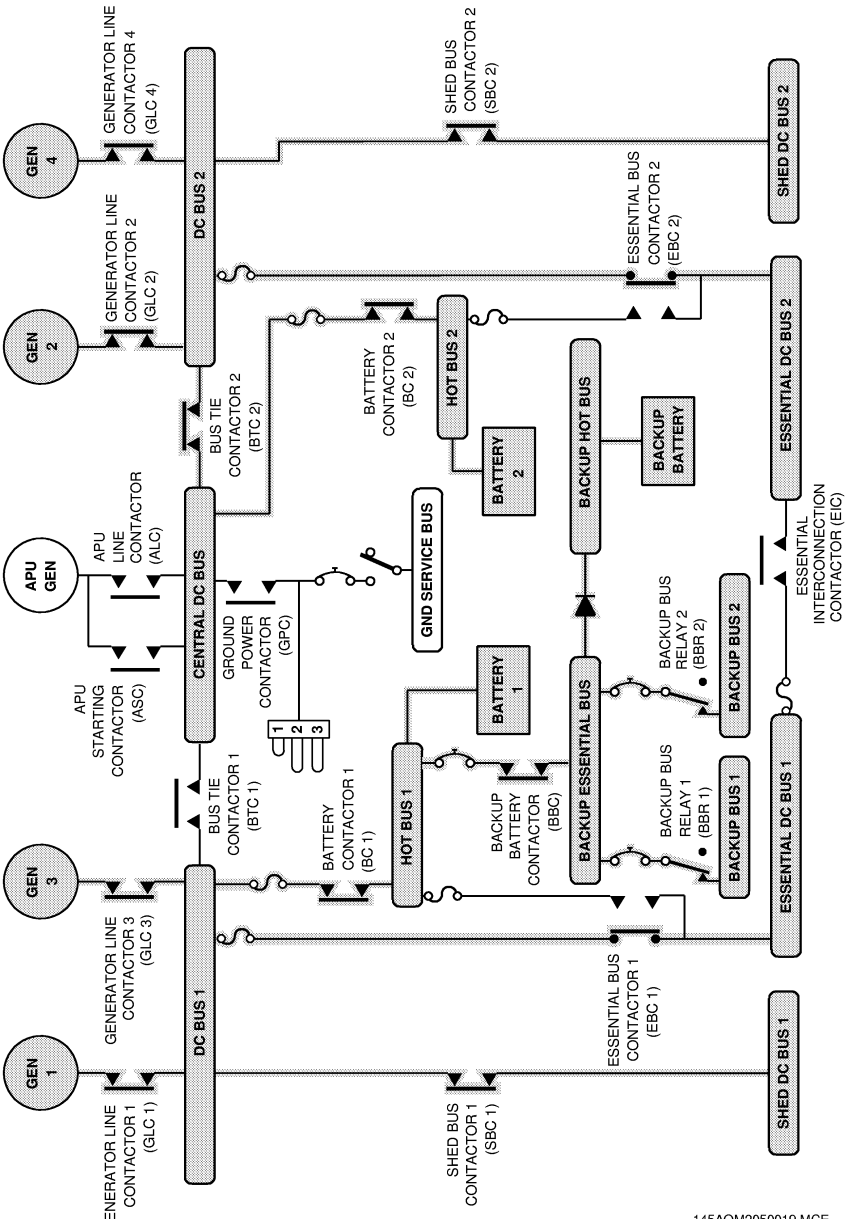


## EDL STATUS DURING NORMAL OPERATION

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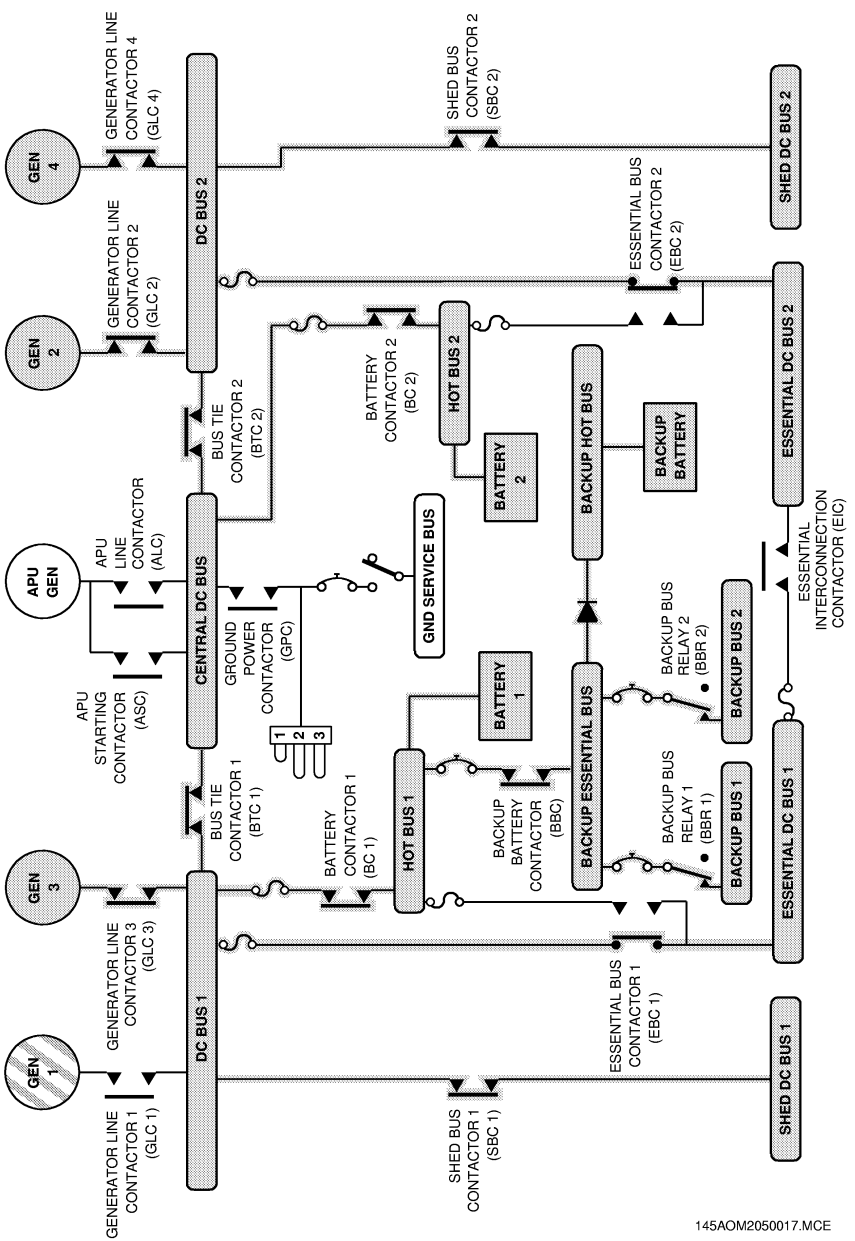


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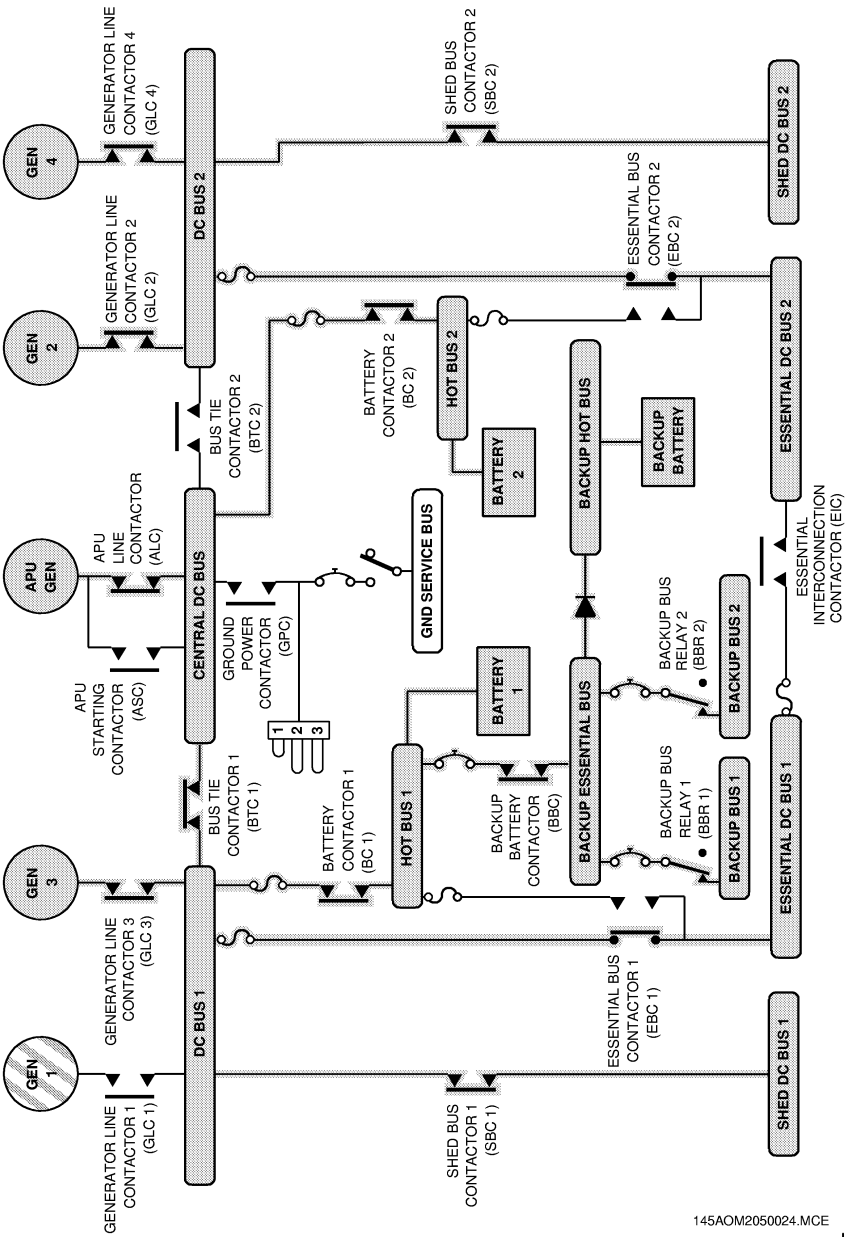
**EDL STATUS AFTER LOSS OF GENERATOR 1
WITHOUT APU GENERATOR**




**EDL STATUS AFTER LOSS OF GENERATOR 1 WITH APU GENERATOR**

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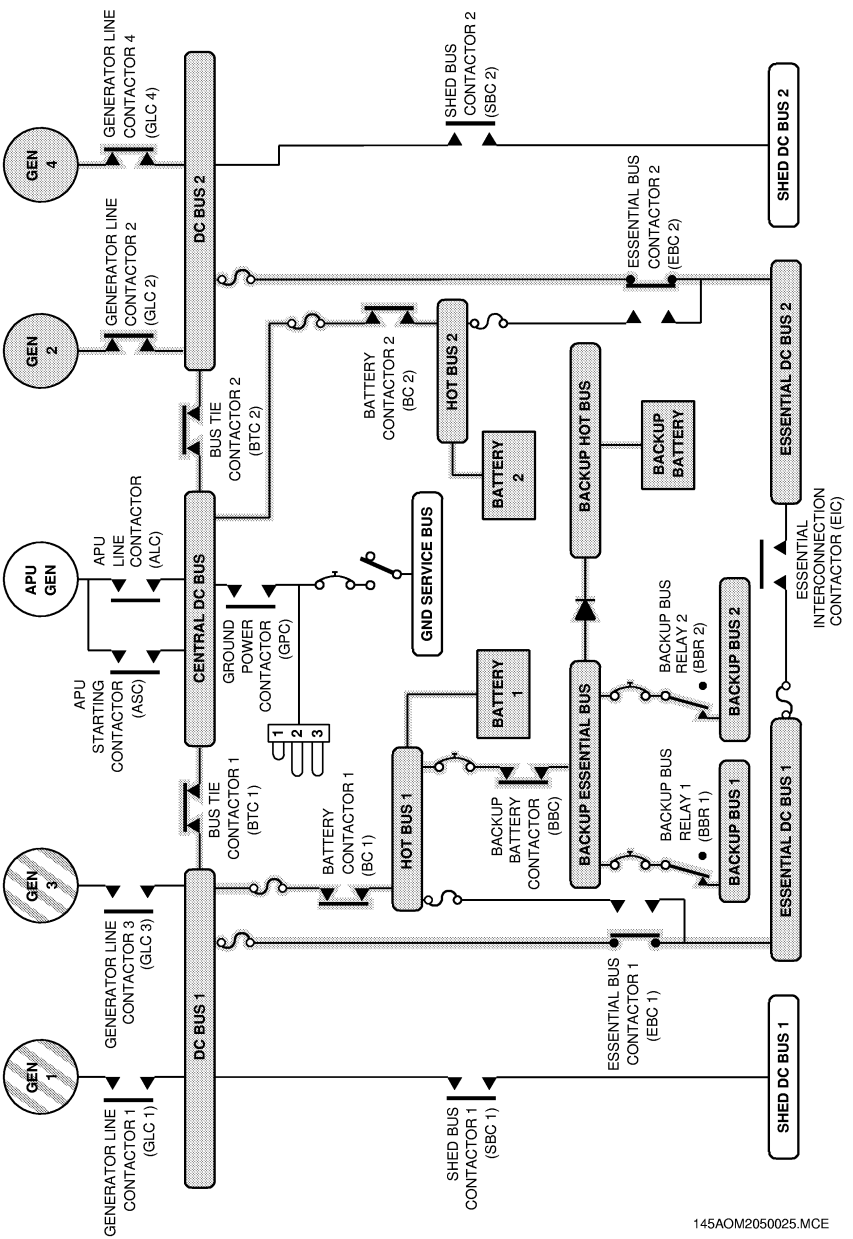


**EDL STATUS AFTER LOSS OF GENERATORS 1 AND 3 WITHOUT APU GENERATOR**

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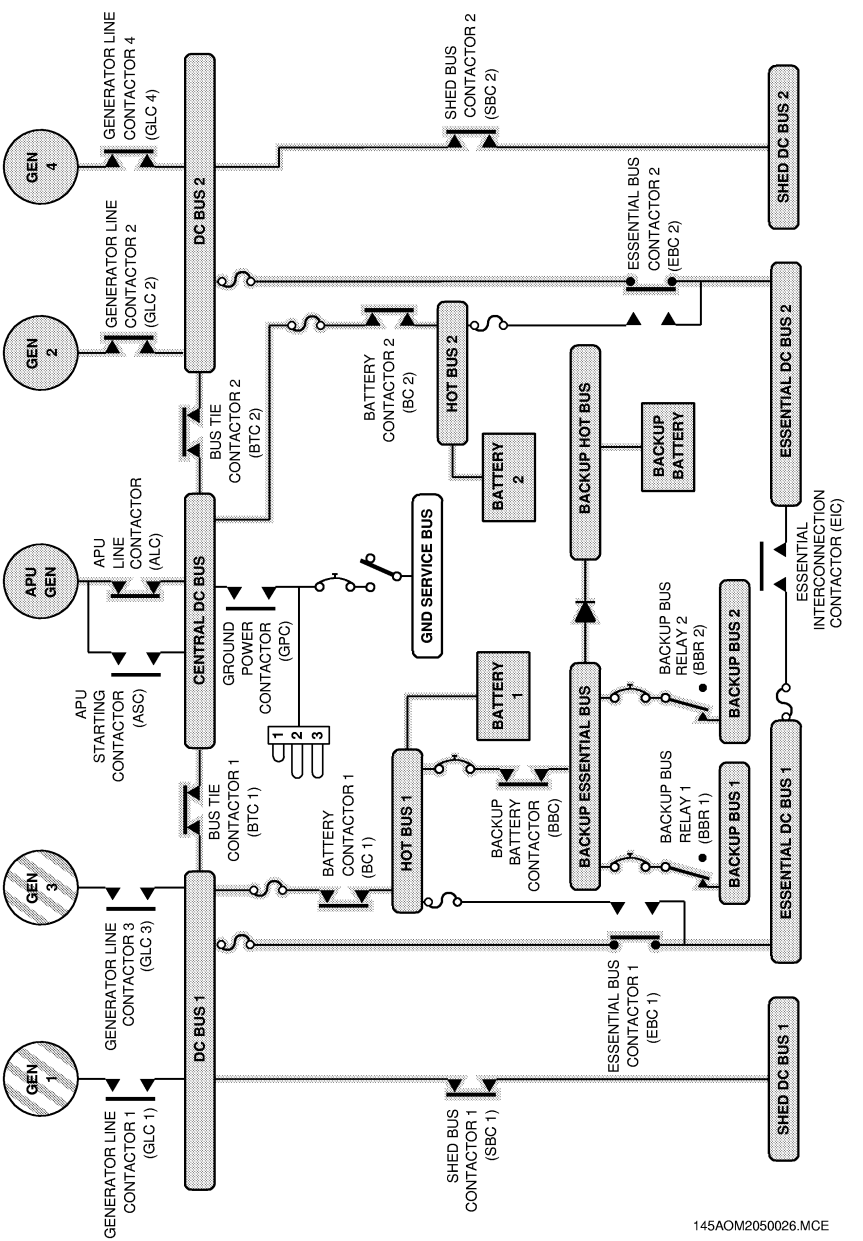


**EDL STATUS AFTER LOSS OF GENERATORS 1 AND 3 WITH APU GENERATOR**

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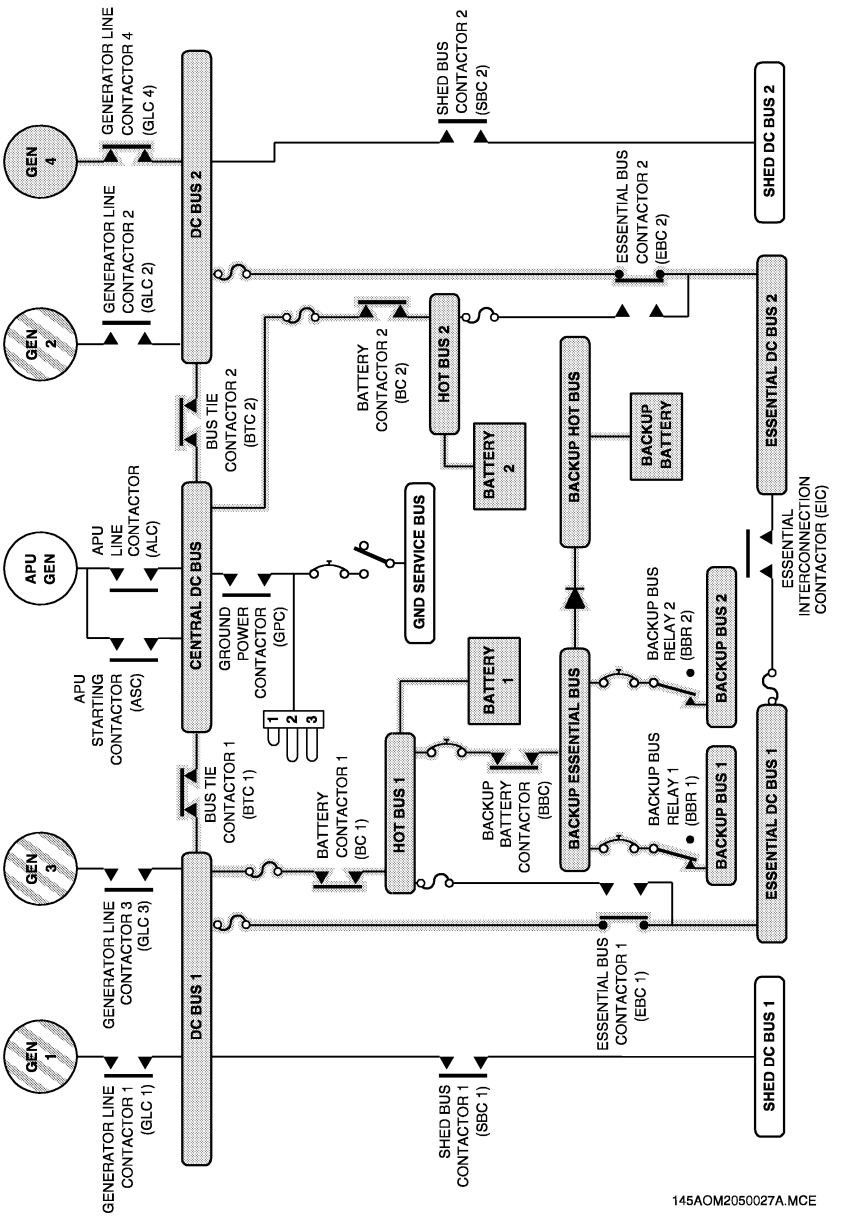
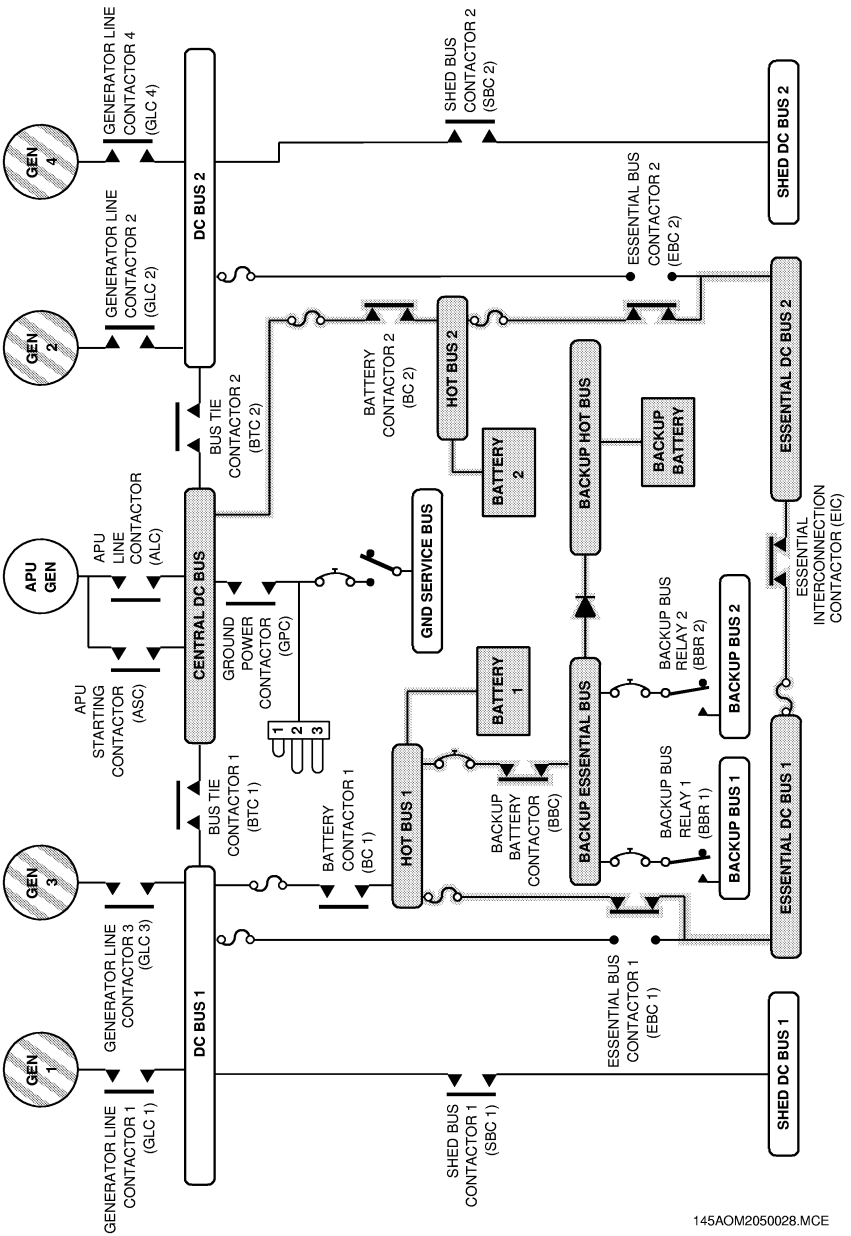



## EDL STATUS DURING LOSS OF THREE ENGINE GENERATORS WITHOUT APU GENERATOR




**EDL STATUS AFTER LOSS OF ALL THE GENERATORS (ELECTRICAL EMERGENCY CONDITION)**

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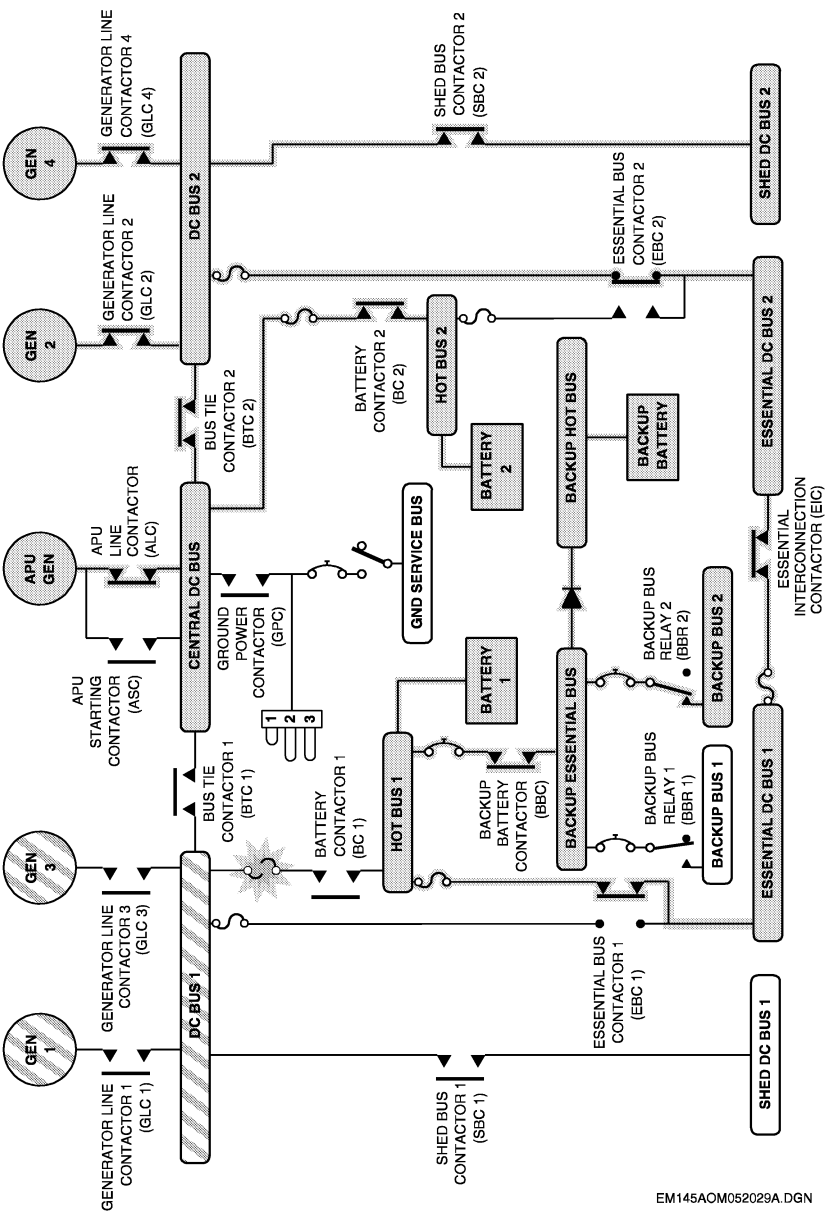
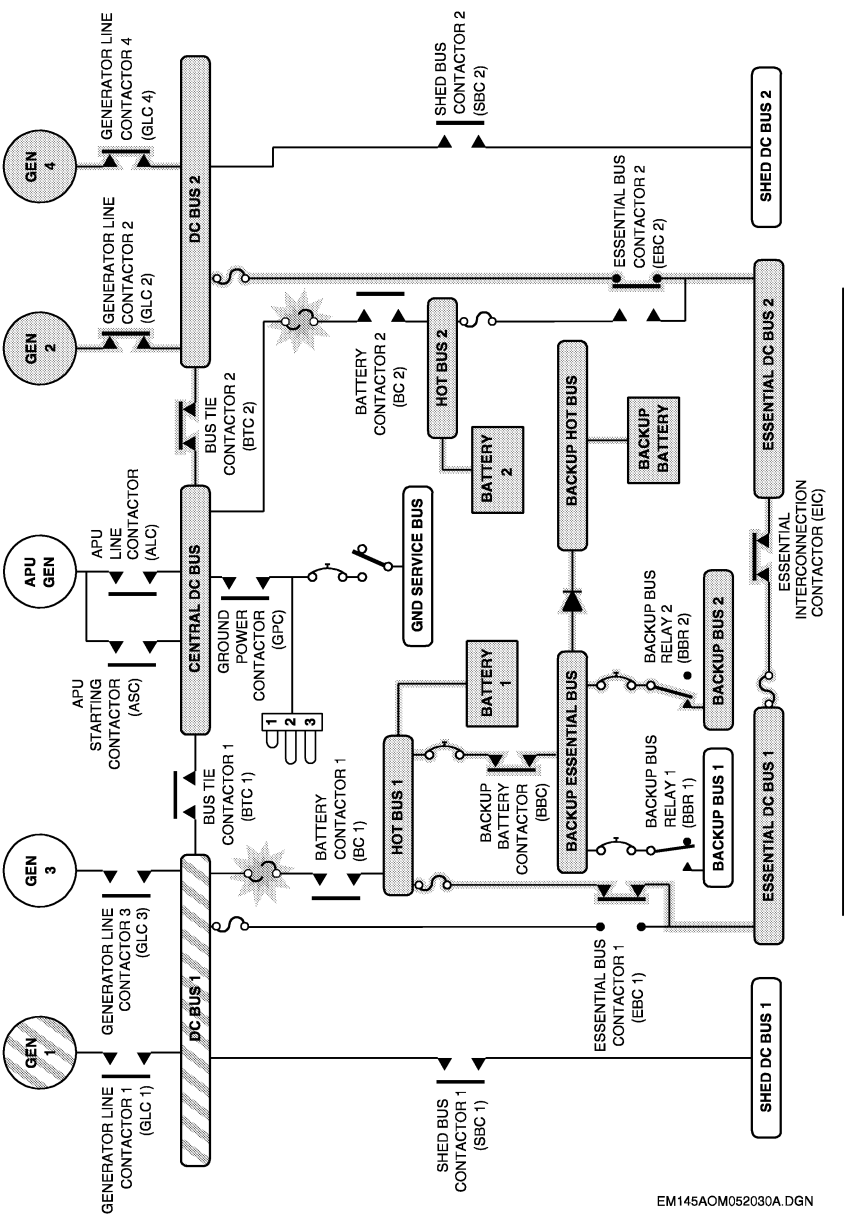



**EDL STATUS AFTER A SHORT CIRCUIT AT DC BUS 1 WITH ALL GENERATORS ON**




**EDL STATUS AFTER A SHORT CIRCUIT AT DC BUS 1 WITH LOSS OF GENERATOR 1 AND WITHOUT APU GENERATOR**

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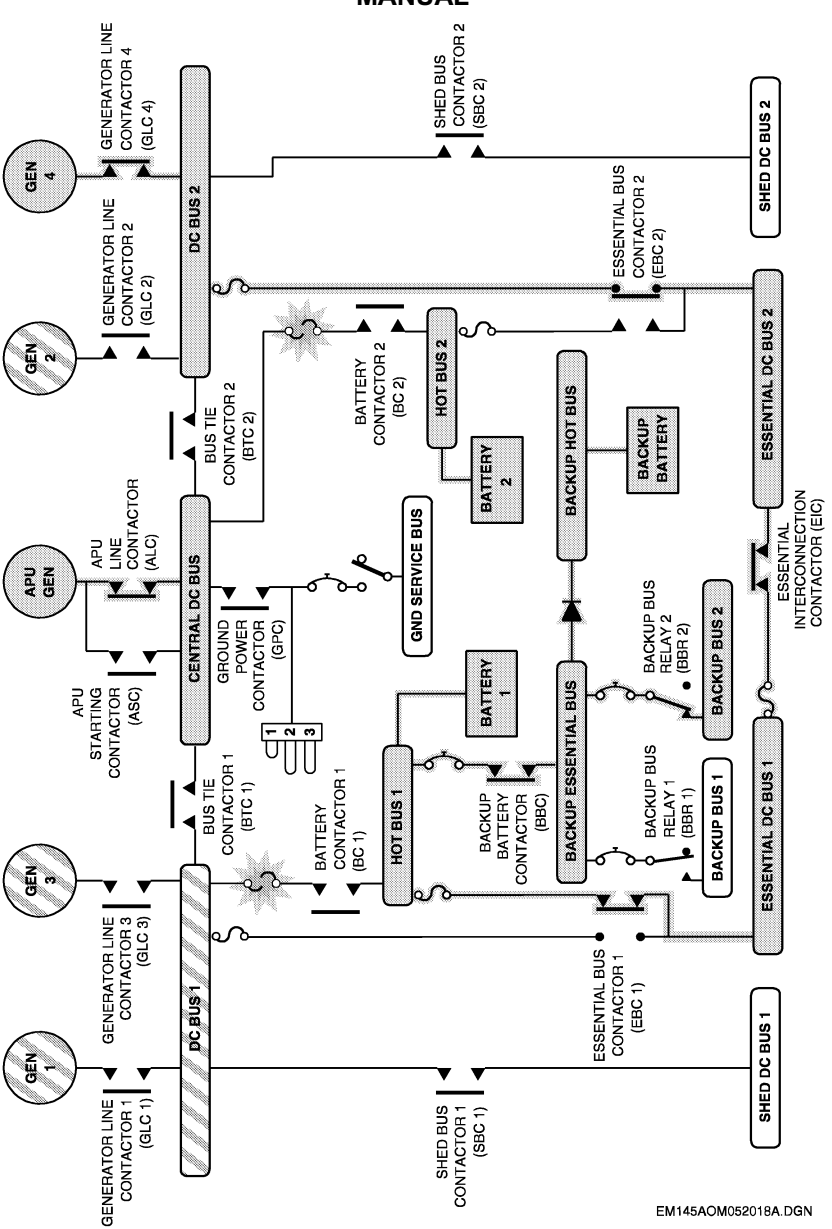


**EDL STATUS AFTER A SHORT CIRCUIT AT DC BUS 1 WITH LOSS OF GENERATORS 1, 2 AND 3 WITH APU GENERATOR ON**

# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | BATT 1 (2) OVTEMP | Associated battery temperature is above 70°C. |
| | ELEC ESS XFR FAIL | Automatic transfer to electrical emergency condition has failed. |
| CAUTION | GEN 1 (2, 3, 4) OVLD | Associated generator current is above 400 A. |
| | GEN 1 (2, 3, 4) OFF BUS | Associated generator is disconnected from the electrical network after engine stabilization due to generator channel failure or button released. |
| | APU GEN OVLD | APU generator current is above 400 A. |
| | APU GEN OFF BUS | APU generator is disconnected from electrical network, due to open ALC, with APU RPM above 95% plus seven seconds. This is caused by generator channel failure or button released. |
| | APU CNTOR CLSD | APU Starting Contactor (ASC) or Line Contactor (ALC) is inadvertently closed. |
| | DC BUS 1 (2) OFF | Associated DC Bus is de-energized. If DC Bus 1 is deenergized the inverter becomes inoperative. |
| | ESS BUS 1 (2) OFF | Associated Essential Bus is deenergized. |
| | SHED BUS 1 (2) OFF | Associated Shed Bus is deenergized. |
| | BATT 1 (2) OFF BUS | Associated battery is disconnected from the electrical network. |
| | BKUP BATT OFF BUS | Backup battery is disconnected from the electrical network. |

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# EICAS MESSAGES (continued)

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | ELEC EMERG ABNORM | Improper transfer to electrical emergency condition has occurred. |
| | 115 VAC BUS OFF | 115 VAC bus is deenergized. |
| ADVISORY | GEN 1 (2, 3, 4) BRG FAIL | Associated generator bearing has failed. |

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# CONTROLS AND INDICATORS

## ELECTRICAL SYSTEM PANEL

### 1 - GENERATOR BUTTON

- Connects (pressed) or disconnects (released) the associated generator to/from the respective DC Bus.
- Pressing and depressing the Generator Button causes all GCU latches protection circuits to be reset if the associated generator is running.
- A striped bar illuminates inside the button when it is released.

### 2 - GROUND POWER UNIT BUTTON

- Connects (pressed) or disconnects (released) the GPU to/from the electrical system.
- A GPU AVAIL inscription illuminates, in the upper half of the button, when the GPU is properly connected to the airplane receptacle and ready to supply power. The GPU AVAIL inscription extinguishes when the button is pressed and the external power is connected to the electrical network.
- A striped bar illuminates inside the button when it is pressed.

### 3 - APU STARTER GENERATOR BUTTON

- Connects (pressed) or disconnects (released) the APU starter generator, when APU RPM is above 95%, plus 7 seconds.
- A striped bar illuminates inside the button when it is released.

### 4 - BATTERY SELECTOR KNOB

OFF - Respective battery contactor is kept open, disconnecting the associated battery from the electrical system.

AUTO - The actuation of the respective battery contactor is controlled according to the Electrical Distribution Logic.

### 5 - ESSENTIAL POWER BUTTON (guarded)

- When pressed the system overrides the automatic transfer to the electrical emergency circuitry, connecting the batteries directly to essential buses, regardless of any other command from the Electrical Distribution Logic.
- When released, the power contactors operate automatically according to the Electrical Distribution Logic.
- A striped bar illuminates inside the button when it is pressed.

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**6 - SHED BUSES SELECTOR KNOB**

OVRD - Closes the Shed Buses Contactors, provided the airplane is on ground and at least one generator is operative.

AUTO - Controls the operation of Shed Buses Contactors according to the Electrical Distribution Logic.

OFF - Deenergizes the Shed Buses manually regardless of any other command from the Electrical Distribution Logic.

**7 - AVIONICS MASTER BUTTONS**

- Connect (pressed) or disconnect (released) the navigation and communication equipment supplied by the avionics switched buses.
- A striped bar illuminates inside the button when it is released.

**8 - BACKUP BATTERY BUTTON**

- Connects (pressed) or disconnects (released) the backup battery to/from the electrical system.
- A striped bar illuminates inside the button when it is released.

**9 - AC POWER BUTTON**

- Connects (pressed) or disconnects (released) the inverter to/from the system.
- A striped bar illuminates inside the button when it is released.

**10- BUS TIES SELECTOR KNOB**

OVRD - Bus Tie Contactors (BTCs) are kept closed regardless of Electrical Distribution Logic, provided that no overcurrent is detected by one of the five GCUs.

AUTO - Controls the operation of the BTCs according to the Electrical Distribution Logic.

OFF - Opens the BTCs and EIC regardless of any other command from the Electrical Distribution Logic.

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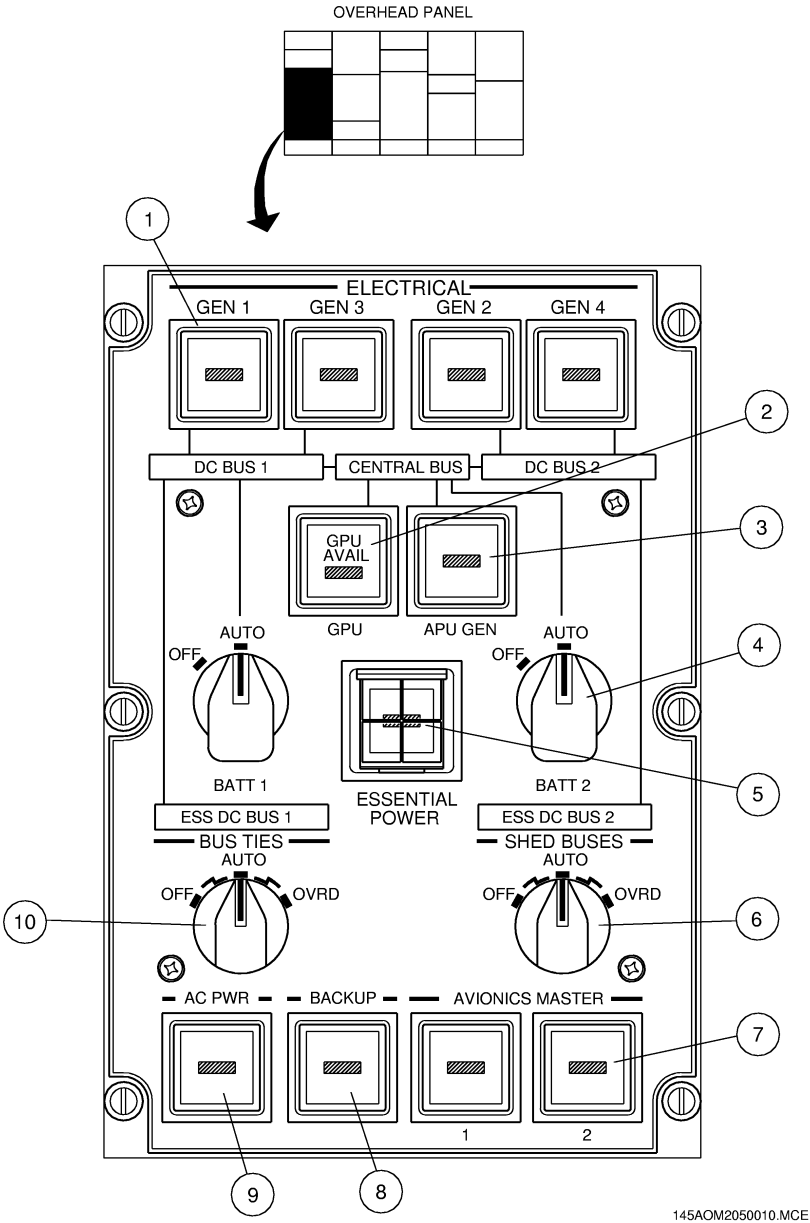


**ELECTRICAL SYSTEM PANEL**

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# MFD ELECTRICAL PAGE

## 1 - LABELS AND UNITS

– Labels and units are always white.

## 2 - GENERATOR VOLTAGE AND CURRENT INDICATION

VOLTAGE:

– Digits are green and boxes are white during normal operation.
– Digits and boxes are amber when the generator is inadvertently off bus.
– Ranges from 0 to 40.0 V, with a resolution of 0.1 V.

CURRENT:

– Digits are green and boxes are white during normal operation.
– Digits and boxes are amber when the generator is inadvertently off bus or when the current is higher than 400 A.
– Ranges from 0 to 600 A, with a resolution of 5 A.

**NOTE:** The APU indication is removed when the APU is not available and/or the APU Master Selector is set to the OFF position with APU RPM below 10%.

## 3 - DC BUS INDICATION

– Green when bus is energized.
– Amber when bus is off.

## 4 - GPU VOLTAGE INDICATION

– Digits are always green.
– Box is always white.
– Ranges from 0 to 40.0 V, with resolution of 0.1 V.

**NOTE:** GPU voltage indication is removed in flight.

## 5 - BUS LINES INDICATION

– Bus lines are always white.

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## 6 - BATTERY VOLTAGE AND TEMPERATURE INDICATION

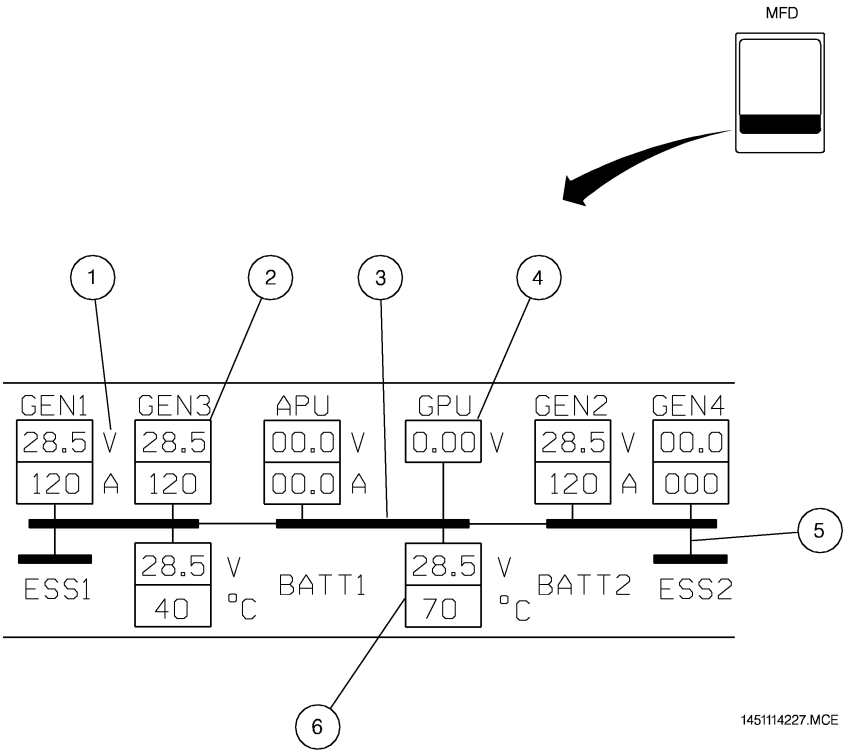
VOLTAGE:

- Digits are green and boxes are white during normal battery operation.
- Digits and boxes are amber when the battery is inadvertently off bus.
- Ranges from 0 to 40.0 V, with a resolution of 0.1 V.

TEMPERATURE:

- Boxes are white during battery normal operation.
- Boxes are amber when the battery is off bus.
- Digits are green when the temperature is below 70°C.
- Ranges from –40°C to 150°C, with a resolution of 1°C.
- Digits and boxes are red when the temperature is greater than 70°C.

**NOTE:** The red alerts supersede any other condition.




**ELECTRICAL PAGE ON MFD**

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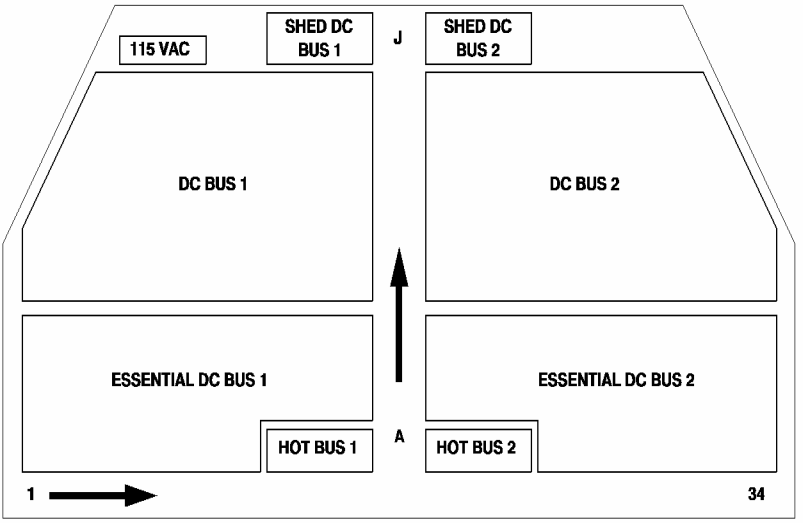
# CIRCUIT BREAKER PANEL AND LOAD DISTRIBUTION

## CIRCUIT BREAKER PANEL

The Circuit Breaker Panel is divided in areas associated to electrical system buses.

Columns and lines on the circuit breaker panel are identified through an alphabetic (for the lines) and numeric (for the columns) code.

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**CIRCUIT BREAKER PANEL MAP**

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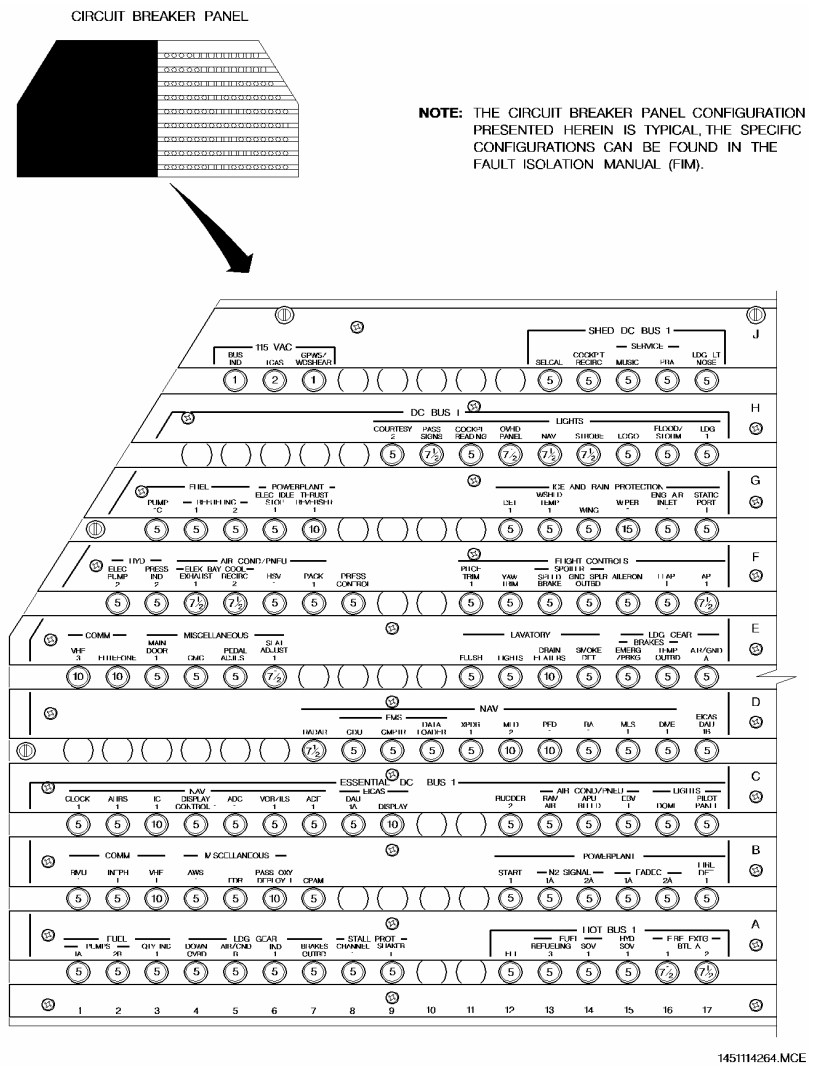


## CIRCUIT BREAKER PANEL (TYPICAL)

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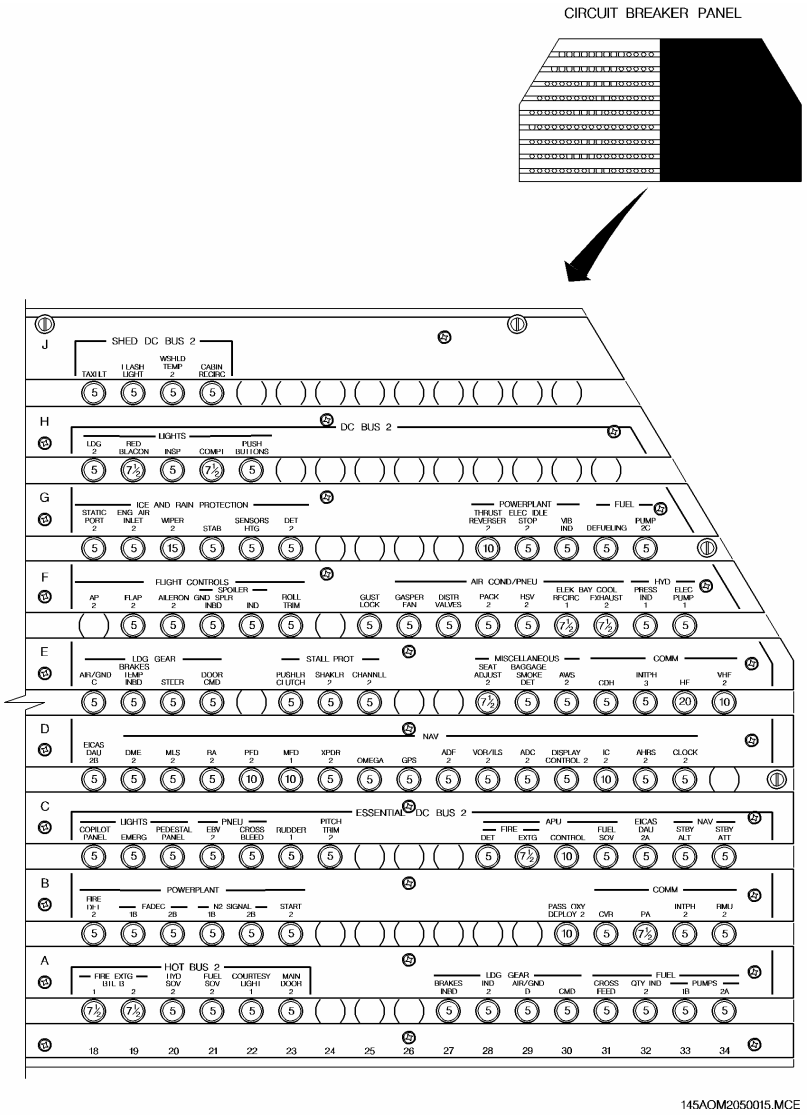


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## CIRCUIT BREAKER PANEL (TYPICAL)

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# DC BUS LOAD DISTRIBUTION (TYPICAL)

The following list identifies the DC buses and the equipment powered by them. Optional equipment are preceded by an asterisk (*).

## DC BUS 1

- AILERON CONTROL SYSTEM 1
- AIR/GND POSITION SYSTEM A
- AOA 1 SENSOR HEATING
- BRAKES TEMPERATURE INDICATION OUTBD
- CABIN LIGHTING 1
- CENTRAL MAINTENANCE COMPUTER
- CLEAR ICE DETECTION SYSTEM - CHANNEL 1
- COCKPIT READING LIGHT
- COURTESY/STAIR LIGHTS 2
- CREW PEDAL ADJUSTMENT
- CREW SEAT ADJUSTMENT 1
- EICAS POWER (DAU 1B)
- * ELECTRICAL FLIGHT IDLE STOP 1
- ELECTRONIC BAY COOLING (EXHAUST 1)
- ELECTRONIC BAY COOLING (RECIRC 2)
- EMER/PARKING BRAKE
- ENG 1 FUEL PUMPS 1C
- * ENG 1 THRUST REVERSER COMMAND
- ENGINE 1 LIP ANTI-ICE
- FLAP POWER/COMMAND 1
- FLOOD/STORM LIGHTS
- FUEL PRESSURE REFUELING 1/2
- GROUND SPOILER OUTBD
- * HEAD-UP GUIDANCE SYSTEM
- HYDRAULIC ELECTRIC PUMP 2
- HYDRAULIC GEN SYS 2 INDICATION
- ICE DETECTOR 1
- INVERTER
- LANDING LIGHTS 1
- LAVATORY FLUSH
- LAVATORY LIGHTS
- LAVATORY SMOKE DETECTOR
- LAVATORY WATER DRAIN HEATER
- LOGOTYPE LIGHTS
- MAIN DOOR CONTROL 1
- NAVIGATION LIGHTS
- OVERHEAD PANEL LIGHTING
- PACK VALVE 1
- PASSENGER SIGNS
- PITCH TRIM 1
- PITOT 1 HEATING
- PNEUMATIC HSV 1
- PRESSURIZATION CONTROL
- SPEED BRAKE
- STATIC PORT HEATING 1
- STROBE LIGHTS
- TAT 1 SENSOR HEATING
- * TCAS 2000
- VENTRAL FUEL TRANSFER PUMP A (EMB-145 XR)
- WINDSHIELD HEATING 1
- WINDSHIELD WIPER SYSTEM 1 (IF INSTALLED)
- WING ANTI-ICE SYSTEM
- YAW TRIM SYSTEM

## DC BUS 2

- ADC 2 POWER/CONTROL
- AHRS 2 POWER
- AILERON CONTROL SYSTEM 2
- AIR/GND POSITION SYSTEM C
- AOA 2 SENSOR HEATING
- AURAL WARNING SYSTEM 2
- BAGGAGE SMOKE DETECTOR
- BRAKES TEMP INDICATION INBD
- CABIN RECIRCULATION
- CLEAR ICE DETECTION SYSTEM - CHANNEL 2
- COMPARTMENT LIGHTS
- COPILOT'S CLOCK
- CREW SEAT ADJUSTMENT 2
- DEFUELING
- DISPLAY PRCS/CONTROL POWER 2 (IC2)
- EICAS POWER (DAU 2B)
- ELECTRICAL FLIGHT IDLE STOP 2
- ELECTRONIC BAY COOLING (RECIRC 1)
- ELECTRONIC BAY COOLING (EXHAUST 2)
- ENG 2 FUEL PUMPS 2C
- * ENG 2 THRUST REVERSER COMMAND
- ENGINE 2 LIP ANTI-ICE
- ENGINE VIBRATION SENSORS
- FLAP POWER/COMMAND 2
- GASPER FAN
- GROUND SPOILER INBD
- * GUST LOCK (ELECTROMECHANICAL)
- HYDR ELECTRIC PUMP 1
- HYDR GEN SYS 1 INDICATION
- ICE DETECTOR 2
- INSPECTION LIGHTS
- * IRS POWER 2
- LANDING GEAR DOOR COMMAND
- LANDING LIGHTS
- OBSERVER AUDIO (INTPH 3)
- OVERHEAD PANEL LIGHTING
- PACK VALVE 2
- PASSENGER CABIN LIGHTS 1/2/3
- PITOT 2 HEATING
- PNEUMATIC HSV 2
- RED BEACON LIGHTS
- ROLL TRIM SYSTEM
- SENSORS HEATING CONTROL
- SPOILER INDICATION
- SPS (SHAKER 2/CHANNEL 2)
- SPS PUSHER
- STABILIZER ANTI-ICE SYSTEM
- STATIC PORT HEATING 2
- STEERING SYSTEM
- TAT 2 SENSOR HEATING
- VENTRAL FUEL TRANSFER PUMP B (EMB-145 XR)
- WINDSHIELD WIPER SYSTEM 2 (IF INSTALLED)

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## AVIONIC SWITCHED DC BUS 1A

AUTOPILOT 1
DME 1
MFD 2 POWER
* MLS 1 POWER/CONTROL
PFD 1 POWER
RADIO ALTIMETER 1

## AVIONIC SWITCHED DC BUS 2A

AUTOPILOT 2
DME 2
* FMS SYSTEM 2 DATA LOADER (#)
* FMS SYSTEM 2 COMPUTER (#)
* FMS SYSTEM 2 CDU (#)
MFD 1 POWER
* MLS 2 POWER/CONTROL
PFD 2 POWER
* RADIO ALTIMETER 2
TUNING BACKUP CONTROL HEAD
VHF SYSTEM 2

## AVIONIC SWITCHED DC BUS 1B

* CMU MARK III
* FLITEFONE
* FMS SYSTEM 1 DATA LOADER
* FMS SYSTEM 1 COMPUTER
* FMS SYSTEM 1 CDU
RADAR SYSTEM
* TDR 1 POWER/CONTROL
* VHF SYSTEM 3

## AVIONIC SWITCHED DC BUS 2B

* ADF 2
* GPS
* HF POWER/CONTROL
* OMEGA
TDR 2 POWER/CONTROL
VOR/ILS/MB 2

## SHED DC BUS 1

COCKPIT RECIRCULATION
* GALLEY OVEN POWER
NOSE LANDING LIGHTS
* MUSIC
* PRE RECORD ANNOUNCEMENTS (PRA)
READING LIGHTS/ATTENDANT CALL 1
* SELCAL SYSTEM

## SHED DC BUS 2

CABIN RECIRCULATION
FLASHLIGHT
* GALLEY
* GALLEY COFFEE MAKER POWER
READING LIGHTS/ATTENDANT CALL 2/3
TAXI LIGHTS
WINDSHIELD HEATING 2

## HOT BUS 1

EMERGENCY LOCATOR TRANSMITER (ELT)
ENG 1 FIRE EXTINGUISHING (BTL A1)
ENG 2 FIRE EXTINGUISHING (BTL A2)
FUEL PRESSURE REFUELING 3
FUEL SHUTOFF VALVES 1
HYDRAULIC SHUTOFF VALVE 1

## HOT BUS 2

COURTESY/STAIR LIGHTS 1
ENG 1 FIRE EXTINGUISHING (BTL B 1)
ENG 2 FIRE EXTINGUISHING (BTL B 2)
FUEL SHUTOFF VALVES 2
HYDRAULIC SHUTOFF VALVE 2
MAIN DOOR CONTROL 2

## BACKUP ESSENTIAL BUS

AHRS POWER 1
DATA ACQUISITION UNIT ½
DISPLAY PRCS/CONTROL POWER 1
EICAS POWER
* IRS POWER 1

## BACKUP HOT BUS

APU GENERATION
DC DISTRIBUTION
DC GENERATION 1
DC GENERATION 2
DC GENERATION 3
DC GENERATION 4
ISIS (EMB-145 XR)

## BACKUP BUS 1

NONE

## BACKUP BUS 2

AHRS POWER 2
* IRS POWER 2

(#) Applicable only if DUAL FMS is installed

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## ESSENTIAL DC BUS 1

ADC 1 POWER/CONTROL
AHRS 1 POWER
AIR/GND POSITION SYSTEM B
APU BLEED
AURAL WARNING SYSTEM 1
BRAKE CONTROL UNIT (OUTBOARD SYSTEM)
COCKPIT DOME LIGHTS
DISPLAY PRCS/CONTROL POWER 1 (IC 1)
EICAS DISPLAY POWER
EICAS POWER (DAU 1A)
ENG 1 FIRE DETECTION 1
ENG 1 FUEL PUMPS 1A
ENG 2 FUEL PUMPS 2B
ENGINE 1 FADEC A POWER
ENGINE 2 FADEC A POWER
ENGINE 1 STARTING
ENGINES N2 SIGNALS 1A
ENGINES N2 SIGNALS 2A
FDR MANAGEMENT
FUEL QUANTITY INDICATION 1
LANDING GEAR CONTROL (DOWN OVRD)
LANDING GEAR NOSE INDICATION 1
* IRS POWER 1
PASSENGER OXYGEN SYSTEM 1
PILOT/COPILOT AUDIO SYSTEM (INTPH 1)
PILOT'S CLOCK
PILOT'S PANEL LIGHTING
PNEUMATIC 1 (EBV 1)
RAM AIR DISTRIBUTION
RMU 1 POWER/CONTROL
RUDDER CONTROL SYSTEM 2
SPS (SHAKER 1/CHANNEL 1)
VHF SYSTEM 1

## ESSENTIAL DC BUS 2

AIR/GND POSITION SYSTEM D
APU CONTROL
APU FIRE DETECTION
APU FIRE EXTINGUISHING
APU FUEL FEED
BRAKE CONTROL UNIT (INBOARD SYSTEM)
COPILOT'S PANEL LIGHTING
CROSS BLEED
EICAS POWER (DAU 2A)
EMERGENCY LIGHTING CONTROL
ENG 2 FIRE DETECTION 2
ENG 1 FUEL PUMPS 1B
ENG 2 FUEL PUMPS 2A
ENGINE 1 FADEC B POWER
ENGINE 2 FADEC B POWER
ENGINE 2 STARTING
ENGINES N2 SIGNALS 1B
ENGINES N2 SIGNALS 2B
FUEL CROSS FEED
FUEL QUANTITY INDICATION 2
ISIS (ALL MODELS EXCEPT EMB-145 XR)
LANDING GEAR CONTROL
LANDING GEAR NOSE INDICATION 2
PASSENGER OXYGEN SYSTEM 2
PEDESTAL PANEL LIGHTING
PILOT/COPILOT AUDIO SYSTEM (INTPH 2)
PITCH TRIM 2
PITOT HEATING 3
PNEUMATIC 2 (EBV 2)
PUBLIC ADRESS
RMU 2 POWER/CONTROL
RUDDER CONTROL SYSTEM 1
STANDBY ALTIMETER
STANDBY ATTITUDE INDICATOR
VOICE RECORDER

## AVIONIC SWITCHED ESSENTIAL DC BUS 1

ADF 1
VOR/ILS/MB 1

## AVIONIC SWITCHED ESSENTIAL DC BUS 2

NONE

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# SECTION 2-06

# LIGHTING

TABLE OF CONTENTS

Block Page

General ..... 2-06-05 ..01
Cockpit Lighting..... 2-06-05 ..01
Controls and Indicators..... 2-06-05 ..04
Passenger Cabin Lighting ..... 2-06-10 ..01
Sterile Light (Optional)..... 2-06-10 ..02
Courtesy and Stairs Lighting ..... 2-06-10 ..02
Controls and Indicators..... 2-06-10 ..03
External Lighting ..... 2-06-15 ..01
Service Compartments Lighting ..... 2-06-15 ..05
Baggage Compartment Lighting..... 2-06-15 ..05
Controls and Indicators..... 2-06-15 ..06
Emergency Lighting ..... 2-06-20 ..01
EICAS Messages ..... 2-06-20 ..04
Controls and Indicators..... 2-06-20 ..04

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# GENERAL

This airplane is equipped with a lighting system in order to illuminate all essential parts located inside and outside of the fuselage and to assure a proper and safe operation of the airplane.

The cockpit is illuminated by dome, chart, fluorescent/flood and reading lights. External lighting consists of navigation, anticollision (strobe and red beacon), landing, taxi, inspection and logotype lights.

The system also provides lighting for baggage and service compartments.

# COCKPIT LIGHTING

The lighting system inside the cockpit is composed of five different types of lights, which are as follows:

- Dome lights.
- Reading lights.
- Chart lights.
- Fluorescent flood/storm light.
- Instruments and panels lights.

## DOME LIGHTS

Cockpit illumination is provided by two dome lights of fixed intensity, commanded by a switch on the overhead panel. One light is located above the pilot's seat and the other is located above the copilot's seat.

## READING LIGHTS

In order to provide adequate light distribution for the reading of maps, check lists and manuals there are three reading lights inside the cockpit, one for the pilot, a second for the copilot and a third for the observer.

By rotating the inner bezel of each of these three light installations, lighting intensity can be adjusted from off to full bright according to crew preference. The aperture or size of the light pattern is independently adjustable from a small to a large square pattern by rotating the outer bezel.

## CHART LIGHTS

Chart lights are provided to illuminate the chart holders located at the pilot's and copilot's control wheel.

The chart light is turned on when the chart holder assembly is lifted. Light intensity is controlled by potentiometer knobs located on each side of the glareshield panel and may be selected from dim to full bright.

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## FLUORESCENT FLOOD/STORM LIGHT (OPTIONAL)

Three flood/storm lights provide a proper lighting level in the cockpit and assures instrument readability when the ambient lighting is too intense with lightning flashes.

The lights are located under the glareshield panel, two for the pilot's and central side and the other for the copilot's side. Light intensity is controlled by potentiometer knobs located on each side of the glareshield panel and may be selected from off to full bright.

## INSTRUMENTS AND PANELS LIGHTS

The instrument and control panel lights system provides lighting for instruments, control panels, and pushbuttons. Light intensity is controlled by potentiometer knobs located on each side of the glareshield panel and on the overhead panel.

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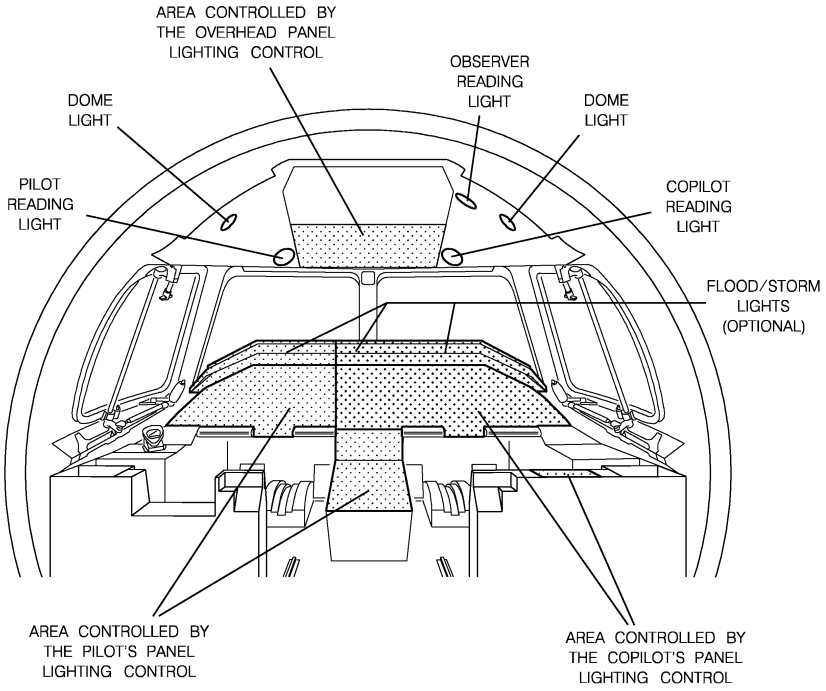


## COCKPIT LIGHTING

# CONTROLS AND INDICATORS

## GLARESHIELD PANEL

### 1 - FLOODLIGHT CONTROL KNOBS

- Turn on/off and regulate the brightness of flood lighting.
- Pilot's knob controls pilot's panel, center panel and control pedestal.
- Copilot's Knob controls copilot's panel.

### 2 - CHART HOLDER LIGHTING CONTROL KNOBS

- Regulate the brightness of associated chart holder lighting.

**NOTE:** Chart light is turned on when the chart holder assembly is lifted.

### 3 - DISPLAYS LIGHTING CONTROL KNOBS

- Regulate the brightness of Electronic Display.
- Pilot's knobs control pilot's PFD and MFD.
- Copilot's knobs control EICAS and copilot's PFD and MFD.

### 4 - PANEL LIGHTING CONTROL KNOBS

- Turn on/off and regulate the brightness of panels lighting.
- Pilot's knobs control pilot's panel, center panel and control pedestal.
- Copilot's knob controls copilot's panel and observer panel.

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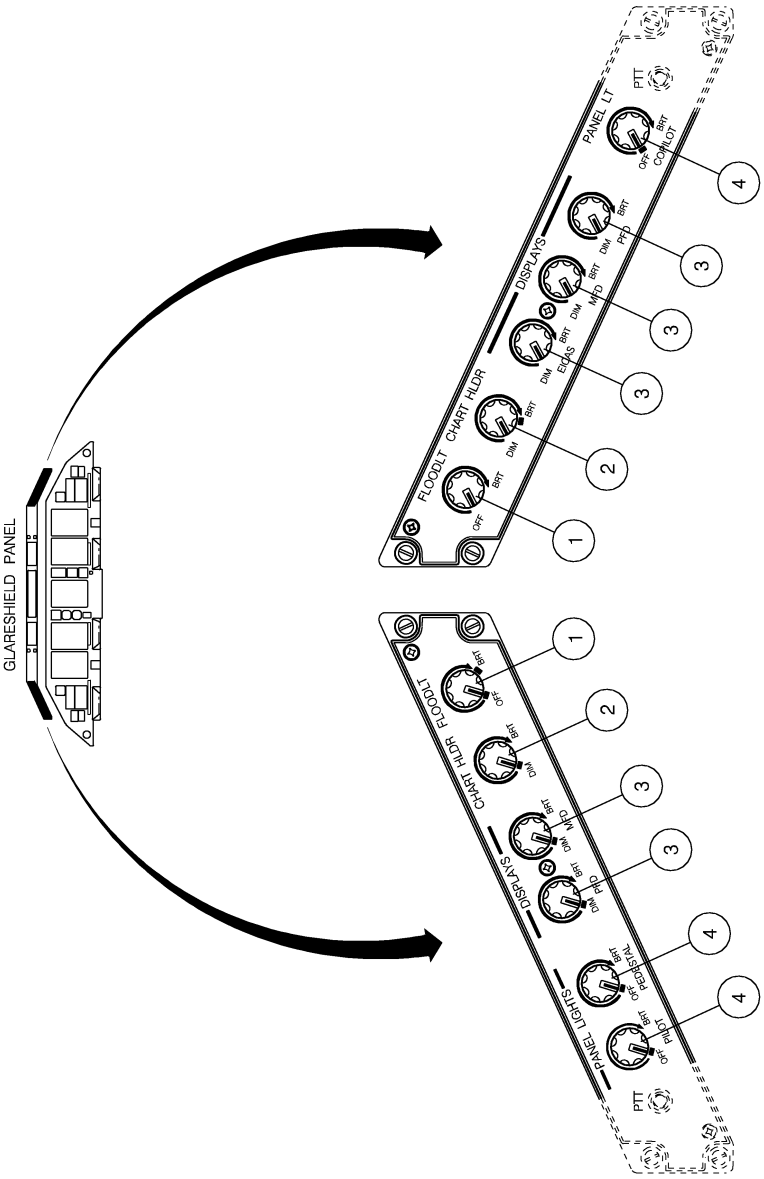


**GLARESHIELD PANEL**

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## OVERHEAD PANEL

### 1 - PUSHBUTTON LIGHTS TEST SWITCH (if installed)

- When actuated to the TEST position (momentary position) allows checking of the striped bars and caption indications.
- The striped bars and caption indications in all pushbuttons located on the main panel, overhead panel, control pedestal and right lateral console will illuminate, allowing verification of lamp integrity.
- The fire handles, APU fire extinguish button, BAGG EXTG button, electromechanical GUST LOCK indication lights, GPU AVAIL annunciator, digital pressurization control button and ATDT CALL button will not illuminate and will not be tested.

### 2- OVERHEAD PANEL LIGHTING CONTROL KNOB

- Turns on/off and regulates the brightness of the overhead panel lighting.

### 3 - COCKPIT DOME LIGHTS SWITCH

- Turns on/off the two cockpit dome lights.

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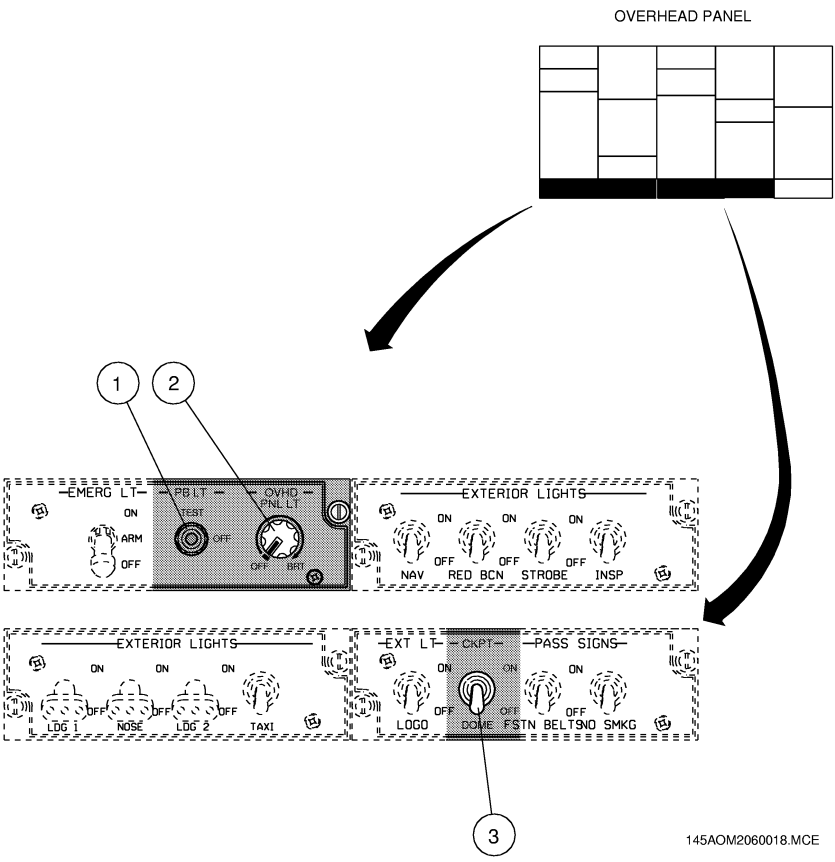


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## OVERHEAD PANEL

## FLIGHT CREW READING LIGHTS

### 1 - INNER RING

- Provides turn on/off and dimming control.

### 2 - OUTER RING

- Provides reading area adjustment, allowing light beam orientation up to 35 degrees from the vertical axis in any direction.

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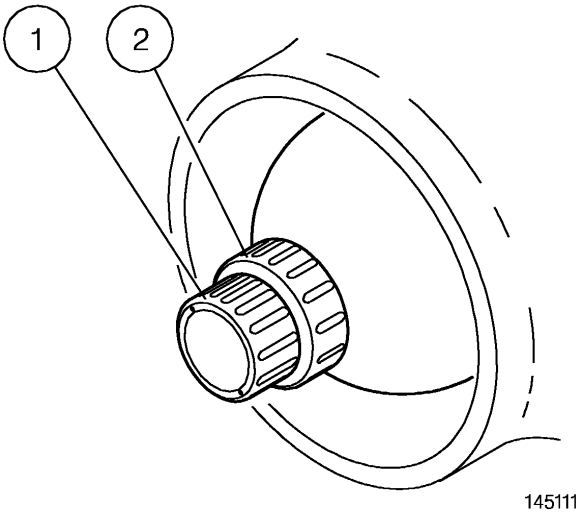


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FLIGHT CREW READING LIGHTS

# PASSENGER CABIN LIGHTING

Passenger cabin lighting includes general illumination, reading lights, lavatory, galley lights and cabin signs.

## GENERAL PASSENGER CABIN ILLUMINATION

General passenger cabin illumination is provided by fluorescent tubes fitted in the fuselage ceiling and sidewall. These lights are controlled by control buttons located on the Attendant Panel.

## READING LIGHTS

A separate reading light and control is provided above each passenger seat, on the Passenger Service Unit (PSU). For PSU details, refer to Section 2-2–Equipment and Furnishings.

## LAVATORY

The lavatory lights are automatically controlled through a microswitch installed in the latch assembly of the door. When the airplane is powered up and the toilet door is open or closed, the lavatory lights turn on in dim mode. If the toilet door is closed and locked, the lavatory lights turn on in the bright mode.

Two illuminated LAVATORY OCCUPIED signs indicate when the lavatory is in use. A RETURN TO SEAT sign in the lavatory illuminates in conjunction with the FASTEN SEAT BELTS sign.

## PASSENGER CABIN SIGNS

The passenger warning signs are illuminated signs that will be clearly visible under normal daylight lighting conditions. They provide passengers and flight attendants with NO SMOKING, FASTEN SEAT BELTS, RETURN TO SEAT, and LAVATORY OCCUPIED instructions.

The NO SMOKING and FASTEN SEAT BELTS signs are controlled through respective switches located on the overhead panel. The signs are repeated on every Passenger Service Unit. An aural signal sounds whenever any passenger sign is turned on or off by the pilot. The NO SMOKING and FASTEN SEAT BELTS signs are also activated when the oxygen dispensing units are open. For PSU details refer to Section 2-2–Equipment and Furnishings.

## GALLEY LIGHT

The galley light illuminates the galley area between forward and aft galleys. The light is controlled through two buttons, located on the Galley Control Panel. For Galley Control Panel details refer to Section 2-2–Equipment and Furnishings.

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## STERILE LIGHT (OPTIONAL)

A blue sterile light, located on the cockpit/pax partition, indicates, when lit, that entry into the cockpit is not allowed. It is commanded through a switch located at the overhead panel.

## COURTESY AND STAIRS LIGHTING

The courtesy and stair lights provide lighting for safe boarding of crewmembers and passengers. The courtesy and stair lights consist of the main door light (entry area), service door light (galley area), stairway lights and cockpit step light as follows:

- Main door light: A light is installed on the main door ceiling panel, above the entry area of the airplane, to illuminate the stair, entry area, aisle toward cockpit and passenger cabin.
- Service door light: A light is installed on the service door ceiling panel in order to light the galley area.
- Stairway lights: Airplanes equipped with airstair main doors have stair lights installed in each step of the main door stair to provide adequate step illumination.
- Cockpit step light: A red light is installed in the step between the passenger cabin and the cockpit to provides light for safe entry into the cockpit. This light is illuminated simultaneously with the main door light.

These lights are controlled by a main door microswitch and a control knob, located on the Entrance Panel, above the standard flight attendant seat on the cockpit partition.

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# CONTROLS AND INDICATORS

## ATTENDANT'S PANEL

### 1 - CABIN LIGHTING CONTROL BUTTONS

ON - All associated cabin lights are turned on.

OFF - All associated cabin lights are turned off.

BRT - All associated cabin lights are set to full brightness.

DIM - All associated cabin lights are set to reduced brightness.

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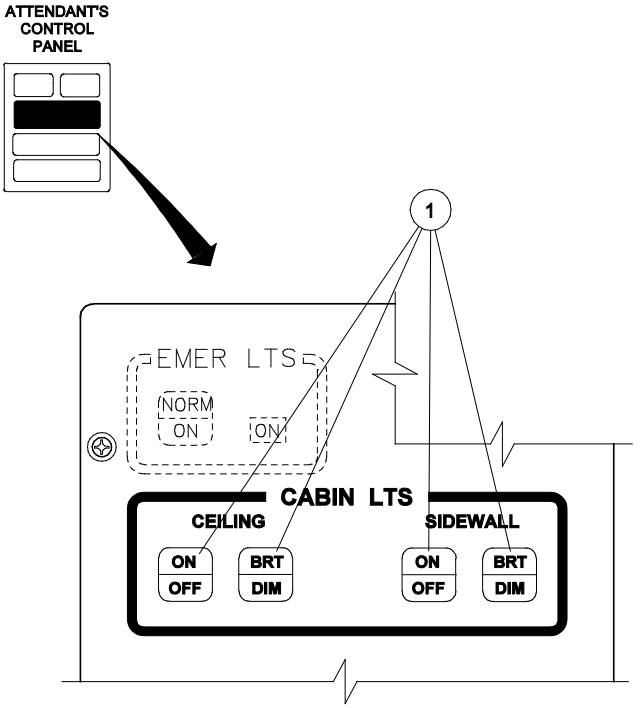


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## ATTENDANT'S PANEL

**NOTE:** For airplanes Post-Mod. SB 145-33-0040, the Dim Mode of the passenger cabin lighting system is disabled.

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## COURTESY LIGHTING PANEL

### 1 - COURTESY AND STAIRS LIGHTING CONTROL KNOB

OFF - All courtesy and stair lights are turned off.

AUTO - All courtesy and stair lights are extinguished when the main door is closed and lit when the main door is open.

**NOTE:** The cockpit dome lights may be commanded through the Courtesy and Stairs Lighting Control Knob provided the airplane is deenergized and the Cockpit Dome Lights Switch is set to the ON position.

ON - All courtesy and stair lights are turned on, when the main door is open. When the main door is closed, only the overdoor light remains on, to illuminate the main door area in flight.

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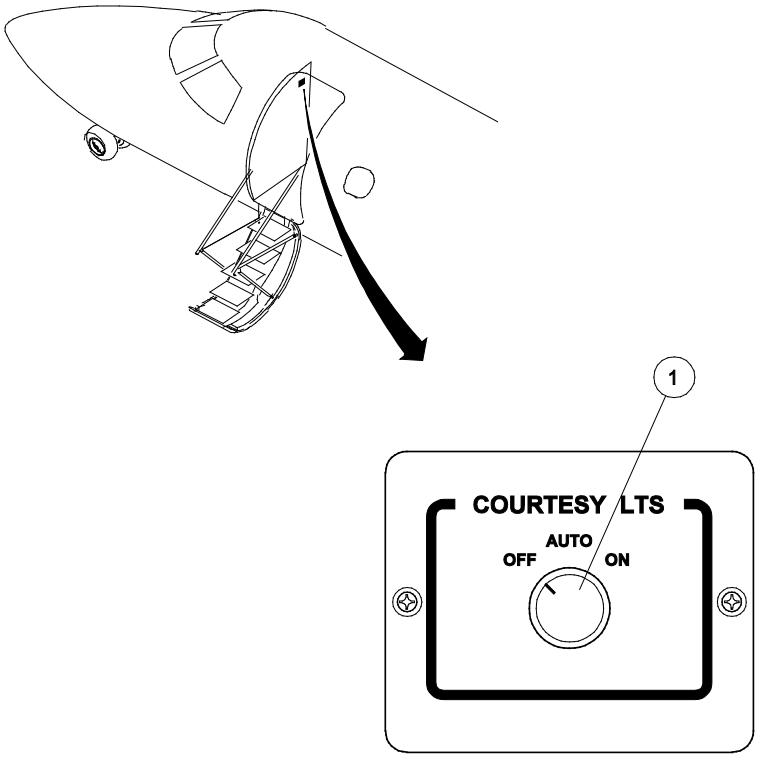


**COURTESY LIGHTING PANEL**

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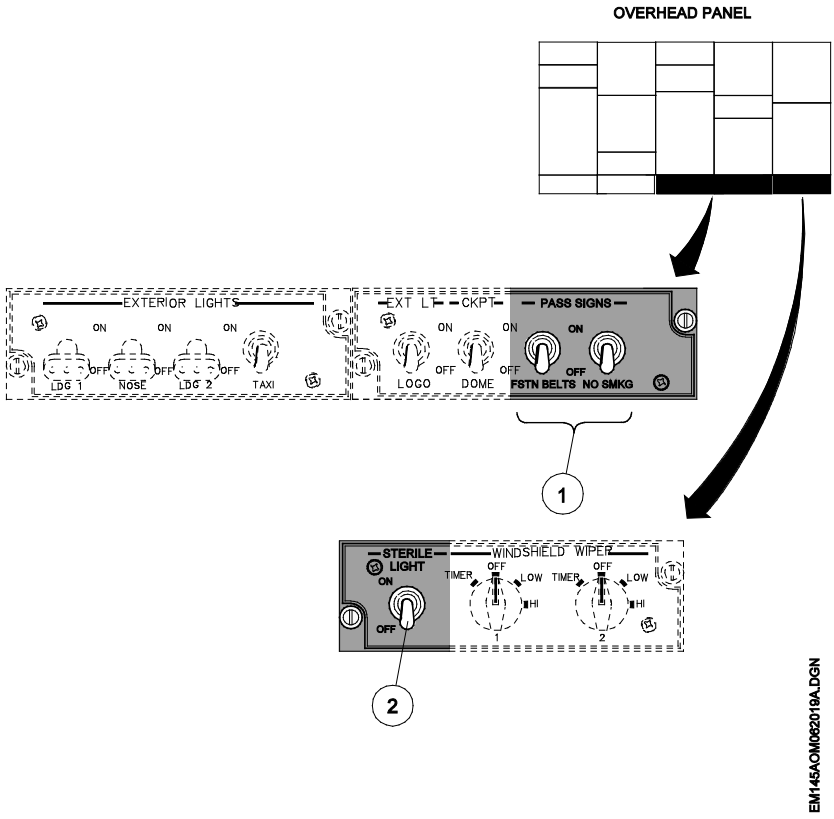
## OVERHEAD PANEL

### 1 - FASTEN SEAT BELTS AND NO SMOKING SIGNS SWITCHES

– Turns on/off the associated passenger signs.

### 2 - STERILE LIGHT SWITCH

– Turns on/off the sterile light.




**OVERHEAD PANEL**

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# EXTERNAL LIGHTING

The external lights necessary to a proper and safe operation of the aircraft are:

- Landing lights.
- Taxi lights.
- Navigation lights.
- Anti-collision lights.
- Wing inspection lights.
- Logotype lights.

## LANDING LIGHTS

The landing lights provide adequate lighting during final approach, flare-out and take-off. Two landing lights are fitted in the wing leading edge close to the fuselage. A third landing light is mounted on the nose landing gear strut. The switches located on the overhead panel are responsible for the control of the landing lights.

## TAXI LIGHTS

The taxi light provides sufficient intensity and beam spread to aid pilots during all taxi operation phases, covering the runway and adjacent areas.
Two taxi lights are fitted on the nose landing gear strut and are commanded by a single switch located on the overhead panel.

## NAVIGATION LIGHTS

The navigation lights include two red navigation lights at the left wingtip, two green navigation lights at the right wingtip, and two white navigation lights at the tail boom. Some airplanes are equipped with four white navigation lights.

Unlike the other models, the EMB-145XR is equipped with two white navigation lights installed at the trailing edge of either wing.

The navigation lights are controlled by means of the NAV LT switch, located on the overhead panel. This switch turns on one lamp at each wingtip and two lamps at the tail boom.

In case a green or red light becomes inoperative, the standby wingtip lamps are activated through a switch located on the cockpit maintenance panel.

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On airplanes equipped with four white navigation lights, in case one or both of the tail navigation lights in use become(s) inoperative, the relevant standby tail lamps are activated through a switch located on the aft ramp hail panel.

## ANTI-COLLISION LIGHTS

The anti-collision lights provide illumination for visual recognition and collision avoidance during all flight/taxi operations. White strobe (anti-collision) lights are fitted to each wing tip and cone top of the horizontal stabilizer. The EMB-145XR, in its turn, is provided with only two white strobe lights, which are located at the winglets.

Red beacon lights are mounted on the upper and lower fuselage. Two different switches, one for strobe lights and another for the red beacon lights are located on the overhead panel.

## WING INSPECTION LIGHTS

Two inspection lights, one on each side of the fuselage, provide lighting of the wing leading edge to allow the crew to verify ice formation. The inspection lights are controlled by a switch located on the overhead panel.

## LOGOTYPE LIGHTS

The logo lights are installed on the underside of the horizontal stabilizer and are aimed at the vertical fin. They provide adequate illumination of the airplane's logo during operation on the ground and in flight. A switch located on the overhead panel controls the logotype lights.

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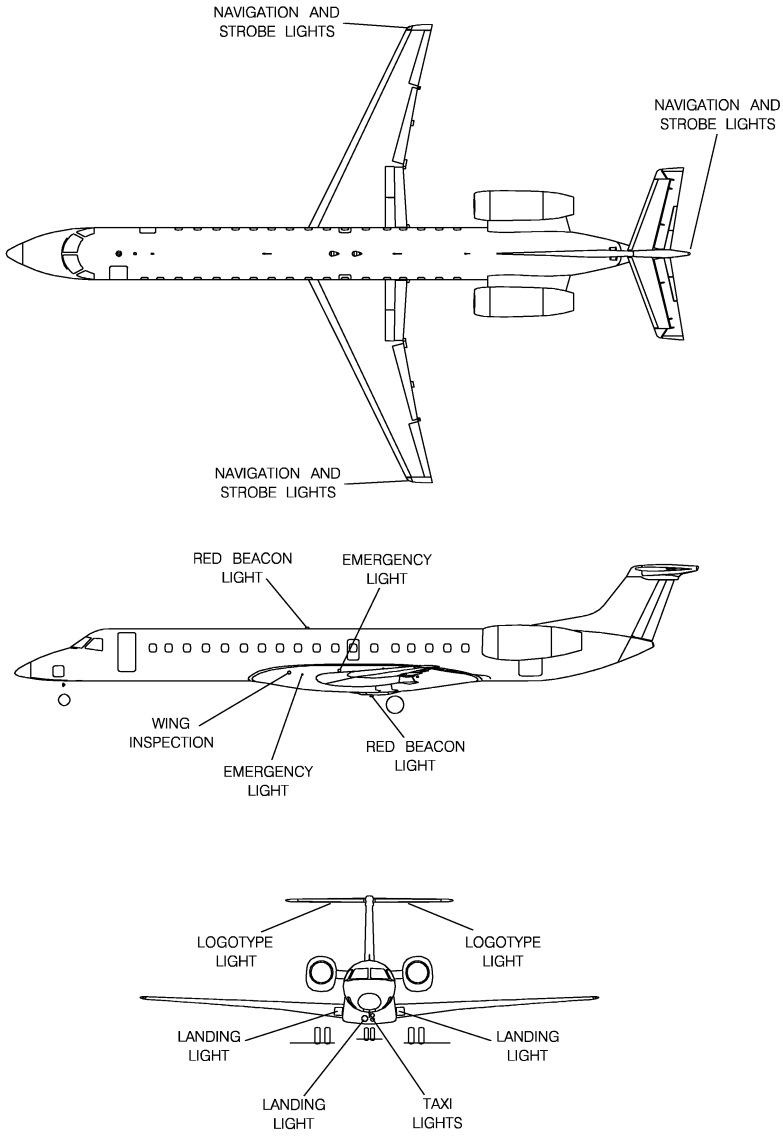


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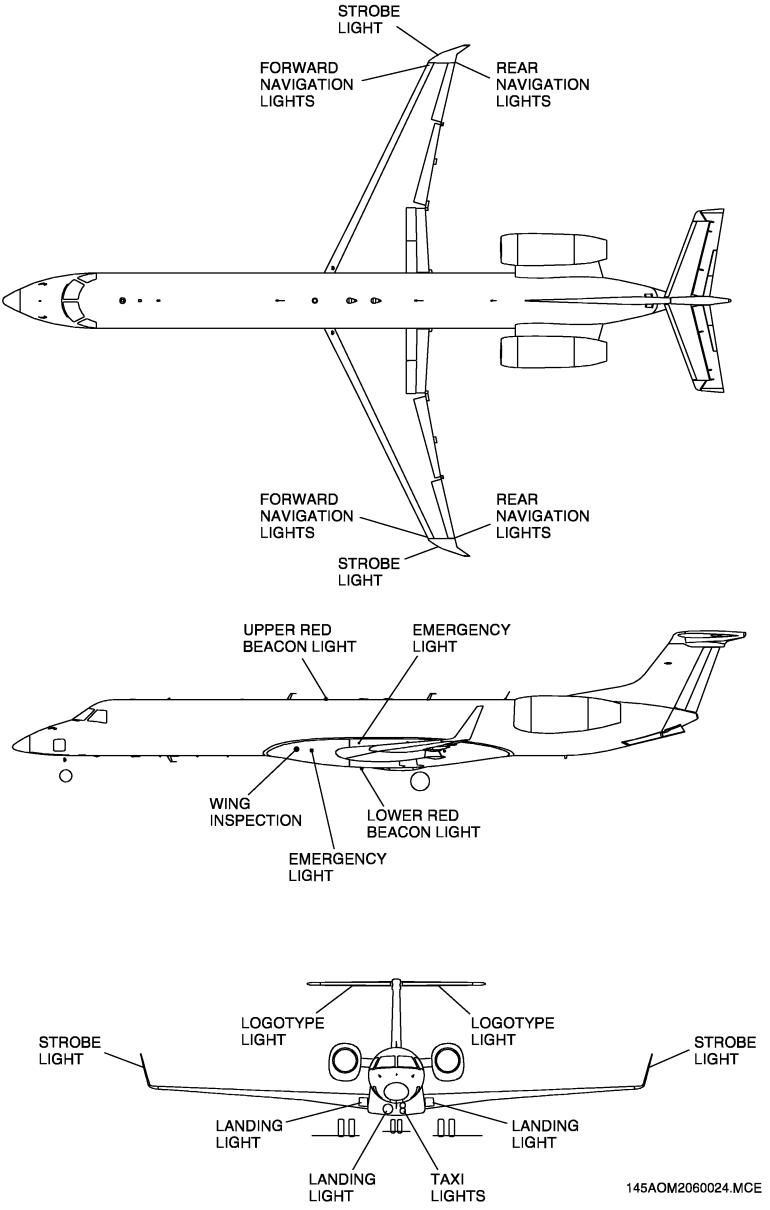


## EXTERNAL LIGHTS - EMB-145XR

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## SERVICE COMPARTMENTS LIGHTING

The system provides lighting in the service compartments for quick inspection and accomplishment of several tasks. Service lights are installed in the nose landing gear, rear and forward electronic bays, tail cone and forward flight control compartments. The lights are controlled by a door micro-switch, that turns on the associated light when the access doors is open, or by dedicated switches, installed in the compartment.

## BAGGAGE COMPARTMENT LIGHTING

The baggage compartment is equipped with three lights installed on the ceiling panel. The baggage lights operate according to the following conditions:

– They come on automatically whenever the cargo door is open, and they go off when the door is closed. For airplanes equipped with a push-button installed on the lavatory, it is possible to turn on the baggage lights in flight to allow visual inspection of the baggage compartment through a inspection sight glass located in the baggage compartment/lavatory partition.

OR

– They come on automatically when the aircraft is energized and they remain on until the aircraft is deenergized.

Some airplanes are optionally equipped with a cargo door light installed in the left pylon that provides external lighting of the baggage compartment. The light is automatically turned on when the baggage compartment door is open.

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# CONTROLS AND INDICATORS

## OVERHEAD PANEL

**1 - NAVIGATION, RED BEACON, STROBE AND WING INSPECTION LIGHTS SWITCHES**

– Turns on/off the associated light.

**2 - LOGOTYPE LIGHTS SWITCH**

– Turns on/off the logotype lights.

**3 - TAXI LIGHTS SWITCH**

– Turns on/off the taxi lights.

**NOTE:** Taxi lights are not turned on if nose landing gear is not down and locked, regardless of the Taxi Lights Switch position.

**4 - LANDING LIGHTS SWITCHES**

– Turn on/off the associated landing light.

**NOTE:** Nose landing light is not turned on if nose landing gear is not down and locked, regardless the of Nose Landing Light Switch position.

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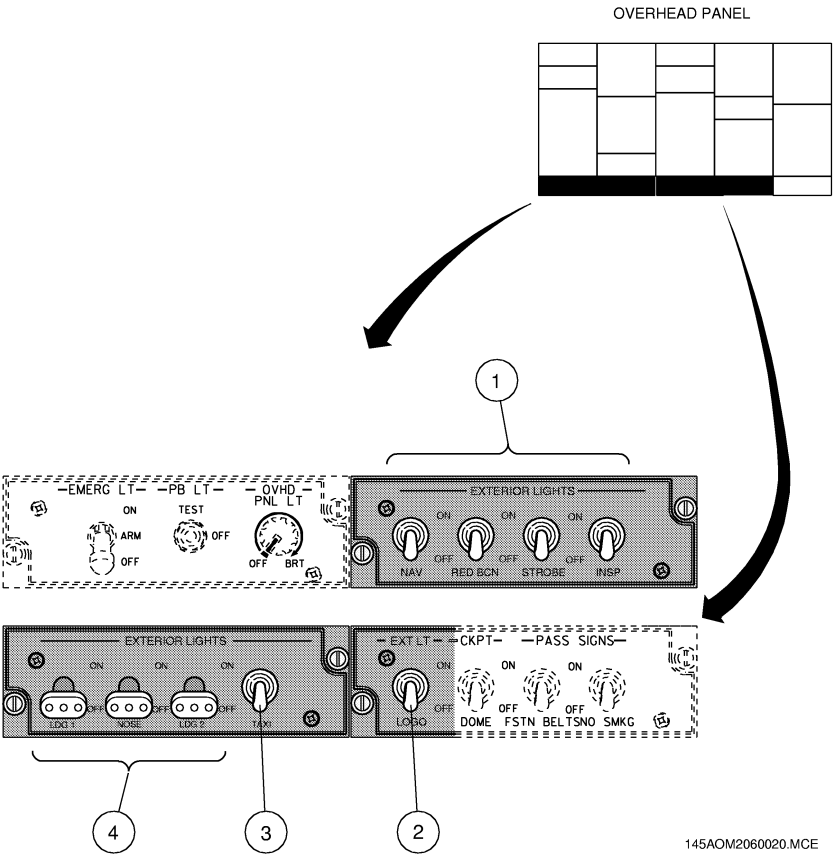


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## OVERHEAD PANEL

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# EMERGENCY LIGHTING

The emergency lighting consists of internal and external lights that provide proper illumination for emergency cabin evacuation. These lights are powered by four dedicated batteries charged through the Essential Bus. Batteries power is sufficient to supply all internal and external emergency lights for approximately 15 minutes.

The exterior emergency lights installed are as follows:

- Two lights installed on each side of the wing-to-fuselage fairing in order to illuminate the wing escape route and the ground area.
- One emergency light installed in the main door and in the service door provides illumination of the external main door and service door areas, when the door is open.

Internal emergency lights consist of the cockpit light, aisle lights, main door lights, galley service door lights, overwing emergency exit lights, floor proximity lights and EXIT signs as follows:

- Cockpit light: This light is located on the cockpit ceiling to provide general cockpit emergency illumination.
- Aisle lights: Four dome lights are located along the aisle for general emergency cabin illumination.
- Main door, galley service door and overwing emergency exits lights: Four lights are installed for the purpose of illuminating the passageway leading from the main aisle to each of the exit openings.
- Floor proximity emergency lights: Either electroluminescent or photoluminescent strips are installed along the passenger cabin floor to provide a means of identifying the emergency escape path even in conditions of dense smoke.

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**NOTE:** Photoluminescent escape path system strips must be charged prior to the first flight of the day. Charging is provided by the interior cabin lighting being the charging time defined by the table below. It should be pointed that during such time, cabin activity is limited to minor aisle traffic of crew and personnel and that operational duration is not limited if daylight ambient conditions exist throughout flight or if cabin lighting is operated on the ON or BRIGHT settings.

| Charge | Bin door position | Charge duration (minutes) | Operational duration (when lights are extinguised) |
|---|---|---|---|
| Initial | Closed | 15 | 4.75 hours |
| | | 30 | 6.5 hours |
| Subsequent | Closed | 15 | 6.75 hours |
| | | 30 | 9 hours |
| | Open | 30 | 5 hours |

– Illuminated EXIT signs: They are installed near each door and emergency exits.

Emergency lighting is controlled through the Emergency Lighting Switch, located on the overhead panel, and through the Attendant Emergency Lighting Button, located on the Attendant's Panel.

A caution message is presented on the EICAS if the system is not armed.

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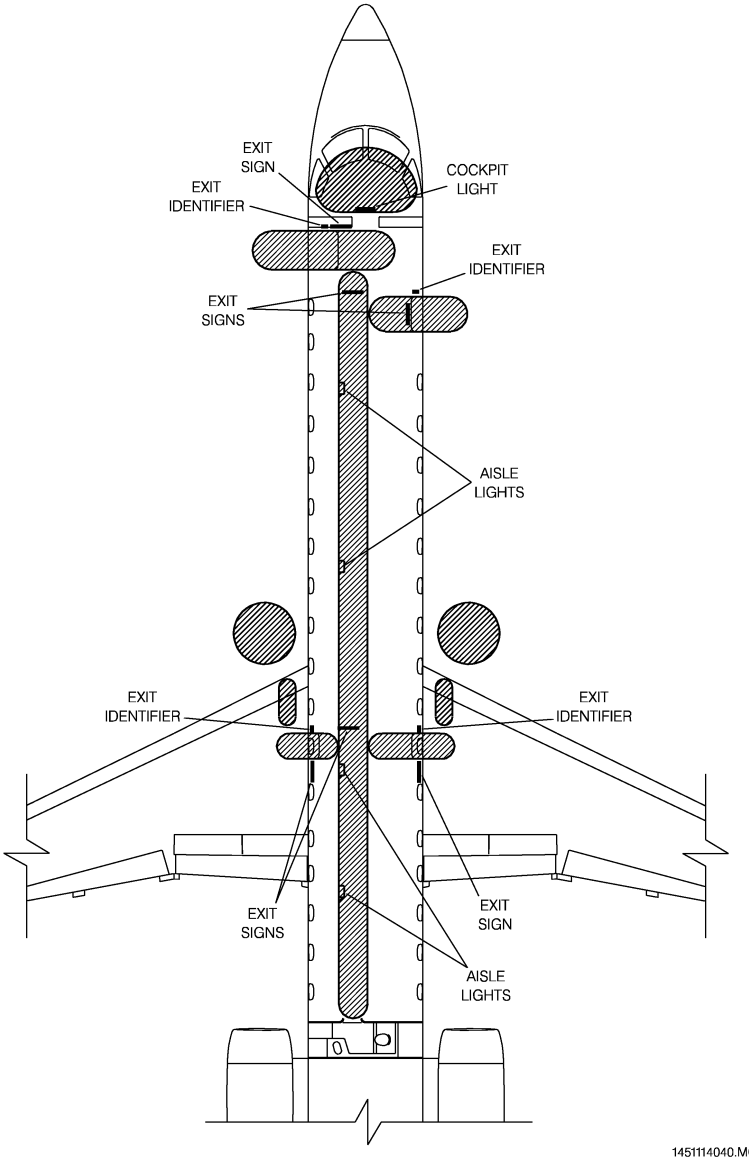


## AREA ILLUMINATED BY EMERGENCY LIGHTING

## EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | EMERG LT NOT ARMD | Emergency lighting system is not armed. |

## CONTROLS AND INDICATORS

### OVERHEAD PANEL

### 1 - EMERGENCY LIGHTING SWITCH

ON - Emergency lights illuminate with power supplied by the dedicated batteries.

ARM- Emergency lights are in standby mode (lights turned off and the batteries being charged) and illuminate automatically in case of an electrical emergency, with power supplied by the dedicated batteries.

OFF - Emergency lights are turned off. Emergency lighting dedicated batteries are not charged.

**NOTE:** The emergency lights are controlled by the Emergency Lighting Switch when the Attendant Emergency Lighting Button, on the Attendant's Panel, is in the NORM mode.

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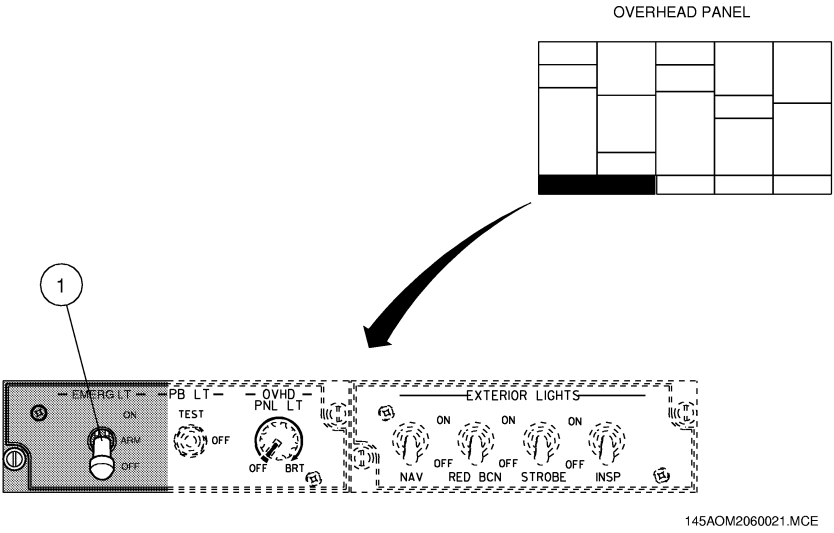


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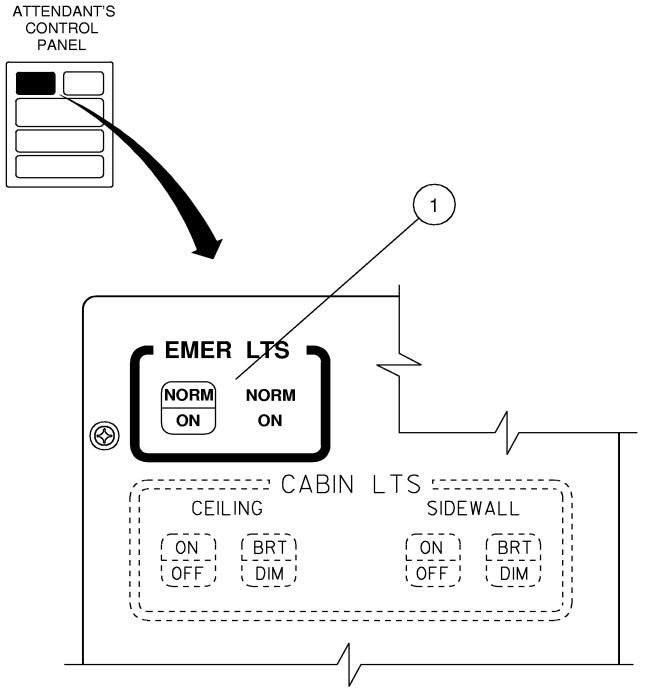
## OVERHEAD PANEL

## ATTENDANT'S PANEL

### 1 - ATTENDANT EMERGENCY LIGHTING CONTROL BUTTON

NORM - Emergency lights remain in the mode selected by Emergency Lighting Switch position in the cockpit.

ON - Emergency lights are turned on with power supplied by dedicated batteries, regardless of Emergency Lighting Switch position on the cockpit.




ATTENDANT'S PANEL

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# SECTION 2-07

# FIRE PROTECTION

TABLE OF CONTENTS

Block Page

General ..... 2-07-05 ..01
Engine and APU Fire Protection System ..... 2-07-10 ..01
Fire/Overheat Detection ..... 2-07-10 ..01
Fire Extinguishing ..... 2-07-10 ..04
Controls and Indicators..... 2-07-10 ..07
EICAS Messages ..... 2-07-10 ..10
Lavatory Fire Protection System ..... 2-07-15 ..01
Lavatory Smoke Detection ..... 2-07-15 ..01
Lavatory Fire Extinguishing ..... 2-07-15 ..01
EICAS Message ..... 2-07-15 ..01
Controls and Indicators..... 2-07-15 ..04
Baggage Compartment Fire Protection System ..... 2-07-20 ..01
Baggage Compartment Smoke Detection System..... 2-07-20 ..01
Baggage Compartment Fire Extinguishing System..... 2-07-20 ..01
EICAS Messages ..... 2-07-20 ..02
Controls and Indicators..... 2-07-20 ..04

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# GENERAL

The fire protection system consists of fire/overheat detection and extinguishing for the engines and APU.

The detection system provides visual and aural means of detecting a localized fire or general overheating. Monitoring circuitry is provided to continuously check the fire detection/extinguishing system and to signal the EICAS in case of failure.

The baggage compartment is provided with a smoke detection system. The class “C” baggage compartment is provided with a fire extinguishing system.

In addition, the lavatory compartment is equipped with a dedicated smoke detection system and the lavatory waste container is equipped with a fire extinguishing system.

Extinguisher bottles are installed to extinguish the fire in the airplane’s engines, APU, baggage compartment and lavatory waste container. Portable halon fire extinguishers installed at the front and rear of the airplane can be used to extinguish small fires in the cockpit or main cabin area. A single water extinguisher is an additional option.

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# ENGINE AND APU FIRE PROTECTION SYSTEM

## FIRE/OVERHEAT DETECTION

The engines and the APU are protected against the occurrence of fire by means of fire detection and fire extinguishing systems.

Essential DC bus 1 powers the engine 1 fire detection system and essential DC bus 2 powers the engine 2 and the APU fire detection system. Hot battery bus 1 and 2 power the engine fire extinguishing system, whereas the APU fire extinguishing system is powered by essential DC bus 2.

The fire/overheat detection system is provided with independent sensor tubes installed in the engines and APU. The sensor tube contains a fixed volume of inert gas (Helium) and a gas-impregnated (Hydrogen) core material. The inert gas provides sensing of overheating. The core element provides sensing of localized fire or high-intensity heating. Overheating causes the sensor tube's internal gas pressure to increase. This closes a switch on the fire/overheating detection system's electrical circuit and activates the warning system. Localized fire or high-intensity heating increases the central core's gas volume, raising the sensor tube's internal pressure, thus activating the alarm switch in the same manner as described above.

Manual resetting of the fire detection system is not available. Upon removal of the fire or overheat condition, a reversible process takes place, and the system automatically returns to the normal standby operation mode.

An integrity switch continuously monitors the sensor tube's integrity. The integrity switch is held closed by the sensor's internal pressure. Should this pressure be lost the integrity switch opens, generating a signal to indicate that the system is inoperative.

Upon detection of a fire/overheat signal in the engine or APU, the associated handle (for the engines) illuminates, an aural warning is generated and a warning message is presented on the EICAS. The visual warning remains activated as long as the fire signal exists. The aural warning may be canceled by pressing the master warning light.

In the case of failure of any fire detector, a caution message is presented on the EICAS.

The APU fire detection system provides a signal to shut down the APU automatically in case of fire warning during ground operation.

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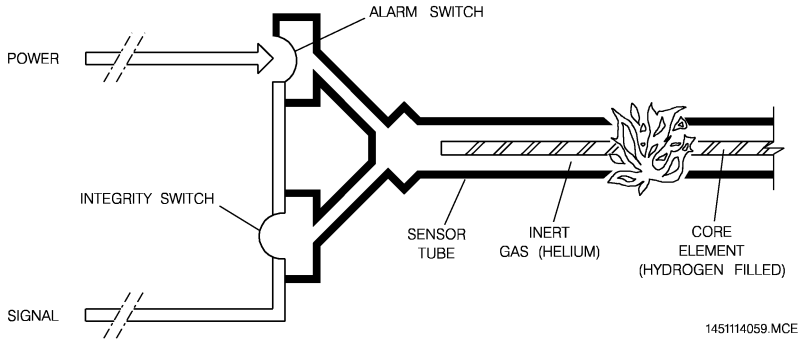


## FIRE OVERHEAT DETECTION SCHEMATIC

## FIRE EXTINGUISHING

Two fire extinguishing bottles for the engines and one for the APU are installed in the airplane's tail cone.

The extinguishing agent discharge is accomplished by braking the extinguisher bottle's seal through an electrically actuated cartridge in the discharge valve.

Each engine fire extinguisher bottle contains two discharge valves, a pressure gauge with a pressure switch and a fill/safety relief valve. The engine bottles are cross-connected by two double check tees to provide dual shot capability, thus one or both bottles can be discharged into one or the other engine. The double-check tee prevents the extinguishing agent of the remaining bottle from filling the emptied bottle in case of a second shot of the system. The engine extinguisher bottles are discharged by pulling and rotating the Fire Extinguishing Handle, which is located on the overhead panel.

**CAUTION:** DO NOT DISCHARGE THE SAME EXTINGUISHER BOTTLE TWICE. ACTUATING THE FIRE HANDLE INTO AN EMPTY BOTTLE MAY CAUSE STRUCTURAL DAMAGE TO THE BOTTLE.

The APU bottle contains only one discharge valve, a pressure gauge with a pressure switch, and a fill/safety relief valve. It provides single shot capability for the APU. The APU extinguisher bottle is discharged by pressing the APU Fire Extinguishing Button, located on the overhead panel.

A caution message is presented on the EICAS should any bottle be discharged or be inoperative for any reason (failed cartridge, loss of pressure, or loss of power).

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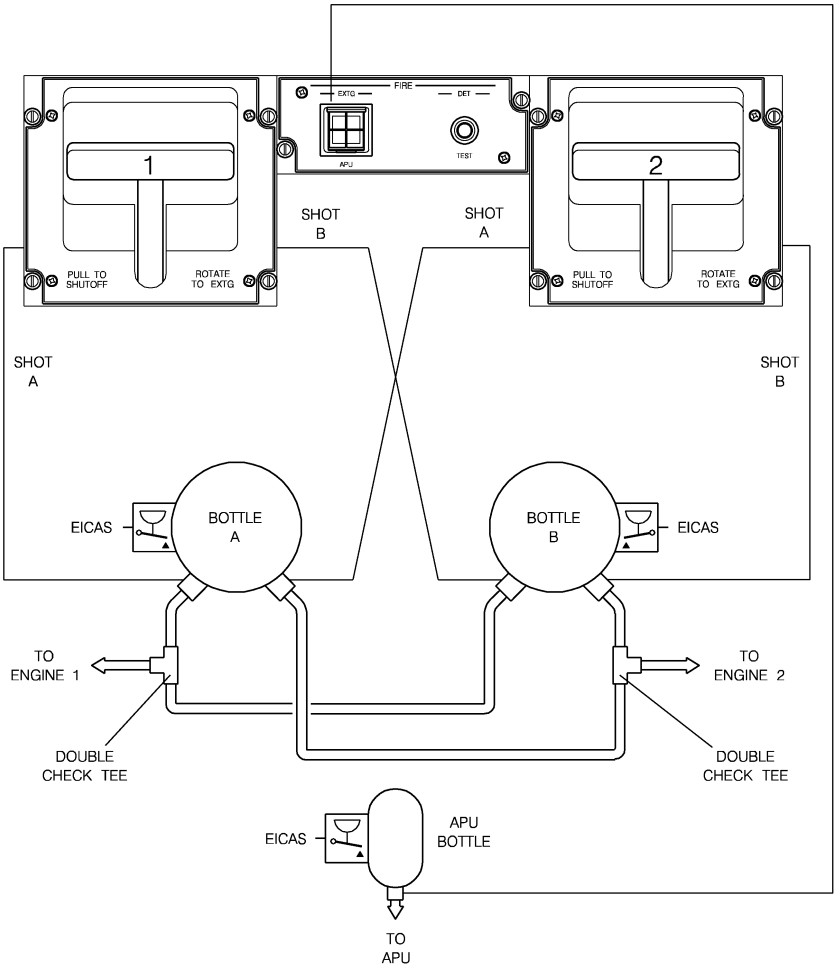


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## ENGINE AND APU FIRE EXTINGUISHING SYSTEM SCHEMATIC

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# CONTROLS AND INDICATORS

## ENGINE AND APU FIRE DETECTION/EXTINGUISHING SYSTEM PANEL

### 1 - ENGINE FIRE EXTINGUISHING HANDLE

- During normal flight conditions, the handle remains flush with the panel.
- A red light illuminates inside the handle upon detection of fire or overheating.
- When pulled, it closes the fuel, hydraulic, bleed air, and lip anti-icing shutoff valves of the associated engine.
- When rotated counterclockwise or clockwise, it respectively discharges extinguisher bottles A or B into the associated engine.

### 2 - APU FIRE EXTINGUISHING BUTTON (guarded)

- When pressed, it closes the APU fuel shutoff valve and discharges the APU fire extinguisher bottle. On APU Model T-62T-40C11, a signal is sent to the ESU to simulate an overspeed condition in order to execute the APU shutdown procedure. On APU Model T-62T-40C14, a stop request signal is sent to the FADEC in order to execute the APU shutdown procedure.

### 3 - FIRE DETECTION SYSTEM TEST BUTTON

- When pressed and held for at least two seconds, it permits the fire detection system to be checked.

  On airplanes equipped with class “C” baggage compartment, the fire test is successfully completed if the conditions below occur simultaneously:
  - The following EICAS fire detection messages are displayed:
    - Warning: APU FIRE, ENG 1 (2) FIRE, BAGG SMOKE
    - Caution: APU FIREDET FAIL, E1 (2) FIREDET FAIL
  - Fire handles illuminate.
  - Baggage fire extinguishing button illuminates.
  - Baggage compartment fan deactivates.
  - WARNING/CAUTION lights flash.
  - Aural warning sounds.

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**NOTE: -** On the ground, when pressed approximately for more than 10 seconds, the APU is shut down, if it is running.
- If it is necessary to repeat the test, wait at least 6 seconds to press the test button again.
- If Fire Detection Test button is held for less than 2 seconds the BAGG EXTG button may remain illuminated. In this case, repeat the test.

On airplanes equipped with class “D” baggage compartment, the fire test is successfully completed if the conditions below occur simultaneously:

– The following EICAS fire detection messages are displayed:
  – Warning: APU FIRE, ENG 1 (2) FIRE
  – Caution: APU FIREDET FAIL, E1 (2) FIREDET FAIL
– Fire handles illuminate.
– WARNING/CAUTION lights flash.
– Aural warning sounds.

**NOTE: -** On the ground, when pressed approximately for more than 10 seconds, the APU is shut down, if it is running.
- If it is necessary to repeat the test, wait at least 6 seconds to press the test button again.

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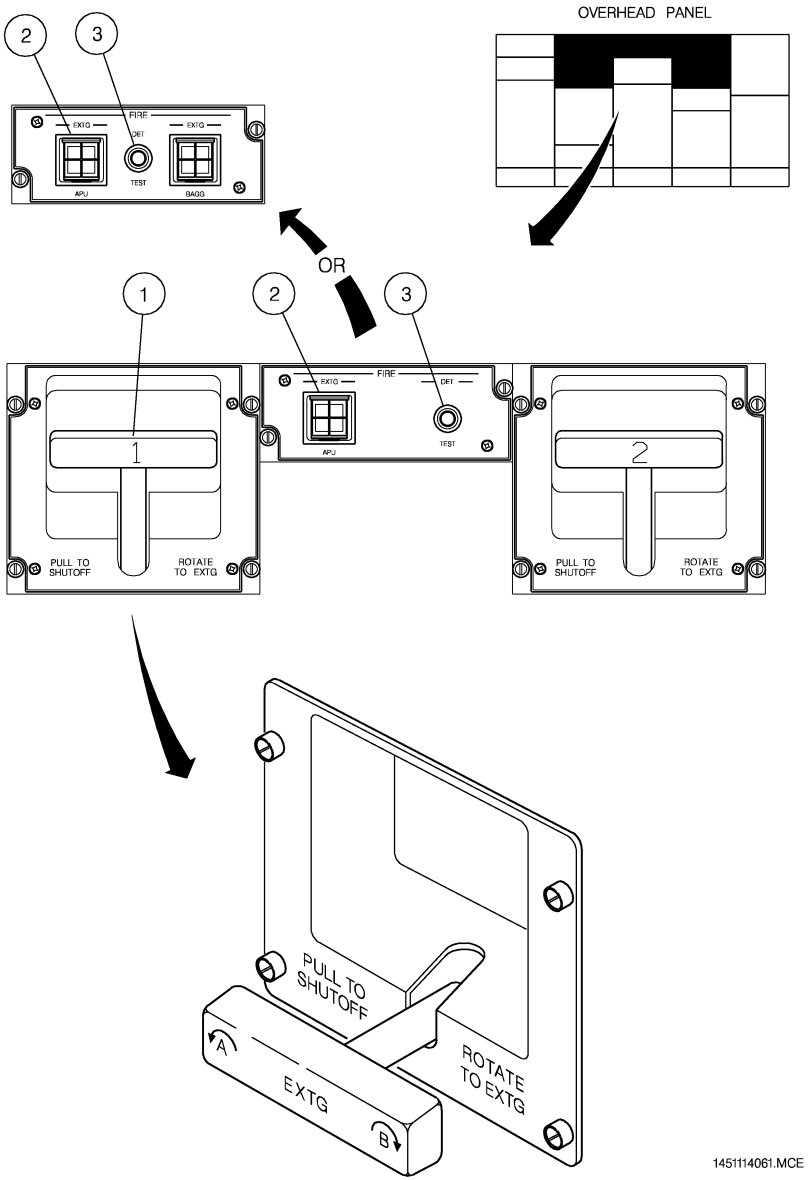


## ENGINE AND APU FIRE DETECTION/EXTINGUISHING PANEL

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## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | APU FIRE | Fire in the APU. |
| | ENG1 (2) FIRE | Fire in associated engine. |
| CAUTION | E1 (2) FIREDET FAIL | Associated engine fire detection system failed. |
| | APU FIREDET FAIL | APU fire detection system failed. |
| | E1 (2) EXTBTLA INOP | Associated bottle has been discharged or is inoperative. |
| | E1 (2) EXTBTLB INOP | |
| | APU EXTBTL INOP | |

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# LAVATORY FIRE PROTECTION SYSTEM

## LAVATORY SMOKE DETECTION

The lavatory smoke detection system consists of a smoke sensor installed in the lavatory ceiling and a Smoke Detector Panel located near the forward galley.

Upon detection of smoke inside the lavatory, the smoke detector signals the panel to activate a red alarm light and a horn. In addition, a warning message is presented on the EICAS. The smoke sensor is less sensitive to smoke from cigarettes.

The EMB-135 has an additional horn, installed in the aft cabin section on the ceiling panel, right in front of the lavatory door.

## LAVATORY FIRE EXTINGUISHING

A single fire extinguisher bottle is installed for fire protection of the lavatory waste container.

The bottle discharging tube outlets are fitted to the waste container, and are provided with temperature sensitive heads. Discharge of the extinguishing agent is accomplished by sensitive heads melting under high temperatures, which opens an outlet passage.

No warning is provided in the cockpit when the waste container extinguisher bottle is discharged.

## EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | LAV SMOKE | Smoke has been detected inside the lavatory. |

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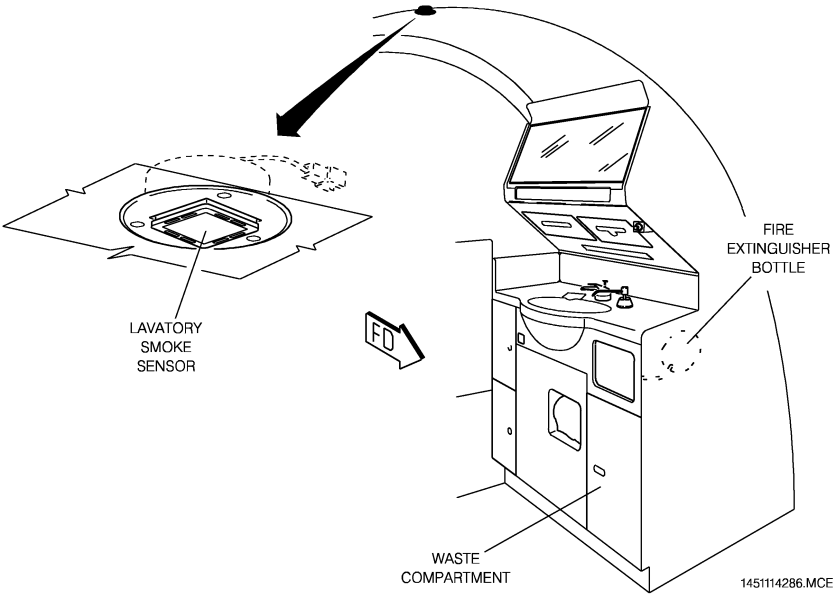



## LAVATORY FIRE PROTECTION SYSTEM

# CONTROLS AND INDICATORS

## LAVATORY SMOKE DETECTOR PANEL

**1 - LAVATORY SMOKE DETECTOR OPERATION LIGHT (green)**

- Illuminates during normal system operation.

**2 - LAVATORY SMOKE DETECTOR ALARM LIGHT (red)**

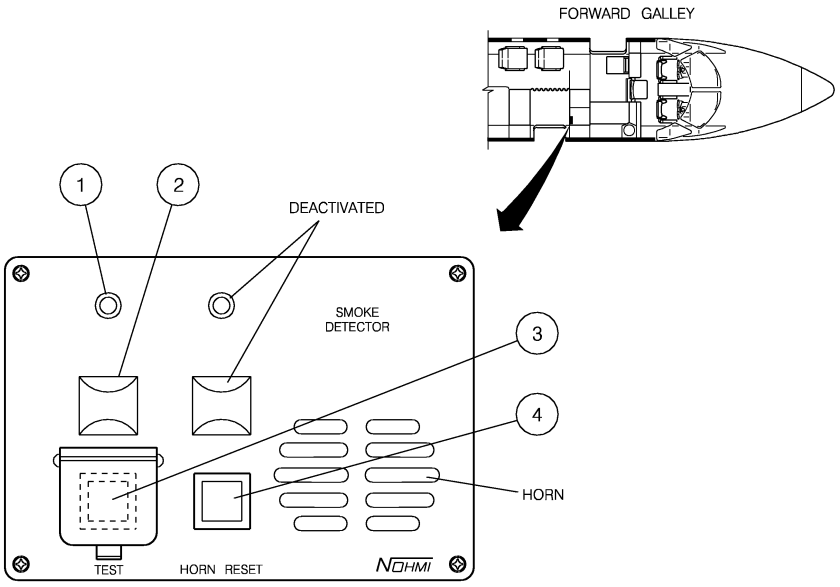
- Flashes in case of smoke detection inside the lavatory. In this case, a horn is also activated.

**3 - LAVATORY SMOKE DETECTOR TEST BUTTON (guarded)**

- When pressed (momentarily), simulates a smoke detection condition and activates all associated alarms (horn, red alarm light and EICAS message).
- During test, the green operation light extinguishes.

**4 - LAVATORY SMOKE DETECTOR RESET BUTTON**

- Cancels the horn and resets the system for operation.

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**LAVATORY SMOKE DETECTOR PANEL**

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# LAVATORY FIRE PROTECTION SYSTEM

The information presented herein is valid for airplanes Post-Mod. SB 145-26-0014 or equipped with an equivalent modification factory incorporated.

## LAVATORY SMOKE DETECTION

The lavatory smoke detection system consists of a smoke sensor installed in the lavatory ceiling and a Smoke Detector Panel located near the forward galley.

Upon detection of smoke inside the lavatory, the smoke detector signals the panel to activate a red alarm flashing light and a horn. In addition, a warning message is presented on the EICAS. The smoke sensor is less sensitive to smoke from cigarettes.

## LAVATORY FIRE EXTINGUISHING

A single fire extinguisher bottle is installed for fire protection of the lavatory waste container.

The bottle discharging tube outlets are fitted to the waste container, and are provided with temperature sensitive heads. Discharge of the extinguishing agent is accomplished by sensitive heads melting under high temperatures, which opens an outlet passage.

No warning is provided in the cockpit when the waste container extinguisher bottle is discharged.

## EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | LAV SMOKE | Smoke has been detected inside the lavatory. |

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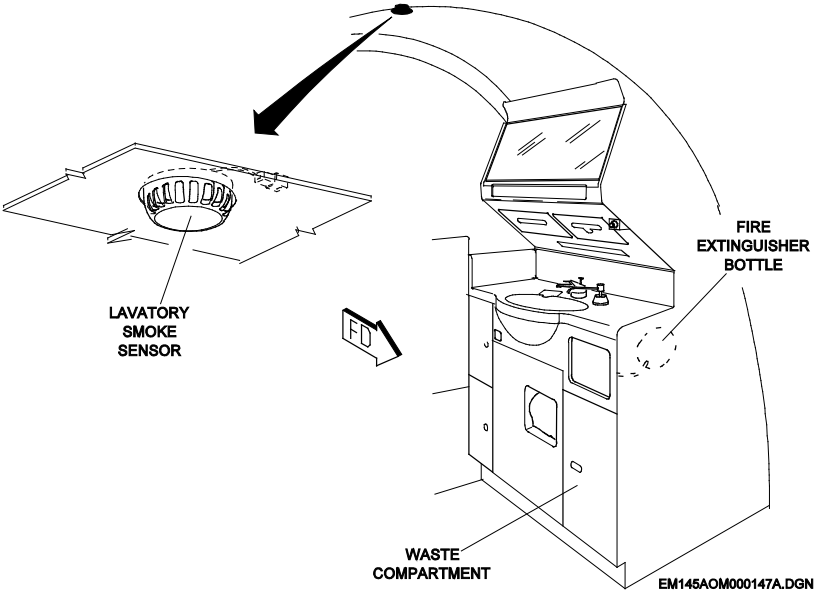


## LAVATORY FIRE PROTECTION SYSTEM



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# CONTROLS AND INDICATORS

## LAVATORY SMOKE DETECTOR PANEL

### 1 - LAVATORY SMOKE DETECTOR ALARM LIGHT (RED)

- Flashes in case of smoke detection inside the lavatory. In this case, a horn is also activated.

### 2 - LAVATORY SMOKE DETECTOR HORN OFF BUTTON

- Turns off the horn alarm when pressed.

### 3 - LAVATORY SMOKE DETECTOR RESET BUTTON

- Cancels the horn and resets the system for operation.

### 4 - LAVATORY SMOKE DETECTOR TEST BUTTON (GUARDED)

- When pressed (momentarily), simulates a smoke detection condition and activates all associated alarms (horn, red alarm light and EICAS message).

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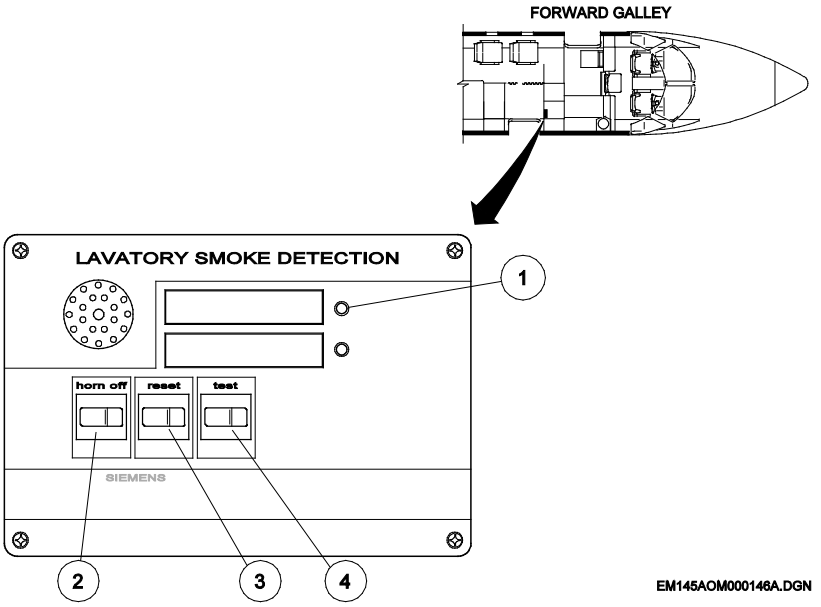


## LAVATORY SMOKE DETECTOR PANEL



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# BAGGAGE COMPARTMENT FIRE PROTECTION SYSTEM

## BAGGAGE COMPARTMENT SMOKE DETECTION SYSTEM

A smoke detection system is provided in the baggage compartment. The system consists of two smoke detection modules installed on the compartment ceiling.

A warning message is presented on the EICAS to indicate smoke detection inside the baggage compartment and this message disappears when the smoke is no longer present.

The smoke sensor resumes normal operation when the fire is extinguished, the smoke has been cleared or the smoke sensor is reset. On airplanes equipped with JAMCO (PN PU 90-431R1) detector, the smoke sensor may also be reset through the power-reset button, located on each smoke detection module.

Flight crew inspection of the baggage compartment is possible for airplanes equipped with an optional sight glass in the rear lavatory partition. For some airplanes a switch is available to turn on the lights in the baggage compartment (Refer to 2-06-15 – Lighting).

## BAGGAGE COMPARTMENT FIRE EXTINGUISHING SYSTEM (OPTIONAL)

Two fire extinguishing bottles are installed in the rear electronic compartment for baggage compartment fire protection.

The High-Rate Discharge Bottle is designed to instantaneously fill the baggage compartment while the Metering Discharge Bottle provides the required level of fire extinguishing agent concentration for at least 60 minutes.

Two smoke detectors are installed in the baggage compartment. Upon smoke detection inside the baggage compartment, either one or both smoke detectors send a signal to deactivate the baggage compartment fan and illuminate the baggage fire extinguisher button on the Fire Detection/Extinguishing Panel. When smoke is no longer present, the baggage compartment fan is reactivated and the baggage fire extinguisher button light turns off.

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## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | BAGG SMOKE | Smoke has been detected inside the baggage compartment. |
| CAUTION | BAGG EXTBTL INOP | Any of the bottles have been discharged or are inoperative, in class C baggage compartment. |

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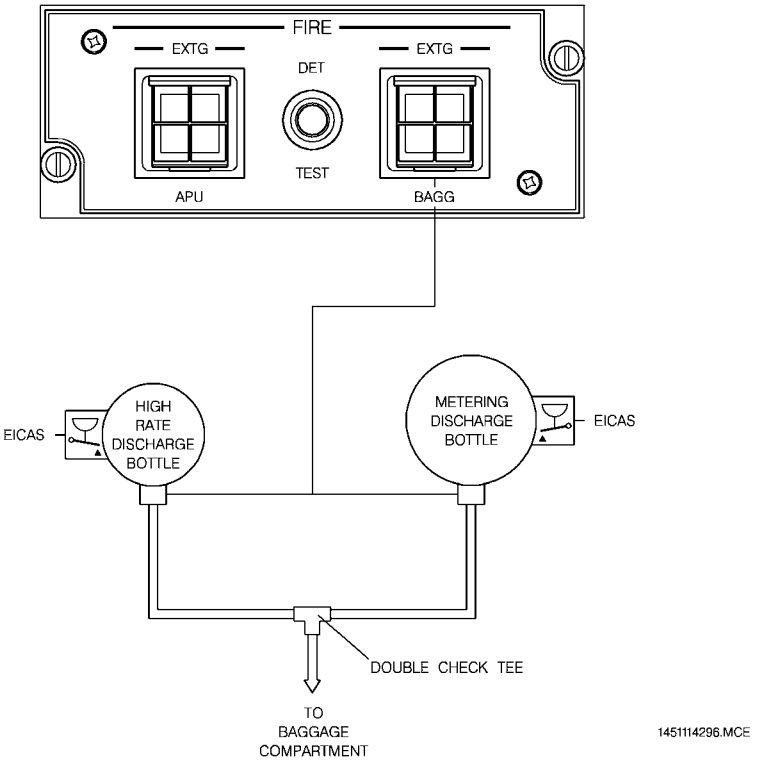


## BAGGAGE FIRE EXTINGUISHING SCHEMATIC



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# CONTROLS AND INDICATORS

## BAGGAGE DETECTION/EXTINGUISHING PANEL (OPTIONAL)

### 1 - BAGGAGE FIRE EXTINGUISHING BUTTON (guarded)

- When lit, button indicates that smoke was detected inside the baggage compartment or that the fan has been deactivated.
- Button remains lit as long as there is smoke inside baggage compartment.
- When pressed:
  - Discharges the baggage fire extinguishing bottles.
  - Deactivates the baggage compartment fan.

**NOTE:** Fire extinguishing agent may activate the smoke detector.

### 2 - FIRE DETECTION SYSTEM TEST BUTTON

- Refer to ENGINE AND APU FIRE DETECTION/EXTINGUISHING PANEL.

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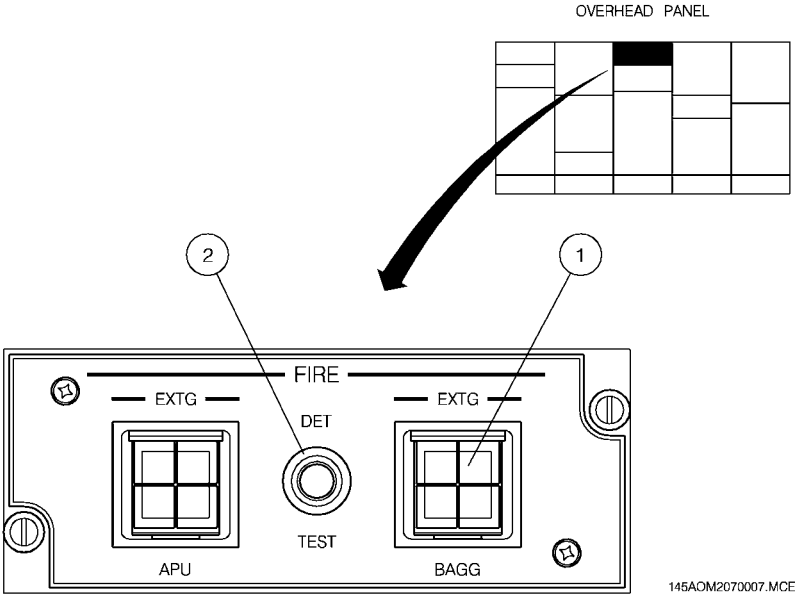


## BAGGAGE DETECTION/EXTINGUISHING PANEL

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## BAGGAGE COMPARTMENT SMOKE DETECTOR

AIRPLANES PRE-MOD S.B. 145-26-0004

### 1 - BAGGAGE SMOKE DETECTOR OPERATION LIGHT (green)

- Illuminates during normal system operation.

### 2 - BAGGAGE SMOKE DETECTOR RESET SWITCH

- Cancels the EICAS message and resets the system for operation.

### 3 - BAGGAGE SMOKE DETECTOR TEST SWITCH

- When pressed (momentarily), simulates a smoke detection condition and activates all associated alarms (red alarm light and EICAS message).
- During test, the green operation light extinguishes.

### 4 - BAGGAGE SMOKE DETECTOR ALARM LIGHT (red)

- Illuminates in case of smoke detection inside the baggage compartment.

## BAGGAGE COMPARTMENT SMOKE DETECTOR

AIRPLANES POST-MOD SB 145-26-0004 OR S/N 145.119, 145.134 AND ON

- Detectors are tested during Fire Detection System test.

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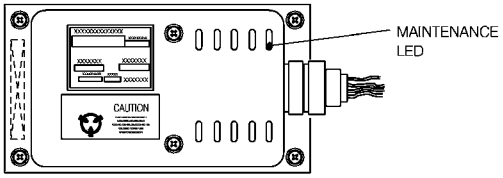


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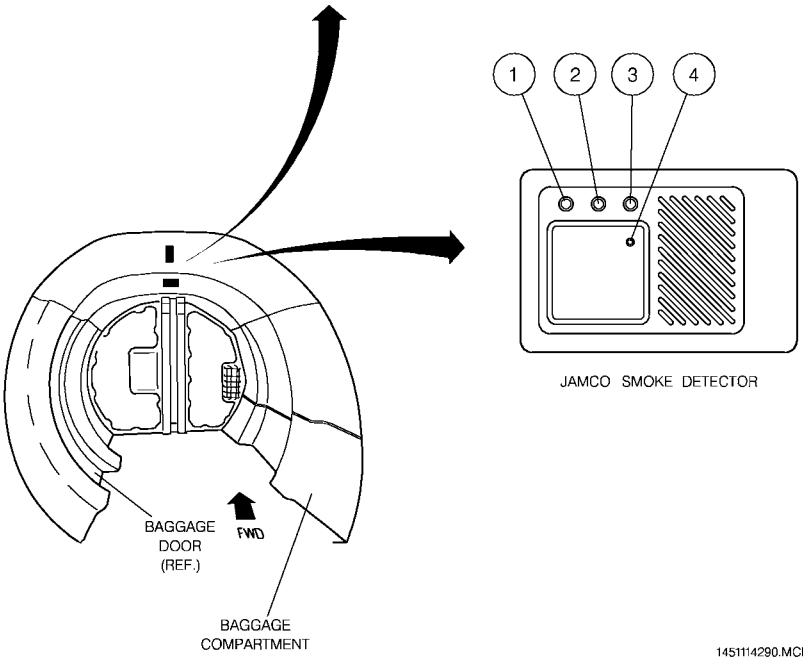


JAMCO SMOKE DETECTOR

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## BAGGAGE COMPARTMENT SMOKE DETECTOR



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# SECTION 2-08

# FUEL

TABLE OF CONTENTS

Block Page

General ..... 2-08-05 ..01
Fuel Tanks ..... 2-08-05 ..02
Fuel Tank Vent System ..... 2-08-05 ..02
Engine and APU Fuel Distribution and Control ..... 2-08-05 ..03
EICAS Messages ..... 2-08-05 ..07
Controls and Indicators ..... 2-08-05 ..08
Fuel System Panel ..... 2-08-05 ..08
MFD Bezel ..... 2-08-05 ..10
Fuel Page on MFD ..... 2-08-05 ..12
EICAS Indications ..... 2-08-05 ..14
Refueling and Defueling ..... 2-08-10 ..01
Pressurized Refueling ..... 2-08-10 ..01
Defueling ..... 2-08-10 ..02
Refueling Panel ..... 2-08-10 ..04
Fuel Measuring Stick ..... 2-08-15 ..01

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# GENERAL

The EMB-145/135 fuel feed system consists of two independent systems, one for each engine, interconnected by a crossfeed line. The fuel system ensure proper fuel supply to the engines and APU under all the operating conditions.

The system allows refueling and defueling operation to be performed either by pressure or by gravity.

**NOTE:** The fuel weight values present in this manual are based on a fuel density of 0.811 kg/liter (6.767 lb/US Gal).

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# FUEL TANKS

The airplane has two fuel tanks, one in each wing. The fuel flows from the wing tip to the wing root by gravity. A collector box in the wing root keeps the electrical pumps inlets submerged. To prevent pumps cavitation, a ejector pump and flaps valves ensure enough fuel in the collector box at all conditions.

The fuel tank capacity changes according to airplane model. The EMB-145LR/LU and EMB-135LR models are equipped with a wing stub tank that increases the tank capacity. These airplanes have the collector boxes located in the wing stub.

| | TANK CAPACITY | | | |
|---|---|---|---|---|
| | Airplanes Without Stub Tank | | Airplanes With Stub Tank | |
| | One Tank | Both Tanks | One Tank | Both tanks |
| Liters | 2573 | 5146 | 3198 | 6396 |
| US gallons | 679.8 | 1359.6 | 844.9 | 1689.8 |
| Kilograms | 2087 | 4173 | 2594 | 5187 |
| Pounds | 4600.2 | 9200.4 | 5717.4 | 11434.9 |

When performing pressure refueling, the usable fuel quantity in each tank may be reduced by 7.9 US Gal (STD, ER and MP models) or 13.2 US Gal (LR model) maximum.

**NOTE:** When operating with the TS-1 fuel, the FQIS may display a fuel quantity 2% (two percent) higher than the actual fuel loaded in the airplane.

Conversion factors:

- 3.785412 liter/US gallon.
- 1.2330456 liter/kg.
- 0.4536 kg/lb.

## FUEL TANK VENT SYSTEM

The purpose of the fuel vent system is to prevent damage to the wings due to excessive buildup of positive or negative pressures inside the fuel tanks. The system consists of float vent valves, vent lines, a surge box and a NACA air intake. The surge box is located in the wing and it is connected to the fuel tank through two float valves. These valves allow at least one venting point to be open between the surge box and the fuel tank under any flight condition. The surge boxes are connected to outside air through a NACA air intake installed under the wing.

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## ENGINE AND APU FUEL DISTRIBUTION AND CONTROL

There are three electric pumps for each wing tank that provides pressurized fuel to the engines and APU. One pump is capable to supply fuel for both engines and APU under all phases of flight, except takeoff and go-around.

During takeoff and go-around one electric pump is required for each engine and the APU.

Engine-driven fuel pumps will provide suction feed if the electric fuel pumps operation is not available limited up to a ceiling altitude of 25000 ft.

**NOTE:** Crossfeed Selector Knob must be OFF during takeoff and go-around.

Five knobs located in the overhead fuel panel controls the electric pumps and crossfeed operation. Two PUMP PWR knobs energizes/de-energizes the electric pumps and the other two PUMP SEL knobs selects which pumps will be operating. The remaining pumps will be on standby. If the fuel pressure drops below 6.5 psi, the remaining pumps are automatically switched on and start cycling, until the pilot selects one of them.

The XFEED knob controls the crossfeed operation.

Crossfeed operation should be performed in case of fuel imbalance between tanks. The crossfeed knob acts over the crossfeed valve and over the electric pumps. Selecting the knob to LOW1 or LOW2 will deenergize the pump associated to the side with low level. The crossfeed valve will open connecting the engine 1 and engine 2 fuel feed lines. The fully-opened crossfeed valve position is indicated on the EICAS by an advisory message. In case of valve failure, the EICAS displays a caution message.

**NOTE:** Crossfeed operation does not allow fuel transfer between tanks.

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Fuel for APU operation is normally supplied from the right side fuel system. Fuel from the left side system may be used by selecting the crossfeed knob to LOW2. The APU fuel shutoff valve will close in the following conditions:

- APU master knob positioned to OFF.
- By pressing the APU fuel shutoff button.
- By pressing the APU fire extinguishing button.
- Automatically, through the APU fire detection system in case of APU fire on ground.

Sensors installed in the tanks and along fuel lines provide signals to indicate system failures and status. Such indications and messages are shown on the MFD Fuel page as well as on the EICAS.

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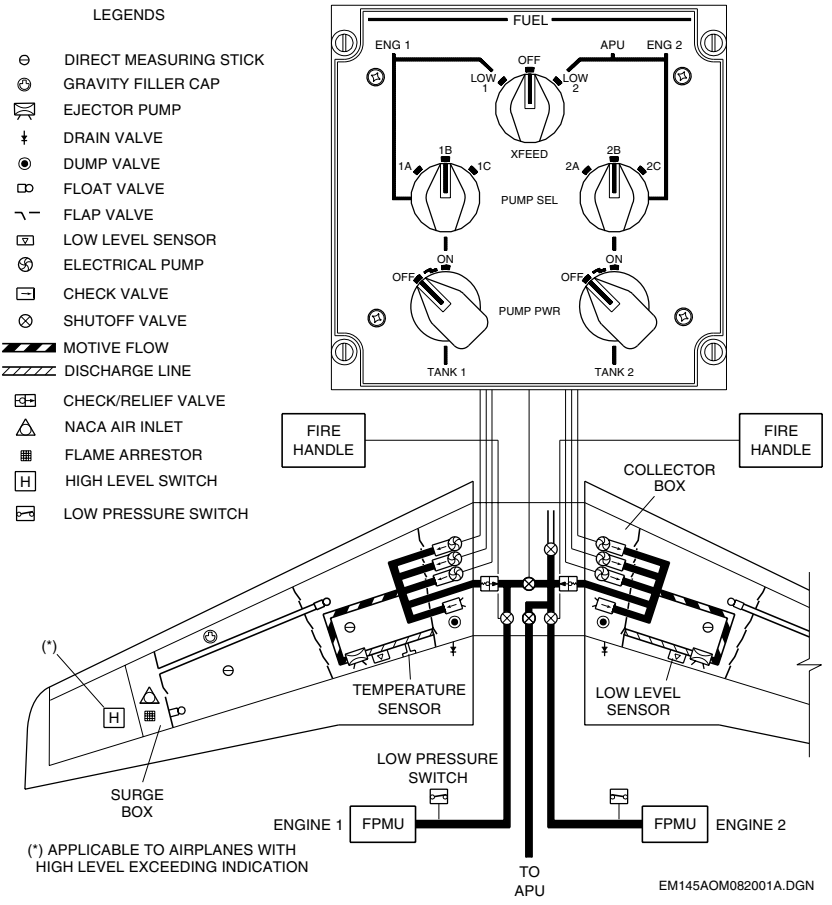


## FUEL SYSTEM SCHEMATIC

## (AIRPLANES WITHOUT STUB TANK)

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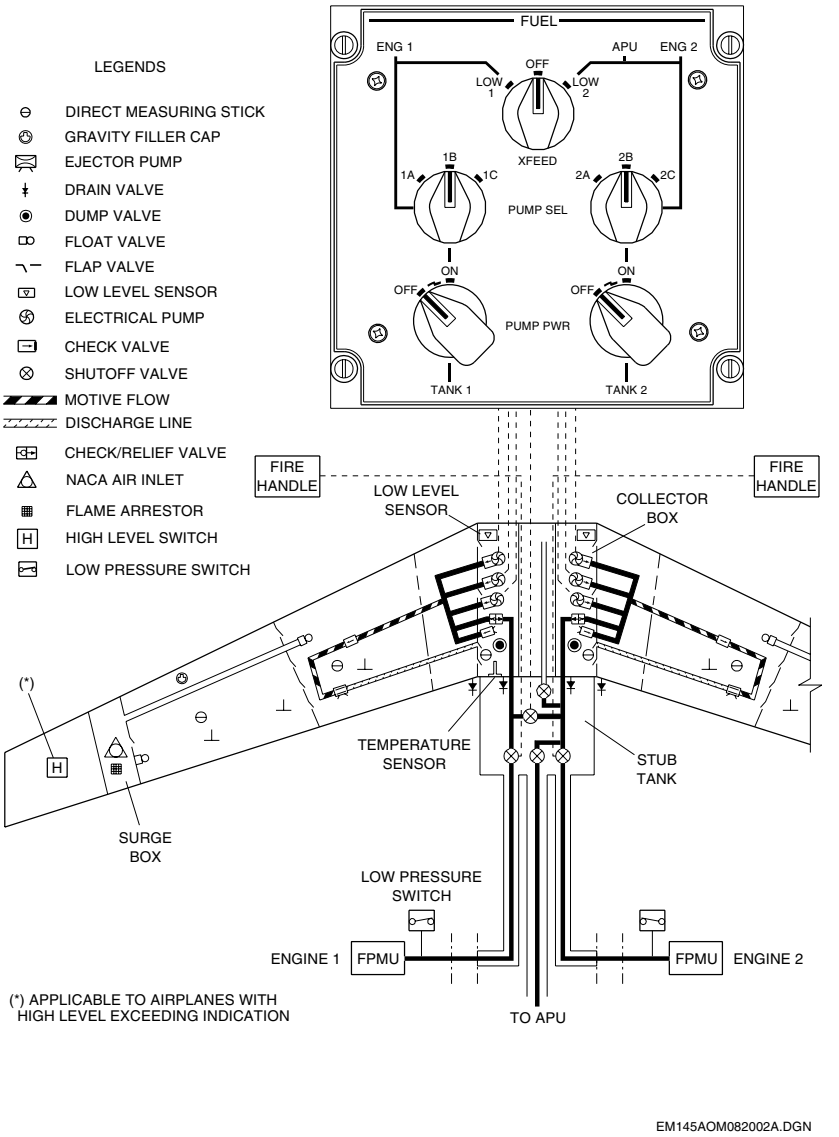


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## FUEL SYSTEM SCHEMATIC

## (AIRPLANES WITH STUB TANK)

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# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | FUEL 1(2) LO LEVEL | The remaining fuel quantity in the associated tank ranges from 210 kg (463 lb) to 265 kg (584 lb), for leveled flight condition. |
| CAUTION | E1(2) FUEL LO PRESS | Fuel pressure is below 6.5 psi. |
| | FUEL TANK LO TEMP | Fuel temperature inside left tank is at or below –40°C. |
| | FUEL XFEED FAIL | Disagreement between crossfeed valve and knob position. |
| | FUEL IMBALANCE | Fuel quantity in one tank differs by 363 kg (800 lb) from the other tank. Message is removed when difference between tanks decreases below 45 kg (100 lb). |
| | APU FUEL LO PRESS | Fuel pressure is below 6.5 psi with APU operating. |
| | E1 (2) FUEL SOV INOP | Associated shutoff valve is not in the commanded position. |
| | APU FUEL SOV INOP | APU shutoff valve is not in the commanded position. |
| | FUELING DOOR OPN | Refueling panel door is open. |
| | FUEL EQ XFEED OPN | - Crossfeed valve remains open after fuel imbalance correction - difference between wing tanks fuel quantities lower than 45 kg (100 lb); or<br>- Crew activated the wing fuel imbalance correction to the wing tank with low level. |

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# EICAS MESSAGES (CONT.)

| TYPE | MESSAGE | MEANING |
|---|---|---|
| ADVISORY | E1 (2) FUEL SOV CLSD | Associated shutoff valve is closed. |
| | APU FUEL SOV CLSD | APU fuel shutoff valve is closed. Message remains on for 10 seconds after APU Master Knob is set to off. If valve has been commanded to close through APU Fuel Shutoff Button or APU Fire Extinguishing Button the message will remain on continuously. |
| | FUEL XFEED OPEN | Crossfeed valve is open. |

# CONTROLS AND INDICATORS

## FUEL SYSTEM PANEL

### 1 - CROSSFEED Selector Knob

LOW1 – Opens the crossfeed valve and turns off the selected pump of the left wing tank.

OFF – Closes the crossfeed valve.

LOW2 – Opens the crossfeed valve and turns off the selected pump of the right wing tank.

### 2 - WING TANK FUEL PUMP SELECTOR KNOB

– Selects which electric pump will be operative for each wing tank. The non-selected wing pumps remain as standby.

### 3 - WING TANK FUEL PUMP POWER KNOB

ON - Turns ON the selected wing fuel pump.

OFF - Turns OFF the selected wing fuel pump.

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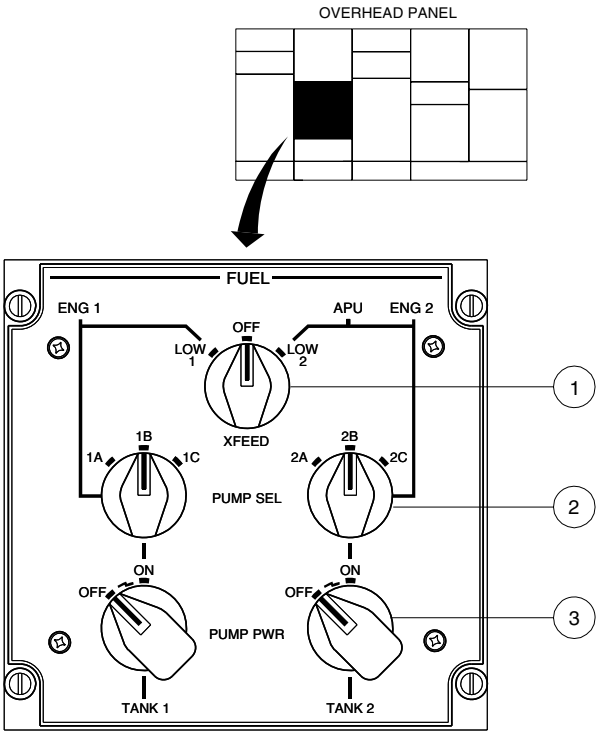


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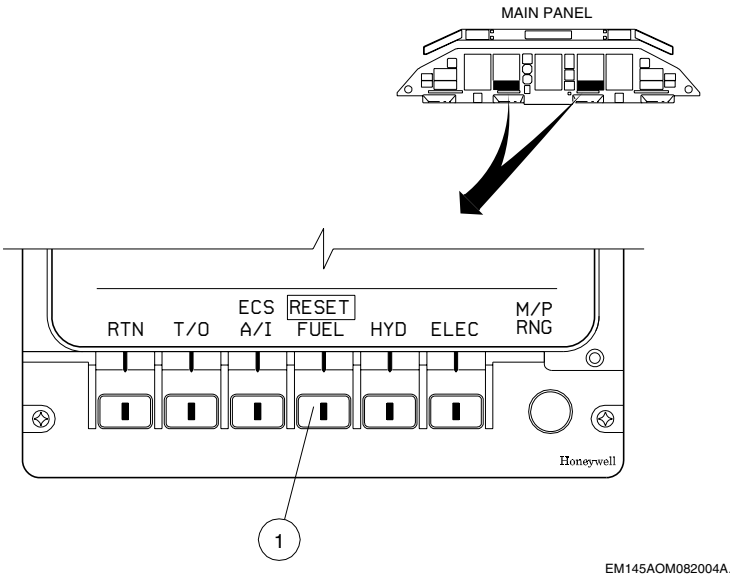
**FUEL SYSTEM PANEL**

# MFD BEZEL

## 1 - FUEL SYSTEM and RESET BUTTON

- Pressing FUEL button selects the fuel system page on MFD. Pressing the button a second time resets the fuel used to zero. Fuel used must be reset individually on each MFD.




**MFD BEZEL**

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# FUEL PAGE ON MFD

## 1 - DIGITAL FUEL QUANTITY INDICATION (TANK 1,TANK 2 and TOTAL)

- The digital fuel tank quantity indicator ranges from 0 to 9990 (for airplanes without stub tank) or from 0 to 15000 (for airplanes with stub tank) with a digital resolution of 10 units, regardless of unit being used (lb or kg), for TANK 1, TANK 2, and TOTAL.
- Colors for each tank identification:
  - Green above 400 kg (880 lb).
  - Amber and boxed from 280 kg to 400 kg (620 lb to 880 lb).
  - Red and boxed below 280 kg (620 lb).
- Colors for TOTAL indication: if TANK1, TANK2 or both fuel quantities enter into red or amber region, total fuel quantity will be boxed (on EICAS and MFD) and displayed in the same color, with the red taking precedence over the amber.
- Amber dashes replace the indication, in the event of any fault which affects fuel gauging.

## 2 - ANALOG FUEL QUANTITY INDICATION

- Quantity is indicated by a vertical bar and a pointer. The colors and ranges are the same used for digital fuel quantity indications.

## 3 - DIGITAL FUEL USED INDICATION

- The fuel used indicator ranges from 0 to 9990 (for airplanes without stub tank) or from 0 to 15000 (for airplanes with stub tank) with a digital resolution of 10 units, regardless of unit being used (lb or kg).
- Color: Green under normal operation. Replaced by Amber dashes (in flight) or amber zero (on ground) if any problem is verified.

## 4 - DIGITAL FUEL TEMPERATURE INDICATION

- Ranges from –60°C to +60°C with a resolution of 1°C.
- Colors:
  - Green above –40°C.
  - Amber and boxed below –40°C.

## 5 - OPERATING PUMP INDICATION

- This indicator displays A, B, C or OFF, depending on which pump is selected and whether it is on or off.
- Color: green.
- Wing tank pumps indication may blink when cycling, until the pilot selects another pump.

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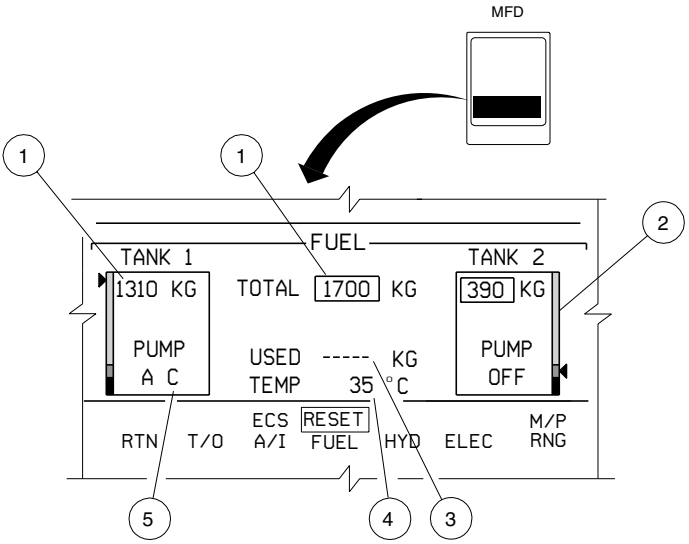


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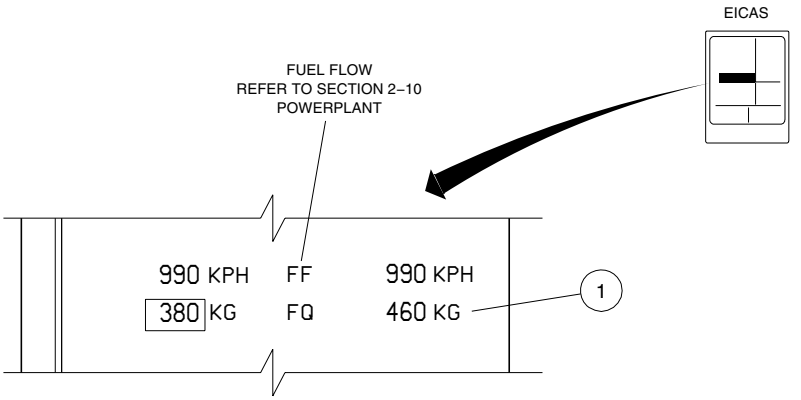
**MFD FUEL PAGE**

# EICAS INDICATIONS

## 1 - FUEL QUANTITY (TANK 1 and TANK 2) AND FUEL FLOW

- Fuel quantity for each tank and fuel flow for each engine is displayed continuously on EICAS.
- Fuel quantity for each tank:
  - Green above 400 kg (880 lb).
  - Amber and boxed from 280 kg to 400 kg (620 lb to 880 lb).
  - Red and boxed below 280 kg (620 lb).
- Fuel flow for each engine:
  - Ranges from 0 to 2000 kph (or 4000 pph) with a resolution of 5 kph (or 10 pph).
  - Color: Green

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# REFUELING AND DEFUELING

Refueling and defueling operations may be performed either by pressure or by gravity. The refueling panel in the right wing-to-fuselage fairing allows pressurized refueling/defueling operation. A gravity filler cap on the upper skin of each wing allows gravity filling. Dump valves and drain valves are used for gravity defueling.

## PRESSURIZED REFUELING

Pressurized refueling operations require the refueling system being energized. This can be accomplished by either energizing the airplane through APU, GPU, battery or running engine, selecting the power selection switch to BATTERY.

As fuel pressure is applied on the adapter the two CLOSED lights will illuminate to indicate that refueling shutoff valves are closed. Selecting the refueling switch to OPEN will open the shutoff valves, starting refueling operation. The shutoff valves will close, stopping the refueling operation, when:

- The fuel level in the tanks lifts the associated pilot valve's float. This level defines the maximum fuel volume approved for that tank, through pressure refueling.
- The selected fuel quantity on the refueling panel is achieved.
- The refueling switch is commanded to closed.

For airplanes with High Level Exceeding Indication System incorporated, an automatic refueling shutoff failure will be identified by the HLEIS (High Level Exceeding Indication System), that will sense, via one HLS (High Level Sensor) in each wing tank, that the fuel level in the failed tank reached over the maximum quantity approved for that tank and will advise the operator by illuminating, on the refueling panel, the "STOP RFL" red indicating light of the failed tank. The operator shall interrupt the refueling operation immediately, after viewing the red light on, to prevent fuel spillage through the vent valve and shall call the maintenance personnel to follow the procedure to remove the extra fuel of the associated tank(s).

The fueling cart or fueling truck shall deliver a refueling pressure (deadhead) within 35 to 50 psi.

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## DEFUELING

Pressurized defueling uses the same adapter as pressure refueling. Pressurized defueling can be performed using the electric fuel feed pumps installed in the tanks or by suction (4 psi max.) provided by an appropriated external source. Selecting the defueling switch to OPEN will open the defueling shutoff valve allowing defueling operation. To defuel the left tank, the crossfeed knob on the overhead fuel panel, in the cockpit, must be positioned to LOW2.

Complete gravity defueling may be achieved by using the drain valve and opening the associated gravity refueling cap. Partial gravity defueling can be done through the dump valves located on the wing under skin near the wing root. Pressurized defueling can only be performed with the airplane normally energized.

**CAUTION:** DO NOT RUN ELECTRIC PUMPS WITH FUEL QUANTITY IN EACH TANK BELOW 30 LITERS (8 US GAL) OR 24 KG (54 LB).

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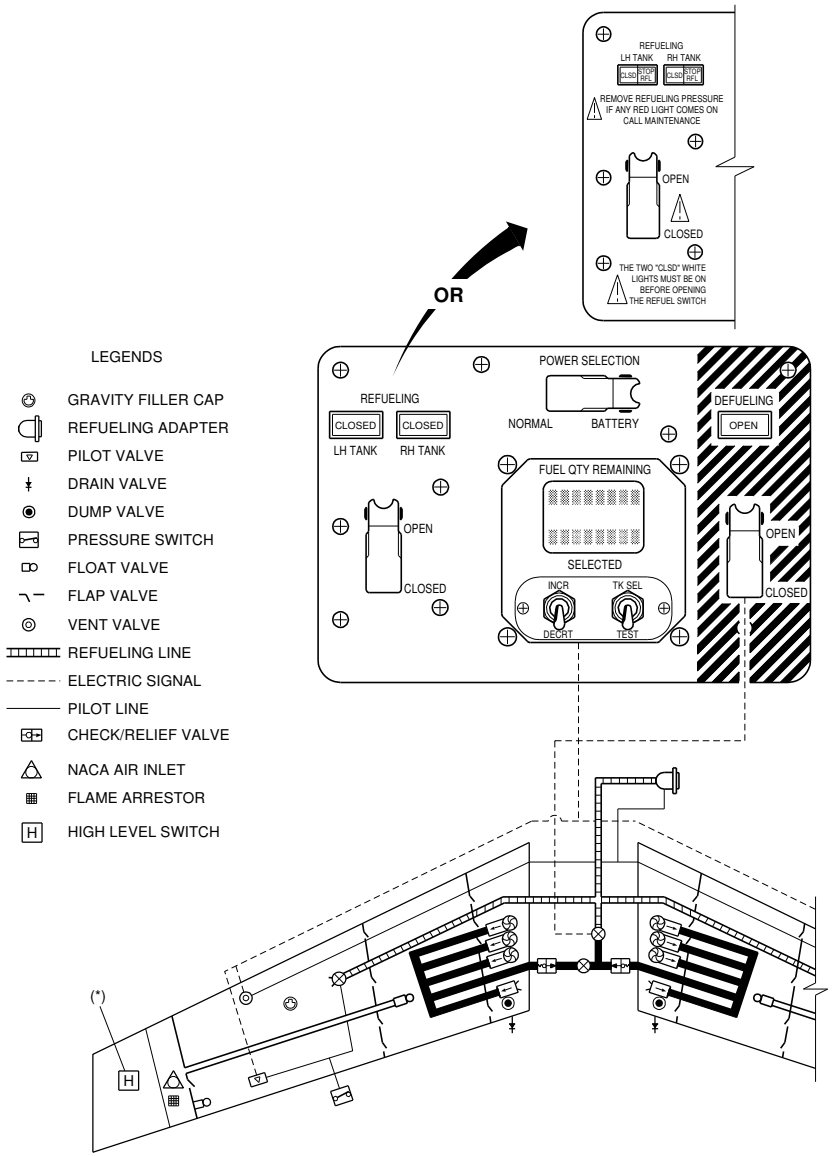


(*) APPLICABLE TO AIRPLANES WITH HIGH LEVEL EXCEEDING INDICATION

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## PRESSURE REFUELING/DEFUELING SYSTEM SCHEMATIC

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# REFUELING PANEL

## 1 - REFUELING CLOSED LIGHTS (WHITE)

– Illuminate when the associated refueling line is pressurized and the associated shutoff valve is closed.

## - STOP REFUELING LIGHTS (RED)

– Illuminate when fuel level in the failed tank reached over the maximum quantity approved for that tank (For airplanes with High Level Exceeding Indication incorporated).

## 2 - POWER SELECTION SWITCH (GUARDED)

NORMAL - Refueling system is energized by the DC Bus 1.

BATTERY - Refueling system is connected to the Hot Bus 1.

## 3 - DEFUELING OPEN LIGHT (WHITE)

– Illuminates when the defueling shutoff valve is open.

## 4 - DEFUELING SWITCH (GUARDED)

– Actuates the defueling shutoff valve to open or to close.

## 5 - FUEL QUANTITY REMAINING INDICATOR

– Displays fuel remaining in each tank or the total as selected by the TK SEL/TEST Switch.
– The selection is identified by the letters L, R and T (L for the left tank, R for the right tank and T for the airplane total quantity).
– The unit of measurement (kg or lb) is also displayed.
– In case of failure, FAIL inscription is displayed blinking and the refueling/defueling operation is interrupted.
– The established accuracy of the EMB-145 airplane Fuel Quantity Gauging System (FQGS) is: ± 2% of the provided indication plus ± 35 kg (77 lb), considering the approved fuels and normal flight attitudes.

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**6 - TK SEL/TEST SWITCH (spring loaded to center position)**

TEST - Initiates indicator built-in and probes conditions test. All light segments illuminate and a failure code is presented, if a failure is detected.

TK SEL - Selects which fuel quantity is going to be displayed in the upper display. When the indicator is energized, the total fuel quantity is shown. Sequentially pushing the switch to TKSEL will select left tank, right tank and total fuel quantity.

**7 - QUANTITY SELECTION SWITCH (SPRING LOADED TO CENTER POSITION)**

- Increment (INCR) or decrement (DECRT) the fuel quantity selection.
- If moved from the neutral position during refueling, it interrupts the operation. The refueling operation will be restored 4 seconds after switch return to the neutral position.

**8 - FUEL QUANTITY SELECTED INDICATOR**

- Displays the fuel quantity in the airplane and the fuel quantity to be refueled.
- When the FAIL inscription is displayed blinking on the fuel quantity remaining indicator and the TKSEL/TEST switch is pushed to TKSEL, the active fail description is momentary displayed in both indicators.
- The indicator displays zero as the refueling compartment door is opened.

**9 - REFUELING SWITCH (GUARDED)**

- When the switch is closed, both wing pilot valves close the refueling shutoff valves.

**NOTE:** The defueling and the power selection switch are moved to close/normal position when the refueling panel door is closed, besides refueling/defueling procedure requires manual closure.

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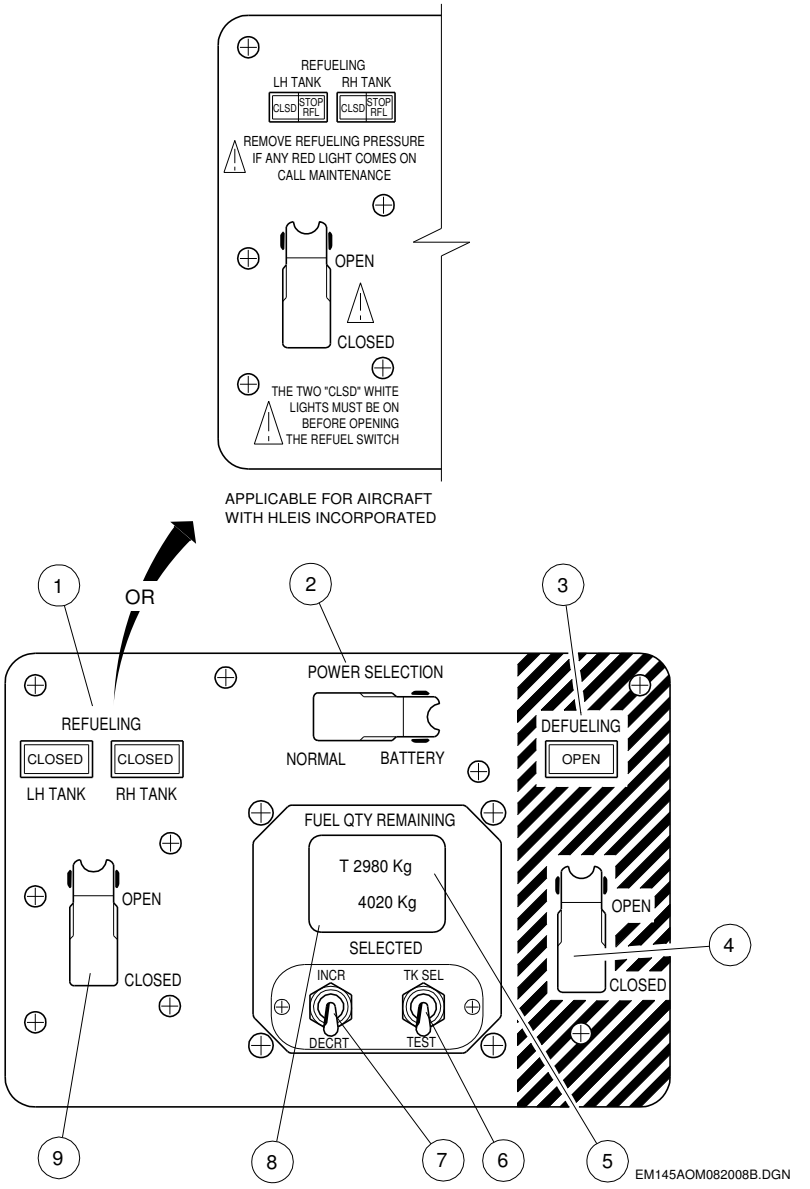


**REFUELING PANEL**

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# FUEL MEASURING STICK

Two measuring sticks under each wing permit to check the fuel quantity in the tanks. Each measuring stick provides visual indication of the total fuel quantity of the associated wing tank.

Information about using the Fuel Measuring Stick can be found in the Ground Servicing Section (1-12-25).

**NOTE:** The EMB-145LR/LU, EMB-135LR, ERJ-140 and EMB-145XR models have two additional measuring sticks, one for each wing stub tank.

The table below provides minimum and maximum stick values:

| STICK POSITION | | AIRPLANES WITHOUT WING STUB TANK | | AIRPLANES WITH WING STUB TANK | |
|---|---|---|---|---|---|
| | | *LITERS* | *US GAL* | *LITERS* | *US GAL* |
| Wing Stub Tank | Min | -- | -- | 7 | 2 |
| | Max | -- | -- | 783 | 207 |
| Internal Point | Min | 448 | 118 | 781 | 206 |
| | Max | 1553 | 410 | 2168 | 573 |
| External Point | Min | 1503 | 397 | 2163 | 571 |
| | Max | 2131 | 563 | 2791 | 737 |

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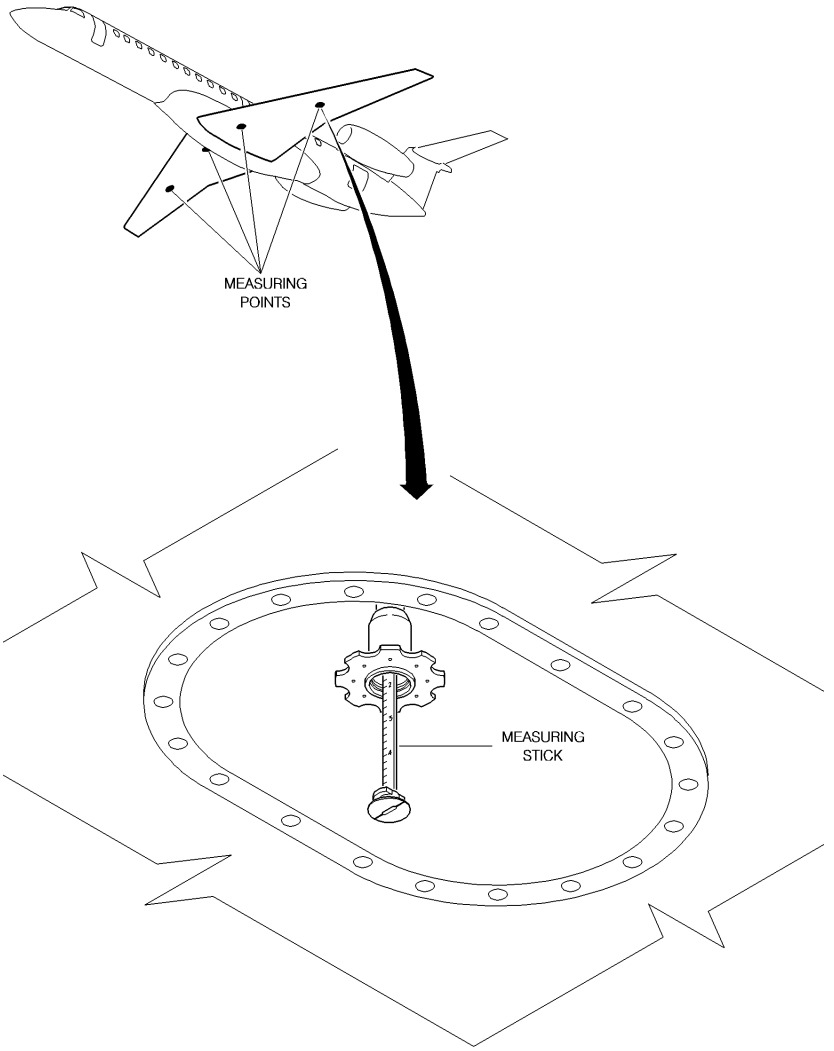


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## MEASURING STICK POINTS

## (AIRPLANES WITHOUT WING STUB TANK)

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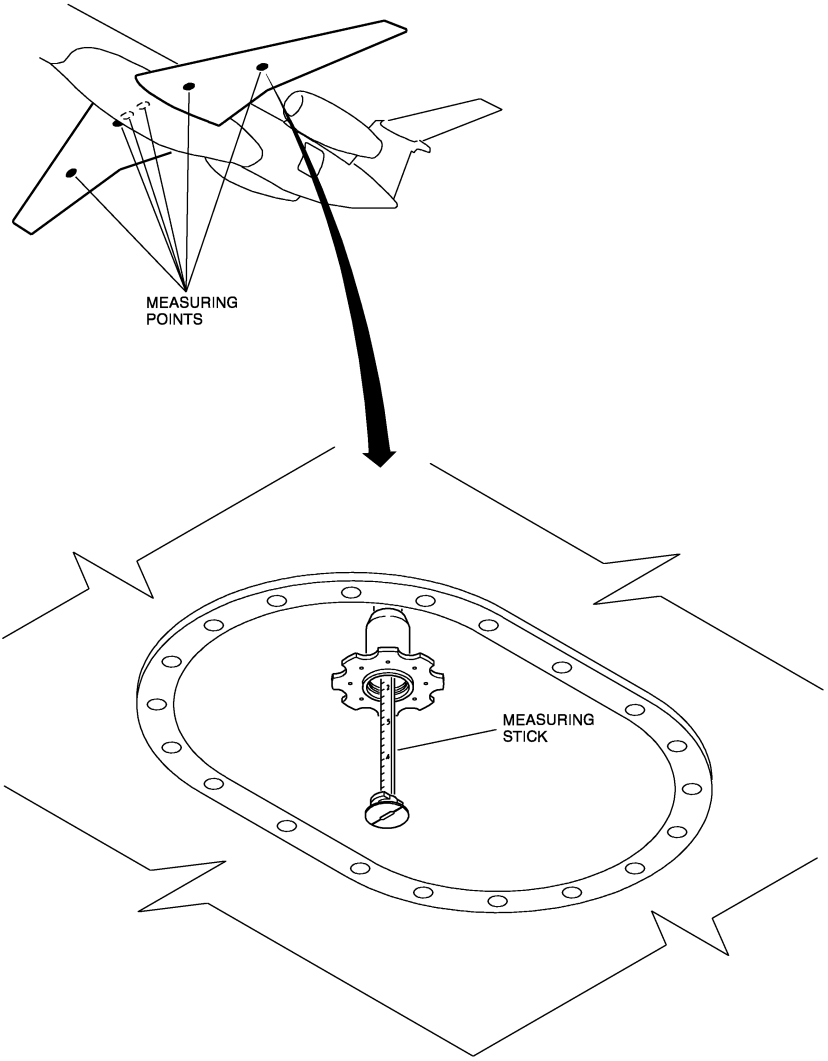


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## MEASURING STICK POINTS

## (AIRPLANES WITH WING STUB TANK)

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# SECTION 2-09

# AUXILIARY POWER UNIT

TABLE OF CONTENTS

Block Page

General ..... 2-09-05 ..01
Control System..... 2-09-05 ..04
APU Starting/Operation..... 2-09-05 ..08
EICAS Messages ..... 2-09-05 ..09
Controls and Indicators ..... 2-09-05 ..10
APU Control Panel ..... 2-09-05 ..10
EICAS Indications..... 2-09-05 ..11

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# GENERAL

The APU is a source of pneumatic and electrical power to be used either simultaneously with or independent of airplane sources, while on the ground or in flight. Basically, it is a constant-speed gas turbine engine, consisting of a single-stage centrifugal compressor, a reverse-flow annular combustion chamber, and a single-stage radial turbine.

The airplane may be equipped with two APU models: T-62T-40C11 or T-62T-40C14. The Model T-62T-40C11 APU is controlled by the Electronic Sequence Unit (ESU), while the Model T-62T-40C14 APU is controlled by the Full Authority Digital Electronic Control (FADEC). Both control systems provide automatic, full-authority, fuel scheduling from start to full load operation, under all ambient conditions and operating modes. In addition, the ESU (or FADEC) automatically controls the APU to shut down should certain failures or events occur during start or operation.

An automatic APU shutdown may occur either on the ground or in flight, and takes place under the following conditions:

On the ground:

- fire;
- overtemperature;
- overspeed;
- underspeed;
- failure to start;
- failure to accelerate;
- failure to light;
- loss of speed data;
- external short;
- loss of ESU (or FADEC) signal;
- ESU (or FADEC) failure;
- bleed valve opening;
- low oil pressure;
- high oil temperature;
- oil pressure switch short;
- loss of EGT.

**NOTE:** In the event of fire, a 10 second delay is allowed before an automatic APU shutdown is initiated.

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In flight:

- overspeed;
- underspeed;
- failure to start;
- failure to accelerate;
- failure to light;
- loss of speed data;
- external short;
- loss of ESU (or FADEC) signal;
- ESU (or FADEC) failure.

The APU compartment is located in the airplane's tailcone, isolated by a titanium firewall. On the left side of the APU compartment, an inspection door allows access and inspection of the APU's components.

The APU starter-generator shaft drives an air-cooling fan. Air is drawn through an NACA air inlet located on the left side of the tailcone. APU draining is ducted to the airplane skin on the right side of the tailcone.

Control switches, alarms, and emergency shutdown means are provided on the cockpit overhead panel.

The normal APU indications and caution/warning messages are presented on the EICAS.

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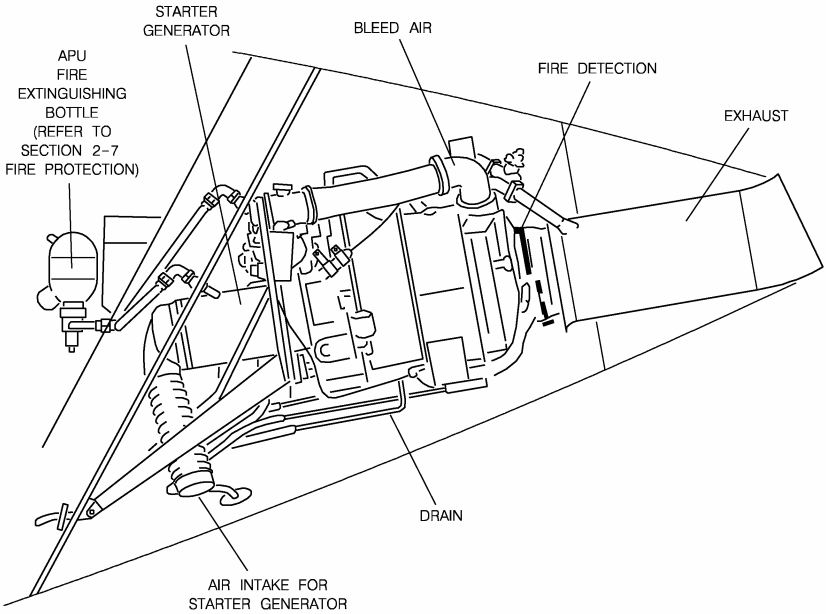


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## APU INSTALLATION

# CONTROL SYSTEM

The APU control systems include the electrical, fuel, ignition, lubrication, and pneumatic systems.

On the Model T-62T-40C11 APU, the electrical control system consists of the Electronic Sequence Unit (ESU) and electric accessories. On the Model T-62T-40C14 APU, the electrical control system consists of the Full-Authority Digital Electronic Control (FADEC). Both control systems incorporate the APU starting system, control logic, and failure indication. Electric accessories provide ESU (or FADEC) inputs and execute output commands.

For airplanes Pre-Mod. SB 145-49-0025 the APU ESU/FADEC is fed by CENTRAL DC BUS and by the ESS DC BUS 2. The APU shuts down if both buses are lost, but it remains on if only one is lost.

For airplanes Post-Mod. SB 145-49-0025 or equipped with an equivalent modification factory incorporated, the APU ESU/FADEC is electrically fed by HOT BUS 1. The APU control system (relays logic) is supplied by ESS DC BUS 2. The APU shuts down immediately if the HOT BUS 1 is lost, or shuts down after 6 seconds if the ESS DC BUS 2 is lost.

The fuel system is composed of the fuel pump, fuel solenoid valves (Start, Main, and Maximum), acceleration control, purge valve, fuel nozzles, fuel filter, and manifold. Acceleration control provides fuel in accordance with a preprogrammed schedule. Fuel from the right wing tank is normally used to supply the APU. Alternatively, fuel from the left wing tank may be used by means of the crossfeed valve.

**NOTE:** The fuel system for the Model T-62T-40C14 APU does not include a start and maximum fuel solenoid valves.

The ignition system provides the electrical power necessary during the APU starting sequence. It consists of an exciter, igniter plugs, and wiring.

The APU has a self-contained lubrication system totally integrated into the accessory gearbox. In addition to lubrication functions, the system provides the required oil cooling, with no need for an external heat exchanger. A thermostat, installed in the oil tank, sends a signal to the EICAS in case the oil temperature exceeds 166°C (331°F).

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The pneumatic control system consists of a flow limiting venturi (for APU Model T-62T-40C11 only), a bleed valve, and an anti-surge valve. The flow limiting venturi maintains the bleed flow below a set value, depending on air conditioning system requirements and atmospheric conditions, thus maintaining the EGT within acceptable levels. The anti-surge valve is controlled by the ESU (or FADEC), which monitors the signal from the APU bleed valve, the Air Turbine Starter (ATS) valve, and the Environmental Control System (ECS) valve.

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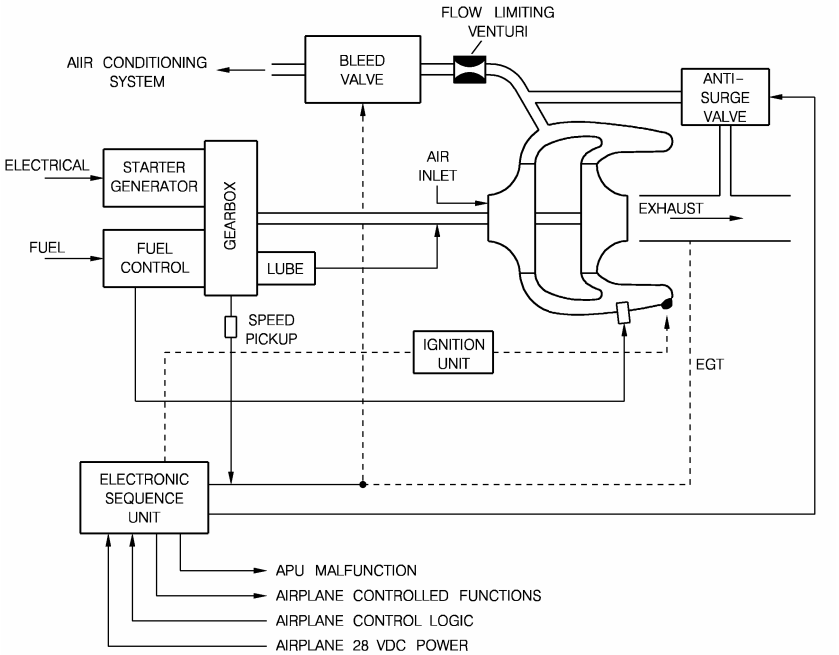


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## APU MODEL T-62T-40C11 SCHEMATIC

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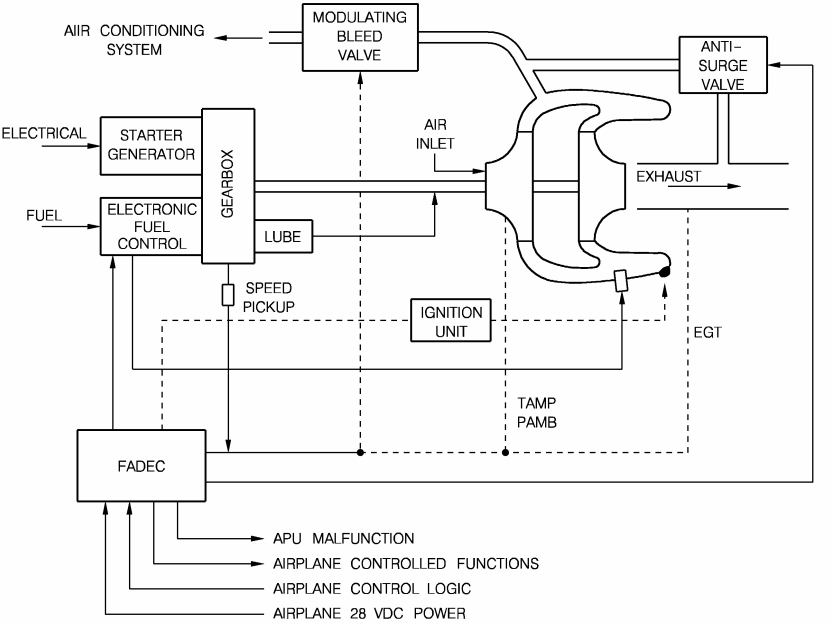


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## APU MODEL T-62T-40C14 SCHEMATIC

# APU STARTING/OPERATION

The APU starting cycle is initiated when the APU Master knob, located on the APU control panel, is moved to the ON position. At this moment, an EGT valid value is shown on the EICAS. On the Model T-62T-40C14 APU, at this time, the fuel shutoff valve is energized to open. When the Master switch is momentarily set to START, DC power is applied to the starter-generator, which will drive the APU compressor up to a speed high enough to obtain sufficient airflow for combustion.

On the Model T-62T-40C11 APU, at approximately 3% rotor speed on the ground (or 0% in flight), the ESU supplies power to the ignition unit as well as power to open the Start Fuel Solenoid Valve, allowing fuel to flow to the combustion chamber. At 14% rotor speed, the Main Fuel Solenoid Valve is energized. The APU continues accelerating up to the 70% rotor speed, when the ESU commands starter disengagement and Start Fuel Solenoid Valve and ignition deenergization.

On the Model T-62T-40C14 APU, at approximately 3% rotor speed on the ground (or 0% in flight), the FADEC supplies power to the ignition unit as well as power to open the Main Fuel Solenoid Valve, allowing fuel flow to the combustion chamber. The APU continues accelerating and, when rotor speed exceeds 50%, the FADEC de-energizes the starter and at 70% rotor speed the FADEC de-energizes the ignition exciter.

The APU acceleration continues by the APU's own means and, 7 seconds after having reached 95% rotor speed, the Maximum Fuel Solenoid Valve is energized (T-62T-40C11 Model) or the FADEC energizes the Ready-to-Load (RTL) output signal (T-62T-40C14 Model), allowing electrical and pneumatic power extraction through the starter-generator and the bleed valve, respectively.

If a failure in the control system occurs, associated with an APU overspeed, the Model T-62T-40C11 APU will automatically shutdown after the rotating parts reach 108% speed, while the Model T-62T-40C14 APU will automatically shutdown after the rotating parts reach 104% speed.

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The APU is shut down by pressing the APU Stop Button or by setting the Master switch to the OFF position. Normal shutdown of the APU should be accomplished by pushing the STOP switch on the cockpit APU control panel. On APU Model T-62T-40C11, a signal is sent to the ESU in order to simulate an overspeed condition, which, aside shutting the APU down, allows the ESU overspeed protection testing. On APU Model T-62T-40C14, a stop request signal is sent to the FADEC in order to execute the APU shutdown procedure; the FADEC overspeed protection is tested during the FADEC power-up.

**NOTE:** The APU FUEL SHUTOFF BUTTON when pressed also shuts the APU down by closing shutoff valve of the APU fuel feed-line.

# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | APU FAIL | APU has been automatically shut down. |
| | APU OIL LO PRESS | Oil pressure is below 6 psi. |
| | APU OIL HI TEMP | Oil temperature is above 166°C (331°F). |

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# CONTROLS AND INDICATORS

## APU CONTROL PANEL

### 1 - APU MASTER KNOB

OFF - Deenergizes the ESU (or FADEC), closes the APU fuel shutoff valve, turns off APU indications and alarms whenever APU RPM is below 5%, and commands APU shutdown.

ON - Energizes the ESU (or FADEC), commands the fuel shutoff valve to open, enables indication and alarms on the EICAS and allows the APU to keep running after starting.

START (momentary position) - Initiates start cycle.

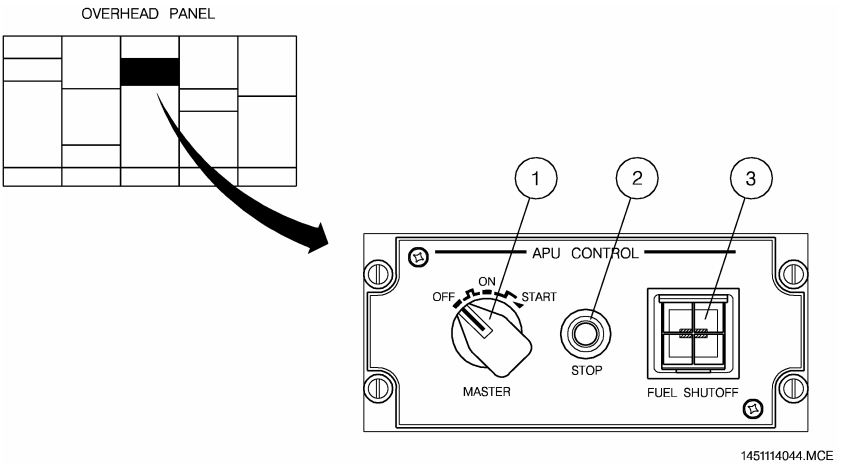
### 2 - APU STOP BUTTON

– Shuts the APU down.

**NOTE:** APU EICAS indications remain operational.

### 3 - APU FUEL SHUTOFF BUTTON (GUARDED)

– Cuts off fuel to the APU.
– A striped bar illuminates inside the button to indicate that it is pressed.




**APU CONTROL PANEL**

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## EICAS INDICATIONS

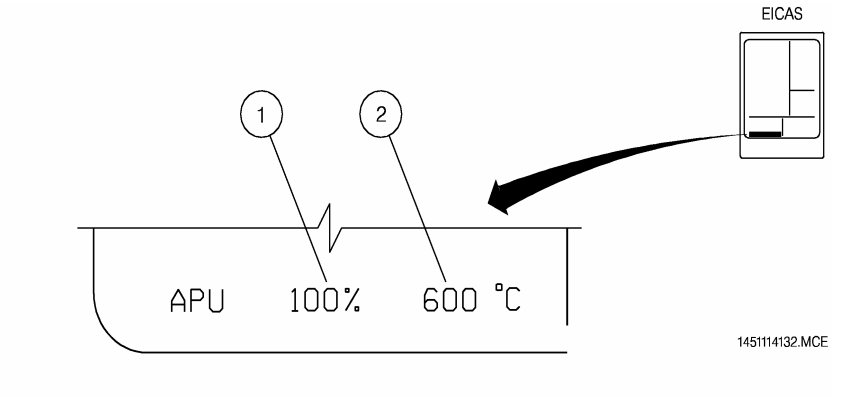
**1 -** APU RPM INDICATION

- Ranges from 0 to 120% speed.
- Green from 96 to 104%.
- Amber and boxed from 0 to 95% and from 105 to 110%.
- Red and boxed above 110%.

**2 -** APU EGT INDICATION

- NORMAL OPERATION
  - Ranges from -54 to 927°C.
  - Green from -54 to 680°C.
  - Amber and boxed from 681 to 717°C.
  - Red and boxed above 717°C.
- START SEQUENCE
  - Ranges from -54 to 927°C.
  - Green from -54 to 838°C.
  - Amber and boxed from 839 to 884°C.
  - Red and boxed above 884°C.

**NOTE:** After APU shutdown, the RPM and EGT indications are replaced by APU OFF inscription provided the APU Master Knob is set to OFF position and APU speed is below 5%.




**EICAS INDICATIONS**

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# SECTION 2-10

# POWERPLANT

TABLE OF CONTENTS


| | Block | Page |
|---|---|---|
| Index | 2-10-00 | 01 |
| General | 2-10-05 | 01 |
| Main Assemblies | 2-10-05 | 02 |
| Fan Module | 2-10-05 | 02 |
| High-pressure Compressor | 2-10-05 | 02 |
| High-pressure Turbine (HPT) | 2-10-05 | 02 |
| Low-pressure Turbine (LPT) | 2-10-05 | 02 |
| Exhaust Cone and Mixer | 2-10-05 | 02 |
| Accessory Gearbox | 2-10-05 | 03 |
| Engine Fuel System | 2-10-10 | 01 |
| Fuel Pump and Metering Unit (FPMU) | 2-10-10 | 01 |
| Fuel Cooled Oil Cooler (FCOC) | 2-10-10 | 02 |
| Compressor Variable Geometry Actuation System | 2-10-10 | 02 |
| Fuel Nozzles | 2-10-10 | 02 |
| Lubrication System | 2-10-15 | 01 |
| Lubricating Oil Supply System | 2-10-15 | 01 |
| Oil Tank | 2-10-15 | 01 |
| Lube and Scavenge Pump | 2-10-15 | 02 |
| Oil Filter Unit | 2-10-15 | 02 |
| Air-Cooled Oil Cooler (ACOC) | 2-10-15 | 02 |
| Fuel-Cooled Oil Cooler (FCOC) | 2-10-15 | 02 |
| Engine Sumps | 2-10-15 | 03 |
| Lubricating Oil Scavenge System | 2-10-15 | 03 |
| Lubricating Oil Vent System | 2-10-15 | 03 |
| Engine Bleed | 2-10-20 | 01 |
| Engine Electrical System | 2-10-25 | 01 |
| Electrical Power Sources | 2-10-25 | 01 |
| Permanent Magnet Alternator (PMA) | 2-10-25 | 01 |
| Ignition System | 2-10-30 | 01 |
| Pneumatic Starting System | 2-10-30 | 02 |
| Air Turbine Starter (ATS) | 2-10-30 | 02 |
| Starting Control Valve (SCV) | 2-10-30 | 02 |
| Starting By Using Ground Equipment | 2-10-30 | 03 |
| Engine Indicating System (EIS) | 2-10-35 | 01 |


User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44



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Engine Sensors ... 2-10-35 ...01
Pressure/Temperature Transducer Sensor ... 2-10-35 ...01
Low Oil-Pressure Sensor ... 2-10-35 ...01
Oil-Level and Low-Level System ... 2-10-35 ...01
Electrical Oil-Filter Impending-Bypass Indicator ... 2-10-35 ...01
Fuel Temperature Sensor ... 2-10-35 ...02
Electrical Fuel-Filter Impending-Bypass Indicator ... 2-10-35 ...02
Magnetic Indicating Plug ... 2-10-35 ...02
Igniter Spark-Rate Detector ... 2-10-35 ...02
Vibration Sensors ... 2-10-35 ...02
Fuel Flowmeter ... 2-10-35 ...02

Powerplant Control System ... 2-10-40 ...01
Full Authority Digital Electronic Control (FADEC) ... 2-10-40 ...01
N1TARGET Calculation ... 2-10-40 ...04
N1REQUEST Calculation ... 2-10-40 ...04
Ground/Flight Idle Thrust Schedule ... 2-10-40 ...05
Closed-Loop Fan Speed Control ... 2-10-40 ...05
N1/N2 Overspeed/Underspeed Protection ... 2-10-40 ...06
Interstage-Turbine Temperature (ITT) Limiting ... 2-10-40 ...06
Acceleration/Deceleration Limiting ... 2-10-40 ...06
Flameout Detection/Autorelight ... 2-10-40 ...07
N1 Reversionary Control Mode ... 2-10-40 ...07
FADEC Inputs Selection and Fault Accommodation ... 2-10-40 ...07
FADEC Discrete Outputs ... 2-10-40 ...08
Alternate FADEC Selection ... 2-10-40 ...08
FADEC Reset ... 2-10-40 ...08

Engine Operation ... 2-10-50 ...01
General ... 2-10-50 ...01
Engine Control ... 2-10-50 ...01
Thrust Ratings ... 2-10-50 ...02
Thrust Management ... 2-10-50 ...03
Thrust Mode Selection ... 2-10-50 ...03
Alternate Takeoff Thrust Control System ... 2-10-50 . 08
Fan-Speed Scheduling ... 2-10-50 ...11
Takeoff Data Setting ... 2-10-50 ...14
Engine Start ... 2-10-50 ...16
Engine Dry Motoring ... 2-10-50 ...17
Engine Shutdown ... 2-10-50 ...18
EICAS Messages ... 2-10-50 ...19

Controls and Indicators ... 2-10-60 ...01
Control Pedestal ... 2-10-60 ...01
Powerplant Control Panel ... 2-10-60 ...03

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44



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Fire Handle ..... 2-10-60 ... 05
Engine Indication on EICAS ..... 2-10-60 ... 05
Takeoff Page on MFD ..... 2-10-60 ... 10
First Engine Backup Page on RMU ..... 2-10-60 ... 12
Thrust Reverser (*) ..... 2-10-70 ... 01
General ..... 2-10-70 ... 01
Lock Protection ..... 2-10-70 ... 01
Operation ..... 2-10-70 ... 01
Operation Logic ..... 2-10-70 ... 02
EICAS Indication ..... 2-10-70 ... 02
Thrust Reverser Interlock ..... 2-10-70 ... 03
EICAS Messages ..... 2-10-70 ... 03

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**NOTE:** Optional equipment are marked with an asterisk (*) and its description may not be present in this manual.



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# GENERAL

The airplane is powered by two fuselage-mounted Rolls-Royce turbofan engines. Engine denominations, thrust (installed, static sea level) and flat rates are as follows:

| ENGINE | MODEL | MAX. T/O THRUST | FLAT RATE |
|---|---|---|---|
| AE3007A | EMB-145 | 7426 lb | ISA+15°C |
| AE3007A1/1 | EMB-145 | 7426 lb | ISA+15°C |
| AE3007A1 | EMB-145 | 7426 lb | ISA+30°C |
| AE3007A1P | EMB-145 | 8169 lb | ISA+19°C |
| AE3007A1E | EMB-145 | 8810 lb | ISA+19°C |
| AE3007A3 | EMB-135 | 7057 lb | ISA+15°C |
| AE3007A1/3 | EMB-135 | 7426 lb | ISA+30°C |

**NOTE: -** Max T/O thrust and flat rate values for AE3007A1P and AE3007A1/3 are based on T/O RSV thrust.
- Max T/O thrust and flat rate values for AE3007A1E are based on E T/O RSV thrust.

The AE3007 is a high bypass ratio, two-spool axial flow turbofan engine. The main design features include:

- A single stage fan,
- A 14-stage axial-flow compressor with inlet guide vanes and five variable-geometry stator stages,
- A 2-stage high pressure turbine to drive the compressor,
- A 3-stage low pressure turbine to drive the fan,
- Dual, redundant, Full Authority Digital Electronic Controls (FADEC),
- Accessory gearbox,
- Air system for aircraft pressurization and engine starting.

Each engine is controlled by redundant FADECs. The FADECs also provide information to the EICAS, although some parameters signals are provided directly from engine sensors. All powerplant parameters are indicated on the EICAS, which also provides warning, caution and advisory messages.

The cockpit control stand incorporates two thrust levers, one for each engine, and four buttons for engine thrust rating selection.

Controls for ignition, FADEC, takeoff data setting, takeoff rating selection and engine Start/Stop are located on the overhead panel.

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# MAIN ASSEMBLIES

## FAN MODULE

Air enters the engine through the fan case inlet and is compressed by a 24-blade, single-stage fan. The compressed air is split into a bypass stream, which bypasses the core through the outer bypass duct, and a core stream that enters the high-pressure compressor.

## HIGH-PRESSURE COMPRESSOR

The compressor rotor consists of 14 stages of individual wheel assemblies, compressor shaft, compressor-to-turbine shaft, and compressor tiebolt. Compressor Variable Geometry (CVG) stators are provided for stages 1 through 5 and for the inlet guide vanes. These stators are driven by servo actuators controlled by the FADECs. High-pressure compressor bleed air tappings are available at the $9^{th}$ and $14^{th}$ stages (compressor discharge).
A combustion liner assembly mixes air and fuel to support combustion, and delivers a uniform, high-temperature gas flow to the turbine.

## HIGH-PRESSURE TURBINE (HPT)

The High Pressure Turbine converts the gas flow coming from the combustion liner into usable mechanical energy to drive the compressor.

## LOW-PRESSURE TURBINE (LPT)

The Low-Pressure Turbine is located downstream of the High-Pressure Turbine and extracts energy from the gas path to drive the fan. The LPT is connected to the fan by means of a shaft extending through the entire high-pressure spool and the compressor assembly. Air exiting the LPT mixes with the bypass air and provides thrust.

## EXHAUST CONE AND MIXER

The forced air mixer provides the mixing for the engine bypass and core gas-flow streams and sets the fan operating line for all operating envelope conditions. The Thrust Reversers deflect the exhaust providing reverse thrust.

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## ACCESSORY GEARBOX

An accessory gearbox is driven by the high-pressure spool and provides driving pads for the following engine and airplane accessories:

- Engine accessories: Fuel Pump and Metering Unit (FPMU), Permanent Magnet Alternator (PMA), and oil pump.
- Airplane accessories: hydraulic pump, electrical generators, and pneumatic starter.

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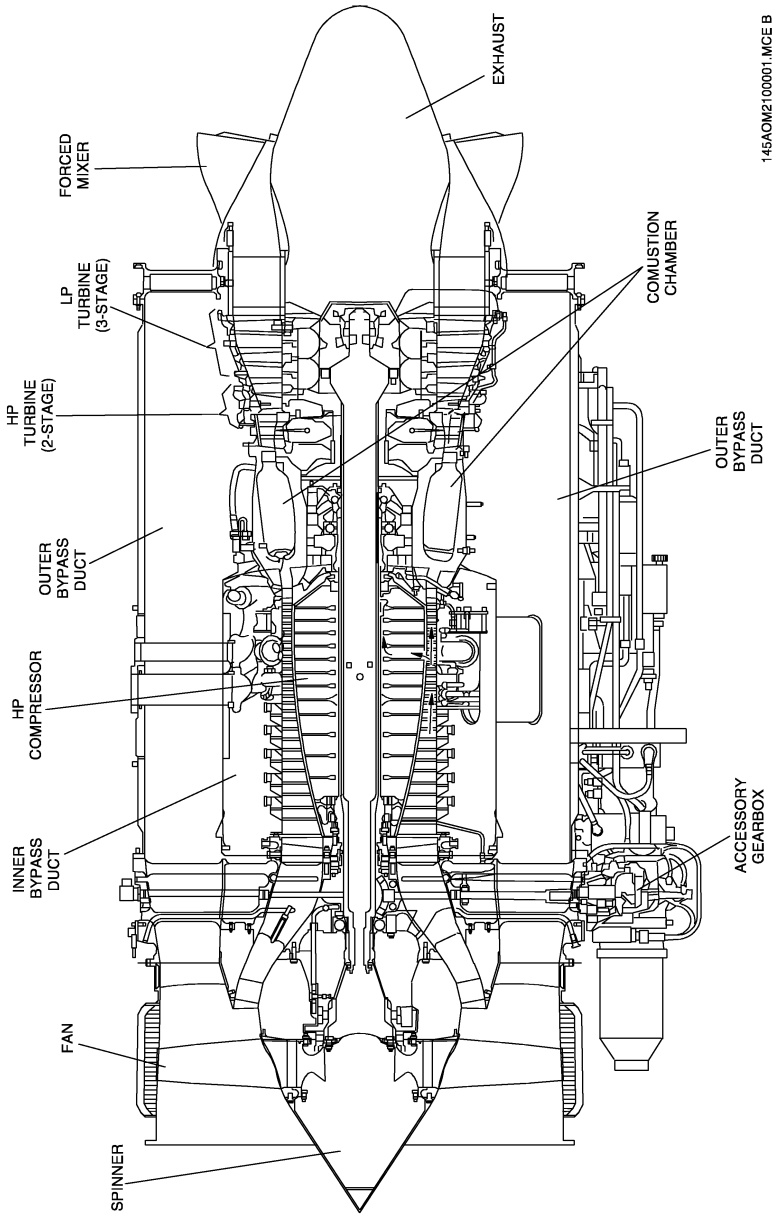


**ROLLS-ROYCE AE 3007 ENGINE**

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# ENGINE FUEL SYSTEM

The Engine Fuel System has a distribution and an indicating system. The distribution system supplies filtered and metered fuel for combustion. Secondary functions include providing pressurized fuel to activate the Compressor Variable Geometry (CVG) system, and providing a cooling medium for lubrication oil. The indicating system components monitor the fuel supply and are located on the engines.

The engine fuel system comprises a Fuel Pump and Metering Unit (FPMU), a Fuel Cooled Oil Cooler (FCOC), a Compressor Variable Geometry (CVG) actuator and fuel nozzles.

## FUEL PUMP AND METERING UNIT (FPMU)

The FPMU is an electrical-mechanical, fully-integrated line replaceable unit which incorporates the engine fuel pumping, filtering, and metering functions, and operates under authority of the engine FADECs. The FPMU controls and supplies fuel to the engine nozzles at correct pressure and flow rate for engine start, correct engine operation, engine stop, and also controls the compressor variable-geometry vanes.

The pump system contains a low-pressure centrifugal pump and a high-pressure gear pump. The centrifugal pump raises the pressure of incoming fuel high enough to meet the inlet pressure requirements of the high-pressure pump, with allowances for pressure losses in the fuel filter and the FCOC. The centrifugal pump also provides vapor-free fuel to the gear pump.

The main fuel filter, located upstream of the gear pump, protects the pump metering unit components and fuel nozzles from fuel contaminants. A fuel flow bypass valve allows continued operation in the event of complete filter blockage.

A fuel flow pressure relief valve across the pump protects the fuel system from overpressure conditions.

An air vent valve provides automatic venting of entrapped air or fuel vapor at the gear pump discharge during engine starting and/or motoring. The vent valve remains closed whenever the vent solenoid is not energized, thus preventing fuel leakage through the vent system if the airplane boost pumps are turned on while the engine is not running.

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The fuel-metering valve is controlled by the FADEC and controls fuel distribution from the gear pump to the engine fuel nozzles.

Downstream of the metering valve, a pressurizing valve (PRV) generates adequate system pressure for the proper functioning of the main metering valve and pressure drop servos and CVG hydraulic actuator. The PRV also provides the primary means for engine fuel shutoff, commanded through the Latching Shutoff Valve, that receives a Stop input from the cockpit through the FADEC.

## FUEL-COOLED OIL COOLER (FCOC)

The FCOC is installed externally on the bottom of the outer bypass duct, aft region. Fuel flows from the FPMU's centrifugal pump to the FCOC where it simultaneously cools the engine's lubrication oil and warms the fuel. A thermal/pressure bypass valve bypasses oil flow to prevent fuel leaving the FCOC from being heated above 93.3°C (200°F). The oil is also bypassed if the differential oil pressure is greater than 50 psi due to hung or cold starts. After the FCOC, the fuel goes to the filter.

## COMPRESSOR VARIABLE GEOMETRY (CVG) ACTUATION SYSTEM

The high-pressure compressor has a variable geometry vane system on its five stages to provide maximum engine performance over a wide range of engine speeds. The FADEC contains a schedule of vane positions versus corrected gas generator speed (N2) that has been selected to provide the optimum compressor efficiency of steady-state conditions and adequate stall margins during transients.

The FADEC senses the vane position and, by means of fuel pressure from the FPMU, commands the CVG actuator movement to position the compressor-inlet guide vanes and the first five rows of compressor vanes to the desired setting.

## FUEL NOZZLES

Each engine has 16 fuel nozzles, that furnish atomized fuel to the combustor at the proper spray angle and pattern, for varying airflow conditions.

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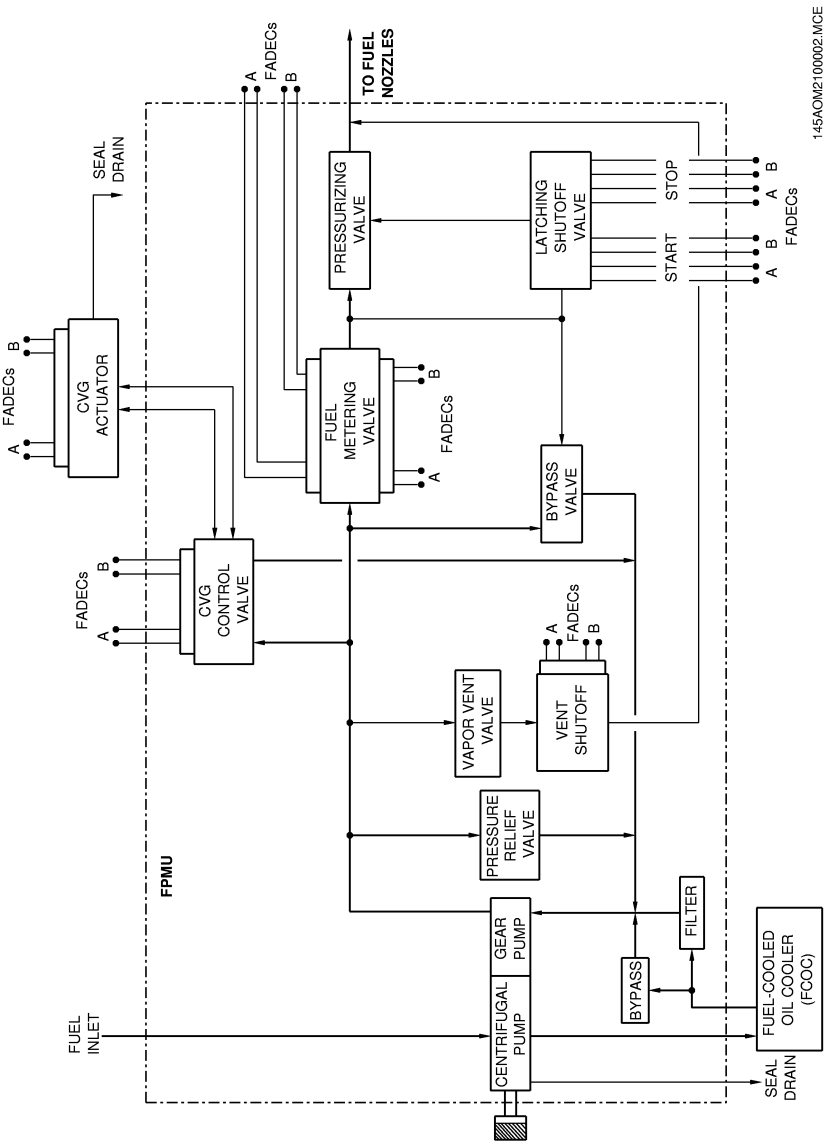


## ENGINE FUEL SYSTEM SCHEMATIC

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# LUBRICATION SYSTEM

The engine lubrication system is a self-contained, pressure-regulated and recirculating dry sump system. The system supplies filtered and pressurized oil to the various engine oil coolers, engine sumps and the accessories gearbox, at the proper temperature, to cool and lubricate the bearings, seals, and gear meshes.

The main subsystems of the oil system are: lubricating oil-supply, engine sumps, lubricating oil scavenge and lubricating oil vent.

## LUBRICATING OIL-SUPPLY SYSTEM

Oil is supplied to the lube and scavenge pump from a pressurized oil tank and is pumped through an oil filter. The oil is then cooled while passing through two heat exchangers (ACOC and FCOC). Oil pressure is controlled by a pressure-regulating valve in the pump housing. A tank pressurizing valve maintains positive pressure in the oil tank to ensure an adequate oil supply to the lube and scavenge pump, and proper oil pressure at altitude. A separate Tank Vent Valve protects the tank from over-pressurization. Oil to the accessory gearbox is distributed through cast passages to the various gear meshes and bearings. Pressurized oil is divided inside the front frame and routed to the fan and front sumps. An external tube delivers oil from the front frame to the compressor diffuser and the rear turbine-bearing support.

The main components of this subsystem are as follows: oil tank, lube and scavenge pump, oil filter unit, air-cooled oil cooler (ACOC) and fuel-cooled oil cooler (FCOC).

### OIL TANK

The oil tank is designed to store a sufficient amount of oil (12 quarts) for lubrication of the engine and the accessory gearbox. The tank has an oil level sight gage and an oil level/low level warning sensor. These sensors allow the oil level to be continuously read remotely, and includes a switch that is actuated when there are 5 quarts or less of usable oil remaining in the tank. A screen on the oil outlet and a chip collector plug at the tank bottom are protective devices that prevent debris from recirculating. The tank is protected from over-pressurization by the externally vented Pressure Relief Valve.

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## LUBE AND SCAVENGE PUMP

The pressure and scavenge pumps are all mounted in a single integral unit. A single shaft drives six pumping elements. One pressure pumping element pumps oil from the tank to the system and five scavenge pumping elements pump oil from the sumps and the gearbox to the oil tank. The pump assembly also includes a pressure regulating valve which controls oil pressure. Main Oil Pressures varies with center sump air pressure. A line connecting one side of the regulating valve to the center sump enables the regulating valve to compensate for the air pressure inside the sump.

## OIL FILTER UNIT

The filter unit includes a replaceable filter element, and mechanical and electrical impending-bypass indicators. A bypass valve opens and allows oil to bypass the filter during cold starts, or when the filter becomes excessively contaminated. A screen is located in the bypass inlet to prevent passage of particles. The electrical impending-bypass indicator provides the remote monitoring of the system.

## AIR-COOLED OIL COOLER (ACOC)

The ACOC is a surface-type heat exchanger with a single plate-fin oil section. Filtered, pressurized oil enters a manifold and flows through the air-cooled heat exchanger. A thermal/pressure bypass valve senses ACOC outlet temperature. When open, this valve allows cold oil to bypass the ACOC and, once closed, forces hot oil to flow through the cooler. The bypass valve also opens if the cooler is obstructed.

## FUEL-COOLED OIL COOLER (FCOC)

The FCOC is a heat exchanger that simultaneously cools the engine lubrication oil and warms the fuel upstream of the FPMU filter. A thermal/pressure bypass valve prevents fuel overheat. This valve also opens in case of cooler obstruction or cold starts.

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## ENGINE SUMPS

There are four engine sumps that encompass five main-shaft bearings, four bevel-gear bearings, and six carbon seals. These sumps are as follows: fan sump, front sump, center sump and aft sump.

## LUBRICATING OIL SCAVENGE SYSTEM

Air and oil are removed from each of the sumps and directed to individual scavenge inlets on the oil pump. The scavenge section of the pump includes five pumping elements and has separate inlets for each of the engine sumps and the accessory gearbox. Each of the sump inlets to the pump includes a debris monitor with magnetic chip collector and screen in order to protect the pumping elements. The gearbox sump inlet to the pump contains only a screen.

## LUBRICATING OIL VENT SYSTEM

All the engine sumps are vented to the accessory gearbox. The oil tank also vents to the gearbox through a core-external line that contains a tank-pressurizing valve. A Tank Vent Valve is located upstream of the pressurizing valve and is vented to the atmosphere.
The gearbox acts as an air/oil separator removing any oil contained in the vent air. The air vented by the gearbox breather is conducted through a transfer tube and dumped to the core exhaust.

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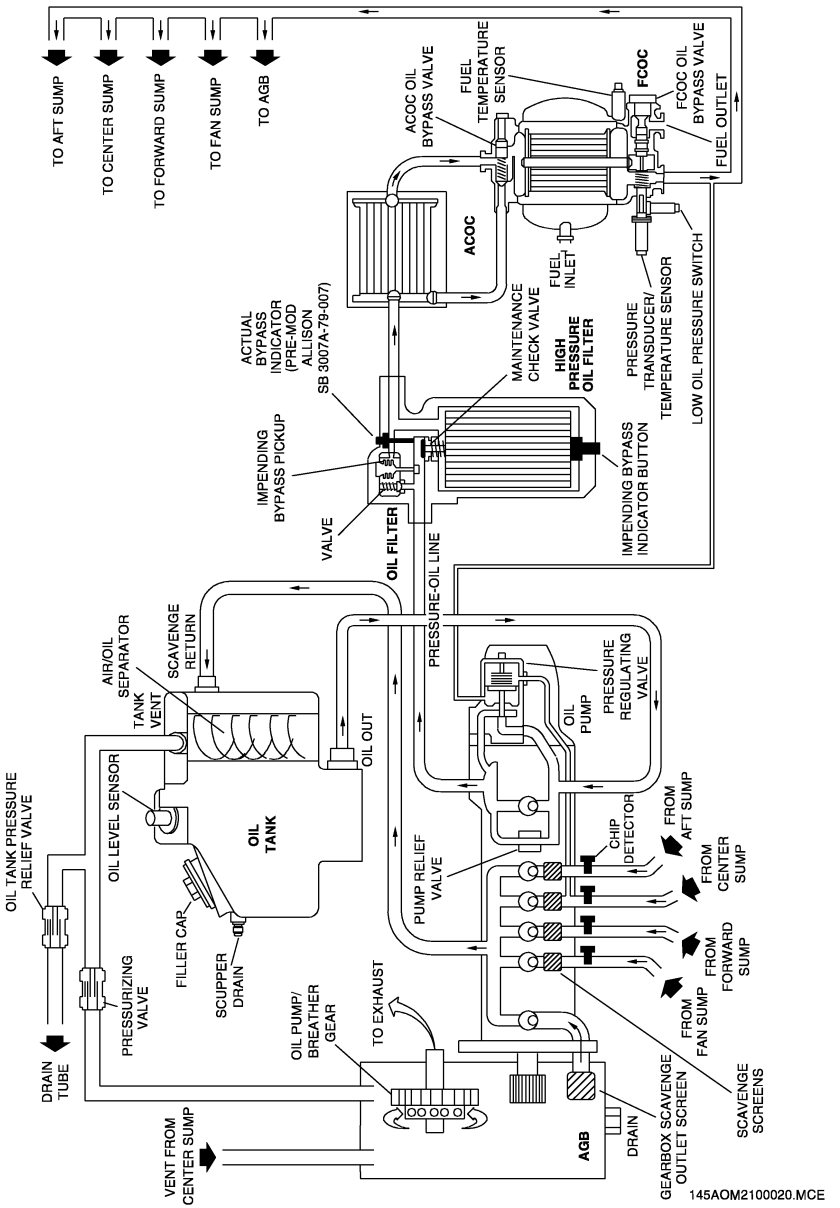


## LUBRICATION SYSTEM SCHEMATIC

# ENGINE BLEED

Air is bled from the compressor 9th stage during engine starting to assist with accelerating to idle rpm.

There are two different types of compressor acceleration bleed valves (CABV). The original type used two valves per engine, located externally on the HP compressor at approximately the 12:00 and 6:00 O'clock positions. The second type is a single valve at 6:00 O'clock position.

The engine also provides bleed air to the Pressurization and Air Conditioning system through the Engine Bleed Valve (EBV). Bleed air for this system is extracted from the 9th or 14th stages depending on the request. Refer to section 2-14-05 for more information.

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# ENGINE ELECTRICAL SYSTEM

## ELECTRICAL POWER SOURCES

Primary electrical power for engine control and the ignition system is provided by a permanent magnet alternator (PMA) that is driven by the engine accessory gearbox. Before the PMA attains sufficient speed to generate electrical power, the airplane 28 V DC system is used to power the FADEC. Aircraft 28 V DC is also used to energize a fail-safe ignition relay, so that in the event of aircraft power loss the ignition is turned on and the air vent valve is closed, thus preventing fuel leakage through the vent port.
The PMA is the only source of power for the igniters. If a PMA failure occurs there will not be any spark from the igniters.

## PERMANENT MAGNET ALTERNATOR (PMA)

The PMA provides electrical power for both engine FADECs and to the redundant ignition systems.
The PMA provides sufficient power to drive the ignition system at all speeds above 10% N2, and powers the FADECs at a minimum of 50% N2. The PMA also provides power to the Thrust Rating Mode Buttons, in case of electrical emergency.
For starting and emergency backup, the engine control system requires aircraft supplied 28 V DC (GPU and/or batteries) power.

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# IGNITION SYSTEM

The engine has a dual redundant ignition system composed of two ignition exciters, two high-tension igniter leads and two igniters.

The ignition system is turned on by the FADEC during engine starting cycle or when an engine flameout condition is detected (auto-relight).

Each ignition exciter is controlled by a separate FADEC and powered by a separate electrical winding of the PMA.

Continuous ignition or ignition off can be manually selected through the Ignition Selector Knob, located on the Powerplant Control Panel and connected to the FADECs. Ignition control is performed according to Ignition Selector Knob position, as follows:

- Ignition Selector Knob set to ON:
  - Both FADECs command associated ignition channel during start, as soon as the PMA provides sufficient power.
  - The ignition is not automatically deactivated when the start cycle is completed.
  - If the engine is already running, both FADECs activate their ignition channels.
- Ignition Selector Knob set to AUTO:
  - During ground start, only the FADEC in control activates the ignition system at the proper time. The engine start will be performed with only one exciter. The exciters will be alternately selected for each subsequent ground start.
  - The FADEC deactivates the ignition system when the engine starting cycle is completed.
  - The auto-relight function activates the ignition system.

**NOTE:** Engines with FADEC B8 software version or later may not turn off igniters during on-ground deceleration to IDLE.

- Ignition Selector Knob set to OFF:
  - If the engine is not running, the FADEC neither activates the ignition system nor actuates the engine fuel valve from closed to open position.
  - If the engine is already running, at least in IDLE thrust, the FADEC does not close the engine fuel valve.

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# PNEUMATIC STARTING SYSTEM

The engine starting system comprises the Air Turbine Starter and the Starting Control Valve. The starting system has the function of supplying airflow for pneumatic engine starting, converting the pneumatic energy into gearbox driving torque.

Pneumatic power source can be selected from the APU, ground air supply source, or cross bleed from the opposite engine.

## AIR TURBINE STARTER (ATS)

The ATS is installed in a dedicated engine accessory gearbox pad and consists basically of an air inlet, an impeller turbine, a reduction gearset, a clutch, and an output shaft.

The ATS converts pneumatic energy into driving torque for engine gas generator spool acceleration up to the self-sustained speed during the starting cycle. The air exhaust from the turbine is discharged into the engine nacelle compartment.

## STARTING CONTROL VALVE (SCV)

The SCV regulates the pressure supplied to the ATS and provides isolation from the pneumatic system following start completion. The valve is electrically controlled and pneumatically actuated.

A SCV visual position indication is available on the valve housing.

A manual override adapter is available on the valve housing, enabling engine start in the case of a valve or associated electrical system failure. The valve is spring-loaded to the closed position.

If the ATS shutoff valve remains open after 53% N2, a caution message is presented on the EICAS.

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## STARTING BY USING GROUND EQUIPMENT

The system is pressurized by pneumatic ground equipment connected to start the engine 2.

The SCV energizes to open when a starting switch ground signal energizes the engine 2 start relay.

When the engine gas generator attains 53% N2, a validation time of 10 seconds elapses before the message “E2 ATS SOV OPN” appears on the EICAS. At 56.4% N2 the FADEC sends a signal to engine 2 start relay be de-energized, thus the SCV is also de-energized and the airflow stops flowing to the ATS turbine. In normal operation conditions, 56.4% N2 is reached in less than 10 seconds.

The ATS turbine stops operating and the engine gas generator speed increases.

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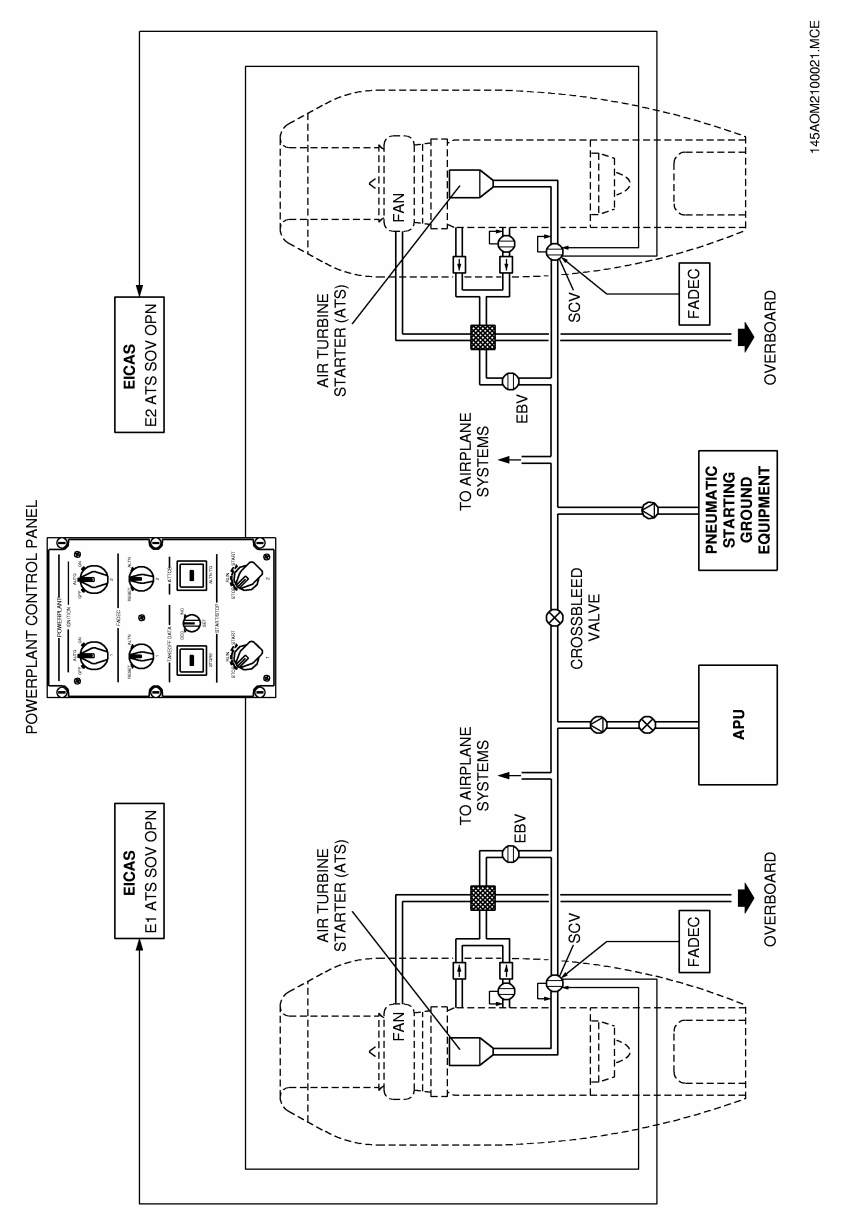


**PNEUMATIC STARTING SYSTEM SCHEMATIC**

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# ENGINE INDICATING SYSTEM (EIS)

The EIS is composed of a wiring harness and a set of engine-mounted sensors. This system is directly connected to the EICAS, providing real time monitoring of the engine oil, fuel, and mechanical systems.

## ENGINE SENSORS

### PRESSURE/TEMPERATURE TRANSDUCER SENSOR

This sensor combines engine oil and temperature transducers in a single housing, mounted on the Fuel-Cooled Oil Cooler (FCOC). The pressure and temperature transducers are electrically independent and require separate signal conditioning.
Due to the characteristic of some pressure sensors, the EICAS may display approximately 90 psi for a 2 minutes period, for actual pressures between 90.5 and 155 psi. Considering this characteristic, pressure indication may jump suddenly from approximately 90 psi to the actual pressure value, after the 2 minutes period is expired.

### LOW OIL-PRESSURE SENSOR

The function of the low oil-pressure sensor is to give an indication when oil pressure is low. This sensor is also mounted on the FCOC. A warning message is presented on the EICAS in case of low oil pressure.

### OIL-LEVEL AND LOW-LEVEL SENSOR

The engine oil-level sensor is a transducer located in the oil tank that gives continuous and accurate oil level readings from 3 quarts to 12 quarts. The low-level sensor is electrically open with 5 quarts or less of oil remaining in the tank and remains closed otherwise. An indication of oil-level is provided on the Takeoff page on the MFD. The indication turns amber when oil level is at 5 quarts or below.

### ELECTRICAL OIL-FILTER IMPENDING-BYPASS INDICATOR

The engine electrical oil-filter impending-bypass indicator is located in the oil-filter assembly. An advisory message is presented on the EICAS if the differential pressure across the oil filter exceeds its set point.

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## FUEL TEMPERATURE SENSOR

The engine fuel-temperature sensor has an indication range of -54° to 176°C (-65° to 350°F) and is located on the FCOC. A caution message is presented on the EICAS in case of fuel low temperature (below 5°C in the engine).

## ELECTRICAL FUEL-FILTER IMPENDING-BYPASS INDICATOR

The engine electrical fuel-filter impending-bypass indicator is located on the engine fuel pump and metering unit (FPMU). An advisory message is presented on the EICAS if the differential pressure across the filter exceeds its set point.

## MAGNETIC INDICATING PLUG

The magnetic indicating plug is located in the oil tank. The magnetic plug contacts are normally open and are electrically closed when conductive material bridges the gap between them.

## IGNITER SPARK-RATE DETECTOR

The engine igniter spark-rate detectors are outputs from the ignition exciters that indicate that an electric field has collapsed in the exciter circuit. A signal is available for each igniter circuit on the engine.

## VIBRATION SENSORS

The engine vibration sensors are accelerometers that detect abnormal fan rotor and turbine rotor vibration. The transducers are connected through the engine wiring harness to the EICAS.

## FUEL FLOWMETER

The fuel flowmeter is a turbine, mass flow sensor. A given fuel flow through the sensor causes the turbine to move to a calibrated position, providing a specific voltage output to the Data Acquisition Unit (DAU). The DAU converts the voltage signal from the sensor into a flow-rate value (pounds or kilograms per hour) for cockpit display. The fuel flowmeter is calibrated for a range between 130 to 4300 pph. During some starts, fuel flow may drop to values out of the flowmeter range. In this case a zero fuel flow will be displayed on EICAS for a few seconds.

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# POWERPLANT CONTROL SYSTEM

Each AE 3007A engine series features a dual redundant electronic control system. The main components of the powerplant control system are the Full Authority Digital Electronic Controls (FADECs), the FPMU, the Permanent Magnetic Alternator (PMA), the Control Pedestal and the Powerplant Control Panel.

Thrust management logic schedules a corrected fan speed (N1) based on a signal from the ADC and cockpit, sending it to engine control logic, which controls the engine fuel flow and compressor variable geometry (CVG) to attain the required engine steady-state and transient response.

Engine control logic also incorporates engine protection logic that prevents engine damage attributable to excessive rotor speed at all times, and temperature limits after the engine has completed a start.

## FULL AUTHORITY DIGITAL ELECTRONIC CONTROL (FADEC)

Each engine is controlled by one of two FADECs that are named FADEC A and FADEC B. All signals between each FADEC and its respective engine and between the FADECs and the airplane are completely redundant and isolated. This allows either A or B FADEC to control the engine independently.

The FADECs are interconnected by dedicated Cross-Channel Data Links. These buses are used to transmit engine data and FADEC status between the two FADECs.

Each FADEC is connected to one of the two FADECs on the opposite engine via data bus. Across this bus, the FADECs communicate the information necessary to implement thrust reverser interlock and Automatic Takeoff Thrust Control System (ATTCS).

Airplane electrical power is fed to the FADEC for engine start as a sole power source until N2 is approximately 50%. Primary electrical power source for each FADEC is generated by a dedicated set of windings in the permanent magnet alternator (PMA). The airplane power source is fed the FADEC as a backup in the event of a failure in the PMA. In the event of total loss of airplane power the pilot would control the engine normally.

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Each FADEC receives command signals from the Control Pedestal and from the Powerplant Control Panel and sends a command signal to the FPMU, which meters the fuel flow to the engine in order to reach the fan spool speed calculated by the FADEC thrust management section.

Both FADECs alternate powerplant control. While one FADEC controls the powerplant, the other remains in standby mode. The standby FADEC monitors all inputs, performs all computations, and performs built-in-test and fault detection. However, the output drivers (fuel flow and CVG control), that command the engine, are powered off.

The active FADEC is alternated at each engine ground start in order to minimize the probability of latent failure within the powerplant control system/airplane interface.

The selection logic resides within the FADECs that memorize which FADEC was used for the last engine start and commands the other one to perform the next start, regardless of which FADEC is used in flight.

For example: If FADEC B was used for the last start, when the pilot actuates the next start, the selection logic will select FADEC A, as shown in the following table:

| Start | In flight (alternated) | Following start |
|---|---|---|
| FADEC A | FADEC B or A | FADEC B |
| FADEC B | FADEC A or B | FADEC A |

For FADEC B9.4.1 and on, besides the automatic FADEC change on each engine ground start, the FADECs are also automatically reset and alternated after the engine start.

Transfer from active FADEC to standby FADEC may also be accomplished automatically, in response to a detected fault, or manually, through the FADEC Selector Knob, located on the overhead panel. The manual selection overrides the automatic selection of the controlling FADEC unless the manually selected FADEC is not capable of safely controlling the engine.

If a fault condition is detected in the engine sensor, actuator interface, or airplane interface of the controlling FADEC, it will maintain control by using data borrowed from the standby FADEC. If required data is not available, the controlling FADEC will use default data or switch to reversionary control mode.

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Control will be transferred to the standby FADEC only when the controlling FADEC detects a fault that will result in degraded engine operation or will render it unable to control the engine.

All measured powerplant control parameters, control system faults and status information are presented on the EICAS.

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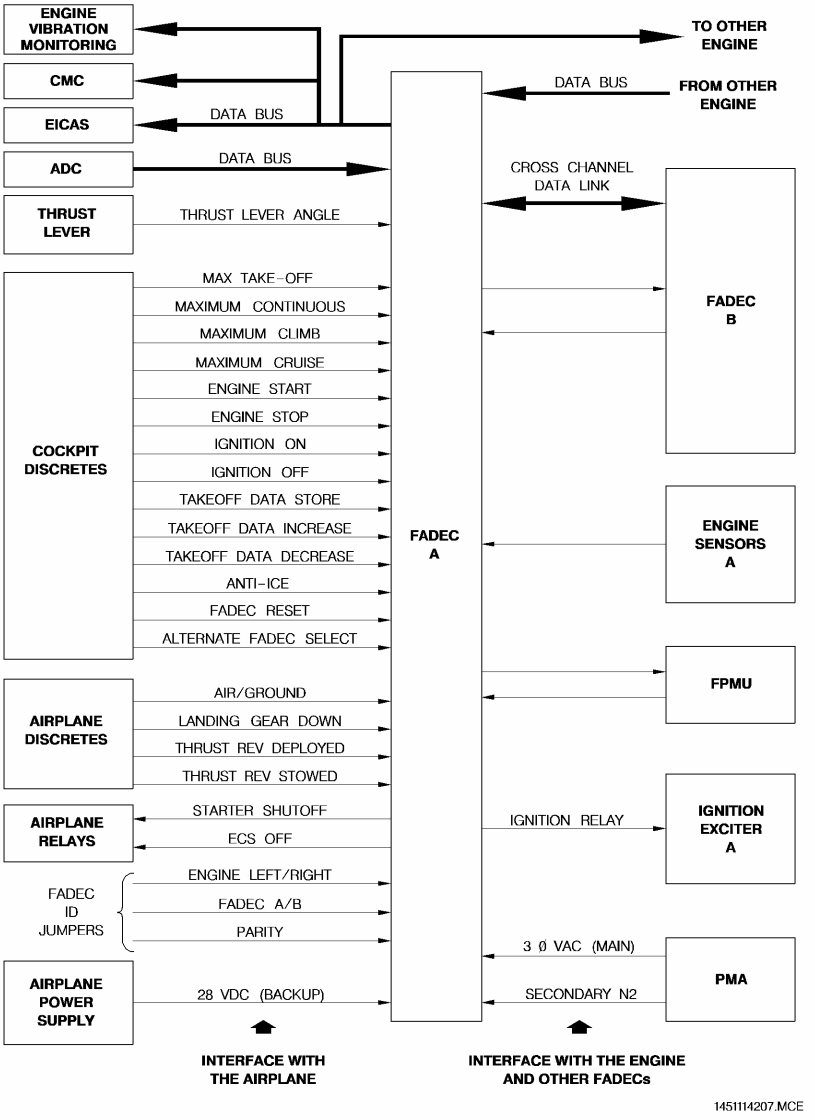


## FADEC SCHEMATIC

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## N1TARGET CALCULATION

The FADEC calculates the maximum available engine thrust for a given thrust rating mode, airspeed and ambient conditions, and bleed air configuration. Maximum thrust corresponds to N1TARGET displayed on the EICAS as a cyan bug on the N1 analogic indicator arc.

When the Thrust Lever is set to the THRUST SET position, the FADEC controls the engine at N1TARGET.

In normal mode (with no ADC faults) the following data are used as primary reference for the N1TARGET calculation:

- Pressure Altitude and Mach Number reference from ADCs.
- Temperature references (REF TO TEMP during takeoff and ADC TAT in flight).
- A-ICE condition (REF A-ICE during takeoff and actual A-ICE system feedback in flight).
- Takeoff mode.

## N1REQUEST CALCULATION

The N1REQUEST is a function of N1TARGET and Thrust Lever Angle. The FADEC controls the engine to N1REQUEST at steady state, except if the thrust lever is at Ground Idle position. In this case, the engine is controlled according to the Ground Idle N2 schedule. N1REQUEST is shown as a green bug on the N1 analogic indication arc on the EICAS.

The following table presents the main Thrust Lever positions, corresponding Thrust Lever Angle bands, and N1REQUEST for ground operation.

| POSITION | TLA | N1REQUEST |
|---|---|---|
| MAX REVERSE | 0 to 4° | N1REV |
| MIN REVERSE | 14° to 22° | N1IDLE |
| IDLE | 22° to 28° | N1IDLE |
| THRUST SET | 72° to 78° | N1TARGET |
| MAX THRUST | Above 78° | N1TARGET |

N1REV is the N1 value for MAX REVERSE thrust.

Each thrust lever modulates engine thrust linearly between IDLE and THRUST SET position. There is no thrust modulation between IDLE and MIN REVERSE.

N1REQUEST is shown as a green bug on the N1 analogic indication arc on the EICAS.

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## GROUND/FLIGHT IDLE THRUST SCHEDULE

There is only one IDLE position on the thrust lever control pedestal. However, there are two different IDLE ratings (ground and flight Idle), set as a function of the Air/Ground input to the FADEC:

– GROUND IDLE SPEED
During ground operations, the FADEC commands the engine to Ground Idle Speed, which is scheduled in order to:

- Avoid engine flameout, overtemperature or inability to accelerate.
- Provide the required air bleed flow pressure and temperature for the ECS.
- Provide the required gas generator speed to drive the accessories.

Ground Idle Speed is scheduled as a function of ambient temperature.

– FLIGHT IDLE THRUST
In flight operation, the FADEC will command the engine to Flight Idle Thrust, which is scheduled in order to:

- Avoid engine flameout, overtemperature or inability to accelerate.
- Provide the required bleed airflow pressure and temperature for the ECS and for the Anti-Icing System. If the FADECs receive an indication that the anti-icing system is on, Flight Idle thrust is rescheduled in order to provide the required air bleed flow, pressure and temperature. This automatic A-ICE Flight Idle rescheduling is inhibited below 15000 ft if the landing gear is down and locked.
- Enable the FADEC to accelerate the engine from Flight Idle Thrust to 100% of the Go-around thrust mode in 8 seconds or less, at or below 9500 ft.

## CLOSED-LOOP FAN SPEED CONTROL

The primary control mode of the engine is closed-loop fan speed control. The fan speed requested by thrust lever is compared to the measured fan speed. An error signal proportional to the difference between the request and measured fan speed is used to adjust the commanded fuel flow to the engine to drive the fan speed error to zero.

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## N1/N2 OVERSPEED/UNDERSPEED PROTECTION

The FADEC limits fuel flow to prevent the excessive rotor speed on both the low-pressure rotor (N1) and the high-pressure rotor (N2). If the fuel flow commanded by the closed-loop results in the surpassing of established rotor speed limits, fuel flow will be limited to that value which will result in rotor speed limit.

The FADEC also incorporates a logic to initiate an engine shutdown if the upper limits of N1 and N2 are exceeded, in order to avoid a potentially destructive overspeed condition.

For FADEC 9.4 and on, there is also a logic to shutdown the engine in case the fan shaft breaks between the N1 sensor and the LP turbine. This prevents undetected overspeed.

Logic within the FADEC incorporates a high-pressure rotor (N2) underspeed shutdown. This logic prevents damaging the turbine via an overtemperature condition if the engine attempts to operate at sub-idle speed. If N2 drops below 54% the FADEC will command a shutdown.

The maximum steady-state rotor speeds are 100% N1 and 102.5% N2 (103.7% N2 for A1E engines). There is no minimum N1 speed.

## INTERSTAGE-TURBINE TEMPERATURE (ITT) LIMITING

The FADEC has provisions for limiting engine fuel flow to prevent exceeding ITT limits. If the fuel flow commanded by the closed-loop fan speed control exceeds established ITT limits, the FADEC will limit the fuel flow to that value that will result in operation within the ITT limit.

## ACCELERATION/DECELERATION LIMITING

Acceleration and deceleration limits within the FADEC logic restrict the rate of commanded engine fuel flow to prevent surge during acceleration or lean blow out during deceleration.

For FADEC 9.4 and on, with Thrust Levers angle equal to or below idle, on ground the engine will be automatically shutdown in case an Uncontrollable High Thrust is detected.

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## FLAMEOUT DETECTION/AUTORELIGHT

Flameout and autorelight detection logic within the FADEC detects an engine flameout and attempts an automatic relight before the engine loses power, if N2 is higher than 53%. In the event that a relight cannot be successfully executed, the FADEC commands an engine shutdown.

During in-flight restarts, both ignition systems are energized.

## N1 REVERSIONARY CONTROL MODE

The FADEC provides a reversionary control mode to accommodate a total loss of fan-speed (N1) signal.

The FADEC stores data on the correlation between N1 and N2 of an average engine in its non-volatile memory, and in the event that all N1 signals are lost, it will control thrust governing N2 speed.

The engine control system is capable of modulating thrust in response to thrust lever movement in the reversionary control mode. However, transient response times may be greater, minimum thrust may exceed flight idle thrust and maximum thrust may be less than that expected during normal control operation.

This mode is evident to the pilot due to the absence of N1 indication on the EICAS.

## FADEC INPUTS SELECTION AND FAULT ACCOMMODATION

For every FADEC input, there is a selection and fault accommodation logic, based on the inputs to both FADECs of the same engine.

The engine control system is highly fault tolerant. Because of redundant sensor inputs and outputs, the control system can accommodate multiple faults with no degradation in engine response. The fault accommodation philosophy is to maintain operation on the controlling FADEC for as long as possible before transferring control to the standby FADEC.

For every detectable fault, the FADEC provides a signal to the EICAS for the alerting message or to the Central Maintenance Computer for the maintenance message.

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## FADEC DISCRETE OUTPUTS

Each FADEC provides two discrete output signals, as follows:

- N2 Speed Switch - Each FADEC activates a discrete output whenever the engine is assumed to be running, based on N2. This signal is activated whenever N2 reaches (accelerating) 56.4% and is deactivated whenever N2 drops below 53%.
- ECS OFF signal.

## ALTERNATE FADEC SELECTION

AUTOMATIC SELECTION

- Whenever the FADEC in control is unable to safely control the engine, it signals the alternate FADEC to automatically take over engine control.

MANUAL SELECTION

- The alternate FADEC may be manually selected to control the engine, by momentarily setting the FADEC Control Knob, located on the overhead panel, in the ALTN position.

The FADEC that is in control (A or B) is indicated on the EICAS.

## FADEC RESET

The FADEC may be reset through the FADEC Control Knob. Upon receiving the FADEC Control Knob input, the FADEC clears recorded inactive faults (faults not currently being detected).

In case any fault persists after the RESET command, it is not cleared.

Reset does not mean electrical power interruption to the FADEC.

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# ENGINE OPERATION

## GENERAL

The Rolls-Royce AE 3007 engine uses an electronic control system based on two Full Authority Digital Electronic Controls (FADECs) that control the engine. These FADECs interface with the engine, airframe, and flight deck. A complete description of the engine control system was presented in the previous chapter.

## ENGINE CONTROL

The engine control system controls the operation of the engine throughout its operating envelope. The system modulates the fuel flow rate to the engine and the position of the variable geometry vanes (CVG) in response to inputs from the airplane's sensors and measurements of engine operating conditions. The engine control system will not command a fuel flow that would result in exceeding rotor speed or temperature operating limits.

The engine control system is designed in such a manner that a single electrical failure will not cause significant thrust changes, result in an uncommanded engine shutdown or prevent a commanded engine shutdown. In case of loss of both FADECs, the engine control system will shut off fuel flow and move the CVGs to the closed position.

The engine control system performs two categories of functions: thrust management and engine control. Thrust management logic interfaces with the airframe and schedules a corrected thrust based on air data and cockpit inputs. The fan speed request is passed to the engine control logic, which controls the engine fuel flow and Compressor Variable Geometry (CVG) in response to the measured parameters in order to attain the required engine response.

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# THRUST RATINGS

The engine control system schedules the corrected fan speed as a function of pressure altitude, Mach number, ambient temperature, anti-ice system condition, thrust mode, and thrust lever angle to achieve the rated thrust conditions.

Thrust ratings modes for AE 3007 engines are:

| Thrust ratings | Applicability | | | | | Selectable | ATTCS ** |
|---|---|---|---|---|---|---|---|
| | A, A1/1, A3 | A1 | A1P | A1/3 | A1E | | |
| Alternate Takeoff-1 | Yes | | | | | ALT T/O-1* | T/O-1* |
| Maximum Takeoff-1 | Yes | Yes | - | - | - | T/O-1* | T/O-1* |
| Takeoff | - | - | Yes | Yes | Yes | T/O* | T/O RSV* |
| E Takeoff | - | - | - | - | Yes | E T/O* | E T/O RSV* |
| Takeoff Reserve | - | - | Yes | Yes | Yes | - | T/O RSV* |
| E Takeoff Reserve | - | - | - | - | Yes | - | E T/O RSV* |
| Maximum Continuous | Yes | | | | | CON | - |
| Maximum Climb | Yes | | | | | CLB | - |
| E Maximum Cllimb | - | - | - | - | Yes | E CLB | - |
| Maximum Cruise | Yes | | | | | CRZ | - |

(*) Restricted to 5 minutes

(**) For A1E engines, E T/O RSV and T/O RSV modes are not intended for normal operation. Their use must be recorded in the maintenance logbook or be tracked by use of engine health monitoring.

For the respective takeoff rating, altitude, and Mach-number condition, fan speed is controlled to maintain constant thrust at any given ambient temperature below the flat-rated ambient temperature.

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# THRUST MANAGEMENT

This section of the FADEC software is responsible for functions directly involved in the required thrust computation and management logic.
Thrust management logic is provided to reduce flight crew workload and enhance the airplane's operation.
Thrust management functions are as follows: thrust mode selection, fan speed (N1) scheduling, Automatic Takeoff Thrust Control (ATTCS), Takeoff Data Setting (TDS), and thrust reverser interlock.

## THRUST MODE SELECTION

Thrust logic management includes several thrust-rating modes that are controlled through associated buttons on the cockpit, set during the takeoff data setting procedure, automatically triggered by the ATTCS or by advancing the Thrust Lever Angle (TLA) above the THRUST SET position.
Thrust-rating mode defines the available engine thrust at the existing ambient conditions.

The following thrust modes are available:

ALTERNATE TAKEOFF (ALT T/O-1)

- All engines:
  This mode is the normal all engines operating takeoff mode and is available only through the use of the Takeoff Data Setting procedure.
  Selection of this mode ensures the best engine durability and economy of operation. In this mode the ATTCS is active, so that T/O-1 mode is triggered in case of engine failure.

MAXIMUM TAKEOFF-1 (T/O-1)

- A, A1, A1/1 and A3 engines:
  This mode is the maximum, all engines operating takeoff mode. For engine durability and economy of operation, this mode should only be selected when ALT T/O-1 is not authorized. The engine will produce the maximum rated thrust for the existing ambient conditions in T/O-1 mode. This mode is automatically selected when ATTCS is triggered during operation in ALT T/O-1 mode. T/O-1 is automatically selected at FADEC power up and at the initiation of the Takeoff Data Setting procedure. T/O-1 is also automatically selected in flight below or descending through 15000 ft provided the landing gear is down and locked.

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T/O-1 is selected if there is weight on wheels, the TLA is at 50° or less and the T/O thrust-rating button is pushed. This mode is also selected if both engines do not agree on the thrust mode or when the thrust mode of the remote engine cannot be determined. Besides, this mode is selected when the T/O thrust-rating button is pushed and the pressure altitude is greater than 1700 ft above takeoff. The T/O-1 mode is automatically selected whenever the TLA is advanced above the THRUST SET position regardless of the mode previously selected. ATTCS is not active in this mode.

- A1P and A1/3 engines:
  This is the One Engine Inoperative (OEI) mode for the normal, all engines operating, ALT T/O-1 mode. In addition to being selected by an ATTCS trigger, it may also be selected from ALT T/O-1 mode, at or below 1700 ft above takeoff pressure altitude, by pushing the T/O thrust-rating button. It is not a normal pilot selectable takeoff mode.

- A1E engine:
  This is the One Engine Inoperative (OEI) mode for the normal, all engines operating, ALT T/O-1 mode. The FADECs will select T/O-1 mode if the T/O switch is pressed and the current mode is ALT T/O-1 during takeoff phase, if the ATTCS is triggered and the current mode is ALT T/O-1 or if the thrust lever is moved beyond THRUST SET position and the current mode is ALT T/O-1.

TAKEOFF (T/O)

- A1P and A1/3 engines:
  This mode is the maximum, all engines operating takeoff mode. For engine durability and economy of operation, this mode should only be selected when ALT T/O-1 is not authorized.
  ATTCS is active in this mode, so that ATTCS triggers upon detection of an engine failure, commanding a thrust increase to T/O RSV mode. The T/O mode is automatically selected at FADEC power up, and at the initialization of the Takeoff Data Setting procedure. T/O is also automatically selected in flight below or descending through 15000 ft provided the landing gear is down and locked. T/O is selected if there is weight on wheels, the TLA is at 50° or less and the T/O thrust-rating button is pushed. This mode is also selected when the T/O thrust-rating button is pushed and the pressure altitude is greater than 1700 ft above takeoff altitude.

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– A1E engine:
This is a medium thrust level, selectable through the Takeoff Data Setting procedure, for all engines operating. For engine durability and economy this mode should be selected if conditions do not permit use of ALT T/O-1 but do not require E T/O mode.

EXTENDED TAKEOFF (E T/O)

– A1E engine:
This mode is the highest level, all engines operating, takeoff mode. For engine durability and economy of operation, this mode should only be selected when T/O mode is not authorized. In case of engine failure the ATTCS triggers the E T/O RSV mode. The E T/O is automatically selected at FADEC power-up and also at initiation of the Takeoff Data Setting procedure. E T/O is also automatically selected in flight, at or below 15000 ft, when the landing gear down and locked is received by the FADECs on both engines. This mode is also selected when the T/O button is pushed and the pressure altitude is greater than 1700 ft above takeoff altitude. The FADECs will select E T/O mode if the T/O switch is pressed after takeoff phase, if the T/O switch is pressed and the current mode is T/O-1 or if the thrust lever is moved beyond THRUST SET position in flight or after takeoff phase.

TAKEOFF RESERVE (T/O RSV)

– A1P and A1/3 engines:
This mode is the corresponding OEI mode for all engines operating in T/O mode. The engine will produce the maximum rated thrust for the existing ambient conditions in this mode. T/O RSV is automatically selected when ATTCS is triggered during operation in T/O mode. T/O RSV is also selected if both engines do not agree on the thrust mode or when the thrust mode of the remote engine cannot be determined. This mode will also be selected from the T/O mode, at or below 1700 ft above takeoff altitude, when the T/O thrust-rating button is pushed.

**NOTE:** T/O RSV is manually selected by advancing one or both TLA above THRUST SET position, regardless of any mode previously selected.

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– A1E engine:
This is the corresponding OEI mode for all engines operating in T/O mode. This mode is accessible through a FADEC command in response to an ATTCS triggering event. The FADECs will select T/O RSV mode if the T/O switch is pressed and the current mode is T/O during takeoff phase, if the ATTCS is triggered and the current mode is T/O or if the thrust lever is moved beyond THRUST SET position and the current mode is T/O. This mode is also accessible by pressing the takeoff button while in T/O and the airplane is in post takeoff condition or on the ground.

**NOTE:** The use of this mode requires a notation in the airplane maintenance log.

EXTENDED TAKEOFF RESERVE (E T/O RSV):

– A1E engine:
This mode is the corresponding OEI mode for all engines operating in E T/O mode. E T/O RSV is automatically selected when ATTCS is triggered during operation in the E T/O mode. The FADECs will select E T/O RSV mode if the T/O switch is pressed and the current mode is E T/O or T/O RSV during takeoff phase, if the ATTCS is triggered and the current mode is E T/O, if the thrust lever is moved beyond THRUST SET position and the current mode is E T/O or if the thrust lever is moved beyond the THRUST SET position and the takeoff button is pressed.

**NOTE:** Use of this mode requires a notation in the airplane maintenance log.

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MAXIMUM CONTINUOUS (CON)

– All engines:
This mode is selected by pushing the CON push button. CON mode is available when the pressure altitude is greater than 300 ft above takeoff altitude and there is no landing gear down and locked, or when the pressure altitude is greater than 1700 ft above takeoff altitude. The CON mode switch inputs to the FADECs are inhibited on ground.

MAXIMUM CLIMB (CLB)

– All engines:
This mode is selected by pushing the CLB push button. CLB mode is enabled when the pressure altitude is greater than 500 ft above takeoff altitude, there is no landing gear down and locked signal and there is no OEI signal, or when pressure altitude is greater than 1700 ft above takeoff altitude and there is no OEI signal. The CLB mode switch inputs to the FADECs are inhibited on ground. For A1E engines CLB is the default mode when T/O or ALT T/O-1 is selected for takeoff.

EXTENDED CLIMB (E CLB)

– A1E engine:
This mode is enabled under the same CLB conditions described above. However, E CLB is the default mode when E T/O is selected. Pressing the CLB button while in CLB mode toggles the climb thrust to E CLB and vice-versa.

MAXIMUM CRUISE (CRZ)

– All engines:
This mode is selected by pushing the CRZ push button. CRZ mode is enabled when the pressure altitude is greater than 500 ft above takeoff altitude, there is no landing gear down and locked signal, and there is no OEI signal, or when pressure altitude is greater than 1700 ft above takeoff altitude and there is no OEI signal.

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## ALTERNATE TAKEOFF THRUST CONTROL SYSTEM

During a takeoff, if an engine failure is detected, the ATTCS automatically resets thrust on the remaining engine from Alternate Takeoff thrust to Maximum Takeoff thrust. In addition, depending on takeoff thrust setting and ambient conditions, the FADECs generate an ECS OFF signal to close the Pack Valves. (Refer to ECU operation on Section 2-14). The conditions to arm, trigger, or disarm the ATTCS are described as follows.

ATTCS ARMING CONDITIONS

ATTCS is armed when:

- Both engines are ATTCS capable,
- Associated thrust lever angle is equal to or higher than 45°.

**NOTE:** ATTCS capable is defined as E T/O (A1E engine), T/O (A1P, A1/3 or A1E engines) or ALT T/O-1 (all engines) mode selected, with the airplane on ground and the engine running.

ATTCS TRIGGERING CONDITIONS

After being armed, the ATTCS is triggered under any of the following conditions:

- The thrust lever for the opposite engine is reduced to below 38° TLA.
- Either FADEC for the on-side engine receives an opposite engine or on-side engine inoperative condition, or a Thrust Lever Angle limited to idle signal.
- The opposite engine does not indicate ATTCS being armed, within 2 seconds after the on-side engine ATTCS has armed.
- The opposite engine disarms ATTCS and the on-side engine does not disarm within 2 seconds.

If ATTCS is armed and either FADEC A or B detects an opposite engine inoperative condition, the controlling FADEC commands the on-side engine to a higher takeoff thrust, as shown in the following table:

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| Engines | Takeoff Selection Two Engines Operation | ATTCS Triggered One Engine Operation |
|---|---|---|
| A, A1, A1/1, A3 | ALT T/O-1 | T/O-1 |
| A1P, A1/3 | ALT T/O-1 | T/O-1 |
| | T/O | T/O RSV |
| A1E | ALT T/O-1 | T/O-1 |
| | T/O | T/O RSV |
| | E T/O | E T/O RSV |

ATTCS DISARMING CONDITIONS

The ATTCS disarms if any of the following conditions is met:

- After being armed, the Thrust Lever Angle is reduced below 42°.
- ATTCS is triggered on either engine.
- No ATTCS capable takeoff mode is selected.

**NOTE:** If thrust lever is moved beyond the THRUST SET position the FADEC automatically commands the engine to the maximum available thrust (T/O-1 mode for A, A1/1, A1 and A3 engines, or T/O RSV mode for A1/3 and A1P engines), disregarding the takeoff mode selected, except for A1E engine (see A1E engine Thrust Mode Selection section).

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## AE3007A1E THRUST MODE SELECTION

Thrust mode selection on A1E engines is a bit more complex than on the other engines. The following tables illustrate how the thrust modes can be selected by pressing the T/O button, by advancing Thrust Levers above THRUST SET, or by the ATTCS.

ADVANCING THRUST LEVERS ABOVE THRUST SET POSITION

| **Thrust Lever Angle above Thrust Set (TLA>78°) ATTCS NOT triggered** | | |
|---|---|---|
| **Current Mode** | **During takeoff phase** | **Post takeoff phase** |
| ALT T/O-1 | T/O-1 | E T/O |
| T/O | T/O RSV | E T/O |
| E T/O | E T/O RSV | E T/O |
| CON, CLB, E CLB CRZ | - | E T/O |
| T/O-1 (1) | T/O-1 | E T/O |
| T/O RSV (1) | T/O RSV | E T/O RSV |
| E T/O RSV (1) | E T/O RSV | E T/O RSV |

(1) If the ATTCS is not triggered, these three modes are only accessible by pressing the T/O button after selecting normal engine takeoff modes through the Takeoff Data Setting procedure.

THE ATTCS

| **Thrust Lever Angle above Thrust Set (TLA>78°) ATTCS triggered** | | | **TLA>78° and T/O button pressed** |
|---|---|---|---|
| **Current Mode** | **After ATTCS trigger** | **TLA > 78°** | |
| ALT T/O-1 | T/O-1 | T/O-1 | E T/O RSV |
| T/O | T/O RSV | T/O RSV | E T/O RSV |
| E T/O | E T/O RSV | E T/O RSV | E T/O RSV |

Pushing the T/O Button with the Thrust Lever above Thrust Set will select E T/O RSV mode regardless of the current takeoff mode or flight phase.

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PRESSING TAKEOFF BUTTON

| Current Mode | During takeoff phase (1) | Post takeoff phase |
|---|---|---|
| ALT T/O-1 | T/O-1 | E T/O |
| T/O-1 | E T/O | E T/O |
| T/O | T/O RSV | E T/O (2) |
| T/O RSV | E T/O RSV | E T/O (3) |
| E T/O | E T/O RSV | E T/O (3) |

(1) Takeoff phase is configured when altitude is less than 1700 ft above takeoff altitude, five minutes or less time has been elapsed since thrust set selection for takeoff and current thrust mode is one of the takeoff modes.

(2) T/O RSV to E T/O is a thrust decrease.

(3) If current thrust is E T/O RSV, flight altitude is between 1700 ft above takeoff altitude and 15000 ft and the takeoff button is pressed, thrust will decrease to E T/O.

**FAN-SPEED SCHEDULING**

The thrust management logic calculates the corrected fan-speed request at any point in the flight envelope. The scheduled, corrected fan speed is computed as a function of pressure altitude, Mach number, air temperature and other airplane signals.

The thrust lever quadrant has five significant thrust positions defined as:

| Thrust Lever Position | Thrust Level Angle |
|---|---|
| Maximum Reverse | 0-4° |
| Minimum reverse | 14-22° |
| Idle | 22-28° |
| Thrust Set | 72-78° |
| Maximum Thrust | 78-85° |

Maximum reverse and maximum thrust are defined by mechanical stops at either extremes of the thrust lever movement. Idle is defined by a mechanical gate that must be lifted to allow the trust lever to transition from forward flight to the reverse flight region. The THRUST SET position on the thrust lever is delineated by a detent at 75°. For any given pressure altitude, Mach number and air temperature the

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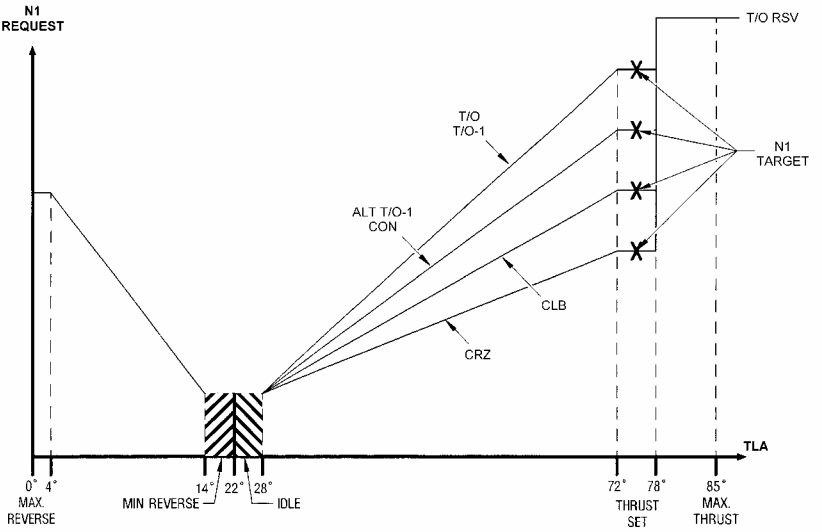
FADEC computes a corrected fan speed corresponding to the thrust lever position. The fan speed computed for the thrust lever position is dependent upon the selectable thrust mode. The Target Thrust (N1 Target) is defined as the thrust corresponding to the corrected fan speed scheduled with the thrust lever at the THRUST SET position. A target thrust is computed for each thrust mode. Flight idle thrust corresponds to the corrected fan speed with the TL at the idle position and is independent of the thrust mode. The FADEC schedules thecorrected fan speed as a function of the thrust lever angle and the thrust mode to result in the following linear relationships:




**A1P and A1/3 Engines**

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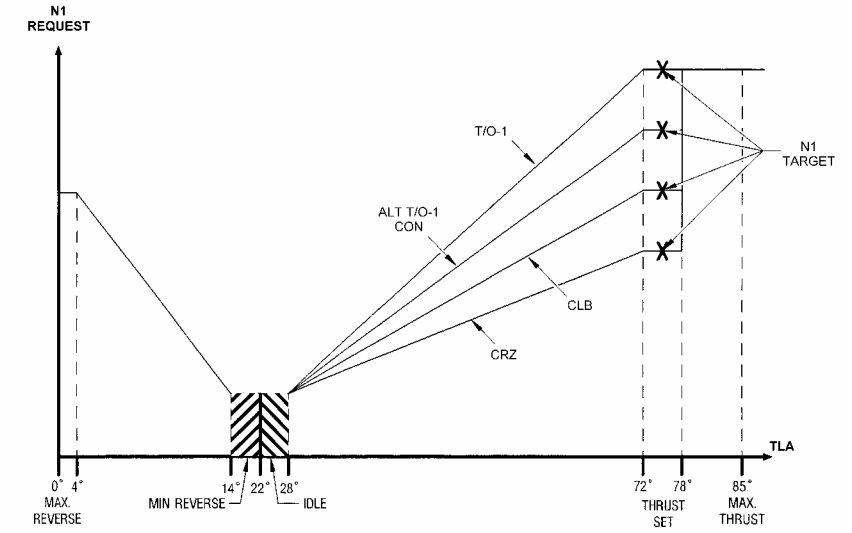


**A, A1, A1/1 and A3 Engines**

Any movement of the thrust levers above the THRUST SET position results in the scheduling of the maximum takeoff thrust, regardless of the current thrust mode, except for A1E engines (refer to A1E Thrust Mode Selection). A thrust lever position below the idle gate schedules reverse thrust provided such action is enabled by the thrust reverser interlock logic.

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## TAKEOFF DATA SETTING

The Takeoff Data Setting function is provided in order to enable the pilot to input reference data into the FADEC prior to takeoff. Such data will be used to calculate N1TARGET during takeoff. The following data has to be input:

- Takeoff Mode (T/O MODE), which corresponds to:
  - T/O-1 or ALT T/O-1 (A, A1/1, A1 or A3 engines).
  - T/O or ALT T/O-1 (A1P or A1/3 engines).
  - E T/O, T/O or ALT T/O-1 (A1E engine).
- Reference Takeoff Temperature (REF TO TEMP), which shall correspond to the Static Air Temperature (SAT) on the ground provided by the Air Traffic Control Tower, ATIS (Automatic Terminal Information Service) or other accurate source.
- Reference Takeoff Anti-Ice Condition (REF A-ICE), which is the anti-ice system condition (ON/OFF) that the FADEC will consider to calculate N1TARGET.

This function is enabled during ground operations only and with thrust lever angle below 50°, before or after engine start.

The takeoff data setting is performed through the Takeoff Data Setting controls (STORE button and SET control) on the overhead panel.

After selecting the takeoff page on the MFD, The Takeoff Data Setting procedure shall be as follows:

a) After the first pressing of the STORE button, the MFD indicates the following initial values for the three takeoff data:

- T/O MODE: T/O-1 for A, A1, A1/1 and A3 engines;
  T/O for A1P or A1/3 engines;
  E T/O for A1E engine.
- REF TO TEMP: T2SYN (if engine is running) or
  ISA Temperature (otherwise).

**NOTE: -** T2SYN is the synthesized total air temperature at the engine fan inlet.
- T2.5 is the fan discharge total air temperature.

- REF A-ICE: OFF.

An arrow points to T/O MODE line. Through the SET Control the takeoff mode ALT T/O-1 may be selected.

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b) At the second pressing of the STORE button, the arrow points to REF TO TEMP, indicating that this parameter may be adjusted. Through the SET control, the initial value may be adjusted to the required temperature. Each momentary command of the SET control will increase (INC) or decrease (DEC) the current value by 1°C. If the SET control is held at the command position for more than 1 second, the REF TO TEMP is changed by 5°C/sec.

**NOTE:** The acceptable REF TO TEMP value range is limited to T2SYN ± 10°C.

c) At the third pressing of the STORE button, the arrow points to REF A-ICE line, indicating that this parameter may be adjusted. Through the SET control, the initial condition (OFF) can be switched to ON and back to OFF alternately.

d) At the fourth pressing of the STORE button:

- If the engines are running and the REF TO TEMP is within limits (T2SYN ± 10°C):
  - The FADECs accept the takeoff data and successfully terminate the procedure.
  - The MFD displays the takeoff data.
  - The FADEC begins to calculate and display the N1TARGET based on the takeoff data.
- If the engines are not running, the adjusted takeoff data will remain displayed in amber color, which means that they have not been accepted yet. Then:
  - After engines start, if the adjusted REF TO TEMP is within limits, the FADECs accept the takeoff data and successfully terminate the procedure, the MFD displays the takeoff data, and the FADEC begins to calculate and display the N1TARGET based on the takeoff data.
  - Otherwise, the takeoff data will not be accepted by the FADECs and the MFD will display dashed lines for all takeoff data in amber color, and a caution message (ENG NO TO DATA) is presented on the EICAS if TLA > 45°.
  - In order to enter the correct takeoff data, the procedure must be started again, through the STORE button.

e) If, after takeoff data had been successfully entered, the pilot needs to correct any of them, the STORE button must be commanded again in order to restart the procedure.

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f) In case of disagreement between the REF A-ICE condition selected by the pilot and the actual Anti-Ice system condition, a caution message (ENG REF A/I DISAG) is displayed on the EICAS, provided the Parking Brake is released (OFF) or with any Thrust Lever Angle above 45°.

g) If any thrust lever is set to an angle above 45° before takeoff data successfully entered, a caution message (ENG NO TO DATA) is presented on the EICAS.

## ENGINE START

Engine start, commanded through the Start/Stop Knob, is automatically managed by the FADEC as follows:

- The FADECs A and B alternate as FADEC in control on every subsequent ground start. If the Ignition Selector Knob is set to AUTO position, a single ignition system, corresponding to the FADEC in control, will be used.
- The FADEC activates the ignition system when N2 is at approximately 14% and commands the fuel solenoid valve to open when N2 is at approximately 31.5% (28.5% for airplanes equipped with FADEC B7.4 and on) or 12 seconds after ignition is activated, if the Ignition Selector Knob is set to AUTO or ON position.
- Whenever the start cycle is completed, the FADEC deactivates the ignition system and provides a discrete signal to command the Starting Control Valve (SCV) to close.
- If the Ignition Selector Knob is set to OFF position, the FADEC neither activates the ignition system nor actuates the fuel valve from closed to open position, in order to enable ground/flight dry motoring.

  **NOTE:** If the engine is already running with TLA above IDLE thrust, the fuel valve is not closed, even if the Ignition Selector Knob is set to OFF position.

- When the engine is started on ground, only the FADEC in control commands ignition, if the Ignition Selector Knob is set to AUTO position. During an in flight start, both FADECs command ignition.

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- If a flameout is detected, the FADEC turns on the ignition system, provided the ignition switch is in the AUTO position, until the engine is restarted.
- During ground starts, the FADEC B7.5 and on monitors N2 speed start limit override. If the N2 speed exceeds 500 rpm, the FADEC starts a timer and if a successful start is not declared within 113 seconds (130 seconds for FADEC 9.4 and on), the FADEC commands an engine shutdown.

  **NOTE:** This is a backup protection only and does not preclude crew to monitor N2 and timely comply with Abnormal Engine Start procedure.

- During ground starts, the FADEC B8.0 and on provides two ways of over-temperature protection:
  - It limits ITT by controlling the engine fuel flow. While the FADEC is able to keep this limit, it is up to the pilot to determine how long the start attempt may continue.
  - In case the temperature limit is exceeded and the pilot does not take action to manually abort the start attempt, the FADEC shuts down the engine to minimize damage by over-temperature.

  **NOTE:** The FADEC auto-shutdown logic is a backup protection only. It does not preclude crew to monitor ITT and timely comply with Abnormal Engine Start procedure.

- During ground starts, the FADEC B9.4 and on will command a shutdown if no lightoff is detected after 30 seconds of fuel introduction.

**ENGINE DRY MOTORING**

An Engine Dry Motoring must be performed for at least 30 seconds after any aborted start to assure that no unburned fuel remains in the combustion chamber and/or to reduce residual ITT prior to attempting another start.

Ignition switch must be rotated to OFF position in order to disable ignition and fuel flow prior to rotating the Stop/Run/Start switch to the start position.

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## ENGINE SHUTDOWN

Normal engine shutdown, through the Start/Stop Knob, is managed by the FADEC, which commands the engine fuel solenoid valve to close. The normal sequence only occurs with the thrust levers positioned at Idle. Thrust levers should be positioned at IDLE before the Start/Stop Knob is positioned at Stop.

A shutdown sequence is also performed whenever N2 is below 54%.

**NOTE:** The Engine Fire Extinguishing Handle, when actuated, also shuts the engine down by closing the respective fuel shutoff valve, interrupting fuel supply from the wing tanks.

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# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | ENG 1-2 OUT | N2 has dropped below 8500 rpm on both engines (underspeed shutdown limit) uncommanded. |
| | ATTCS FAIL (if applicable) | ATTCS failure associated with a low N1. |
| | E1 (2) ATTCS NO MRGN | The engine has no ITT or N2 margin to achieve higher thrust if ATTCS is trigged. |
| | E1 (2) OIL LOW PRESS | Oil pressure has dropped below 34 psi and the engine is running or the pressure switch has failed at the closed position and the engine is not running. |
| | E1 (2) LOW N1 | Engine does not achieve requested N1. |
| CAUTION | E1 (2) FUEL LO TEMP | The fuel temperature in the engine has dropped below 5°C. |
| | E1 (2) ATS SOV OPN | The engine ATS shutoff valve (SCV) remained open above 53% N2. |
| | ENG REF A/I DISAG | Disagreement between the REF A-ICE condition selected by the pilot and the actual anti-icing system condition has been detected by the engine control associated with Parking Brake released (OFF) or with any TLA above 45°. |

(Continued)

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| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | E1 (2) CTL A (B) FAIL | A failure in the Engine control system has been detected. |
| | E1 (2) CTL FAIL (if applicable) | A failure in the Engine control system has been detected. |
| | ENG1 (2) TLA FAIL | Thrust Lever Angle sensor has failed. |
| | ENG NO TO DATA | Takeoff Data has not been successfully entered with engine running and above 53% N2. |
| | FADEC ID NO DISP (if applicable) | There are different FADEC applications installed in the airplane. |
| | ENG 1 (2) OUT (if applicable) | N2 has dropped below 8500 rpm (underspeed shutdown limit) uncommanded. |
| | E1(2) NO DISP (if applicable) | Associated FADEC has detected a non-dispatch failure condition. |
| | E1 (2) EXCEEDANCE (if applicable) | ITT or N2 exceeded the current ITT or N2 limit during an interval of the flight leg. |
| | E1 (2) FPMU NO DISP (if applicable) | An incompatible FPMU was installed on a A1E engine. |
| ADVISORY | E1 (2) OIL IMP BYP | The differential pressure across the oil filter has exceeded the normal range. |
| | E1 (2) FUEL IMP BYP | The differential pressure across the fuel filter has exceeded the normal range. |

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| TYPE | MESSAGE | MEANING |
|---|---|---|
| ADVISORY | E1 (2) ADC DATA FAIL | Loss of either ADC data or synthesized T2 used as temperature source. |
| | E1 (2) FADEC FAULT (if applicable) | A dispatchable MMEL FADEC fault was detected. |
| | E1 (2) CTL A (B) DEGRAD (if applicable) | A dispatchable MMEL FADEC fault was detected. |
| | E1 (2) SHORT DISP (if applicable) | A dispatchable MMEL FADEC fault was detected. |
| | CHECK XXX PERF (XXX=A, A1, A1/1, A1P, A3, A1/3, A1E) (if applicable) | Inform the FADEC application installed in the airplane. Displayed only on ground with flaps 0° and parking brakes applied. |

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# CONTROLS AND INDICATORS

## CONTROL PEDESTAL

### 1 - GUST LOCK LEVER

Limits thrust lever movement and locks the elevator control surfaces when set in LOCKED position.
Refer to Section 2-13 – Flight Controls.

### 2 - THRUST LEVER

MAX - Provides maximum takeoff thrust.

THRUST SET - Provides N1TARGET thrust setting.

IDLE - Provides ground and flight idle thrust settings.

MAX REV - Provides maximum reverse thrust.

**NOTE**: Protection against inadvertent thrust reverser command in flight is provided through the mechanical idle stop and the electrical flight idle stop.

### 3 - FRICTION LOCK

Rotated clockwise, thrust lever movement becomes progressively more resistant, so that thrust levers will not slip.

### 4 - THRUST RATING MODE buttons

T/O - Selects maximum takeoff thrust-rating mode.

CON - Selects maximum continuous thrust-rating mode.

CLB - Selects maximum climb thrust-rating mode.

CRZ - Selects maximum cruise thrust-rating mode.

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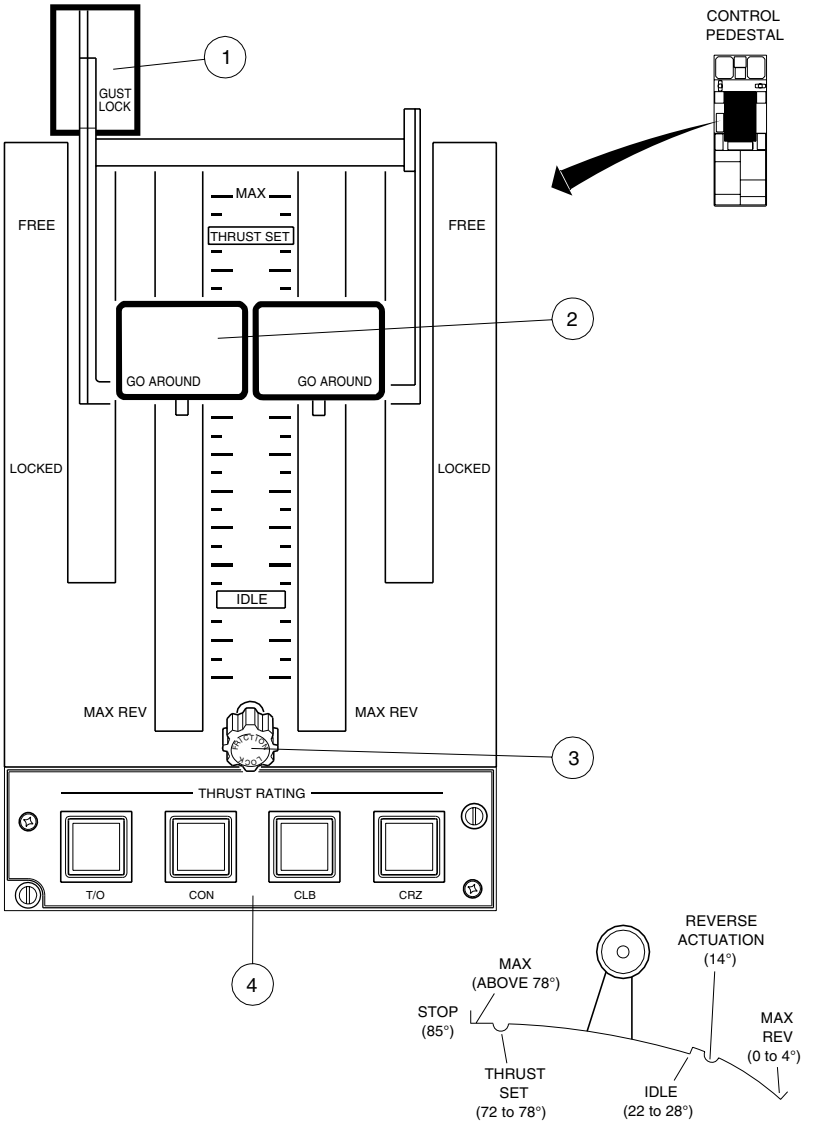


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## CONTROL PEDESTAL

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# POWERPLANT CONTROL PANEL

## 1 - IGNITION SELECTOR KNOB

OFF - Deenergizes the ignition system.

AUTO - FADECs control the ignition system automatically, depending on the engine requirement.

ON - Commands the FADEC to activate continuously the two ignition channels.

## 2 - FADEC CONTROL KNOB (SPRING-LOADED TO NEUTRAL)

RESET - Resets the FADECs, and clears faults.

ALTN - Alternates the FADEC in control.

**NOTE:** The knob becomes inoperative if held in any position for more than 3 seconds.

## 3 - TAKEOFF DATA STORE BUTTON

- Initiates and terminates takeoff data setting.
- At the first pressing, an arrow points to T/O MODE line.
- At the second pressing allows REF TO TEMP adjustment.
- At the third pressing allows REF A-ICE to be input.
- At the fourth pressing, if REF TO TEMP is within limits, the takeoff data is accepted and the procedure is successfully accomplished.
- For complete procedures refer to Takeoff Data Setting paragraph.

**NOTE:** The button becomes inoperative if held pressed for more than 3 seconds.

## 4 - TAKEOFF DATA SET CONTROL

- When turned, selects the T/O MODE, increases (INC) or decreases (DEC) the REF TO TEMP value and also switches the A-ICE condition state presented on the MFD during takeoff data setting.
- Momentary actuation changes the REF TO TEMP values by 1°C. If the control is held for more than 1 second at the INC or DEC position, REF TO TEMP is changed by 5°C/sec.
- The mode T/O-1 can be switched to ALT T/O-1 and back to T/O-1 alternately (A, A1, A1/1, and A3 engines).
- The mode T/O can be switched to ALT T/O-1 and back to T/O alternately (A1P and A1/3 engines).
- The modes E T/O, T/O or ALT T/O-1 can be switched alternately (A1E engine).
- The A-ICE initial condition (OFF) can be switched to ON and back to OFF alternately.

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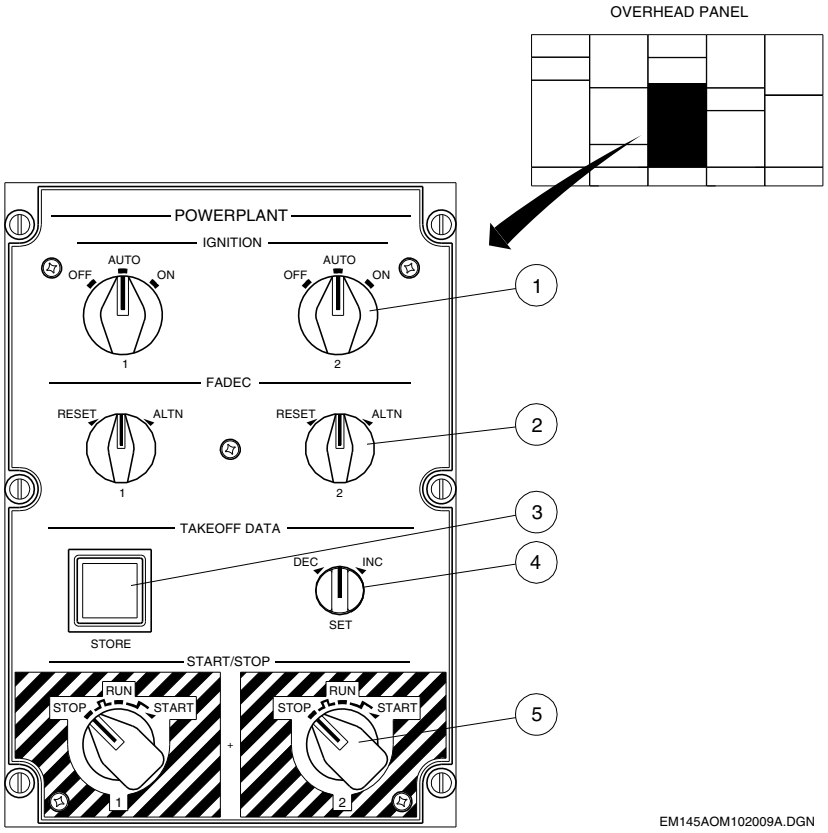
## 5 - START/STOP SELECTOR KNOB

STOP - Commands the FADEC to shut the engine down, provided associated Thrust Lever is at IDLE.

RUN - Allows normal engine operation.

START - This is a momentary position that initiates the engine start cycle.

**NOTE:** On airplanes Post-Mod. SB 145-71-0003 or S/N 145.075 and on, each Start/Stop selector knob is equipped with a transparent protection guard over the knob for better engine identification.




**POWERPLANT CONTROL PANEL**

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## FIRE HANDLE

The Fire Handle, located on the Fire Protection Control Panel, allows engine emergency shutdown. For further information on fire controls, refer to Section 2-07 – Fire Protection.

## ENGINE INDICATION ON EICAS

### 1 - N1 TARGET INDICATION

- Corresponds to the maximum available engine thrust for a given thrust-rating mode, airspeed, ambient condition, and bleed air status.
- Digits are cyan.
- Ranges from 0 to 100% RPM with a resolution of 0.1%.
- Indicated by a cyan T-shaped bug.
- Indication is removed from the display for request values greater than 100% or less than 0%.

### 2 - THRUST-RATING MODE ANNUNCIATION

- Indicates the current thrust-rating mode.
- Labels: T/O-1 or ALT T/O-1 (A, A1, A1/1, A3 engines);
  T/O or ALT T/O-1 (A1P or A1/3 engines);
  E T/O, T/O or ALT T/O-1 (A1E engine);
  CON, CLB, or CRZ.
- Color: cyan
- When engines operate in alternate takeoff mode a green ATTCS annunciation is presented below the takeoff label to indicate that the ATTCS system is armed.

### 3 - THRUST REVERSER ANNUNCIATION (OPTIONAL)

- Indicates the position of the upper and lower Thrust Reverser doors.
- Label: REV
- Color:
  - Fully open: green
  - In transition: amber (if applicable)

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## 4 - N1 INDICATION

- Displays N1 in RPM percentage.
- Scale:
  - Ranges from 0 to 100%. Extends up to 110% if exceeding the red line.
  - Colors: green from 0 to 99.9%
    red line at 99.9%
- Digits:
  - Ranges from 0 to 120% RPM, with a resolution of 0.1%.
  - Colors: green from 0 to 99.9%
    red at 100.0% and above

## 5 - FADEC IN CONTROL ANNUNCIATION

- Indicates the FADEC channel that is controlling the engine.
- Labels: A or B
- Color: green

## 6 - IGNITION CHANNEL ANNUNCIATION

- Indicates the ignition channel that is enabled.
- Labels: IGN A, IGN B, IGN AB, or IGN OFF
- Color: green

## 7 - INTERTURBINE TEMPERATURE INDICATION

- Scale:
  - During engine start:
    - green from 300 to 800°C
    - red line at 801°C
  - Takeoff mode:
    - green from to 921°C(A and A1/1 engines).
      from 300 to 947°C (A1/3, A1, A1P and A3 engines).
      from 300 to 992°C (A1E engine).
    - red line at 922°C (A and A1/1 engines).
      at 948°C (A1/3, A1, A1P and A3 engines).
      at 993°C (A1E engine).

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- CON, CLB and CRZ modes:
  - green: from 300 to 867°C (A and A1/1 engines).
    from 300 to 900°C (A1/3, A1, A1P and A3 engines).
    from 300 to 935°C (A1E engine).
  - amber: from 868 to 921°C (A and A1/1 engines).
    from 901 to 947°C (A1/3, A1, A1P and A3 engines).
    from 936 to 970°C (A1E engine).
  - red line at 922°C ( A and A1/1 engines ).
    at 948°C ( A1/3, A1, A1P and A3 engines).
    at 971°C (A1E engine).
  - If the red line is exceeded, the scale extends a further 50°C.
- Digits:
  - Ranges from -65 to 1999°C with a resolution of 1°C.
  - Color: corresponds to the color of the scale.

**8 - N2 INDICATION**

- Displays N2 in RPM percentage.
- Digits:
  - Ranges from 0 to 120% RPM with a resolution of 0.1%.
  - Colors:
    EICAS 18.5 and before:
    - green from 0 to 102.4%.
    - red from 102.5% and above.

    EICAS 19 and on with A1, A1/1, A3, A1/3, A1P engines:
    - green from 0 to 102.5%.
    - red from 102.6% and above.

    EICAS 19 and on with A1E engines:
    - green from 0 to 103.8%.
    - red from 103.9% and above.

**9 - FUEL FLOW INDICATION**

- Ranges from 0 to 2020 KPH (or 4450 PPH) with a resolution of 10 KPH (or 10 PPH).
- Color: green

**10 - LOW-PRESSURE AND HIGH-PRESSURE TURBINE VIBRATION INDICATION**

- Ranges from 0 to 2.5 inches per second (IPS).
- Low-pressure scale and pointer colors:
  - green from 0 to 1.8 IPS.
  - amber above 1.8 IPS.
- High-pressure scale and pointer colors:
  - green from 0 to 1.1 IPS.
  - amber above 1.1 IPS.

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**11 - OIL TEMPERATURE INDICATION**

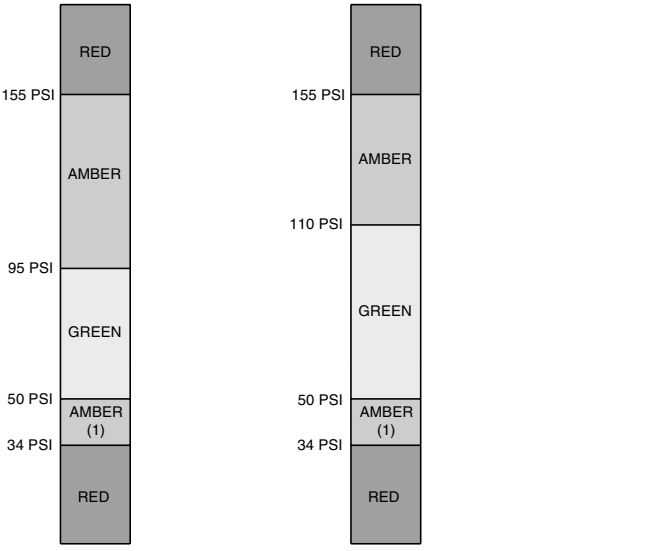
- Ranges from -54°C to 180°C with a resolution of 1°C.
- Scale, pointer, and digit colors:
  - amber below 21°C.
  - green from 21 to 126°C.
  - red above 126°C.

**12 - N1 REQUEST BUG**

- Indicates N1 requested by the Thrust Lever position.
- Indicated by a green filled triangle.
- Ranges from 0 to 100% RPM.
- Indication is removed from the display for request values greater than 100% or less than 0%.

**13 - OIL PRESSURE INDICATION**

Scale, pointer, and digit colors depend on the FADEC version as shown below:




(1) For N2 < 88% the amber band between 34 psi and 50 psi does not exist, and the green band lower limit is 34 psi.

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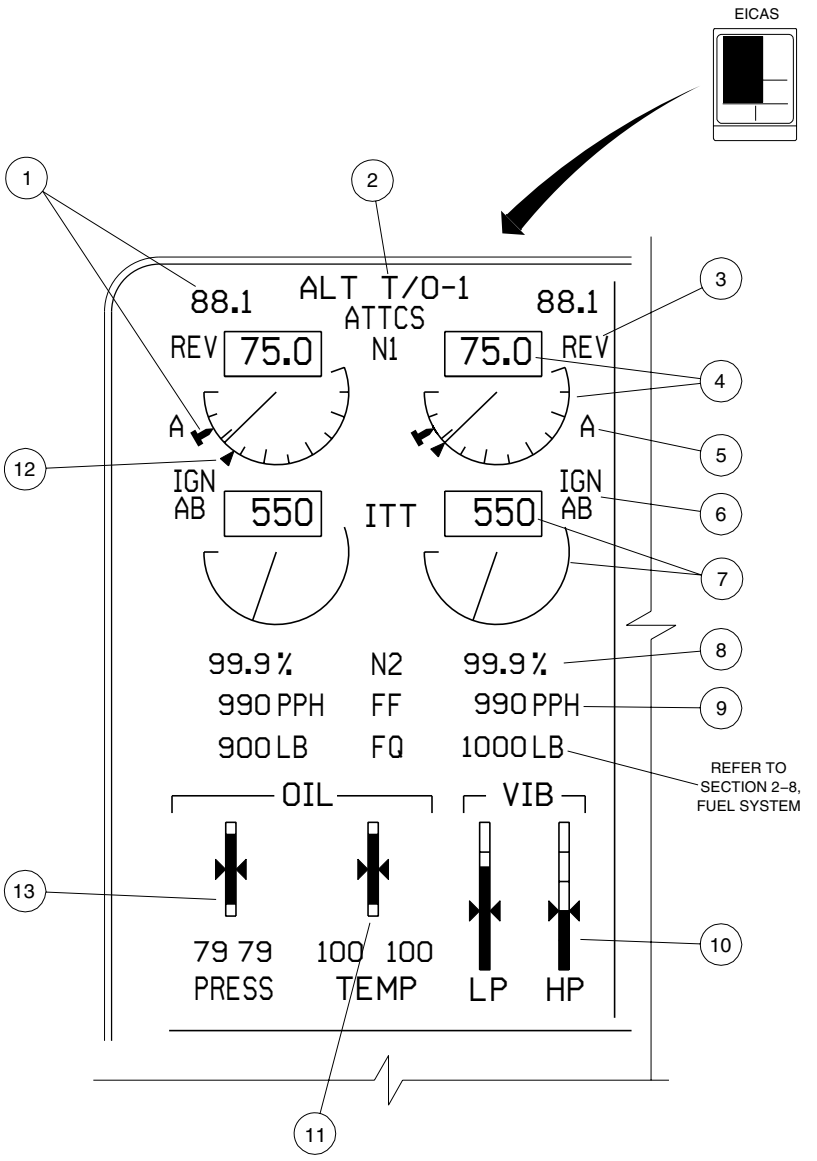


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**ENGINE INDICATION ON EICAS**

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# TAKEOFF PAGE ON MFD

## 1 - TAKEOFF MODE INDICATION

- Indicates Takeoff Mode as selected through the Takeoff Data Set Control.
  - Labels: T/O-1 or ALT T/O-1 (A, A1, A1/1, A3 engines);
    T/O or ALT T/O-1 (A1P or A1/3 engines);
    E T/O, T/O or ALT T/O-1 (A1E engine);
- In flight, the indication is removed from the display.

## 2 - REFERENCE TAKEOFF TEMPERATURE INDICATION

- Indicates reference takeoff temperature as adjusted through the takeoff data set control.
- In flight, the indication is removed from the display.

## 3 - REFERENCE ANTI-ICE STATUS INDICATION

- Indicates reference anti-ice status as selected through the takeoff data set control.
- Labels: ON or OFF
- In flight, the indication is removed from the display.

## 4 - OIL LEVEL INDICATION

- Ranges from 0 to 13 US Quarts for left engine and from 0 to 14 US Quarts for right engine with a resolution of 1 US Quart.
- Digits:
  - green from 6 to 14 US Quarts
  - amber below 6 US Quarts

**NOTE:** The right engine is capable of measuring a higher oil level due to sensor position.

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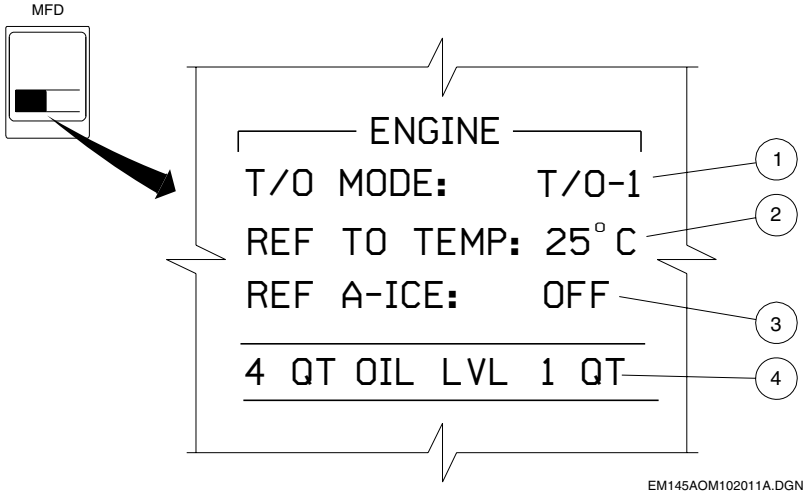


**TAKEOFF PAGE ON MFD**

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# FIRST ENGINE BACKUP PAGE ON RMU

- Contains thrust modes, N1, ITT, N2, Fuel Flow, Oil Pressure and Oil Temperature indications.
- Only the N1 indication contains analog and digital indication. The other indications are in digital format.
- Label and legend color: white
- Data color limits: same as the EICAS display.

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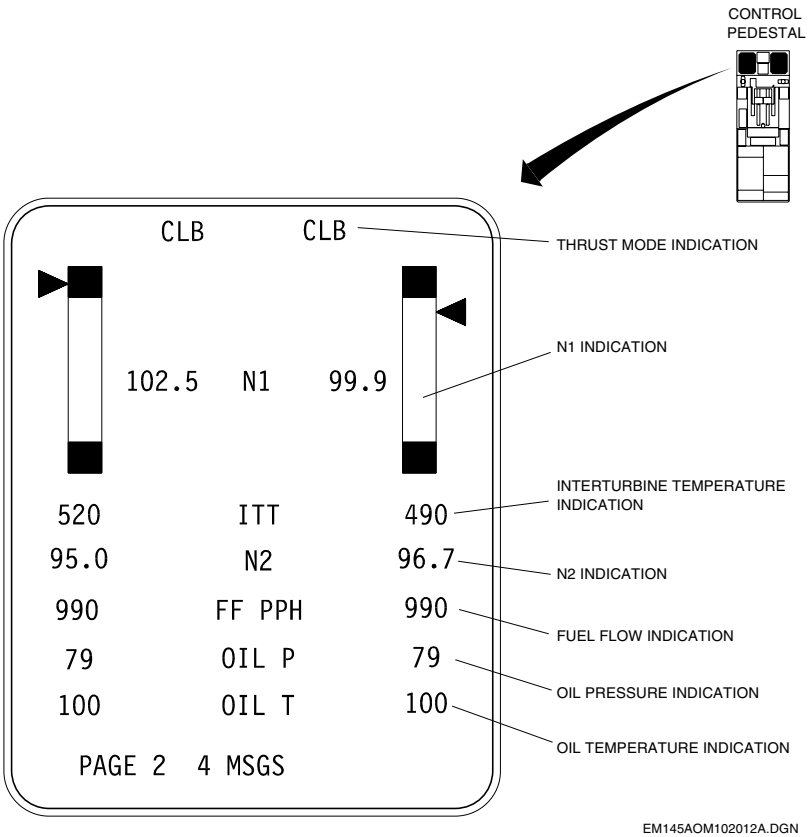


**FIRST ENGINE BACKUP PAGE ON RMU**

# THRUST REVERSER (OPTIONAL)

## GENERAL

Each engine may be equipped with an optional thrust reverser.

The thrust reverser is for ground operation only, and its function is to direct engine exhaust gases forward and outwards to produce deceleration of the airplane.

The thrust reverser system consists of an electric control/indication, an hydro-mechanical actuation system, and two pivoting doors.

When stowed, the thrust reverser is part of the exhaust nozzle.

## LOCK PROTECTION

The system incorporates three locking systems to avoid inadvertent in-flight deployment. The actuators and doors are mechanically locked in the stowed position through the primary and secondary locks. In case the primary and secondary reverser locks fail, the tertiary lock prevents the door from deploying. In the stowed position, the doors are held by the primary lock only, with the secondary and tertiary locks remaining unloaded. The primary and secondary locks are electrically commanded/controlled and hydraulically powered to unlock. The tertiary lock is electrically commanded/controlled and electrically powered to unlock, thus providing a separate and fully independent locking system.

## OPERATION

The thrust reverser is commanded by the backward movement of the Thrust Lever. Upon selection, the mechanical locks are removed and hydraulic pressure is applied to deploy the thrust reverser doors. In reverser mode, the doors rotate about a fixed axis. Rotation of the doors is controlled by extension and retraction of the hydraulic door actuators.

After pivoting, the rearmost part of the doors blocks the normal nacelle discharge path and directs the flow through the aperture created by its rotation.

The loss of electrical and/or hydraulic power does not result in inadvertent deployment.

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## OPERATION LOGIC

Each FADEC will command Maximum Reverse thrust on ground only, when the associated thrust reverser is deployed and associated thrust lever is requesting reverse thrust whenever either of the following conditions are met:

- Airplane on the ground indication from both main landing gears, and main landing gear wheels running above 25 kt, or
- Airplane on the ground indication from both main landing gears and from nose landing gear.

During landing, when the Thrust Levers are set to below IDLE, the FADEC commands reverse thrust only after the Thrust Reverser doors (both engines) are completely deployed. If the Thrust Lever is requesting forward thrust, the FADEC will command IDLE thrust if the associated engine thrust reverser indicates that there is a ¨not stowed¨ or a ¨deployed¨ condition.

If one engine is inoperative or one thrust reverser is not deployed, the FADEC of the operative side will only command Reverse Thrust if the associated Thrust Lever is requesting reverse thrust and the Thrust Lever of the affected side is set to IDLE. Such a feature is provided to avoid uncommanded thrust asymmetry.

## EICAS INDICATION

An indication of right and left thrust reversers deployed is presented on the EICAS. If a failure or a disagreement is detected, a caution message is presented on the EICAS.

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## THRUST REVERSER INTERLOCK

The FADECs interface with the thrust reverser system of the corresponding engine.

Each FADEC receives two pieces of information from the thrust reverser system:

– Stowed: If all doors of the corresponding engine are stowed.

– Deployed: If all doors of the corresponding engine are deployed.

For flight operation there is also a flat between IDLE and MAX REVERSE position. The FADEC enables reverse thrust depending on the position of the reverser doors and on the position of the engine thrust lever, and reduces the engine thrust to IDLE, if there is an indication of an inadvertent thrust reverser deployment in flight, which normally is not possible due to the Flight Idle electrical stop.

## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | ENG1 (2) REV FAIL | -Thrust reverser doors not stowed and in transit with Thrust Levers set at or above IDLE, or<br>-Thrust Levers set below IDLE in flight. |
| | ENG1 (2) REV DISAGREE | -At least one thrust reverser door not fully open, or<br>-Thrust reverser system not isolated from hydraulic system (Thrust Lever set at or above IDLE), or<br>-Door locking or position switch signal failure with Thrust Levers set at or above IDLE (ground only). |
| ADVISORY | E1 (2) IDL STP FAIL | Idle stop has failed. |

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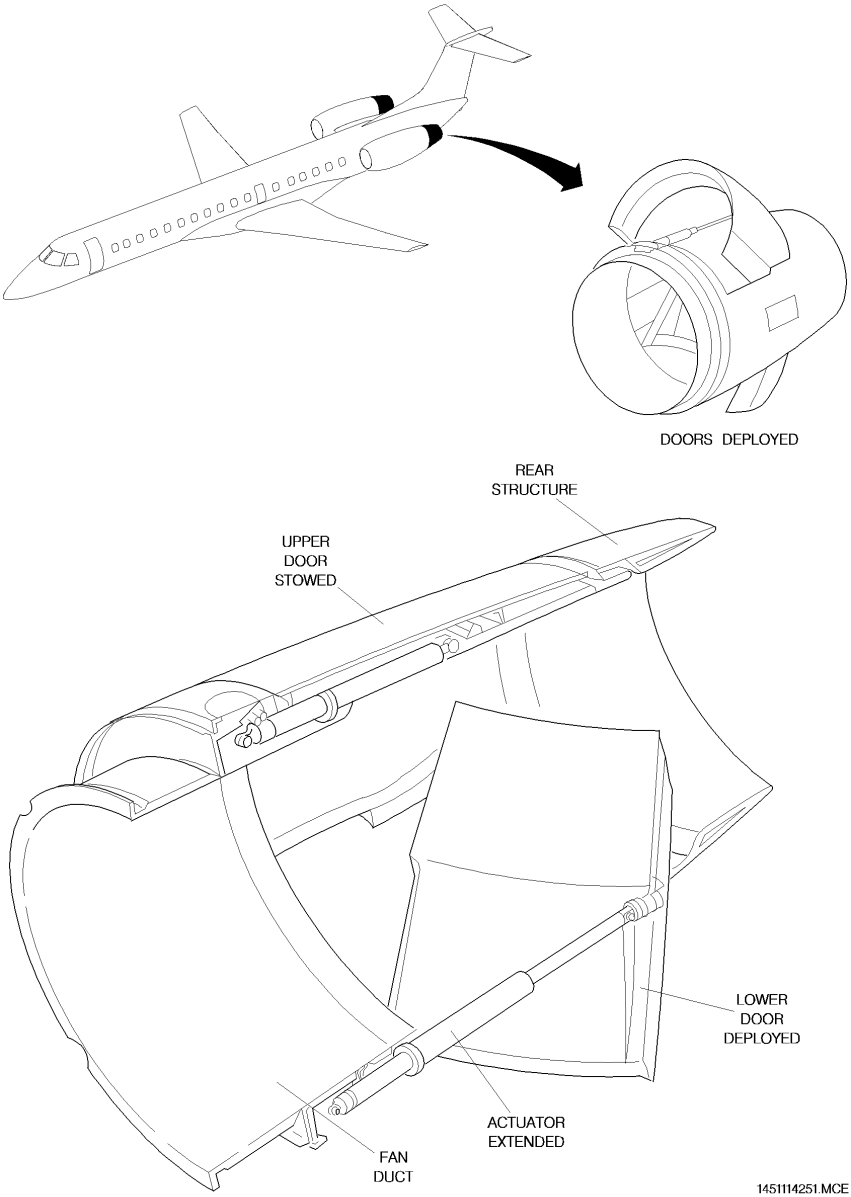


## THRUST REVERSER

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# SECTION 2-11

# HYDRAULIC

TABLE OF CONTENTS

Block Page

General ..... 2-11-05 ..01
System Description ..... 2-11-05 ..02
EICAS Messages ..... 2-11-05 ..05
Controls and Indicators ..... 2-11-05 ..06

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# GENERAL

The airplane is equipped with two independent hydraulic systems, each powered by one engine driven-pump and one electric motor-driven pump. Both hydraulic systems are identical, except for the services each system provides and a priority valve installed in the hydraulic system 1.

There are ground connections for refilling and ground tests purposes. Indications of hydraulic system parameters are provided on the MFD and EICAS displays.

The services provided by each hydraulic system are presented below:

| SYSTEM | HYDRAULIC POWER SUPPLY |
|---|---|
| Ailerons | SYSTEM 1 and 2 |
| Rudder | SYSTEM 1 and 2 |
| Landing Gear | SYSTEM 1 |
| Main door | SYSTEM 1 |
| Steering | SYSTEM 1 |
| Brakes (Outboard Wheels) | SYSTEM 1 |
| Brakes (Inboard Wheels) | SYSTEM 2 |
| Emergency/Parking Brake | SYSTEM 2 |
| Thrust Reverser 1 | SYSTEM 1 |
| Thrust Reverser 2 | SYSTEM 2 |
| Outboard Spoilers | SYSTEM 2 |
| Inboard Spoilers | SYSTEM 1 |

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# SYSTEM DESCRIPTION

Each hydraulic system consists of a hydraulic fluid reservoir, a manifold, one engine-driven pump, one electric motor-driven pump, one shutoff valve, one accumulator and a priority valve installed in the hydraulic system 1.

## RESERVOIR

The hydraulic fluid stored in the reservoir is pressurized, to avoid pump cavitation. This pressurization function is performed by fluid drained from the pressure line. The reservoir is equipped with a quantity indicator which transmits information to the MFD and EICAS displays for indication and warning purposes. A thermal switch is responsible for the high temperature message, if the fluid temperature increases above 90°C.

## SHUTOFF VALVE

A shutoff valve is installed between the reservoir and the engine-driven pump. It cuts the hydraulic fluid supply to the engine-driven pump, if there is a fire on the related engine or in case of hydraulic fluid overheat. This valve may be closed either through the engine fire extinguishing handle or through a dedicated button on the overhead panel.

## ENGINE-DRIVEN PUMP

The engine-driven pump provides continuous fluid flow at 3000 psi for operation of the various airplane hydraulically-powered systems. The pump is connected to the engine accessory gearbox and, as long as engine is running, it generates hydraulic pressure. During engine start, the fluid remaining in the suction line is sufficient to avoid pump cavitation and provide reservoir pressurization.

## ELECTRIC MOTOR-DRIVEN PUMP

The electric motor-driven pump has the same connections as the engine-driven pump, but has a lower flow capacity. The pump normally operates in the automatic setting mode, turning on when the associated hydraulic pressure drops below 1600 psi or the associated engine N2 drops below 56.4%.

If the pump starts operating in the automatic mode, it will be turned off after the pressure or N2 are reestablished to normal values. The electric pump may be turned on at pilot command, through the selector knob on the overhead panel, furnishing continuous fluid flow at 2900 psi.

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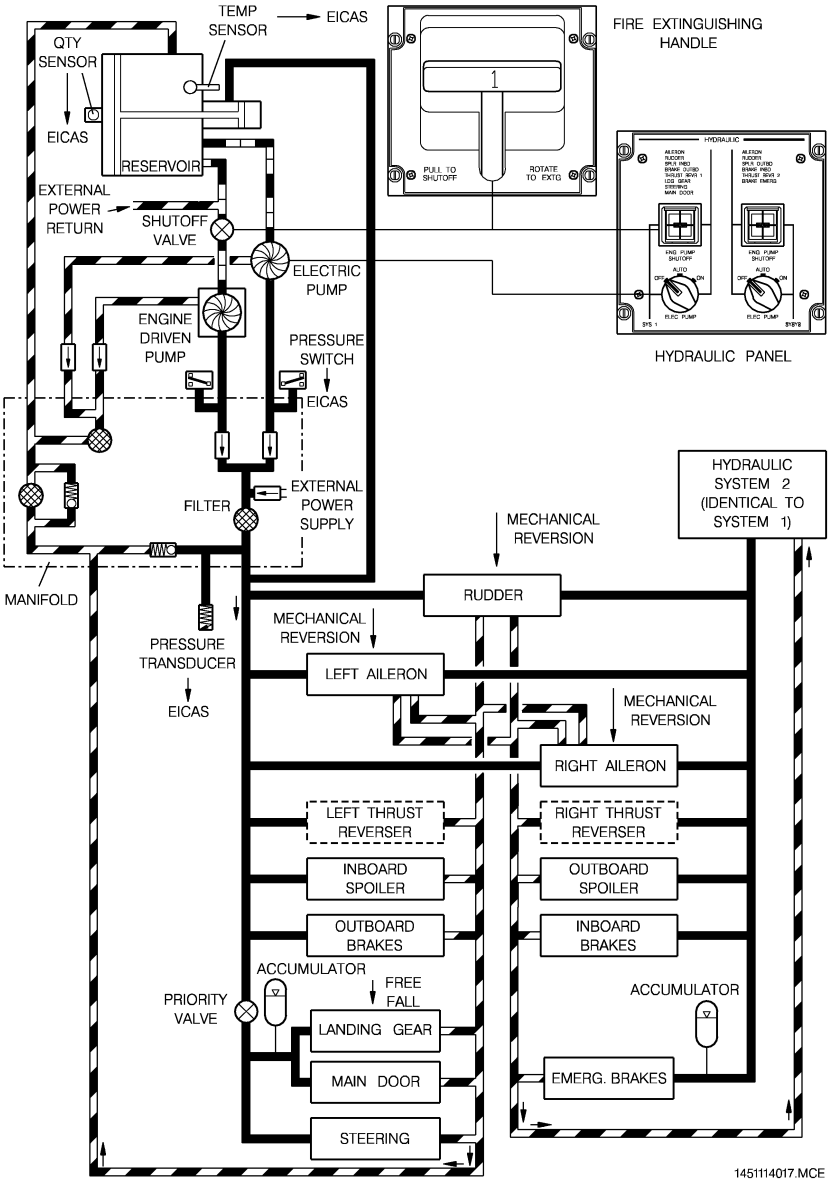


## HYDRAULIC SYSTEM SCHEMATIC

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## MANIFOLD

The manifold provides the following functions:

-Fluid filtering (pressure and return lines).

-Overpressure relief (main and electrical pumps).

-Pressure indications (main and electrical pumps).

Fluid leaving the pump flows to the manifold, where it is filtered and then routed to the airplane systems. Inside the manifold, a check valve prevents the fluid from returning to the pump, while a relief valve diverts the excess fluid to the return line. The return line is supplied by the fluid coming from the airplane systems, fluid drained from the pump, fluid from the relief valve, and fluid refilled by the maintenance personnel. Under any situation the fluid is filtered and returned to the reservoir. The manifold incorporates two pressure switches to detect low hydraulic pressure, and a pressure transducer to indicate system pressure. Signals from the pressure switches and pressure transducer are sent to the MFD and EICAS displays.

## PRIORITY VALVE

The hydraulic system 1 incorporates a priority valve. If the system is powered by the electric motor-driven pump and the landing gear is commanded to retract, the valve will provide minimum flow to the landing gear system and give priority to the flight control services. In this case, the landing gear will operate through the accumulator pressure.

## ACCUMULATOR

Each hydraulic system has one accumulator. The function of the accumulator is to keep the surges of the hydraulic pumps at a minimum, and to keep a 3000 psi pressure available for operation of the landing gear and main door (system 1) or operation of the emergency parking brake (system 2).

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# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | HYD SYS 1 (2) FAIL | Associated hydraulic system is not pressurized (inhibited when the airplane is on the ground, engine is shut down and parking brake is applied). |
| | HYD SYS 1 (2) OVHT | Associated hydraulic system fluid temperature is above 90°C. |
| ADVISORY | E1 (2) HYD PUMP FAIL | Engine-driven pump is not generating pressure with associated engine running. |
| | E1 (2) HYDSOV CLSD | Associated hydraulic shutoff valve is closed. |
| | HYD1 (2) LO QTY | Fluid level in the associated reservoir is below one liter. Report to the maintenance personnel if the hydraulic reservoir operates empty. |
| | HYD PUMP SELEC OFF | Associated electric pump selected OFF with the parking brake released. |

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# CONTROLS AND INDICATORS

## HYDRAULIC SYSTEM PANEL

### 1- ENGINE PUMP SHUTOFF BUTTON (guarded)

- Closes (pressed) or opens (released) the associated engine pump shutoff valve.
- A striped bar illuminates in the button to indicate that it is pressed.

### 2- ELECTRIC HYDRAULIC PUMP CONTROL KNOB

OFF - Associated pump is turned off.

AUTO - Associated pump is kept in standby mode, ready to operate if the engine-driven pump outlet pressure drops below 1600 psi or the associated engine N2 drops below 56.4%.

ON - Associated pump is turned on.

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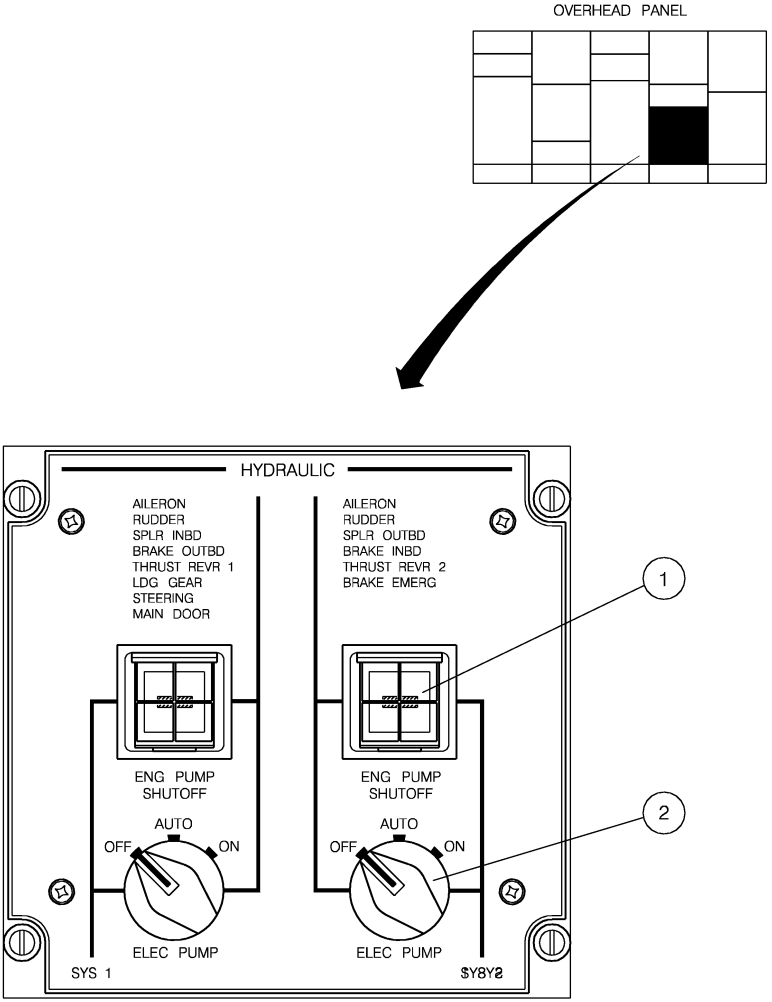


**NOTE:** For airplanes not equipped with Thrust Reverser, the THRUST REVR 1 and THRUST REVR 2 inscriptions are not presented on the Hydraulic System Panel.

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## HYDRAULIC SYSTEM PANEL

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# HYDRAULIC PAGE ON MFD

## 1- FLUID QUANTITY INDICATION

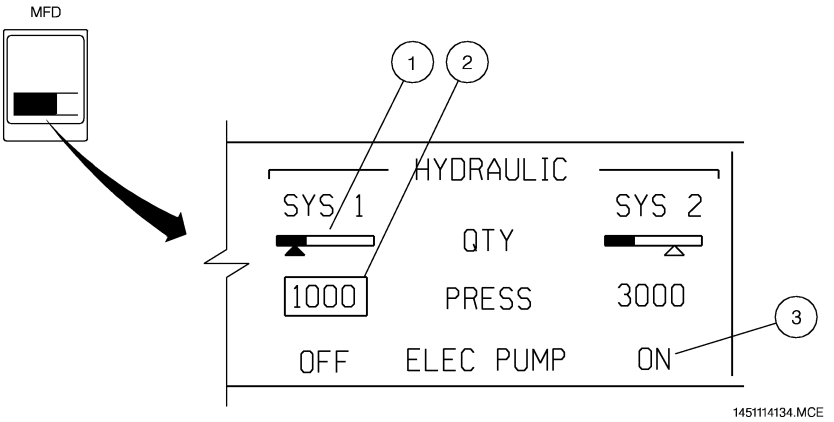
- Ranges from zero to maximum hydraulic fluid quantity.
- Scale (horizontal line) and pointer:
  - green when greater than 1 liter.
  - amber when equal to or less than 1 liter.
- Pointer disappears if data is invalid.

## 2- PRESSURE INDICATION

- Ranges from 0 to 4000 psi, with a resolution of 100 psi.
- Digits:
  - green from 1300 to 3300 psi.
  - amber and boxed below 1300 and above 3300 psi.
- Digits are replaced by amber dashes if data is invalid.

## 3- ELECTRIC PUMP STATUS

- Indicated by the green label ON or OFF.




**HYDRAULIC PAGE ON MFD**

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# SECTION 2-12

# LANDING GEAR AND BRAKES

TABLE OF CONTENTS

Block Page

General ..... 2-12-05 .. 01
Air/Ground Indication System ..... 2-12-05 .. 02
Landing Gear Operation ..... 2-12-05 .. 03
Landing Gear Retraction ..... 2-12-05 .. 03
Landing Gear Extension ..... 2-12-05 .. 05
Landing Gear Warning ..... 2-12-05 .. 06
EICAS Messages ..... 2-12-05 .. 07
Controls and Indicators ..... 2-12-05 .. 07
Brake System ..... 2-12-10 .. 01
Normal Brake System ..... 2-12-10 .. 02
Emergency/Parking Brake System ..... 2-12-10 .. 08
EICAS Messages ..... 2-12-10 . 10
Controls and Indicators ..... 2-12-10 . 10
Nose Wheel Steering System ..... 2-12-15 .. 01
EICAS Messages ..... 2-12-15 .. 02
Controls and Indicators ..... 2-12-15 .. 04
EMB-145 Minimum Turning Radii ..... 2-12-15 .. 07
EMB-135 Minimum Turning Radii ..... 2-12-15 .. 09
EMB-140 Minimum Turning Radii ..... 2-12-15 .. 11

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# GENERAL

The EMB-145 landing gear incorporates braking and steering capabilities. The extension/retraction, steering and braking functions are hydraulically assisted, electronically controlled and electronically monitored. EICAS indications and messages alert crew to system status and failures. Each landing gear is equipped with alternate means of actuation in case of normal actuation system failure.

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# AIR/GROUND INDICATION SYSTEM

Air/ground indication is determined by a system that detects landing gear shock absorber compression and relays information to the landing gear electronic unit for gear control. The system consists of five weight-on-wheel proximity switches. Two of them are installed on each main landing gear leg and one on the nose landing gear leg.

The Landing Gear Electronic Unit (LGEU) processes the main landing gear proximity switches' signals information in four independent channels and controls various equipment operations. Logic processing includes the position signal and its validity. If all proximity switch signals are valid, four signals are processed to assure that at least three signals indicate identical status for releasing the air/ground signal output.

Should one proximity switch signal be invalid, the logic will process the remaining three signals so that at least two indicate the same status. If a second proximity switch is invalid, the two remaining signals are processed only if both send the same signal. Disagreement between these two remaining proximity switches causes the Landing Gear Electronic Unit to de-energize the channels and provide a default output signal.

The nose landing gear proximity switch signal is sent only to the thrust reverser logic (if installed) and steering control.

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# LANDING GEAR OPERATION

Landing gear retraction and extension are powered by the hydraulic system 1. An accumulator prevents pressure fluctuations and assists gear retraction after takeoff. The main landing gear legs retract inboard, while the nose landing gear retracts forward. Each main gear leg is mechanically linked to its respective door, which remains open when the gear is down. The doors close automatically when the main landing gear is retracted. The nose landing gear doors are hydraulically actuated and operate in sequence with the nose gear.

Gear retraction and extension are electrically commanded. If normal extension fails, the landing gear can be extended through an electrical override system. If the electrical override is not available, a free-fall system allows gear extension. Gear position is indicated on the EICAS display.

## LANDING GEAR RETRACTION

Landing gear retraction is commanded through the Landing Gear Lever, installed on the main panel. Positioning the lever to the UP position signals the LGEU to command the Nose Gear Door Solenoid Valve and the Landing Gear Electrovalve. This allows pressure from the hydraulic system 1 to simultaneously reach landing gear and down unlock actuators. All gear legs are then retracted into their respective wheel wells.

The LGEU logic only allows the nose gear doors to close after the nose landing gear is locked in the UP position. When the uplock boxes are actuated, the proximity switches signal the LGEU that the gear is up and locked and that the Landing Gear Electrovalve may be deenergized. Nose landing gear door actuators are kept pressurized, but the gear actuator lines are connected to the return.

To preclude an inadvertent retraction command while on the ground, the air/ground system provides a signal to a solenoid inside the Landing Gear Lever. This locks the lever and prevents movement towards the UP position. For emergency purposes only, a lock release button is provided beside the lever, allowing this protection to be overriden.

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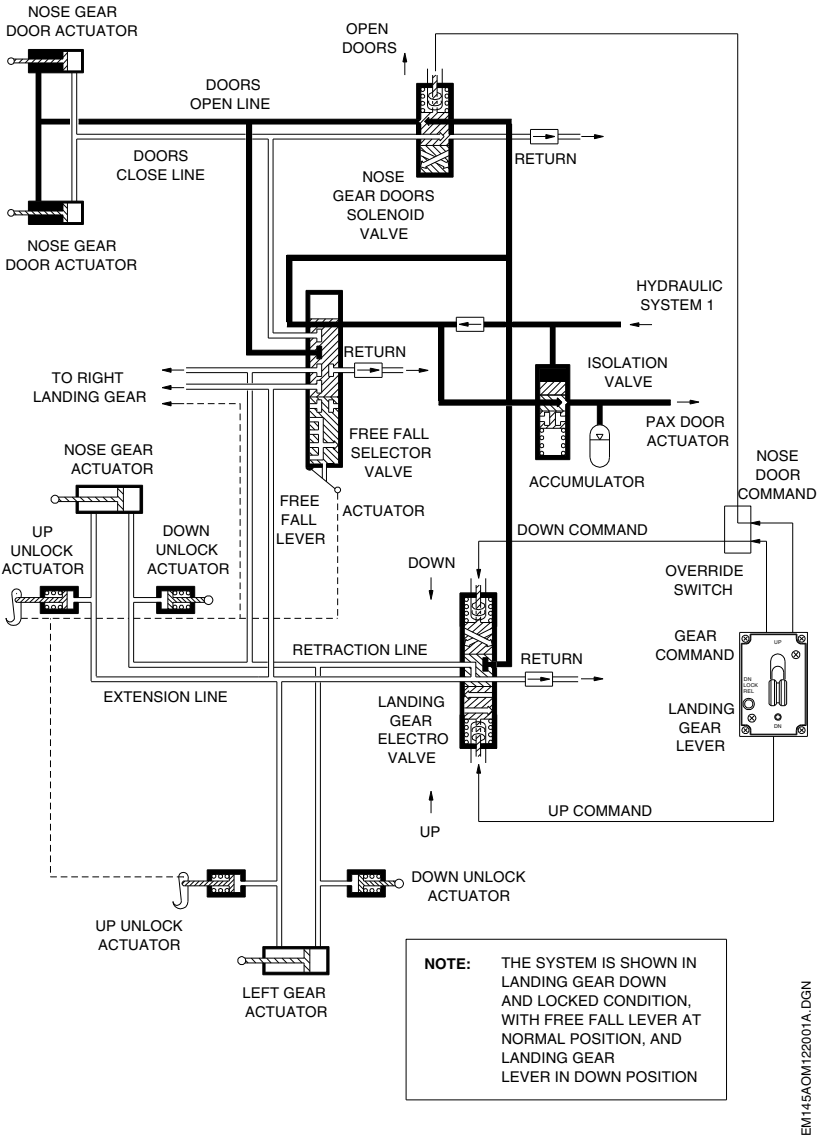


## LANDING GEAR SCHEMATIC

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# LANDING GEAR EXTENSION

## NORMAL EXTENSION

Positioning the Landing Gear Lever to the DOWN position signals the LGEU to command the Landing Gear Electrovalve and the Nose Gear Doors Solenoid Valve. This allows pressure from the hydraulic system 1 to simultaneously reach the landing gear and door actuators, and also the up unlock actuators.

When the gear legs reach the down position, the down lock boxes are actuated. The proximity switches signal the LGEU that the gear is down and locked and that the Landing Gear Electrovalve may be de-energized.

## ELECTRICAL OVERRIDE EXTENSION

The Electrical Override system is used to extend the landing should there occur a normal landing gear extension failure. This system bypasses the LGEU and actuates directly the Landing Gear Electrovalve and the Nose Gear Doors Solenoid Valve. The control switch is installed inside the free-fall lever compartment, on the floor, beside the copilot's seat. Extension through override is made in steps, first opening the doors and then extending the gear. When extension is completed, selecting the override switch to normal position deenergizes the Landing Gear Electrovalve and depressurizes all lines. The switch is safeguarded, being in the non-actuated position whenever the compartment door is closed.

## FREE-FALL EXTENSION

Free-Fall extension is available in case of failure of both normal extension and electrical override extension. Actuation of free-fall landing gear extension is performed by pulling up the lever installed inside the free-fall lever compartment, on the floor, beside the copilot's seat.

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This mechanically actuates the Free-Fall Selector Valve and unlocks the three landing gear legs uplocks. The Free-Fall Selector Valve isolates the hydraulic system pressure and connects the landing gear system hydraulic lines to the return. With the system unpressurized and the uplocks deactivated, all gear legs fall by gravity until they reach their downlock devices. If one main gear does not lock down, increase the aerodynamic drag by side slipping the airplane to help lock the affected leg.

Once actuated, the free-fall lever remains locked in the vertical position until mechanically released.

## LANDING GEAR WARNING

A LANDING GEAR voice message is provided to alert pilots any time the airplane is in a landing configuration and the gear legs are not locked down. The warning may be activated under one of three conditions:

1. Radio Altitude below 1200 ft, Flap Selector Lever set lower than 22°, one thrust lever set below 59° and the other thrust lever set below 45° (or the associated engine inoperative).

   **NOTE:** In case of Radio Altimeter loss, the message may be activated at any altitude, but may be canceled through the Landing Gear Warning Cutout Button.

2. Radio Altitude below 1200 ft, Flap Selector Lever between 22° and 45°, one thrust lever set below 59° and the other thrust lever set below 45° (or the associated engine inoperative).

   **NOTE: -** The Voice message cannot be canceled.
   - In case of Radio Altimeter loss, the message may be activated at any altitude.

3. Flap Selector Lever set at 45°.

   **NOTE:** The Voice message cannot be canceled.

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## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | LG/LEVER DISAGREE (1) | After 20 seconds of gear command, at least one landing gear is not in the selected position.<br><br>After 20 seconds of gear command to the UP position, once "NLG UP/DOOR OPN" is displayed on EICAS. |
| CAUTION | LG AIR/GND FAIL (2) | LGEU failure, failure of two weight-on-wheel proximity switches, or nose weight-on-wheel proximity switch in disagreement with air/ground system indication. |
| | NLG UP/DOOR OPN (if applicable) | Nose LG is locked up and nose LG door is open. |

**NOTE: 1)** For airplanes Post-Mod. SB 145-34-0125, the message is displayed when the Landing Gear in Transit position remain unchanged for more than 20 seconds.

**2)** If the message is displayed for about 3 or 5 seconds during the landing gear extension only and extinguishes when the landing gear is down and locked, it could be considered a false indication and should be disregarded.

## CONTROLS AND INDICATORS

### LANDING GEAR CONTROL BOX

#### 1 - LANDING GEAR LEVER

UP - Selects landing gear retraction.

DOWN - Selects landing gear extension.

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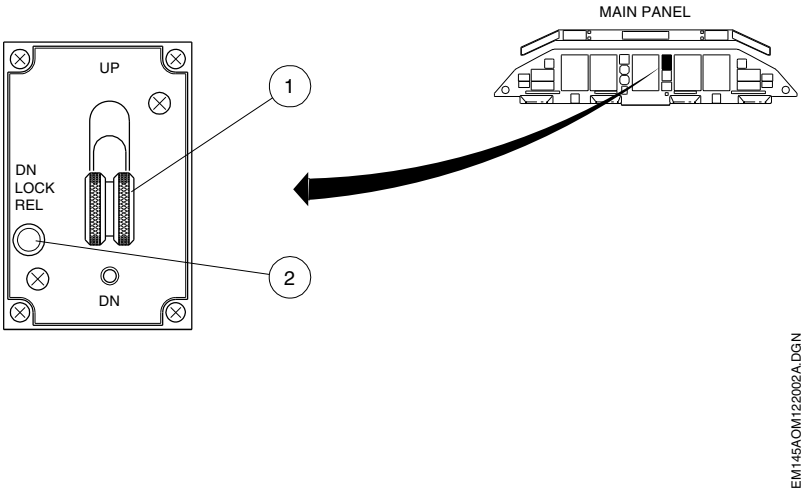
## 2 - DOWNLOCK RELEASE BUTTON

- Mechanically releases the lever lock, allowing the landing gear lever to be moved to the UP position when on the ground or in case it cannot be moved to the UP position after takeoff.




**LANDING GEAR CONTROL BOX**

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## FREE-FALL LEVER COMPARTMENT

### 1 - FREE-FALL LEVER

- When pulled up, depressurizes the landing gear hydraulic line and releases all gear uplocks.
- The lever is kept at the actuated position by a mechanical lock.

### 2 - FREE-FALL LEVER UNLOCK BUTTON

- When pressed, unlocks the free-fall lever, allowing it to be returned to the normal position, thus restoring the hydraulic operation of the landing gear.

### 3 - ELECTRICAL OVERRIDE SWITCH (GUARDED)

NORMAL - Landing gear retraction and extension are automatically performed and controlled by the Landing Gear Electronic Unit.

DOORS - Opens the nose landing gear doors.

GEAR/ DOORS - Extends the landing gear.

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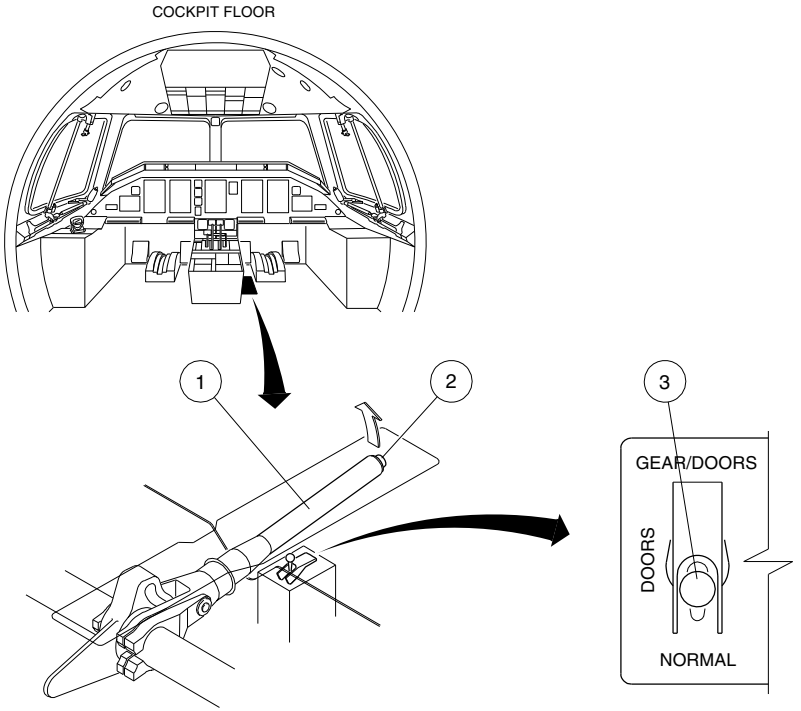


**FREE-FALL LEVER COMPARTMENT**

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## LANDING GEAR WARNING CUTOUT BUTTON (guarded)

- When pressed, this button cancels the landing gear warning voice message if the Radio Altimeter is inoperative with Flap Selector Lever set lower than 22°, one thrust lever set below 59° and the other thrust lever set below 45° (or the associated engine inoperative).
- An amber indication bar illuminates inside the button and remains illuminated to indicate that a cancel action was performed.
- The amber indication bar extinguishes if the Thrust Levers are advanced or Flap Selector Lever is set at 22° or higher or landing gear is down and locked.

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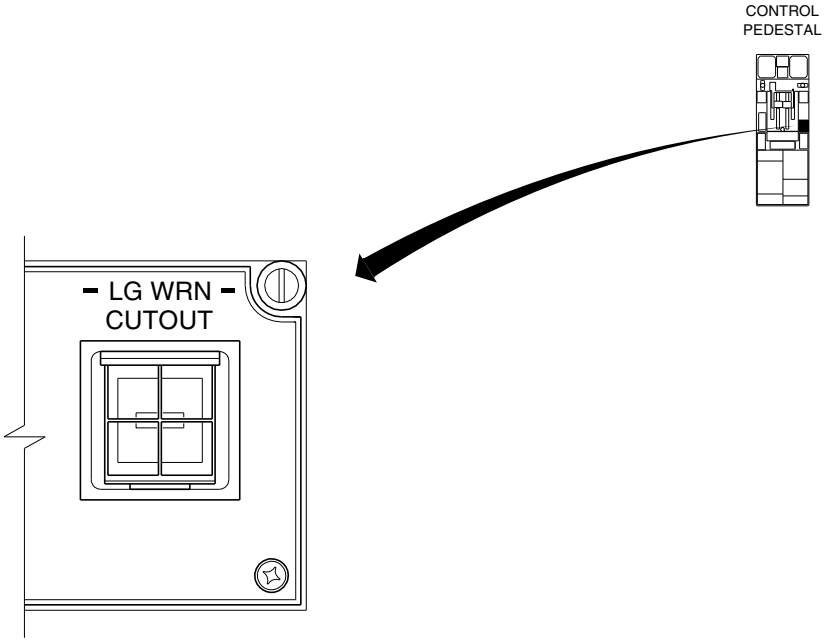


**NOTE:** THE LANDING GEAR WARNING CUTOUT BUTTON MAY ALSO BE LOCATED ON THE MAIN PANEL.

EM145AOM122004A.DGN

## LANDING GEAR WARNING CUTOUT BUTTON

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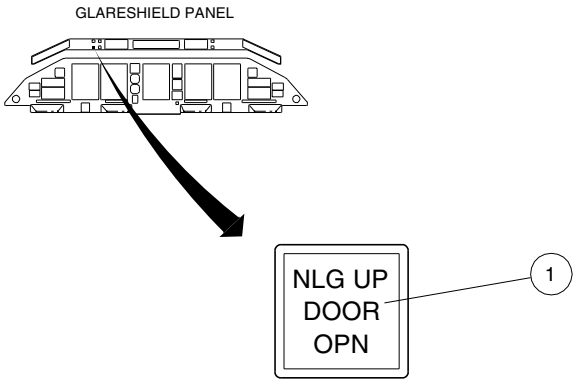
## GLARESHIELD PANEL

### 1 - NOSE LANDING GEAR DOORS INDICATION LIGHT (IF INSTALLED)

– Illuminates to indicate that the nose landing gear is locked in the retracted position and at least one door is not closed.

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**GLARESHIELD PANEL**

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## EICAS INDICATIONS

### 1 - LANDING GEAR POSITION

- Position is indicated by three boxes, one for each gear.
- Landing gear down and locked is indicated by a green DN label inside a green box.
- Landing gear in transit is indicated when the box is crosshatched in amber and black.

  For airplanes Post-Mod. SB 145-34-0125, when the conditions for Landing Gear in Transit position remain unchanged for more than 20 seconds, the following occurs:
  - The indication crosshatched in amber and black turns to red and black, and
  - The EICAS message LG/LEVER DISAGREE is displayed.
- Landing gear up and locked is indicated by a white UP label inside a white box.
- Landing gear lever disagreement (landing gear is not in the selected position after 20 seconds) is indicated by a box cross-hatched in red and black or by a red label (UP or DN) inside a red box.
- Indication of landing gear downlocked is also presented on the RMU through the green LG DOWN LOCKED legend.

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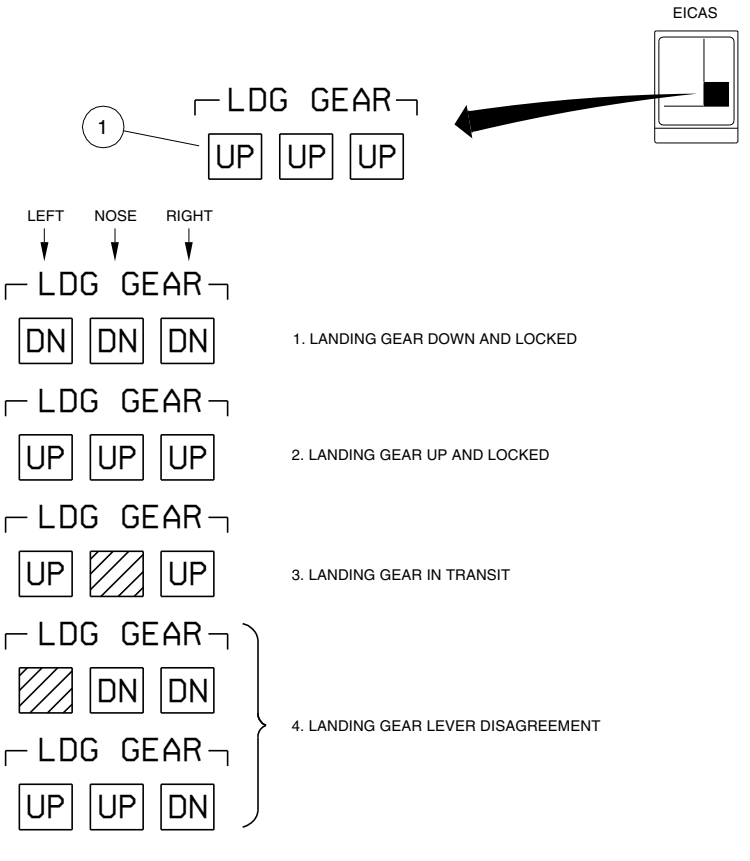


## LANDING GEAR POSITION INDICATION ON EICAS

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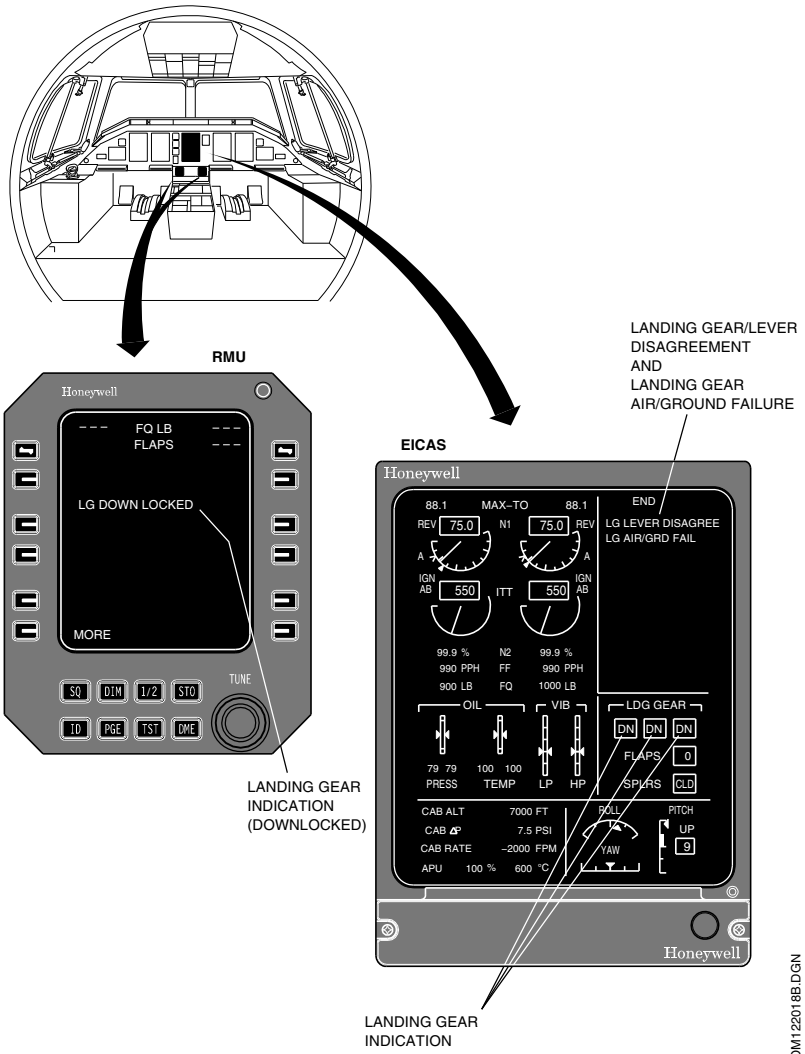


## LANDING GEAR INDICATIONS



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# BRAKE SYSTEM

The braking system consists of the normal brake system, emergency/parking brake system, and gear-retracting-in-flight braking.

The normal brake system is supplied by hydraulic systems 1 and 2. It is electronically commanded and monitored. The emergency/parking brake system is supplied only by hydraulic system 2 and is mechanically actuated. Normal braking is controlled by the pedals. Emergency braking is controlled by the emergency/parking brake handle. Gear-retracting-in-flight braking is controlled by both hydraulic systems and by a mechanical stop within the nose gear wheel well. This braking is electronically commanded and monitored.

Braking through the pedals incorporates some protections not available when using the emergency brake handle. Brake temperature is shown on the MFD Hydraulic Page.

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## NORMAL BRAKE SYSTEM

Normal brake system is operated by rudder pedal inputs. The brakes are powered by two independent hydraulic systems. It is controlled and monitored by the Brake Control Unit (BCU). The BCU receives signals from the pedal position transducers and commands the four Brake Control Valves (BCV) to modulate required pressure to the wheel brakes. BCVs 1 and 4 control the hydraulic pressure from system 1 to the outboard wheels. BCVs 2 and 3 control the hydraulic pressure from system 2 to the inboard wheels.

The hydraulic system 1 and the ESS DC BUS 1 supply the main brake system for the control of the outboard wheels. The hydraulic system 2 and the ESS DC BUS 2 supply the main brake system for the control of the inboard wheels.

Pressure and wheel speed transducers send signals to the BCU so that it can monitor brake performance and send the appropriate signals to the crew alerting system and other systems. The BCU also receives signals from the landing gear position and condition, air/ground situation, and hydraulic system status. The system displays messages on the EICAS to indicate a failure in one pair of brakes or a failure in a single wheel brake (brake degraded performance). In the event of brake system failure, the BCU will shut down the affected hydraulic system through the shutoff valves. The shutoff valves are energized whenever the landing gear is extended and de-energized after landing gear retraction.

Protective functions controlled by the normal braking system include anti-skid protection, locked wheel protection, and touch-down protection.

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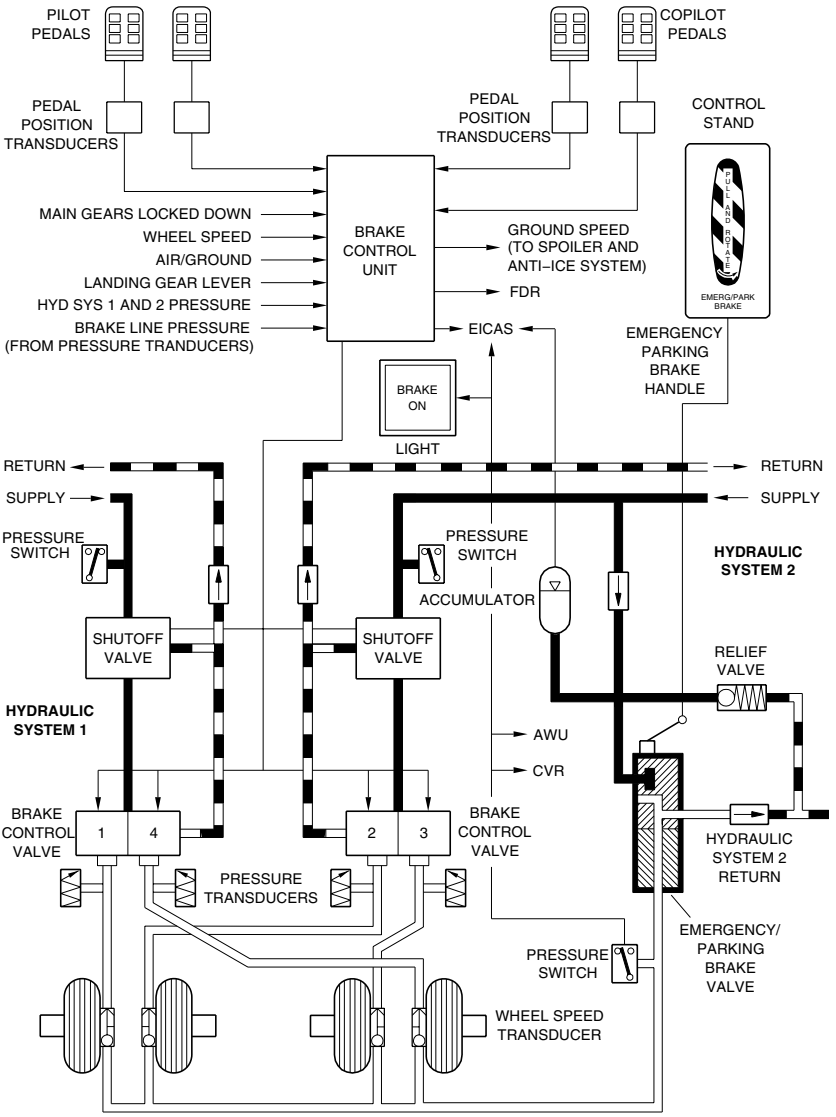


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## BRAKE SYSTEM SCHEMATIC

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## ANTI-SKID PROTECTION

The anti-skid protection controls the amount of hydraulic pressure applied by the pilots on the brakes. The anti-skid provides the maximum allowable braking effort for the runaway surface in use. It minimizes tire wear, optimizes braking distance, and prevents skidding.

To perform this function, the BCU computes the wheel speed signal from the four speed transducers.

BCU monitors constantly wheels velocity through wheel speed transducers. If a skid occurs, then wheel velocity decreases suddenly compared with a calculated deceleration ratio proportional of the pedal deflection, then BCU will command brake pressure release until the wheel velocity returns to the expected one. This anti-skid protection is monitored and controlled for each wheel, independently.

When one of such signals decreases below the average of the remaining wheels, a skidding is probably occurring, and braking pressure has to be relieved. After that wheel speed has returned to the average speed, normal braking operation is restored.

The anti-skid does not apply pressure on the brakes, but only relieves it. So, to perform a differential braking technique, the pilot should reduce pressure on the side opposite to the turn, instead of applying pressure to the desired side.

The anti-skid system incorporates the locked wheel protection and touchdown protection features.

## LOCKED WHEEL PROTECTION

Locked wheel protection is activated for wheel speeds above 30 kt. It compares wheel speeds signals. If one wheel speed is 30% lower than that of another, a full brake pressure relief is commanded to the associated wheel, allowing wheel speed recovery. The 30% tolerance between the wheel speeds is provided to permit an amount of differential braking, for steering purposes.

For wheel speeds below 30 kt, the locked wheel protection is deactivated and the brake system actuates without the wheel speed comparator. For wheel speeds below 10 kt, the anti-skid protection is deactivated, allowing the pilot to lock and pivot on a wheel.

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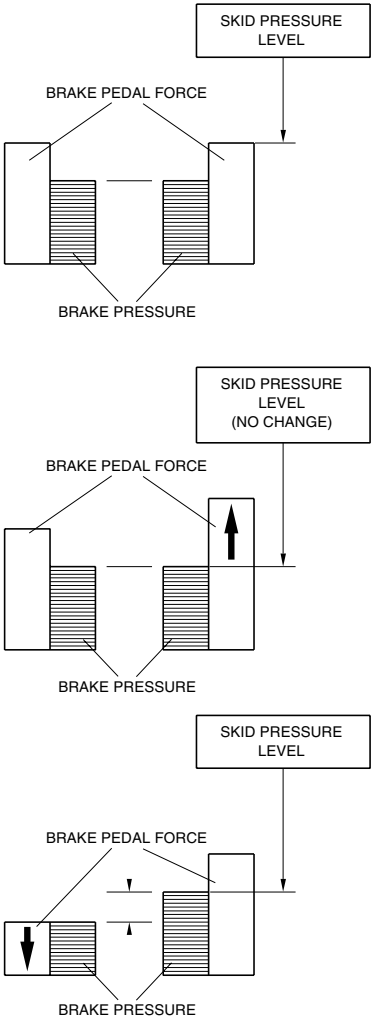
THE ANTI–SKID FUNCTION MODULATES THE BRAKE PRESSURE TO A LEVEL WHICH PREVENTS THE WHEELS FROM SKIDDING. IF ONE OF THE WHEELS LOCKS, THE ANTI–SKID FUNCTION REDUCES THE BRAKE PRESSURE OF THE ASSOCIATED PAIR, THUS ELIMINATING THE SKIDING.

IF THE PILOT APPLIES DIFFERENTIAL PEDAL FORCE TO STEER THE AIRPLANE THROUGH DIFFERENTIAL BRAKING, THE ANTI–SKID FUNCTION MAINTAINS THE SKID PRESSURE LEVEL, THUS PRECLUDIND THE AIRPLANE FROM TURNING.

THE CORRECT ACTION CONSISTS IN A REDUCTION OF THE OPPOSITE PEDAL FORCE TO A POINT BELOW THE SKID LEVEL, WHICH PERMITS THE REDUCTION OF THE CORRESPONDING BRAKE PRESSURE.

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## DIFFERENTIAL BRAKING TECHNIQUE

## TOUCHDOWN PROTECTION

The touchdown protection system inhibits brake actuation before the main wheels spin up during landing. Brake actuation will be allowed only after 3 seconds from the latest touchdown or after the wheels have spun-up to 50 kt. In bouncing landings, the countdown is reset after each runway contact.

Touchdown protection is provided by the brake system receiving signals from main landing gear weight-on-wheel proximity switches. If one landing gear proximity switch fails at the air position, the brake system will operate normally. However, if both proximity switches fail at the air position, braking capacity will be available only for wheel speeds above 10 kt.

Below 10 kt, a loss of the main brake capacity will occur, but emergency braking is still available.

## GEAR-RETRACTING-IN-FLIGHT BRAKING

Gear-retracting-in-flight braking prevents the landing gear from being retracted when the wheels are turning. This system computes signals from the air/ground indicating system and from the landing gear lever position. As soon as the airplane is airborne and the gears are commanded to retract, it applies braking pressure to the main wheels. The nose wheels are braked by a stop within the nose landing gear wheel well.

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## EMERGENCY/PARKING BRAKE SYSTEM

The emergency/parking brake system is used when parking the airplane or when the normal braking system has failed. The emergency/parking brake system is mechanically commanded and hydraulically actuated. It is totally independent of the BCU, so it has none of the normal braking system protections.

The emergency/parking brake is controlled through a handle located on the left side of the control pedestal. This modulates the Emergency/Parking Brake Valve. When the Emergency/Parking Brake Valve is actuated, hydraulic pressure coming from a dedicated accumulator is equally applied to the four main landing gear brakes. Braking capacity is proportional to the handle displacement. A BRAKE ON indicating light illuminates to indicate that pressure is being applied to the wheel brakes. A locking device allows the handle to be held in the actuated position, for parking purposes.

The accumulator is supplied by hydraulic system 2. A caution message is displayed on the EICAS in case of accumulator hydraulic low pressure. After the message is displayed, if no leakage exists, at least one full emergency/parking brake application is available. If overpressure occurs due to overheating, a thermal relief valve allows hydraulic system communication with the return. A refilling connection is provided to allow pressurization of the accumulator.

The accumulator allows 6 complete emergency actuation or at least 24 hours of parking brake actuation.

**NOTE:** To prevent transfer of hydraulic fluid from one system to the other, normal braking should be applied and held while the parking brake is fully applied or released.

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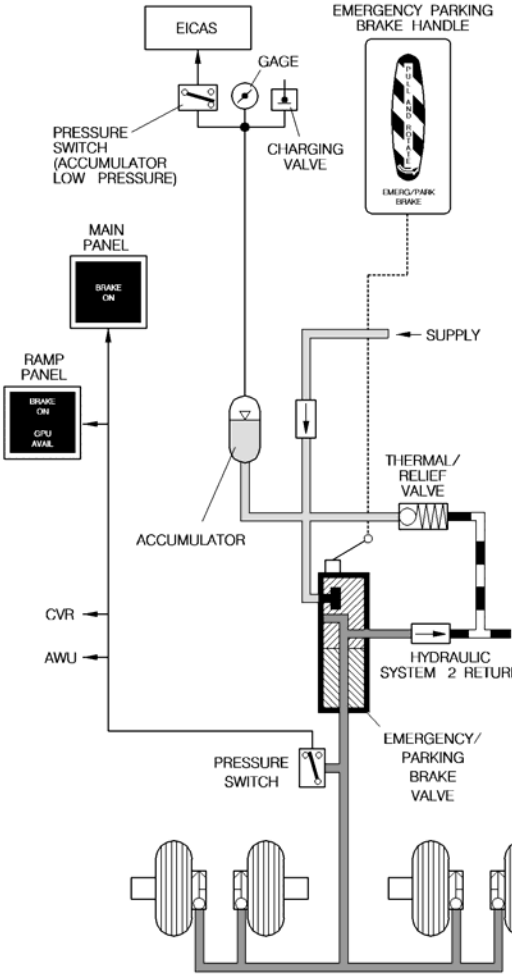


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**EMERGENCY/PARKING BRAKE SYSTEM SCHEMATIC**

## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | EMRG BRK LO PRES | Emergency/parking brake accumulator presents a low pressure condition. |
| | BRK OUTBD (INBD) INOP | Outboard and/or inboard pair of brakes is inoperative. |
| | BRAKE OVERHEAT | Any brake temperature has exceeded 420°C.(*) |
| | BRAKE DEGRADED | Total or partial loss of braking capability of one outboard wheel (1 or 4) and/or one inboard wheel (2 or 3), or internal BCU failure. |

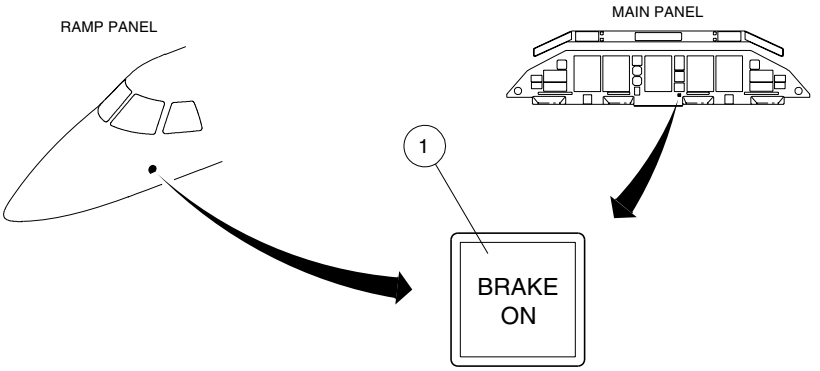
**NOTE:** (*) For EMB-145 airplanes equipped with LR brakes, the brake overheat set point is 450°C.

## CONTROLS AND INDICATORS

### MAIN PANEL/RAMP PANEL

### 1 - BRAKE ON LIGHT

– Illuminates when emergency/parking brake is applied.

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**BRAKE ON LIGHT**

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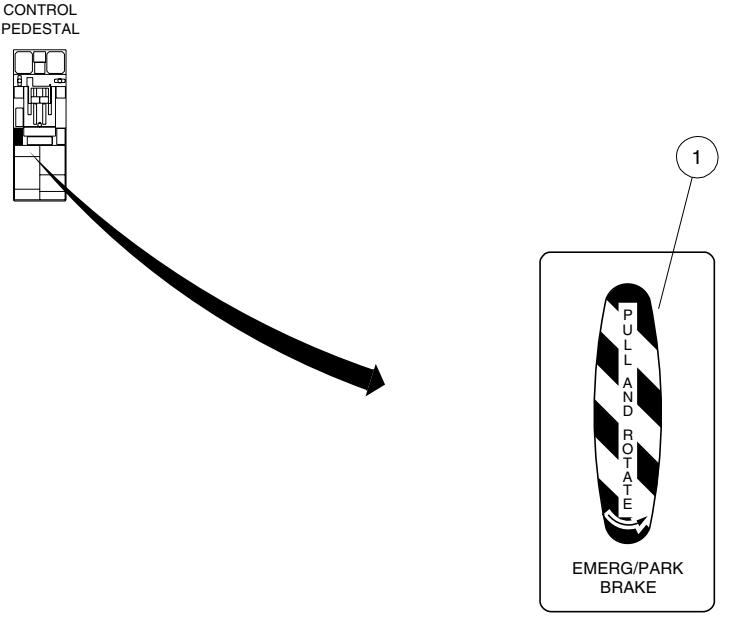
## CONTROL PEDESTAL

### 1 - EMERGENCY/PARKING BRAKE HANDLE

- Actuates the emergency/parking brake valve.
- Pull the handle and rotate to lock in the fully-actuated position.

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**EMERGENCY/PARKING BRAKE HANDLE**

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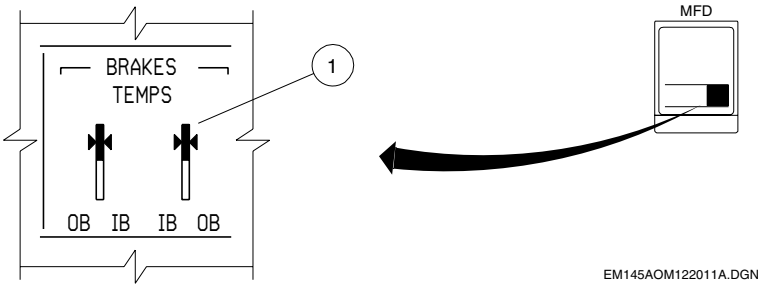
## MFD INDICATIONS

### 1 - BRAKE TEMPERATURE INDICATION

- Temperature is indicated by two vertical bars (one for each main landing gear) and four pointers (one for each brake).
- The scale ranges from 0 to 500°C.
- The scale and pointer are green when temperature is below 200°C, and amber when equal or greater than 200°C.
- The temperature indication pointer is removed from the display in case of loss of temperature sensor signal.

**NOTE:** For EMB-145 airplanes equipped with LR brakes, the scale and pointer are green when temperature is below 250°C, and amber when equal or greater than 250°C.




**BRAKE TEMPERATURE INDICATION**

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# NOSE WHEEL STEERING SYSTEM

The nose wheel steering system is electronically controlled and hydraulically operated. It is powered by the hydraulic system 1. The Electronic Control Module is energized when the landing gear is down and locked, with the airplane on ground. In this condition, steering can be controlled by either the pedals or the steering handle. In either case, the commanded displacement is measured by a potentiometer box, which transmits the signal to the Electronic Control Module. The Electronic Control Module signals the hydraulic manifold to pressurize the steering actuator in the commanded direction. For monitoring purpose, a feedback potentiometer in the nose landing gear leg transmits nose wheel displacement information to the Electronic Control Module.

Maximum nose wheel displacement values due to actuation of the steering handle and pedals are presented in the table below in degrees:

| CERTIFICATION | APPLICABILITY | PEDALS ONLY | STEERING HANDLE ONLY | HANDLE AND PEDALS |
|---|---|---|---|---|
| CTA/JAA | All Airplanes | 5° | 71° | 76° |
| FAA | Pre-Mod. SB 145-32-0002 | 5° | 50° | 55° |
| | Post-Mod. SB 145-32-0002 or S/N 145.029 and on | 5° | 71° | 76° |

**NOTE:** Steering handle actuation with nose wheels beyond their operational limits may cause damage to the nose wheel steering system.
Check if the nose wheel position indication mark is within the nose wheel position indication scale limits.

A position sensor set to 7° disengages the system if the nose wheel is rotated above this limit by using the rudder pedals. To reengage the system, resume command through the handle.

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The steering system may be manually disengaged through buttons located on the pilots' control wheels and allows free steer of the nose wheel. The STEER INOP message appears when the Steering Disengage Button is pressed. This is a system characteristic and not a malfunction. Automatic system disablement occurs as soon as the airplane is airborne. Nose wheel centering with the nose gear shock absorber extension is provided by a cam. The nose wheel is also centered by caster effect whenever the system is disengaged.

If the Electronic Control Module detects a failure, the EICAS is signaled to present a caution message. In these cases, for airplanes Post-Mod. SB 145-32-0104 or with an equivalent modification factory incorporated, the tiller commands will be inhibited if wheel speed is above 25 kt.

Optionally, some airplanes are equipped with an external Steering Disengagement Switch which allows ground personnel to disengage steering prior to towing operations. The switch actuates directly on the steering system, shutting its power down. The disengagement switch inhibits the steering actuation commanded by the steering handle and the rudder pedals. A caution message is displayed on the EICAS whenever the steering system is disengaged by the external switch. Steering Disengagement Switch is installed in a compartment on the left front fuselage.

## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | STEER INOP | Steering system is inoperative. Message is presented only on ground. |

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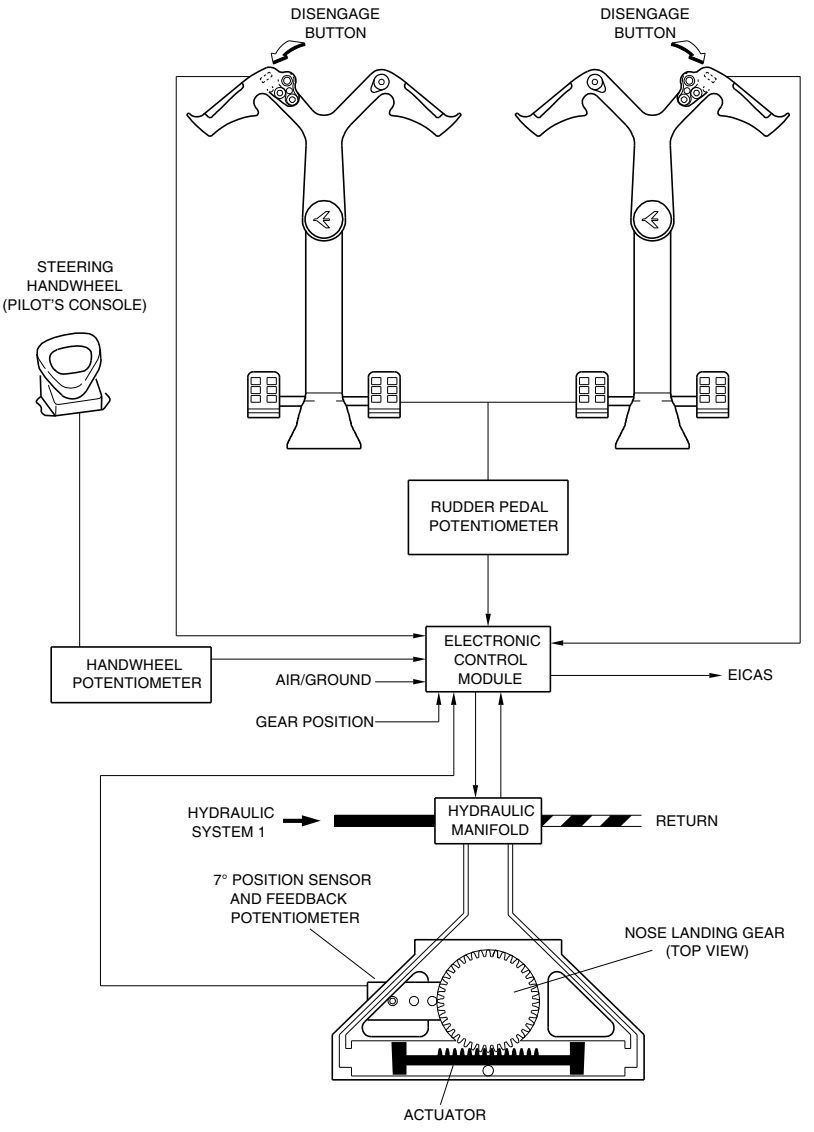


**NOSE WHEEL STEERING SCHEMATIC**

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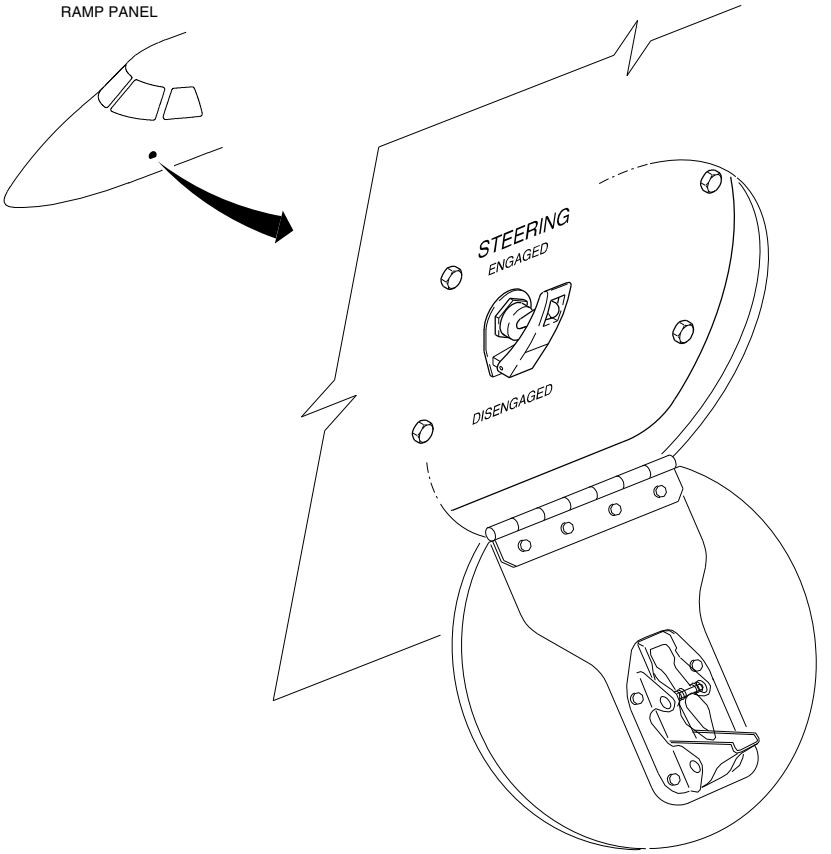
# CONTROLS AND INDICATORS

STEERING DISENGAGEMENT SWITCH (GUARDED)

- ENGAGED - Allows normal steering system operation.
- DISENGAGED - Disables steering system operation.




**STEERING DISENGAGEMENT SWITCH COMPARTMENT**

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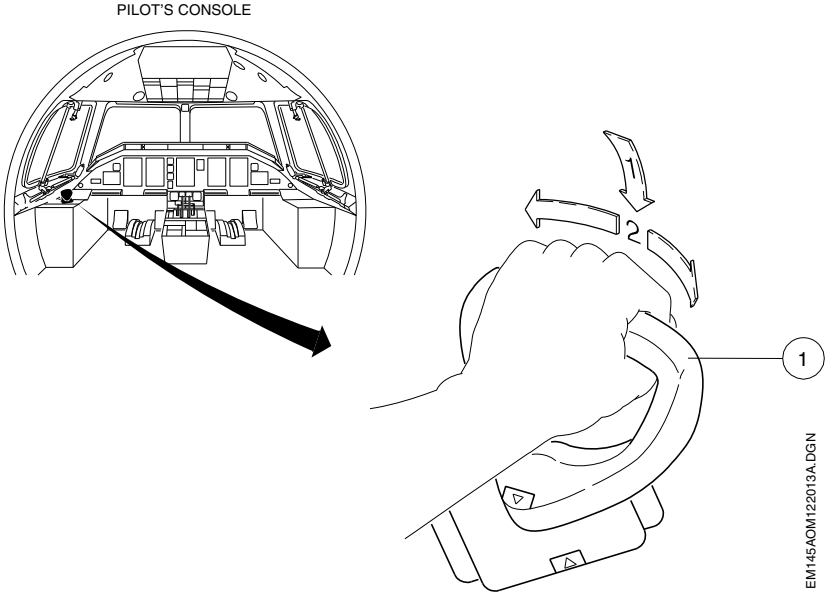
## PILOT'S CONSOLE

### 1 - STEERING HANDLE

- Commands nose wheel steering, allowing 71° deflection to either sides.
- The steering handle can be moved downward and to either sides. When steering handle is moved downward the handle potentiometer output signal is connected to the Electronic Control Module. Push the handle down (step 1) to enable the command or to reset the steering system after disconnection. Rotate left or right (step 2), with the steering handle on down position, to command steering.

**NOTE: -** For airplanes operating under FAA certification and Pre-Mod SB 145-32-0002 the nose wheel steering deflection is limited to 50° to either sides.

- The Steering Handle has priority over the Steering Disengage Button when both are pressed (in case of jammed rudder, the Steering Handle is used to control the airplane and the pilot must keep the Steering Disengage Button pressed to avoid undesired pedal command once on ground).




**STEERING HANDLE**

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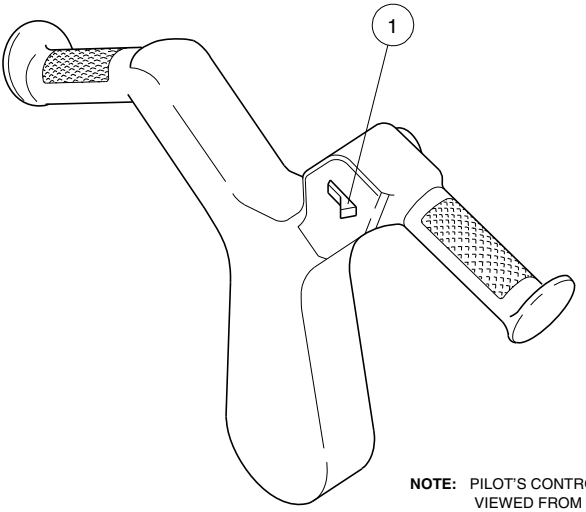
## CONTROL WHEEL

### 1 - STEERING DISENGAGE BUTTON

– When pressed disengages the nose wheel steering system.




**NOTE:** PILOT'S CONTROL WHEEL SHOWN, VIEWED FROM BEHIND.

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**STEERING DISENGAGE BUTTON**

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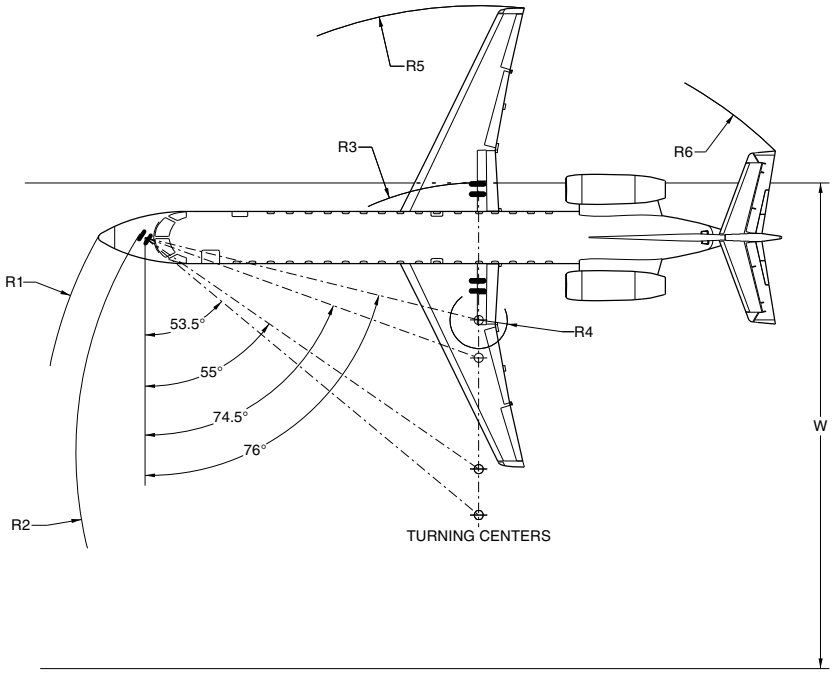
# EMB-145 MINIMUM TURNING RADII




| STEERING ANGLE | NOSE R1 | NOSE GEAR R2 | OUTBOARD GEAR R3 | INBOARD GEAR R4 | RIGHT WINGTIP R5 | RIGHT TAILTIP R6 | WIDTH W |
|---|---|---|---|---|---|---|---|
| 53.5° | 19.79 m | 18.19 m | 13.08 m | 8.31 m | 20.81 m | 19.43 m | 31.27 m |
| | 64 ft 11 in | 59 ft 8 in | 42 ft 3 in | 27 ft 3 in | 68 ft 3 in | 63 ft 9 in | 102 ft 6 in |
| 55° | 19.48 m | 17.86 m | 12.50 m | 7.74 m | 20.24 m | 19.00 m | 30.36 m |
| | 63 ft 11 in | 58 ft 7 in | 41 ft 0 in | 25 ft 5 in | 66 ft 5 in | 62 ft 4 in | 99 ft 6 in |
| 74.5° | 17.10 m | 15.21 m | 6.39 m | 1.62 m | 14.17 m | 15.12 m | 21.94 m |
| | 56 ft 1 in | 49 ft 11 in | 21 ft 0 in | 5 ft 4 in | 46 ft 6 in | 49 ft 7 in | 72 ft 0 in |
| 76° | 17.01 m | 15.11 m | 5.99 m | 1.25 m | 13.77 m | 14.92 m | 21.21 m |
| | 55 ft 9 in | 49 ft 7 in | 19 ft 8 in | 4 ft 1 in | 45 ft 2 in | 48 ft 11 in | 69 ft 7 in |

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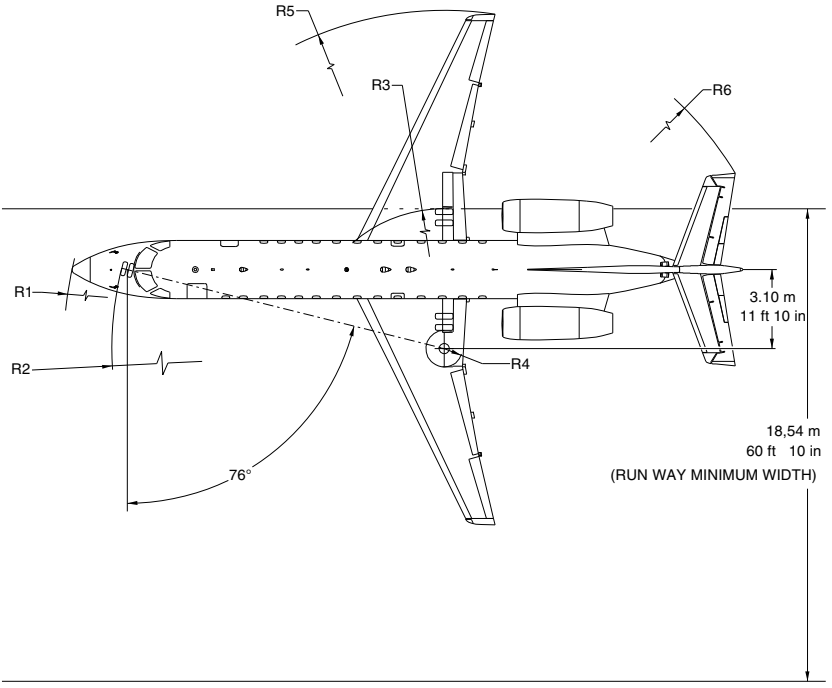
# EMB-135 MINIMUM TURNING RADII




| STEERING STEEL | NOSE R1 | NOSE GEAR R2 | OUTBOARD GEAR R3 | INBOARD GEAR R4 | RIGHT WINGTIP R5 | RIGHT TAILTIP R6 |
|---|---|---|---|---|---|---|
| 76° | 14.94 m | 13.05 m | 5.49 m | 0.72 m | 13.27 m | 13.34 m |
| | 49 ft 0 in | 42 ft 10 in | 18 ft 0 in | 2 ft 4 in | 43 ft 7 in | 43 ft 9 in |

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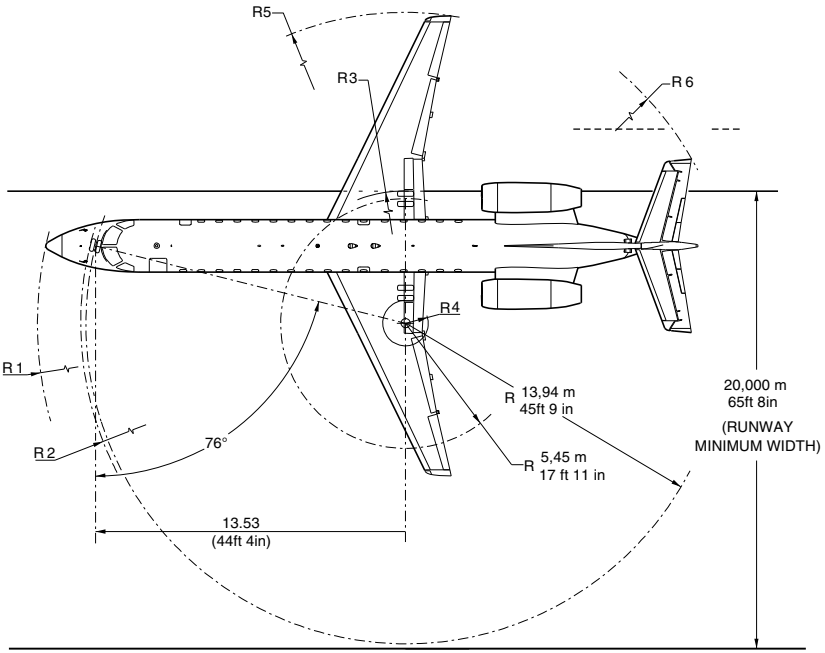
# EMB-140 MINIMUM TURNING RADII




| STEERING STEEL | NOSE R1 | NOSE GEAR R2 | OUTBOARD GEAR R3 | INBOARD GEAR R4 | RIGHT WINGTIP R5 | RIGHT TAILTIP R6 |
|---|---|---|---|---|---|---|
| 76° | 16.05 m | 14.16 m | 5.74 m | 0.98 m | 13.53 m | 14.40 m |
| | 52 ft 8 in | 46 ft 6 in | 18 ft 10 in | 3 ft 3 in | 44 ft 5 in | 47 ft 3 in |

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# SECTION 2-13

# FLIGHT CONTROLS

TABLE OF CONTENTS

Block Page

General ..... 2-13-05 .. 01
Pitch Control ..... 2-13-10 .. 01
General ..... 2-13-10 .. 01
Elevator ..... 2-13-10 .. 02
General ..... 2-13-10 .. 02
Jammed Elevator ..... 2-13-10 .. 02
Jammed Elevator Operation ..... 2-13-10 .. 02
Tabs ..... 2-13-10 .. 02
General ..... 2-13-10 .. 02
Servo Tabs ..... 2-13-10 .. 02
Spring Tabs ..... 2-13-10 .. 03
Pitch Trim System ..... 2-13-10 .. 05
General ..... 2-13-10 .. 05
System Components ..... 2-13-10 .. 05
Horizontal Stabilizer Control Unit (HSCU) ..... 2-13-10 .. 05
Horizontal Stabilizer Actuator (HSA) ..... 2-13-10 .. 05
System Operation ..... 2-13-10 .. 06
Pitch Trim Channels Priority ..... 2-13-10 .. 08
Pitch Trim System Protection ..... 2-13-10 .. 08
Switch Protection ..... 2-13-10 .. 08
Runaway Protection ..... 2-13-10 .. 08
Inadvertent Actuation Protection ..... 2-13-10 .. 09
HSA Excessive Load Protection ..... 2-13-10 .. 09
EICAS Messages ..... 2-13-10 .. 10
Controls and Indicators ..... 2-13-10 .. 12
Control Stand ..... 2-13-10 .. 12
Control Wheel ..... 2-13-10 .. 14
Control Pedestal Aft Panel ..... 2-13-10 .. 15
EICAS Indication ..... 2-13-10 .. 17
Roll Control ..... 2-13-15 .. 01
Aileron Control System ..... 2-13-15 .. 02
Roll Trim System ..... 2-13-15 .. 04

User: fhhernа0f - Printed By myTechCare - Nov 21/24 - 00:45:44

EICAS Messages ..... 2-13-15 .. 06
Controls and Indicators ..... 2-13-15 .. 06
Flight Controls Panel ..... 2-13-15 .. 06
Control Stand ..... 2-13-15 .. 07
Control Pedestal Aft Panel ..... 2-13-15 .. 08
EICAS Indications ..... 2-13-15 .. 09
Yaw Control ..... 2-13-20 .. 01
Rudder Control System ..... 2-13-20 .. 02
Automatic Shutoff Through the Speed Switch ..... 2-13-20 .. 04
Rudder Hardover Protection ..... 2-13-20 .. 04
Rudder Deflection ..... 2-13-20 .. 05
Airplanes Under CTA and FAA Certification ..... 2-13-20 .. 05
Airplanes Under JAA Certification ..... 2-13-20 .. 05
Yaw Trim System ..... 2-13-20 .. 06
EICAS Messages ..... 2-13-20 .. 08
Controls and Indicators ..... 2-13-20 .. 09
Flight Controls Panel ..... 2-13-20 .. 09
Control Pedestal Aft Panel ..... 2-13-20 .. 10
Main Panel ..... 2-13-20 .. 11
EICAS Indications ..... 2-13-20 .. 12
Gust Lock System ..... 2-13-25 .. 01
Mechanical Gust Lock System ..... 2-13-25 .. 01
Electromechanical Gust Lock System ..... 2-13-25 .. 01
Locking Operation ..... 2-13-25 .. 02
Unlocking Operation ..... 2-13-25 .. 04
Controls and Indicators ..... 2-13-25 .. 06
Glareshield Panel ..... 2-13-25 .. 06
Control Stand ..... 2-13-25 .. 07
Flap System ..... 2-13-30 .. 01
Flap System Operation ..... 2-13-30 .. 02
EICAS Messages ..... 2-13-30 .. 04
Controls and Indicators ..... 2-13-30 .. 04
Control Pedestal Aft Panel ..... 2-13-30 .. 04
EICAS Indications ..... 2-13-30 .. 06
Spoiler System ..... 2-13-35 .. 01
Ground Spoiler ..... 2-13-35 .. 02
Speed Brake ..... 2-13-35 .. 02
EICAS Messages ..... 2-13-35 .. 04
Controls and Indicators ..... 2-13-35 .. 04
Control Stand ..... 2-13-35 .. 04
EICAS Indications ..... 2-13-35 .. 06

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# GENERAL

The primary flight control system consists of elevators, ailerons and rudder. Elevators are mechanically actuated. The ailerons and rudder are hydraulically powered and may also be mechanically actuated in case of loss of both hydraulic systems.

Trim system is provided in all axis. Tabs are provided for pitch control only, and are not available for ailerons and rudder.

A gust lock system blocks elevator controls on the ground, avoiding damage to the control systems in case of strong wind gusts. The rudder and ailerons are hydraulically damped for the same purpose.

An electrically operated flap system is provided with five discrete positions.

Speed brakes installed overwing allow increased descent rate and help in decelerating the airplane. Ground spoilers destroy lift, thus providing better braking effectiveness.

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**FLIGHT CONTROL SURFACES**

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# PITCH CONTROL

## GENERAL

Pitch control is provided by mechanically-actuated elevators and an electrically-positioned horizontal stabilizer which is commanded through the Pitch Trim System. Tabs are automatically positioned, thus reducing pilots effort.

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# ELEVATOR

## GENERAL

The primary pitch control system is performed by the elevators, which are actuated through a fully duplicated set of command circuits.

## JAMMED ELEVATOR

In case of jamming of one of the circuits (left or right), both elevator panels may be disconnected through a handle located on the control pedestal. This procedure will release the free elevator panel from its jammed counterpart, allowing the free panel to be commanded.

When disconnected, an amber light illuminates on the control stand. Controls cannot be reconnected during flight, requiring maintenance action.

## JAMMED ELEVATOR OPERATION

The autopilot elevator servo and the stick pusher servo are connected on the left side of the disconnection device. Once disconnection is actuated, the stick pusher will actuate only on the left side and autopilot must not be used.

# TABS

## GENERAL

There are four tabs, two on each elevator panel, located near the elevator root. The outer tabs are servo tabs and the inner tabs are spring tabs.

## SERVO TABS

The deflection of the servo tabs is proportional to the elevator deflection. Since the servo tabs proportionally deflects in the opposite direction to the elevators, it promotes a reduction in the forces required.

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## SPRING TABS

The spring tabs are connected in such a way that elevator deflection in one direction causes the spring tab to move in the opposite direction, thus reducing the amount of force required to move the elevator.

Spring tab deflection is proportional to the control column force and, therefore, to the aerodynamic load imposed on the elevator. At low speeds, the spring tab remains in the neutral position. At high speeds, where the aerodynamic load is greater, the tab functions as an aid in moving the elevator.

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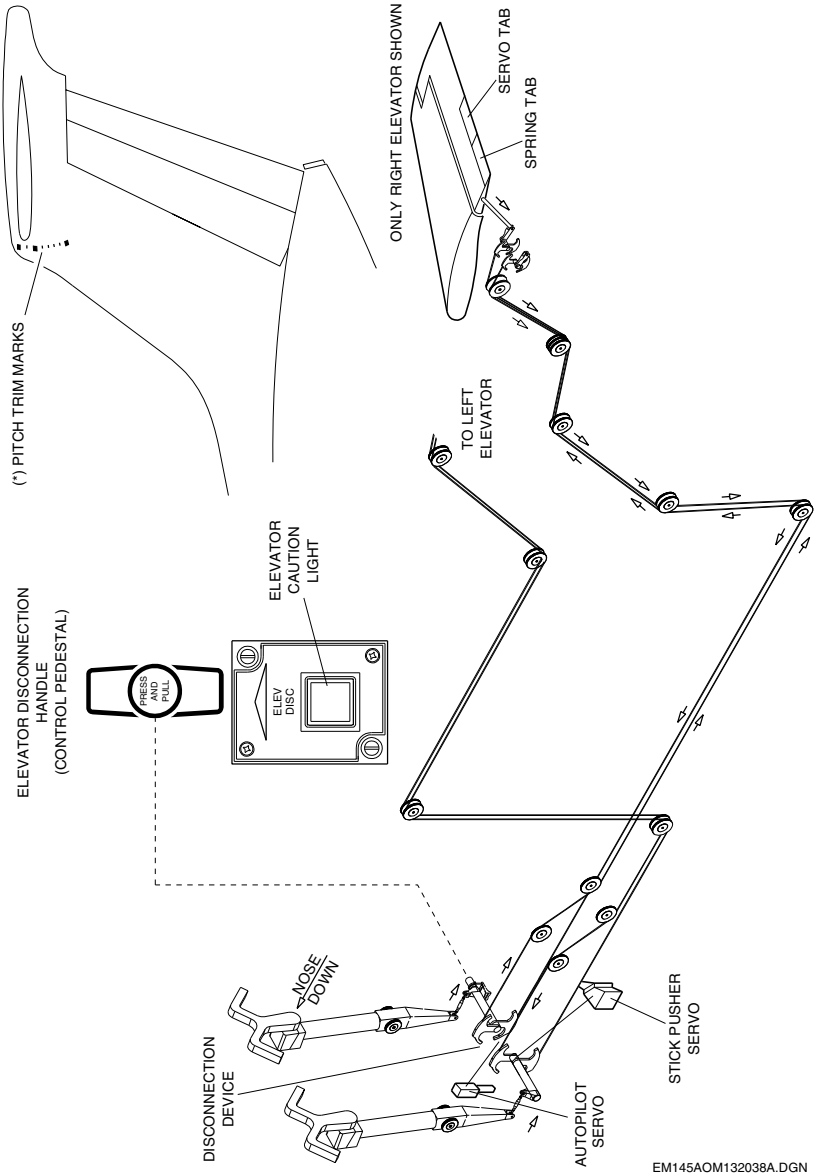


## ELEVATOR SCHEMATIC

(*) The thick marks represent, respectively, 4° nose down (top of the scale), neutral, and 10° nose up (bottom of the scale) and each intermediate marks represent a 2° variation.



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# PITCH TRIM SYSTEM

## GENERAL

Pitch trim is accomplished by an electrically-actuated movable horizontal stabilizer. The system may be either automatically or manually commanded. In both cases, the pitch trim signal is sent to the Horizontal Stabilizer Control Unit (HSCU) channels, which after processing it, command the electric motor in the Horizontal Stabilizer Actuator (HSA).

## SYSTEM COMPONENTS

### Horizontal Stabilizer Control Unit (HSCU)

The Horizontal Stabilizer Control Unit (HSCU) is located in the rear electronic compartment at the rear fuselage. It incorporates two identical control channels, main and backup. These channel operations are totally independent from each other. If the pitch trim main channel is inoperative, the horizontal stabilizer can still be commanded through the backup channel.

The HSCU controls the trimming rate (in degrees/second) based upon the airplane airspeed. The trimming rate reduces as the airspeed increases. The HSCU also checks the stabilizer surface position. When the Takeoff Configuration Check Button is pressed, if the surface is not within the takeoff green band limits, an aural warning message is sounded to the crew.

### Horizontal Stabilizer Actuator (HSA)

The Horizontal Stabilizer Actuator (HSA) consists of an electromechanical actuator driven by two DC motors. One of the motors is driven by the main control channel of the Horizontal Stabilizer Control Unit (HSCU) and the other motor is driven by the backup channel of the HSCU. Only one motor will be driven at a time.

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## SYSTEM OPERATION

Pitch trim commands may be done manually through the main switches on the control wheels or through backup switch on the control pedestal aft panel and automatically commanded through the autopilot or speed brake actuation.

When using the main control wheel trim switches or the backup trim switch, it is necessary to command both halves simultaneously because, if just one half is commanded, the control unit will not provide any command to the actuator.

In the case of activation of any stick shaker, the pitch trim up command will be inhibited.

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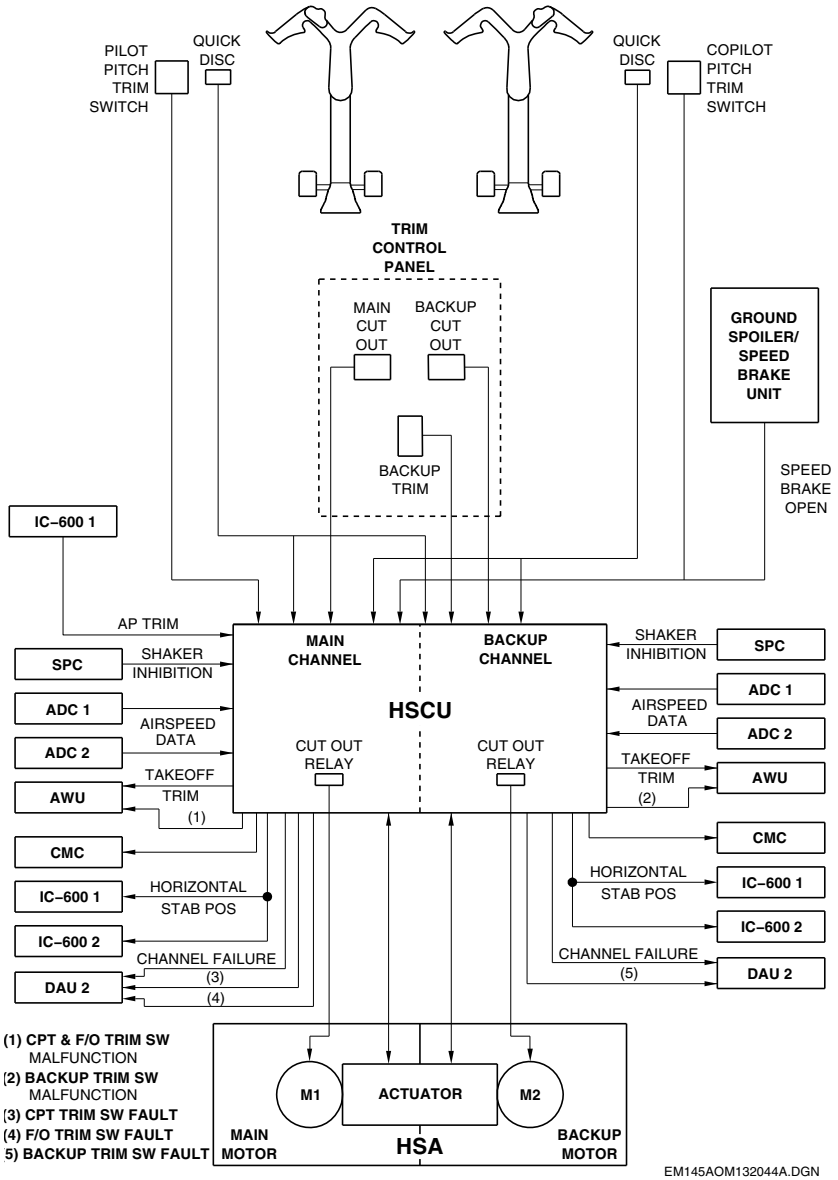


## PITCH TRIM SCHEMATIC

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## PITCH TRIM CHANNELS PRIORITY

Command priorities are: LH switch actuation overcomes the RH switch actuation, which, in turn, overcomes the autopilot. There is no priority with respect to the actuation of the main pitch trim switches and the backup pitch trim switches, the first being commanded taking priority. The main and backup pitch trim switches should not be commanded simultaneously. For the case of a simultaneous command of both channels, there is an specific logic inside the HSCU:

- For airplanes equipped with an HSCU P/N 362100-1009, -5009 or newer, the message PIT TRIM 1 (2) INOP will be displayed on the EICAS, associated to the second switch commanded. This message will disappear around 4 seconds after the second pitch trim switch is released.
- For airplanes equipped with an HSCU P/N 362100-1007, if the switches are commanded in different directions, the secondly commanded channel will become inoperative for the remainder of the flight and the respective message, PIT TRIM 1 (2) INOP, will be displayed on EICAS.

## PITCH TRIM SYSTEM PROTECTION

### Switch Protection

When only one half of the main control wheel trim switch or backup trim switch is commanded for more than 7 seconds continuously, the control unit will recognize that one half of the switch is failed stuck at the commanded position and will disregard any other command coming from that faulty switch.

**NOTE:** For airplanes equipped with HSCU -1009 or -5009 or newer and AWU -5 a TRIM voice message is provided to alert pilots that just one half of switch is being commanded and those equipped with HSCU -1009 or -5009 or newer and EICAS version 18 and on the messages PTRIM CPT SW FAIL, PTRIM F/O SW FAIL and PTRIM BKP SW FAIL will be displayed on the EICAS.

### Runaway Protection

A quick-disconnect button on each control wheel allows disconnection from the entire pitch trim system. In case of a runaway horizontal stabilizer, the button must be kept pressed until a definite disengagement is accomplished through the cutout buttons on the control pedestal.

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### Inadvertent Actuation Protection

A continuous command of any trim switch is limited to 3 seconds, even if the trim switch is pressed longer than 3 seconds. As a result, when manually actuating the trim, it is necessary to release the switch after a 3-second actuation, then actuate it again to continue the trim command. This feature intends to minimize the effects of an inadvertent trim command of the main and backup trim switches or Ground Spoiler/Speed Brake Unit. The autopilot command is not limited in time and has another logic to preclude inadvertent actuation.

**NOTE:** For airplanes equipped with an HSCU -5009 MOD.2 or newer and AWU -5 a TRIM voice message is provided to alert pilots that the trim switch is being pressed for more than 3 seconds.

### HSA Excessive Load Protection

The crew should keep the airplane trimmed to avoid excessive loads on the Horizontal Stabilizer Actuator (HSA), especially after takeoff. High loads on horizontal stabilizer may stall the HSA, inducing a temporary loss of pitch trim command.

For airplanes equipped with an HSCU P/N 362100-1007 if the trim switches are actuated for a period of time that totalizes 8 seconds during the period when the horizontal stabilizer actuator is stalled, the control unit will switch the associated system (main or backup) off and the message PIT TRIM 1 (2) INOP will be permanently displayed on the EICAS.

For airplanes equipped with an HSCU P/N 362100-1009, -5009 or newer, if the pitch trim switches are actuated during the period when the Horizontal Stabilizer Actuator is stalled, the message PIT TRIM 1 (2) INOP will be displayed on the EICAS. The message will disappear if the trim switch is released or any horizontal stabilizer motion is detected. If the trim switches are actuated for a period of time that totalizes 16 seconds during the period when the horizontal stabilizer actuator is stalled, the control unit will switch the associated system (main or backup) off and the message PIT TRIM 1 (2) INOP will be permanently displayed on the EICAS.

**NOTE:** For airplanes equipped with EICAS version 18 and on, the messages PIT TRIM 1 (2) INOP have been replaced with PTRIM MAIN INOP or PTRIM BACKUP INOP.

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## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | PIT TRIM 1 (2) INOP | Pitch trim system 1 (main) or system 2 (backup) is inoperative, or<br><br>Quick Disconnect button is kept pressed for more than 5 seconds (airplanes equipped with EICAS 17.5 only). This message will disappear after the button is released, or<br><br>Pitch trim system 1 (main) or system 2 (backup) being actuated with the HSA stalled. |
| | PTRIM MAIN INOP (*) | Pitch trim main system is inoperative, or<br><br>Quick Disconnect button is kept pressed for more than 11 seconds. This message will disappear after the button is released, or<br><br>Main trim switch(es) actuation associated with the horizontal stabilizer being commanded by the backup switch, or<br><br>Main trim switch being actuated with the HSA stalled. |

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## EICAS MESSAGES (CONTINUED)

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | PTRIM BACKUP INOP (*) | Pitch trim backup system is inoperative, or<br><br>Quick Disconnect button is kept pressed for more than 11 seconds. This message will disappear after the button is released, or<br><br>Backup trim switch actuation associated with horizontal stabilizer being commanded by the main channel, or<br><br>Backup trim switch being actuated with the HSA stalled. |
| CAUTION | PTRIM CPT SW FAIL (*) | Pilot´s pitch trim switch is inoperative. |
| | PTRIM F/O SW FAIL (*) | Copilot´s pitch trim switch is inoperative. |
| | PTRIM BKP SW FAIL (*) | Pitch trim backup switch is inoperative. |

(*) APPLICABLE TO AIRPLANES EQUIPPED WITH EICAS VERSION 18 AND ON.

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# CONTROLS AND INDICATORS

## CONTROL STAND

### 1 - ELEVATOR DISCONNECTION HANDLE

- When pulled, disconnects pilot's from copilot's controls.
- To pull the handle, the safety lock button must be pressed.

### 2 - ELEVATOR DISCONECTION LIGHT

- Illuminates to indicate that the elevator mechanism is disconnected.

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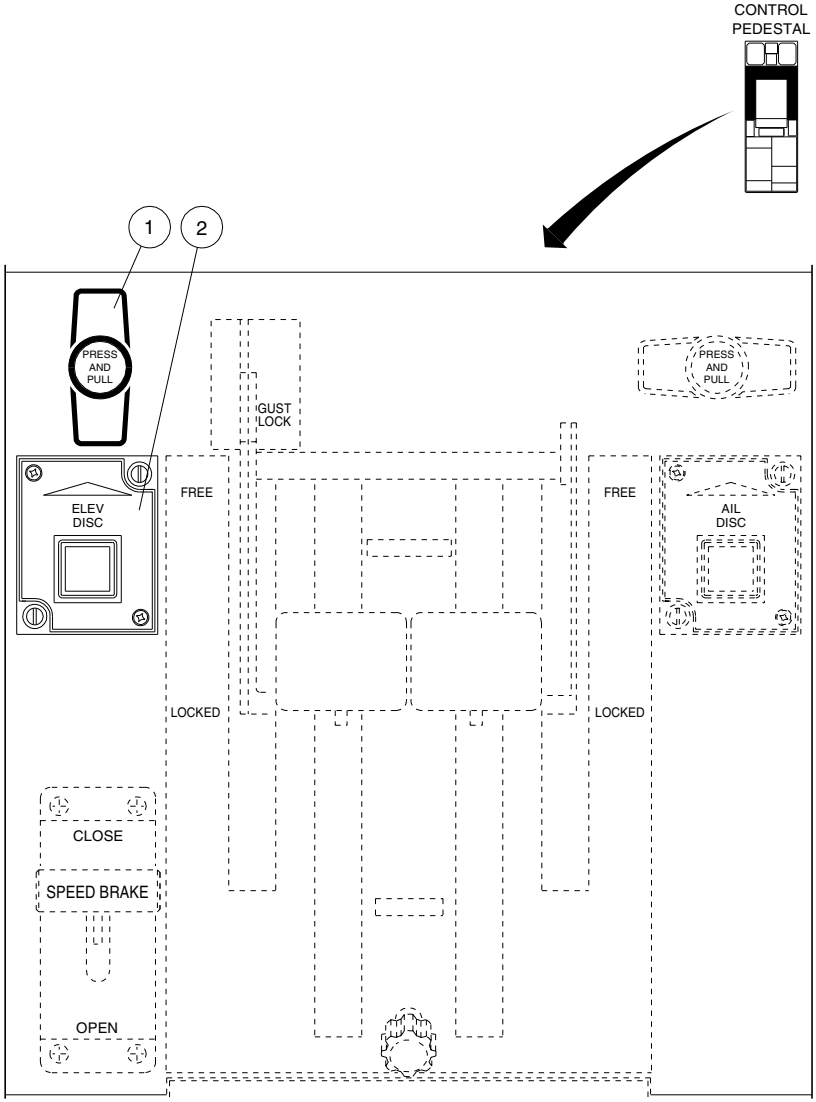


**CONTROL STAND**

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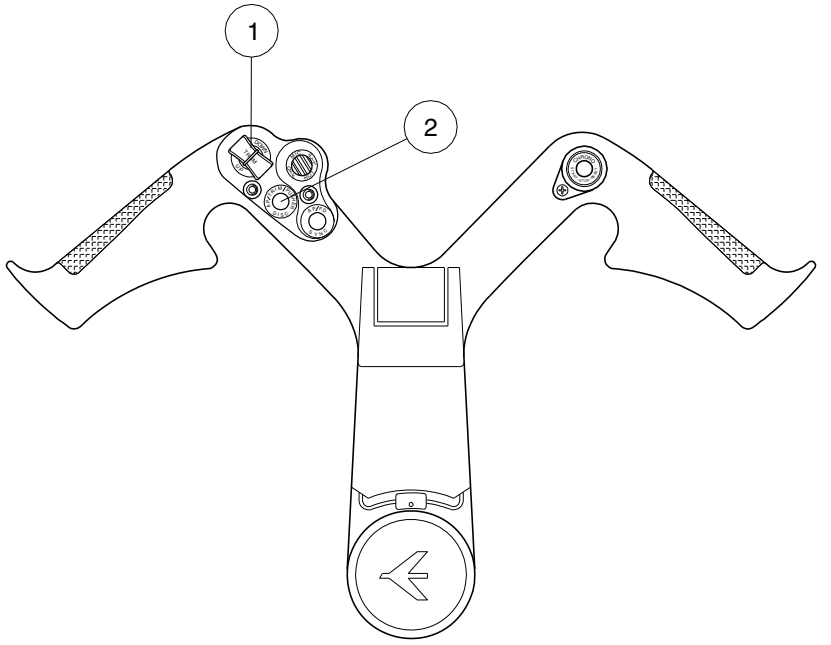
## CONTROL WHEEL

### 1 - PITCH TRIM SWITCH (SPRING-LOADED TO NEUTRAL)

- Allows trimming the airplane when the autopilot is not engaged. The trim switch is a 3-position (UP/OFF/DN) rocker switch.
- Operating the switch while the autopilot is engaged causes the autopilot to disengage.
- It is divided into two segments, which have to be actuated together to provide command.

### 2 - QUICK-DISCONNECT BUTTON (MOMENTARY ACTION)

- When pressed, disconnects all trim systems.

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## CONTROL PEDESTAL AFT PANEL

**1 - PITCH TRIM MAIN SYSTEM CUTOUT BUTTON (SAFETY GUARDED)**

- Cuts out (pushed out) or enables (pushed in) the Main Pitch Trim system.
- A striped bar illuminates inside the button to indicate that it is pushed out.
- Autopilot is not available.

**2 - PITCH TRIM BACKUP SYSTEM CUTOUT BUTTON (SAFETY GUARDED)**

- Cuts out (pushed out) or enables (pushed in) the Backup Pitch Trim system.
- A striped bar illuminates inside the button to indicate that it is pushed out.
- Autopilot is available.

**3 - PITCH TRIM BACKUP SWITCH (SPRING-LOADED TO NEUTRAL)**

- Pushed out forward or backward actuates the pitch trim through the backup channel.
- Operation of the switch while the autopilot is engaged causes the autopilot to disengage.
- It is divided into two segments, which have to be actuated together to provide command.

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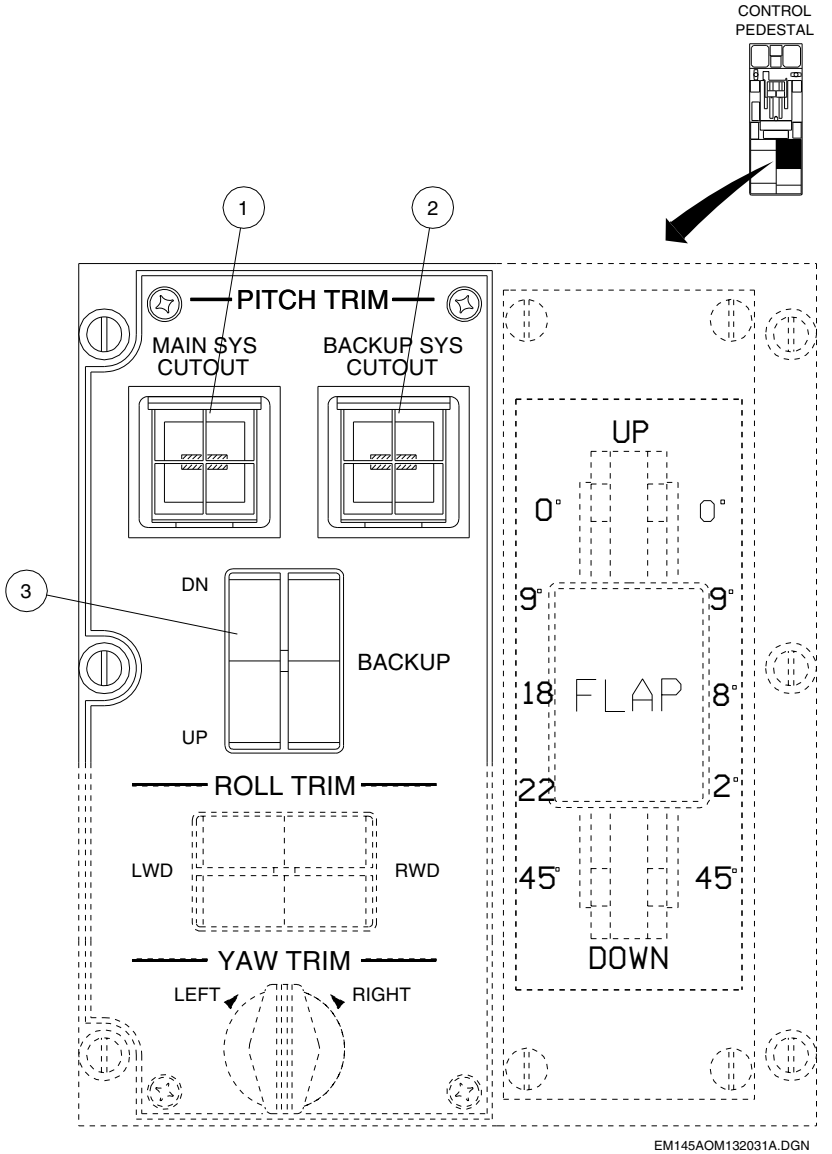


**CONTROL PEDESTAL AFT PANEL**

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## EICAS INDICATION

### 1 - PITCH TRIM indication

- A green pointer moving on a white vertical scale represents the amount of pitch compensation.
- Trim position is indicated digitally in a white box.
- The letters UP or DN are presented above the box to indicate that the airplane is trimmed up or down.
- Scale ranges from 4° nose down (bottom of scale) to 10° nose up (top of scale). Every thick mark on the scale represents 3.5° of pitch.
- A green band is provided on the analog scale from 4° to 8° nose up to indicate the allowable takeoff position range for the horizontal stabilizer.

**NOTE**: Due to the system's resolution, it's possible to have the digits, box and pointer turning amber, in spite of the fact that the pitch trim indication is displayed at 4º or 8º. The trim setting color displayed on the EICAS depends on the horizontal stabilizer surface position. For the unit 8 displayed on the EICAS the surface position can be between 7.7° and 8.7° going upward and between 8.3° and 7.3° going downward. The color change would occur when the surface position is 8.1°. For this reason, when setting pitch trim to 8, first select 7. Then, increase slowly and stop trimming immediately when the value 8 is displayed. For the unit 4 displayed on the EICAS, the surface position can be between 3.7° and 4.7° going upward and between 4.3° and 3.3° going downward. The color change would occur when the surface position is 3.9°. For this reason, when setting pitch trim to 4, first select 5. Then, decrease slowly and stop trimming immediately when the value 4 is displayed. This procedure prevents to set the trim at the top or bottom of the green band in order to avoid the possibility of encountering takeoff config warnings.

- In the event of a pitch trim miscomparison, the pointer, digital value, and the direction indication are removed from display.
- If the pitch trim is out of the green band and the airplane is on the ground, the pointer and digital indications will turn amber.

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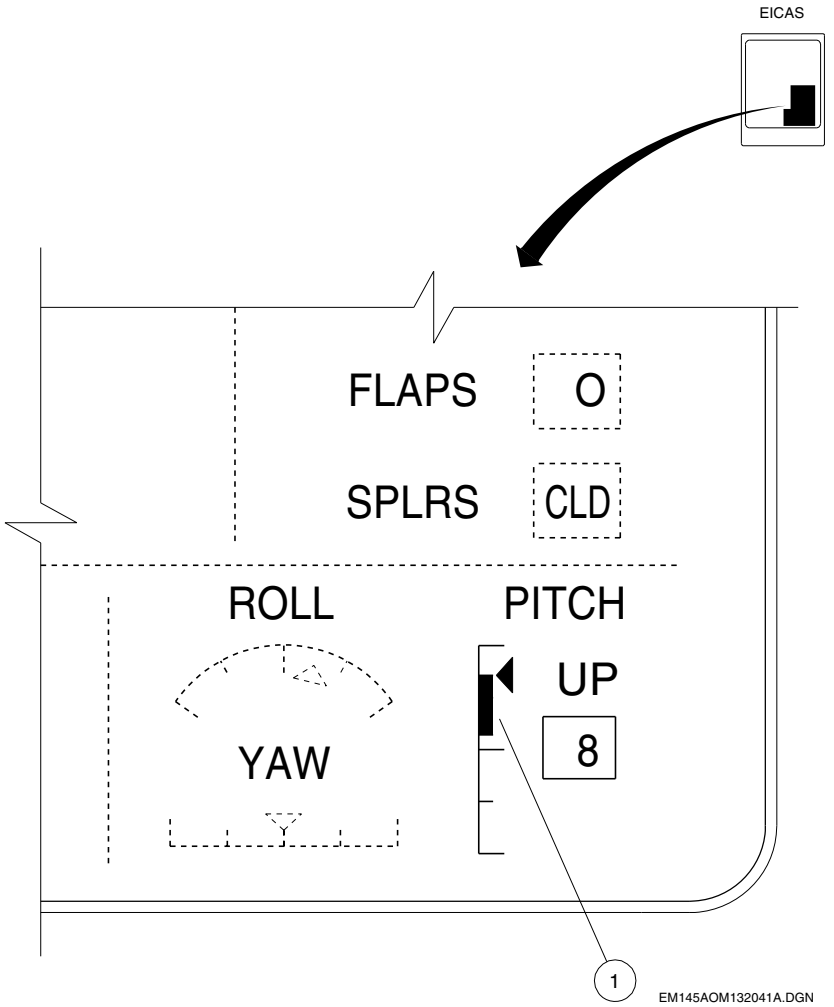
– If the airplane is on the ground, any thrust lever angle is above 60° and pitch trim is outside the green band, the digits, box, and pointer turn red, the aural warning TAKEOFF TRIM sounds and the EICAS warning message NO TAKEOFF CONFIG is displayed.




**EICAS INDICATIONS**

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# ROLL CONTROL

Roll control is provided by hydraulically-actuated ailerons controlled by either control wheel.

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## AILERON CONTROL SYSTEM

The ailerons are positioned by the pilot´s control wheels, which are linked together by a torque tube and cables to supply mechanical input to two separate hydraulic actuators.

Each aileron actuator is supplied by both hydraulic systems. Either hydraulic system is capable of providing full power control. If necessary, each hydraulic system supply can be shut off, by means of a button installed on the overhead panel. In case of loss of both hydraulic systems, rotation of the pilot´s control wheels mechanically positions the ailerons.

In case of jamming of either aileron, both panels may be disconnected through a handle located on the control pedestal. This procedure will release the free aileron from its jammed counterpart allowing the free panel to be commanded. When disconnected, an amber light illuminates on the control stand. Controls cannot be reconnected during flight, requiring maintenance action.

An autopilot servo is installed on the left side of the torque tube. The roll trim servo and the artificial feel unit are installed on the right side of the torque tube. In case of system disconnection, the artificial feel unit will actuate on the right aileron only and the autopilot must not be used. The artificial feel unit is provided to give pilots a aerodynamic load feedback imposed on the aileron surface.

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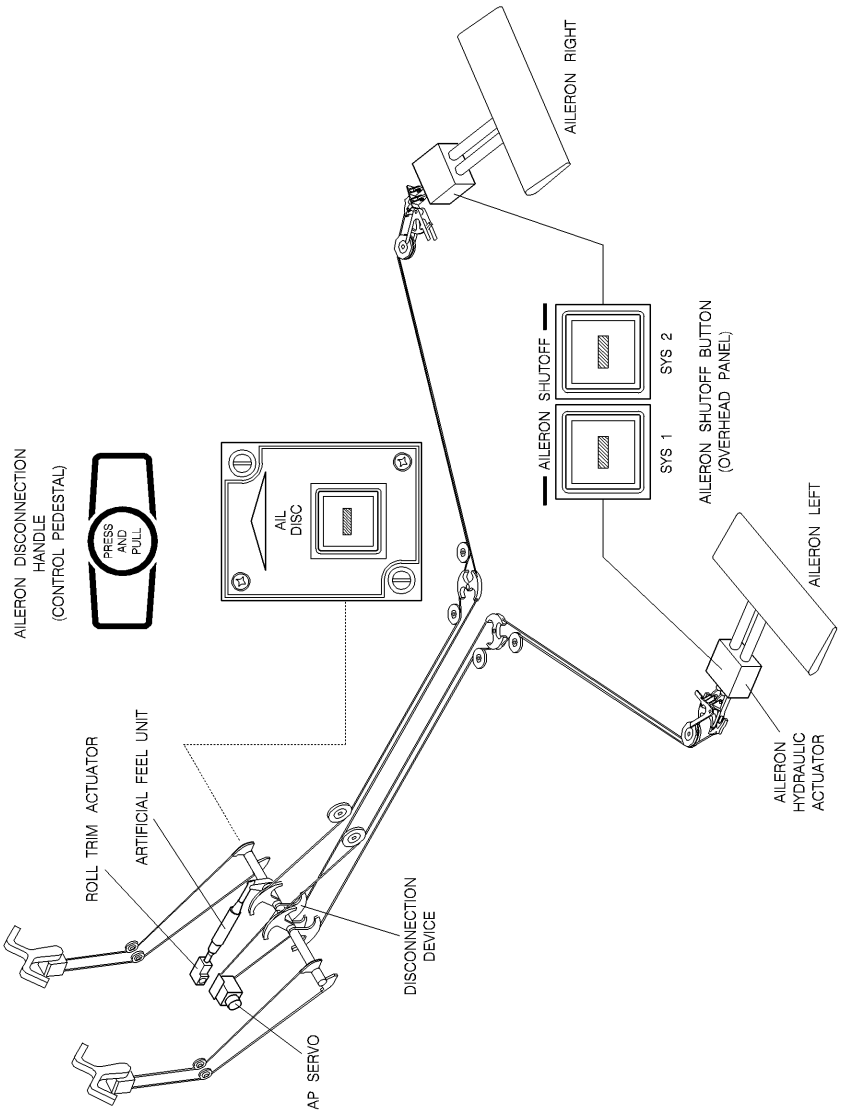


## AILERON SCHEMATIC

## ROLL TRIM SYSTEM

Roll trim is performed by relocating the aileron's neutral position. It is provided through an electromechanical actuator linked to the artificial feel unit and commanded through a switch on the control pedestal aft panel. If the aileron trim switches are activated with the autopilot engaged, the aileron neutral point is repositioned. When the autopilot is disengaged, the ailerons move to the repositioned aileron neutral point.

A continuous command of the roll trim switch is limited to 3 seconds, even if the trim switch is pressed longer than 3 seconds. As a result, when manually actuating the trim, it is necessary to release the switch after a 3-second actuation, then actuate it again to continue the trim command. This feature intends to minimize the effects of an inadvertent trim command failure.

When using the roll trim switch, it is necessary to command both segments simultaneously since, if just one segment is commanded, the control unit will not provide any command for the actuator.

A quick-disconnect button installed on the control wheels allows, while kept pressed, to disconnect the roll trim.

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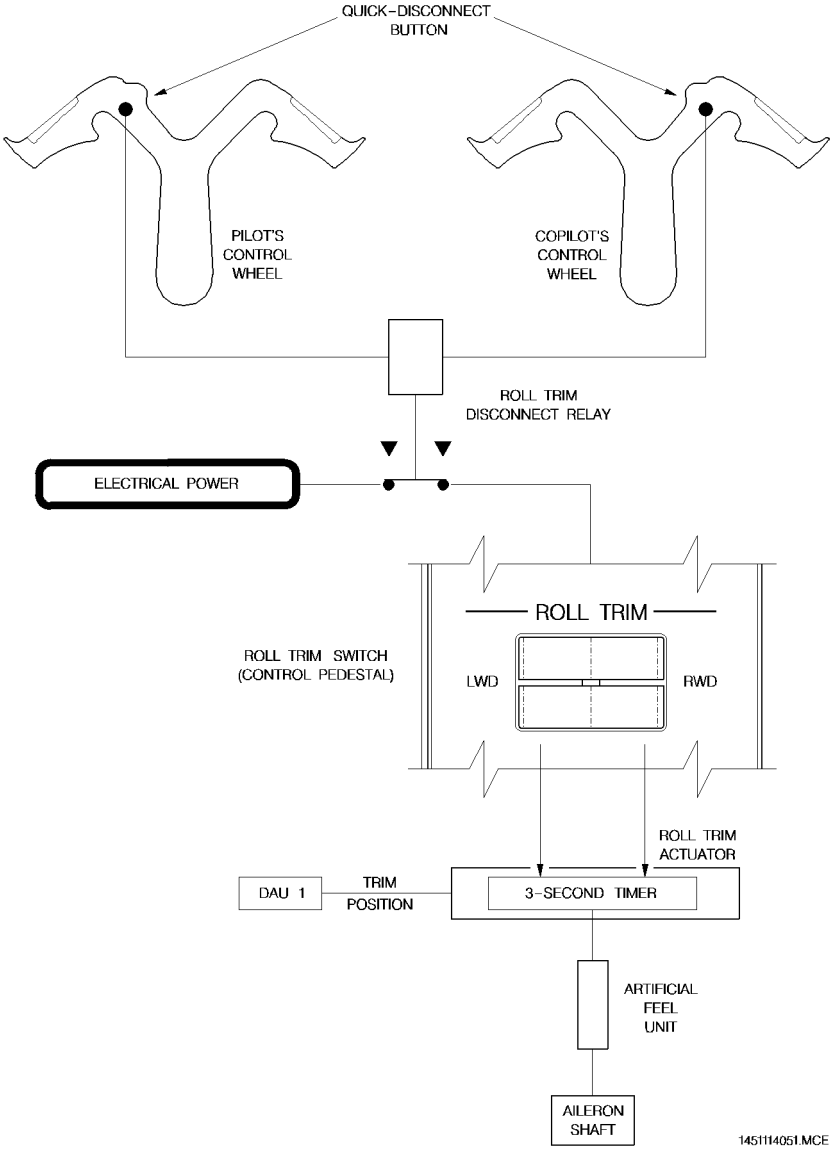



## ROLL TRIM SCHEMATIC

# EICAS MESSAGES

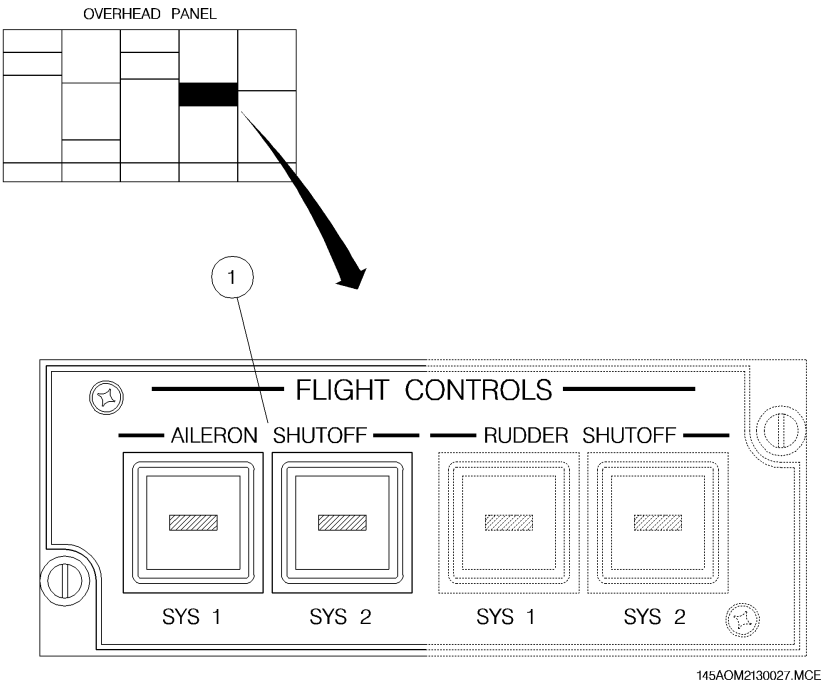
| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | AIL SYS 1 (2) INOP | Aileron actuation through hydraulic power is inoperative. |

# CONTROLS AND INDICATORS

## FLIGHT CONTROLS PANEL

### 1 - AILERON SHUTOFF BUTTON

- Enables (pressed) or disables (released) the supply of hydraulic power from the associated system to the aileron units.
- A striped bar illuminates in the button to indicate that it is released.




**FLIGHT CONTROLS PANEL**

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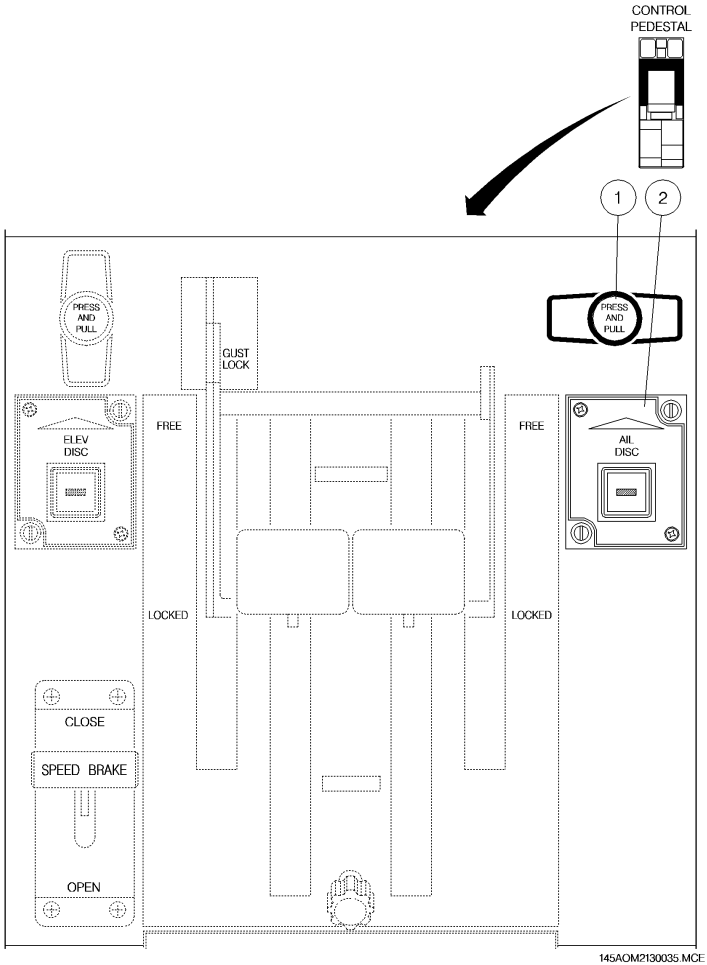
# CONTROL STAND

## 1 - AILERON DISCONNECTION HANDLE

- When pulled, disconnects pilot's from copilot's controls.
- To pull the handle, the safety lock button must be pressed.

## 2 - AILERON DISCONNECTION LIGHT

- When the striped bar is illuminated, indicates that the aileron disconnection mechanism is actuated.




**CONTROL STAND**

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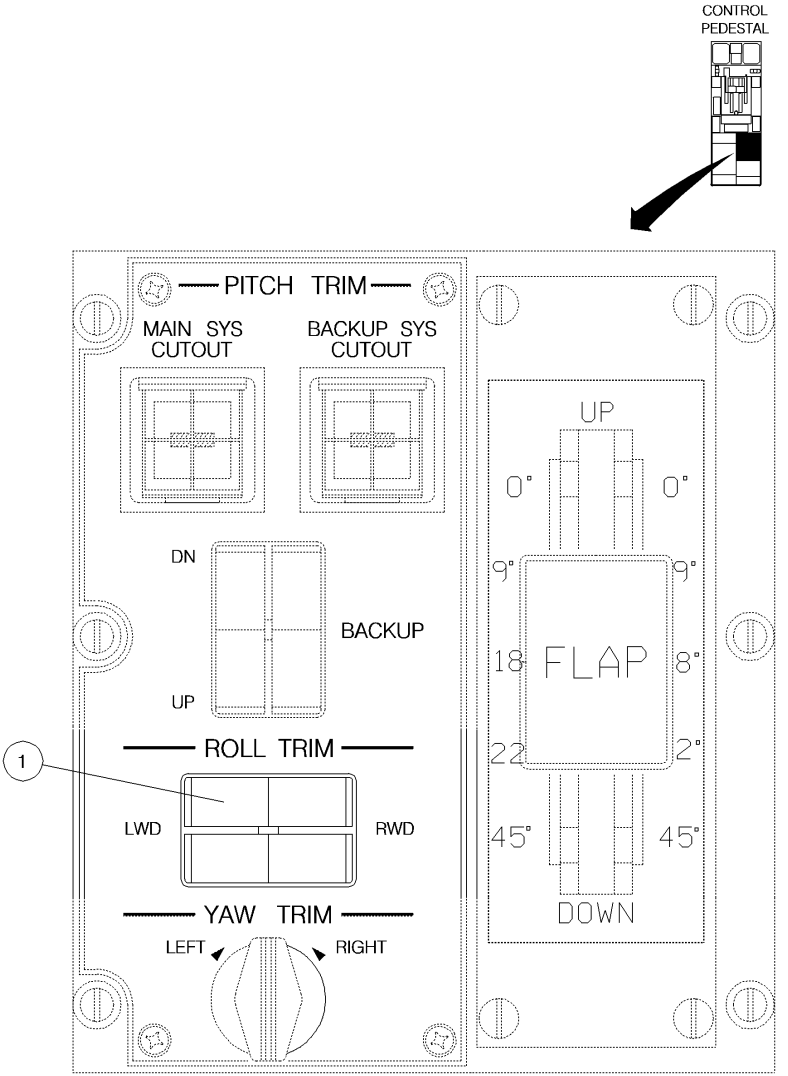
# CONTROL PEDESTAL AFT PANEL

## 1 - ROLL TRIM SWITCH (spring-loaded to neutral)

– Pressed left or right actuates the roll trim to roll left or right.




**CONTROL PEDESTAL AFT PANEL**

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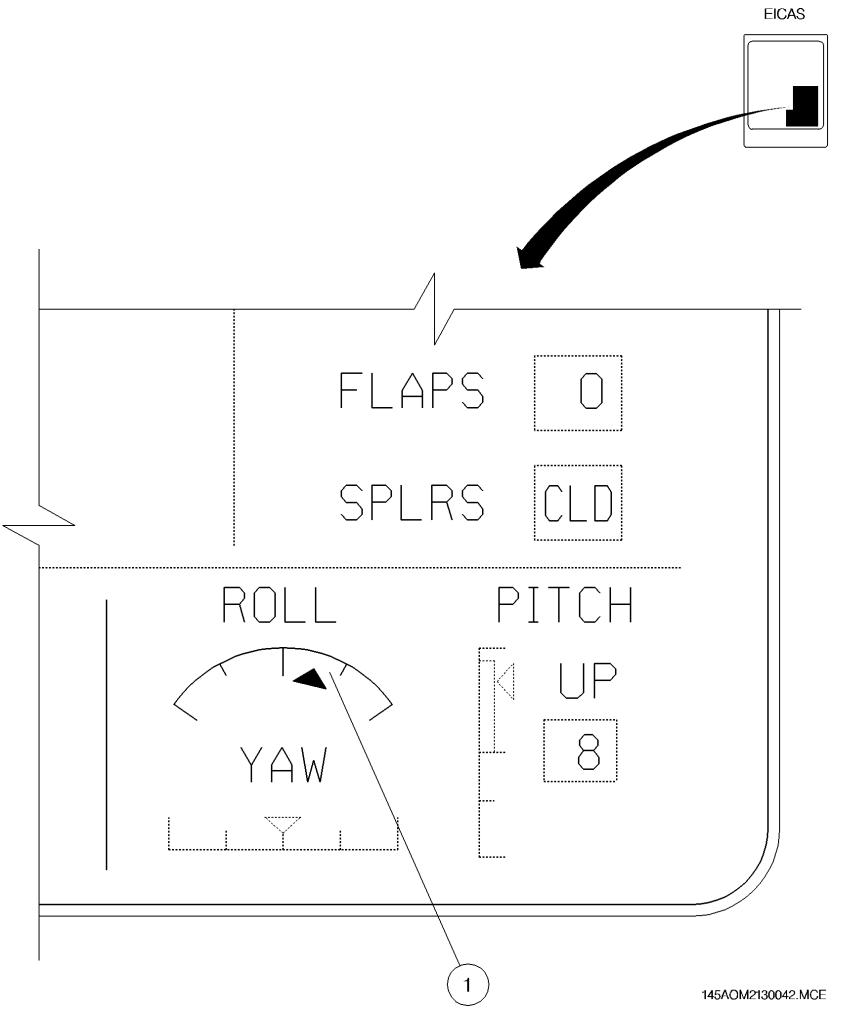
# EICAS INDICATIONS

## 1- ROLL TRIM POSITION

- Indicated by a green pointer moving on a white semicircle scale.
- Center of the scale is zero trimming.
- Each mark represents 50% of trimming range for the associated side.




**EICAS INDICATIONS**

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# YAW CONTROL

Yaw control is provided through hydraulically-powered rudders, which may also be mechanically commanded. A yaw trim system assists in moving and holding the rudder in the desired position.

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## RUDDER CONTROL SYSTEM

Directional control about the yaw axis is provided by two in-tandem rudders. Forward rudder is driven by the control system, while the aft rudder is linked to the forward rudder and deflected as a function of forward rudder deflection. Either set of rudder pedals will position the rudder through a Power Control Unit (PCU). The mechanical control is fully duplicated, consisting of cables running from the pedals in the cockpit to the rear fuselage, where the PCU is commanded to position the forward rudder. The rudder can also be commanded through the autopilot.

The rudder PCU is a dual hydraulic unit, simultaneously powered by both hydraulic systems. Each PCU hydraulic circuit controls the hydraulic power to one respective rudder actuator. Therefore, the rudder system is divided into Rudder System 1 and Rudder System 2.

The PCU also incorporates an artificial feel device that provides the pedals with an artificial feel of the aerodynamic load imposed on the rudder.

Rudder System 1 and/or Rudder System 2 may be either manually or automatically shut off. The manual shut off operation is provided through the Rudder Shutoff Buttons, located on the Overhead Panel. The automatic shut off operation is provided through the speed switch and through the hardover protection function.

When operating under mechanical mode the aerodynamic loads on the rudder are directly transmitted to the pedals and, therefore, to the pilots. Since no rudder hydraulics control is available, artificial feel and trim functions will also not be available. Some characteristics can be observed:

– greater control forces;

– sluggish response of rudder to pedals inputs;

– backlash of rudder pedals around neutral position when changing the force application from one to the other pedal.

If either or both rudder systems are inoperative, caution messages are presented on the EICAS.

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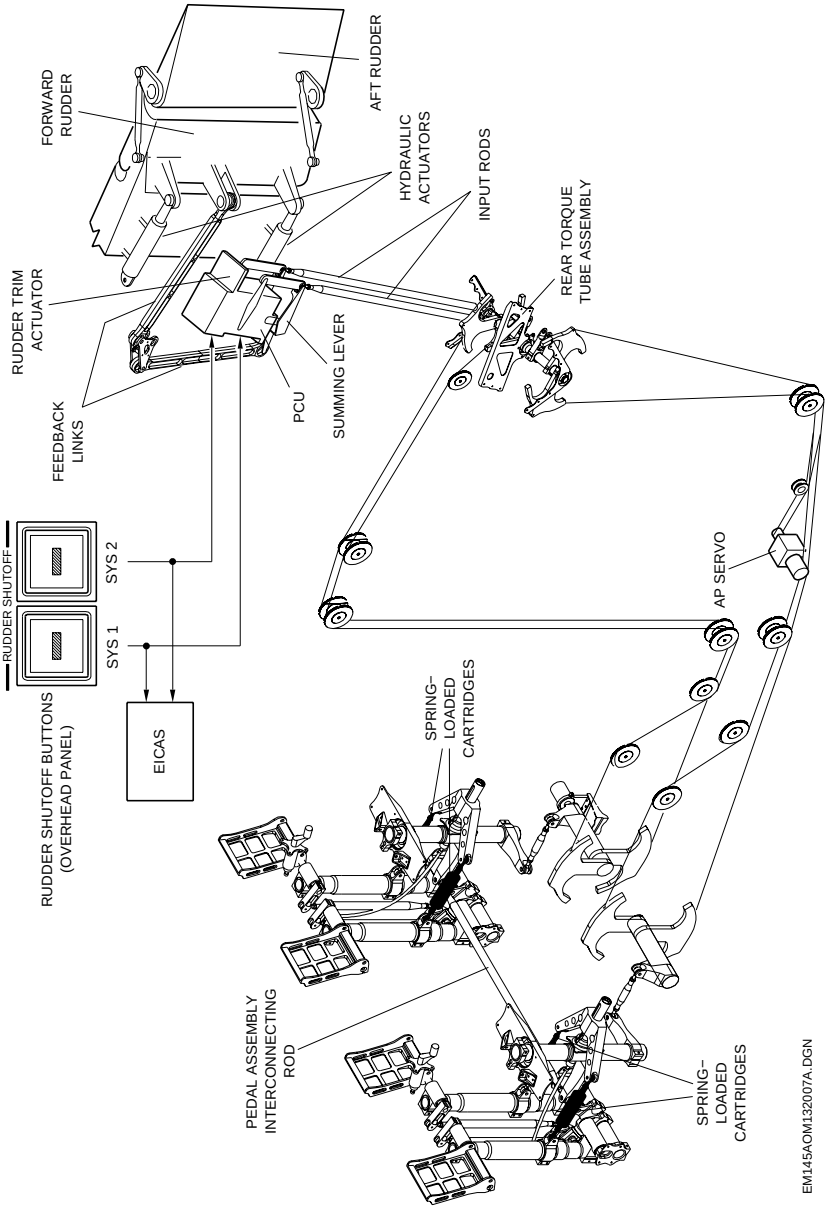


**RUDDER SCHEMATIC**



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## AUTOMATIC SHUTOFF THROUGH THE SPEED SWITCH

During normal operation both systems are powered at speeds below 135 KIAS. Above 135 KIAS, Rudder System 1 is automatically shut off.

If the automatic shut off fails to shut off a system above 135 KIAS, a caution message is presented on the EICAS. In this case, it is necessary to manually shut off system 1 or 2, according to the checklist.

If Rudder System 2 hydraulic power supply fails, Rudder System 1 automatically takes over the rudder and an associated caution message is presented on the EICAS.

## RUDDER HARDOVER PROTECTION

The rudder hardover protection function automatically selects the mechanical reversion mode as a function of pedal input force, rudder deflection, and airplane engine operation (two or single-engine operation). This feature was designed to activate in case of a runaway rudder and a caution message is presented on the EICAS.

The rudder systems are automatically shut off if all conditions below are met simultaneously:

- Rudder deflected above 5°±1°.
- Force above 59 kg (130 lb) on the pedal to counteract rudder deflection.
- Both engines running above 56% N2.

**CAUTION: DO NOT RESET THE RUDDER SYSTEMS IF THE MECHANICAL REVERSION MODE WAS RESULTANT OF A RUDDER RUNAWAY FOLLOWED BY THE HARDOVER PROTECTION ACTIVATION.**

If mechanical reversion mode was not resultant of a rudder runaway followed by hardover protection activation, a reset function is available on the Overhead Panel, by pressing both Rudder Shutoff Buttons off and on again.

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The following remarks are applicable to the rudder hardover protection:

– The signal from the Pedal Spring-Loaded Cartridges to shut off the rudder systems are applicable only if the pilots are applying force to one side with the rudder deflected above 5° ± 1° to the opposite side. If pilot command input and the rudder deflection are in the same direction, the system will not be shut off, regardless of how strong the pilot input.
– During single-engine operation, when the rudder system is more significantly required, the rudder hardover protection is disabled and the RUD HDOV PROTFAIL caution message may be presented on the EICAS.
– If a disagreement between FADECs from the same engine occurs, rudder hardover protection is deactivated and the RUD HDOV PROTFAIL caution message is presented on the EICAS.

## RUDDER DEFLECTION

### AIRPLANES UNDER ANAC AND FAA CERTIFICATION

The rudder's main control primary stops, limit rudder deflection at ± 15° on ground or in flight.

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## YAW TRIM SYSTEM

Yaw trim is accomplished by an electromechanical actuator, which receives signals from the yaw trim knob.

A continuous command of the yaw trim knob is limited to 3 seconds, even if the trim knob is actuated longer than 3 seconds. As a result, when manually actuating the trim, it is necessary to release the knob after a 3-second actuation, then actuate it again to continue the trim command. This feature intends to minimize the effects of an inadvertent trim command failure.

Yaw trim position is presented on EICAS display.

A quick-disconnect button installed on the control wheels allows, while kept pressed, disconnecting the yaw trim.

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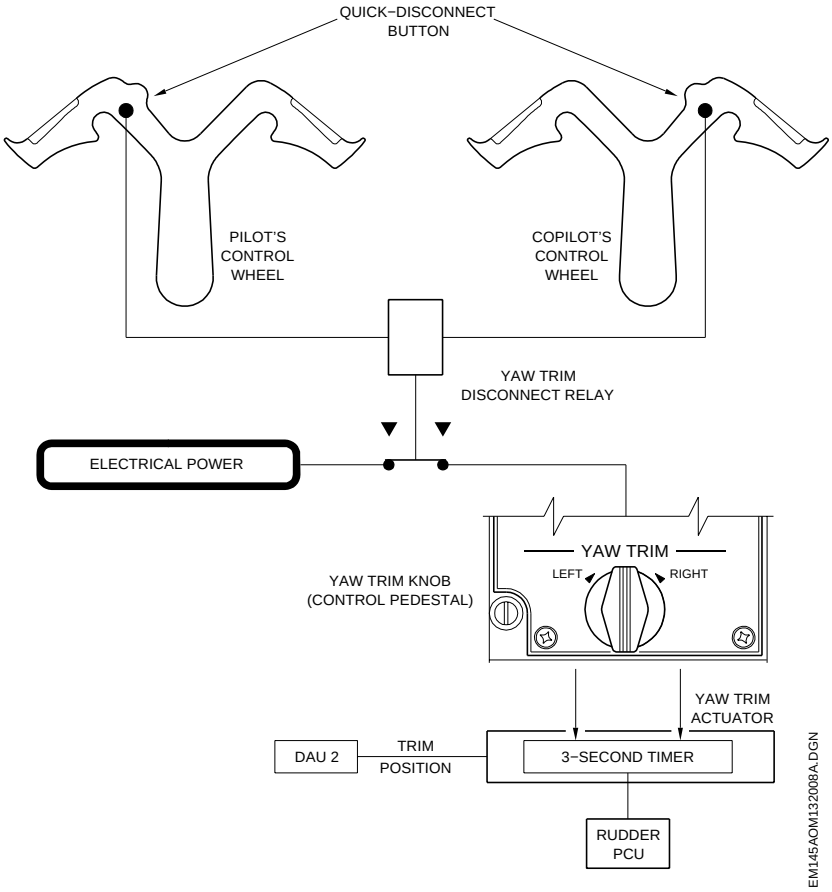


## YAW TRIM SCHEMATIC



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# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | RUDDER SYS 1 INOP | Rudder System 1 is inoperative. Message is presented under the following conditions:<br>–Below 135 KIAS.<br>–Above 135 KIAS if airspeed of both ADC's is invalid. |
| | RUDDER SYS 2 INOP | Rudder System 2 is inoperative. |
| | RUDDER SYS 1–2 INOP | Both Rudder Systems are inoperative. |
| | RUDDER OVERBOOST | Both rudder systems hydraulic actuators are pressurized above 135 KIAS. |
| | RUD HDOV PROTFAIL | –Disagreement between both FADECs of a same engine.<br>–Rudder position micro-switches indicate rudder to right and left simul-taneously. |

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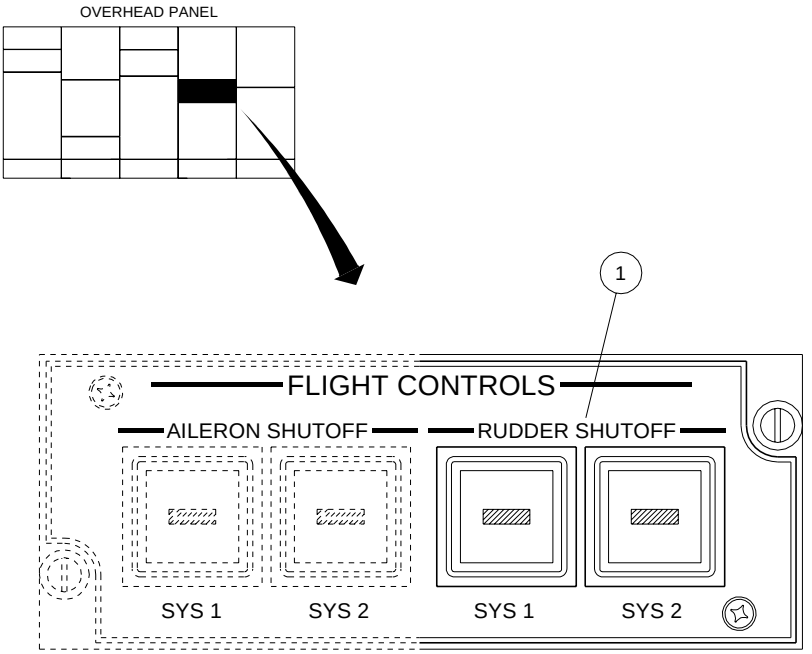
# CONTROLS AND INDICATORS

## FLIGHT CONTROLS PANEL

### 1 - RUDDER SHUTOFF BUTTON

- Enables (pressed ) or disables (released) the associated rudder hydraulic actuator.
- A striped bar illuminates in the button to indicate that it is released.

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**FLIGHT CONTROLS PANEL**

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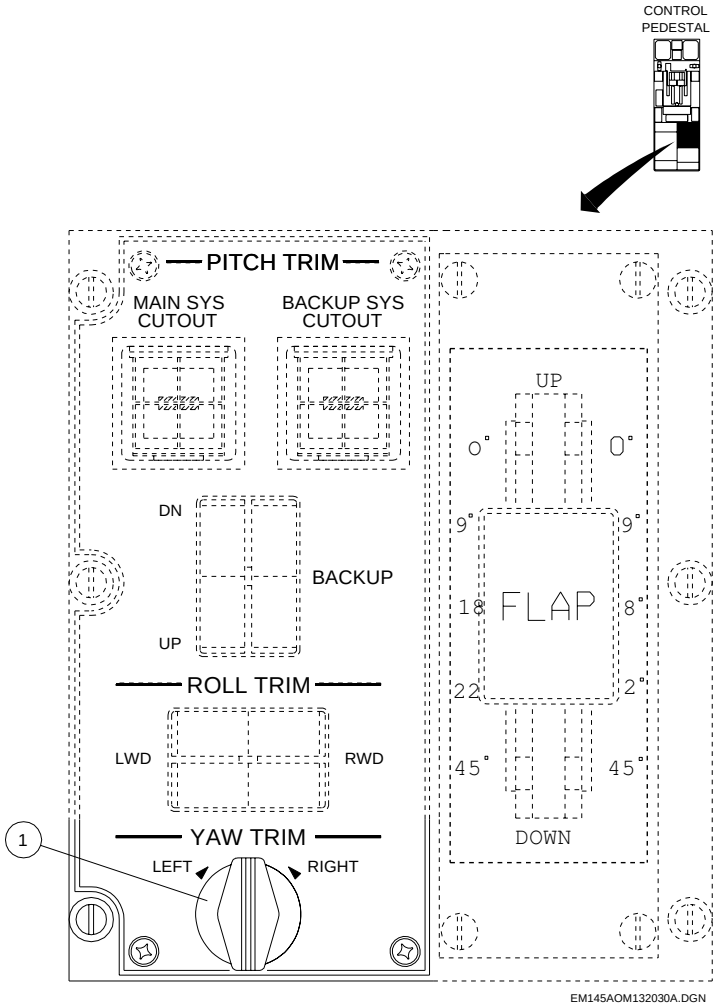
# CONTROL PEDESTAL AFT PANEL

## 1 - YAW TRIM KNOB (spring-loaded to neutral)

– Rotated clockwise or counterclockwise actuates the yaw trim, right or left.

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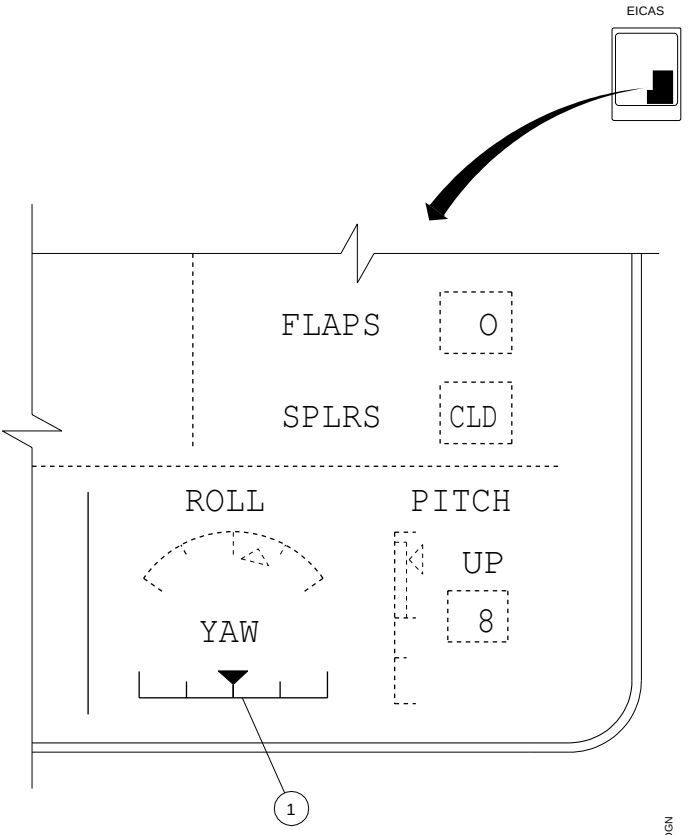
# EICAS INDICATIONS

## 1- YAW TRIM POSITION

- Indicated by a green pointer moving on a horizontal scale.
- Center of the scale is zero trimming.
- Each mark represents 50% of trimming range for the associated side.

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# GUST LOCK SYSTEM

A gust lock system is provided to lock the elevator to avoid damage to elevator components in the case the aircraft is subject to strong gusts on the ground. The aileron and rudder surfaces do not need to be mechanically locked since their actuation systems naturally damp any undesired movement.

There are two different gust lock systems:

- Mechanical Gust Lock System
- Electromechanical Gust Lock System

## MECHANICAL GUST LOCK SYSTEM

The gust lock system is mechanically-actuated and can be identified by a yellow lever on the control pedestal with the inscription GUST LOCK. The mechanical gust lock actuates on the torque tube which is attached to the control column.

To lock the elevator, the control column must be pushed and held fully forward and the gust lock lever moved backwards from the FREE to LOCKED position. Aside locking the elevators, it also restricts both thrust levers to a minimum thrust above IDLE position.

To unlock the system, push the control column forward while the safety lock device is lifted and the lever is moved forward from the LOCKED to FREE position.

## ELECTROMECHANICAL GUST LOCK SYSTEM

The electromechanical gust lock can be identified by a yellow and black striped safety lock device on the control pedestal with the inscription ELEC GUST LOCK, and by two indication lights on the glareshield panel.

The electromechanical gust lock acts directly on the elevator panels, preventing them from moving. Basically, the system is composed of locking pins driven by an electromechanical actuator, which is commanded by the gust lock lever. Gust lock system operation (locking and unlocking) is possible on the ground only. Once airborne, the system is deenergized to prevent gust lock lever movement and inadvertent actuation.

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The gust lock indication lights located on the glareshield panel illuminate to indicate the unlocking cycle or when a failure in the system occurs or when it is pressed for test. For airplanes Post-Mod. SB 145-27-0101 or equipped with an equivalent modification factory incorporated, when the TLA is higher than 59° and the gust lock system is still locked, the lights will illuminate indicating that an unlocking cycle has initiated.

When the gust lock lever is at locked position, the thrust levers are prevented from moving beyond the thrust setting needed for ground maneuvering. However, the gust lock lever was designed to allow extra travel for one of the thrust levers. For Airplanes Post-Mod. SB 145-27-0115 or equipped with an equivalent modification factory incorporated, depending on how the gust lock lever is installed, it allows the pilot to choose the thrust lever to have extra travel to be used during taxi.

For airplanes Post-Mod. SB 145-27-0126 or equipped with an equivalent modification factory incorporated, a movable stop member installed on the gust lock lever limits the movement for one of the thrust levers at a time, allowing pilots to operate single engine taxi.

When the movable stop member is on the RH side of the thrust levers, the pilot may perform a single engine taxi with engine 1 running, and vice-versa.

The system is fed by DC Bus 2 and has a dedicated circuit breaker, located on the overhead circuit breaker panel.

**LOCKING OPERATION**

To lock the elevator proceed as follows:

A. Pull the control column backwards to any position from neutral to full nose up.

B. Lift the safety lock device (1) and move the gust lock lever from the unlocked (FREE) to the locked position (2).

C. Push the control column fully forward until the control column movement is restricted. Locking is completed.

**NOTE:** During the locking operation, indication lights remain off.

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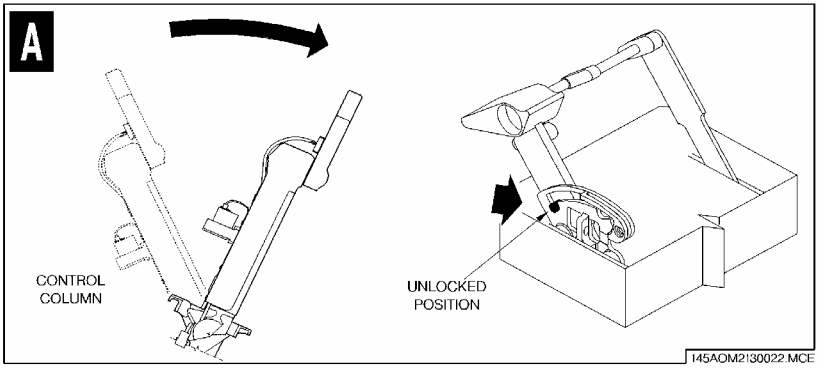
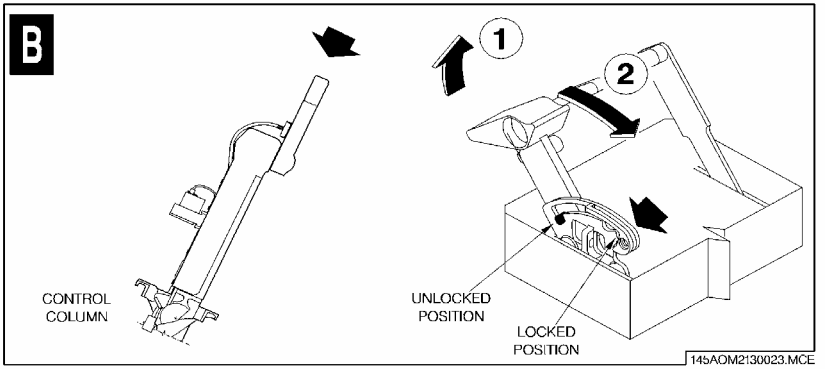
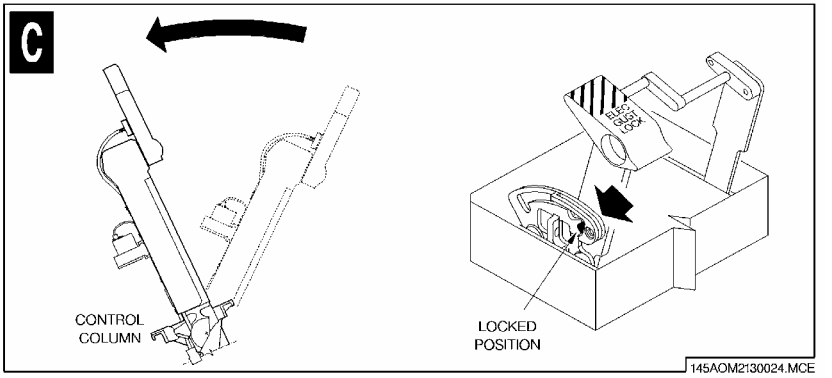
**TO LOCK:**

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## UNLOCKING OPERATION

To unlock the elevator proceed as follows:

A. Lift the safety lock device (1) and move the gust lock lever to its intermediate detented position (2).

B. At this position, the locking pins are commanded to open and the elevators will be unlocked after approximately 10 seconds. The indication lights will illuminate during the unlocking cycle, remaining off after that.
After the indication lights go off, pull the control column backwards to any position from neutral to full nose up.

C. Lift the safety lock device (3) and pull the gust lock lever from the intermediate position to its full forward inflight resting position (4), completing the unlocking cycle.

**NOTE:** Gust lock lever command from the intermediate to the unlocked (FREE) position is not possible prior to pulling column rearward.

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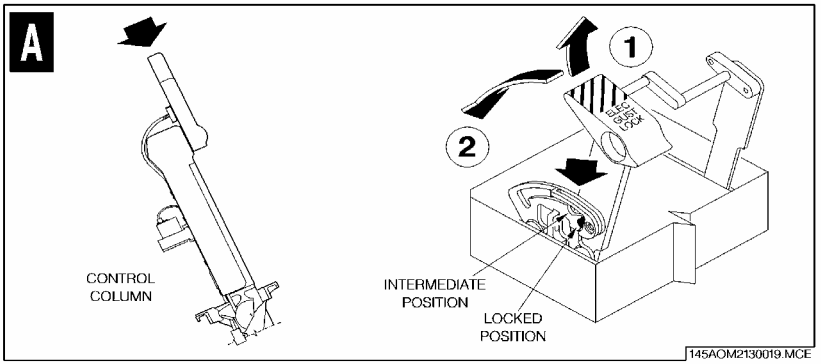
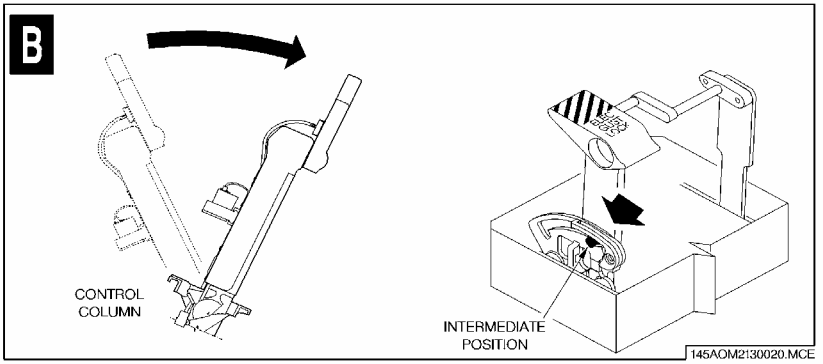
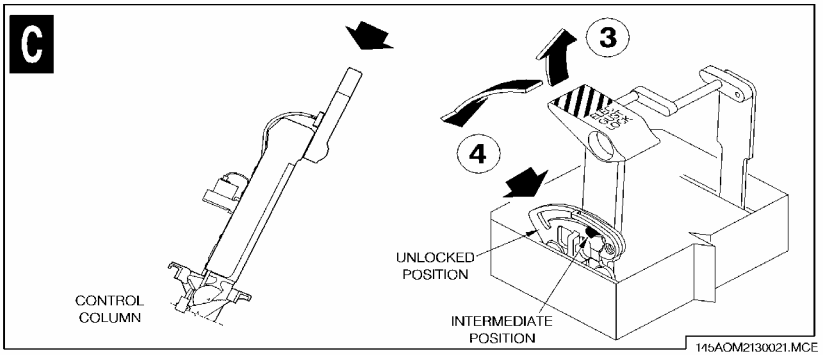
**TO UNLOCK:**

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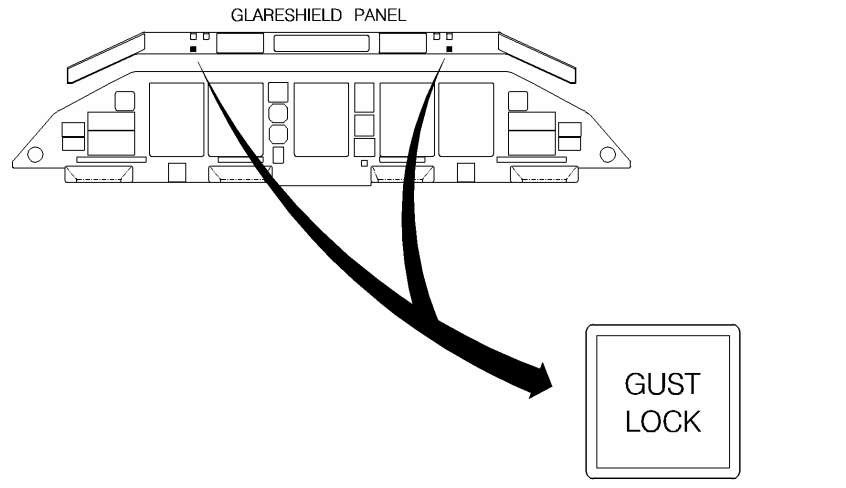
# CONTROLS AND INDICATORS

## GLARESHIELD PANEL

### GUST LOCK INDICATION LIGHTS (*)

- Color: amber
- Illuminates during the unlocking cycle to indicate that the locking pins were commanded to unlock the elevator surfaces.
- Illuminates in case of failure.
- Illuminates when it is pressed.

**NOTE:** For airplanes Post-Mod. SB 145-27-0125 or with an equivalent modification factory incorporated, the Gust Lock Caution Lights remain blinking until unlocking cycle is completed. This cycle is completed with the gust lock lever at unlocked position (full forward).

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(*) Applicable only to airplanes equipped with electromechanical gust lock system.



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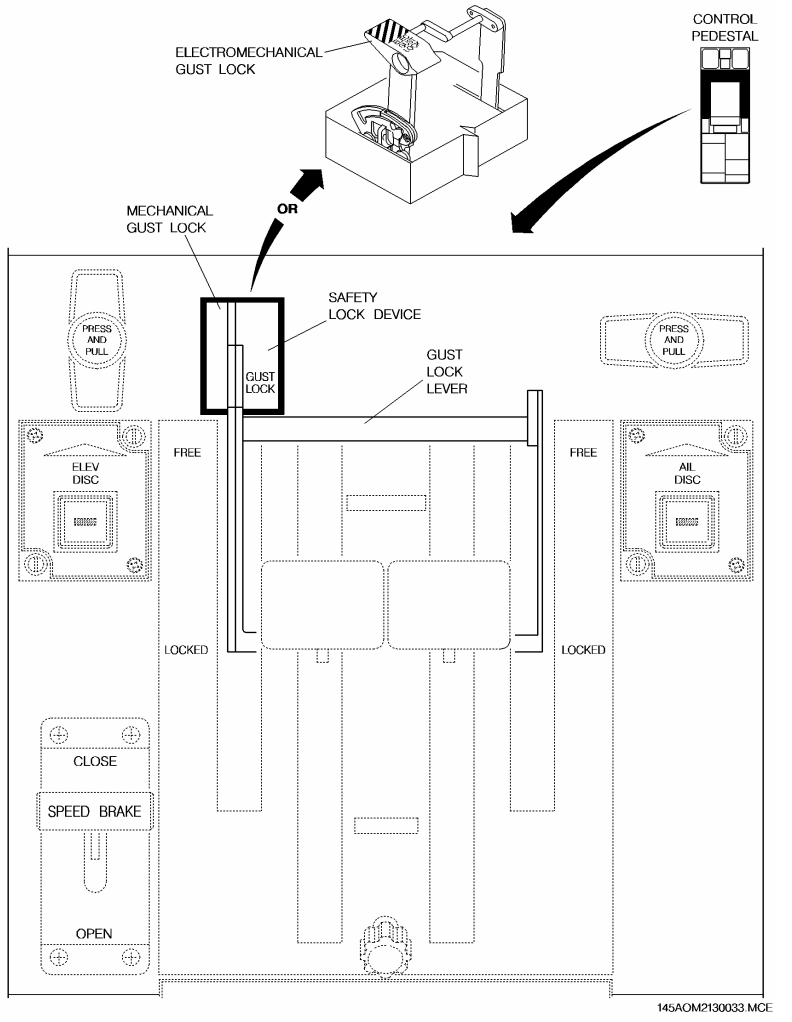
# CONTROL STAND

## GUST LOCK LEVER

- Actuated backward, locks both elevator and thrust control levers.
- The safety lock has to be lifted to move the lever.

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# FLAP SYSTEM

The flaps are electrically operated, consisting of two double-slotted flap panels installed to each wing.

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## FLAP SYSTEM OPERATION

The Flap Selector Lever provides five detent settings at 0°, 9°, 18°, 22° and 45° positions. Intermediate positions cannot be selected. When any position is selected, the selector lever signals to the Flap Electronic Control Unit (FECU) to move the flap panels. The FECU also monitors system failures and flap position, sending signals to the EICAS and other related systems.

Flap Power and Drive Unit (FPDU) drive the flap panels. The FPDU is a gearbox with two electric motors connected to that unit. Each motor is controlled by the FECU through one independent channel. Both motors drive all the flap actuators through flexible shafts. If a motor, or its associated FECU control channel, or associated velocity sensor or transmission brake fail, the affected channel is disengaged and its associated motor actuation is interrupted. The remaining motor can drive all flap panels at half speed. An EICAS message is presented to indicate that flaps are being moved at a lower speed. If both motors or control channels fail, an EICAS message is presented to indicate that the system is inoperative.

Flap actuators are torque-limited to safeguard structure against excessive loading should flaps or actuators jam. Velocity sensors installed at the end of the flexible shafts detect panels asymmetry. In such cases, the system is disabled.

On the ground a protection circuit prevents flap movement when the airplane is energized and a disagreement is detected between flap position and flap selector lever. To override such protection, it is necessary to lift up and release the flap selector lever.

Two switches on the Flap Selector Lever send signals to the Landing Gear Warning System to alert pilots any time the airplane is in a landing configuration and the gear legs are not locked down.

Flap position is shown on the EICAS display. There are also flap marks on the wing trailing edge, indicating 9° and 22°, which becomes visible when flap moves to those positions.

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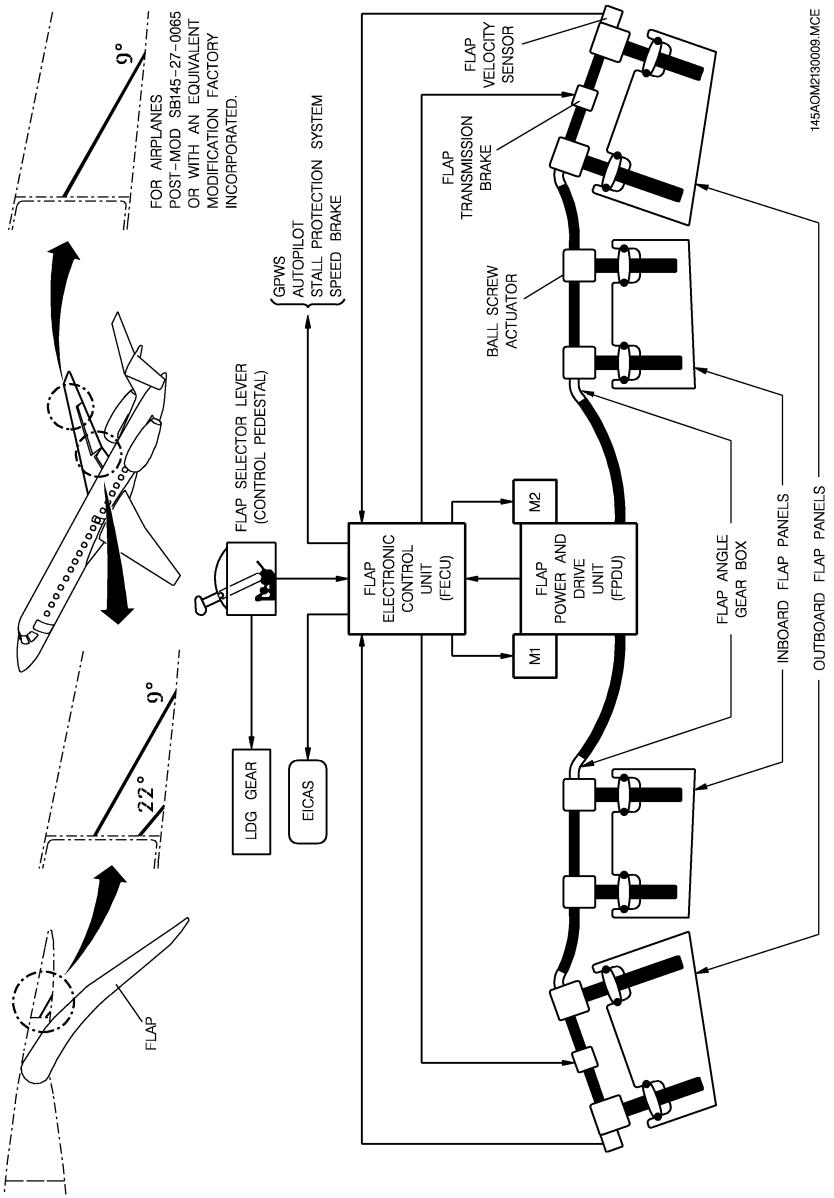


**FLAP SCHEMATIC**

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# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | FLAP FAIL | Both flap channels are inoperative. |
| ADVISORY | FLAP LOW SPEED | One flap channel is inoperative. |

## FLAP AURAL WARNING (TAKEOFF FLAPS)

If the airplane is on the ground, any thrust lever angle is above 60° and the flaps are not in the certified takeoff position, the digits, box, and pointer turn red, and the aural warning TAKEOFF FLAPS sounds. In addition, only for flaps position of 0° and 45°, the EICAS warning message NO TAKEOFF CONFIG is displayed.

# CONTROLS AND INDICATORS

## CONTROL PEDESTAL AFT PANEL

### 1 - FLAP SELECTOR LEVER

- Moved to the detent positions, selects each discrete flap position.
- To move the lever it is necessary to pull it up.
- Intermediate positions are not enabled.

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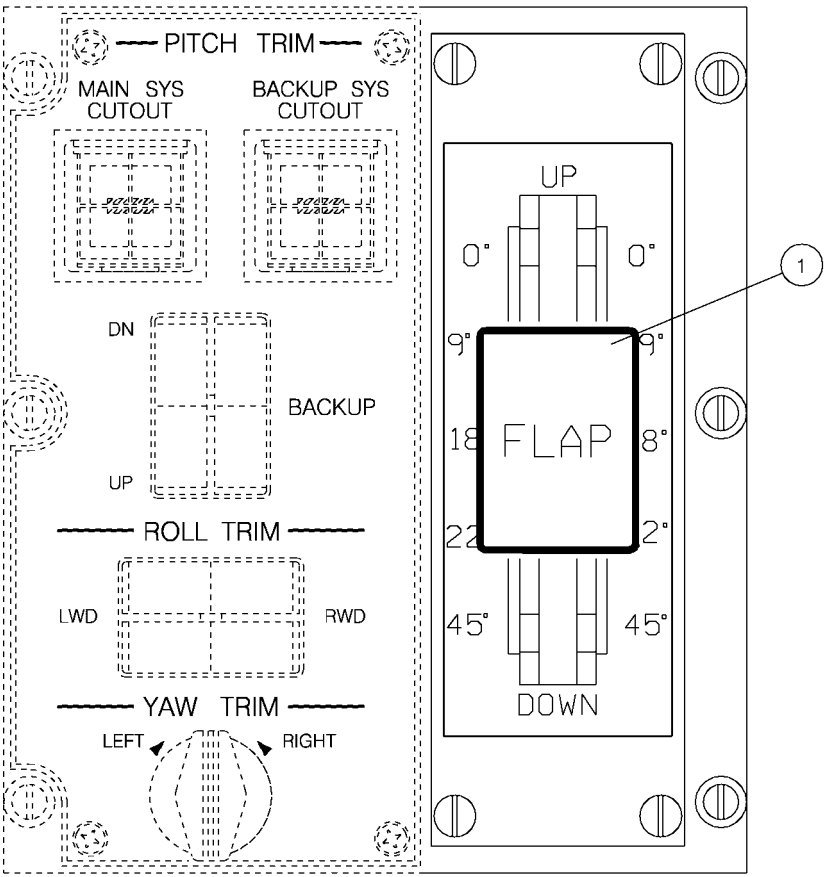


**CONTROL PEDESTAL AFT PANEL**

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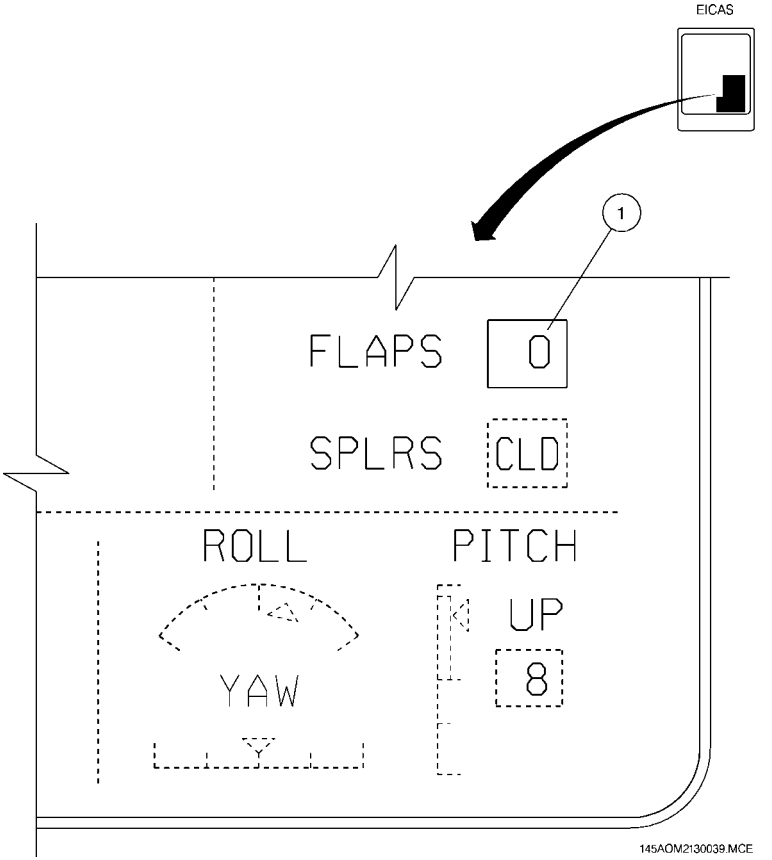
# EICAS INDICATIONS

## 1- FLAPS POSITION

- Ranges from 0° to 45°, with discrete indication on 0°, 9°, 18°, 22° and 45°.
- Colors:
  - Box: white.
  - Digits: - green (except 0, which is white).
    - changes to a green dash when flaps are in transit.
- In-transit flap position is replaced by the actual flap position if flap fails.
- If data is invalid, digits are replaced by amber dashes and box becomes amber.




**EICAS INDICATIONS**

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# SPOILER SYSTEM

Spoiler system consists of speed brake and ground spoiler subsystems. Speed brakes allow increased descent rate and assist in decelerating the airplane. Ground spoilers destroy lift, thus providing better braking effectiveness.

Spoilers are electrically commanded and hydraulically actuated. A Spoiler Control Unit is responsible for permitting the spoiler panels to open or not. Four spoiler panels are provided, two per wing surface. The outboard spoilers provide both speed brake and ground spoiler functions, while the inboard spoilers provide only a ground spoiler function. The actuation of either subsystem is fully independent.

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## GROUND SPOILER

The Spoiler Control Unit (SCU) automatically performs ground spoiler opening, without pilots' interference. The SCU enables the ground spoilers to open whenever the following conditions are met:

– Airplane on the ground.
– Main landing gear wheels running above 25 kt.
– Both engines thrust lever angles set to below 30° or both engines N2 below 56%.

If any of those conditions is not met, the ground spoilers will not open. A status indication is presented on the EICAS to indicate that the spoilers are open or closed. If a failure is detected, a caution message is presented on the EICAS.

## SPEED BRAKE

When speed brake is commanded with autopilot engaged, the auto pitch trim is provided through the autopilot; when the autopilot is not engaged the Spoiler Control Unit provides the auto pitch trim command.

The speed brakes will open when the speed brake lever is set to open and the following conditions are met:

– Thrust lever angle of both engines set to below 50°.
– Flaps at 0° or 9°.

If the speed brake lever is commanded to the OPEN position and any of the speed brake open condition is not met, the speed brake panels are kept closed and a caution message is presented on the EICAS. If the speed brake panels are open and any of the speed brake open condition is not met, the speed brake panels automatically close and an EICAS message is presented. In both cases, the speed brake lever must be moved to the CLOSE position to remove the EICAS message.

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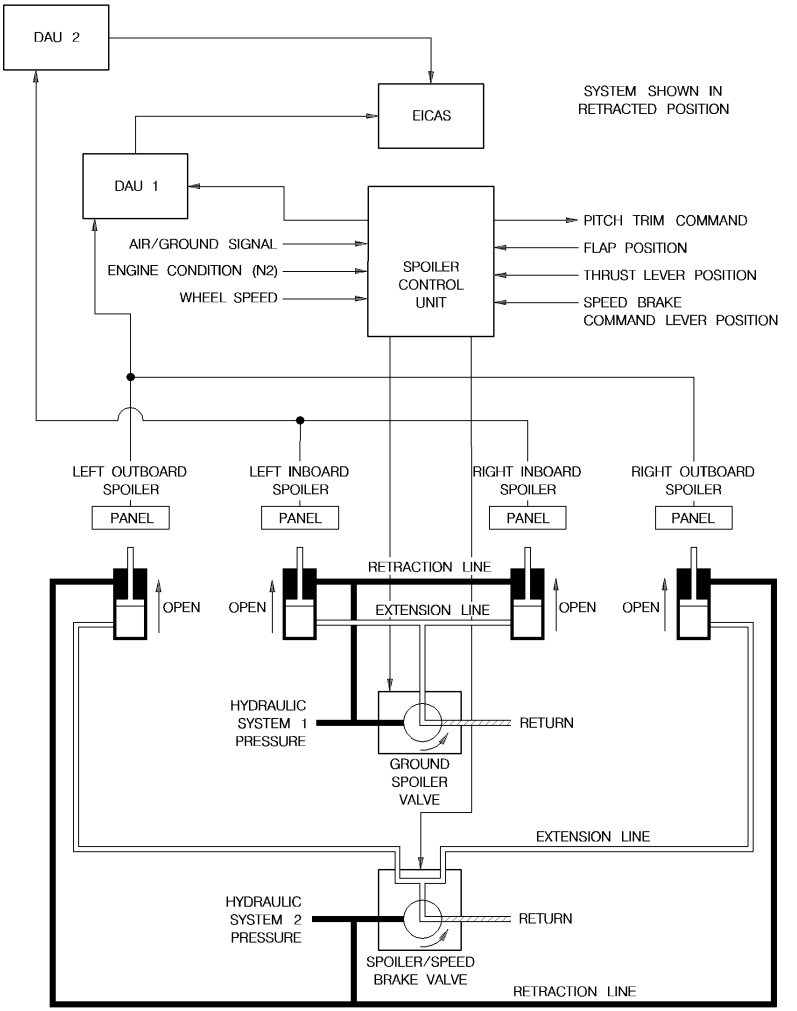


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## SPOILER SYSTEM SCHEMATIC

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# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | SPOILER FAIL | Any spoiler panel open inadvertently, failed to open or any failure in the input signals. |
| | SPBK LVR DISAGREE | Speed Brake Lever commanded to OPEN but opening logic is not satisfied. |

## SPOILER AURAL WARNING (TAKEOFF SPOILERS)

If the airplane is on the ground, any thrust lever angle is above 60° and any spoiler/speed brake panel is deployed, the digits, box, and pointer turn red, the aural warning TAKEOFF SPOILERS sounds and the EICAS warning message NO TAKEOFF CONFIG is displayed.

# CONTROLS AND INDICATORS

## CONTROL STAND

### 1 - SPEED BRAKE LEVER

– Actuated to the OPEN position commands outboard spoiler panels to open, provided enabling conditions are met.

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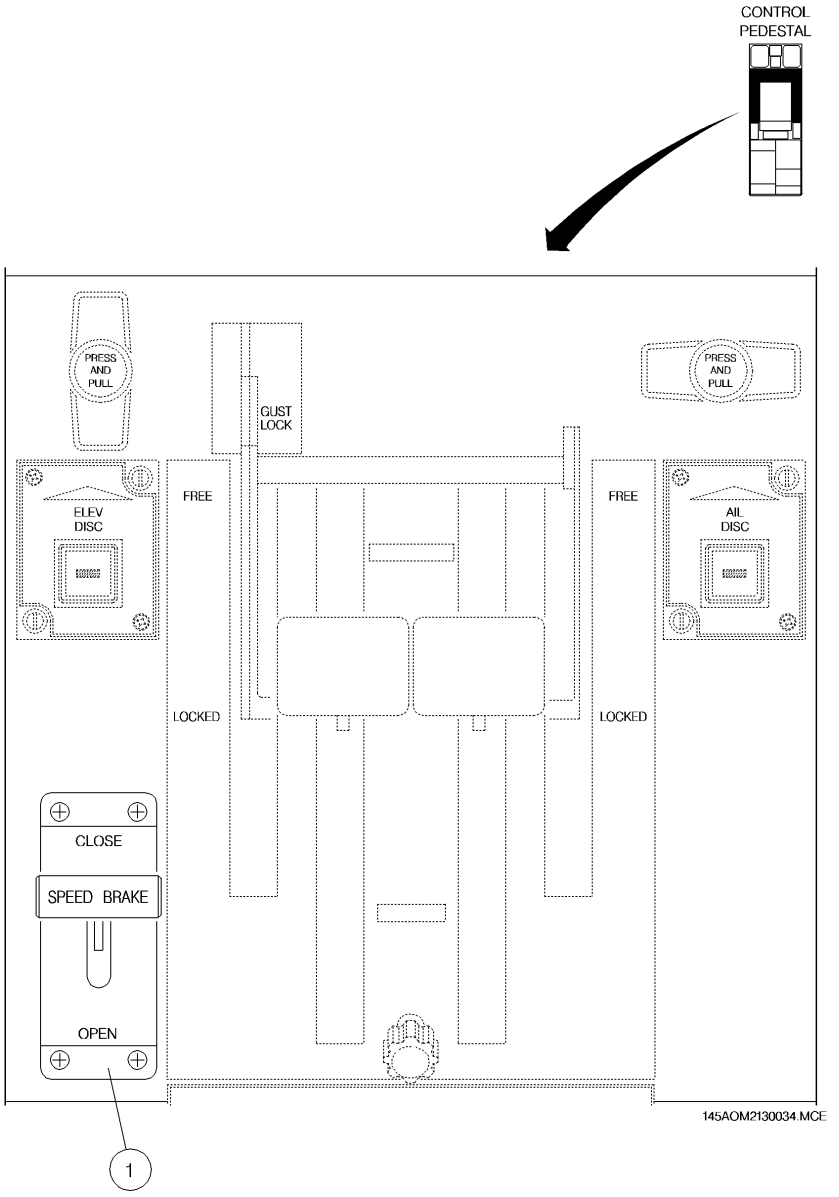


**CONTROL STAND**

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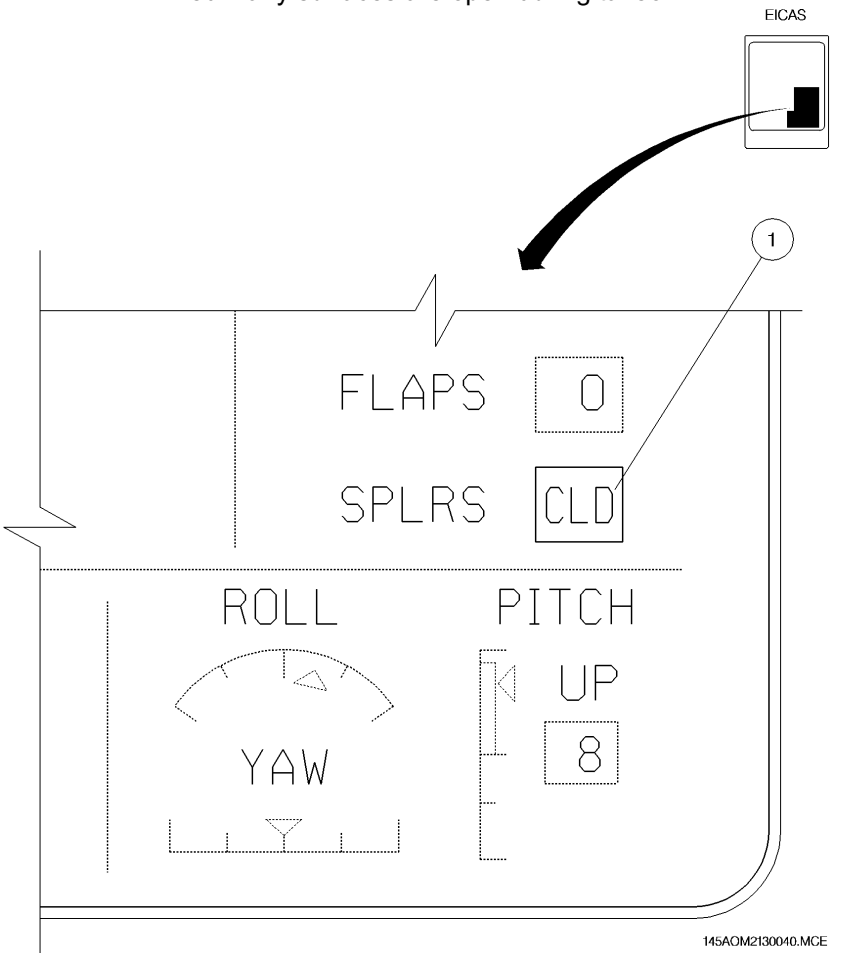
# EICAS INDICATIONS

## 1- SPOILERS INDICATION

- Displays OPN when any of the surfaces are open, or CLD when all of the surfaces are closed.
- Colors:
  - Box: white.
  - CLD: white.
  - OPN: - green in normal condition.
    - red if any surfaces are open during takeoff.




**EICAS INDICATIONS**

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# SECTION 2-14

# PNEUMATICS, AIR CONDITIONING AND PRESSURIZATION

TABLE OF CONTENTS

Block Page

General ..... 2-14-05 ..01
Pneumatic System ..... 2-14-05 ..02
Pneumatic System Function Logic ..... 2-14-05 ..06
Cross Bleed Valve Operational Logic ..... 2-14-05 . 6A
EICAS Messages ..... 2-14-05 ..07
Air Conditioning System ..... 2-14-10 ..01
ECU Operation ..... 2-14-10 ..02
Cabin Temperature Control ..... 2-14-10 ..05
Air Conditioning Distribution ..... 2-14-10 ..06
Pack Valve Operational Logic ..... 2-14-10 ..08

EICAS Messages ..... 2-14-10 ..11
Controls and Indicators ..... 2-14-10 ..13
Environmental Control System (ECS) and Pneumatic Page on the MFD ..... 2-14-10 ..16
Attendant´s Control Panel ..... 2-14-10 ..18
Pressurization System ..... 2-14-15 ..01
Operation in Automatic Mode ..... 2-14-15 ..02
Operation in Manual Mode ..... 2-14-15 ..07
EICAS Messages ..... 2-14-15 ..08
Controls and Indicators ..... 2-14-15 ..08
Electronic Bay Cooling System ..... 2-14-20 ..01
Forward Electronic Bay ..... 2-14-20 ..01
Rear Electronic Bay ..... 2-14-20 ..02
EICAS Messages ..... 2-14-20 ..02
Baggage Ventilation System ..... 2-14-25 ..01

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# GENERAL

The pneumatic system can be supplied by the engines, APU or a ground pneumatic source.

The APU or ground pneumatic source supplies the system prior to the engine start. The engines normally supply bleed air for pneumatics after engine start.

The air conditioning system receives air from the pneumatic system and provides conditioned air to the cabin. The system is controlled by two Environmental Control Units (ECU).

The pressurization system uses bleed air from the air conditioning system to pressurize the airplane. Cabin pressure is controlled by modulating the outflow valves. The system is controlled by an automatic mode and has a manual back-up mode.

Cooling for rear and forward electronic compartments is provided by the ventilation system.

System information and messages are presented on the EICAS.

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# PNEUMATIC SYSTEM

The pneumatic system receives compressed and hot air from the following sources:

– Engines compression stage
– APU
– Ground pneumatic source

The pneumatic system is used for: engine start, air conditioning, pressurization and anti-ice system.

Engine bleed air comes from the 9th (low pressure) or 14th (high pressure) engine stages depending on the system demand.

The 14th stage High Stage Valve (HSV), which is electrically commanded and pneumatically-actuated, opens automatically during low engine thrust operations, engine cross bleed start and anti-ice operation.

As thrust increases, the HSV closes and the 9th BACV (Bleed Air Check Valve) opens supplying bleed air to the system.

Bleed air for engine anti-ice system is provided through the tapping upstream of the HSV.

An Engine Bleed Valve (EBV), which is electrically commanded through the Bleed Air Button and pneumatically-actuated, is installed downstream of the pre-cooler.

Bleed air for the Air Turbine Starter (refer to Section 2-10 - Powerplant) is provided through the tapping downstream of the EBV.

Each engine supplies air to its corresponding air conditioning pack and anti-ice system when the respective EBV is open.

During take-off in specific thrust modes using engine bleed air, the operative air conditioning pack is closed by FADEC's ECS-OFF logic signal, featuring no engine bleed airflow demand when operating under no icing condition.
With no engine bleed air demand and high engine's thrust set, for airplanes Post-Mod. SB 145-36-0028 or equipped with an equivalent modification factory incorporated, EBV regulates its downstream pressure in the vicinities of its closed position and then BLD 1-2 VLV CLSD EICAS advisory message may be displayed for airplanes equipped with EICAS version 19 and on.

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In case of icing encounter during no bleed airflow demand, for airplanes Pre-Mod SB 145-36-0028 EBV remains open and for airplanes Post-Mod SB 145-36-0028 or equipped with an equivalent modification factory incorporated, EBV is opened by the pneumatic system's functional logic to allow engine bleed airflow to anti-ice system.

A Cross-Bleed Valve (CBV), which is electrically commanded through the Cross Bleed Knob and pneumatically actuated, provides the segregation or interconnection between both sides in case of APU operation or one engine pneumatic supply.

The pneumatic system’s functional logic opens or closes automatically the CBV, if the Cross Bleed Knob is on AUTO position, during engine start, depending on the available pneumatic source: APU, ground pneumatic source or opposite engine.

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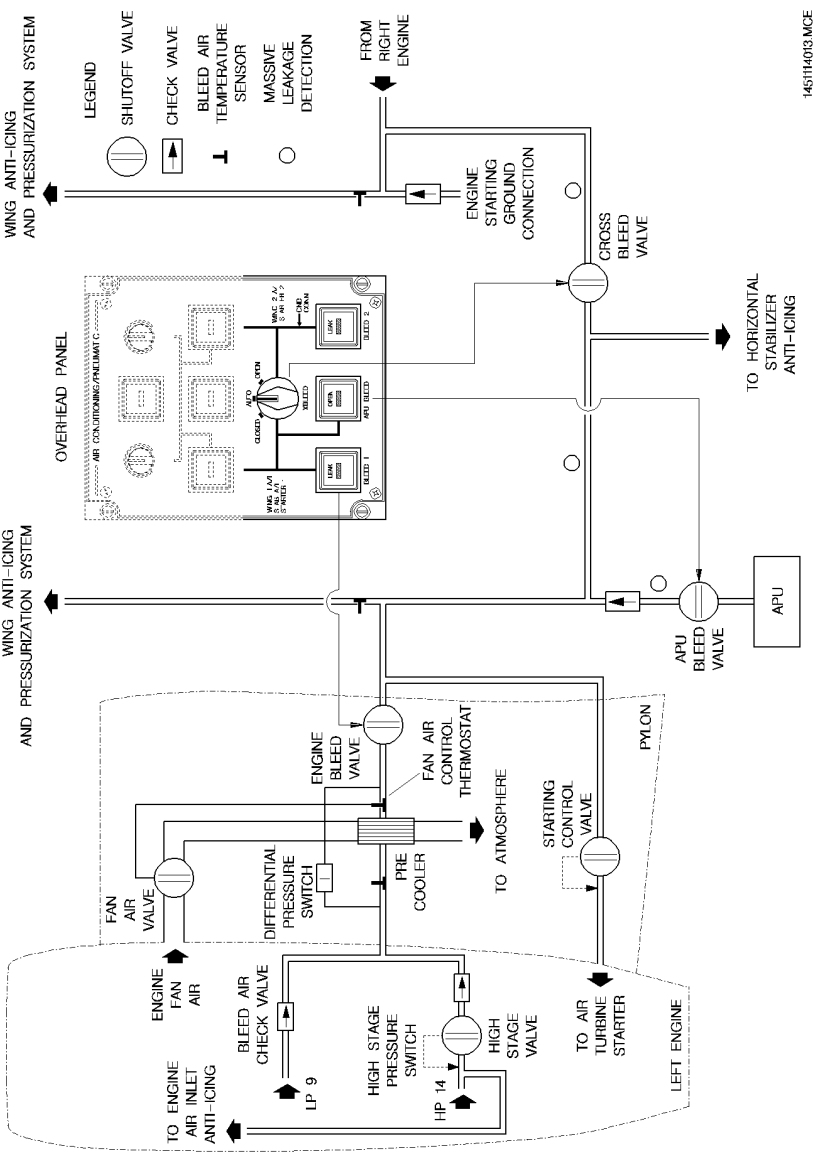


**PNEUMATIC SYSTEM SCHEMATIC**

The functional logic opens automatically the CBV and both HSVs and closes the left air conditioning pack below 24600 ft, whenever the anti-icing system is operating, on airplanes Pre-Mod. SB 145-36-0028.

On airplanes equipped with a pressure regulating and shutoff EBVs (Post-Mod. SB 145-36-0028), the functional logic also opens both HSVs and closes one pack below 24600 ft, but does not open the CBV if the anti-icing system is operating.

| | Air Conditioning ON | Ice Protection ON |
|---|---|---|
| Airplanes Pre-Mod. SB 145-36-0028 | Cross-bleed Closed | Cross-bleed Open |
| Airplanes Post-Mod. SB 145-36-0028 or equipped with an equivalent modification factory incorporated. | Cross-bleed Closed | |

Bleed air from the APU, that is used primarily as an auxiliary pneumatic source, is provided in the left side of the pneumatic system to supply the air conditioning and engine starting either on ground or inflight.

An APU Bleed Valve (ABV), which is electrically controlled through the APU Bleed Button and pneumatically-actuated, provides APU bleed control.

The pneumatic system functional logic automatically closes the ABV whenever any engine is supplying bleed air to the left pneumatic side.

An APU Check Valve is installed downstream of the APU bleed valve.

A ground pneumatic source connection, including a check valve, is installed on the right side of the pneumatic system. Its main purpose is to supply pressurized air to start the engines.

Leak detectors (thermal switches) are installed along all the pneumatic lines. Should a duct leakage occur, these detectors activate a warning message in the EICAS.

Should an intense hot air leakage occur three Massive Leakage Detectors (thermal switches – formerly located at the pre-cooler and currently located in the rear electronic compartment area) will close the EBV of the affected side, as well as the CBV, ABV and HSV.

For Airplanes Post-Mod. SB 145-36-0030, all detectors, Massive Leak Detectors and Leak Detectors also can close the EBV, CBV, HSV and ABV if a duct leakage occur. All detectors activate a warning message in the EICAS in case duct leakage.

Bleed temperatures upstream and downstream of the pre-cooler are monitored through temperature sensors. Temperature downstream of the pre-cooler is presented on a vertical bar indication on the MFD.

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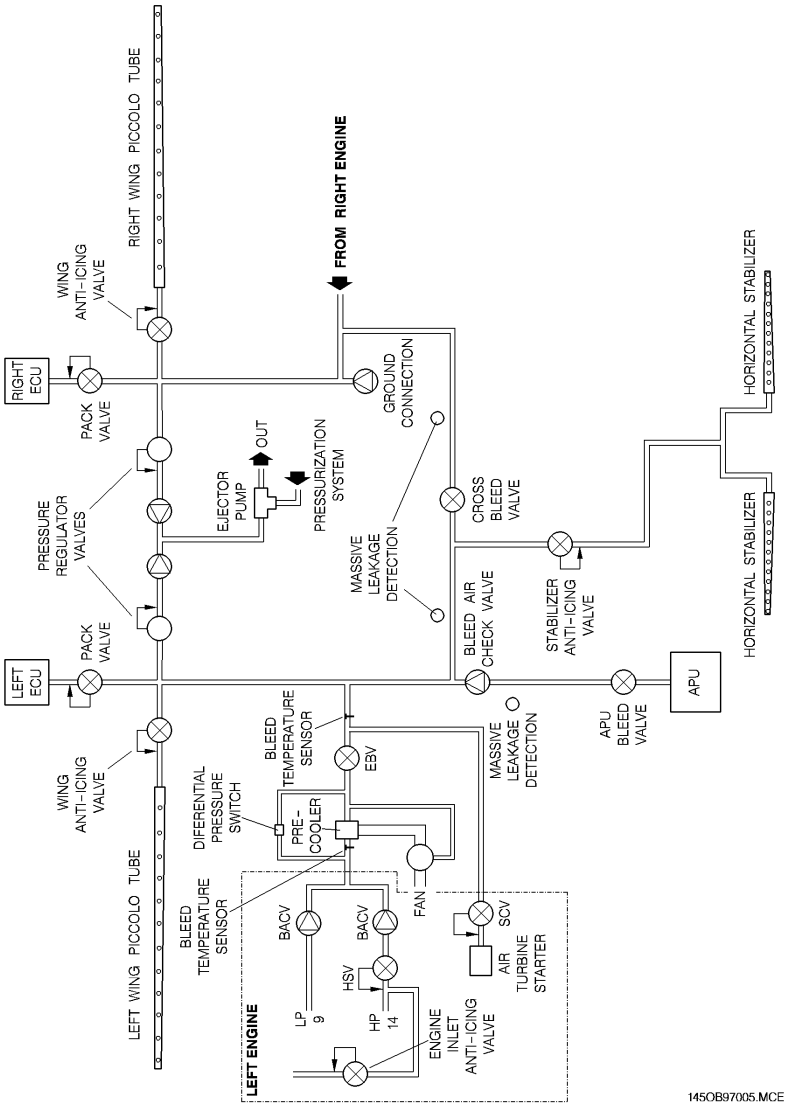


## INTEGRATED PNEUMATIC SYSTEM SCHEMATIC

# PNEUMATIC SYSTEM FUNCTIONAL LOGIC

The pneumatic system functional logic provides automatic control and protection for itself and the user systems, giving priority according to the airplane operation or condition.

## ENGINE BLEED VALVE LOGIC

The Engine Bleed Valve (EBV) opens when the following conditions occur simultaneously:

- Bleed Air Button is pressed to open the valve;
- Respective Essential Bus is energized;
- There is no massive leakage on the respective side of the rear electronic compartment;
- There is no leakage downstream of the respective pre-cooler;
- Respective engine N2 is above 56.4%; and
- Respective engine fire extinguishing handle is not pulled.
- Bleed is requested by one of the bleed consuming systems (airplanes Post-Mod. SB 145-36-0028).

## APU BLEED VALVE OPERATIONAL LOGIC

The APU Bleed Valve (ABV) receives an electrical input to open when the following conditions occur simultaneously:

- APU Bleed Button is pressed to open the valve;
- Essential DC Bus 1 is energized;
- Engine 1 bleed valve is closed (no pressure from the left side);
- Engine 2 bleed valve or cross-bleed valve is closed (no pressure from the right side);
- APU rpm above 95% after 7 seconds; and
- There is no massive leakage on the APU line.

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## CROSS BLEED VALVE OPERATIONAL LOGIC

The Cross-Bleed Valve (CBV) receives an electrical input to open when the following conditions occur:

- Essential DC Bus 2 is energized;
- There is no massive bleed leakage downstream of the pre-cooler or in the Rear Electronic Compartment; and
- Cross Bleed Knob is set to OPEN; or
- Cross Bleed Knob is set to AUTO and one of the following conditions occurs:
  - Engine 2 is starting; or
  - Engine 1 is starting assisted by engine 2 or external pneumatic source (with APU Bleed Valve manually commanded to the close position); or
  - The Horizontal Stabilizer Anti-Icing System is operating (airplanes Pre-Mod. SB 145-36-0028).

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# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | BLD 1 (2) LEAK<br>BLD APU LEAK | Duct leakage in the associated bleed line. Temperature in the duct region exceeds 91°C (195°F). The switch deactivates at 79°C (175°F). |
| | BLD 1 (2) OVTEMP | Associated pre-cooler downstream temperature above 305°C (581°F). |
| CAUTION | APU BLD VLV FAIL | Disagreement between actual position and commanded position of the APU Bleed Valve. |
| | BLD 1 (2) LOW TEMP | Abnormal low or asymmetric bleed temperature, or pre-cooler outlet temperature sensor failure. |
| | BLD 1 (2) VLV FAIL | Disagreement between actual position and commanded position of the associated Engine Bleed Valve. |
| | CROSS BLD FAIL | Disagreement between actual position and commanded position of the Cross-Bleed Valve. |
| | CROSS BLD SW OFF | Cross Bleed Knob selected CLOSED with at least one engine running after brake release. |
| | HS VLV 1 (2) FAIL | Disagreement between actual position and commanded position of the associated High Stage Valve. |
| ADVISORY | BLD 1 (2) VLV CLSD | Associated Engine Bleed Valve position. This message is inhibited on ground or during associated engine start. |
| | CROSS BLD OPEN | Cross Bleed Valve open. |

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# AIR CONDITIONING SYSTEM

Airplane air conditioning is provided by two Environmental Control Units (ECU) supplied by the Pneumatic System.

Each side is provided with independent controls, protection devices, and cross-connected air distribution lines for the various modes of operation.

Cockpit and passenger cabin temperature selections are independent and may be controlled either manually or automatically. The left ECU controls the temperature in the cockpit and the right ECU controls the temperature passenger cabin.

The system is normally operated in the automatic mode. In case of automatic mode failure, a manual mode is available.

The pilots may transfer the passenger cabin temperature control to the Attendant Panel.

The air conditioning distribution is performed by the gasper system and general outlets with cross-connection between the cockpit and passenger cabin lines.

This feature, associated with the ram air inlets, allows the cockpit and passenger cabin to be supplied with fresh air, in case of failure of both ECUs.

Recirculating air, driven by two electrical fans, is mixed to fresh air in order to improve passenger and crewmembers' comfort.

A ground cart connection is available at the right-hand duct, connected to the outside through a check valve in the fuselage. The pre-conditioned air from the ground cart is delivered to the cabin directly through the distribution lines.

The air conditioning system incorporates protection features in the temperature controllers which shut off the system in case of malfunctions (duct leakage, duct overtemperature, and pack overtemperature).

The cockpit and passenger cabin temperature indications are presented on the MFD. Caution and advisory messages are presented on the EICAS.

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## ECU OPERATION

Each ECU consists of a dual heat exchanger, an air cycle machine (compressor, turbine, and fan), a condenser, a water separator and related control and protective devices, installed forward of the airplane wing root, inside the wing-to-fuselage fairing.

The automatically-controlled bleed air from the pneumatic system supplies the ECU. Downstream pressure is regulated by the Pack Valve (Pressure Regulating and Shutoff Valve).

After the Pack Valve, the airflow is divided into two lines:

- One cold line that passes through to the Air Cycle Machine.
- One hot line that bypasses the Air Cycle Machine.

Both airflow lines are gathered at the expansion turbine discharge.

In the Air Cycle Machine (ACM), air is cooled in the primary heat exchanger and passes through the compressor, thus causing a pressure increase. The air then goes to the secondary heat exchanger where it is cooled again.

After leaving the secondary heat exchanger, the high-pressure cooled air passes through a condenser and a water separator for condensed water removal. Spray nozzles uses the separated water to improve the heat exchanger efficiency.

The main airstream is ducted to the turbine and expanded to provide power for the compressor and cooling fan. This energy removal produces very low turbine discharge temperatures, achieving adequate low temperatures in the process.

The cold exit air is mixed with warm air supplied by the recirculation fan and/or with the hot bypass air immediately upon leaving the turbine. A check valve is provided in the recirculation duct to prevent reverse flow if the recirculation fan is inoperative.

The ECU outlet air temperature is controlled through the dual temperature control valve. One valve adds hot bleed air to the turbine discharge while the other valve restricts the compressor inlet flow.

The ECUs are cooled in flight by external ACM fans, using the external ram air. On the ground, the ECUs are cooled by the ACM fans only.

The system has emergency ventilation, as an alternate means to allow the outside air into the cabin. The impact air passes through the same ram air inlets that are used to cool the dual heat exchangers.

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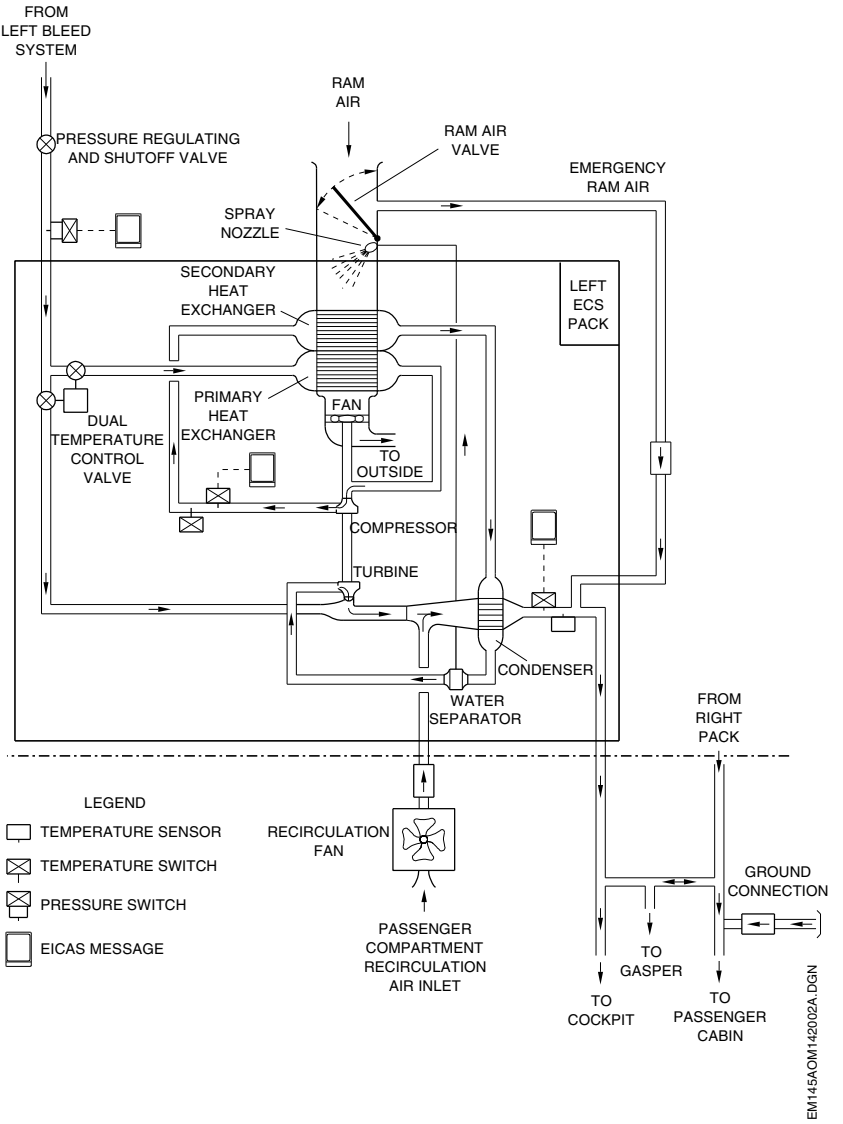


## AIR CONDITIONING SYSTEM SCHEMATIC



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When the ECUs air supply is shut off in flight, the emergency ram air is activated and the ram air valves are opened automatically, allowing ram air to be routed to the distribution lines. Ram air may also be used to ventilate the airplane interior for cabin smoke evacuation and cabin ventilation purposes with the airplane depressurized and the ECUs turned off.

**NOTE:** For normal operations with both packs operative, the Pneumatic System automatic logic closes the left Pack Valve whenever the anti-icing system is operating below 24600 ft.

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# CABIN TEMPERATURE CONTROL

## AUTO MODE

In the automatic mode (temperature knobs pressed), the temperatures in the passenger cabin and in the cockpit are controlled by the digital temperature controllers that receive information from the temperature sensors (ducts, passenger cabin, or cockpit), maintaining the temperature set on the associated temperature knob.

## MANUAL MODE

In manual mode (temperature knobs pulled), the temperature in the passenger cabin and in the cockpit are controlled by the temperature control module, that receives information from the temperature knobs and the duct temperature sensor.

The manual mode should be used only if a failure occurs in the automatic mode and may be noticed when the temperature is not maintained within the temperature limits of the automatic mode (between 18 and 29°C) after cabin temperature stabilization.

If switching from auto mode to manual mode is required, proceed as follows:

- Set the knob to mid range position (12 o'clock).
- Wait for system to stabilize (approximately 30 seconds).
- Switch to manual.
- Smoothly turn the knob to the required point.

Once in the manual mode, the pilot must continuously monitor the temperature and actuate on the Temperature and Mode Selector Knob.

**NOTE:** On airplanes Pre-Mod. SB 145-21-0011, for cruise flight times of 1:30 h or longer, it is recommended that the passenger cabin temperature be controlled by using the manual mode.

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## AIR CONDITIONING DISTRIBUTION

The air conditioning distribution system provides conditioned air to the cockpit and passenger cabin.

The main source of conditioned air to the cockpit is the left pack, with a single distribution system for cooling or heating air.

The cockpit is provided with two FEET AIR handles and air outlets, allowing each pilot to individually control the airflow.

For CRT displays ventilation, a shutoff valve on each side, electrically-driven and independently controlled by a thermal switch, allows cold air to be supplied for this function only.

The main source of conditioned air to the passenger cabin is the right pack and partially by the left pack, through a cross connection duct.

The air distribution system for the passenger cabin is divided into three lines. One line is distributed to the lower ducts, installed at the foot level on both cabin sidewalls. The second line is for the upper ducts of both sidewalls. The third line is dedicated to the gasper. If the duct temperature is below 24°C (75°F), the associated temperature switches command the recirculation fans to increase airflow.

The gasper air subsystem provides air to individual air outlets (gasper), as well as for the rear electronic compartment, oxygen cylinder compartment and relay box ventilation. The air to the gasper is provided by a gasper fan and by one branch from the cross connection of the general distribution system. The gasper fan is similar to the recirculation fan, but it is operated in normal condition only. One thermal switch is installed in the branch line to close fresh air in case of heating condition (above 24°C). In this case, only air from the gasper fan is available.

The recirculation air subsystem, consists of two recirculation fans, and is usually operated to save the engine bleed. It must be kept off should there be smoke in the cabin, or on hot days while on the ground. This reduces the pull-down period and should be turned on in cold soak conditions to reduce pull-up period.

The operational logic to open the Engine Bleed, Cross-bleed, APU Bleed, and Pack Valves will be analyzed herein separately, for better system comprehension. This system also actuates on the Anti-icing System Valves. For further information, refer to Section 2-15 - Ice and Rain Protection.

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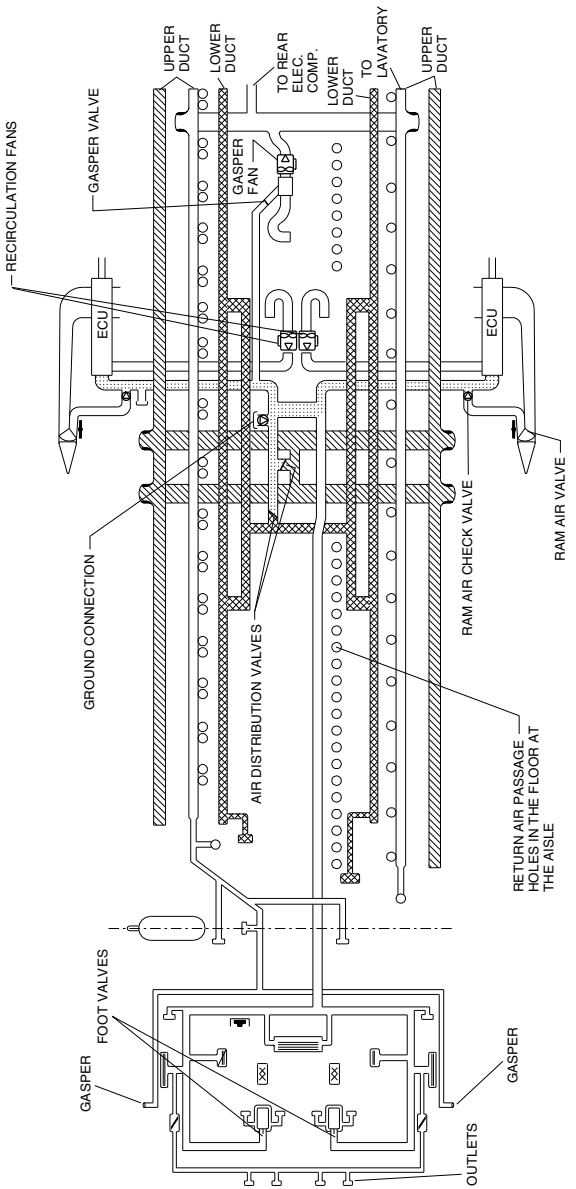


## AIR CONDITIONING SYSTEM DISTRIBUTION



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# PACK VALVE OPERATIONAL LOGIC

The Pack Valve receives an electrical input to open when the following conditions occur simultaneously:

- Air Conditioning Pack Button is pressed to open the valve;
- Respective DC Bus is energized;
- Respective engine is not starting;
- No engine is starting using the APU as pneumatic source;
- No failure in the related pack is detected (overpressure, overtemperature or duct leakage downstream of the Pack Valve); and
- No discrete ECS (Environmental Control System) OFF signal is sent from any related FADEC (A or B).

The FADEC`s discrete ECS OFF signals are produced according to the following conditions:

**1 - During Takeoff or Go Around:**

| ACTIVATION CONDITIONS FOR ECS OFF SIGNALS | | | | |
|---|---|---|---|---|
| | | | PRESSURE ALTITUDE / TAT °C | |
| ENGINE | FADEC | MODE | ALL ENGINES OPERATIVE (takeoff only) | ONEENGINE INOPERATIVE (4) |
| A or A1/1 | ALL | T/O-1 | Up to 1700 ft above takeoff altitude and TAT above -18°C (-0.4°F) | Lower than 9700 ft (1) |
| A1 or A3 | ALL | T/O-1 | Up to 1700 ft above takeoff altitude (2) | Lower than 9700 ft (3) |
| A1/3 or A1P | ALL | T/O-1,T/O or T/O RSV | Up to 1700 ft above takeoff altitude (2) | Lower than 9700 ft (3) |
| A1E | ALL | T/O-1, T/O, E T/O, T/O RSV or E T/O RSV | Up to 1700 ft above takeoff altitude (2) | Lower than 9700 ft (3) |

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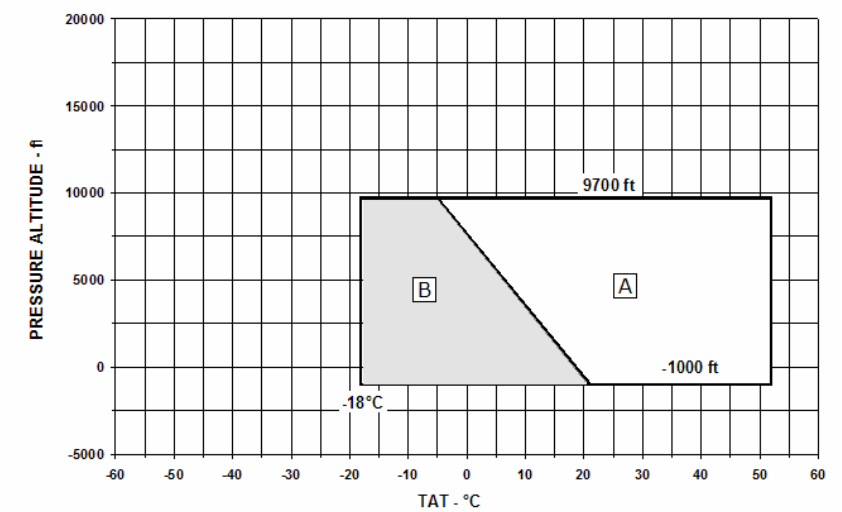
**NOTE: 1)** The ECS OFF signal is activated for the pack associated with the operating engine if the pressure altitude is lower than 9700 ft and TAT is above -18°C (areas A and B in the following envelope).

**2)** TAT above 19°C (66°F) at sea level, decreasing linearly to -5°C (23°F) at 9700 ft.

**3)** The ECS OFF signal is activated for the Pack associated with the operating engine if the pressure altitude is lower than 9700 ft and TAT is above 19°C at sea level, decreasing linearly to -5°C at 9700 ft (area A in the following envelope).

**4)** A Low N1 condition (actual N1 does not achieve requested N1) is considered one engine inoperative.




**FADEC´S ECS OFF ENVELOPE**

The ECS OFF logic is valid only when the packs are using engine bleed. If APU bleed is being used, the ECS OFF logic is inhibited and the pack valves will not shut down.

The FADEC's discrete ECS OFF signal is not produced when using ALT T/O-1 mode during takeoffs with all engines operative.

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On all EMB-145 XR models, packs are automatically reset when the conditions for the ECS OFF signal cease to exist. When both packs are automatically reset, pack 2 will be commanded to open 10 seconds after pack 1 opening, to avoid passenger discomfort due to packs return.

On other airplane models, if a FADEC commands its associated pack to close through the ECS OFF signal, the pilot must reset the pack when the conditions for the automatic shut down of the pack cease to exist, i.e., an automatic restart of the pack does not exist.

**2 - During reverse use:**

The ECS OFF signal is not activated during reverse use.

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# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | PACK 1 (2) OVLD | Associated ECU compressor temperature above 243°C (470°F) or ECU inlet pressure above 55 psig. |
| | PACK 1 (2) OVHT | Associated ECU outlet temperature above 93°C (200°F). |
| | PACK 1 (2) VLV FAIL<br>RAM AIR VLV FAIL | Disagreement between associated valve actual position and commanded position. |
| ADVISORY | PACK 1 VLV CLSD | Left pack valve closed with no icing condition,<br>or<br>Left pack valve closed with airplane above 24600 ft. |
| | PACK 2 VLV CLSD | Right pack valve closed. |

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# CONTROLS AND INDICATORS

## AIR CONDITIONING AND PNEUMATIC CONTROL PANEL

### 1 - Cockpit temperature and mode selector knob

- PRESSED - Controls the left pack in automatic mode through the Digital Temperature Controller. The cockpit temperature may be set between 18°C (65°F) and 29°C (85°F).
- PULLED - Controls the left pack in manual mode through the temperature control module. No temperature range is established.

### 2 - PASSENGER CABIN TEMPERATURE AND MODE SELECTOR KNOB

- PRESSED - Controls the right pack in automatic mode through the Digital Temperature Controller. The passenger cabin temperature may be set between 18°C (65°F) and 29°C (85°F).
- PULLED - Controls the right pack in manual mode through the manual mode circuit in the temperature control module. No temperature range is established.
- ATTD - The passenger cabin temperature control is transferred to the attendant's panel in automatic mode only.

### 3 - RECIRCULATION BUTTON

- Turns on (pressed) or turns off (released) both recirculation fans.
- A striped bar illuminates inside the button to indicate that it is released.

### 4 - AIR CONDITIONING PACK BUTTON

- Opens (pressed) or closes (released) the Pressure Regulating and Shutoff Valve of the associated ECU.
- A striped bar illuminates inside the button to indicate that it is released.

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**5 - GASPER BUTTON**

- Turns on (pressed) or turns off (released) the gasper fan inflight only.
- A striped bar illuminates inside the button to indicate that it is released.
- On ground, the gasper fan is turned on as soon as the associated DC Bus is energized.

**6 - CROSS-BLEED KNOB**

- CLOSED- Closes the Cross-bleed Valve.
- AUTO - Selects automatic operation mode of the Cross-bleed Valve.
- OPEN - Opens the Cross-bleed Valve.

**7 - BLEED AIR BUTTON**

- Opens (pressed) or closes (released) the associated Engine Bleed Valve.
- A striped bar illuminates inside the button to indicate that it is released.
- A LEAK inscription illuminates inside the button to indicate a duct leakage in the associated bleed line.

**NOTE:** The LEAK inscription is not available on some airplanes.

**8 - APU BLEED BUTTON**

- Opens (pressed) or closes (released) the APU Bleed Valve.
- A striped bar illuminates inside the button to indicate that it is pressed.
- An OPEN inscription illuminates inside the button to indicate that the APU Bleed Valve is in the open position.

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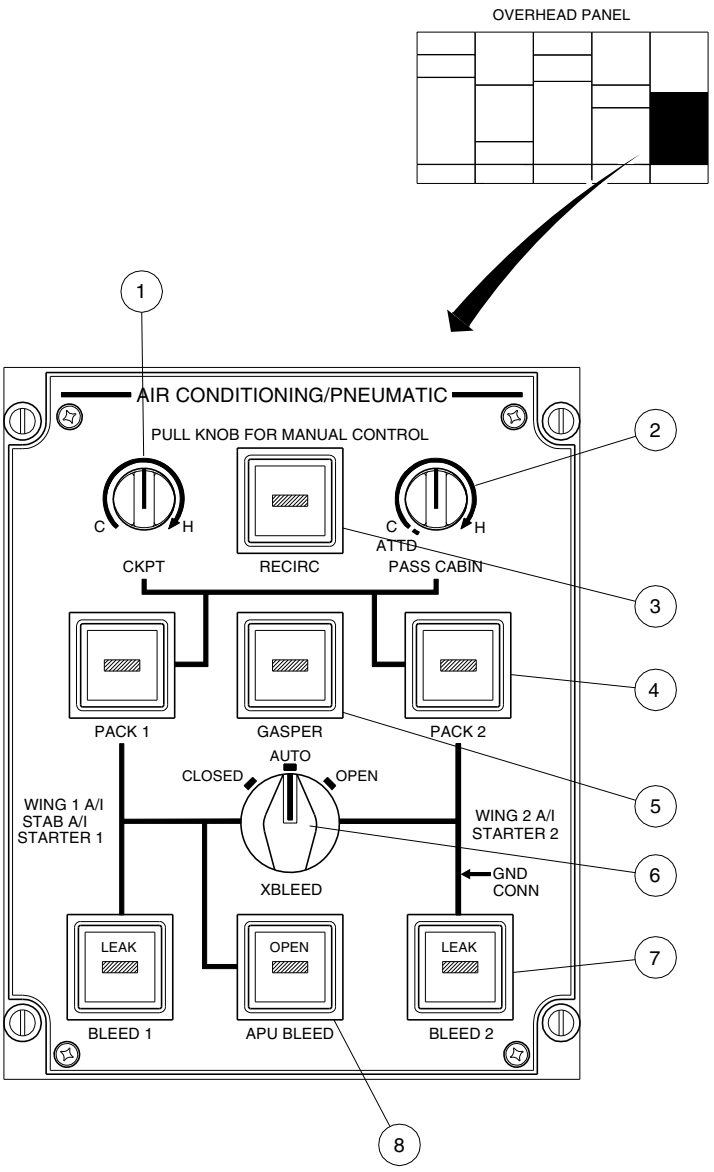


EM145AOM142003A.DGN

## AIR CONDITIONING AND PNEUMATIC CONTROL PANEL

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# ENVIRONMENTAL CONTROL SYSTEM (ECS) AND PNEUMATIC PAGE ON THE MFD

## 1 - PASSENGER CABIN TEMPERATURE INDICATION

- Indicates the temperature inside the passenger cabin.
- Digits are green.
- Legends are white.
- Ranges from -10 to 50°C (14 to 122°F).

## 2 - Cockpit temperature indicatION

- Indicates the temperature inside the cockpit.
- Digits are green.
- Legends are white.
- Ranges from -10 to 50°C (14 to 122°F).

## 3 - BLEED TEMPERATURE INDICATION

- Indicates the bleed air temperature downstream of the pre-cooler on the left and right engine.
- Scale and Pointer:
  - White for the scale, below 260°C (500°F) to indicate potentially low thermal energy availability to the anti-icing system. Amber for the pointer, only if the pointer is in the white band of the scale and the message “BLD 1 (2) LOW TEMP” is shown on EICAS.

    If the pointer is in the white band of the scale and the message “BLD 1 (2) LOW TEMP” is not presented in the EICAS, the pointer will be green.
  - Green from 260 to 305°C (500 to 581°F) to indicate the acceptable range.
  - Red above 305°C (581°F) to indicate an overtemperature condition.
  - In case of an outlet temperature sensor failure, the respective pointer is removed from the vertical temperature bar.

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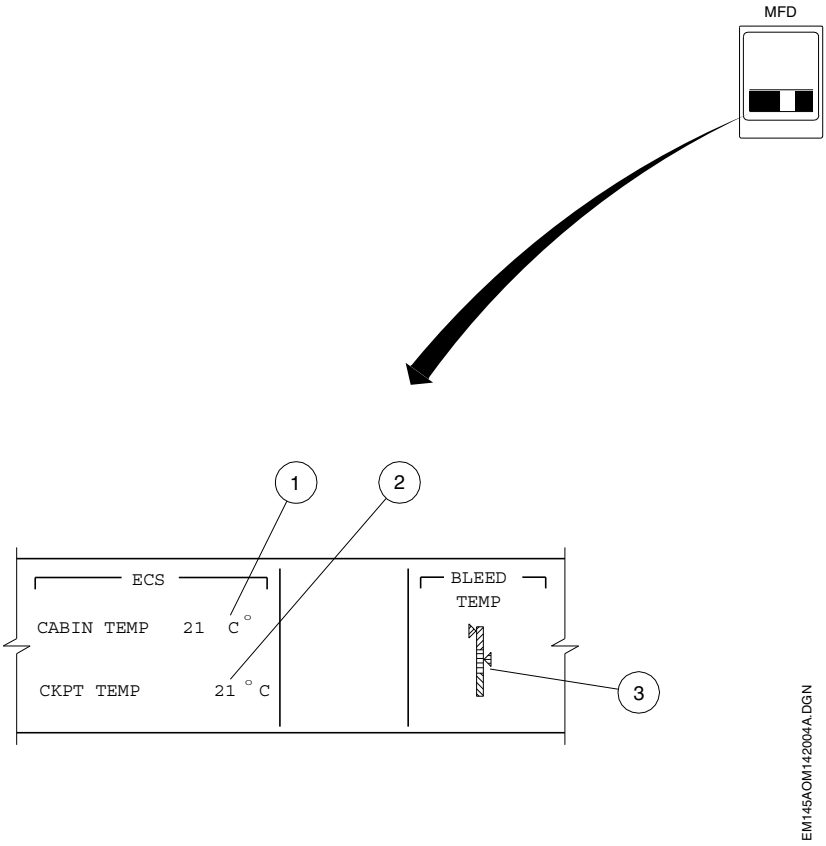


**ENVIRONMENTAL CONTROL SYSTEM (ECS) AND PNEUMATIC PAGE ON MFD**

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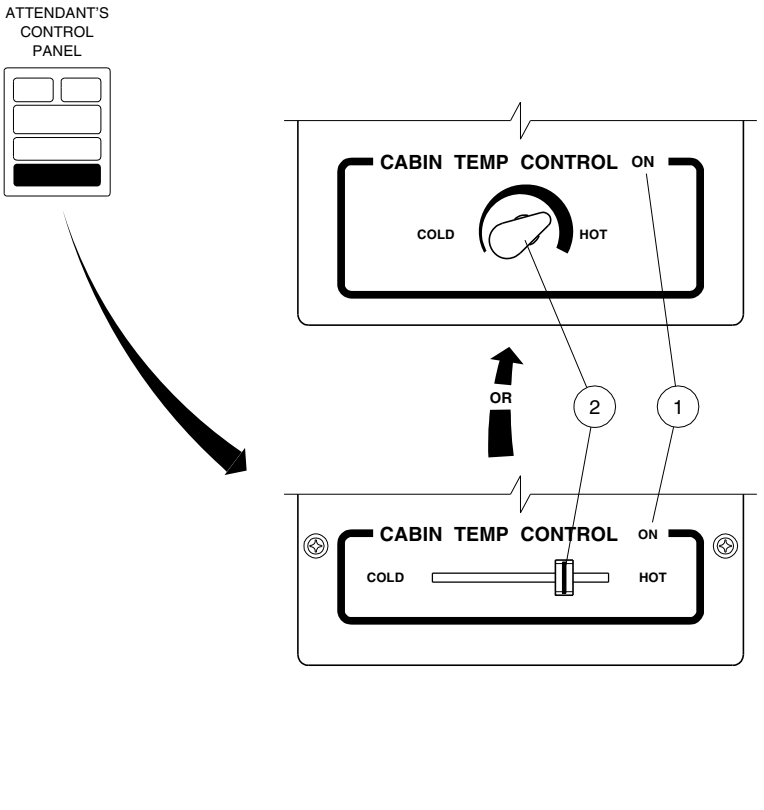
# ATTENDANT'S CONTROL PANEL

## 1 - ON INDICATOR LIGHT (GREEN)

- Illuminates to indicate that the passenger cabin temperature control is transferred to the attendant's panel.

## 2 - PASSENGER CABIN TEMPERATURE CONTROL (KNOB OR SLIDING CONTROL)

- Actuates on the passenger cabin temperature controller (right ECU) in the automatic mode, provided the Passenger Cabin Temperature and Mode Selector is set to the ATTD position.
- The attendant may set the passenger cabin to between 18°C (65°F) and 29°C (85°F).




**ATTENDANT'S CONTROL PANEL**



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# PRESSURIZATION SYSTEM

The Cabin Pressure Control System (CPCS) controls the cabin pressure by regulating the cabin air exhaust rate supplied by the ECUs.

The CPCS comprises two subsystems:

- One digital electropneumatic subsystem(automatic mode).
- One pneumatic subsystem (manual mode).

Both subsystems comprise a digital controller, a manual controller, an electropneumatic outflow valve, a pneumatic outflow valve, an air filter, two pressure regulator valves, an ejector pump, two static ports, and a Cabin Pressure Acquisition Module (CPAM).

Both outflow valves receive static pressure signals from static ports for overpressure relief and negative pressure relief functions, actuating pneumatic devices to inhibit airplane structural damage or injury in case of improper system operation. The safety devices provide the following features:

– Positive cabin differential pressure relief: 8.2 psi maximum.
– Negative cabin differential pressure relief: - 0.3 psi.
– Cabin altitude limitation (when in the auto mode): 15000 ft maximum.

The system is normally operated in the automatic mode. The manual mode is used in case of automatic mode failure.

The cabin air filter is provided to prevent nicotine and dust to enter the outflow valve chamber.

Indications of cabin altitude, cabin differential pressure, and cabin altitude rate of change are presented on the EICAS.

A caution message is presented on the EICAS in case of automatic mode failure, requiring the crew to select the manual mode.

The CPAM and CPCS have internal tolerances of ± 100 ft and ± 200 ft, respectively. Then, depending on these tolerances accumulation, the displayed cabin altitude may be increased up to 300 ft. Although displayed in the amber range for airplanes equipped with EICAS version up to 16, it may not be considered an abnormal condition if cabin altitude indication remains stabilized at or below 8300 ft.

If, however, the cabin altitude indication continuously increases and the system is out of its normal range of operation, causing a cabin depressurization, the CPAM sends a signal to the aural warning system to alert the crew when cabin altitude is above 9900 ± 100 ft.

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# OPERATION IN AUTOMATIC MODE

The automatic mode maintains minimum cabin altitude according to the airplane operating altitude, imposing minimum cabin altitude rate of change.

The automatic mode is controlled by the digital controller and requires a landing altitude to be entered prior to takeoff. According to the landing altitude, the measured cabin pressure, ADC inputs (airplane altitude, altitude rate of change and barometric correction), air/ground position, and thrust lever position, the digital controller determines the adequate opening of the electropneumatic outflow valve. The pneumatic outflow valve is slaved to the electropneumatic outflow valve and both operate simultaneously, maintaining the same position while in the automatic mode

Different operation sequences are automatically initiated by the Digital Controller following the received inputs.
The Digital Controller schedules a cabin altitude that is the value that the measured cabin altitude must be equal to.
Cabin altitude rate of change varies according to the different operation sequences.

Proper operation of the pressurization system in the automatic mode requires that the following conditions be met:

- Automatic mode is selected on the Digital Controller (button not pressed and MAN inscription not illuminated). The pressurization system is in the automatic mode when electrical power is first applied.
- Landing altitude is entered in the Digital Controller prior to the takeoff. Should the landing altitude not be entered, the system will automatically consider 8000 ft as the landing altitude.
- Manual Controller is set to DN position (full counterclockwise). If the Manual Controller is out of the DN position, the pneumatic valve tends to open causing inappropriate automatic mode operation.

## DETERMINATION OF THE THEORETICAL CABIN ALTITUDE

The theoretical cabin altitude is a function of the airplane operating altitude. It is calculated in such a way that the maximum cabin differential pressure (7.8 psi) is reached at the lowest possible airplane altitude considering a minimum cabin altitude rate of climb and a maximum airplane rate of climb.

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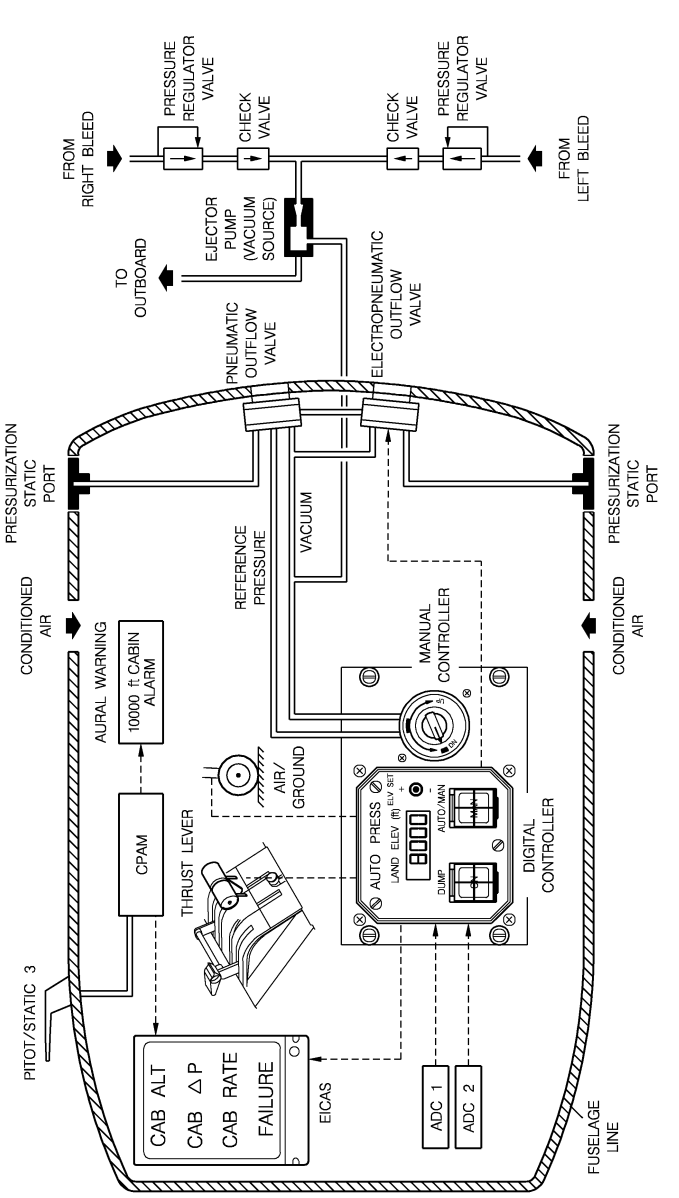


**CABIN PRESSURE CONTROL SYSTEM SCHEMATIC**

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## AUTOMATIC PREPRESSURIZATION SEQUENCE ON GROUND

This sequence is initiated and maintained as long as the airplane is on the ground and the engine 1 thrust lever is set to THRUST SET position or above. It causes the cabin altitude to descend toward an altitude equivalent to 0.2 psi (15 mbar) below the takeoff altitude.

The purpose of the automatic prepressurization is to avoid cabin bumps due to the irregular airflow on the fuselage during rotation and takeoff and also to keep a controlled cabin altitude just after rotation, as the cabin altitude tends to follow the airplane altitude.

In the case of takeoff with air conditioning supply, the cabin altitude is controlled with an altitude rate of descent equal to –450 ft/min.

In the case of takeoff without air conditioning supply, the outflow valves are closed, also avoiding cabin bump.

## TAKEOFF SEQUENCE

This sequence is initiated after the airplane leaves the ground with the purpose of avoiding reselecting the landing altitude, in case it is necessary to return to the takeoff airport.

It causes the cabin altitude to continue descending towards the altitude equivalent to 0.2 psi below the takeoff altitude. If an altitude of 0.2 psi below the takeoff altitude has already been reached during the pre-pressurization sequence, the cabin altitude does not change.

The takeoff sequence lasts until the theoretical cabin altitude becomes greater than the actual cabin altitude, or until 15 minutes have elapsed since the sequence initiation, whichever occurs first.

## FLIGHT SEQUENCE

This sequence is initiated after the takeoff sequence is finished, to establish a cabin altitude and a cabin altitude rate of change during flight. The Digital Controller schedules a cabin altitude that is the greatest value between the theoretical cabin altitude and the selected landing altitude minus 11 mbar (300 ft at SL).

The cabin altitude rate of change is controlled at different values depending on the scheduled cabin altitude and the airplane vertical speed, but is limited to –450 ft/min during descent and as following while climbing:

- 500 ft/min (for airplanes Pre-Mod. SB 145-21-0006);
- 600 ft/min (for airplanes Post-Mod. SB 145-21-0006 or S/N 145.050 up to 145.362);
- 700 ft/min (for airplanes S/N 145.363 and on).

Barometric correction, when required, is automatically provided by the Air Data Computer (ADC).

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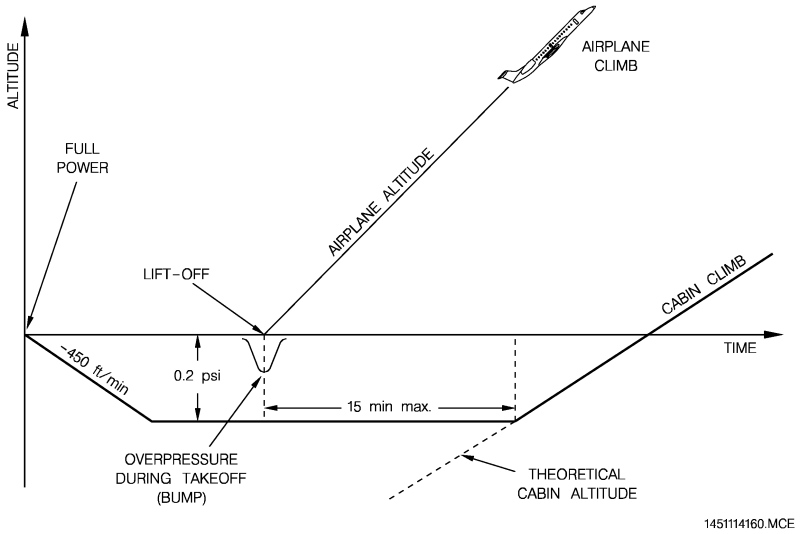
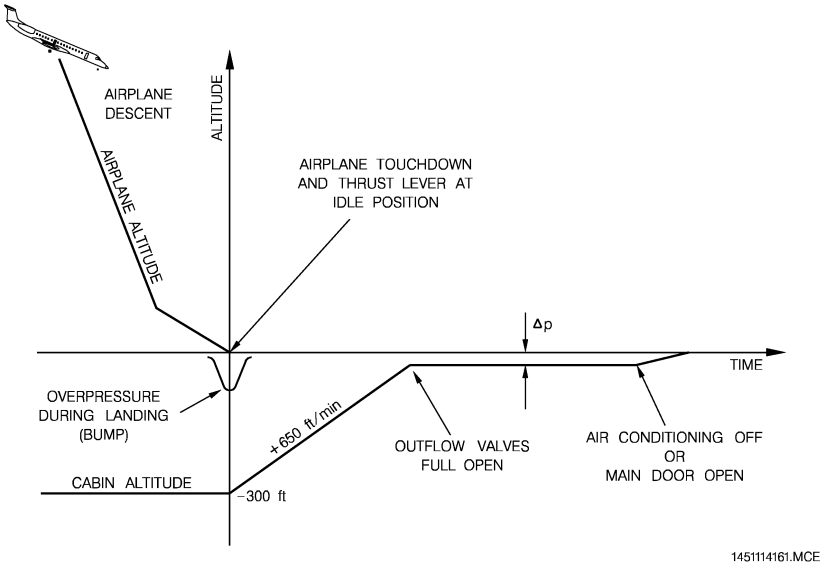



## AUTOMATIC PREPRESSURIZATION AND TAKEOFF SEQUENCE




## AUTOMATIC DEPRESSURIZATION SEQUENCE ON GROUND

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## AUTOMATIC INCREASED RATE OF DESCENT SEQUENCE

This sequence is initiated when the airplane descent rate is greater than 200 ft/min, in order to satisfy all airplane rapid descent cases. The cabin altitude rate of change limits may be accordingly increased, depending on the remaining flight time which is calculated considering the airplane operating altitude, airplane vertical speed and the selected landing altitude.

Therefore, the cabin altitude rate of descent limit may be increased to a value between –450 ft/min and –1300 ft/min (for EMB 145 models Pre-Mod. SB 145-21-0006) or –450 ft/min and –500 ft/min (for EMB 145 Post-Mod. SB 145-21-0006 or S/N 145.050 and on, EMB-135 and ERJ-140 models).

## AUTOMATIC DEPRESSURIZATION SEQUENCE ON GROUND

This sequence is initiated when the airplane is on the ground and the engine 1 thrust lever is in the IDLE position.

To avoid a cabin bump during the landing, it is necessary that the airplane land with the cabin being submitted to a small differential pressure. For that reason, the automatic mode always controls, for landing, a cabin altitude equal to the selected landing altitude minus 300 ft. This sequence cancels this differential pressure corresponding to 300 ft, as well as reduces cabin bump when the air conditioning is turned off or the main door is open.

Cabin depressurization is controlled at a rate of climb equal to 650 ft/min, up to the full opening of the outflow valves.

In automatic mode, the rapid cabin depressurization is commanded by the Dump Button.

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## OPERATION IN MANUAL MODE

Manual operation is accomplished through the manual controller which actuates only the pneumatic outflow valve, while the electropneumatic outflow valve is kept closed, by selecting MAN in the Pressurization Mode Selector Button and rotating the Manual Controller until the desired cabin rate of change is reached. The crew is responsible for monitoring cabin differential pressure within acceptable values.

In manual mode, the DUMP button is not effective and a rapid cabin depressurization is commanded by turning the manual controller to the UP position (clockwise stop). In this mode, the cabin altitude limitation at 15000 ft does not exist as it does in the automatic mode.

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# EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | PRESN AUTO FAIL | Automatic pressurization mode failure. |

# CONTROLS AND INDICATORS

## DIGITAL CONTROLLER

### 1 - LANDING ALTITUDE INDICATOR

- Displays the selected landing altitude.
- Displays a failure code if any failure is detected during power-up and continuous monitoring tests . In this case, the selection of the landing altitude is disabled.
- Successful power-up test is displayed (all light segments illuminated) until a landing altitude is selected.
- Displays blanks when Dump button or Mode Selector Button is pressed.

### 2 - LANDING ALTITUDE SELECTOR SWITCH

- Sets the landing altitude in the Landing Altitude Indicator.
- Altitude changes in 100-ft steps. Holding the selector for more than 5 seconds changes the altitude in a 1000 ft/sec rate.
- Landing altitude setting from –1500 ft to +14000 ft.

### 3 - PRESSURIZATION MODE SELECTOR BUTTON (guarded)

- Provides selection of either automatic mode (button released) or manual mode (button pressed) of operation.
- When pressed, the MAN inscription illuminates inside the button.

**NOTE:** In case of electrical failure that leads to the complete turning off of the automatic mode turning off, manual mode should be selected by pressing the Pressurization Mode Selector Button, but the MAN inscription will not be illuminated.

### 4 - PRESSURIZATION DUMP BUTTON (guarded)

- Provides rapid cabin depressurization up to 14500 ft.
- When pressed, an ON inscription illuminates inside the button.
- This button is effective in the automatic mode only.

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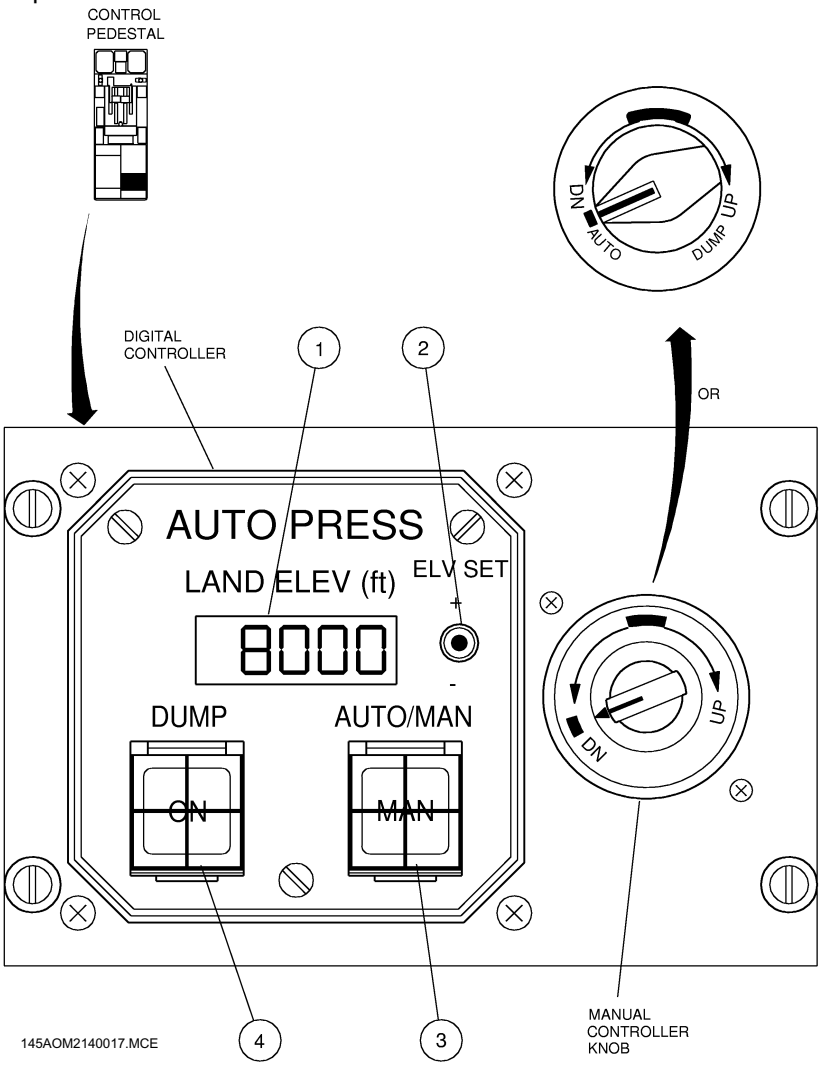
**MANUAL CONTROLLER KNOB**

- Selects cabin rate of change between –1500ft/min (at DN position) and approximately + 2500ft/min (at UP position), when in the manual operating mode.
- When operating in the AUTO mode, it must be set to the DN position.




**PRESSURIZATION CONTROLS AND INDICATORS**

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# PRESSURIZATION INDICATION ON EICAS

## 1 - CABIN ALTITUDE INDICATION

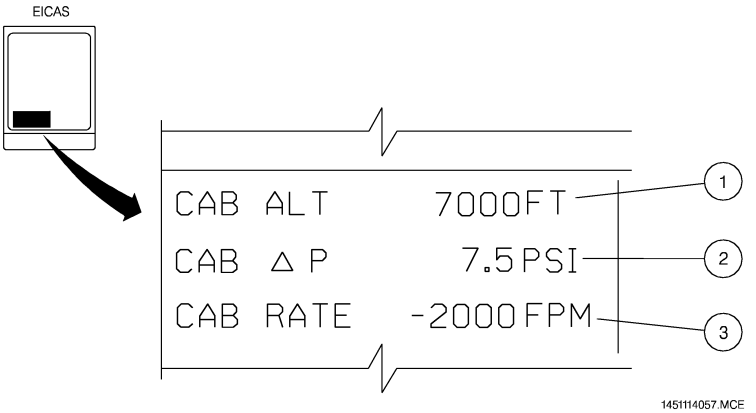
- Displays cabin altitudes, regardless of the operating mode.
- Ranges from – 1500 to 37000 ft, with a resolution of 100 ft.
- Green: from – 1500 to 8000 ft (for EICAS versions up to 13).
  from – 1500 to 8100 ft (for EICAS version 14 up to16).
  from – 1500 to 8300 ft (for EICAS version 16.5 and above).
- Amber: from 8100 to 9900 ft (for EICAS versions up to 13).
  from 8200 to 9900 ft (for EICAS version 14 up to 16).
  from 8400 to 9900 ft (for EICAS version 16.5 and above).
- Red: from 10000 to 37000 ft.

## 2 - DIFFERENTIAL PRESSURE INDICATION

- Displays the differential pressure between the cabin interior and the outside, regardless of the operating mode.
- Ranges from – 0.5 to 10.0 psi, with a resolution of 0.1 psi.
- Green: from 0.0 to 7.9 psi.
- Amber: from – 0.3 to – 0.1 psi and from 8.0 to 8.3 psi.
- Red: from – 0.5 to – 0.4 psi and from 8.4 to 10.0 psi.

## 3 - CABIN RATE OF CHANGE INDICATION

- Displays the cabin rate of change, regardless of the operating mode.
- Ranges from –2000 to 2000 ft/min, with a resolution of 50 ft/min.
- Green full range.
- For rates out of range the indication is replaced by amber dashes.




**PRESSURIZATION INDICATION ON EICAS**

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# PRESSURIZATION SYSTEM

The information presented herein is only applicable to airplanes properly equipped for takeoff and landing operation above 8000 ft.
Airplanes properly equipped accomplished any of the following Service Bulletins or have an equivalent modification factory incorporated:
- SB 145-00-0031
- SB 145-00-0033
- SB 145-21-0050

The Cabin Pressure Control System (CPCS) controls the cabin pressure by regulating the cabin air exhaust rate supplied by the ECUs.

The CPCS comprises two subsystems:

- One digital electropneumatic subsystem (automatic mode).

- One pneumatic subsystem (manual mode).

Both subsystems comprise a digital controller, a manual controller, an electropneumatic outflow valve, a pneumatic outflow valve, an air filter, two pressure regulator valves, an ejector pump, two static ports, and a Cabin Pressure Acquisition Module (CPAM).

Both outflow valves receive static pressure signals from static ports for overpressure relief and negative pressure relief functions, actuating pneumatic devices to inhibit airplane structural damage or injury in case of improper system operation. The safety devices provide the following features:

– Positive cabin differential pressure relief: 8.2 psi maximum.
– Negative cabin differential pressure relief: - 0.3 psi.
– Cabin altitude limitation (when in the auto mode): 15000 ft maximum.
The system is normally operated in the automatic mode. The manual mode is used in case of automatic mode failure.

The cabin air filter is provided to prevent nicotine and dust to enter the outflow valve chamber.

Indications of cabin altitude, cabin differential pressure, and cabin altitude rate of change are presented on the EICAS.

A caution message is presented on the EICAS in case of automatic mode failure, requiring the crew to select the manual mode.

The CPAM and CPCS have internal tolerances of ± 100 ft and ± 200 ft, respectively. Then, depending on these tolerances accumulation, the displayed cabin altitude may be increased up to 300 ft.

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If, however, the cabin altitude indication continuously increases and the system is out of its normal range of operation, causing a cabin depressurization, the CPAM sends a signal to the aural warning system to alert the crew when cabin altitude is above 9900 ± 100 ft.

Some airplanes are equipped and certified with HIGH ALT mode. HIGH ALT is a designation for High Altitude Takeoff and Landing Operation mode which allows operations above 8000 ft up to 13500 ft. The pilot activates the HIGH ALT mode manually by pressing a Bezel Button on the MFD Display. When HIGH ALT mode is selected an indication on MFD Display becomes boxed and the message “HI ALT LDG-T/O” will appear on EICAS. This message will advise the flight crewmembers the shift of aural warning from 9900 ± 100 ft to 14500 ± 500 ft; the shift of cabin altitude color range indication on EICAS, and the inhibition of Cabin Pressure Control System (CPCS) takeoff-abort mode.

Also, for these airplanes equipped and certified with HIGH ALT mode the passengers oxygen masks switches are set to deploy masks at 14500 ± 500 ft cabin altitude pressure.

When HIGH ALT mode is not active the airplane is in NORMAL mode operation. In NORMAL mode operation the airplane functions are exactly the same as in airplanes not equipped with HIGH ALT system. Some following information with NORMAL mode inscription in this chapter refers to either cases.

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## OPERATION IN AUTOMATIC MODE

The automatic mode maintains minimum cabin altitude according to the airplane operating altitude, imposing minimum cabin altitude rate of change.

The automatic mode is controlled by the digital controller and requires a landing altitude to be entered prior to takeoff. According to the landing altitude, the measured cabin pressure, ADC inputs (airplane altitude, altitude rate of change and barometric correction), air/ground position, and thrust lever position, the digital controller determines the adequate opening of the electropneumatic outflow valve. The pneumatic outflow valve is slaved to the electropneumatic outflow valve and both operate simultaneously, maintaining the same position while in the automatic mode.

Different operation sequences are automatically initiated by the Digital Controller following the received inputs.

The Digital Controller schedules a cabin altitude that is the value that the measured cabin altitude must be equal to.

Cabin altitude rate of change varies according to the different operation sequences.

Proper operation of the pressurization system in the automatic mode requires that the following conditions be met:

– Automatic mode is selected on the Digital Controller (button not pressed and MAN inscription not illuminated). The pressurization system is in the automatic mode when electrical power is first applied.
– Landing altitude is entered in the Digital Controller prior to the takeoff. Should the landing altitude not be entered, the system will automatically consider 8000 ft as the landing altitude.
– Manual Controller is set to DN position (full counterclockwise). If the Manual Controller is out of the DN position, the pneumatic valve tends to open causing inappropriate automatic mode operation.

### DETERMINATION OF THE THEORETICAL CABIN ALTITUDE

The theoretical cabin altitude is a function of the airplane operating altitude. It is calculated in such a way that the maximum cabin differential pressure (7.8 psi) is reached at the lowest possible airplane altitude considering a minimum cabin altitude rate of climb and a maximum airplane rate of climb.

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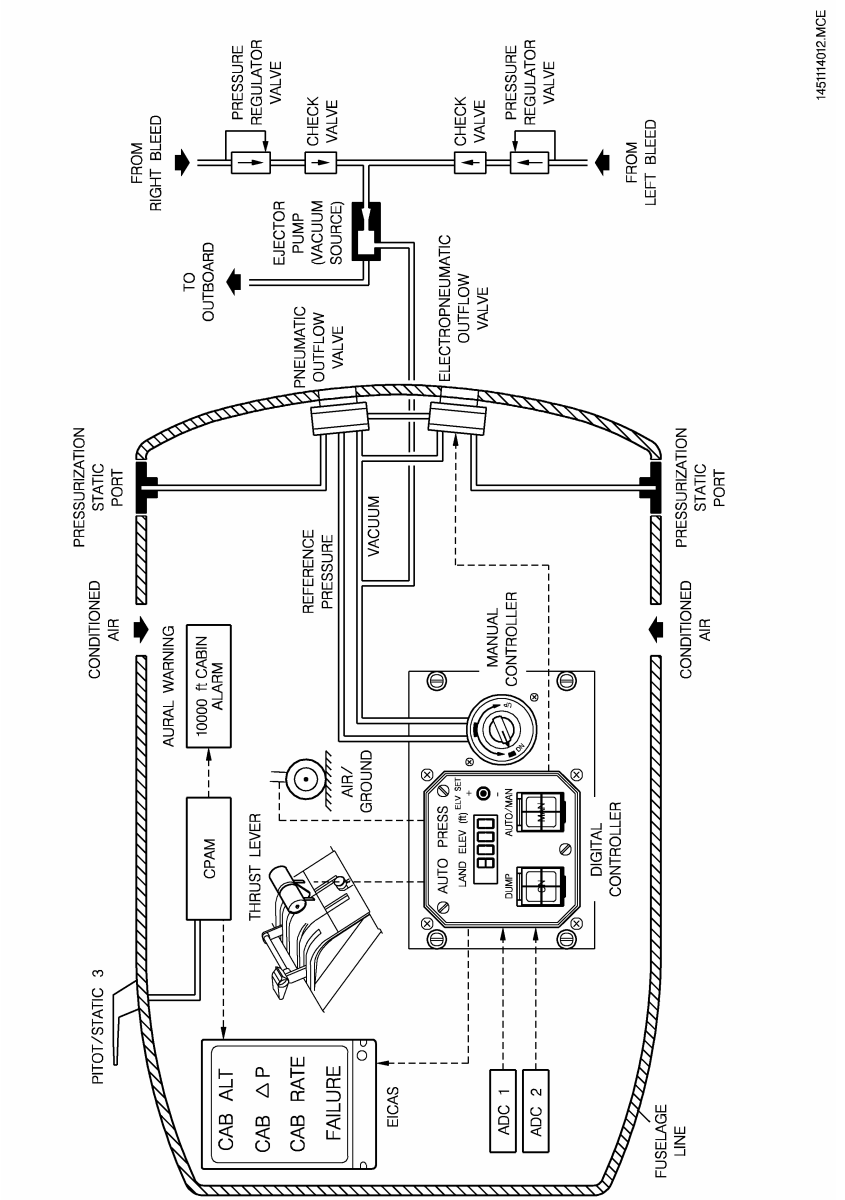


**CABIN PRESSURE CONTROL SYSTEM SCHEMATIC**



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## AUTOMATIC PREPRESSURIZATION SEQUENCE ON GROUND (NORMAL MODE OPERATION)

This sequence is initiated and maintained as long as the airplane is on the ground and the engine 1 thrust lever is set to THRUST SET position or above. It causes the cabin altitude to descend toward an altitude equivalent to 0.2 psi (15 mbar) below the takeoff altitude.

The purpose of the automatic prepressurization is to avoid cabin bumps due to the irregular airflow on the fuselage during rotation and takeoff and also to keep a controlled cabin altitude just after rotation, as the cabin altitude tends to follow the airplane altitude.

In the case of takeoff with air conditioning supply, the cabin altitude is controlled with an altitude rate of descent equal to –450 ft/min.

In the case of takeoff without air conditioning supply, the outflow valves are closed, also avoiding cabin bump.

## TAKEOFF SEQUENCE

## (NORMAL MODE OPERATION)

This sequence is initiated after the airplane leaves the ground with the purpose of avoiding reselecting the landing altitude, in case it is necessary to return to the takeoff airport.

It causes the cabin altitude to continue descending towards the altitude equivalent to 0.2 psi below the takeoff altitude. If an altitude of 0.2 psi below the takeoff altitude has already been reached during the prepressurization sequence, the cabin altitude does not change.

The takeoff sequence lasts until the theoretical cabin altitude becomes greater than the actual cabin altitude, or until 15 minutes have elapsed since the sequence initiation, whichever occurs first.

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## FLIGHT SEQUENCE

## (NORMAL MODE OPERATION)

This sequence is initiated after the takeoff sequence is finished, to establish a cabin altitude and a cabin altitude rate of change during flight. The Digital Controller schedules a cabin altitude that is the greatest value between the theoretical cabin altitude and the selected landing altitude minus 11 mbar (300 ft at SL).

The cabin altitude rate of change is controlled at different values depending on the scheduled cabin altitude and the airplane vertical speed, but is limited to –450 ft/min during descent and as following while climbing:

- 500 ft/min (for airplanes Pre-Mod. SB 145-21-0006);
- 600 ft/min (for airplanes Post-Mod. SB 145-21-0006 or S/N 145.050 up to 145.362);
- 700 ft/min (for airplanes S/N 145.363 and on).

Barometric correction, when required, is automatically provided by the Air Data Computer (ADC).

## FLIGHT SEQUENCE

## (HIGH ALT MODE OPERATION)

During HIGH ALT mode operation the cabin altitude will automatically descend (at 500 ft/min) to 8000 ft altitude level immediately after takeoff, avoiding exposing the passengers to 15 minutes of high cabin altitude.

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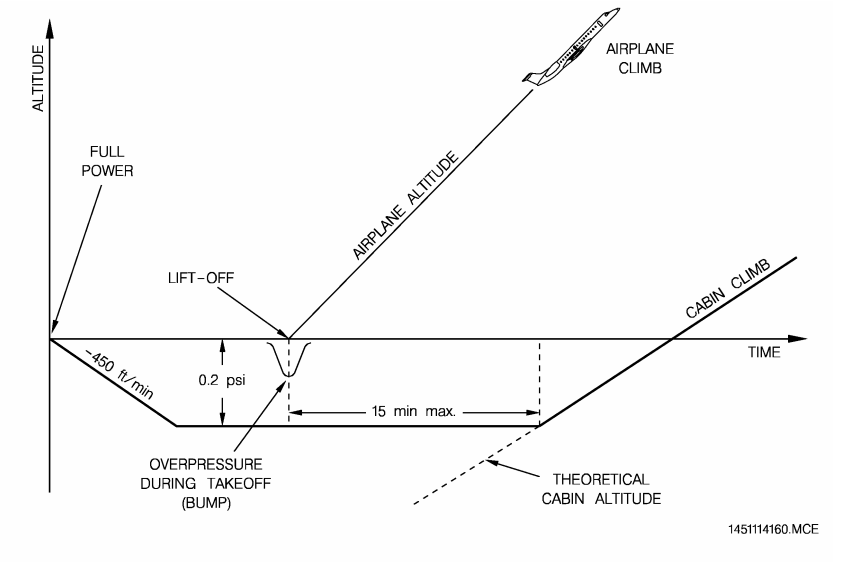
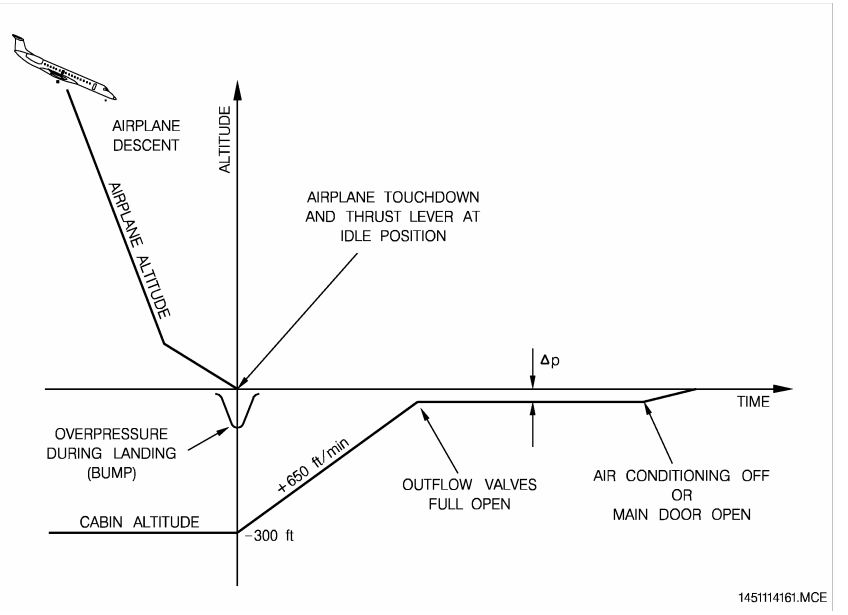



**AUTOMATIC PREPRESSURIZATION AND TAKEOFF SEQUENCE**




**AUTOMATIC DEPRESSURIZATION SEQUENCE ON GROUND**

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## AUTOMATIC INCREASED RATE OF DESCENT SEQUENCE

This sequence is initiated when the airplane descent rate is greater than 200 ft/min for at least 10 seconds, in order to satisfy all airplane rapid descent cases. The cabin altitude rate of change limits may be accordingly increased, depending on the remaining flight time which is calculated considering the airplane operating altitude, airplane vertical speed and the selected landing altitude.

Therefore, the cabin altitude rate of descent limit may be increased to a value between –450 ft/min and –1300 ft/min (for EMB-145 models Pre-Mod. SB 145-21-0006) or –450 ft/min and –500 ft/min (for EMB-145 Post-Mod. SB 145-21-0006 or S/N 145.050 and on and EMB-135 models).

## AUTOMATIC DEPRESSURIZATION SEQUENCE ON GROUND

This sequence is initiated when the airplane is on the ground and the engine 1 thrust lever is in the IDLE position.

To avoid a cabin bump during the landing, it is necessary that the airplane land with the cabin being submitted to a small differential pressure. For that reason, the automatic mode always controls, for landing, a cabin altitude equal to the selected landing altitude minus 300 ft. This sequence cancels this differential pressure corresponding to 300 ft, as well as reduces cabin bump when the air conditioning is turned off or the main door is open.

Cabin depressurization is controlled at a rate of climb equal to 650 ft/min, up to the full opening of the outflow valves.

In automatic mode, the rapid cabin depressurization is commanded by the Dump Button.

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## OPERATION IN MANUAL MODE

Manual operation is accomplished through the manual controller which actuates only the pneumatic outflow valve, while the electropneumatic outflow valve is kept closed, by selecting MAN in the Pressurization Mode Selector Button and rotating the Manual Controller until the desired cabin rate of change is reached. The crew is responsible for monitoring cabin differential pressure within acceptable values.

In manual mode, the DUMP button is not effective and a rapid cabin depressurization is commanded by turning the manual controller to the UP position (clockwise stop). In this mode, the cabin altitude limitation at 15000 ft does not exist as it does in the automatic mode.

## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | PRESN AUTO FAIL | Automatic pressurization mode failure. |
| ADVISORY | HI ALT LDG-T/O | High Altitude Takeoff and Landing mode activate. |

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# CONTROLS AND INDICATORS

## DIGITAL CONTROLLER

### 1 - LANDING ALTITUDE INDICATOR

- Displays the selected landing altitude.
- Displays a failure code if any failure is detected during power-up and continuous monitoring tests. In this case, the selection of the landing altitude is disabled.
- Successful power-up test is displayed (all light segments illuminated) until a landing altitude is selected.
- Displays blanks when Dump button or Mode Selector Button is pressed.

### 2 - LANDING ALTITUDE SELECTOR SWITCH

- Sets the landing altitude in the Landing Altitude Indicator.
- Altitude changes in 100-ft steps. Holding the selector for more than 5 seconds changes the altitude in a 1000 ft/sec rate.
- Landing altitude setting from –1500 ft to +14000 ft.

### 3 - PRESSURIZATION MODE SELECTOR BUTTON (guarded)

- Provides selection of either automatic mode (button released) or manual mode (button pressed) of operation.
- When pressed, the MAN inscription illuminates inside the button.

**NOTE:** In case of electrical failure that leads to the complete turning off of the automatic mode turning off, manual mode should be selected by pressing the Pressurization Mode Selector Button, but the MAN inscription will not be illuminated.

### 4 - PRESSURIZATION DUMP BUTTON (guarded)

- Provides rapid cabin depressurization up to 14500 ft.
- When pressed, an ON inscription illuminates inside the button.
- This button is effective in the automatic mode only.

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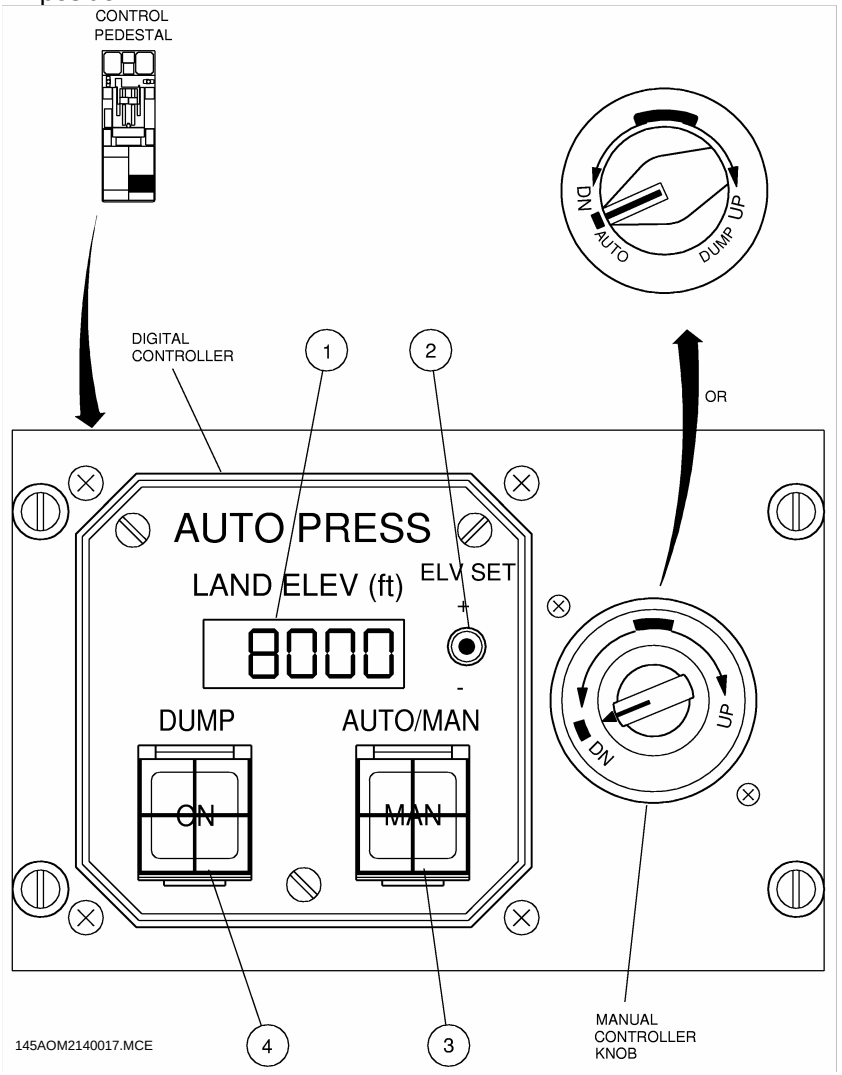
## MANUAL CONTROLLER KNOB

- Selects cabin rate of change between –1500 ft/min (at DN position) and approximately + 2500 ft/min (at UP position), when in the manual operating mode.
- When operating in the AUTO mode, it must be set to the DN position.




**PRESSURIZATION CONTROLS AND INDICATORS**



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**MFD**

**1 - HIGH ALT STATUS INDICATION**

- Displays HIGH ALT activation status.
- Boxed: HIGH ALT mode activated.
- Unboxed: HIGH ALT mode deactivated.

**2 - HIGH ALT BEZEL BUTTON**

- Provides HIGH ALT activation when pressed.

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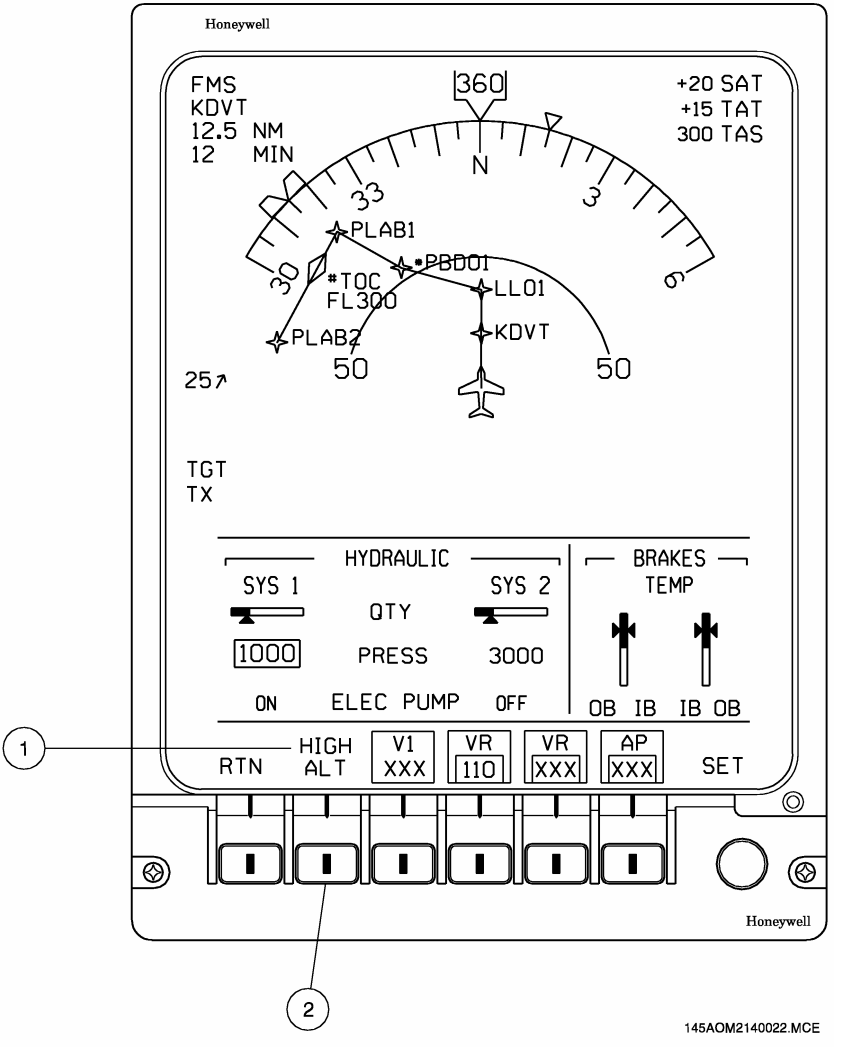


**MFD HIGH ALT MODE ACTIVATION**



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## PRESSURIZATION INDICATION ON EICAS

### 1 - CABIN ALTITUDE INDICATION

- Displays cabin altitudes, regardless of the operating mode.
- Ranges from – 1500 to 37000 ft, with a resolution of 100 ft.

| Cabin altitude indication color | Cabin altitude range (ft) | |
|---|---|---|
| | Normal mode operation | High altitude takeoff and landing mode operation (HIGH ALT mode) * |
| Green | -1500 to 8300 | -1500 to 8300 |
| Amber | 8400 to 9900 | 8400 to 14400 |
| Red | 10000 to 37000 | 14500 to 37000 |

### 2 - DIFFERENTIAL PRESSURE INDICATION

- Displays the differential pressure between the cabin interior and the outside, regardless of the operating mode.
- Ranges from – 0.5 to 10.0 psi, with a resolution of 0.1 psi.
- Green: from 0.0 to 7.9 psi.
- Amber: from – 0.3 to – 0.1 psi and from 8.0 to 8.3 psi.
- Red: from – 0.5 to – 0.4 psi and from 8.4 to 10.0 psi.

### 3 - CABIN RATE OF CHANGE INDICATION

- Displays the cabin rate of change, regardless of the operating mode.
- Ranges from –2000 to 2000 ft/min, with a resolution of 50 ft/min (for EICAS versions up to 18.5).
- Ranges from –4000 to 4000 ft/min, with a resolution of 50 ft/min (for EICAS versions 19 and on).
- Green full range.
- For rates out of range the indication is replaced by amber dashes.

**NOTE:** (*) Only for airplanes equipped with HIGH ALT mode.



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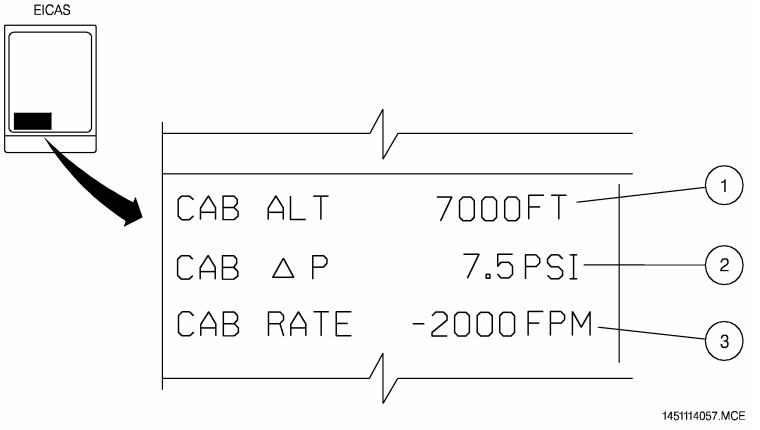


**PRESSURIZATION INDICATION ON EICAS**

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# ELECTRONIC BAY COOLING SYSTEM

## FORWARD ELECTRONIC BAY

An automatic cooling system is provided in the nose electronic bay, where most of the electronic equipment is installed. This system maintains the temperature inside the bay within the avionics operational limits.
The system comprises two NACA air inlets, two shutoff valves, two recirculation fans, two exhaust fans, two check valves, four control thermostats, and two overtemperature thermostats.

The NACA air inlets are provided with water separators and drains to deter water ingestion by the air inlets into the compartment.

All the fans are powered by four dedicated Inverter Modules.
When the airplane is energized, the inverter modules are turned on, supplying power to the recirculation fans.
The electrical power supply to the recirculation fan 2, exhaust fan 1 and shutoff valve 1 is completely segregated from the remaining components, to prevent a total loss of the system in case of an electrical system single failure. Each recirculation fan operates continuously when its associated bar is energized.

A check valve is installed on each exhaust duct (left and right) to avoid water ingestion through the exhaust fans.

If the forward electronic bay internal temperature exceeds 24°C (75°F) the control thermostats open the shutoff valves and turn the exhaust fans on. When the temperature drops below 19°C (66°F), the shutoff valves are closed and the exhaust fans are turned off.

In the event that the temperature limit is reached, two overtemperature thermostats are actuated and a caution message is presented on the EICAS.

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## REAR ELECTRONIC BAY

In flight or during operation with the doors closed, rear electronic bay cooling is performed by conditioned air discharged from the cabin. When this air flows from the underfloor area to the outflow valves, installed on the rear pressure bulkhead, it passes through this compartment, cooling it.

During ground operation, with the airplane unpressurized, an air outlet blows air from the gasper fan line towards the rear electronic bay.

# EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | ELEKBAY OVTEMP | Temperature inside the forward bay exceeds 71ºC (160°F) maximum. |

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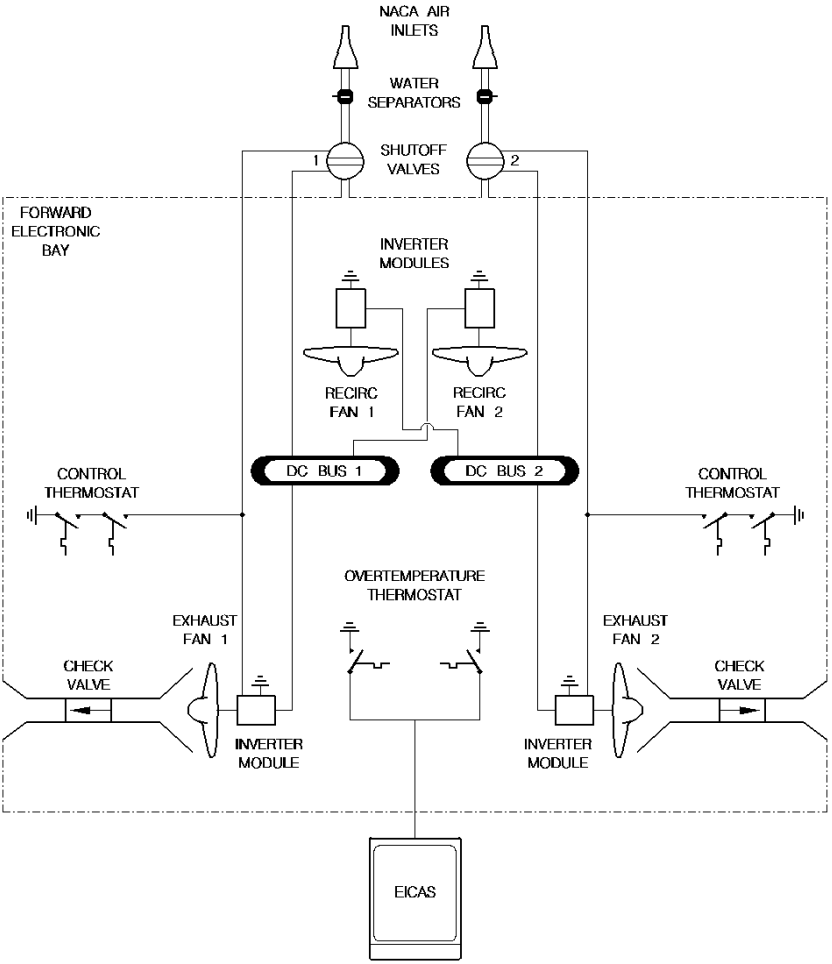


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## FORWARD ELECTRONIC BAY COOLING SCHEMATIC

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# BAGGAGE VENTILATION SYSTEM

Airplanes equipped with “class-C” baggage compartment have a Baggage Ventilation System installed. Although no dedicated temperature control is available (the “class-C” baggage compartment is heated by the passenger cabin air flowing into it), the Baggage Ventilation System provides an adequate environment for carrying live animals in the compartment.

The Baggage Ventilation System is composed of two ambient check valves and a baggage compartment fan.

Whenever the recirculation fan is off, the forward check valve prevents reverse flow into the passenger cabin and the two check valves prevent smoke or fire extinguishing agent penetration into the passenger cabin or into the rear electronic compartment, (refer to Section 2-7 - Fire Protection).

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# SECTION 2-15
# ICE AND RAIN PROTECTION

TABLE OF CONTENTS

Block Page

General ..... 2-15-05 .. 01
Bleed Air Thermal Anti-Icing System ..... 2-15-10 .. 01
Wing, Stabilizer and Engine Anti-icing Valves Operational Logic ..... 2-15-10 .. 03
EICAS Messages ..... 2-15-10 .. 08
Windshield Heating System ..... 2-15-10 .. 09
EICAS Messages ..... 2-15-10 .. 10
Windshield Differentiation ..... 2-15-10 .. 11
Sensor Heating System ..... 2-15-10 .. 13
EICAS Messages ..... 2-15-10 .. 14
Lavatory Water Drain and Nipple Heating System ..... 2-15-10 .. 15
Ice Protection Controls and Indicators ..... 2-15-10 .. 15
Ice Protection Control Panel ..... 2-15-10 .. 15
Ice Detection System ..... 2-15-15 .. 01
EICAS Messages ..... 2-15-15 .. 01
Windshield Wiper System (if applicable) ..... 2-15-15 .. 02
Windshield Wiper Control Panel (if applicable) ..... 2-15-15 .. 02

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# GENERAL

Airplane ice protection system is provided by heating critical ice build up areas through the use of either hot air or electrical power. The system is fully automatic and under icing conditions, activates the entire protection system (the only exception is the windshield heating system).

The hot air-heated areas are:
– Wing and horizontal stabilizer leading edges.
– Engine air inlet lips.

The electrically heated areas are:
– Windshields.
– Pitot tubes, Pitot-static tube, AOA sensors, TAT probes, ADCs and pressurization static ports.
– Lavatory water drain and water service nipples.

Two fully independent wiper systems remove rain from the windshields.

**NOTE:** For airplanes Pre-Mod. SB 145-30-0055 and Post-Mod. SB 145-30-0054 (or with an equivalent modification factory incorporated), the Rain Repellent Coating replace the Windshield Wipers. Approved Rain Repellent Coatings are listed in AMM chapter 30-41-04.

All ice protection systems provide signals to the EICAS for malfunctioning system display.

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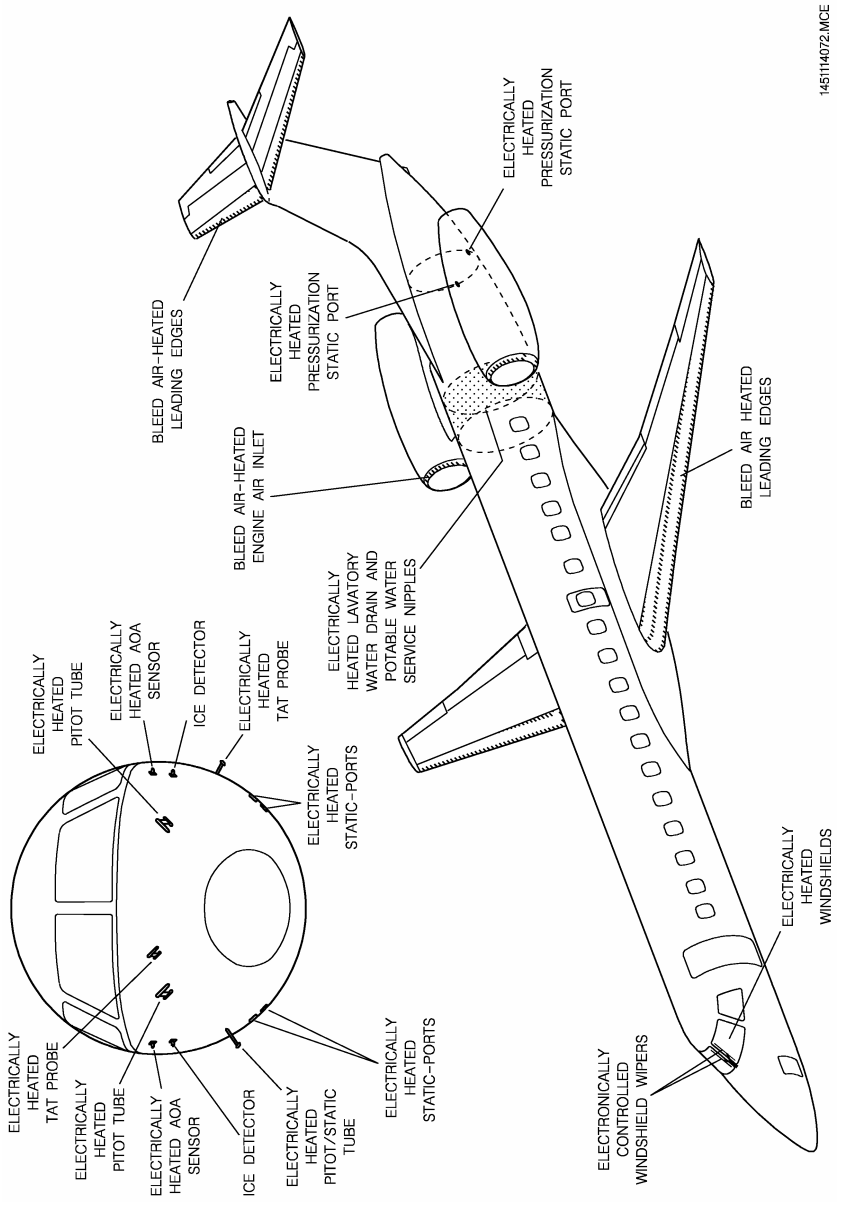


**ICE AND RAIN PROTECTION SYSTEM**



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# BLEED AIR THERMAL ANTI-ICING SYSTEM

The bleed air thermal anti-icing system is supplied with hot air tapped from the engines. In the automatic mode, the system is turned on through activation of either ice detector. Manually, setting the OVERRIDE Knob to the ALL position activates the system.

Adequate ice protection for the wing and horizontal stabilizer leading edges and engine air inlet lips is ensured by heating these surfaces. Hot air supplied by the Pneumatic System is ducted through perforated tubes, known as Piccolo tubes. Each Piccolo tube is routed along the surface, so that hot air jets flowing through the perforations heats the surface. Dedicated slots are provided for hot air exhaustion after the surface has been heated.

During night flights, inspection lights, installed on the wing-to-fuselage fairing, illuminate the wing leading edges, allowing the crew to check for ice accumulation.

Each subsystem comprises an anti-icing valve (pressure regulating/shutoff valve). A restrictor limits the airflow rate supplied by the Pneumatic System. It is monitored by pressure sensors, that indicate abnormal low and high air pressure conditions. The pressure sensors protect the respective subsystem against either insufficient or excessive airflow rate.

The wing and stabilizer low pressure protection mode has a redundant detection by means of a second low pressure sensor on the stabilizer system and a differential pressure switch ($\pm$ 2 psi) that compares root pressure on the left and right half-wing Piccolo tubes.

Air leakage is detected by thermostats installed close to each duct connection. Low pressure switches provide an additional protection against unacceptable leakage level.

The Piccolo tubes integrity is monitored as follows:

Horizontal stabilizer: By one differential pressure switch comparing the left and right Piccolo tubes pressure.

Half-wing: It depends on the airplane model. By one differential pressure switch in each Piccolo tube comparing the root and tip pressures or, by manometric switches measuring the tip pressure only.

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Engine ice protection is provided by heating the engine air inlet lip, through the use of non-temperature-controlled hot air tapped directly upstream of each high stage valve. As the engine air inlet has enough airflow surrounding the lip when the engine is running, the engine air inlet lip anti-icing system can be operated on the ground normally and with no limitations. Each engine has its own protection system independent of the airplane's pneumatic system.

The left hand Pneumatic System supplies the horizontal stabilizer anti-icing subsystem. Each half-wing anti-icing subsystem is supplied by its respective side of the Pneumatic System.

The bleed air thermal anti-icing system may be deactivated by buttons, located on the overhead panel.

On the ground, the FADEC incorporates an automatic logic to reduce the maximum available thrust to avoid a sudden engine thrust loss during lift-off, even with the thrust lever set at MAX position.

In flight, the FADEC allows the engines to deliver the maximum rated thrust to compensate for the effect of the high bleed air consumption by the wing and horizontal stabilizer thermal anti-icing subsystems. Moreover, the FADEC provides an automatic logic to ensure a minimum available thrust during icing conditions, even during low thrust setting conditions. This logic is automatically inhibited when the landing gear is extended, in order to improve the airplane's rate of descent and glide slope path adjusting capability.

The APU bleed air is not hot enough to perform anti-icing functions. Therefore it must not be used for such applications.

A caution message is presented on the EICAS if the thermal anti-icing system is turned on during non-icing conditions.

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## WING, STABILIZER AND ENGINE ANTI-ICING VALVES OPERATIONAL LOGIC

Since the Bleed Thermal Anti-icing System is supplied by the Pneumatic System, it is integrated to the functional logic that provides automatic control and protection for the system.

The Wing and Stabilizer Anti-icing Valves receive an electrical input to open when the following conditions occur:

- The Ice Detection Test Knob is set to 1 or 2, or
- The airplane is in-flight or attained a ground speed above 25 kt, and
- The Ice Detection Override Knob is set to ALL, or
- The Ice Detection Override Knob is set to AUTO or ENG and any ice detector is activated.

**NOTE: -** The Wing and Stabilizer Anti-icing Valves are inhibited from opening on the ground and at a ground speed below 25 kt to prevent structural damage caused by surface heating, except during ice detection testing. The ice detection test should not be activated for more than 15 seconds.

**-** An ICE COND-A/I INOP message may be displayed on ground in icing conditions at a ground speed below 25 kt. For the logic of this message, refer to Section 1-00-30 (EICAS Versions) of AOM. If the message is displayed, the associated procedure must be accomplished.

- The Engine Anti-icing Valves receive an electrical input to open when the following conditions occur:
- The Ice Detection Override Knob is set to ALL or ENG, or
- The Ice Detection Override Knob is set to AUTO position and any ice detector is activated, or
- The Ice Detection Test Knob is set to 1 or 2.

The engine anti-ice system logic has a narrow range between normal operating pressures and a low pressure value that, if reached, would trigger an E1(2) A/ICE FAIL message on the EICAS. This message may be presented in flight whenever the engines are set at low thrust settings. This message may be cleared increasing the engine anti-ice system pressure by advancing the thrust levers with Ice Detection Override Knob in AUTO. If the message does clear and the related Engine Air Inlet OPEN inscription remains illuminated, the system is operating normally and the flight may be continued.

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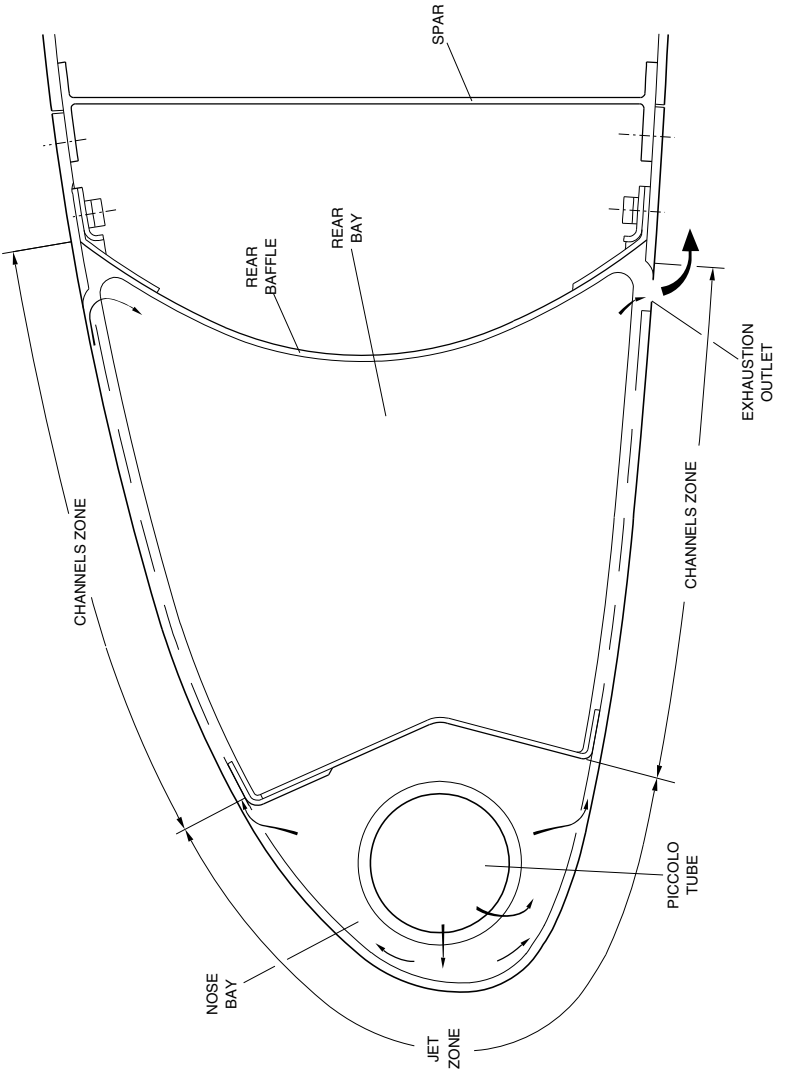


## WING ANTI-ICING SYSTEM SCHEMATIC



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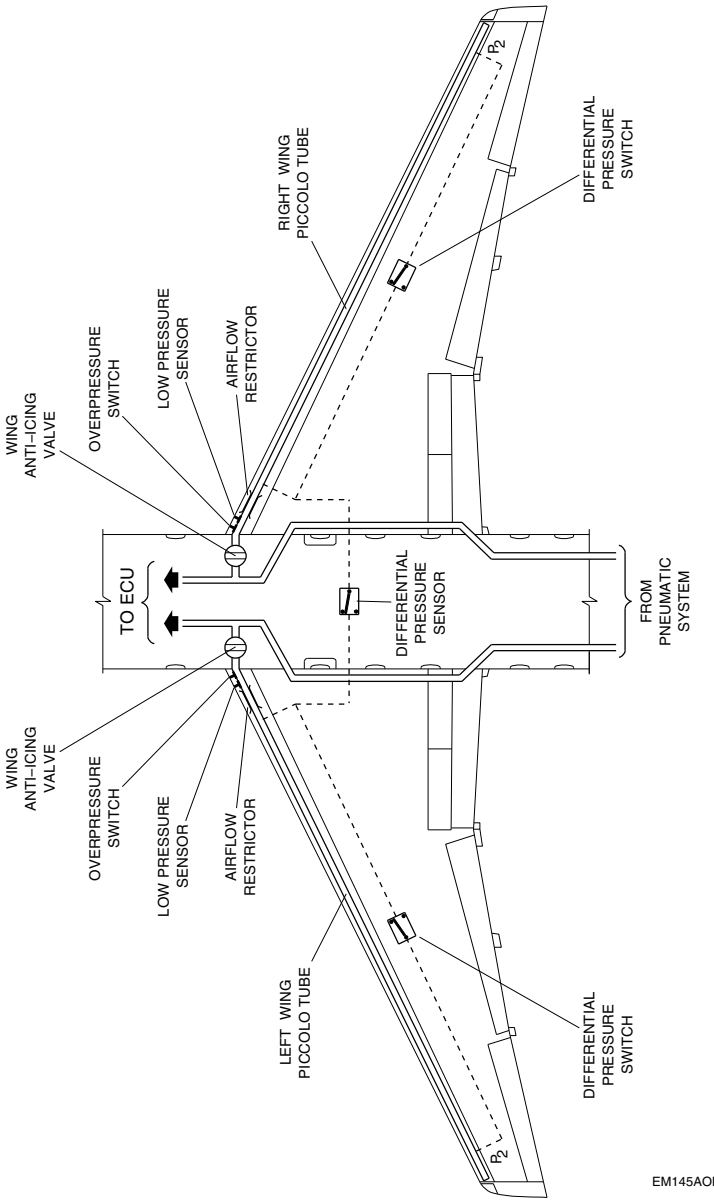


AIRPLANES PRE-MOD. SB 145-30-0019

**WING ANTI-ICING SYSTEM SCHEMATIC**



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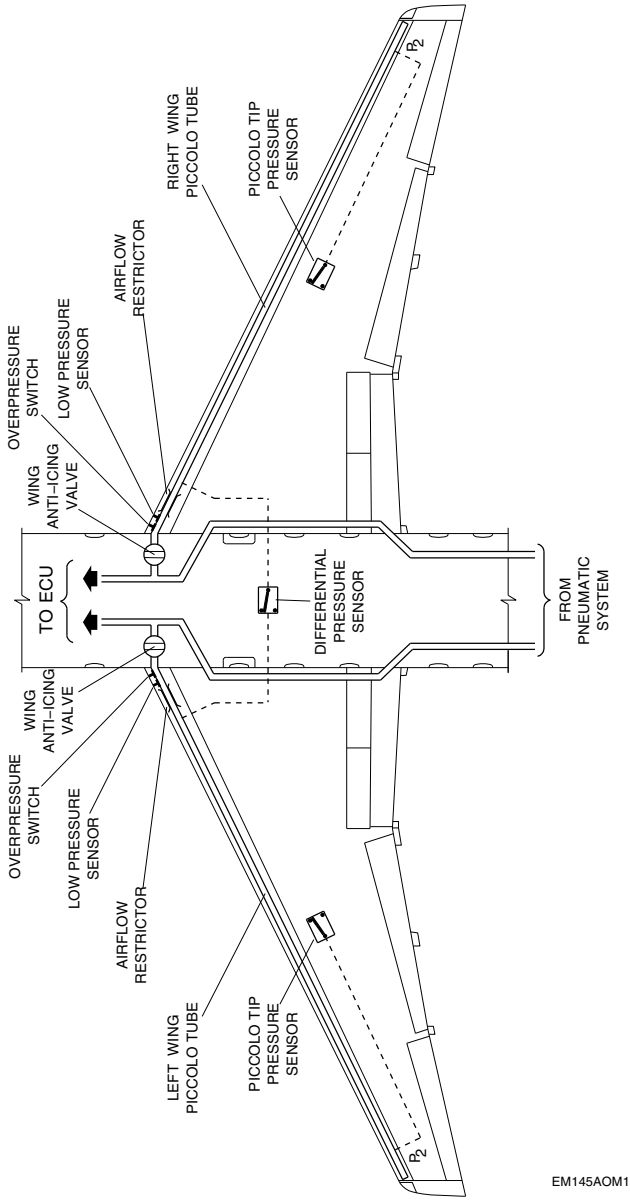


AIRPLANES POST-MOD. SB 145-30-0019

**WING ANTI-ICING SYSTEM SCHEMATIC**



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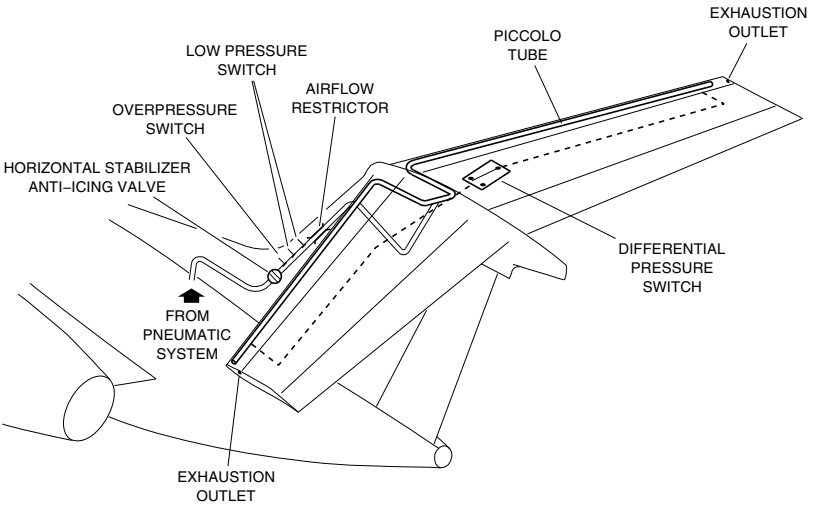


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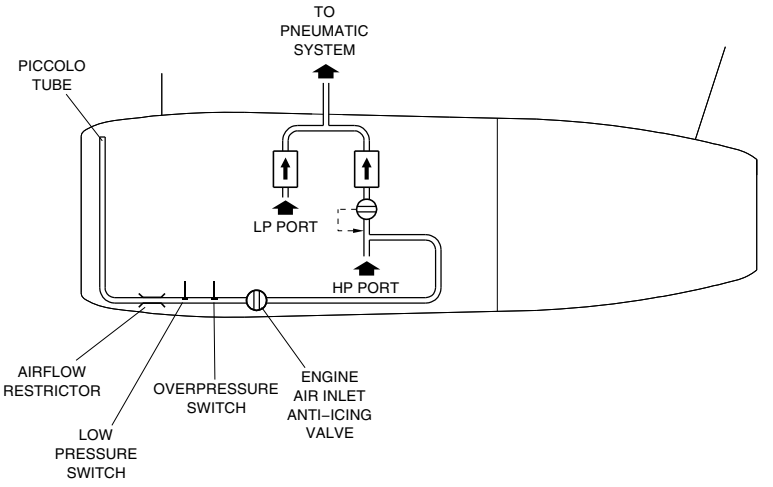
## HORIZONTAL STABILIZER ANTI-ICING SYSTEM SCHEMATIC

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## ENGINE AIR INLET ANTI-ICING SYSTEM SCHEMATIC

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## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | ICE COND-A/I INOP | Any Bleed Air Thermal anti-icing subsystem not functioning properly under icing conditions. |
| CAUTION | A/ICE LOW CAPACITY | Low pressure condition downstream of any wing or stabilizer anti-ice valve or wing pressure asymmetry. |
| | A/ICE SWITCH OFF | Any Bleed Air Thermal anti-icing button turned off. |
| | E1 (2) A/ICE FAIL | – Low pressure condition.<br>– Valve failure.<br>– Any switch failure.<br>– Overpressure condition.<br>– Any system failure. |
| | NO ICE-A/ICE ON | Any anti-icing valve opened in flight out of icing conditions. |
| | STAB A/ICE FAIL | – Low pressure condition.<br>– Valve failure.<br>– Any switch failure.<br>– Duct leakage.<br>– Any system activation device failure. |
| | WG A/ICE FAIL | – Low pressure condition, or<br>– Disagreement between valve position and system command, or<br>– Piccolo tube failure. |
| ADVISORY | ENG A/ICE OVERPRES | Inflight overpressure condition detected. |

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# WINDSHIELD HEATING SYSTEM

The windshields are electrically heated to prevent ice and fog formation or for deicing and defogging purposes. Due to a higher thermal inertia to bring heat to windshield inner layer, when Descent phase is initiated the system must be turned ON to prevent fogging. During all the others flight phases, the system must be kept OFF except when icing conditions are anticipated or if situation requires. For airplanes equipped with PPG windshield, the windshield heating system may be selected ON during all flight phases.

The outer glass layer has no structural significance but provides a rigid, hard and protected surface.

Windshield heating is accomplished through an electric conductive grid embedded in its interlayer, which functions as an electric resistor.

Individual buttons located on the overhead panel control left and right windshield heating. Separate power supplies are provided for each windshield heating element and its control circuit.

Each windshield element is provided with three temperature sensors. One sensor is used for temperature control and a second sensor is used for overheat protection. A third sensor is provided as a spare for use by maintenance personnel, should a failure occur in any of the two sensors.

For airplanes Pre-Mod. SB 145-30-0033, each windshield element has a dedicated temperature controller that receives a signal from the associated temperature sensors and controls the windshield temperature. When the temperature reaches the upper limit (45°C), power supply to the heater is interrupted. When the temperature is below the lower limit (40°C), power supply is automatically restored. A caution message W/S HEAT FAIL is presented on the EICAS when a system failure is detected or the windshield temperature exceeds 55°C.

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For airplanes Post-Mod. SB 145-30-0033 or with an equivalent modification factory-incorporated, the temperature controller has two modes of operation, defog heat and anti-ice heat mode. When the windshield heating push button is set to ON, the controller continuously monitors the windshield temperature; as temperature drops below 26°C (defog mode), it modulates power input to the electric conductive grid and maintains this temperature. If ice detectors sense ice formation, the controller automatically increase power input to maintain the temperature at 43°C (anti-ice mode). If both ice detectors are inoperative, the Override knob on the Overhead Panel set to ALL position provides manual means to put both systems into anti-ice mode automatically increasing power input to maintain the temperature at 43°C. A caution message W/S HEAT FAIL is presented on the EICAS when a system failure is detected or the windshield temperature exceeds 65°C.

## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | W/S 1 (2) HEAT FAIL | For airplanes Pre-Mod. SB 145-30-0033, associated windshield heating system failure (< 38°C) or associated overheat condition (> 55°C). For airplanes Post-Mod. SB 145-30-0033, associated windshield heating system failure or associated overheat condition (> 65°C). |

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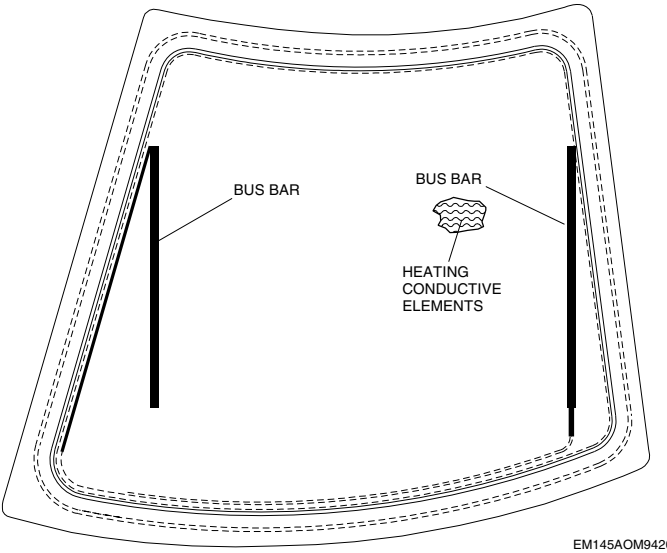
# WINDSHIELD DIFFERENTIATION

## SIERRACIN WINDSHIELD

Sierracin windshields can be easily identified by their green colored tint and by the positions of the bus bars to which the heater filaments are attached, in the vertical direction, as shown below:




**SIERRACIN WINDSHIELD SCHEMATIC**

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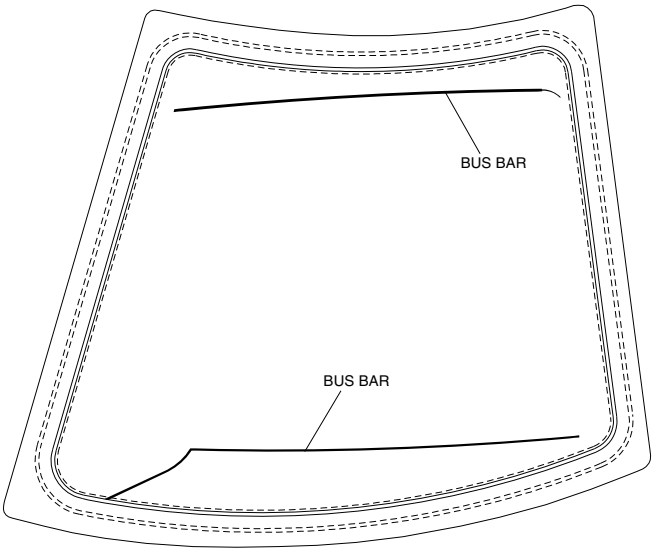
## PPG WINDSHIELD

PPG windshields can be easily identified by the positions of the bus bars to which the heater filaments are attached, in the horizontal direction, as shown below:

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**PPG WINDSHIELD BUS BARS POSITIONS**

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# SENSOR HEATING SYSTEM

The Sensor Heating System provides automatic operation for the heater elements of Pitot tubes 1 and 2, Pitot/Static 3, Pressurization System and ADS Static Ports, TAT sensors 1 and 2, and AOA vanes 1 and 2, thus providing constant temperature and ice-free operation during all flight phases.

All the sensors are electrically heated and controlled by three buttons, located on the overhead panel.

In the automatic mode, the sensor heating system operates according to three functional logics:

- Pitot 1 and 2 and Pitot/Static 3, AOA 1 and 2, ADS Static Ports 1, 2, 3 and 4, and Pressurization Static Ports 1 and 2 are heated whenever at least one engine is running (N2 above 54.6%).
- A separate logic assures Pitot/Static 3 and Pressurization System Static Port 2 heating in any flight condition.
- For airplanes Pre-Mod SB 145-30-0028, TAT 1 and 2 are heated provided either Engine 1 or 2 anti-icing subsystem is functioning or airplane is in flight (the TAT sensor normal range of operation is from - 99ºC to + 99ºC).
- For airplanes Post-Mod. SB 145-30-0028 and on, TAT heating is on when Thrust Levers are set above 65º position or when the airplane is airbone.

**NOTE:** For airplanes Pre-Mod. SB 145-30-0028, when operating in icing conditions on the ground with the Engine Anti-Ice turned ON, if a TAT invalid indication is displayed on the MFD due to temperature values beyond the sensor normal range (TAT digits replaced by three amber dashes) with the consequent AHRS reversion to the Basic Mode, disregard the information and continue the takeoff normally. The TAT invalid indication and AHRS reversion will remain until the airplane reaches a sufficient speed to bring the TAT sensors into the normal range of operation. This may occur on the ground or when airplane is airborne and the airplane will return to the normal condition (AHRS Full Performance) and no pilot's or maintenance personnel's action is required.

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Heater deactivation is accomplished either when the above conditions are not met or when the associated control button is manually pressed.

Caution messages are presented on the EICAS to indicate that the sensor heating is inoperative. These messages are inhibited during the takeoff and approach phases.

## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | PITOT 1 (2, 3) INOP | – Associated sensor heating inoperative with any engine running (N2 above 60%).<br>– Both engines N2 below 50%. |
| | AOA 1 (2) HEAT INOP | – Associated sensor heating inoperative with any engine running (N2 above 60%) and airplane airborne.<br>– Both engines N2 below 50%. |
| | TAT 1 (2) HEAT INOP | Associated sensor heating inoperative in icing conditions and airplane airborne. |

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# LAVATORY WATER DRAIN AND NIPPLE HEATING SYSTEM

The lavatory waste water drain and water service nipples (overflow and fill) are heated by electric resistors to prevent clogging by water freezing under any atmospheric conditions on the ground and in flight.

The heating is automatically turned on when the DC BUS 1 is powered.

Refer to Section 2-2 – Equipment and Furnishings.

# ICE PROTECTION CONTROLS AND INDICATORS

## ICE PROTECTION CONTROL PANEL

### 1 - ENGINE AIR INLET ANTI-ICING BUTTONS

- Turns off (released) or permits (pressed) the automatic activation of the associated engine air inlet anti-icing subsystem.
- A striped bar illuminates inside the button to indicate that it is released.
- An OPEN inscription illuminates inside the button to indicate that the associated engine air inlet anti-icing valve is open.

### 2 - WING ANTI-ICING BUTTON

- Turns off (released) or selects the automatic mode (pressed) of the half-wing anti-icing subsystems.
- A striped bar illuminates inside the button to indicate that it is released.
- An OPEN inscription illuminates inside the button to indicate the following conditions:
  - Both valves are open with the system commanded to open.
  - At least one valve is open with the system not commanded to open.

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### 3 - HORIZONTAL STABILIZER ANTI-ICING BUTTON

- Turns off (released) or permits (pressed) the automatic activation of the horizontal stabilizer anti-icing subsystem.
- A striped bar illuminates inside the button to indicate that it is released.
- An OPEN inscription illuminates inside the button to indicate that the horizontal stabilizer anti-icing valve is open.

### 4 - SENSOR HEATING BUTTONS

- The left button controls Pitot tube 1, AOA 1 vane, TAT 1 probe, ADC Static Ports 1 and 3, and pressurization static port 1.
- The central button controls Pitot/Static tube 3 and pressurization static port 2.
- The right button controls the Pitot tube 2, AOA 2 vane, TAT 2 probe and ADC static ports 2 and 4.
- When pressed, the associated sensor heating system operates in the automatic mode according to its functional logic. When released, the associated sensor heating system is turned off.
- A striped bar illuminates inside the button to indicate that it is released.

### 5 - ICE DETECTION TEST KNOB

Permits the half-wing, horizontal stabilizer and engine air inlet anti-icing subsystems to operate for test purposes, by simulating an icing condition on ice detectors 1 and 2. The adequate system operation is confirmed by the illumination of the OPEN inscriptions in the anti-icing buttons, which indicate the current valve position.

**NOTE:** The ICE CONDITION, ICE DET 1 (2) FAIL and BLD 1 (2) LOW TEMP messages are displayed during test. The CROSS BLD OPEN message is also presented for airplanes Pre-Mod. SB 145-36-0028.

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### 6 - ICE DETECTION OVERRIDE KNOB

ENG - Turns on the engine air inlet anti-icing subsystems for ground speeds below 25 kt. Above 25 kt the wing and horizontal stabilizer anti-icing subsystems are also turned on if icing condition is detected.

AUTO - Allows the automatic operation of the bleed air anti-icing system.

**NOTE:** If ground speed is equal or above 25 kt and an icing condition is detected, wing and horizontal stabilizer anti-icing subsystems are turned on. The engine anti-icing subsystem is turned on as soon as an icing condition is detected.

ALL - Turns on the complete bleed air anti-icing system provided airplane is on ground at speed equal or above 25 knots or in flight.

**NOTE:** On ground, below 25 kt, only engine anti-icing is turned on.

### 7 - WINDSHIELD HEATING BUTTON

– Turns on (pressed) or turns off (released) the windshield heating system.
– A striped bar illuminates inside the button to indicate that it is released.

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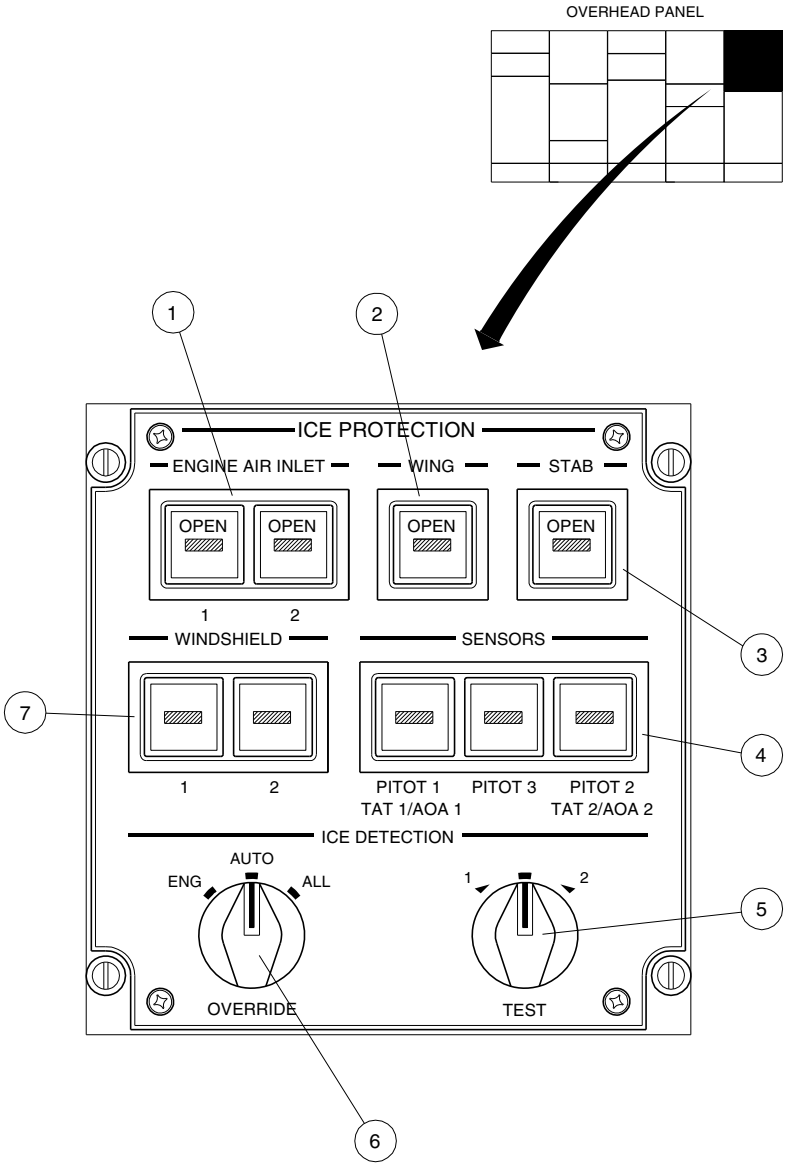


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## ICE PROTECTION CONTROL PANEL

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# ICE DETECTION SYSTEM

Ice detectors 1 and 2 are respectively installed at the airplane's left and right nose section, to provide icing condition detection.

The ice detector was designed to pick up ice quickly. Therefore, in the most cases, ice will be detected before it can be noticed by the crew.

**NOTE:** Notwithstanding ice detector monitoring, the crew remains responsible for monitoring icing conditions and for manual activation of the ice protection system if icing conditions are present and the ice detection system is not activating the ice protection system.

A 0.5 mm (0.020 inch) ice thickness, on any probe, causes bleed air anti-icing system automatic mode activation, a SPS angle of attack set values reduction (refer to Stall Protection System on Section 2-4 – Crew Awareness), and an advisory message to be presented on the EICAS.

During ice encounters, the icing signal remains active during 60 seconds. Simultaneously, an internal ice detector heater is activated to de-ice the unit and probe. When the probe's natural frequency is recovered, heating is de-energized. Once deiced, the sensing probe cools within a few seconds and is ready to once more monitor ice build-up. Then a new detection cycle begins and remains as long as the ice condition persists.

In case of failure of any or both ice detectors, a caution message is presented on the EICAS and the bleed air thermal anti-icing system may be activated through the OVERRIDE knob on the Ice Detection panel.

The system's normal operation may be checked through the TEST knob on the Ice Protection panel.

## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | ICE DETECTORS FAIL | Both ice detectors have failed. |
| | ICE DET 1 (2) FAIL | Associated ice detector has failed. |
| ADVISORY | ICE CONDITION | At least one of the probes has detected ice. |

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# WINDSHIELD WIPER SYSTEM (IF APPLICABLE)

**NOTE:** For airplanes Pre-Mod. SB 145-30-0055 and Post-Mod. SB 145-30-0054 (or with an equivalent modification factory incorporated), the Rain Repellent Coating replace the Windshield Wipers. Approved Rain Repellent Coatings are listed in AMM chapter 30-41-04.

A two-speed windshield wiper is provided for the left and right windshields. Each system comprises a motor-converter, a wiper arm, and blades. A control box provides speed control, synchronization, and off-screen park functions for both systems through independent channels.

Each system has its own independent power supply and a four-position knob on the overhead panel.

## WINDSHIELD WIPER CONTROL PANEL (IF APPLICABLE)

1 - WINDSHIELD WIPER SELECTOR KNOB

TIMER - Provides intermittent operation of the associated windshield wiper in single cycles (two strokes) with an 8 second time interval between two cycles, in high speed.

OFF - Associated wiper blades travel to the windshield inboard position, parking out of pilots vision.

LOW - Associated wiper operates at approximately 80 ± 10 strokes per minute.

HIGH - Associated wiper operates at approximately 140 ± 14 strokes per minute.

**NOTE:** Dry windshield operation leads the motor-converter to a stall condition, due to the high friction level. The controller senses the motor-converter current surge and drives the arm directly to the parked position. The system remains inoperative until the Windshield Wiper Selector Knob is set to OFF position and a new operation mode is selected.

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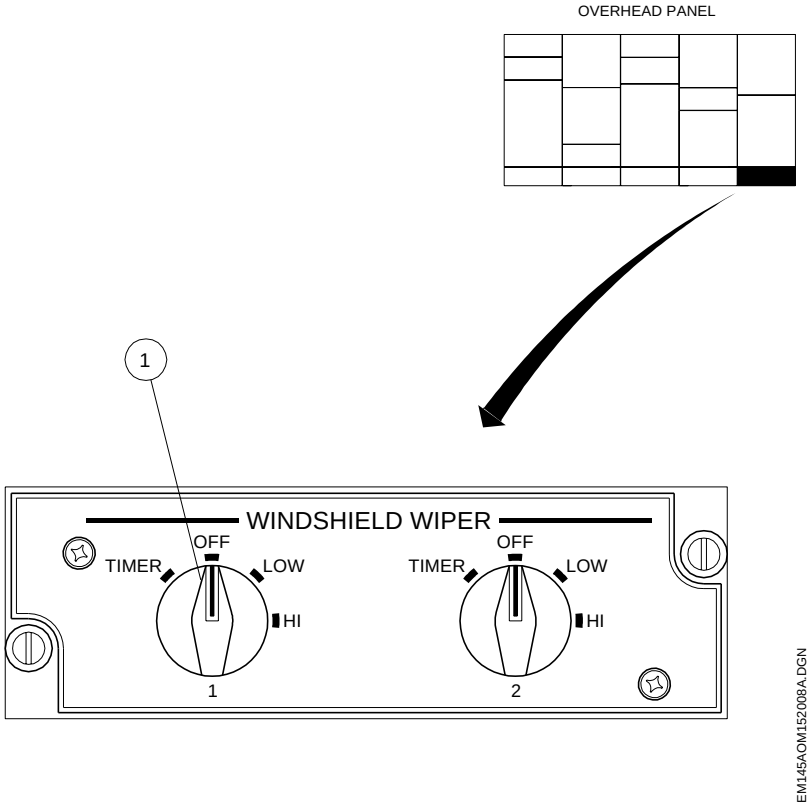


**WINDSHIELD WIPER CONTROL PANEL**

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# SECTION 2-16

# OXYGEN

TABLE OF CONTENTS

| | Block | Page |
|---|---|---|
| General | 2-16-05 | 01 |
| Flight Crew Oxygen | 2-16-10 | 01 |
| EICAS Message | 2-16-10 | 05 |
| ECS Page on MFD | 2-16-10 | 05 |
| Crew Mask Stowage Boxes | 2-16-10 | 06 |
| Crew Mask | 2-16-10 | 07 |
| Controls and Indicators (EROS Mask) | 2-16-10 | 08 |
| Controls and Indicators (PURITAN Mask) | 2-16-10 | 10 |
| Smoke Goggles | 2-16-10 | 12 |
| Passenger Oxygen | 2-16-15 | 01 |
| Controls and Indicators | 2-16-15 | 05 |
| Portable Oxygen Cylinder | 2-16-20 | 01 |
| Protective Breathing Equipment | 2-16-25 | 01 |
| EROS (Air Liquide) PBE Unit | 2-16-25 | 02 |
| PURITAN Bennet PBE Unit | 2-16-25 | 04 |
| Minimum Oxygen Pressure for Dispatch | 2-16-30 | 01 |
| Flight Crew Oxygen System | 2-16-30 | 01 |
| Portable Oxygen Cylinder | 2-16-30 | 01 |
| Oxygen Pressure Correction Chart | 2-16-30 | 02 |
| Oxygen Consumption Chart | 2-16-30 | 04 |

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# GENERAL

The oxygen system is divided into two different and separate systems: a gaseous-type for crewmembers (pilot, copilot and observer) and a chemical generation-type one for passengers and flight attendants.

The crewmembers oxygen is a conventional, high pressure gaseous-type system, in which the oxygen is stored in a cylinder at high pressure and distributed at low pressure to the masks.

The passengers oxygen system is supplied through chemical oxygen generators, which is distributed through dispensing units in several different locations in the cabin.

For airplanes Post-Mod. SB 145-35-0008 or equipped with an equivalent modification factory incorporated, gaseous oxygen supply is provided in the lavatories.

In addition to the flight crew and passenger oxygen systems, equipment for smoke protection and fire fighting is provided both in the cockpit and in the passenger cabin.

The system is monitored so that all the necessary parameters are informed to the flight crew and flight attendants.

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# FLIGHT CREW OXYGEN

The flight crew is provided with oxygen through a conventional high-pressure gaseous system. The system employs a 50-cu.ft cylinder in which the oxygen is stored at high pressure (1850 psi), installed on the right side of the cockpit/passenger cabin partition, to feed the cockpit crew masks.

The system is protected from overpressurization by a safety disc located on the lower right side of the aircraft's nose. Discharge through the safety disc may be visually verified when the discharge indicator (green disc) has been blown out. If the cylinder pressure drops below 400 psi, a caution message is presented on EICAS.

The cylinder is provided with an integrated shutoff/regulator valve, that controls oxygen outlet pressure. The regulator valve at the ON position supplies the crew distribution lines at low pressure rate (70 psi). A relief valve opens if the pressure exceed 90 psi.

The cockpit is provided with a quick-donning diluter/demand-type mask, available inside mask stowage boxes adjacent to each crew station, and a smoke protection kit. The smoke protection kit consists of two smoke goggles to be used with the diluter/demand masks by the pilot and copilot, and one Protective Breathing Equipment (PBE) unit for fire fighting.

Two additional PBE units are also available in the passenger cabin to protect crewmembers or flight attendants from smoke during fire fighting operation.

An oxygen service panel, located on right side of the front fuselage, allows access to the oxygen cylinder and monitoring of oxygen quantity through a pressure gauge. Some airplanes may have a factory incorporated removable panel located behind the copilot's seat that provides access to the oxygen cylinder and its replacement. The cylinder pressure is also indicated on the MFD (ECS page).

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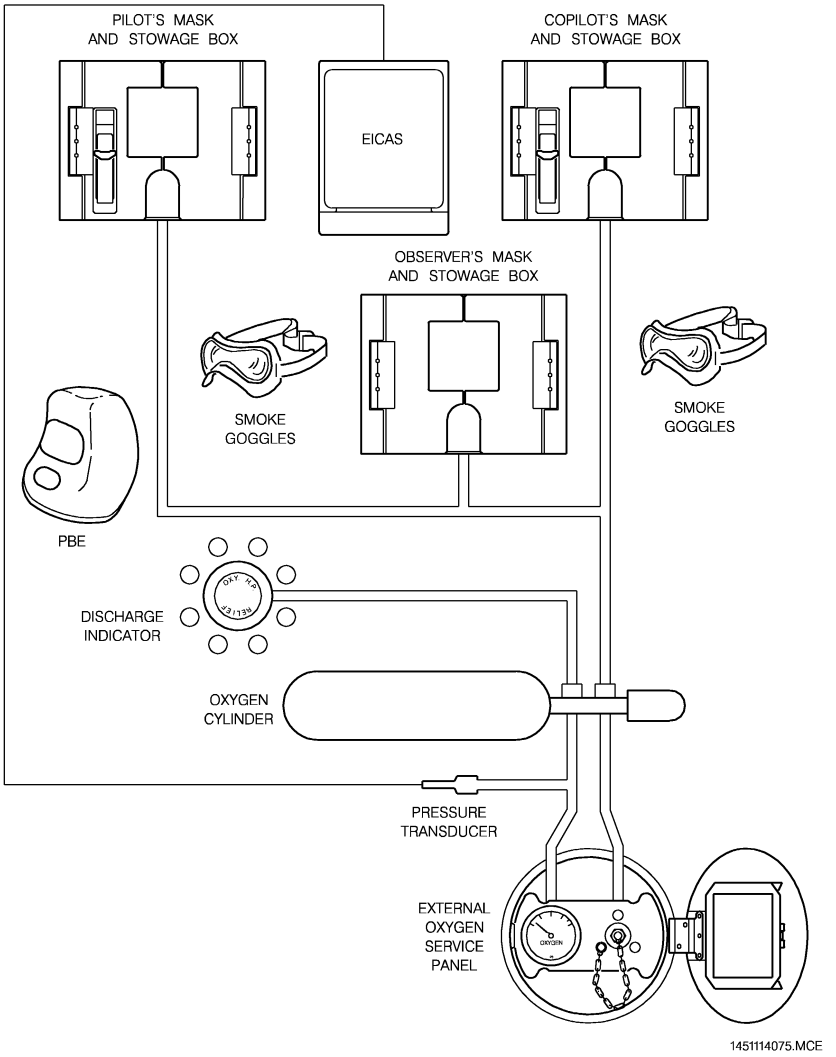


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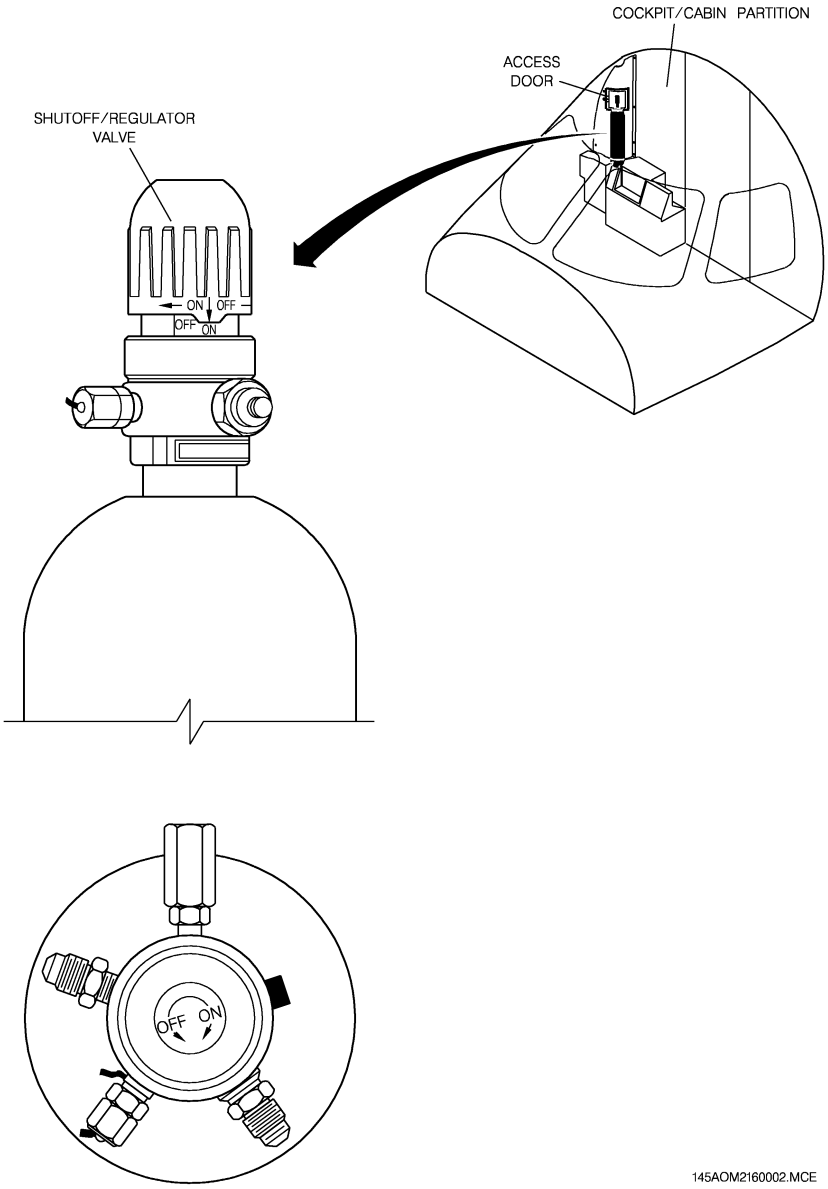
## FLIGHT CREW OXYGEN SYSTEM SCHEMATIC

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## MAIN OXYGEN CYLINDER

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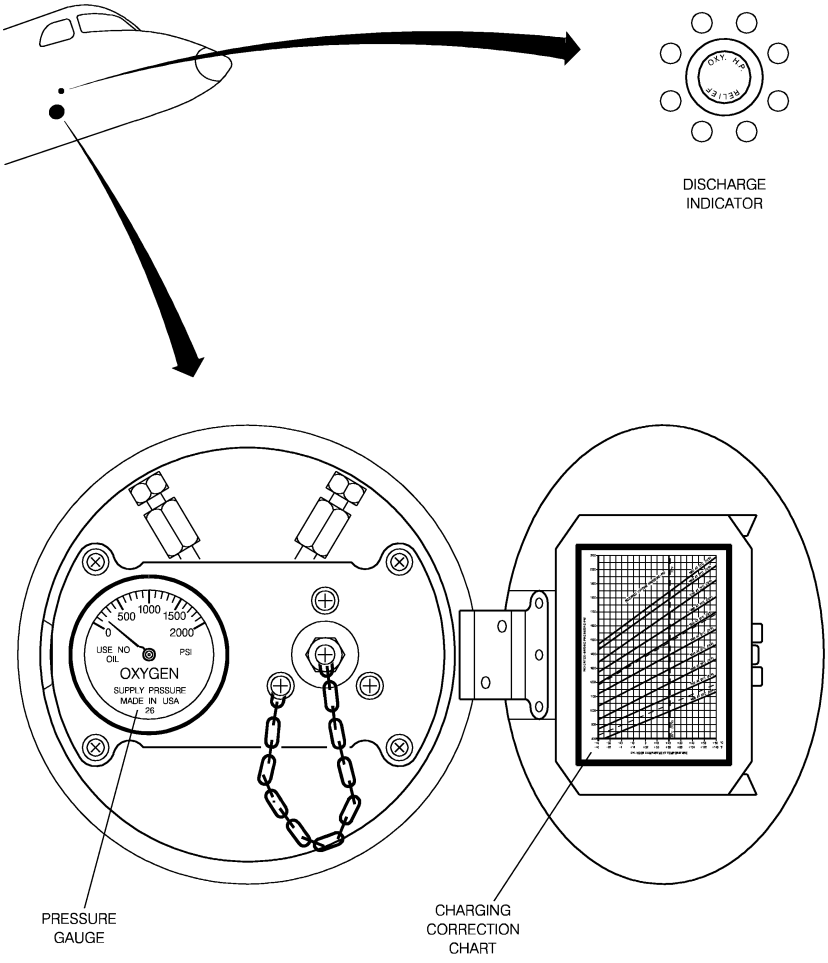


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## OXYGEN SERVICE PANEL

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## EICAS MESSAGE

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | OXYGEN LO PRESS | Oxygen cylinder pressure below 400 psi. Remaining oxygen sufficient for about 12 minutes for pilot, copilot, and observer. |

## ECS PAGE ON MFD

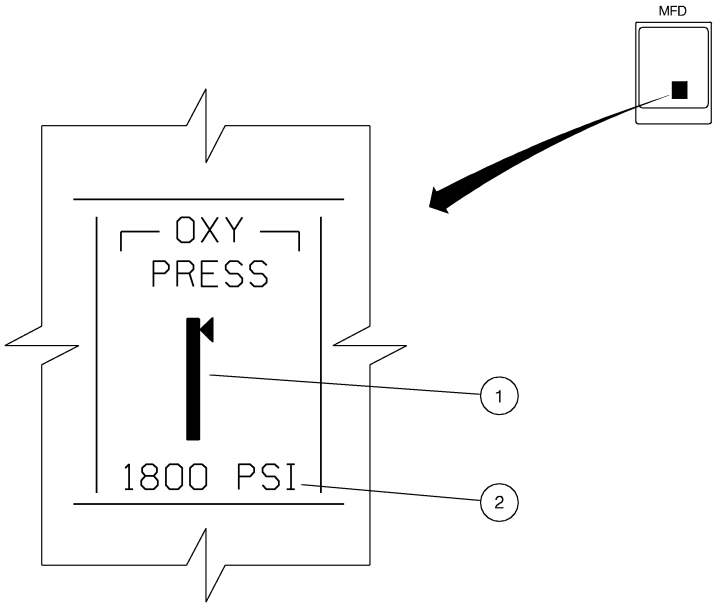
### 1 - ANALOGIC OXYGEN PRESSURE INDICATION

Pointer:

- Green between 410 to 1850 psi.
- Amber between 250 to 400 psi.
- Red between 0 to 240 psi.

### 2 - DIGITAL OXYGEN PRESSURE INDICATION

- Ranges from 0 to 1850 psi, with a resolution of 10 psi.
- Digits are green between 410 to 1850 psi.
- Digits are amber between 250 to 400 psi.
- Digits are red between 0 to 240 psi.

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**ECS PAGE ON MFD**

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## CREW MASK STOWAGE BOXES

The crew mask stowage boxes are directly connected to the oxygen distribution line and to the communication system. The pilot and copilot boxes incorporate a shutoff valve, which keeps the mask regulator unpressurized while in the stowed position.

When the box doors are opened, the shutoff valve is brought to open position, thus allowing the oxygen flow to the mask.

After the mask has been taken out of the stowage box, the doors can be closed without interrupting oxygen supply to the mask. To stop the oxygen flow, it is necessary to close the left door and activate the Test/Shutoff Sliding Control.

Pilot and copilot mask stowage boxes are also provided with a flow indicator.

**NOTE:** The observer's mask stowage box is not provided with Test/ Shutoff Sliding Control (EROS Mask) or Test/Reset Button (PURITAN Mask) and, although the masks are permanently pressurized, oxygen will flow only on demand.

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## CREW MASK

The crew mask is a quick-donning oro-nasal type that allows oxygen flow on demand or under pressure, as required.

The mask is provided with an automatic oxygen dilution system that provides pure oxygen with cabin altitude over 33000 ft. It can also be manually selected to the 100% position to provide pure oxygen at all altitudes or to EMERGENCY position to maintain positive pressure in the venting orifice.

The quick-donning operation is as follows:

- Hold the mask with one hand by the hose and the inflation control valve (red ears).
- Pull the mask out of the box.
- Press the inflation control valve (red ears) firmly. The harness inflates rapidly, and takes a shape large and rigid enough to allow the user to don it quickly.
- Release the regulator ears. The harness will then deflate, securing the mask to the user's face.

**NOTE:** The EROS Mask is provided with two red ears, while the PURITAN Mask possesses one red ear and one black ear.

The pilot and copilot masks are provided with a venting valve, a venting orifice (refer to smoke goggles in this section) and a microphone.

The observer's mask is similar to that of the pilot and copilot, with the exception that the observer's mask has no venting valve and features a flow indicator installed in the supply hose.

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# CONTROLS AND INDICATORS (EROS MASK)

## MASK STOWAGE BOX/CREW MASK

**1 - TEST/SHUTOFF SLIDING CONTROL (spring-loaded in the pilot and copilot boxes only)**

- When pressed, with the mask stowed, allows testing of the oxygen mask. Flow indicator turns yellow for a short time. The OXY ON flag appears on the lid face.
- When pressed, with the mask not stowed and the left door closed, shuts off oxygen to the mask. The OXY ON flag disappears on the lid face.

**2 - OXY ON FLAG (white)**

- Appears when the box shutoff valve is open and oxygen is supplied to the mask.

**3 - FLOW INDICATOR (pilot and copilot boxes only)**

- A yellow star appears when oxygen is flowing.

**4 - VENTING VALVE CONTROL (pilot and copilot masks only)**

- When actuated forward, opens the venting valve.
- A red band is visible to indicate that the control is actuated.

**5 - HARNESS INFLATION CONTROL VALVE (red ear)**

- When pressed, inflates the harness and allows mask donning.

**6 - FLOW INDICATOR (observer mask only)**

- The black shutter disappears when pressure is applied to the mask.

**7 - TEST/EMERGENCY SELECTOR KNOB**

- When rotated clockwise, 100% oxygen is supplied under positive pressure at all cabin altitudes. This mode must be selected when using smoke goggles.
- When pressed, tests if the regulator demand mechanism operates satisfactorily.

**8 - NORMAL/100% SELECTOR**

N - Oxygen/air mixture is supplied on demand. Mixture ratio is dependent on the cabin altitude. Above 33000 ft, pure oxygen is supplied.

100% - Pure oxygen is supplied at all cabin altitudes on demand. This mode must be selected in conjunction with EMERGENCY position, when protective breathing is required.

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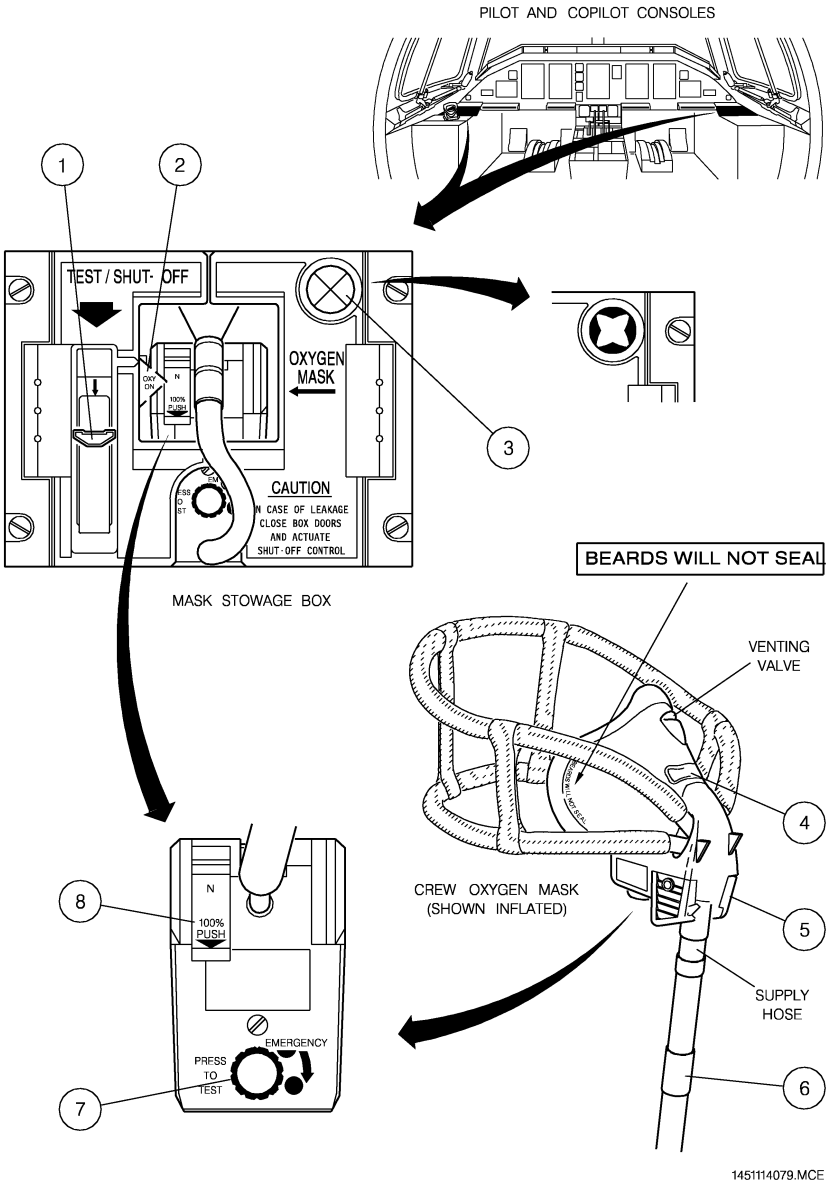


## MASK STOWAGE BOX/CREW MASK (EROS MASK)



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# CONTROLS AND INDICATORS (PURITAN MASK)

## MASK STOWAGE BOX/CREW MASK

**1 - FLOW INDICATOR (pilot and copilot only)**
- A bright star appears when oxygen is flowing.

**2 - TEST/RESET Button (spring-loaded in the pilot and copilot boxes only)**
- When pressed, with the mask stowed, allows testing the oxygen mask. Flow indicator shows a bright contrast for a short time. The OXY ON flag appears on the lid face.
- When pressed, with the mask not stowed, shuts off oxygen to the mask. The OXY ON flag disappears on the lid face.

**3 - OXY ON FLAG (white)**
- Appears when the box shutoff valve is open and oxygen is supplied to the mask.

**4 - PURGE VALVE (pilot and copilot masks only)**
- Automatically opens when the smoke goggles are donned.
- Supplies oxygen only in EMERGENCY position.

**5 - FLOW INDICATOR (observer mask only)**
- Indicates oxygen pressure.
- Color: Green for proper pressure.
  Red for low pressure.

**6 - HARNESS INFLATION CONTROL VALVE (red ear)**
- When pressed, inflates the harness and allows mask donning.

**7 - CONTROL KNOB**
- When rotated, allows selection of oxygen supply modes.
- Oxygen supply mode is indicated by a white mark.

**8 - NORMAL POSITION**
- Oxygen/air mixture is supplied. Mixture ratio depends on the cabin altitude.
- In the event of an emergency decompression, a 100% oxygen flow will be provided.

**9 - 100% POSITION**
- Pure oxygen is supplied at all cabin altitudes.

**10 - EMERGENCY POSITION**
- Pure oxygen with a slight positive pressure is supplied at all cabin altitudes.

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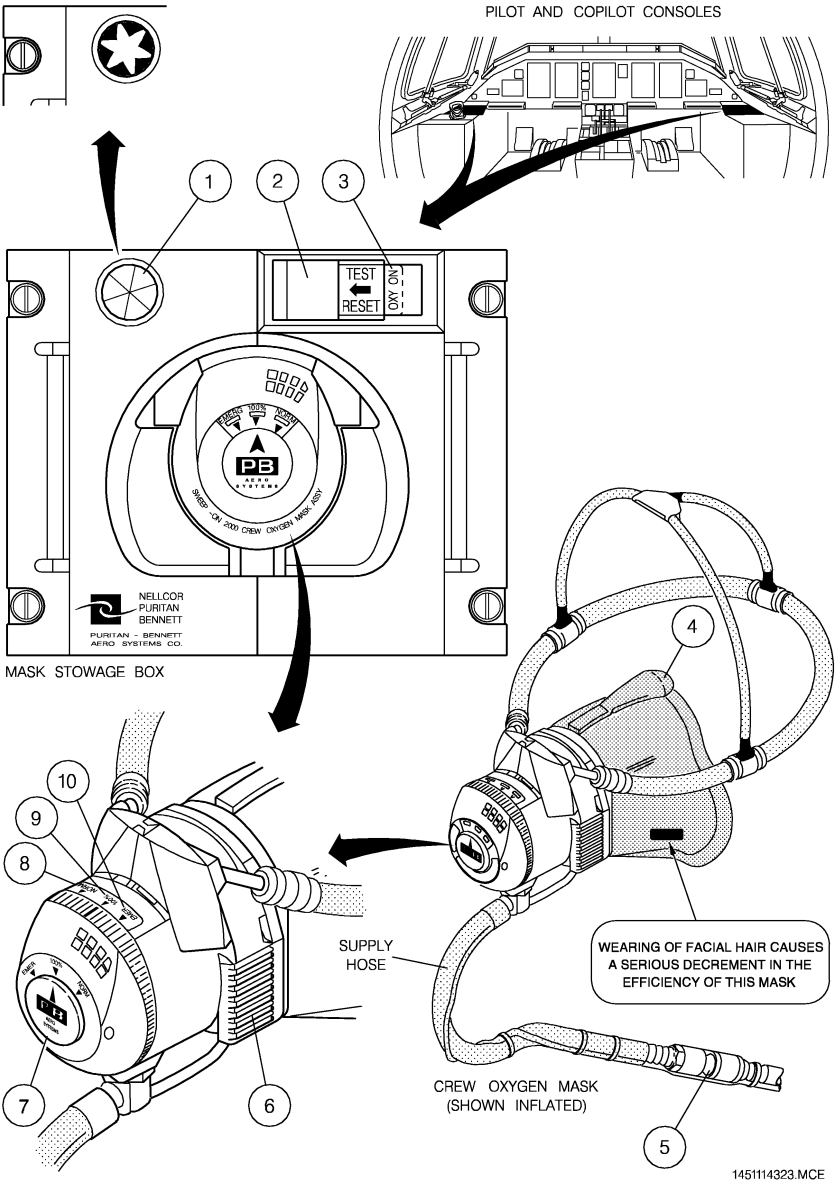


## MASK STOWAGE BOX/CREW MASK (PURITAN MASK)

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## SMOKE GOGGLES

The smoke goggles were designed for use with the crew mask assembly, matching the mask face cone. The venting valve, located on the mask shell and manually actuated by the user, allows direct communication between venting orifice and goggles.
When mask regulator is selected to emergency position, a metered oxygen flow will be directed to the goggles' cavity so as to allow continuous venting and preventing any infiltration of harmful gases.

**NOTE:** For the Puritan Mask, the purge valve automatically opens when the smoke goggles are donned.

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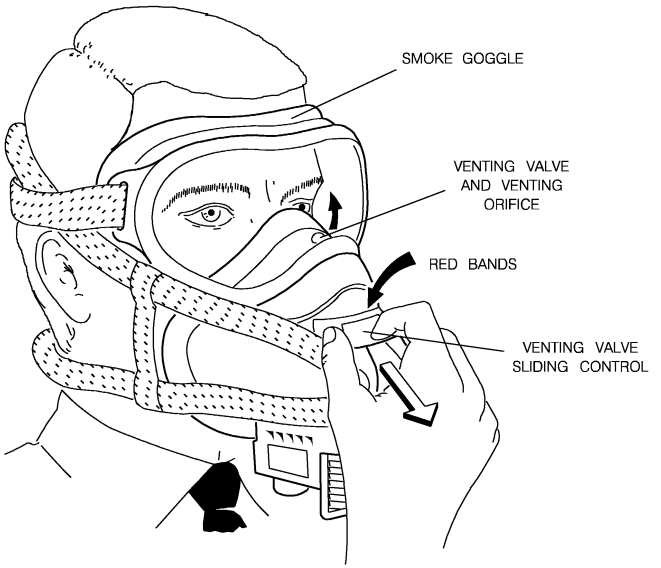


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**SMOKE GOGGLES**

# PASSENGER OXYGEN

Oxygen supplied to the passengers and flight attendants comes from chemical oxygen generators and continuous-flow masks installed in proper dispensing units.

For airplanes Post-Mod. SB 145-35-0008 or equipped with an equivalent modification factory incorporated, gaseous oxygen supply is provided in the lavatories.

The dispensing units are located in the right and left overhead bins, lavatory, and flight attendant stations. Some airplanes are optionally equipped with an extra dispensing unit installed at the galley area. Each unit is equipped with one, two, or three continuous flow masks. The oxygen masks are held in a mask retainer. The mask must be pulled out of the retainer.

The Passenger Oxygen Control Panel is at the right lateral console, above the mask stowage box of the copilot. The system is automatically activated, provided the Passenger Oxygen Selector Knob is set to the AUTO position and cabin pressure altitude is above 14000 ft (*). The system may be activated manually, at any altitude, by setting the Passenger Oxygen Selector Knob to MANUAL position.

**NOTE:** (*) For airplanes equipped with High Altitude Takeoff and Landing system, passengers masks deploy at 14500 ± 500 ft cabin altitude.

Dedicated altimetric switch and electric latches assure the automatic release of the oxygen masks by opening the dispensing units. A timer circuit is provided to maintain electric latches energized during 6 seconds on automatic or manual mode activation. The oxygen ON indicator light, on the Passenger Oxygen Control Panel, illuminates to indicate that the electric latches are energized. In this case, the NO SMOKING and FASTEN SEAT BELTS signs in the passenger cabin are automatically illuminated. These indicators and passenger advisory lights remain illuminated until the oxygen system is reset.

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Activating the system causes the masks to drop from their dispensing units. Each oxygen generator is activated when any mask in the associated dispensing unit is released. Pulling one mask down causes all masks in that unit to drop and 100% oxygen flows to all masks. Oxygen flows for approximately 12 minutes. Once oxygen flow was started, there is no way to stop it.

**CAUTION:** ONCE ACTUATED, EACH CHEMICAL GENERATOR SUPPLIES OXYGEN CONTINUOUSLY, WHETHER THE MASKS CONNECTED TO IT ARE BEING USED OR NOT.

**NOTE:** When oxygen is supplied, high temperature is produced in the oxygen chemical generator.

An in-line flow indicator is visible in the transparent oxygen hose whenever oxygen is flowing to the mask.

If the system is activated and the door of a dispensing unit does not open, the attendant may drop the masks through a door-opening tool. This tool is located near the cabin attendant stations.

A portable oxygen cylinder and a Protective Breathing Equipment (PBE) unit are installed near each cabin attendant station.

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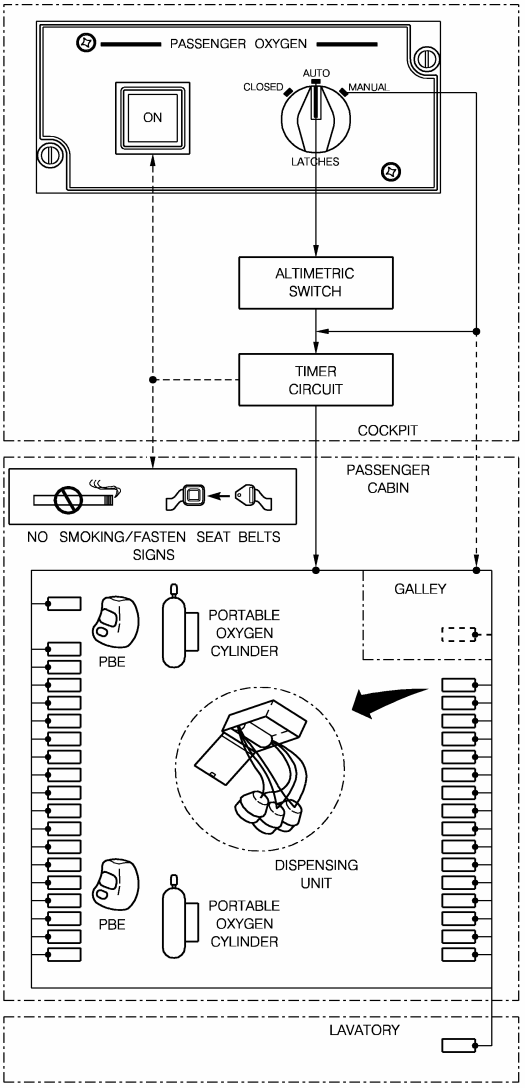


**PASSENGER OXYGEN SYSTEM SCHEMATIC**

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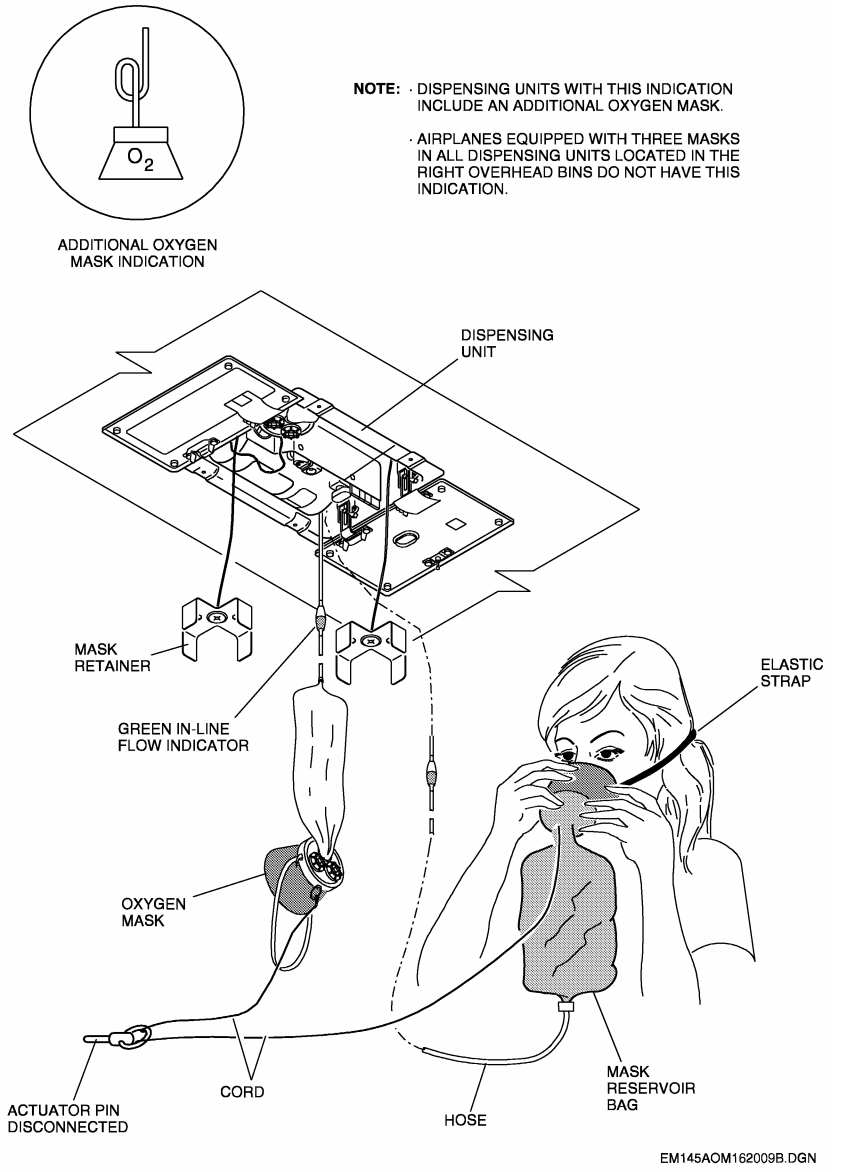


## DISPENSING UNITS/PASSENGER MASKS

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# CONTROLS AND INDICATORS

## PASSENGER OXYGEN CONTROL PANEL

1 - OXYGEN ON INDICATOR LIGHT (WHITE)

- Indicates that the electric latches are energized.

2 - PASSENGER OXYGEN SELECTOR KNOB

CLOSED - Disables the automatic deployment of passenger masks. Also resets oxygen ON indicator and passenger cabin signs after system activation either on automatic or manual mode.

AUTO - Automatically deploys the passenger masks provided that cabin pressure altitude is above 14000 ft (*).

**NOTE:** (*) For airplanes equipped with High Altitude Takeoff and Landing system, passengers masks will deploy at 14500 ± 500 ft cabin altitude.

MANUAL (momentary position) - Actuates the passenger oxygen system at any altitude, overriding the altimetric switch, and may be used in case of AUTO mode failure.

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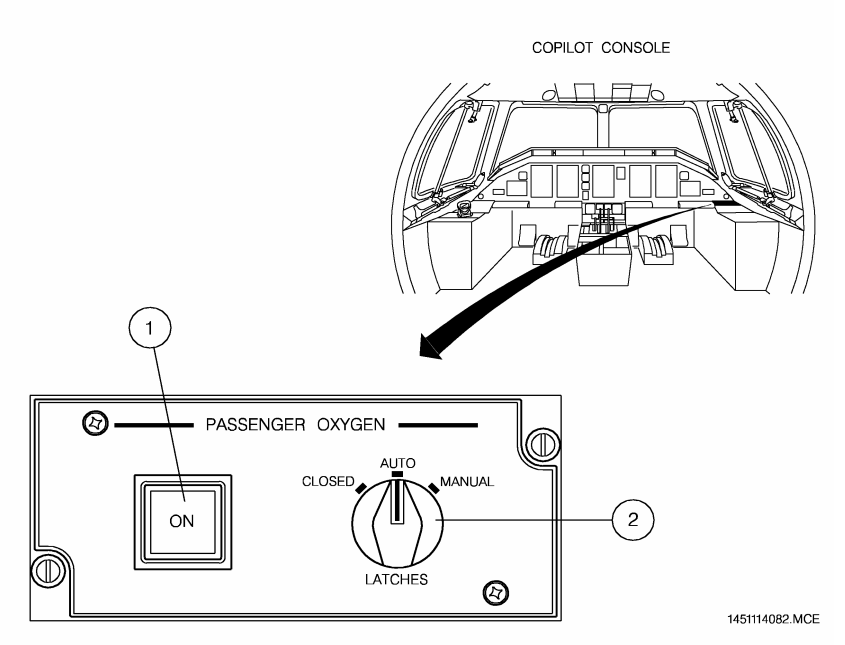


**PASSENGER OXYGEN CONTROL PANEL**

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# PORTABLE OXYGEN CYLINDER

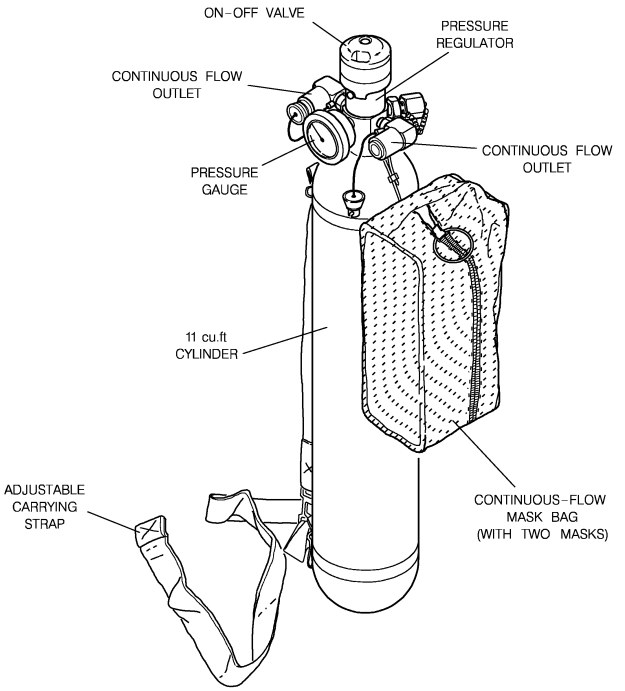
The cylinder has 312 liters (11 cu.ft) holding 280 liters of usable oxygen and is provided with an ON-OFF regulator installed on the cylinder neck. Two continuous-flow masks go with the cylinder.

A gauge is provided to monitor the cylinder pressure.

The cylinder is equipped with two outlets that permit the connection of the continuous-flow masks furnished in the cylinder bag. The supplied masks when connected to the bottle are designed to deliver a maximum of 4 liters per minute of oxygen.

The cylinders are positioned near the cabin attendant stations and are to be used exclusively for therapeutic first-aid purposes.

The minimum portable oxygen cylinder pressure for dispatch is 1200 psi for oxygen bottle P/N 176965-14 (11 cu.ft or 311 liters) and 1550 psi for oxygen bottle P/N 5500A1UBF25A (4.25 cu.ft or 120 liters); both will last at least 30 minutes.




**PORTABLE OXYGEN CYLINDER**

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# PROTECTIVE BREATHING EQUIPMENT

The airplane is equipped with three EROS or PURITAN smoke hood-type Protective Breathing Equipment (PBE) units. The PBE unit is an emergency equipment that offers a 15-minute minimum oxygen supply for crewmember and flight attendant protection against the effects of smoke, toxic gases, and hypoxia.

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## EROS (AIR LIQUIDE) PBE UNIT

Operation automatically starts when the hood is donned, with no additional device actuation. An actuation lever is pushed up to a vertical position by user head and thus breaks a frangible valve that releases oxygen into the hood. User can hear oxygen flow release inside the hood..

Due to the neoprene neck collar, phonic membrane, and regulated overpressure inside the hood, no toxic gases or smoke can enter the hood.

The rigid visor cannot be folded and features an anti-fogging treatment for good visibility. The phonic membrane allows good communications characteristics. The hood protects user's head from flames or incandescent objects that may fall from burning structures or interiors parts.

The smoke hood is stowed inside a vacuum-sealed aluminized bag, itself contained and attached to the bottom, internal side of a rigid flat orange box that is provided with a green "good condition" indicator, which indicates that the mentioned bag was not opened yet. Should the indicator be red, this indicates that there no longer exists a vacuum inside the bag and the PBE unit must be replaced.

Extraction of the hood automatically tears the aluminized container bag and thus allows a direct presentation of the hood.

### OPERATION

When use of hood is needed:

1 - Take the box and push the spring lock.

2 - Pull the box cover upward.

3 - Extract the hood and deploy the hood by a brisk downward movement.

4 - Open the neck collar seal by placing thumbs in front of the red pointers to facilitate hood donning, especially when spectacles are worn by user.

5 - Don the hood. Next, pick up the fire extinguisher and combat the onboard fire and/or smoke.

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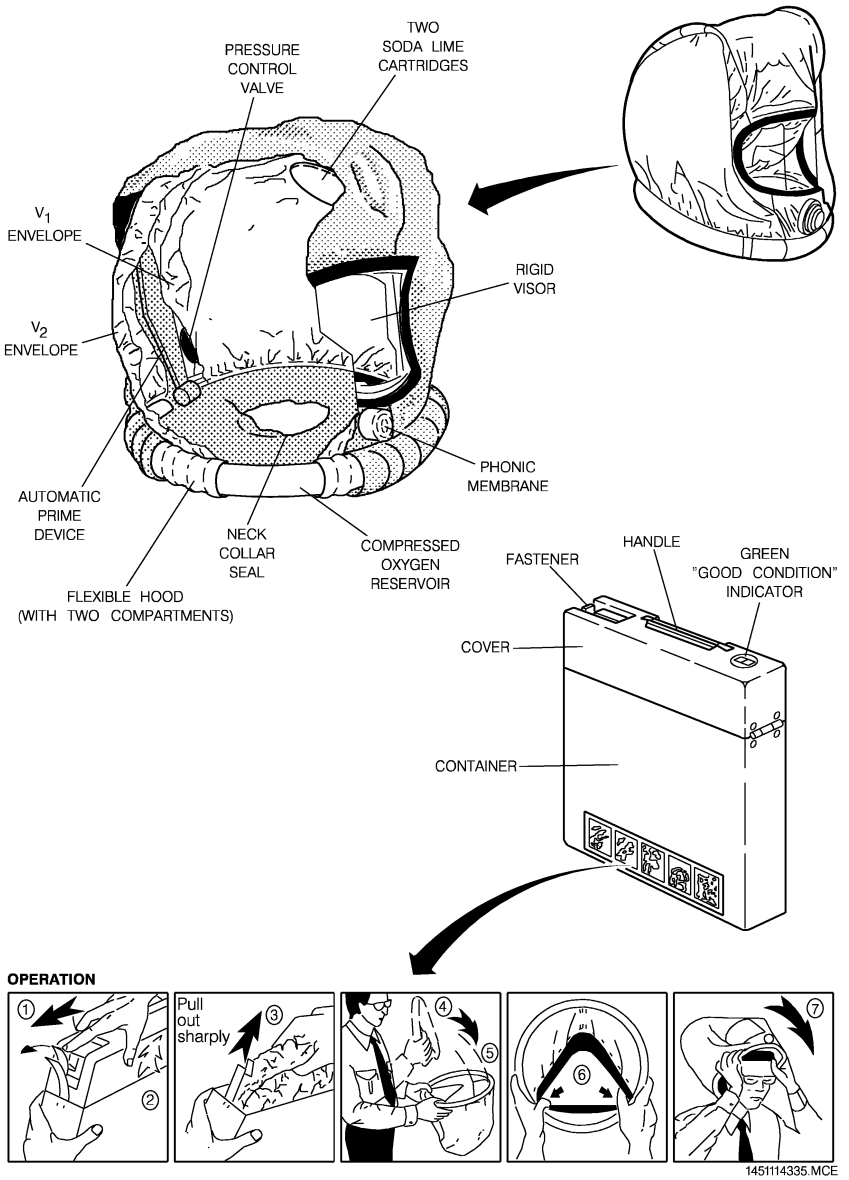


## HOOD SCHEMATIC AND STOWAGE - EROS

## PURITAN BENNET PBE UNIT

During the donning sequence, a chlorate candle is automatically actuated as the adjustment straps are pulled to secure the oronasal mask cone against the face. The oxygen generated by a chlorate candle will inflate the hood, providing adequate initial breathing volume.

A speaking diaphragm is installed in the oronasal mask cone to enhance communication.

Determining the unit's serviceability consists in visually checking the vacuum seal through the clear access door of the hood's container. If the sealed bag appear tightly compressed, the seal is in good condition. On the other hand, if the sealed bag appears inflated, the unit should be replaced.

### OPERATION

When use of the hood is needed:

1 - Grasp and strongly pull red access handle to disengage the cover. Locate red I.D. tag and pull sharply to tear open vacuum-sealed bag.

2 - Pull PBE out of sealed bag and shake hood to open.

3 - Place both hands inside the neckseal opening with palms facing each other and PBE visor facing downward with the CO2 container resting on top of hands.

4 - With the head bent forward, guide PBE neckseal over the top of the head and down over the face using the hands to shield the face and glasses from the oronasal mask cone.

5 - With both hands, grasp the adjustment straps at the lower corners of the visor and pull outward sharply to actuate the starter candle. Within 1-5 seconds, a rushing noise of oxygen entering the hood will be heard and inflation will be evident.

**CAUTION:** THE OXYGEN PRODUCED BY PBE UNIT WILL VIGOROUSLY ACCELERATE COMBUSTION. DO NOT INTENTIONALLY EXPOSE THE PBE UNIT TO DIRECT FLAME CONTACT OR REMOVE IT IN THE IMMEDIATE PRESENCE OF FIRE OR FLAME. DUE TO OXYGEN SATURATION OF THE HAIR. DO NOT SMOKE OR BECOME EXPOSED TO FIRE OR FLAME IMMEDIATELY AFTER REMOVING PBE UNIT.

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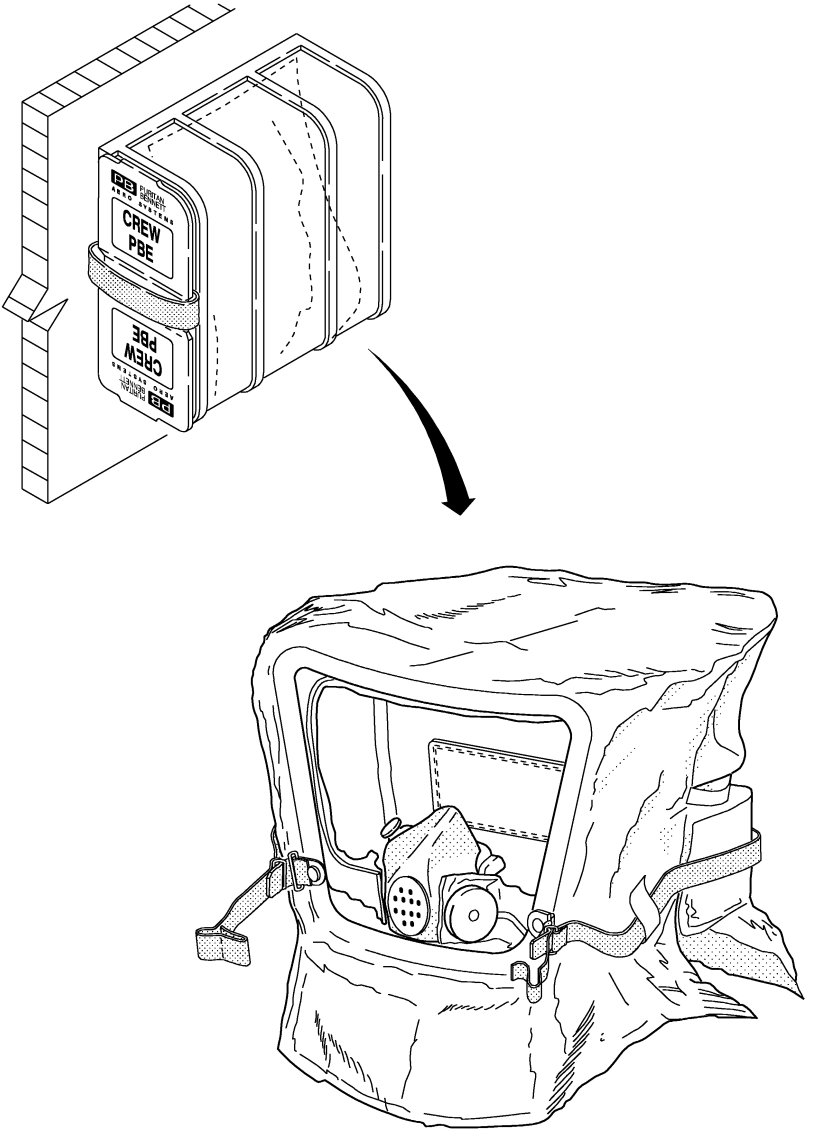


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## HOOD SCHEMATIC AND STOWAGE - PURITAN

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# MINIMUM OXYGEN PRESSURE FOR DISPATCH

## FLIGHT CREW OXYGEN SYSTEM

Crew Comprising Pilot and Copilot: 1100 psi

Crew Comprising Pilot, Copilot and Observer: 1500 psi

**NOTE:** The minimum oxygen pressure for dispatch was calculated at an ambient temperature of 21°C (70°F). For other temperatures, refer to Oxygen Pressure Correction Chart as a function of the cylinder compartment temperature.

For additional oxygen consumption, refer to Additional Pressure Required Table to calculate how much Additional Oxygen Cylinder Pressure will be required for dispatch.

### ADDITIONAL OXYGEN PRESSURE REQUIRED

ALTITUDE: 8.000 UP TO 14.000 FT
CYLINDER VOLUME: 50 CU.FT
UNIT: PSI FOR 1 MINUTE

| | Oxygen/air mixture mode supplied for the mask | |
|---|---|---|
| | **NORMAL** | **100%** |
| 1 crewmember | 3.70 | 16.77 |
| 2 crewmembers | 7.40 | 33.54 |
| 3 crewmembers | 11.10 | 50.31 |

## PORTABLE OXYGEN CYLINDER

For airplane dispatchability, the minimum pressure shown on the gauge of the portable oxygen cylinder must be in accordance with the minimum guideline set either for the airline or regulator authority.

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## OXYGEN PRESSURE CORRECTION CHART

An Oxygen Pressure Correction Chart is located on the oxygen service panel door. This chart is provided for the maintenance personnel's use when recharging the oxygen cylinder. Additionally, it may be used by the crew to check if the oxygen cylinder's pressure is above the minimum oxygen pressure for dispatch.

To use the chart for recharging purposes:

Enter the chart with the cylinder compartment temperature (cockpit temperature) and go vertically up to the desired pressure at 21°C. From the intersection point, trace to the left to read the indicated gauge pressure to be attained.

To use the chart for dispatching purposes:

Enter the chart simultaneously with the cylinder compartment temperature (cockpit temperature) and indicated gauge oxygen pressure (on MFD or oxygen service panel). The intersection determines the oxygen cylinder's equivalent pressure at 21°C, by interpolating the two adjacent standard curves.

**EXAMPLE**

Associated condition:

- Crew..... PILOT, COPILOT AND OBSERVER
- Indicated gauge pressure ..... 1600 PSI
- Cylinder compartment temperature ..... 30°C

As the intersection is above the dashed line for the associated condition, the airplane may be dispatched.

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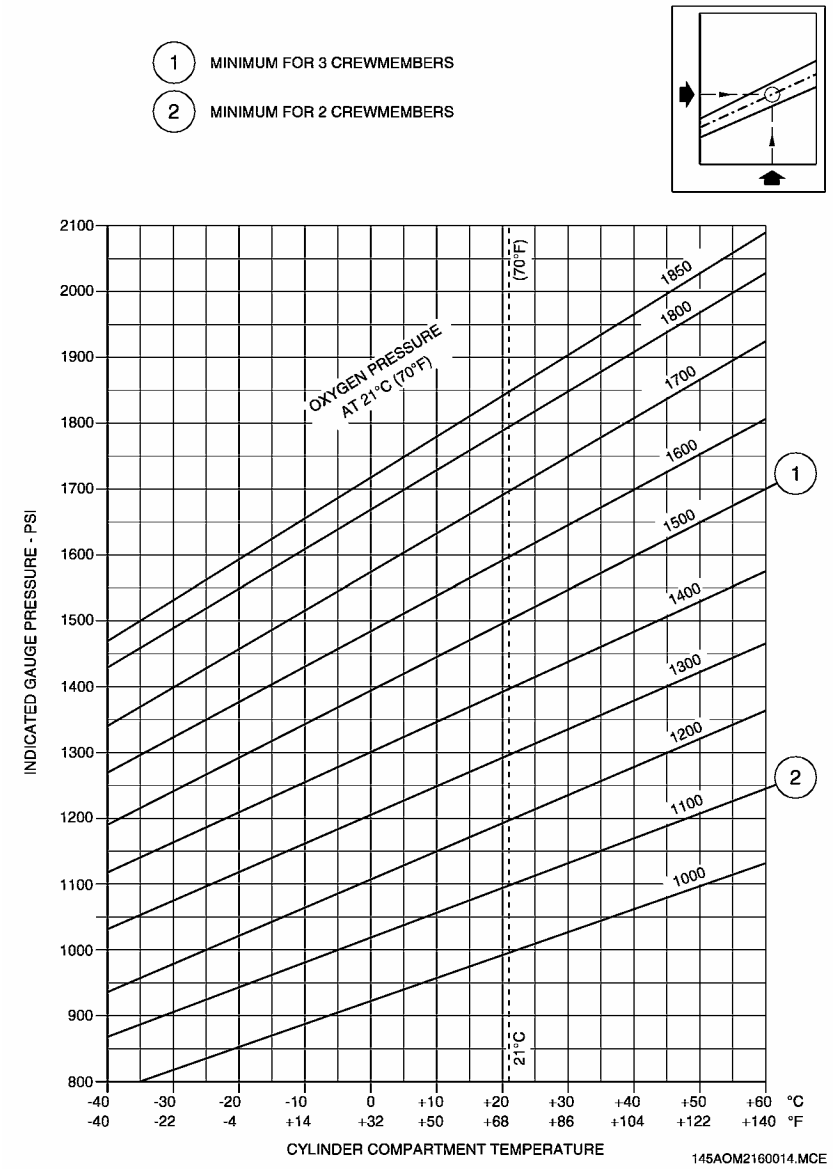


## OXYGEN PRESSURE CORRECTION

## OXYGEN CONSUMPTION CHART

The Oxygen Consumption Chart is provided to allow the Flight Crew to know the remaining number of pre-flight oxygen mask tests available before the oxygen cylinder recharging is necessary. This chart should be used by the maintenance personnel to choose the best moment to recharge the oxygen cylinder.

The Oxygen Consumption chart has been plotted for 21°C (70°F) conditions. For different temperatures, the Oxygen Pressure Correction chart must be used to obtain the pressure at 21°C and then see what is the number of the remaining oxygen mask tests.

### EXAMPLE

Associated condition:

- Crew..... PILOT, COPILOT, AND OBSERVER
- Indicated Gauge Pressure ..... 1750 psi
- Cylinder Compartment Temperature ..... 30°C

According to the Oxygen Pressure Correction chart, for the associated conditions, the pressure for 21°C is 1700 psi.

According to the Oxygen Consumption chart, for 1700 psi there are approximately 22 remaining pre-flight tests before recharging the oxygen cylinder becomes necessary. The airplane's dispatch being therefore allowed.

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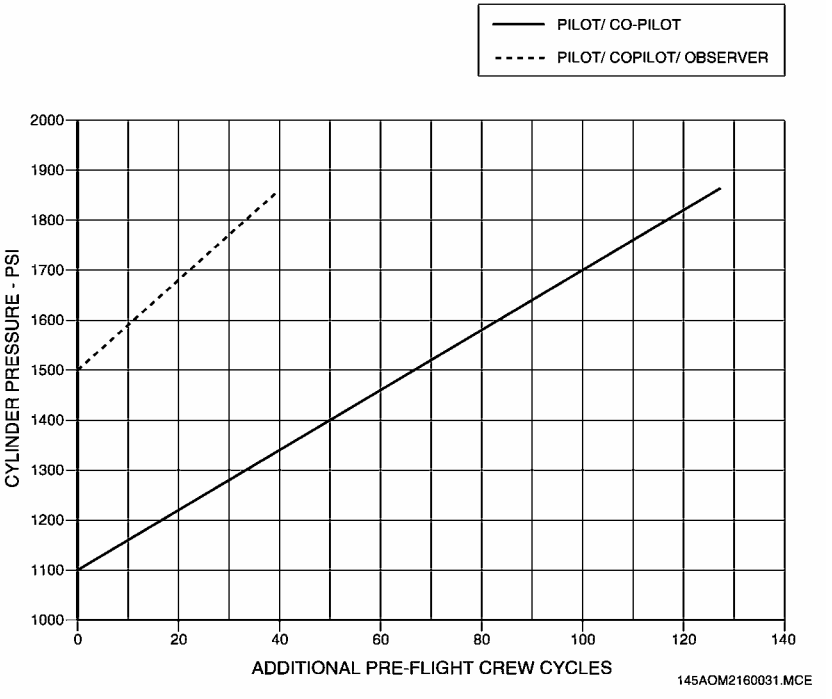


**NOTE:** The Oxygen Consumption chart has been plotted for 21°C (70°F) conditions.

## OXYGEN CONSUMPTION

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# SECTION 2-17

# FLIGHT INSTRUMENTS

TABLE OF CONTENTS

| | Block | Page |
|---|---|---|
| General | 2-17-05 | ..01 |
| Air Data System (ADS) | 2-17-10 | ..01 |
| Flight Instruments | 2-17-15 | ..01 |
| Standby Instruments | 2-17-20 | ..01 |
| Radio Altimeter System | 2-17-25 | ..01 |
| Chronometer/Clock | 2-17-30 | ..01 |
| Flight Data Recorder System | 2-17-35 | ..01 |

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# GENERAL

The Flight Instruments System comprises the Air Data System (ADS), the attitude, altitude, airspeed, and vertical speed indications on the Primary Flight Display (PFD), the Flight Data Recorder System (FDRS), and the Digital Clock.

The conventional flight data information is presented on the Primary Flight Display (PFD).

Standby electromechanical instruments are provided as backup, should there occur a complete failure in the electronic flight instrument system. The standby instruments are Magnetic Compass, Airspeed Indicator, Altitude Indicator, and Attitude Indicator.

Optionally the airplane may be equipped with an Integrated Standby Instrument System (ISIS) that replaces the standby electromechanical instruments (except the Magnetic Compass) in a single display.

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# AIR DATA SYSTEM (ADS)

The Air Data Systems are designed for sensing, processing, and transmitting air data information to various systems and instruments of the airplane.

The ADS 1 (LH) consists of one Air Data Computer (ADC), one Pitot Tube, one Total Air Temperature Probe (TAT) and two Static Ports.

The ADS 2 (RH) consists of one Air Data Computer (ADC), one Pitot Tube, one Total Air Temperature Probe (TAT) and two Static Ports.

The Standby System consists of one Pitot/Static Tube, one Standby Altimeter and one Standby Airpeed Indicator.

The Pitot and Pitot/Static tubes, TAT probes and Static Ports are heated for anti-icing purposes. For further information about the anti-icing system, refer to Section 2-15, Ice and Rain Protection.

The ADSs 1 and 2 interface with the airplane's systems through the ADCs, as follows:

- IC-600 - Both ADCs supply pressure altitude, barometrically corrected altitude, true airspeed, calibrated airspeed, vertical speed, Mach number, static air temperature, $V_{MO}$ and total air temperature to both IC-600.
- FADEC - The ADC 1 supplies the FADEC 1A and 2A, and the ADC 2 supplies the FADEC 1B and 2B with total pressure, Mach number, and total air temperature.
- HSCU - The ADCs provide calibrated airspeed for the HSCUs.
- TRANSPONDER - Both ADCs provide pressure altitude information for both transponders/TCAS.
- AHRS (AH-900 only) - The ADC 1 supplies AHRS 1 and ADC 2 supplies AHRS 2 with true airspeed.
- FMS - The ADC 1 provides true airspeed for the FMS.
- WEATHER RADAR - The ADC 2 provides altitude data for the weather radar.
- SPS - Both ADCs provide Mach number information for the Stall Protection System.
- GPWS - The ADC 1 provides airspeed (CAS and TAS), altitude, and vertical speed information for the GPWS.

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- CPCS - Both ADCs provide pressure altitude, barometric correction, and altitude rate of change data for the pressurization Digital Controller.
- ICE PROTECTION - Both ADCs provide altitude trip point for the ice protection system.
- RUDDER SYSTEM - Both ADCs supply the rudder system with the calibrated airspeed trip point.
- AWU - Both ADCs supply the AWU with the overspeed warning output.

The ADCs functional test mode is entered when the momentary ADC Test Switch, located on the Maintenance Panel, is commanded to test, provided the airplane speed is below 50 kt and the airplane is on the ground.

The barometric pressure data discrete inputs to the ADCs are set on the PFD Bezel (barometric pressure selection and correction).

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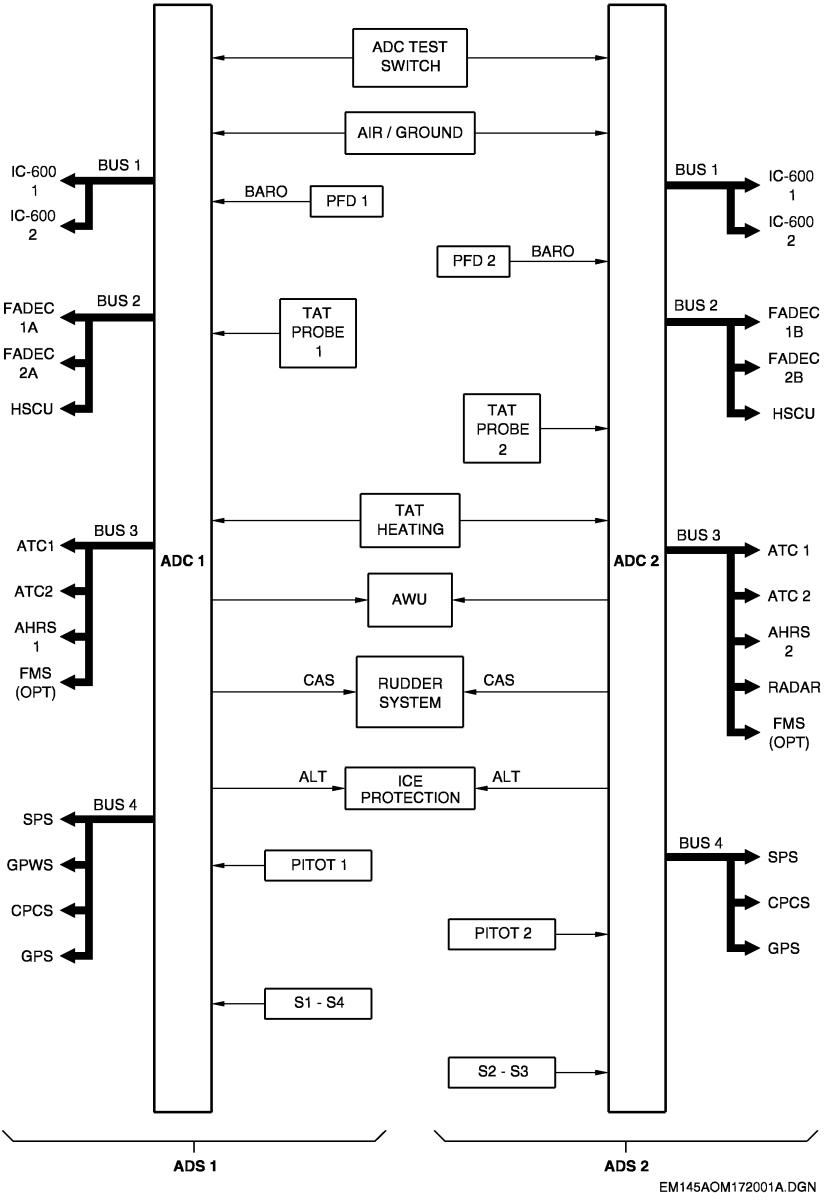


## AIR DATA SYSTEMS SCHEMATIC

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## ADS SENSORS

Pitot tubes 1 and 2 are positioned on the top of the airplane's nose. Pitot/Static tube 3 is positioned on the right side of the airplane's nose.

Pitot tubes 1 and 2 supply total air pressure to the respective ADC.

Four Static ports supply static pressure to both ADCs.

The Pitot/Static tube 3 supplies total air pressure to the Standby Airspeed Indicator, and static pressure to the Standby Airspeed Indicator and Standby Altimeter. Furthermore, Pitot/Static tube 3 supplies static pressure to the Cabin Pressure Acquisition Module (CPAM).

The TAT probe 1 is installed on the left side of the airplane's nose, and the TAT probe 2 is installed at the right side of the airplane's nose.

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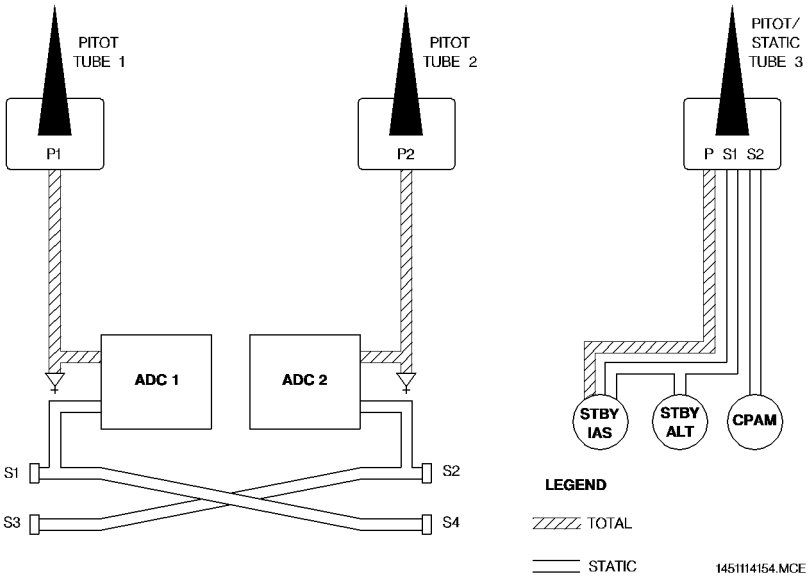
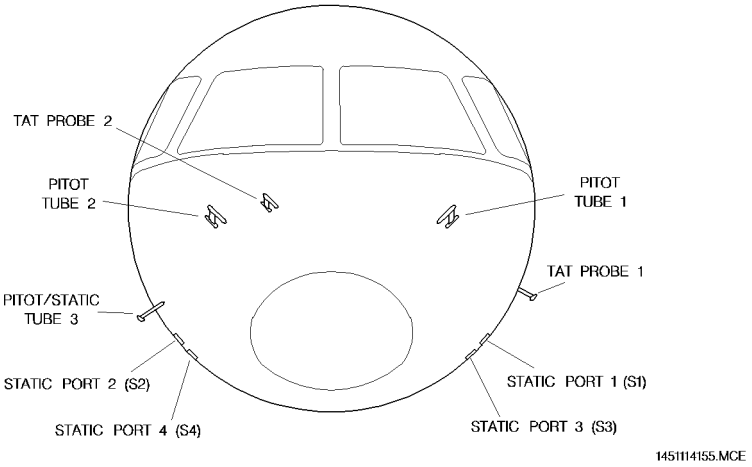



## ADS SENSORS SCHEMATIC




## ADS SENSORS POSITIONING

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# ADS INDICATIONS

## MFD

### 1 - STATIC AIR TEMPERATURE (SAT) INDICATION

- The SAT is presented as a digital readout in degrees Celsius.
- Colors:
  - Digits: green
  - Labels: white
- Ranges from –99 to +99°C with a resolution of 1°C.
- In the event of ADC failure or invalid SAT, the digits are replaced by three amber dashes.

### 2 - TOTAL AIR TEMPERATURE (TAT) INDICATION

- The TAT is presented as a digital readout in degrees Celsius.
- Colors:
  - Digits: green
  - Labels: white
- Ranges from –99 to +99°C with a resolution of 1°C.
- In the event of ADC failure or invalid TAT, the digits are replaced by three amber dashes.

### 3 - TRUE AIRSPEED (TAS) INDICATION

- The TAS is presented as a digital readout in knots.
- Colors:
  - Digits: green
  - Labels: white
- Ranges from 0 to 999 kts with a resolution of 1 kt.
- In the event of ADC failure or invalid TAS, the digits are replaced by three amber dashes.

## PFD

### 1 - AIR DATA SOURCE ANNUNCIATION

- Label: ADC1 or ADC2.
- Color: amber when only one ADC is supplying both sides or each ADC is supplying opposite side systems (ADC or SG pressed on the Reversionary Panel - refer to section 2-4, Crew Awareness).
- Annunciation is removed when each ADC is supplying the respective side systems (ADC 1 supplying captain's side and ADC 2 supplying copilot's side).

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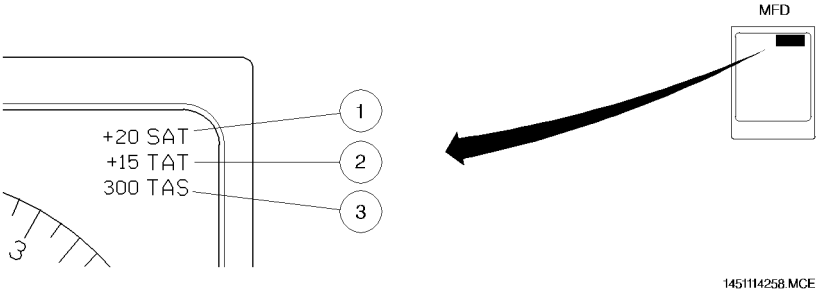
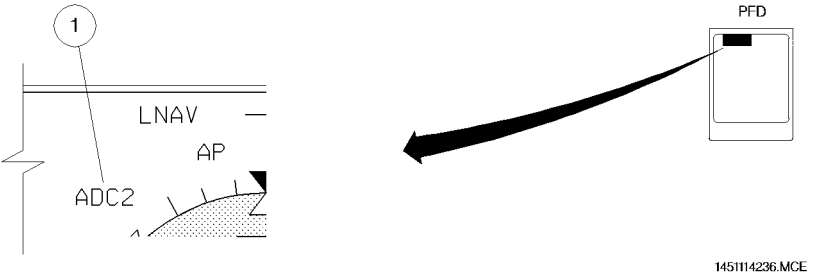



**ADS INDICATIONS ON THE MFD**




**ADS INDICATION ON THE PFD**

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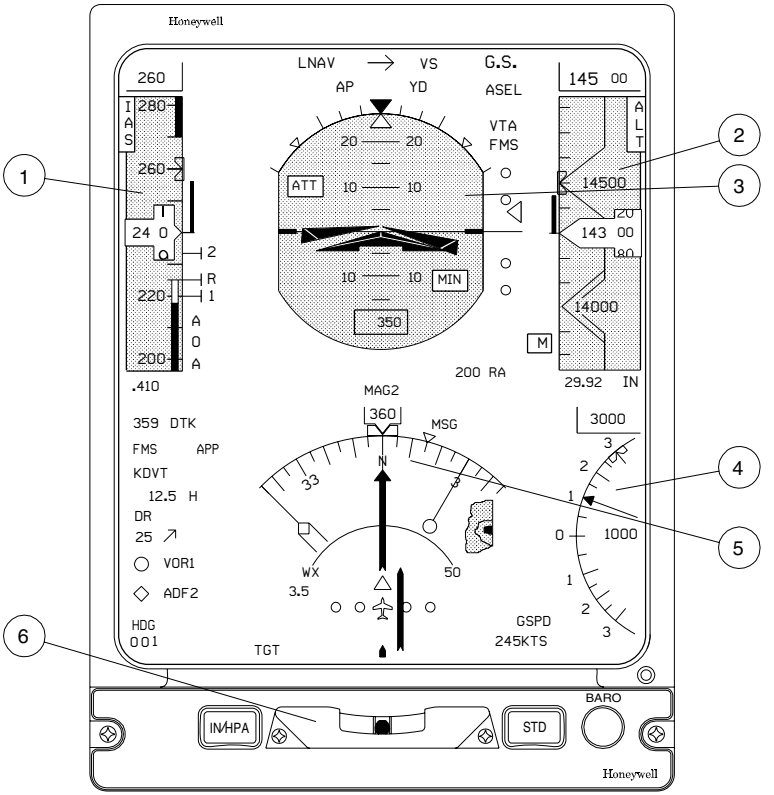
# FLIGHT INSTRUMENTS

The primary flight instruments are presented on the PFDs.

Indicated airspeed (1), altitude (2) and vertical speed (4) are provided by the ADS.

Attitude (3) and heading (5) information are provided by the AHRS or IRS. For further information on these systems and indications, refer to section 2-18, Navigation and Communication.

Slip/Skid indicator (6) is a purely mechanical system.

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**PRIMARY FLIGHT INSTRUMENTS ON THE PFD**

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# AIRSPEED INDICATION

## SPEED INDICATION ON THE PFD

The KIAS and Mach number are displayed in tape format on the PFDs. The speed tape also displays target speed and respective speed bug, set through the Flight Guidance Controller (refer to section 2-19, Autopilot), reference speed bugs, to be used during takeoff and landing operations (refer to “speed bugs setting through MFD”, in this section), speed trending vector and overspeed visual warnings.

### 1 - OVERSPEED INDICATION BAR

- Color: red
- Extends from $V_{MO}/M_{MO}$ to higher airspeeds on the scale. If the airplane exceeds $V_{MO}/M_{MO}$, the digits in the airspeed window and the digital Mach readout will be displayed in red, and an aural warning will be triggered. If the acceleration trend vector exceeds $V_{MO}$ or $M_{MO}$, the digits in the airspeed window and the digital Mach readout are displayed in amber.

### 2 - AIRSPEED SCALE AND VERTICAL TAPE

- Color:
  - Scale: white
  - Tape: gray
- Ranges from 40 to 400 KIAS with a resolution of 10 KIAS.
- The vertical tape provides a trend indication of IAS and displays digital airspeed each 20 KIAS.

### 3 - AIRSPEED TREND VECTOR

- Color: magenta
- The airspeed trend vector is an indication of the acceleration direction and it represents the airspeed that the airplane would attain in 10 seconds if the current airplane acceleration is maintained.
- The trend vector extends vertically from the center of the airspeed vertical tape.
- Extends upward for positive acceleration and downward for negative acceleration.
- Disabled during takeoff.

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## 4 - REFERENCE SPEED BUGS (V1, VR, V2, AP)

- Color:
  - $V_1$: magenta
  - $V_R$: cyan
  - $V_2$: White
  - AP: green
- Presented when the associated digital indication is selected or above 40 KIAS on the ground.
- Removed above $V_2$ + 42 kt.
- May be out of view, if airspeed is reduced below 230 KIAS followed by an increase above 230 KIAS. To display the speeds again, press the reference speed buttons.
- When the airplane speed is below 40 knots, $V_1$, $V_R$, and $V_2$, as set on the MFD, are displayed in the bottom portion of the airspeed tape in the form of a digital indication. Upon power up, the digital indications for the set bugs are dashes.

## 5 - MACH NUMBER DIGITAL INDICATION

- Color:
  - Green for normal airspeeds.
  - Amber for $V_{MO}/M_{MO}$.
  - Red from $V_{MO}/M_{MO}$ to higher airspeeds.
- Ranges from 0.05 to 1.000 M with a resolution of 0.001 M.
- Mach number and label are displayed when speed exceeds 0.45 M and remains until it drops below 0.05 M.

## 6 - LOW AIRSPEED AWARENESS

- Displayed in the airspeed scale when the airspeed is near stall speed for the current configuration.
- Colors:
  - White: indicates the speed range from 1.23 $V_S$ to 1.13 $V_S$.
  - Amber: indicates the speed range from 1.13 $V_S$ to $V_S$. Stick shaker may be activated in this range.
  - Red: indicates $V_S$. Stick pusher is activated.

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## 7- CURRENT AIRSPEED DISPLAY

- Color:
  - Green for normal airspeeds.
  - Amber for $V_{MO}$ /$M_{MO.}$
  - Red from $V_{MO}$/$M_{MO}$ to higher airspeeds.
- Ranges from 40 to 400 KIAS with a resolution of 1 KIAS.

## 8 - AIRSPEED COMPARISON MONITOR DISPLAY

- Color: amber
- Label: IAS
- Displayed in case of a difference of 5 KIAS between the airspeed indication on the PFDs.
- Flashes for 10 seconds and then becomes steady.

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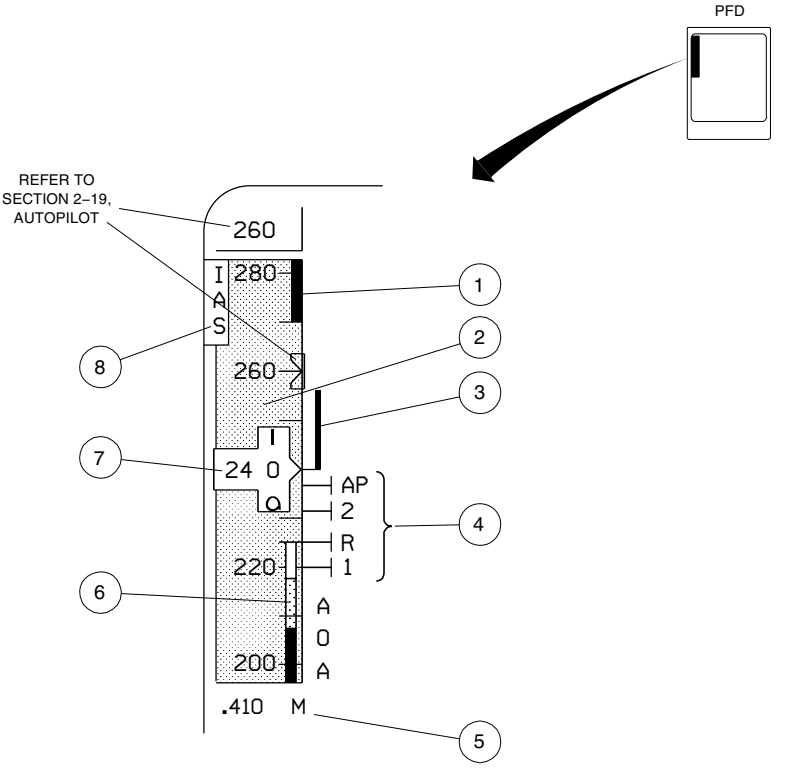


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**AIRSPEED INDICATION ON THE PFD**

## SPEED BUGS SETTING THROUGH MFD

The MFD SPDS submenu allows setting speed bugs on the PFD speed tape. This submenu is accessed by selecting the MFD submenu, then the SPDS submenu.

### 1 - REFERENCE SPEED DIGITAL INDICATIONS

- Minimum value is:
  - $V_1$ : 89 kt
  - $V_R$ : 89 kt or $V_1$, whichever is higher.
  - $V_2$ : 89 kt or $V_R$, whichever is higher.
  - AP : 89 kt
- Values are removed from the PFD when airplane is airborne.
- Displays dashes on power-up system.
- When selected, dashes are replaced by speed value.
- Selected Reference Speed is surrounded by two white boxes.

### 2 - REFERENCE SPEED SET KNOB

- When rotated clockwise or counterclockwise, increments or decrements the associated airspeed value and moves the associated bug accordingly (if the bug is in view).

### 3 - REFERENCE SPEED BUTTONS ($V_1$, $V_R$, $V_2$, AP)

- Allows selection of V1, V2, VR or AP speeds, for setting purposes.
- Enables movement of the associated speed bug on the PFD.
- Sequentially pressing each button causes the following:
  - First pressing causes the associated speed indication dashes to be replaced by the speed value and two white boxes to be displayed around the indication.
  - Next pressing removes the inner box and displays the associated bug on the PFD.
  - Next pressing removes the outer box and the associated bug on the PFD.

### 4 - HIGH ALTITUDE LANDING AND TAKEOFF (HI ALT) OPERATION BUTTON

- Activates HI ALT mode for takeoff and landing operations in altitudes above 8000 ft up to and including 10000 ft.

**NOTE:** HI ALT operation is available for airplanes equipped with HI ALT system and certified to operate in HI ALT mode.

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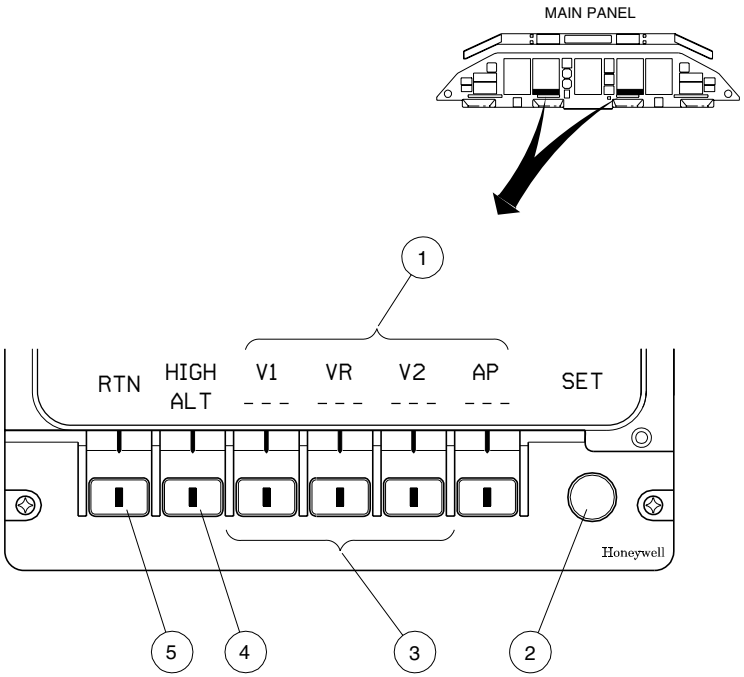
## 5 - RETURN BUTTON

- Returns the MFD to the MAIN Menu.
- If any of the speeds are displayed with both surrounding inner and outer boxes, pressing the RTN Button removes the inner box before returning the menu to the MFD Bezel Menu.

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**MFD SPDS SUBMENU**

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# ALTITUDE INDICATION

## ALTITUDE INDICATIONS ON THE PFD

The altitude is displayed in tape format on the PFD. The altitude tape also displays the Flight Guidance Controller preselected altitude (ASEL), respective preselected altitude bug (refer to section 2-19, Autopilot), and altitude trending vector.

### 1 - ALTITUDE SCALE AND VERTICAL TAPE

- Color:
  - Scale: white
  - Tape: gray
- Ranges from –1000 to 60000 ft, with a resolution of 100 ft.
- The vertical tape moves behind the current altitude window and displays a range of ± 550 ft from the actual altitude.
- The vertical tape displays digital altitude every 200 ft for altitudes from zero up to 10000 ft and every 500 ft for altitudes above 10000 ft.

### 2 - ALTITUDE COMPARISON MONITOR DISPLAY

- Color: amber
- Label: ALT
- Displayed in case of a difference of 200 ft or more between the altitude indications on PFDs.
- Flashes for 10 seconds and then becomes steady.

### 3 - ALTITUDE CHEVRON

- Color: White
- The double line chevron indicates multiples of 1000 ft. The single line chevron indicates every 500 ft increments.

### 4 - CURRENT ALTITUDE DISPLAY

- Color: green
- Ranges from –1000 to 60000 ft with a resolution of 20 ft.

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**5 - ALTITUDE TREND VECTOR**

- Color: magenta
- The altitude trend vector represents the altitude that the airplane should attain in 6 seconds if the current altitude rate (Vertical Speed) is maintained.
- Displayed as a vertical bar that extends from the center of the altitude tape upward for positive vertical speeds and downward for negative vertical speeds.

**6 - LOW ALTITUDE AWARENESS**

- Color:
  - band: brown
  - limiting line: yellow
- Provided through a raster band that will be displayed on the bottom of the altitude tape in case the radio altitude is below 550 ft.
- Covers the lower half of the altitude tape when the airplane is on ground.

**7 - BAROMETRIC ALTITUDE CORRECTION DISPLAY**

- Color:
  - digits: cyan
  - label: white
- Ranges from 542 to 1083 hPa (16.00 to 32.00 inHg) with a resolution of 1 hPa (0.01 inHg).

**8 - BARO KNOB**

- Allows setting barometric altitude correction value.
- Rotating clockwise or counterclockwise increments or decrements barometric altitude correction.

**9 - STANDARD BUTTON**

- Adjusts barometric altitude correction to standard setting (29.92 inHg or 1013.25 hPa).

**10 - IN/HPA BUTTON**

- Selects barometric pressure unit between inches of mercury (inHg) and hectopascals (hPa).

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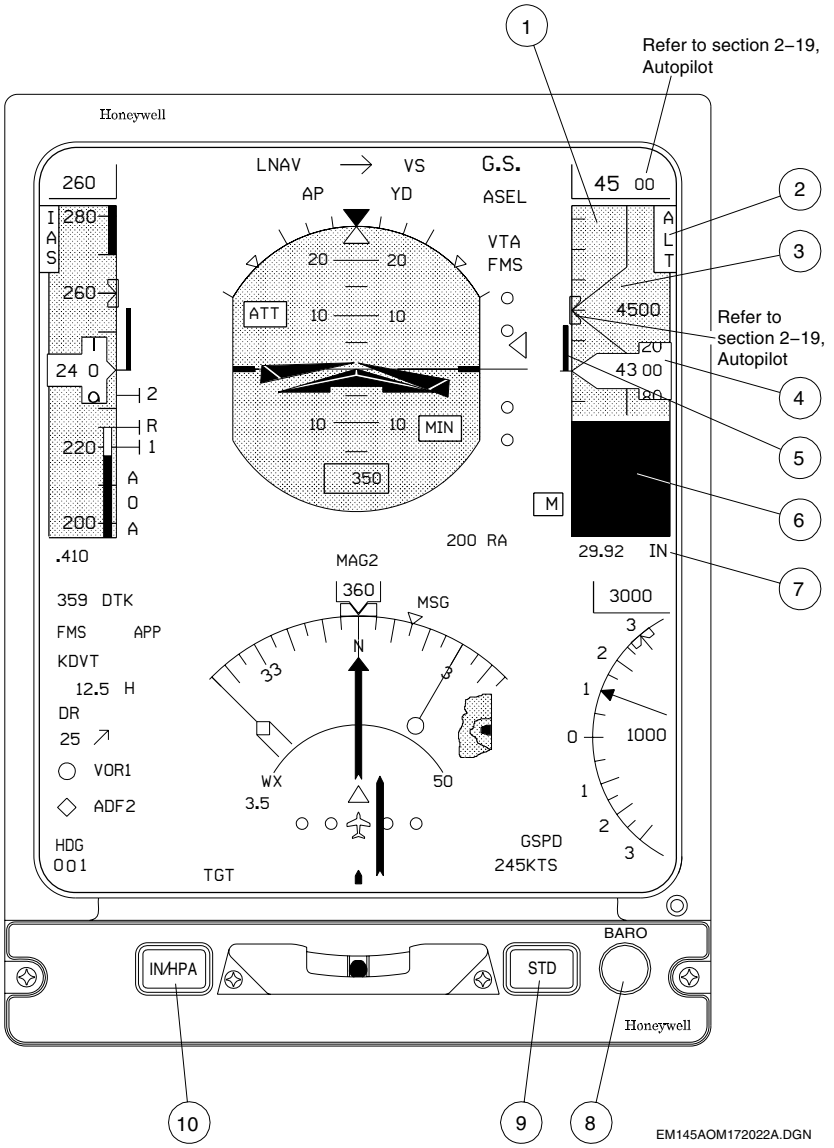


**ALTITUDE INDICATION ON THE PFD**

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# VERTICAL SPEED INDICATION

The vertical speed is displayed in analogic and digital formats on the PFD.

Besides presenting the current vertical speed, the Vertical Speed Indicator (VSI) also displays target vertical speed and respective bug, set through the Flight Guidance Controller (refer to section 2-19, Autopilot).

The PFD VSI also indicates vertical direction and minimum vertical speed to be attended during evasive maneuvers, according to TCAS commands. For further information on TCAS, refer to Section 2-4, Crew Awareness.

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## 1 - ANALOGIC VERTICAL SPEED INDICATION

- Color:
  - Scale: white
  - Pointer: green
- Ranges from –3000 to +3000 ft/min
- Scale has marks every 500 ft/min up to 3000 ft/min, with labels every 1000 ft/min.
- The scale is non-linear to provide increased resolution around zero vertical speed.

## 2 - DIGITAL VERTICAL SPEED INDICATION

- Color: green
- Ranges from –9999 to +9999 ft/min with a resolution of 50 ft/min.
- Indication is displayed in the center of the scale.
- Indication is displayed when vertical speed exceeds –550 ft/min or +550 ft/min, and remains until it returns to –500 ft/min or +500 ft/min.

**NOTE:** For invalid vertical speed, the pointer and the digital indication are removed from the display and replaced by a red boxed V over S.

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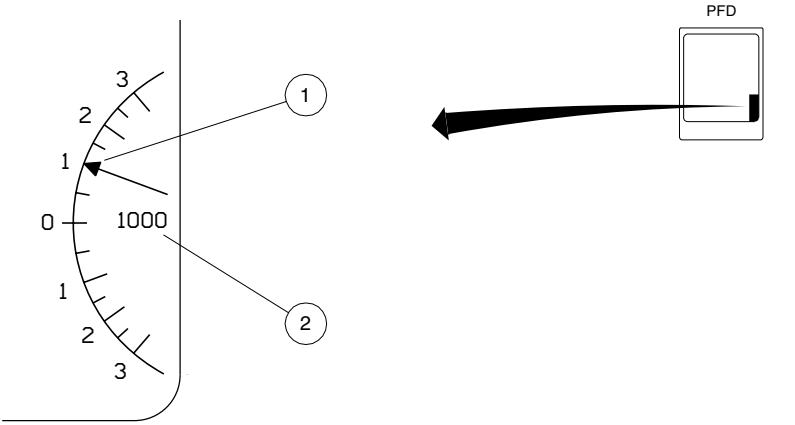


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**VERTICAL SPEED INDICATION ON PFD**

# STANDBY INSTRUMENTS

Standby instruments are provided to supply flight data information in case of PFD and MFD loss.

The standby instruments comprise the following functions: pitch and roll attitudes, airspeed, altitude and magnetic heading.

Such instruments are conventional units and most of them are available even in case of total loss of electrical power.

Optionally, the conventional units may be replaced by a single display, the Integrated Standby Instruments System (ISIS). However, as the magnetic heading displayed by this equipment is received from the AHRS 1 or IRS 1, the conventional Magnetic Compass is provided as a back-up unit.

The pilot is responsible for checking the standby instruments indications against PFD indications, in order to ensure that the back-up units will present reliable indication in an emergency situation.

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# MAGNETIC COMPASS

The Standby Magnetic Compass indicates the airplane's magnetic heading by sensing the earth's magnetic field. The magnetic heading is indicated by reading a graduated horizontally-mounted card against a fixed lubber line, which represents the airplane's longitudinal axis.

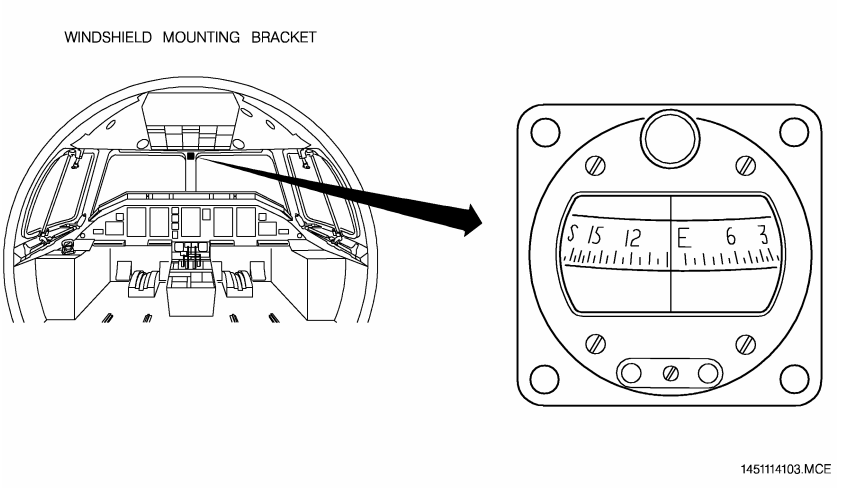
This card is graduated as follows:

- Half dots between the tens dots (005°, 015°, 025°,...).
- Full dots every ten degrees (010°, 020°,...).
- Full dots and respective magnetic heading indication every 030° (030°, 060°,...).
- Full dots and the N, E, S and W characters at the respective cardinal points (North, East, South and West).

Two calibration cards are supplied for the compass, one for normal operational condition (pitots on and windshield heating off) installed above the compass, and one for electrical emergency condition, installed on the main panel left corner.

The Standby Magnetic Compass receives 5 V DC for internal lighting.

**NOTE:** Magnetic compass reading shall always be done considering conditions written in applicable calibration cards.




**MAGNETIC COMPASS**

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## STANDBY AIRSPEED INDICATOR

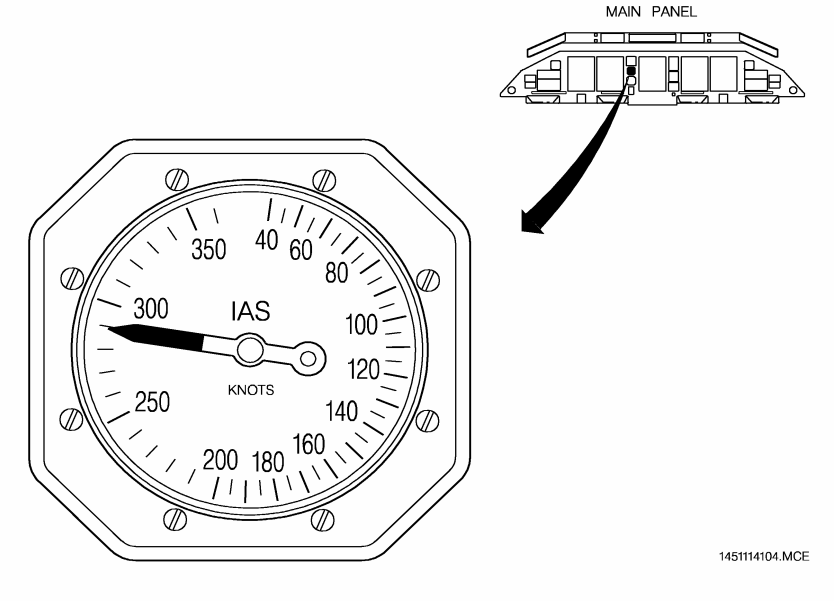
The Standby Airspeed Indicator provides airspeed indication by means of a pointer moving over a fixed scale, calibrated in knots.

The scale is graduated form 40 to 360 KIAS as follows:

- Half dots between the tens dots (45, 55, 65,...).
- Full dots every ten dots (40, 50, 60,...).
- Full dots and respective airspeed indication every 20 KIAS (40, 60, 80,...).

The Pitot/Static tube 3 provides dynamic pressure to this indicator.

The Standby Airspeed Indicator is powered 5 V DC for internal lighting.




**STANDBY AIRSPEED INDICATOR**

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# STANDBY ALTIMETER

The Standby Altimeter consists of an aneroid barometer, with the altitude scale graduated in feet, and the barometric adjustment scale graduated in inches of mercury or hectopascals.

The Pitot/Static tube 3 provides static pressure to this indicator.

This instrument receives 5 V DC for internal lighting.

**1 - ALTITUDE COUNTER**

- Indicates pressure altitude.
- Ranges from –1000 ft to 50000 ft with the following increments:
  - Right drum counter is numbered at 100 ft intervals.
  - Center drum counter is numbered at 1000 ft intervals.
  - Left drum counter is numbered at 10000 ft intervals.
- First digit (left drum counter) is replaced by an orange and white crosshatched area for negative altitudes, and by a black and white crosshatched area for altitudes below 10000 ft.

**2 - SCALE**

- Full dots every 100 ft.
- Half dots every 20 ft.

**3 - ALTIMETER SETTING COUNTER**

- Displays the adjusted reference pressure.
- Ranges from 22.15 to 31.00 inHg (750 to 1050 hPa), with 0.01 inHg (1hPa) increments .

**4 - BARO KNOB**

- Allows setting the reference pressure.

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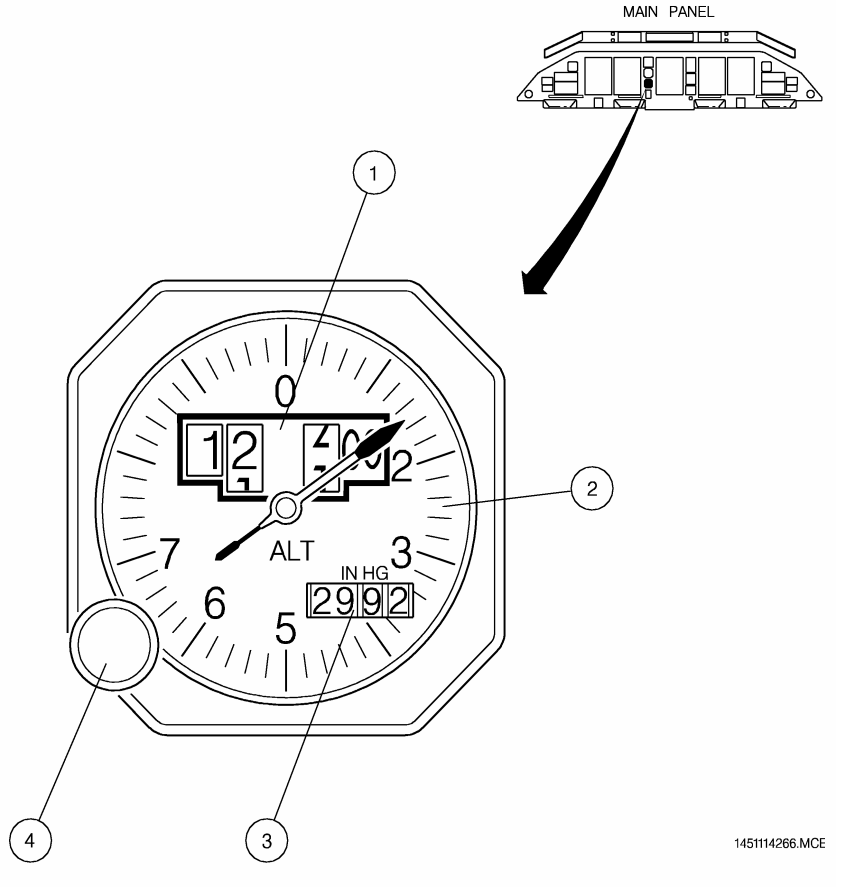


**STANDBY ALTIMETER (TYPICAL)**



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## STANDBY ATTITUDE INDICATOR

The Standby Attitude Indicator is a conventional electrically powered attitude gyro, whose primary purpose is to supply attitude information in the event of a total loss of the PFD and MFD.

The Standby Attitude Indicator is powered by 28 V DC, from the Essential DC Bus 2. In case of an electrical emergency, it will operate solely on the airplane batteries, and for about 40 minutes. In case of total electrical power loss to this equipment, it is capable of providing a minimum of 9 minutes of useful attitude information due to high-rotor speed and mechanical erection system. Internal lighting is provided by 5 V DC.

It is recommended that the indicator be caged before the airplane is energized and after the airplane is deenergized. Its indication will be reliable after its rotor speed is completely stabilized, which occurs within 3 minutes after it is uncaged.

Any adjustment during the flight, although not normally required, should be made by momentarily caging the indicator with the airplane in level flight.

**NOTE:** Never cage an operating indicator while the airplane is pitching or rolling.

During normal operation, Standby Attitude Indicator may present induced errors during transient airplane conditions, such as acceleration and deceleration or turns.

Horizontal acceleration experienced during takeoff, climb-out, descent and landing might cause gyro precession inducing display errors. Acceleration and decelerations ranging from 20 kt/min to 100 kt/min may induce errors from 1° to 5° (pitch up) and from 1° to 2° (roll). When the airplane is turning with less than 10° of bank angle, the Standby Attitude Instrument may present induced errors of up to 2°/min. For bank angles greater than 10° it may present induced errors around 1°/min.

During normal operation the errors are automatically corrected at a nominal 2.5°/min when the airplane is stabilized in straight and leveled flight.

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**1 - ROLL INDEX**

- Roll scale graduated to provide measurement of bank angle by the roll pointer.
- Full dots at 0°, 30°, 60° and 90°, and half dots at 10° and 20°.

**2 - ROLL POINTER**

- Indicates the bank angle against the roll index scale.

**3 - HORIZON LINE**

- Earth's horizon relative line.
- The field below the horizon line is indicated in black ("dive"), and above, in light blue ("climb").

**4 - CAGE KNOB**

- Pull to the fully extended position, rotate clockwise and release at the detent position to cage the indicator.
- Pull, rotate counterclockwise and release smoothly to uncage.

**5 - MINIATURE AIRPLANE**

- Indicates airplane roll and pitch attitudes relative to the horizon line.

**6 - PITCH SCALE**

- Gives direct reading of airplane pitch attitude.
- Marked every 5° in pitch.

**7 - POWER WARNING FLAG**

When in view, indicates power off, caged condition, open motor winding, or loss of power.

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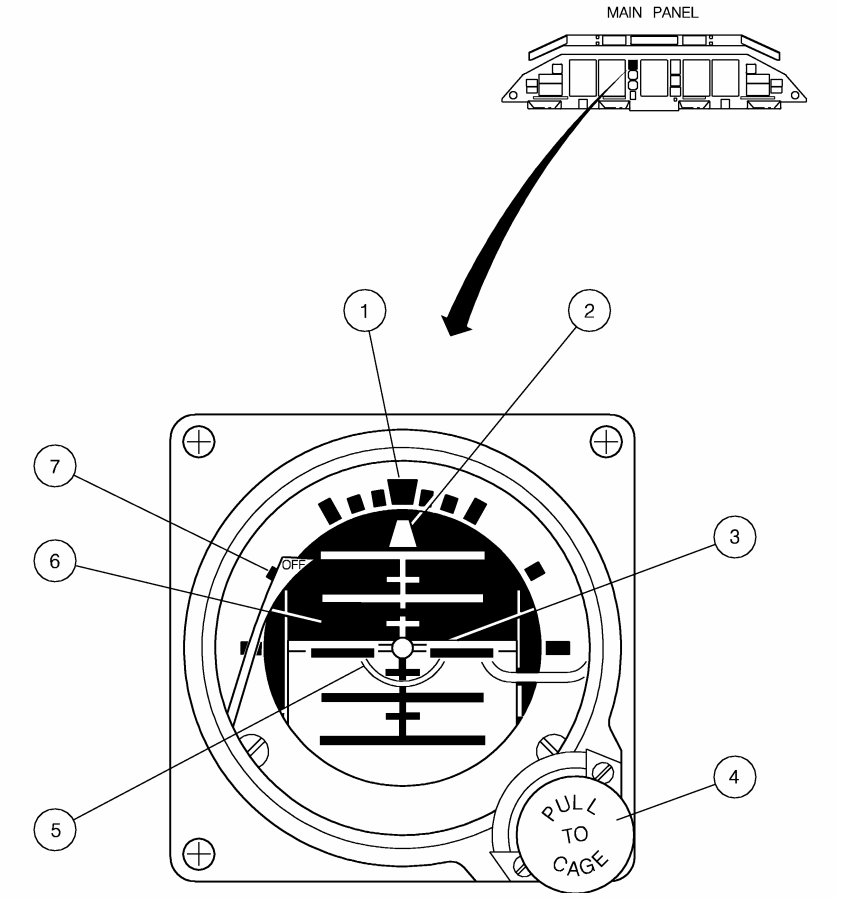


**STANDBY ATTITUDE INDICATOR**

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## INTEGRATED STANDBY INSTRUMENT SYSTEM (ISIS THALES)

The ISIS provides the following parameters:

- Attitude (pitch and roll);
- Standard or barometric-corrected altitude and associated barometric pressure;
- Indicated airspeed;
- Indicated Mach number;
- VMO (Maximum Operating Speed);
- Skid/Slip information;
- Magnetic heading (from AHRS 1or IRS 1).

For all EMB-145 models except EMB-145 XR model the ISIS relies on 28 V DC power, provided by the Essential DC Bus 2. In case of an electrical emergency, it will operate solely on the airplane batteries for approximately 40 minutes.

For the EMB-145 XR model, the ISIS relies on 28 V DC power, provided by the Backup Hot Bus. In case of an electrical emergency, it will operate solely on the airplane batteries for approximately 240 minutes.

For the EMB-145 XR model, the ISIS will be de-energized when the battery knobs are positioned to OFF while the airplane is powered by the GPU or generators.

The system is powered as soon as the airplane batteries are switched to AUTO. Then, the ISIS starts its alignment phase, which takes about 90 seconds to be completed and can be identified on the screen by the “INIT 90 s” flag.

**NOTE:** The airplane must not be moved during the first 90 seconds after power-up, while the ISIS is undergoing alignment. Moving the airplane during this period can cause in-flight attitude indication errors, that are not noticeable on ground. For ISIS Post-Mod. SB 145-34-0049 and on, the “ATT” flag is displayed in this case.

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## ATTITUDE

Using the data from the respective sensors after its conversion to digital format, the system computes and displays attitude.

The CAGE button resets attitude to provide a fast erection function. The CAGE function is not operational during the initialization mode and must only be used in stabilized flight conditions.

If a failure of the attitude function is detected by internal monitoring, attitude display information, e.g. brown and blue background, pitch scale, roll scale and roll pointer is removed and replaced by black background, and an ATT flag is displayed.

## ALTITUDE

Altitude data is provided by processing static pressure sensed by Pitot/Static tube 3.

Altitude is displayed in tape format. Pushing the STD button sets the ISIS reference barometric pressure to standard (QNE). The barometric pressure can be adjusted, starting from the standard value, by using the rotary BARO knob.

In case a failure of the altitude function is detected by the internal monitoring system, the altitude tape is removed and an ALT flag is displayed.

## INDICATED AIRSPEED

Airspeed data is provided by processing dynamic pressure sensed by Pitot/Static tube 3.

Airspeed is presented in tape format. In case a failure is detected by the internal monitoring system, the airspeed tape and pointer are removed and a SPD flag is displayed.

## SECONDARY PARAMETERS

In addition to primary parameters, the system computes and displays the following secondary parameters:

- Magnetic heading.
- Mach number.
- VMO.
- Lateral acceleration/Slip indication.

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## ISIS CONTROLS AND INDICATORS

### 1 - BRIGHTNESS ADJUSTMENT

- Push buttons labeled + and - adjust brightness.

### 2 - AIRSPEED INDICATION

- Airspeed tape positioned vertically on the upper left segment of the display.
- Ranges from 40 to 520 kt and the scale is graduated every 5 kt between 40 and 250 kt. From 250 to 520 kt the scale is graduated every 20 kt with digital indications every 20 kt. The indications and graduations are displayed in white.

### 3 - VMO/MMO

- VMO is indicated by a red tape associated to the airspeed tape.
- Digits of the airspeed tape and Mach number display are green when the airspeed and Mach number are lower than $V_{MO}/M_{MO}$ and red when the airspeed and Mach number are equal to or greater than $V_{MO}/M_{MO}$.

### 4 - ROLL INDICATION

- Roll scale graduated at 0°, 10°, 20°, 30°, 45° and 60°, to provide bank angle measurement, indicated by the roll pointer.

### 5 - STD BUTTON

- Pushing the button sets the barometric setting to Standard Atmospheric Pressure.

### 6 - REFERENCE BAROMETRIC PRESSURE

- Displayed in cyan on a digital read-out in hPa or inHg.
- When Standard Atmospheric Pressure is selected, the 1013 value is displayed in cyan instead of barometric pressure value.
- HPA or IN displayed in white and in upper case.

### 7 - LATERAL ACCELERATION

- The range is ± 0.2 g.

Symbol displayed in black surrounded in white, just below the roll reference triangle.

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**8 - ALTITUDE INDICATION**

- Altitude tape positioned vertically on the upper right segment of the display.
- Ranges from -2000 to 50000 ft with 5 digits green display read-out in a yellow frame. A NEG indication is displayed vertically in white in case of negative altitude.

**9 - PITCH INDICATION**

- The pitch scale comprises white reference lines every 2.5° between -30° and +30°, and the associated pitch angle values, in white, every 10° between -50° and +50° and at ±80°. The sector above the horizon line of the screen is blue and the sector below is brown.
- Beyond ±30°, red chevrons are displayed to indicate excessive pitch angle and the direction to follow in order to reduce it.

**10 - BARO ROTARY KNOB**

- Allows performing QFE/QNH settings.
- When the knob is turned at a slow rate, the value increases in 0.01 inHg or 1 hPa increments. When turned at a faster rate, the increment is in 0.05 inHg or 5 hPa steps.

**11 - MAGNETIC HEADING**

- Given by the horizontal displacement of the heading scale.
- Indication symbol yellow and heading scale graduated by white dots every 5°, with a white two-digit indication every 20°. The last digit (0) is not shown (e.g., 320° is thus presented as 32). The visible range is 50°.

**12 - CAGE BUTTON**

- Resets attitude to provide a fast erection function.
- When it is maintained pressed for more than two seconds, resets the horizon function to zero and warning a “ATT 10s” flag is displayed.

**13 - MACH NUMBER INDICATION**

- The range is from 0.1 to 1 M and is displayed for Mach above 0.45 and when decreasing until Mach 0.40.

The decimal point and the two digits on the lower left corner of the display are green when the airspeed and Mach number are lower than $V_{MO}/M_{MO}$ and red when the airspeed and Mach Number are equal to or greater than $V_{MO}/M_{MO}$.

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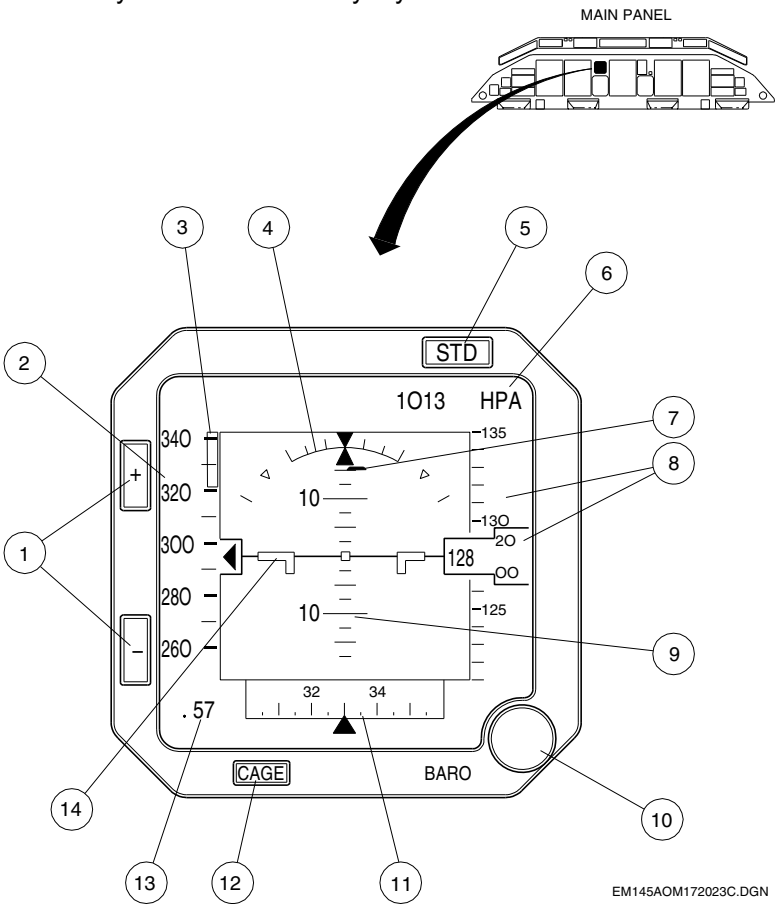
## 14 - AIRCRAFT SYMBOL

- Displayed on the center of the horizon area.
- Black symbol surrounded by a yellow area.




**INTEGRATED STANDBY INSTRUMENT SYSTEM**



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## ISIS ABNORMAL OPERATION

In case of abnormal operation or failure detection in one or several ISIS functions, the following flags are displayed:

| LABEL | MEANING | ACTION |
|---|---|---|
| ALT (white digits inside a red filled box) | Indicates loss of altitude function. It is displayed instead of the altitude scale. | Report to maintenance. |
| ATT (white digits inside a red filled box) | If during alignment phase, indicates an ISIS failure to align. | The system's electrical power must be reset. Make sure the airplane is stationary during subsequent ISIS alignment. |
| | If during any other phase of operation, indicates loss of attitude function. | Report to maintenance. |
| ATT : CAGE (black digits inside an yellow filled box) | Indicates that ISIS has to be caged. It is displayed in the upper mid-section of the screen. | Hold the airplane in straight and level flight and at constant speed. Press the CAGE Button for at least 2 seconds until the ATT 10s flag is removed. |
| HDG (white digits inside a red filled box) | Indicates loss of magnetic heading function. It is displayed in place of the heading scale. | Report to maintenance. |

Continued

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| LABEL | MEANING | ACTION |
|---|---|---|
| M (white digit inside a red filled box) | Indicates loss of Mach number function. It is displayed instead of the Mach number. | Report to maintenance. |
| MAINT (white digits) | Indicates a parity error presented by the discrete inputs. In this case, the previous discrete input configuration is maintained. | Report to maintenance. |
| OUT OF ORDER (white digits) | Indicates failure detection with loss of integrity. It is displayed with the associated code failure. The associated parameters are saved in memory for future equipment maintenance. | Report to maintenance. |
| SPD (white digits over a red filled box) | Indicates loss of airspeed function. It is displayed instead of the airspeed scale. | Report to maintenance. |
| VMO (white digits over a red filled box) | Indicates VMO error. It is displayed in the upper left corner of the screen, in lieu of the “MAINT” flag. | Report to maintenance. |
| WAIT ATT (black digits over an yellow filled box)<br>(ISIS V1)<br>or<br>ATT RST (cyan digits over a black filled box)<br>(ISIS V2) | Indicates that IMU is out of domain attitude. In this case, the roll and pitch scale, the lateral acceleration, and the airplane symbol are not displayed. WAIT ATT is displayed in the upper mid-section of the screen. ATT RST is displayed in the lower mid-section of the screen. | Report to maintenance. |

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# RADIO ALTIMETER SYSTEM

The Radio Altimeter system is a high-resolution, short-pulse radio altitude indicator designed for automatic continuous operation, providing radio altitude, low altitude awareness, and decision height information on the PFD.

The system consists of a radio altimeter transceiver and two flush-mounted antennas (RA 1), and is controlled through the Display Control Panels. Optionally a second Radio Altimeter Subsystem (RA 2) can be installed.

The decision height setting is provided through the decision height setting knob on the Displays Control Panel. The decision height and the associated RA label are displayed adjacent to the lower right side of the attitude sphere.

The Radio Altimeter interfaces with the Aural Warning Unit to provide an warning audio signal for autopilot disconnection. For further information, refer to section 2-18, Autopilot.

## RADIO ALTIMETER EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| ADVISORY | RAD ALT FAIL | Indicates the RA has failed on airplanes equipped with a single unit, or both RAs have failed, on airplanes equipped with two RAs. |
| | RAD ALT 1 (2) FAIL | On airplanes equipped with two RA, the associated unit has failed. |

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# RADIO ALTIMETER CONTROLS AND INDICATORS

## DISPLAYS CONTROL PANEL

### 1 - DECISION HEIGHT SETTING KNOB

When rotated, allows decision height setting.

### 2 - TEST BUTTON

In flight conditions only, this button allows testing the associated Radio Altimeter.

To perform the Radio Altimeter test the DH must be set to 200 ft and the button must be kept pressed. The following indications are presented on the PFD:

- A magenta TEST annunciation is presented adjacent to the upper left side of the attitude sphere.
- An amber MIN label is displayed in the RA Minimum annunciator. The label flashes for about 5 seconds, and then becomes steady.
- An amber RA comparison label is displayed in the down left side of the attitude sphere.
- The Radio Altitude field indicates 100 ± 10 ft.

Additionally, the following EICAS messages are presented according to the following configuration:

- For airplanes equipped with one Radio Altimeter:
  - If tested at LH side:
    - (E)GPWS INOP
    - WINDSHEAR INOP
    - RAD ALT 2 FAIL
  - If tested at RH side:
    - (E)GPWS INOP
    - WINDSHEAR INOP
    - RAD ALT 1 FAIL
- For airplanes equipped with two Radio Altimeters with RA1 connected to the EGPWS:
  - If tested at LH side:
    - (E)GPWS INOP
    - WINDSHEAR INOP
  - If tested at RH side:
    - No message associated

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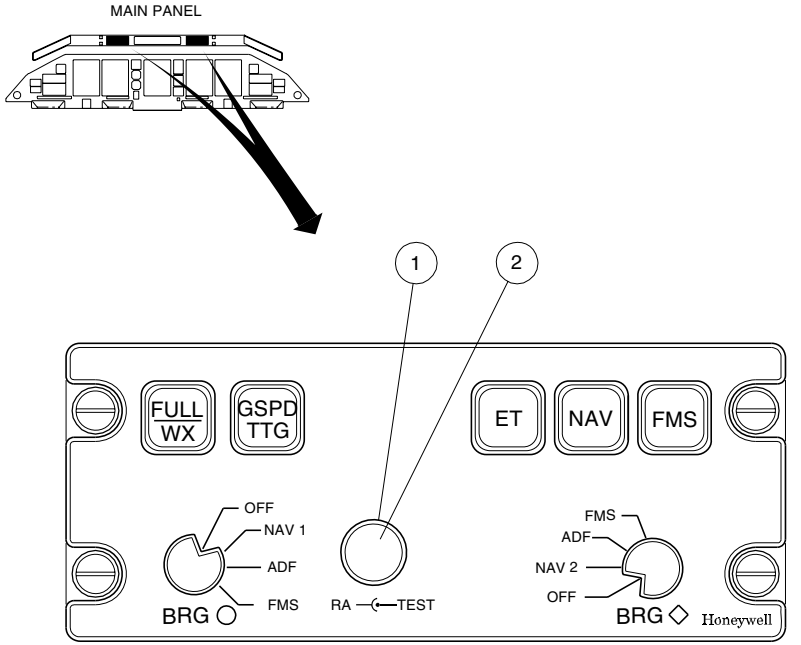
- For airplanes equipped with two Radio Altimeters both connected to the EGPWS:
  - If LH or RH side are tested separately:
    - No message associated
  - If both sides are tested at the same time:
    - (E)GPWS INOP
    - WINDSHEAR INOP

When released, the PFD indications resume the initial condition and the EGPWS voice message may occur:

- TOO LOW TERRAIN

On the ground, pressing this button allows testing the IC-600 computers. For more details, refer to Section 2-4, Crew Awareness.

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**DISPLAYS CONTROL PANEL**

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**PFD**

**1 - RA MINIMUM ANNUNCIATOR**

- Color:
  - Box: white
  - MIN label: amber
- Indicates that the airplane radio altitude is within a certain range of the decision height.
- When an armed RA Minimum condition occurs and the radio altitude is in the range of 100 ft above the decision height setting, a black box appears on the annunciator field.
- At radio altitudes equal to or below the decision height setting, a MIN label is displayed inside the box. The label will flashe for 10 seconds, and then becomes steady.
- The RA Minimum annunciator is armed when the following conditions occur simultaneously:
  - Airplane in flight.
  - Radio Altitude and decision height are valid.
  - Radio Altitude greater than 100 ft above the decision height setting for at least 5 seconds.
  - A decision height is being displayed.
- In the event of a Radio Altimeter failure, the RA Minimum annunciator is removed from the display.

**2 - RADIO ALTITUDE INDICATION**

- Color:
  - Digits: green.
  - Box: white
- Ranges from –20 to 2500 ft.
- Resolution: 5 ft below 200 ft, 10 ft above 200 ft.
- Displayed inside a box on the bottom center of the attitude sphere.
- In the event of all Radio Altimeters failure, the radio altitude digits will be replaced by an amber label RA inside an amber box.

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**3 - DECISION HEIGHT INDICATION**

- Color:
  - Digits: cyan
  - RA label: white
- Ranges from 5 to 999 ft.
- Resolution: 5 ft below 200 ft, 10 ft above 200 ft.
- If the decision height is set to zero, the indication is removed from the display.
- In the event of a Radio Altimeter failure, the decision height digits are replaced by amber dashes.

**4 - RADIO ALTITUDE COMPARISON MONITOR DISPLAY**

- Label: RA
- Color: amber
- Displayed when the difference between the on-side and cross-side radio altitude is greater than a set point which is variable with radio altitude.
- An amber RA1 is displayed in the event of Radio Altimeter 2 failure. Radio Altitude source is RA1.
- An amber RA2 is displayed in the event of Radio Altimeter 1 failure. Radio Altitude source is RA2.

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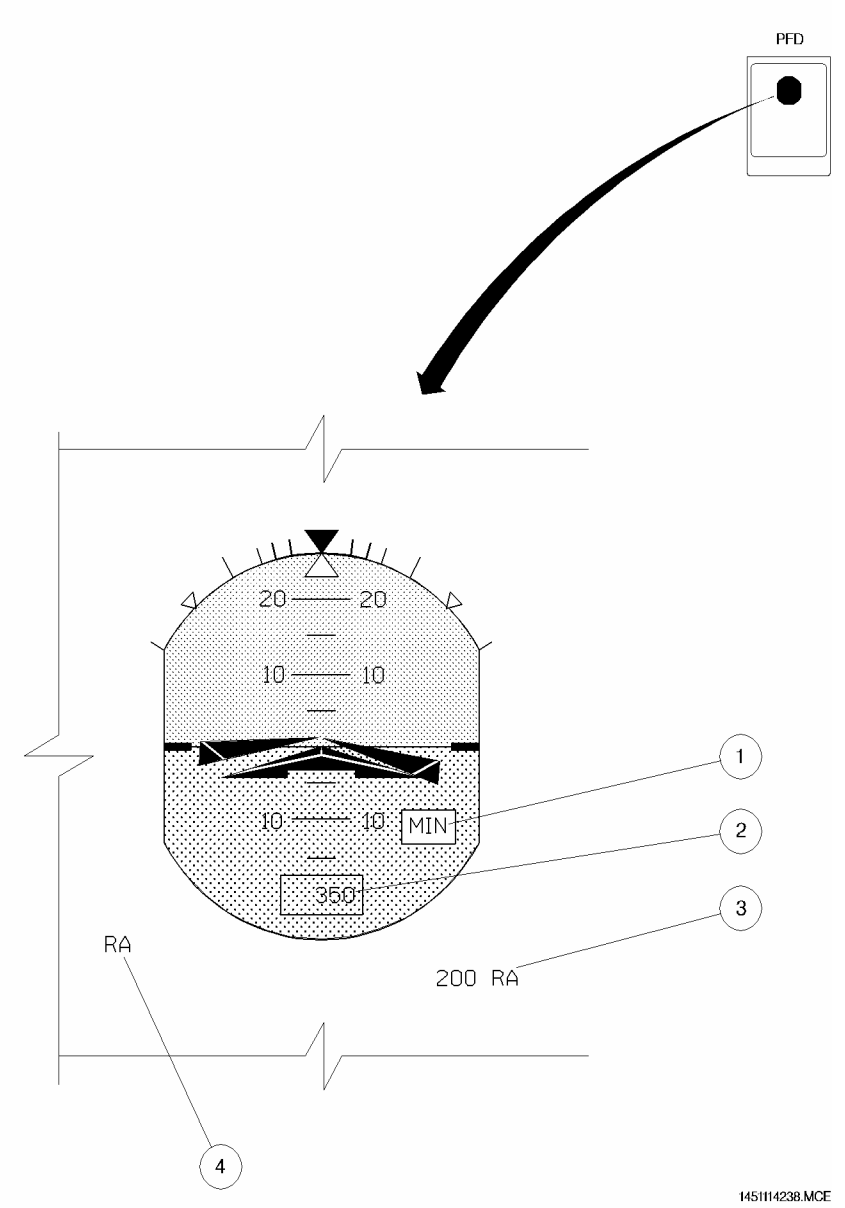


**RADIO ALTIMETER INDICATIONS ON THE PFD**

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# CHRONOMETER/CLOCK (TYPICAL)

The chronometer/clock provides the flight crew with Greenwich Mean Time (GMT), local time (LOC), elapsed time (ET), chronological time (CHR), DATE, and flight number. The instrument is powered by the airplane's electrical system and an internal battery. When the airplane is deenergized, the displays are blanked, although the functions continue to be updated in the memories with exception of the ET and chronometer functions. Display may also blank when a failure exists in the instrument.

## CHRONOMETER/CLOCK CONTROLS AND INDICATORS

### 1 - CHRONOMETER BUTTON

- Successive pressings control start, stop, and reset of the chronometer indicator and pointer providing the following:
  - START: Replaces elapsed time by chronometer indications, starting its counting.
  - STOP: Freezes chronometer indicator and pointer.
  - RESET: Returns the chronometer pointer to zero and replaces chronometer indication by elapsed time.

**NOTE:** A chronometer button is also provided on each control wheel.

### 2 - GMT, LOC, DATE, AND FLIGHT NUMBER INDICATOR

- Displays Greenwich Mean Time in the 24-hour format. A fixed dot appears between the two-hour digits, above the GMT inscription.
- Displays local time in the 24-hour format. A fixed dot appears between the two minute digits, above the LOC inscription.
- Displays the date, alternating between month/day and year every second.
- Displays the flight number from 0000 to 9999.

### 3 - CHRONOMETER POINTER

- Measures chronometer seconds over an analog scale.

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## 4 - ELAPSED TIME AND CHRONOMETER INDICATOR

- Displays elapsed time (ET), which corresponds to the flight time (from 0 to 99 hours and 59 minutes). Elapsed time reading starts only when the airplane takes off and can only be reset to zero when the airplane is on the ground.
- Displays chronometer minutes from 0 to 99. When CHR is used, accumulated elapsed time is not affected.

## 5 - ELAPSED TIME BUTTON

- Successive pressings supply the following:
  - On ground: Displays ET.
    Resets ET to zero.
    Displays chronometer minutes.
  - In flight: Displays ET.
    Displays chronometer minutes.

## 6 - MULTIPLE SELECTOR

SET - Allows time setting. When in the SET position, successive pressings of the ET button causes the selector to cycle between GMT minutes, GMT hours, LOC minutes, LOC hours, days, months, and years (with power up, the year is pre-selected to 90). Once the function is selected (it flashes on and off), the CHR button may be used to increment the selected digit at a rate of one unit every half second (continuous pressing) or manually, step by step.

GMT - Selects Greenwich Mean Time to be displayed on the associated indicator.

LOC - Selects the local time to be displayed on the associated indicator.

DATE - Selects the date to be displayed on the associated indicator.

FLT NR - Selects the FLIGHT NUMBER to be displayed on the associated indicator.

- To set the flight number, proceed as follows:
  - With the selector in the FLT NR position, repeatedly press the ET button to select the digit to be set in the following order: thousands, hundreds, tenths, and units.
  - Press the CHR button to increment the selected digit at a rate of one unit per half second or manually, step by step.

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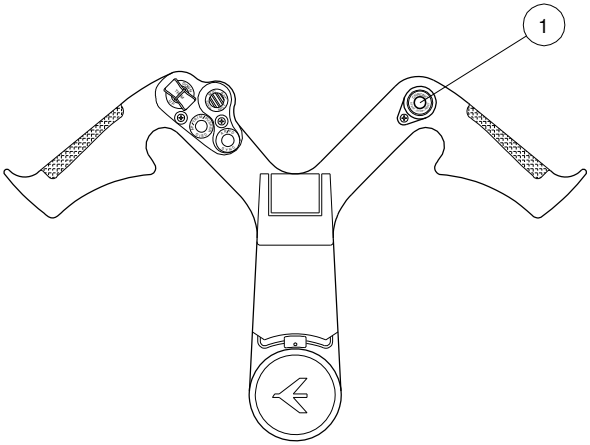


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**CONTROL WHEEL**

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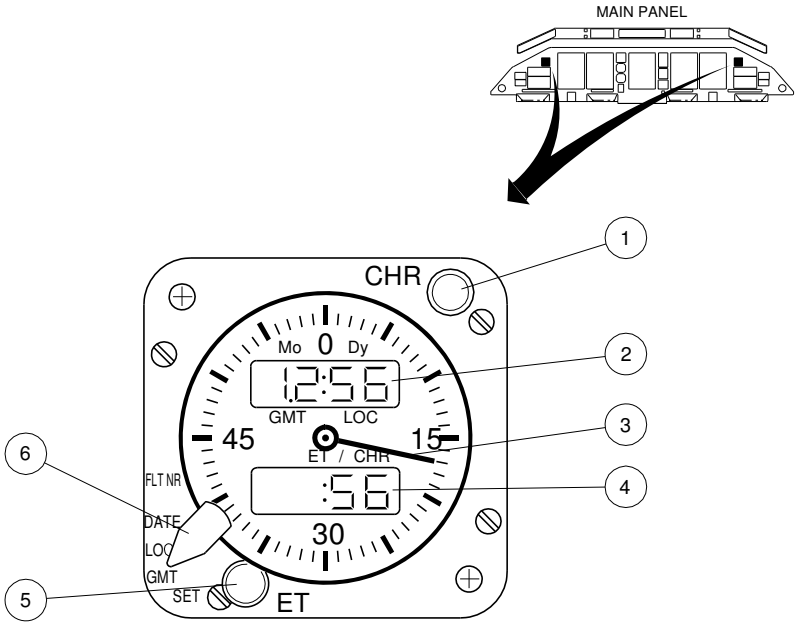


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**CLOCK**

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# DIGITAL CHRONOMETER/CLOCK (OPTIONAL)

The digital chronometer/clock provides the flight crew with Greenwich Mean Time (GMT), local time (LOC), elapsed time (ET), chrono time (CHR), DATE, and flight number. It includes tactile dome switches and an additional functionality: the synchronization with GPS. Also, the chronometer time – minutes and seconds – is presented in digital form (instead of indicating seconds in analog form by a sweep hand).

The instrument is powered by the airplane's electrical system and an internal battery. When the airplane is deenergized, the displays are blanked, although the functions continue to be updated in the memories with exception of the ET and chronometer functions. Display may also blank when a failure exists in the instrument.

## DIGITAL CHRONOMETER/CLOCK CONTROLS AND INDICATORS

**1 – SEL ET PUSH-BUTTON**

- This push-button selects Elapsed Time to be displayed.

**2 – RST ET PUSH-BUTTON**

- This push-button resets Elapsed Time displayed.

**3 – 6-DIGIT DISPLAY**

- Displays Universal Time Coordinated (UTC) in hours, minutes and seconds,
- Date (DT) in months, days and years,
- Local time (LT) in hours, minutes and seconds,
- GPS time (GPS) in hours, minutes and seconds,
- And Flight number format: XX XX Fn.

**4 – 4-DIGIT DISPLAY**

- Displays chronometric time (CHR) in minutes and seconds,
- Displays elapsed time (ET) in minutes and hours.

**5 – CHRONOMETER PUSH-BUTTON**

- This push-button selects Chronometer to be displayed.

**6 – PUSH-BUTTON MODE SELECTOR**

- This push-button selects the following features: DATE (DT),
- GPS,
- INT – internal computed,
- LOCAL TIME (LT),
- And F/N – flight number.

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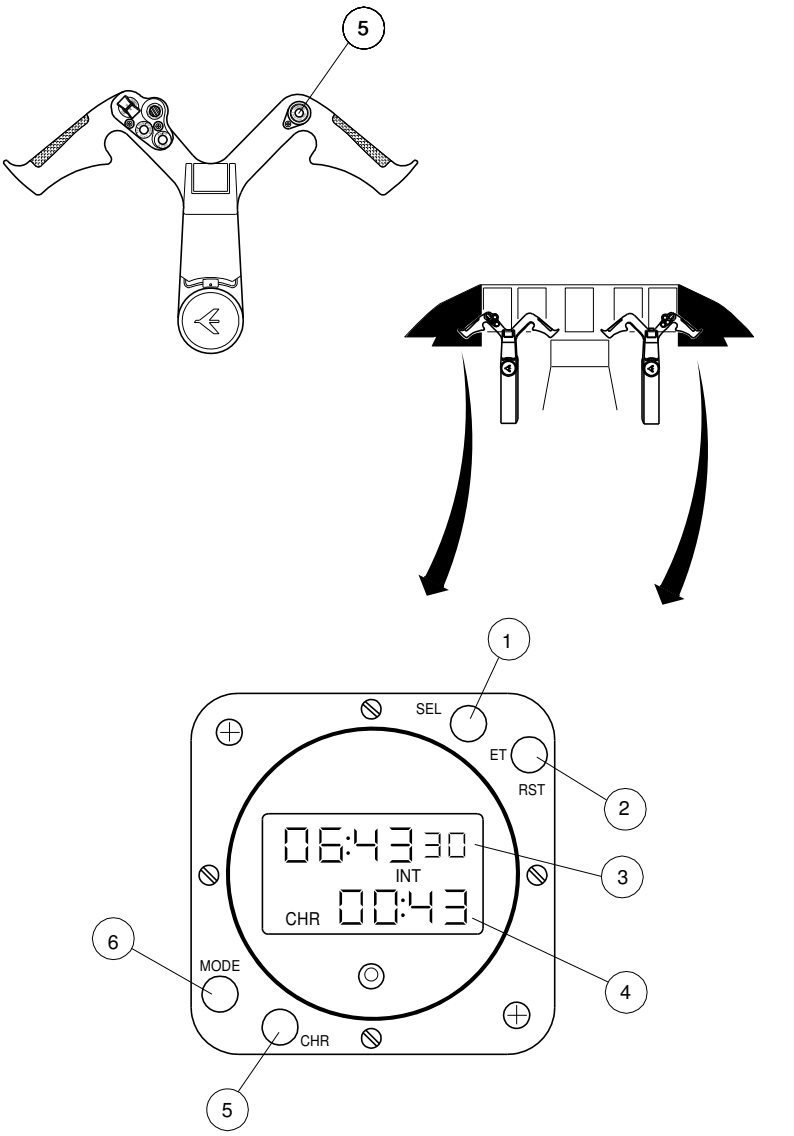


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**DIGITAL CHRONOMETER**

# FLIGHT DATA RECORDER SYSTEM

The Flight Data Recorder System (FDRS) has been designed to automatically acquire and record several airplane and system parameters, without pilot action, from engine start to engine shutdown on every flight.

The FDRS comprises the following units and components:
- One solid-state Flight Data Recorder.
- One underwater locator beacon attached to the Crash Survivable Memory Unit (CSMU) case.
- One triaxial accelerometer.
- Five wirewound precision potentiometers.
- One impact switch.
- Two Data Acquisition Units (DAUs).
- One Auxiliary Flight Data Acquisition Unit (AFDAU) (optional).
- Five surface position sensors (optional).
- Eight load cells sensors to measure the pilot/copilot force into control commands (optional).
- One Analog Digital Converter dedicated to load cells sensors (optional).

An FDR malfunction is detected by means of the power-up built-in test or the continuous self-checking test. An EICAS message is generated to indicate the failure.

The CSMU is a shock-and-heat-resistant container, which records all inputs in the last 25 hours, in a high-density solid-state memory.

The DAUs interface with various airplane systems, in order to supply data to the FDRS.

The AFDAU is solely used for the FDR system and is the unit responsible for receiving all airplane inputs (data to be acquired DAU's, etc.) and sending them to the FDR unit.

An AFDAMU is an AFDAU plus a DMU. The function of the DMU is to process data acquired by the DAU and additional parameters in order to store them in a manner that can be easily accessed for analysis by the operator. AFDAMU performs the function of AFDAU and QAR equipment.

Operational data is recorded when the Red Beacon is switched ON or the airplane is airborne.

The setting of the required flight number to be recorded, along with the system data, is made on the clock as described in this section.

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## QUICK ACCESS RECORDER SYSTEM

The airplane may be equipped with an Extended Quick Access Recorder (EQAR) or an Optical Quick Access Recorder (OQAR), which have been designed to automatically acquire and record the flight data sent from DAU 1 and DAU 2 to FDR and CMC, without pilot action, as soon as the airplane is energized.

All the information is recorded in a removable rewritable magnetic optical disk, thus reducing the time for ground data analysis to a minimum. No provision has been made to warn flight crew about system status; consequently, there is no EICAS message associated with this equipment.

## FDRS EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | DFDR FAIL | Flight Data Recorder System failure. |
| ADVISORY | FDAU FAIL | Auxiliary Flight Data Acquisition Unit failure. |

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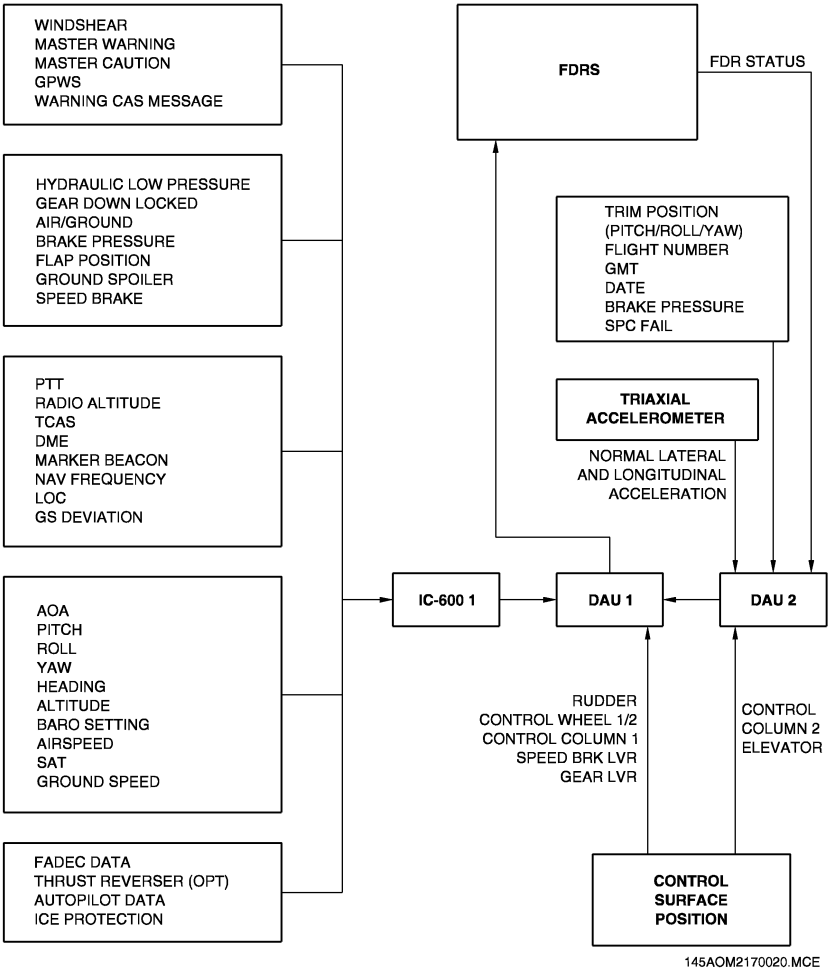


## FLIGHT DATA RECORDER SYSTEM SCHEMATIC

**(for airplanes not equipped with AFDAU)**

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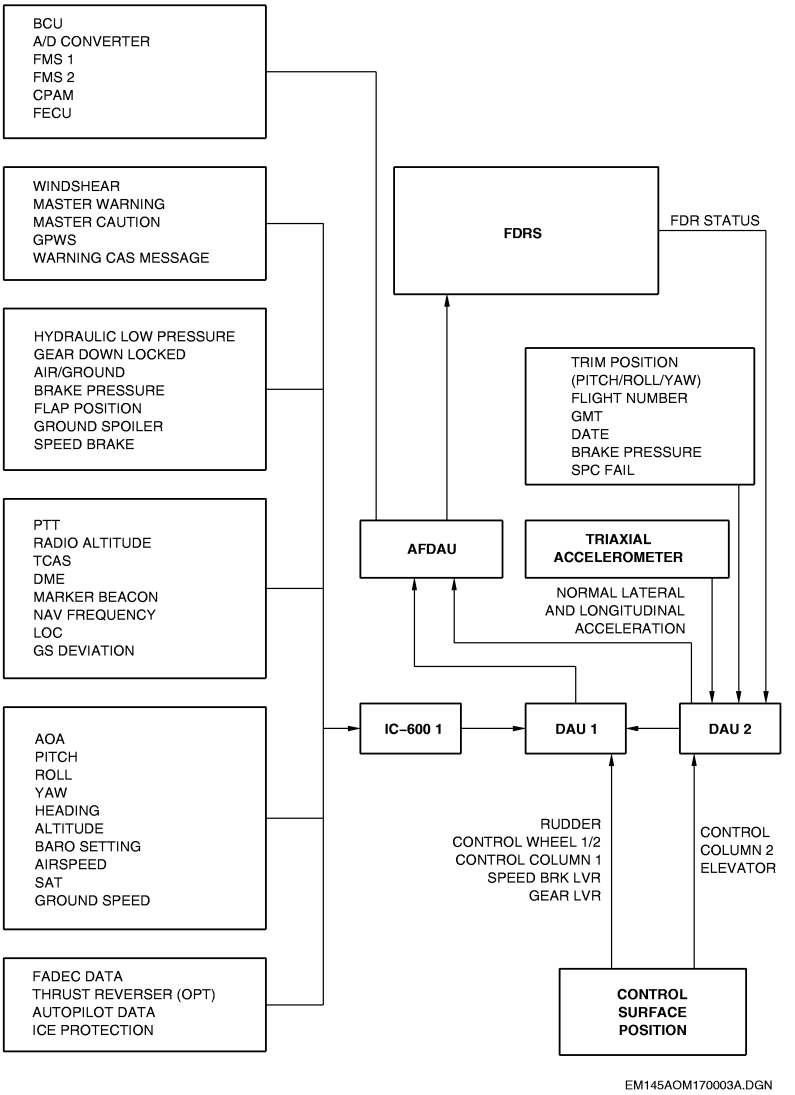


## FLIGHT DATA RECORDER SYSTEM SCHEMATIC

## (for airplanes equipped with AFDAU - FDR 88 parameters)

AOM-145/1114

# SECTION 2-18
# NAVIGATION AND COMMUNICATION

TABLE OF CONTENTS


| | Block | Page |
|---|---|---|
| General | 2-18-01 | 01 |
| Radio Management System (RMS) | 2-18-05 | 01 |
| Integrated Communication Unit (RCZ-851E) | 2-18-07 | 01 |
| Integrated Navigation Unit (RNZ-851) | 2-18-09 | 01 |
| Radio Management Unit (RMU) | 2-18-11 | 01 |
| RMU Pages | 2-18-11 | 01 |
| RMU Normal Operation | 2-18-11 | 03 |
| RMU Abnormal Operation | 2-18-11 | 09 |
| RMU Controls and Indicators | 2-18-11 | 10 |
| Tuning Backup Control Head | 2-18-13 | 01 |
| Normal Mode | 2-18-13 | 01 |
| Emergency Mode | 2-18-13 | 01 |
| Self-Test | 2-18-13 | 01 |
| TBCH Controls and Indicators | 2-18-13 | 02 |
| Digital Audio Panel | 2-18-15 | 01 |
| Normal Mode | 2-18-15 | 01 |
| Emergency Mode | 2-18-15 | 01 |
| Digital Audio Panel Controls and Indicators | 2-18-15 | 03 |
| EICAS Messages | 2-18-19 | 01 |
| Communication Controls and Indicators | 2-18-20 | 01 |
| HF Communication System - HF-230 (*) | 2-18-21 | 01 |
| HF Operating Modes | 2-18-21 | 01 |
| HF Normal Operation | 2-18-21 | 03 |
| HF Controls and Indicators | 2-18-21 | 09 |
| HF Communication System - KHF-950 (*) | 2-18-21 | 01 |
| HF Operating Modes | 2-18-21 | 01 |
| HF Normal Operation | 2-18-21 | 03 |
| HF Controls and Indicators | 2-18-21 | 08 |


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HF Communication System - KHF-1050 (∗) ..... 2-18-21 ..01
Third VHF Communication System (∗) ..... 2-18-22 ..01
Third VHF COM Controls and Indicators ..... 2-18-22 ..01
Third VHF Navigation/Communication System (∗) ..... 2-18-22 ..01
Third VHF NAV/COM Controls and Indicators ..... 2-18-22 ..01
Third VHF Navigation System (∗) ..... 2-18-22 ..01
Third VHF NAV Controls and Indicators ..... 2-18-22 ..01
SELCAL System (∗) ..... 2-18-23 ..01
SELCAL Controls and Indicators ..... 2-18-23 ..02
Aircraft Communication Addressing and Reporting System (ACARS) (∗) ..... 2-18-24 ..01
ACARS Operation ..... 2-18-24 ..04
ACARS Controls and Indicators ..... 2-18-24 ..05
Honeywell Mark III CMU (∗) ..... 2-18-24 ..01
CMU Normal Operation ..... 2-18-24 ..04
CMU Abnormal Operation ..... 2-18-24 ..04
CMU Controls and Indicators ..... 2-18-24 ..06
Printer Controls and Indicators ..... 2-18-24 ..08
Cockpit Voice Recorder ..... 2-18-25 ..01
Self-Test ..... 2-18-25 ..01
Erase Function ..... 2-18-25 ..02
Cockpit Voice Recorder Controls and Indicators ..... 2-18-25 ..02
Passenger Address System ..... 2-18-27 ..01
Passenger Address Operating Modes ..... 2-18-27 ..02
Passenger Address Controls And Indicators ..... 2-18-27 ..04
Satcom System (∗) ..... 2-18-28 ..01
Introduction ..... 2-18-28 ..01
Satcom Operation ..... 2-18-28 ..01
Satcom Controls and Indicators ..... 2-18-28 ..05
Attitude And Heading Reference System (AHRS) (∗) ..... 2-18-30 ..01
AH-800 AHRS Version ..... 2-18-30 ..04
AH-800 Operating Modes ..... 2-18-30 ..05
AH-800 EICAS Messages ..... 2-18-30 ..06
AH-800 Controls and Indicators ..... 2-18-30 ..08

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AH-900 AHRS Version ..... 2-18-30 .. 10
AH-900 Operating Modes ..... 2-18-30 .. 11
AH-900 EICAS Messages ..... 2-18-30 .. 13
AHRS Indications on the PFD ..... 2-18-30 .. 16
Inertial Reference System (IRS) (∗) ..... 2-18-30 .. 01
Inertial Reference System Components ..... 2-18-30 .. 04
IRS Operating Modes ..... 2-18-30 .. 05
IRS Operating Procedures ..... 2-18-30 .. 10
IRS EICAS Messages ..... 2-18-30 .. 12
IRS Controls and Indicators ..... 2-18-30 .. 14
IRS Indications on the PFD ..... 2-18-30 .. 16
Flight Management System (∗) ..... 2-18-35 .. 01
FMS Operating Modes ..... 2-18-35 .. 02
FMS Controls and Indicators ..... 2-18-35 .. 06
FMS Operating Modes (FMZ 2010 – FMS NZ 6.1.1) ..... 2-18-35 .. 10
FMS Controls and Indicators (FMZ 2010 – FMS NZ 6.1.1) ..... 2-18-35 .. 13
Navigation Displays ..... 2-18-40 .. 01
Displays Controls and Indicators ..... 2-18-40 .. 02
Weather Radar System ..... 2-18-45 p01
General ..... 2-18-45 .. 03
Weather Radar Normal Operation ..... 2-18-45 .. 04
Interpreting Weather Radar Images ..... 2-18-45 .. 04
Radar Warm Up Period ..... 2-18-45 .. 06
Ground Operation Precautions ..... 2-18-45 .. 06
Weather Radar Operating Modes and Functions ..... 2-18-45 .. 07
Radome ..... 2-18-45 .. 18
Weather Radar Behavior ..... 2-18-45 .. 19
Weather Radar Controls and Indicators ..... 2-18-45 .. 21
Lightning Sensor System (LSS) (∗) ..... 2-18-50 .. 01
LSS Operation ..... 2-18-50 .. 02
LSS Controls and Indicators ..... 2-18-50 .. 05
Barometric Vertical Navigation (Baro-VNAV) (∗) ..... 2-18-60 .. 01
Baro-VNAV Components ..... 2-18-60 .. 01
VNAV Indications ..... 2-18-60 .. 03
PFD Indications ..... 2-18-60 .. 03
EICAS ..... 2-18-60 .. 07
CDU ..... 2-18-60 .. 08

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VNAV Submodes ..... 2-18-60 ..09
VNAV Arm (VNAV) ..... 2-18-60 ..09
VNAV Flight Level Change (VFLC) ..... 2-18-60 ..09
VNAV Altitude Capture (VASL) ..... 2-18-60 ..12
VNAV Altitude Hold (VALT) ..... 2-18-60 ..12
VNAV Path (VPTH) ..... 2-18-60 ..12
Vertical DIRECT-TO ..... 2-18-60 ..17
VNAV Vertical Glide Path (VGP) ..... 2-18-60 ..20
VNAV and Holding or Orbit Patterns ..... 2-18-60 ..21
Go-Around Operations
(Missed Approach Procedure) ..... 2-18-60 ..22
Speed Command ..... 2-18-60 ..23
Speed Protection ..... 2-18-60 ..23
Temperature Compensation ..... 2-18-60 ..24
Required Navigation Performance (RNP) (∗) ..... 2-18-65 ..01
RNP Indications ..... 2-18-65 ..01
RNP Operation ..... 2-18-65 ..03
Localizer Performance with Vertical Guidance (LPV) (∗) .. 2-18-70 ..01
LPV Approach Loading ..... 2-18-70 ..01
LPV Indications ..... 2-18-70 ..03
LPV Armed Annunciation ..... 2-18-70 ..04
LPV Active Annunciation ..... 2-18-70 ..05
Final Approach Segment (FAS)
Data Block ..... 2-18-70 ..06
LPV Unavailable Annunciation ..... 2-18-70 ..07
LPV Alerts and Advisory Messages ..... 2-18-70 ..09
Missed Approach Following an LPV Approach ..... 2-18-70 ..10
LPV Inactive Status ..... 2-18-70 ..10
EGPWS Mode 5 Alerting ..... 2-18-70 ..10
LPV Miscompare Monitors ..... 2-18-70 ..10
Head-Up Guidance System (HGS) (∗) ..... 2-18-75 ..01
HGS Components ..... 2-18-75 ..04
HGS Modes of Operation ..... 2-18-75 ..07
HGS EICAS Messages ..... 2-18-75 ..14
HGS Capability Test ..... 2-18-75 ..14
HGS Controls and Indicators ..... 2-18-75 ..14
Identification Friend or Foe System (IFF) (∗) ..... 2-18-80 ..01
Selector Panel ..... 2-18-80 ..02
IFF Transponder Controls and Indicators ..... 2-18-80 ..04

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Tactical V/UHF Communication System (*) ..... 2-18-90 .. 01
Introduction ..... 2-18-90 .. 01
Main Components ..... 2-18-90 .. 02
Transceiver XT 6011 ..... 2-18-90 .. 02
Remote Control Unit GB 6500 ..... 2-18-90 .. 03
Operation ..... 2-18-90 .. 04
Built-In Test (BIT) Design ..... 2-18-90 .. 04
Normal Operation ..... 2-18-90 .. 04
Tactical U/VHF Selection ..... 2-18-90 .. 06
Abnormal Operation ..... 2-18-90 .. 06
Controls and Indicators ..... 2-18-90 .. 07
Remote Control Panel GB 6500 ..... 2-18-90 .. 07
Automatic Dependent Surveillance Broadcast (ADS-B OUT) ..... 2-18-95 .. 01
Introduction ..... 2-18-95 .. 01
Controls and Indicators ..... 2-18-95 .. 03
RMU ATC/TCAS Control Page ..... 2-18-95 .. 03
RMU Radio Page - ATC/TCAS Window ..... 2-18-95 .. 05

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**NOTE:** Optional equipment are marked with an asterisk (*) and its description may not be present in this manual.



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# GENERAL

The standard EMB-145 navigation and communication resources are provided by the Radio Management System (RMS). The RMS is controlled through two Radio Management Units (RMU 1 and 2), an auxiliary control unit, the Tuning Backup Control Head (TBCH), and three individual Digital Audio Panels (DAP).

The two RMUs provide radio frequency and mode control. Alternatively, the RMU 2 frequencies may be selected through the TBCH.

The Audio System is controlled via three individual Digital Audio Panels, available for the captain, copilot and observer.

The Radio Management System also provides interface with the Passenger Address System, Aural Warning Unit and Cockpit Voice Recorder.

Optional communication equipment includes an HF transceiver, Third VHF NAV/COM, SELCAL and Aircraft Communication Addressing and Reporting System (ACARS).

The navigation may be performed using only the standard navigation radio sensors, or using the Flight Management System (FMS) resources. The FMS is an optional equipment that uses the standard navigation radio sensors, GPS (Global Positioning System) sensors, and, also optionally, the IRS (Inertial Reference System) for positioning and navigation.

Heading inputs to the Integrated Navigation Unit are provided by the AHRS (Attitude and Heading Reference System) or by the IRS. These equipment also provide roll and pitch attitudes for the Electronic Attitude Director Indicator (EADI).

The navigation information is normally presented on the PFD and MFD and may also be available on the RMU, through its navigation backup page.

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# RADIO MANAGEMENT SYSTEM (RMS)

The EMB-145 models are equipped with a Radio Management System (RMS) that provides management of the following equipment and associated functions:

- Dual VHF COM
- Dual VHF NAV (VOR, LOC, GS and Marker Beacon)
- Single or dual (optional) ADF
- Single or dual (optional) Transponder (ATC and Mode S)
- TCAS
- MLS (optional)
- Single or dual (optional) DME (including DME Hold)
- Digital Audio Panel

The RMS consists basically of the following major components:

- Remote mounted:
  - Integrated Navigation Unit (INU)
  - Integrated Communication Unit (ICU)
- Cockpit Mounted:
  - 2 Radio Management Unit (RMU)
  - 1 Tuning Backup Control Head (TBCH)
  - 3 Digital Audio Panel (DAP)

With the exception of the Digital Audio Panel, all components of the RMS are connected through the digital Radio System Buses (RSB) that allows complete control and information exchange between the units of the entire RMS. Audio switching control is provided by means of the controls on the Digital Audio Panel itself. The audio signals are transmitted from the remote units to the Digital Audio Panel through dedicated digital audio buses.

The navigation and communication data are displayed on the RMU, PFD and MFD displays.

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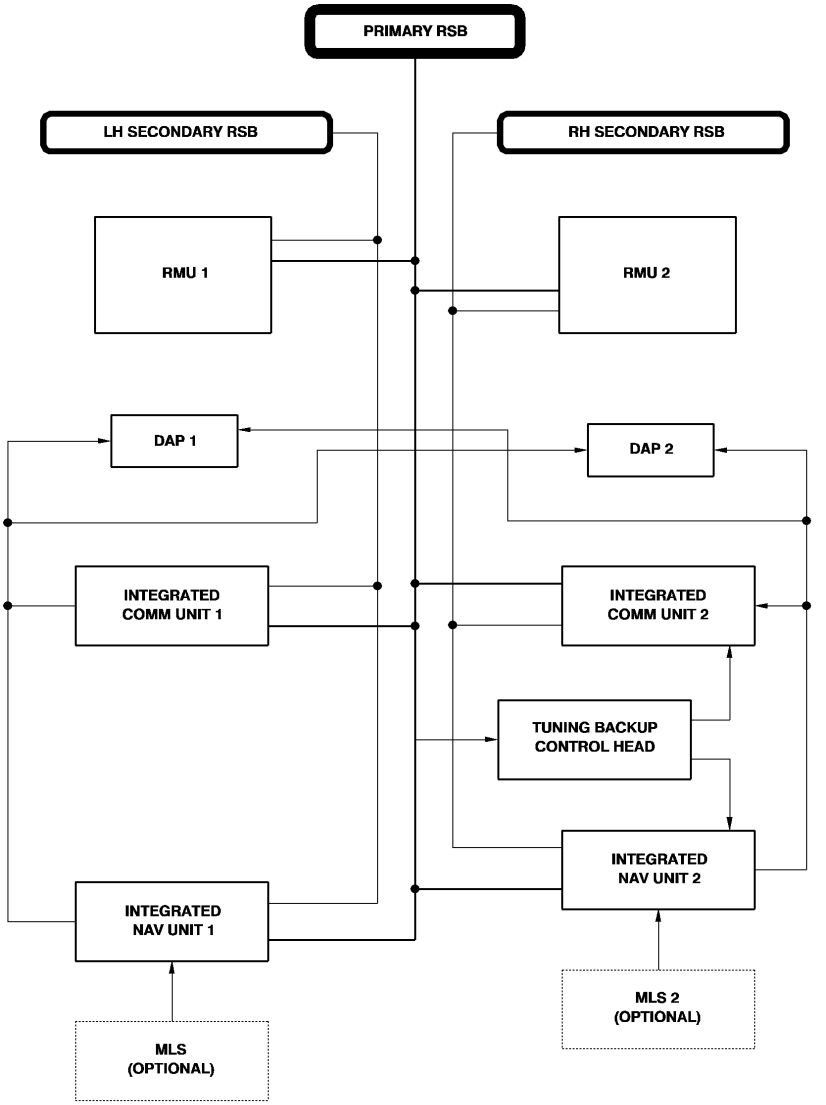


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## RMS SCHEMATIC

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# INTEGRATED COMMUNICATION UNIT (RCZ-851E)

The Integrated Communication Unit incorporates an internal VHF communication transceiver module and the ATC transponder module which interfaces through a cluster module to the Radio System Bus for operation.

This unit provides digitized audio signals to the Digital Audio Panel and conventional analog audio interfaces to other systems. The following modules may be provided in this unit:

- VHF Communication Transceiver Module (TR-850) - This module is a conventional VHF COM transceiver that operates in the frequency range of 118 to 136.975 MHz.

- Mode S Diversity Transponder Module (XS-852) - This transponder module provides full ATCRBS, Mode S and TCAS data communications capability. The Mode S Transponder module has the encoding and decoding capability required for Mode S operation in addition to the capability to operate as a conventional Air Traffic Control Radio Beacon Service (ATCRBS) transponder. The Mode S operation allows digital addressing of an individual airplane and the transmission of messages back and forth between the air and the ground.

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# INTEGRATED NAVIGATION UNIT (RNZ-851)

The Integrated Navigation Unit is a complete self-contained navigation system. The system consists of the VOR, localizer, glide slope and marker beacon receiver modules, the ADF module, a six-channel scanning DME module, and audio digitizers. The system also incorporates two L-Band antenna (optional), two ADF antenna (optional), two MB antenna, two VOR/ILS antenna and one GS dual antenna.

The following modules are provided in this unit:

– VHF NAV Receiver Module (NV-850) - The VHF NAV receiver is a module of the Integrated Navigation Unit and houses the major navigation functions of the VOR/LOC receiver, glide slope receiver and marker beacon receiver.
The ILS meets Category II instrument landing requirements.
Housed within the NAV receiver is a glideslope receiver which provides 40 channels of glideslope information for the conventional ILS. Also includes a 75 MHz marker beacon receiver which detects and transmits the tones of the marker beacons to the Audio System.

– DME Transceiver Module (DM-850) - The DME module is a six-channel DME that simultaneously tracks four selected channels for distance, groundspeed and time to station as well as monitoring two additional channels for the ident functions. This feature gives the system the capability of tracking four channels and having the decoded identifier readily available from two additional channels. The unit dedicates two of the four selected channels to the FMS (if installed). Thus, with the FMS installed, there are two remaining channels to control and display ident, distance, time to station and ground speed. Even with the FMS installed, the preset or standby VOR channel, when selected, provides instant station identification since it was one of the two additional channel being monitored.

– ADF Receiver Module - The ADF System comprises the ADF receiver (DF-850) and the companion ADF antenna (AT-860). The ADF receiver operates in the frequency ranges of 100 to 1799.5 kHz and 2181 to 2183 kHz (marine emergency frequency range).

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# RADIO MANAGEMENT UNIT (RMU)

The Radio Management Unit consists of a display and a bezel panel that provide control of the communications and radio navigation equipment. Additional airplane systems information is also available on specific RMU selectable pages.

The EMB-145 is equipped with two RMUs, each one responsible for controlling the on-side radio equipment (e.g., RMU 1 controls the NAV/COM 1). However, through the cross-side operating mode, it is possible to select the opposite side radio frequencies.

There is no master switch for the RMUs: when the airplane is energized, both RMUs (and the EICAS) are automatically turned ON. However, only the COM 1 radio is available (dashes on the remaining RMUs fields) until the AVIONICS MASTER is switched ON.

Additionally, in the event of an electrical emergency, the RMU is a backup display for the main panel (PFDs and MFDs). In this condition the main panel is turned off and the NAVIGATION Backup Page, which presents basic navigation information, may be accessed through RMU page.

## RMU PAGES

Available RMU pages are as follows: RADIO Page, NAV and COM Pages, ATC/TCAS Control Page, NAVIGATION Backup Page, ENGINE Backup Pages 1 and 2, SYS SELECT Page (COM band options) and MAINTENANCE Page. For airplanes equipped with KHF-1050, HF MEMORY Page and HF Control Page are also available.

Pressing the Page Control Button (PGE) selects the Page Menu. Pressing the Line Select Button associated with the desired page will cause the respective page to be displayed. The RADIO Page will be displayed again when the Line Select Button associated with the RETURN TO RADIOS label is pressed.

RADIO PAGE

Normally presented after power up, the RADIO Page is divided into five dedicated windows. Each window groups the data associated with a particular function: COM, NAV, ATC/TCAS, ADF. HF and MLS may also be available. In addition, the windows provide complete control of the frequency and operating modes of the associated function.

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NAVIGATION/COMMUNICATION MEMORY PAGES

The Memory Page presents two similar displays called First Memory Page and Second Memory Page. The First Memory Page shows memory locations 1 through 6 and the Second Memory Page shows memory location 7 through 12. Both the COM and NAV Memory Pages are functionally identical.

HF MEMORY PAGE (only for KHF-1050)

The HF Memory Page manages the 12-channel non-volatile memory frequencies and their transmission/reception mode, mode of operation and squelch level .

HF CONTROL PAGE (only for KHF-1050)

The HF Control Page allows the pilot to select and adjust the active and preset frequency, transmission/reception mode, mode of operation, squelch level and Transmission (TX) power.

ATC/TCAS CONTROL PAGE

The ATC/TCAS Control Page allows the pilot to select various TCAS operational features:

- Intruder Altitude
  - REL: Target's altitude displayed relative to one's own airplane (default).
  - FL: Target's altitude displayed as flight level (reverts to REL after 20 sec).
- TA Display
  - AUTO: Traffic targets displayed only when TA or RA target conditions exist.
  - MANUAL: All traffic targets displayed within the viewing airspace.
- Flight ID
  Allows Mode S coding to reflect the current flight's call sign.
- ADS-B Status (only for airplanes Post-Mod. SB 145-34-0118 or equipped with an equivalent modification factory incorporated):
  - NORMAL (white): GPS data is received on the active transponder.
  - FAIL (yellow): No GPS data is received on the active transponder.
  - DEGRADED (yellow): GPS navigation integrity or accuracy parameters do not meet ADS-B standards, as recognized by the active transponder.

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- Flight Level 1/2
  Display of the transponder's encoded altitude and the air data source for that altitude.

NAVIGATION BACKUP PAGE

The NAVIGATION Backup Page consists of a backup navigation display that presents HSI, MB, DME, NAV (VOR) and ADF information

ENGINE BACKUP PAGE

The ENGINE Backup Page displays information normally presented on the EICAS, as engine and systems indications, as well as EICAS messages. The ENGINE Backup Page is divided into two pages. The first presents only engine indications, while the second presents systems indications and EICAS messages. For further information on Engine Backup Page refer to Section 2-10 - Powerplant and 2-4 - Crew Awareness.

SYSTEM SELECT PAGE

The SYS SELECT Page allows the selection of COM 1 and COM 2 between Narrow and Wide bands.

MAINTENANCE PAGE

This page displays test results information depending on the type of test that is being carried out (power on self-test or pilot activated self-test). Two pages may be presented if a failure is detected, depending on whether the failure is in the RMS or in one of the radios. This page is not available in flight.

**RMU NORMAL OPERATION**

RMU SELF-TEST

On the ground, the RMS performs a self-test each time power is applied after power off periods greater than 10 seconds. This test monitors the primary and secondary radio buses as well as the individual Radio Systems for proper operation. Each function test status is displayed in its respective window.

Under normal conditions, the COM will be operational within 7 seconds after power on and the remaining radio equipment units within 50 seconds. The test can be terminated by pressing the Test Button in the RMU Bezel Panel.

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If any bus or radio test parameter failure occurs, an associated error message will be displayed on the test failure window, below the COM and NAV windows. Radio System failures are displayed in the first failure window and function failures in a second failure window. The failure windows may be removed by pressing and holding the Test Button. If the test is successfully completed the RMU will display the RADIO Page with the same radio configuration prior to the last power down.

**NOTE:** Any radio equipment that is not powered up when the test is initiated by the RMU will generate an error message.

Additionally, the pilot may perform a test by pressing the Test Button on the RMU Bezel Panel, which causes the activation of the self-test of the component associated with the window in which the yellow cursor is located. Upon successful completion of this test, a PASS message will be displayed for a short time in the window, indicating the successful completion of the test. If this test is not successfully completed, an error message (ERR) will be displayed in the window.

**NOTE:** Errors detected by the self-test indicate one or more parameter outside their self-test limit, but may not necessarily indicate non-operation of the function. The pilot should verify the operation of the function.

CROSS-SIDE OPERATION

The RMU is provided with a feature called cross-side operating mode. This feature allows the RMU to be changed from its normal operating mode of tuning the on-side radio equipment to the mode of tuning the opposite side radio equipment.

The cross-side operation is selected by pressing the cross-side Transfer Button, labeled 1/2, on the RMU Bezel Panel, with the yellow cursor box in any window, except the ATC/TCAS window. The entire RMU display and operation is transferred from the opposite side to the side that has commanded the Cross-side Operating Mode. If the yellow cursor box is in the ATC/TCAS window, pressing the cross-side Transfer Button selects which transponder (1 or 2) will be in operation.

In the cross-side operation, the RMU Window/Control Side Ident will be displayed in magenta on the side that has selected the operation and any change made will be displayed in yellow on the opposite side RMU to indicate that the change was carried out remotely.

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COM OPERATION

The normal COM operation is enabled with the RMU RADIO Page displayed. The COM window has two frequency lines. The upper line displays the active COM frequency while the lower line displays the preset frequency. Pressing the Line Select Button associated with the preset frequency will cause the yellow cursor box to move to enclose that frequency. In this condition, the enclosed preset frequency may be changed through the Frequency Tuning Knobs. When the Frequency Tuning Knobs are actuated, the label MEMORY and the associated memory location number, both below the lower frequency line, will change to a TEMP label indicating that the new preset frequency is not yet stored in the memory of the RMU. Frequency storage may be accomplished by pressing the Memory Storage Button, labeled STO, on the RMU Bezel Panel. This action will also provide the previous MEMORY label and the associated memory location number to replace the TEMP label, indicating that the new preset frequency has been stored in the indicated memory location.

Placing the yellow cursor box to enclose the MEMORY label, by pressing a second time the Line Select Button beside the COM window, will allow scrolling through the entire RMU stored memory. This may be performed by rotating the Frequency Tuning Knob either clockwise to memory location increment or counterclockwise to decrement.

The exchange between the active frequency displayed in the upper line of the window and the preset frequency displayed in the lower line may be accomplished by pressing the Frequency Transfer Button on the upper left corner of the RMU Bezel Panel. This effectively causes the COM to change to the new active frequency that previously was the preset frequency. In this condition, the previous active frequency drops down to the second line of the COM window and becomes a temporary preset frequency. This is indicated by the TEMP label displayed under that frequency. The TEMP label also indicates, in this case, that the frequency displayed in the second line has not been stored in a memory location.

**NOTE:** The RMU controls the third VHF for airplanes equipped with Honeywell Third VHF System RCZ-833/853 models.

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- Direct COM Tuning

Direct COM tuning is accomplished by pressing and holding for approximately 3 seconds the Line Select Button beside the COM preset frequency line. The yellow cursor box will enclose the active frequency, allowing direct COM tuning to that frequency, and the preset frequency line will be blank.

To exit from direct COM tuning, press and hold the Line Select Button beside the preset frequency line, until the preset frequency appears on the COM window.

- Squelch Function

The COM squelch function is controlled through the Squelch Control Button, labeled SQ, on the RMU control bezel. Pressing this button will cause the COM radio to open its squelch and allow any noise or signal present in the receiver to be heard in the Audio System. The squelch open condition is indicated by the SQ label displayed on the top of the COM window. Pressing the Squelch Control Button again will close the radio squelch immediately.

- Automatic Time-Out

After approximately two minutes of continuous transmission, the transceiver turns its transmitter off and a beep sound in the audio system alerts the pilot to the fact. The transceiver then reverts to receiver mode in order to prevent a stuck microphone button from blocking the communications channel. Should the time-out occur, the pilot can reset it by simply releasing the push to talk button and pressing it again.

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NAV OPERATION

The NAV operation is identical to the COM operation. However, NAV controls are accomplished by actuation of the Frequency Transfer Button and the Line Select Button located on the upper RH of the RMU Bezel Panel. Furthermore, the NAV window has an additional function called DME Split Tuning Mode. The operation in the DME Split Tuning Mode is similar to the operation in the DME Hold Mode.

The NAV system also incorporates FMS auto-tuning capability. Through the NAV Memory Page it is possible for the FMS to perform automatic tuning of the navigation radios (raw data) along the route by pressing the upper RH Frequency Transfer Button, which enables or disables the FMS auto-tuning capability. When the VOR or the ILS frequency is auto-tuned by the FMS, a magenta VOR or ILS frequency and a magenta AUTO label will be displayed on the top border of the RADIO Page NAV window.

DME OPERATION

In normal DME operations only one of the six DME channels is paired with the VOR active frequency and one other with the preset VOR frequency. However, pressing the DME Select Button, labeled DME, on the RMU Bezel Panel, will enable the DME to be tuned independently of the VOR active frequency.

Pressing the DME Select Button once will cause the NAV window to split into two windows. The top window will display the active VOR frequency and the lower window, with the DME label, will display the active DME frequency in VHF format. When the NAV window is split, an H (DME Hold) label is displayed in the DME window to indicate that the DME is not paired with the active VOR/ILS frequency. In this case the DME hold condition will also be announced on the PFD. In this condition, the DME may be tuned directly by simply pressing the associated Line Select Button beside the DME window and tuning the new DME channel through the Frequency Tuning Knobs.

Pressing the DME Select Button again will cause the frequency to be displayed in the channel format (TACAN).

Pressing the DME Select Button for the third time will cause the NAV window to resume its normal mode with the active and preset frequencies being displayed while returning the DME to the condition of channeling with the active VOR frequency.

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HF OPERATION (only for KHF-1050)

The KHF-1050 High-Frequency Communications System operates in a frequency range of 2.0 to 29.9999 MHz with resolution of 100 Hz, and has different operating modes: Amplitude modulation (AM), upper side-band voice (UV), lower side-band voice (UL), upper side-band data (UD), lower side-band data (LD) and continuos wave (CW).

The AM, UV and UL operating modes may be used, and the UV operating mode is highly recommended due to its quality and range. The UD, LD and CW operating modes are inoperative and its use will take no effect. Therefore, the UD, LD and CW modes should not be selected.

Simplex Operation means that the transmission and reception frequencies are the same, while Split (or Semi-duplex) Operation means transmission (TX) and reception (RX) on different frequencies. International Telecommunication Union (ITU) is a Split Operation, and Emergency is a Simplex Operation, both with defined frequencies and selected by a channel number.

**NOTE: -** The use of Lower Side-band is legal for some international and off-shore communications, but is not authorized for use in the United States and most European countries.

**-** Be sure all personnel are clear of the HF antenna when performing radio checks. Serious RF burns can result from direct contact with the antenna and its terminals when the system is transmitting .

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During normal operation, the following annunciators may display:

| COLOR | MESSAGE | MEANING |
|---|---|---|
| YELLOW | ERR | HF radio is annunciating a fault. |
| | RX INH | HF reception with one system is inhibited because the other system is transmitting or has just finished a transmission. |
| | SQ | Squelch is opened with the SQ function key (squelch test mode). |
| | TX INH | One system is keyed, but the other system was keyed first. |
| | TX MIN | HF is keyed and transmit power setting is minimum. |
| | TX MED | HF is keyed and transmit power setting is medium. |
| | TX | HF is keyed and transmit power setting is maximum. |

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ADF OPERATION

The tuning of ADF frequencies is similar to that performed on the airplane's other radio equipment. Pressing the Line Select Button beside the ADF frequency display will move the yellow cursor box to surround the ADF frequency in the RMU display. Then, slowly turning the Frequency Tuning Inner Knob clockwise causes the ADF frequencies to advance in 0.5 kHz increments, while slowly turning the outer knob clockwise will cause the frequencies to advance in 10 kHz increments. ADF tuning through the Frequency Tuning Knobs is accomplished using proportional rate. If the knobs are turned in slow deliberate steps, the frequency will follow likewise. However, if the knob is turned rapidly, the frequency will skip several steps, depending upon the speed at which the knob is turned. This allows accomplishing large frequency changes with a very slight rotation of the knob.

The RMU also has the capability of storing an ADF frequency. This is accomplished by selecting the desired ADF frequency and then pressing the Memory Storage Button on the RMU Bezel Panel. To retrieve the stored frequency from memory, the ADF frequency Line Select Button must be pressed for 2 seconds.

The ADF is provided with a mode control capability. ADF operational modes can be selected by moving the yellow cursor box to the ADF modes field in the ADF window and then pressing the Line Select Button beside the ADF modes field or rotating the Frequency Tuning Knobs. Repeatedly pressing the Line Select Button will cause the modes to step in one direction while rotating the Frequency Tuning Knobs will select the modes either up or down the current location.

The ADF operational modes are the following:

- ANT - The ADF receives signal only.
- ADF - The ADF receives signal and calculates relative bearings to station.
- BFO - The ADF adds a beat frequency oscillator for reception of CW signals.
- VOICE - The ADF opens width of IF bandwidth for better aural reception.

**NOTE:** Bearing information is available in the ADF and BFO modes only.

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TRANSPONDER AND TCAS OPERATION

Transponder operation is similar to other radio equipment since it requires moving the yellow cursor box to a desired function. In order to tune a desired ATC code, press the Line Select beside the ATC code display. This action will enable the Frequency Tuning Knobs to change the ATC codes. The outer knob sets the thousands and hundreds digits and the inner knob sets the tens and ones digits.

Pressing and holding the code Line Select Button will recall the stored preset code (typically used for VFR). A new code may be stored by setting the code and then pressing the Memory Storage Button on the RMU Bezel Panel.

Pressing the Line Select Button associated with the transponder operating mode display will move the yellow cursor box to surround the mode annunciation in the ATC/TCAS window allowing to set a new transponder mode if a non-standby mode is selected. Once the mode annunciation is surrounded, pressing the Transfer Button 1/2 will select which transponder will be in operation (e.g., 1 ATC ON to 2 ATC ON).

The transponder operational modes are the following:

- ATC ON - Replies on Modes S and A, no altitude reporting.
- ATC ALT - Replies on Modes A, C and S, with altitude reporting.
- TA ONLY - TCAS Advisory Mode is selected.
- TA/RA - TCAS Traffic Advisory/Resolution Advisory Mode is selected.

**RMU ABNORMAL OPERATION**

Loss of the Primary Radio Bus will disable the cross-side control capability and also the TBCH. However, no radio functions will be lost. The radios on both sides will still be functional through the Secondary Radio Buses.

Loss of the left and/or right Secondary Radio Bus will not disable the radio functions. The radios may be tuned, in this condition, through the Primary Radio Bus or through the cross-side control feature.

As a safety feature of the RMU, if any component of the Radio System fails to respond to the commands from the RMU, the frequencies or the operating commands associated with that particular function will be removed from the RMU display and replaced with dashes.

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## RMU CONTROLS AND INDICATORS

## RMU BEZEL PANEL

### 1 - FREQUENCY TRANSFER BUTTON

- When pressed, the active frequency (upper line) and the preset frequency (lower line) in the COM or NAV windows exchange location and function.

### 2 - LINE SELECT BUTTONS

- The first press of the button moves a yellow cursor box to surround the data field associated with that particular Line Select Button. This enables the Frequency Tuning Knobs to change the data or the mode marked by the cursor. For some functions, additional pressing of the Line Select Button will toggle modes or recall stored frequencies. The Line Select Buttons, if kept pressed, allows ADF and ATC memories to be recalled, and to enter or exit Direct Tune Mode for COM and NAV.

### 3 - FREQUENCY TUNING OUTER KNOB

- Allows the data field enclosed by the cursor to be modified. The data may be frequency setting, stored frequencies or mode, depending upon the data field. When setting a frequency, this knob controls the digits to the left of the decimal point. Furthermore, this knob also controls the RMU brightness, which is enabled by pressing the Dimming Button.

### 4 - FREQUENCY TUNING INNER KNOB

- Is functionally similar to the Frequency Tuning Outer Knob except that when setting the frequency, this knob controls the digits to the right of the decimal point.

### 5 - MEMORY STORAGE BUTTON

- Pressing this button will cause a temporary (TEMP) COM or NAV pre-select frequency to be stored in the memory and assigned numbered location, provided the cursor has first been placed around that frequency.

**NOTE: -** ADF and ATC have only one memory location.

**-** For HF memory operation, refer to HF Memory Page description.

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**6 - DME SELECT BUTTON**

- Allows selection of the DME Hold Mode, tuning a different DME channel, not paired with the VOR/ILS frequency, without changing the active VOR frequency. Repeated pressing of this button enables display and selection of the DME channels in VHF and TACAN formats, and then back to the paired VOR/DME mode.

**7 - CROSS-SIDE TRANSFER BUTTON**

- With the cursor in any window, except the ATC, TCAS or HF display, pressing this button will transfer the entire RMU operation and display from the cross-side system.
- With the cursor in the ATC or TCAS window, pressing this button selects which transponder will be in operation.
- With enhanced TCAS, the button allows control of TCAS data in the cross-side display.
- With the cursor in the HF window, pressing this button toggles the display between HF1 and HF2 tuning pages. There will be dashes in the window if the HF in view is not the selected HF.

**8 - TEST BUTTON**

- When pressed, causes the component associated with the present position of the yellow cursor box to activate its internal self-test circuits for a complete end-to-end test of the function. To properly accomplish the equipment self-test, the Test Button must be pressed and held down as follows:
  - About 2 seconds for COM transceiver self-test.
  - From 5 to 7 seconds for DME, ATC and ADF self-test.
  - About 20 seconds for NAV (VOR/ILS) self-test.
- Releasing the Test Button at any time immediately returns the equipment to its normal operation in the actual function.
- If the Test Button is held pressed for 30 seconds or more, the radios are automatically commanded back into normal operation.

**9 - PAGE CONTROL BUTTON**

- Provides access to the page menu.

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**10 - DIMMING BUTTON**

- The RMU features an automatic screen brightness adjustment, within a limited range, to keep the display visibility optimized. The Dimming Button enables RMU brightness to be controlled manually through the Frequency Tuning Outer Knob. The manual dimming control can be disabled by pressing the Dimming Button again or any Line Select Button.

**11 - TRANSPONDER IDENTIFICATION MODE BUTTON**

- Selects the Transponder Identification Response Mode. The ident squawk will stop after 18 seconds.

**12 - SQUELCH CONTROL BUTTON**

- Causes the COM radio to open its squelch allowing any noise or signal present in the radio to be heard in the Audio System. The label SQ is displayed on the top line of the COM window when the squelch is open. When pressed a second time the Squelch Control Button closes the squelch.

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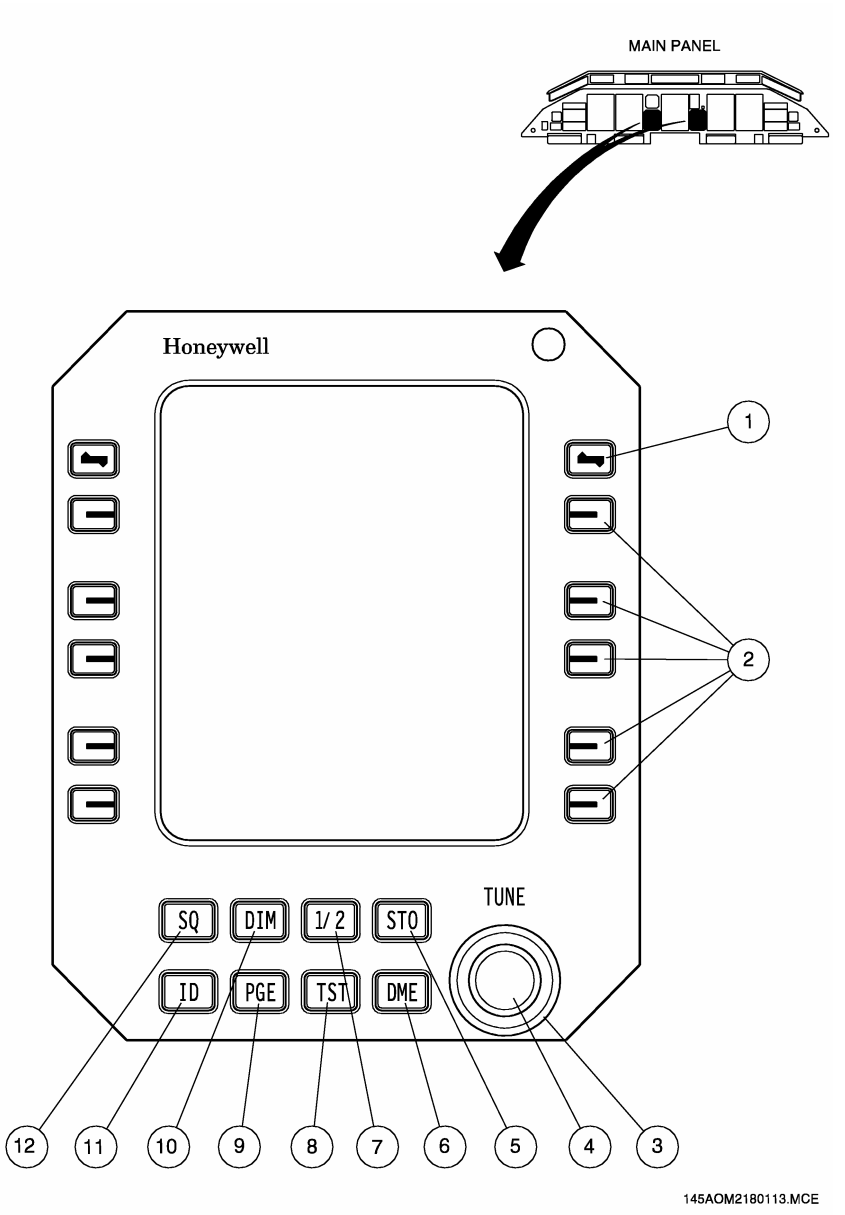


## RMU BEZEL PANEL

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## RMU DISPLAY

PAGE MENU

### 1 - PAGE MENU IDENTIFICATION

- Indicates that Page MENU is selected.
- Color: White.

### 2 - NAVIGATION PAGE LABEL

- To access the NAVIGATION Page, press the Line Select Button adjacent to this label.
- Color: Green.

### 3 - ENGINE PAGE LABEL

- To access the ENGINE Page, press the Line Select Button adjacent to this label.
- Color: Green.

### 4 - SYS SELECT PAGE LABEL

- To access the SYS SELECT Page, press the Line Select Button adjacent to this label.
- Color: Green.

### 5 - MAINTENANCE PAGE LABEL

- To access the MAINTENANCE Page, press the Line Select Button adjacent to this label.
- Color: Green.

### 6 - RETURN TO RADIOS PAGE LABEL

- To return to the RADIOS Page, press the Line Select Button adjacent to this label.
- Color: Green.

### 7 - ATC/TCAS PAGE LABEL

- To access the ATC/TCAS Page, press the Line Select Button adjacent to this label.
- Color: Green.

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**8 - HF MEMORY (only for KHF-1050)**

- To access the HF MEMORY Page, press the Line Select Button adjacent to the desired page.
- Color: Green .

**9 - HF CONTROL (only for KHF-1050)**

- To access the HF Control Page, press the Line Select Button adjacent to the desired page.
- Color: Green.

**10 - COM AND NAV MEMORY PAGE LABEL**

- To access the COM or NAV MEMORY Pages, press the Line Select Button adjacent to the desired page.
- Color: Green.

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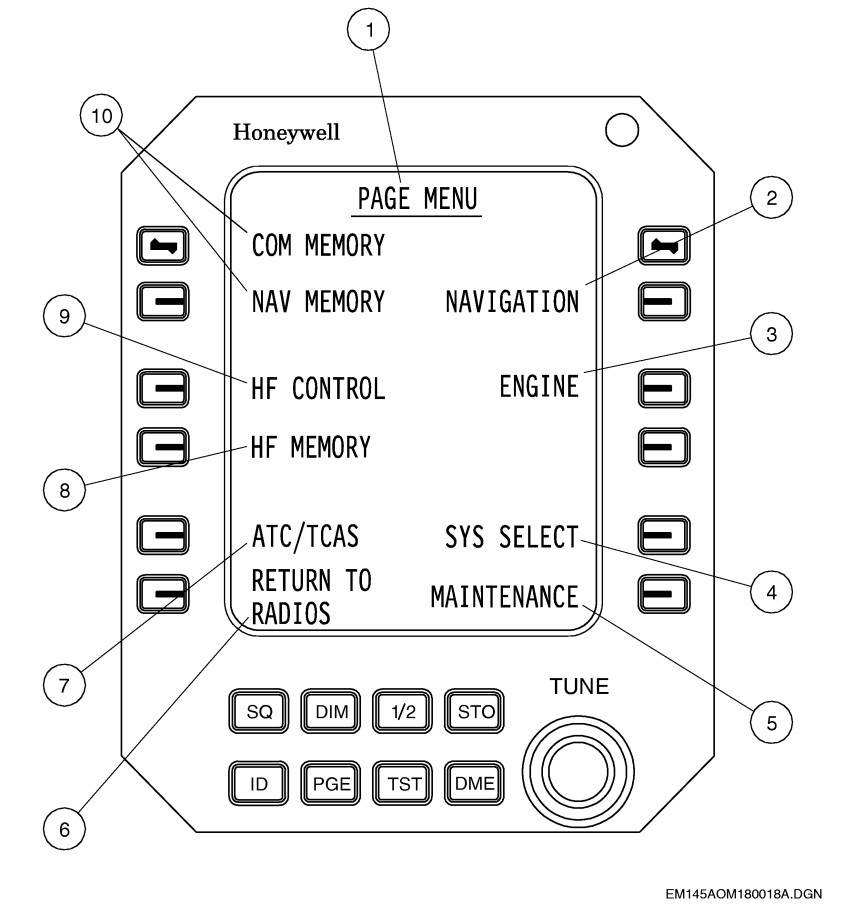


**PAGE MENU**

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RADIO PAGE

**1 - PRESET FREQUENCY MEMORY LOCATION (ONLY FOR NAV AND COM WINDOWS)**

- Identifies the preset frequency as temporary (TEMP label) or retrieved from the memory (MEMORY label followed by its memory location).
- Colors:
  - Cyan for on-side operation.
  - Yellow for cross-side operation.
- When marked by the yellow cursor box, the memory location labels and their associated stored frequencies can be scrolled by using the Frequency Tuning Knobs.

**2 - COM WINDOW/CONTROL SIDE IDENTIFICATION**

- Identifies the window and which source equipment (side 1 or 2) is active in that RMU.
- Colors:
  - White for on-side source.
  - Magenta for cross-side source.

**3 - VHF COM ACTIVE FREQUENCY**

- Indicates the active frequency for that window.
- Colors:
  - White for on-side operation.
  - Yellow for cross-side operation.
- Digits are replaced by dashes in case of any failure in the associated source.

**4 - VHF COM PRESET FREQUENCY**

- Indicates the preset frequency.
- Colors:
  - Cyan for on-side operation.
  - Yellow for cross-side operation.

**NOTE:** When DME Hold is not selected, the NAV Window also presents a similar preset frequency field.

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**5 - NAV WINDOW/CONTROL SIDE IDENTIFICATION**

- Identifies the window and which source equipment (side 1 or 2) is active in that RMU.
- Colors:
  - White for on-side source.
  - Magenta for cross-side source.

**6 - VHF NAV ACTIVE FREQUENCY**

- Indicates the active frequency for that window.
- Colors:
  - White for on-side operation.
  - Yellow for cross-side operation.
- Digits are replaced by dashes in case of any failure in the associated source.

**7 - DME HOLD MODE ANNUNCIATION**

- Indicates that the DME is in Hold Mode and the active DME channel is selected separately from the active VOR/ILS frequency.
- Color: Yellow.

**8 - DME STATION IDENTIFICATION CODE**

- Displays the digital identification code of the ground station to which the DME is tuned with.
- Color: White.

**9 - DME HOLD MODE FREQUENCY**

- Indicates the active frequency in DME Hold Mode operation, in VHF (represented) or TACAN formats.
- Color: White.

**10 - ADF WINDOW/CONTROL SIDE IDENTIFICATION**

- Identifies the window and which source equipment (side 1 or 2) is active in that RMU.
- Colors:
  - White for on-side source.
  - Magenta for cross-side source.

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**11 - ADF ACTIVE FREQUENCY**

- Indicates the active frequency for that window.
- Colors:
  - White for on-side operation.
  - Yellow for cross-side operation.
- Digits are replaced by dashes in case of any failure in the associated source.

**12 - ADF MODES FIELD**

- Displays the ADF modes as selected either through the second ADF Line Select Button (achieved by repeated pressing) or through the Frequency Tuning Knobs when the yellow cursor box is located in this field.
- Color: Green.

**13 - HF WINDOW (only for KHF-1050)**

- Identifies the window and which source equipment (side 1 or 2) is active in that RMU.
- Colors:
  - White for on-side source.
  - Magenta for cross-side source.

**14 - HF ACTIVE FREQUENCY (only for KHF-1050)**

- Indicates the active frequency for that window.
- Colors:
  - White for on-side operation.
  - Yellow for cross-side operation.

**15 - RADIO FREQUENCY TRANSMISSION MODE**

- Indicates the HF Transmission Mode.
- Color: Green.

**16 - HF PRESET FREQUENCY (only for KHF-1050)**

- Indicates the active frequency for that window.
- Colors:
  - White for on-side operation.
  - Yellow for cross-side operation.

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**17 - TRANSPONDER OPERATING MODE ANNUNCIATION**

- Displays the active transponder operating mode as selected through the Frequency Tuning Knobs when the yellow cursor box is located in this field. Pressing the Line Select Button beside this field will alternate between the pre-selected transponder mode and the standby mode.
- Color: Green.

**18 - ATC CODE**

- Displays the active ATC code number.
- Color: White.

**19 - ATC/TCAS WINDOW**

- Identifies the window as the ATC/TCAS window.
- Colors: White.

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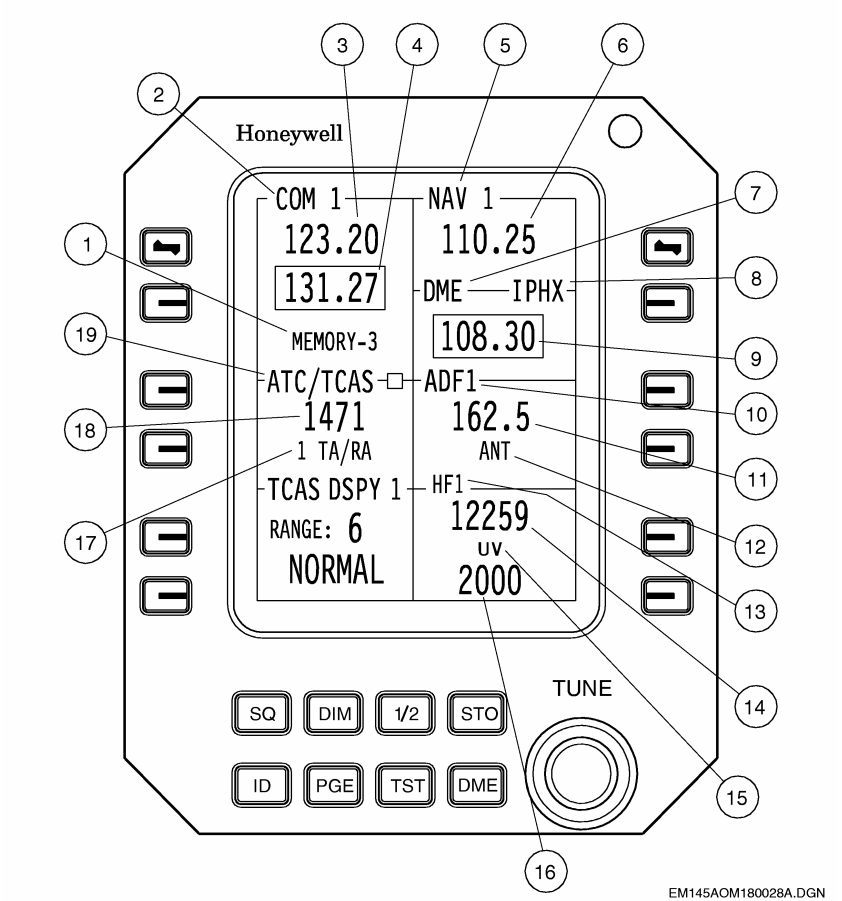


**RMU RADIO PAGE**

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COM MEMORY PAGE

**1 - MEMORY PAGE IDENTIFICATION**

- Identifies the page as a COM Memory Page.
- Color: White.

**2 - ACTIVE COM FREQUENCY**

- Identifies the COM frequency that is currently active.
- Color: White.

**3 - SQUELCH MODE INDICATION**

- Indicates if squelch is open.
- Color: Yellow.

**4 - MEMORY PAGE SELECTED ANNUNCIATION**

- Indicates that the Memory Page is selected.
- Color: Green.

**5 - MEMORIES DISPLAY**

- Displays the preset frequencies and their associated locations.
- When there is no frequency stored in a memory location only the location number will be displayed in the associated memory display line.
- Colors:
  - Memory identifications are green.
  - Frequency is cyan.

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**6 - MEMORY INSERT PROMPT**

- If it is desirable to insert a new frequency in a particular memory location, simply press the Line Select Button beside the location line, moving the yellow cursor box to that line. Then press the Line Select Button beside the Insert prompt label. This will cause all the data in memory from the insert location downward to shift one position down. The cursor will remain in the insertion selected location allowing the new frequency to be tuned and stored in that memory location. A MEM FULL (Memory Full) annunciation will be displayed in the RMU display if the 12 memory locations are filled and the Line Select Button associated with the Insert prompt is pressed.
- Color: Green.

**7 - MEMORY DELETE PROMPT**

- To delete a frequency from the memory, press the Line Select Button adjacent to the line associated with the frequency to be deleted. Then press the Line Select Button adjacent to the Delete prompt. The frequency enclosed by the cursor will be deleted from the memory. Higher numbered memory locations will then move upward to fill the empty memory location.
- Color: Green.

**8 - RADIO PAGE RETURN PROMPT**

- Pressing the associated Line Select Button will return the RMU display to the RADIO Page.
- Color: Green.

**9 - MEMORY MORE PROMPT**

- The More prompt allows to display memory locations 7 through 12, by pressing the associated Line Select Button. All actions described for memory locations 1 through 6 are also applicable to memory locations 7 through 12. If locations 1 through 6 are not filled, the Second Memory Page will not be accessible.
- Color: Green.

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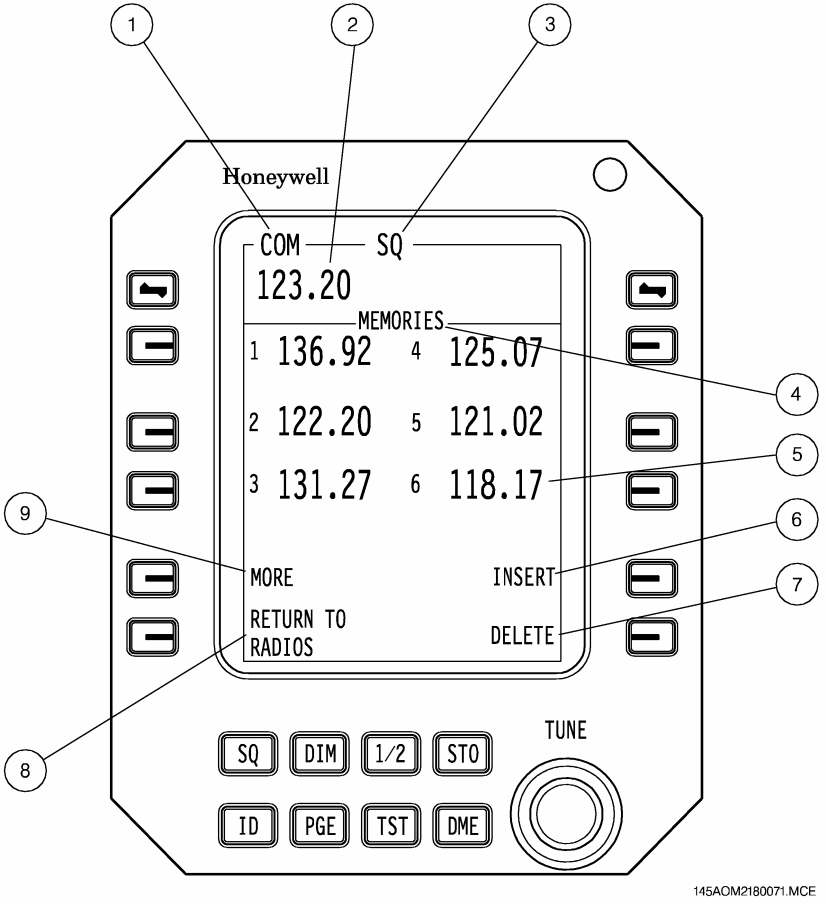


## RMU COM MEMORY PAGE



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NAV MEMORY PAGE

**1 - MEMORY PAGE IDENTIFICATION**

- Identifies the page as a NAV Memory Page.
- Color: White.

**2 - ACTIVE NAV FREQUENCY**

- Identifies the NAV frequency that is currently active.
- Color: White.

**3 - NAV FMS STATUS ANNUNCIATION**

- In the NAV Memory Page, this field displays the FMS ENABLED or DISABLED annunciation. This will be present whether or not the Radio System interfaces with the FMS.
- Color: Yellow.

**NOTE:** When the VOR or the ILS frequency is auto-tuned by the FMS, a magenta VOR or ILS frequency and a magenta AUTO label will be displayed on the top border of the RADIO Page NAV window.

**4 - MEMORY PAGE SELECTED ANNUNCIATION**

- Indicates that the Memory Page is selected.
- Color: Green.

**5 - MEMORIES DISPLAY**

- Displays the preset frequencies and their associated locations.
- When there is no frequency stored in a memory location only the location number will be displayed in the associated memory display line.
- Colors:
  - Memory identifications is green.
  - Frequency is cyan.

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**6 - MEMORY INSERT PROMPT**

- If it is desirable to insert a new frequency in a particular memory location, simply press the Line Select Button beside the location line, moving the yellow cursor box to that line. Then press the Line Select Button beside the Insert prompt label. This will cause all the data in memory from the insert location downward to shift one position down. The cursor will remain in the insertion selected location allowing the new frequency to be tuned and stored in that memory location. A MEM FULL (Memory Full) annunciation will be displayed in the RMU display if the 12 memory locations are filled and the Line Select Button associated with the Insert prompt is pressed.
- Color: Green.

**7 - MEMORY DELETE PROMPT**

- To delete a frequency from the memory, press the Line Select Button adjacent to the line associated with the frequency to be deleted. Then press the Line Select Button adjacent to the Delete prompt. The frequency enclosed by the cursor will be deleted from the memory. Higher numbered memory locations will then move upward to fill the empty memory location.
- Color: Green.

**8 - RADIO PAGE RETURN PROMPT**

- Pressing the associated Line Select Button will return the RMU display to the RADIO Page.
- Color: Green.

**9 - MEMORY MORE PROMPT**

- The More prompt allows to display memory locations 7 through 12, by pressing the associated Line Select Button. All actions described for memory locations 1 through 6 are also applicable to memory locations 7 through 12. If locations 1 through 6 are not filled, the Second Memory Page will not be accessible.
- Color: Green.

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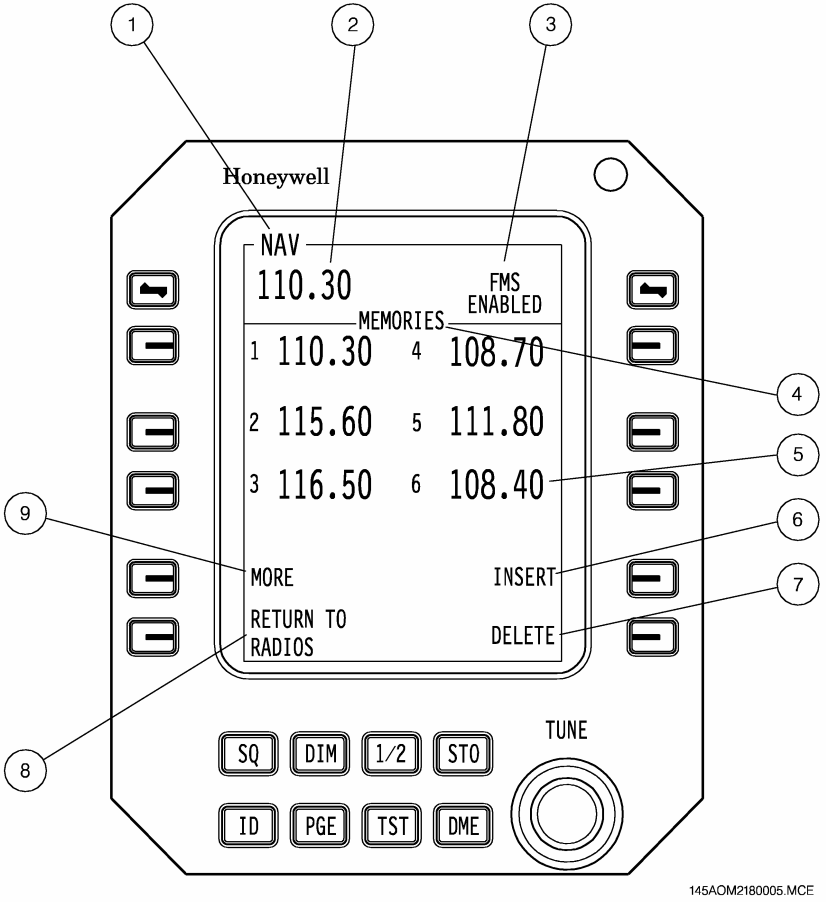


**RMU NAV MEMORY PAGE**



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HF MEMORY PAGE (only for KHF-1050)

**1 - MEMORY PAGE IDENTIFICATION**

- Identifies the page as an HF Memory Page.
- Color: White.

**2 - MEMORY POSITION**

- Identifies the Memory Position.
- Color: Green.

**3 - MEMORY FREQUENCY**

- Identifies the Memory Frequency.
- Color: Blue.
- Pressing the Upper Line Select Button positions the cursor around the active frequency.
- If in Split Mode, pressing the Upper Line Select Button positions the cursor around the Receive Frequency. It also toggles between the active Receive and Transmission frequency.
- If in Emergency or ITU mode, holding the Upper Line Select Button displays the corresponding frequency and emission mode, and releasing it returns the display to the active channel.

**4 - MEMORY EMISSION MODE**

- Identifies the HF emission mode (UV, LV, UD, LD, AM or CW) that is in Memory.
- Color: Green.

**5 - SPLIT MODE MEMORY**

- Example of a Split Mode Memory identifying the Receiving (RX) and Transmitting (TX) Modes and Frequencies.

**6 - RADIO PAGE RETURN PROMPT**

- Pressing the associated Line Select Button will return the RMU display to the RADIO Page.
- Color: Green.

**7 - MEMORY MORE PROMPT**

- Pressing the associated Line Select Button toggles the memory window through the 12 memory locations, displaying three memory locations at a time.
- Color: Green.

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**8 - ACTIVE HF MODE OF OPERATION**

- Pressing the associated Line Select Button changes the mode for the channel that is selected by the cursor box.
- Color: Green.

**9 - LOAD PROMPT**

- Pressing the associated Line Select Button loads the information from the memory location selected by the cursor box into the active channel.
- Color: Green.

**10 - ACTIVE HF EMISSION MODE**

- Identifies the HF transmission mode (UV, LV, UD, LD, AM or CW) that is currently active.
- Color: Green.

**11 - ACTIVE HF FREQUENCY**

- Identifies the HF frequency that is currently active.
- Color: White.

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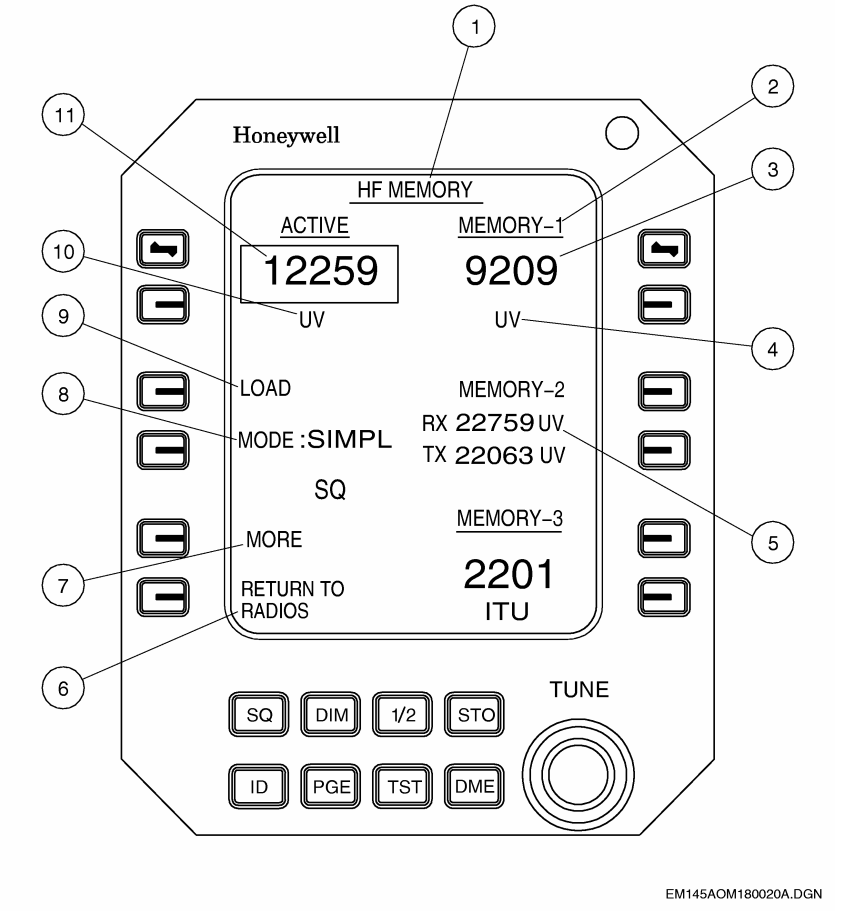


**HF MEMORY PAGE (only for KHF-1050)**

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HF CONTROL PAGE (only for KHF-1050)

**1 - CONTROL PAGE IDENTIFICATION**

- Identifies the page as an HF Control Page.
- Color: White.

**2 - PRESET HF TRANSMISSION FREQUENCY**

- Identifies the page as an HF Control Page.
- Color: White.
- Pressing the Upper Line Select Button positions the cursor around the preset frequency.
- If in Split Mode, pressing the Upper Line Select Button positions the cursor around the Receive Frequency. It also toggles between the preset Receive and Transmission frequency.
- If in Emergency or ITU mode, holding the Upper Line Select Button displays the corresponding frequency and emission mode, and releasing it returns the display to the preset channel.
- Pressing the Lower Line Select Button positions the cursor around the preset frequency.
- If the cursor is already positioned in the preset frequency, the Lower Line Select Button toggles through the different emission modes (UV, LV, UD, LD, AM and CW).
- If in Split Mode, pressing the Lower Line Select Button positions the cursor around the Transmission Frequency. It also toggles between the preset Receive and Transmission frequency.
- If in Emergency or ITU mode, holding the Lower Line Select Button displays the corresponding frequency and emission mode, and releasing it returns the display to the preset channel.

**3 - TRANSMIT POWER**

- Identifies the Transmit Power level. Available levels are MIN, MED and MAX.
- Pressing the associated Line Select Button changes the Transmit Power level.

**4 - MEMORY STORAGE BUTTON**

- Stores the information in the preset channel into the selected memory location.

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**5 - SQUELCH LEVEL**

- Identifies the Squelch Level. Available levels are MIN, MED and MAX.
- Pressing the associated Line Select Button changes the Squelch Level.

**6 - ACT MODE (ACTIVE MODE)**

- Pressing the associated Line Select Button changes the active mode of operation (Simple, Split, Emergency and ITU).

**7 - TRANSFER FUNCTION**

- Pressing the associated Line Select Button switches the information in the preset and active windows. The STO key must be pushed in order to save the information in the memory location.

**8 - ACTIVE HF TRANSMISSION FREQUENCY**

- Identifies the Active HF Transmission Frequency.
- Color: Green.
- Pressing the Upper Line Select Button positions the cursor around the active frequency.
- If in Split Mode, pressing the Upper Line Select Button positions the cursor around the Receive Frequency. It also toggles between the active Receive and Transmission frequency.
- If in Emergency or ITU mode, holding the Upper Line Select Button displays the corresponding frequency and emission mode, and releasing it returns the display to the active channel.
- Pressing The Lower Line Select Button positions the cursor around the active frequency.
- If the cursor is already positioned in the active frequency, the Lower Line Select Button toggles through the different emission modes (UV, LV, UD, LD, AM and CW).
- If in Split Mode, the Lower Line Select Button positions the cursor around the Transmission Frequency. It also toggles between the active Receive and Transmission frequency.
- If in Emergency or ITU mode, holding the Lower Line Select Button displays the corresponding frequency and emission mode, and releasing it returns the display to the active channel.
- After setting the frequency, pushing the PPT button momentarily initiates the antenna tuning.

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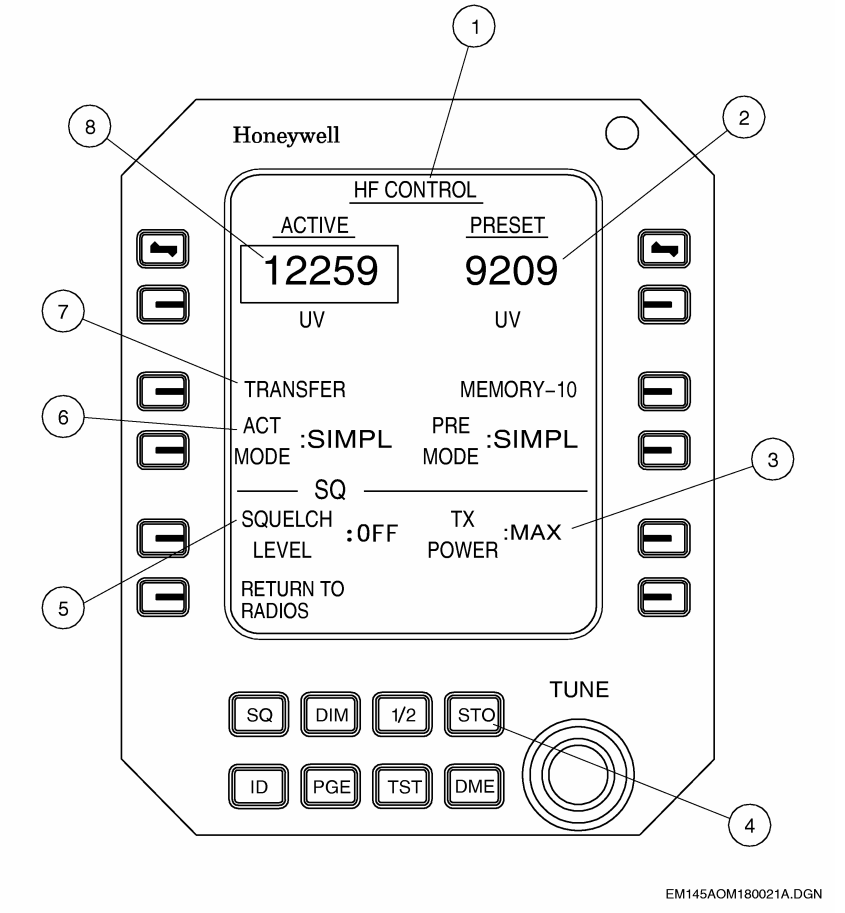


**HF CONTROL PAGE (only for KHF-1050)**

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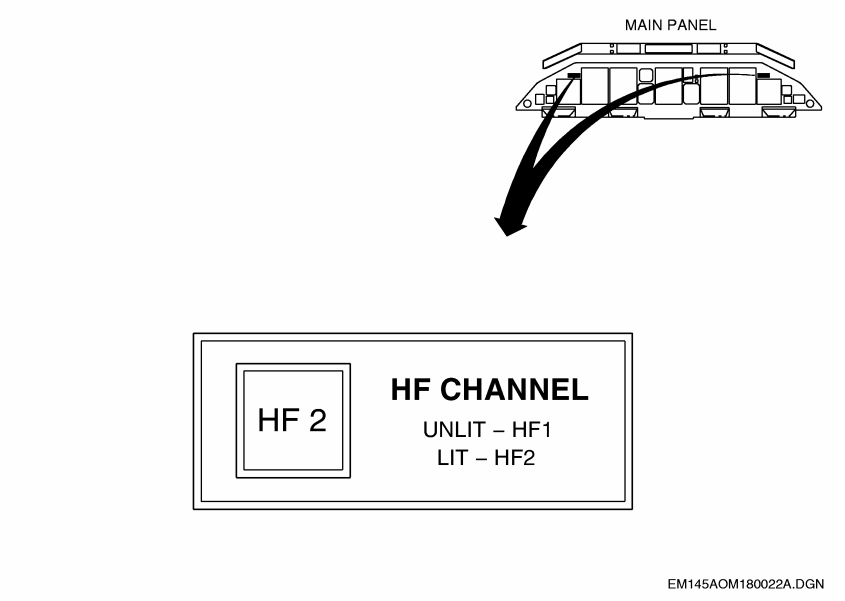
HF SELECTOR PANEL (only for KHF-1050)

The airplane may be equipped with one (Single installation) or two (Dual installation) HF systems.

In case of Dual installation, press the HF2 button (on the Pilot or Copilot position) to toggle between HF1 and HF2 radio system. The HF1 radio system is selected when the button is unlit, and the HF2 is selected when the button is lit. The HF2 buttons always assume the same state (both unlit or both lit).

To toggle between HF1 and HF2 Tuning pages, press the Cross-side Transfer Button (1/2).




**HF SELECTOR PANEL WITH DUAL INSTALLATION**

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ATC/TCAS CONTROL PAGE

**1 - INTRUDER ALTITUDE DISPLAY**

- REL (green): Target's altitude displayed relative to one's own airplane (default).
- FL (cyan): Target's altitude displayed as flight level (reverts to REL after 20 sec).

**2 - TA DISPLAY**

- AUTO (green): Traffic targets displayed only when TA or RA target condition exists.
- MANUAL (cyan): All traffic targets displayed within the viewing airspace.

**3 - FLIGHT ID**

- Allows Mode S coding to reflect the current flight's call sign. The outer tuning knob moves the character position designator and the inner tuning knob selects the desired alphanumeric character.
- Color: White.

**4 - ADS-B STATUS (only for airplanes Post-Mod. SB 145-34-0118 or equipped with an equivalent modification factory incorporated)**

- NORMAL (white): GPS data is received on the active transponder.
- FAIL (yellow): No GPS data is received on the active transponder.
- DEGRADED (yellow): GPS navigation integrity or accuracy parameters do not meet ADS-B standards, as recognized by the active transponder.

**5 - FLIGHT LEVEL 1/2**

- Display of the transponder's encoded altitude and the air data source for that altitude.
- Color: Green.

**6 - RADIO PAGE RETURN PROMPT**

- Pressing the associated Line Select Button will return the RMU display to the RADIO Page.
- Color: Green.

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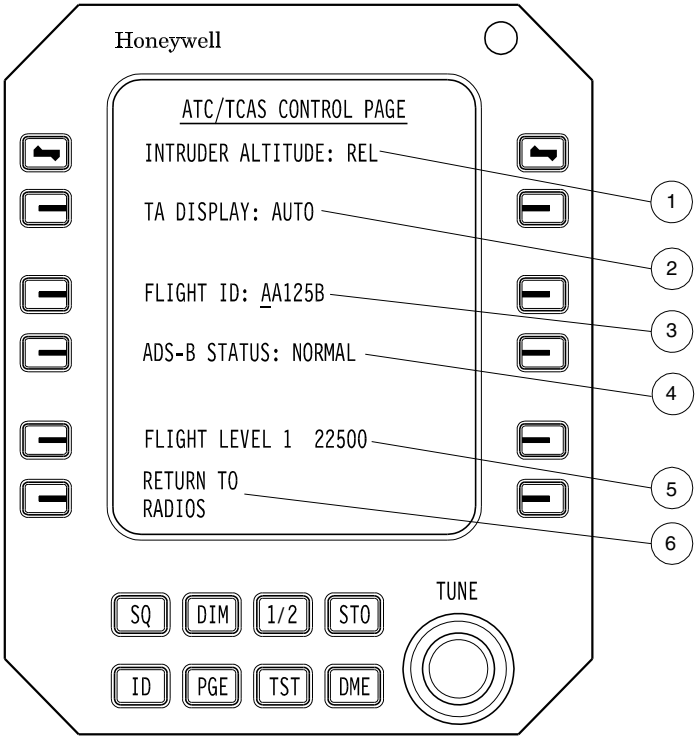


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**RMU ATC/TCAS CONTROL PAGE**

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NAVIGATION BACKUP PAGE

**NOTE: -** Navigation information presented on the Navigation Backup Page is operationally identical to that normally presented on the PFD.

- The compass card is presented only in arc partial format.
- The selected course and the DME distance to station are boxed.
- NAV and ADF active frequencies are also presented.

**1 - ACTIVE NAV FREQUENCY**

**2 - BEARING 1 POINTER**

**3 - BEARING 2 POINTER**

**4 - ACTIVE ADF FREQUENCY**

**5 - COURSE DEVIATION BAR**

**6 - COURSE DEVIATION SCALE**

**7 - DME DISTANCE TO STATION**

**8 - MARKER BEACON DISPLAY**

**9 - SELECTED COURSE**

**10 - BEARING 2 SOURCE ANNUNCIATION**

**11 - BEARING 1 SOURCE ANNUNCIATION**

**12 - COMPASS CARD DISPLAY**

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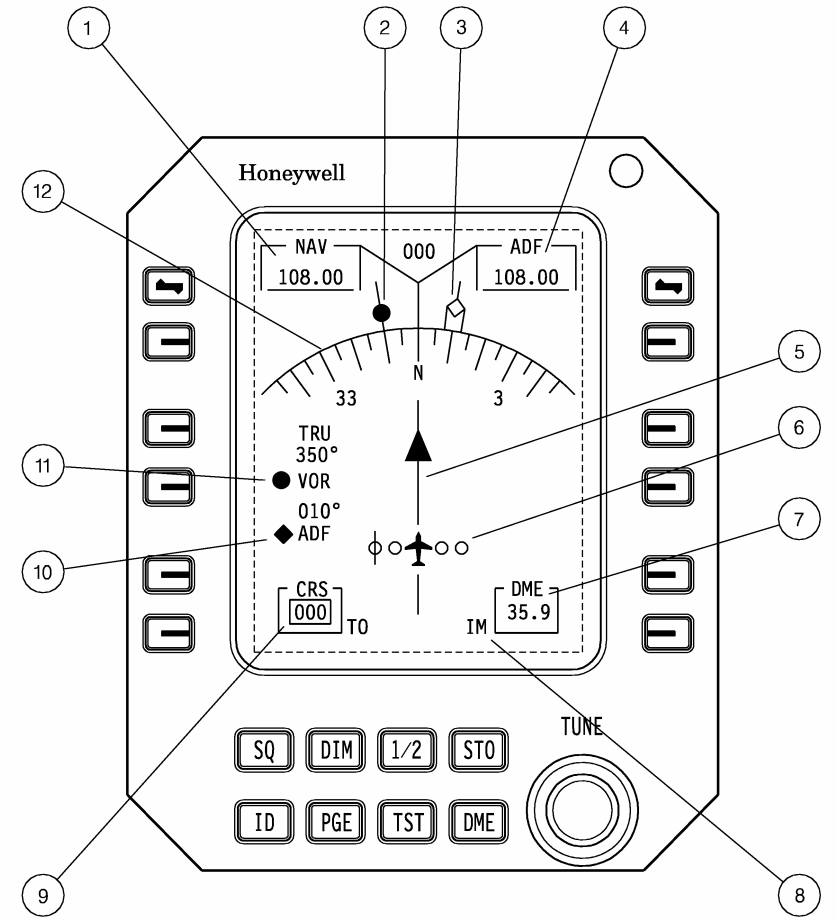


**RMU NAV BACKUP PAGE**

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RMU ENGINE BACKUP PAGES

**1 - THRUST MODES**

- This is the thrust mode when both engines are operating in the same mode. If the engines are operating in different modes, it is displayed above each N1 indication with its respective thrust mode.
- Labels: T/O-1 or ALT T/O-1 (A, A1, A1/1, A3 engines);
  T/O or ALT T/O-1 (A1P or A1/3 engines);
  E T/O, T/O or ALT T/O-1 (A1E engine);
  CON, CLB or CRZ.

**2 - N1 INDICATION (FAN SPEED)**

- Displays N1 speed in RPM percentage both digitally and on an analog scale.

**3 - INTERSTAGE TURBINE TEMPERATURE (ITT)**

- Indicates the temperature in degrees Celsius.

**4 - N2 INDICATION (CORE SPEED)**

- Displays N2 speed in RPM percentage.

**5 - FUEL FLOW INDICATION (FF)**

- Indicates fuel flow in PPH or KPH.

**6 - OIL PRESSURE**

- Indicates engine oil pressure in psi. Refer to section 2-10 Powerplant for further information.

**7 - OIL TEMPERATURE**

- Oil temperature indication ranges from 0° to 180°C.

**8 - FUEL QUANTITY (FQ)**

- Indicates the fuel quantity for each tank in lb or kg.

**9 - FLAPS**

- Flaps indication ranges from 0° to 45°, with discrete indications on 0°, 9°, 18°, 22°, 45°.
- In-transit, flap position is replaced by the actual flap position.

**10 - LANDING GEAR DOWN LOCKED**

- Landing gear down locked is presented on the RMU through the green indication LG DOWN LOCKED.

**11 - SPOILER OPEN**

- Displays SPOILER OPEN when any of the surfaces are open.

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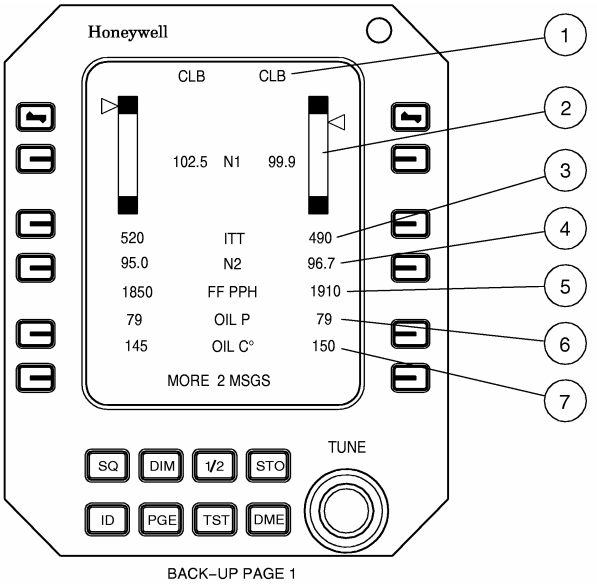
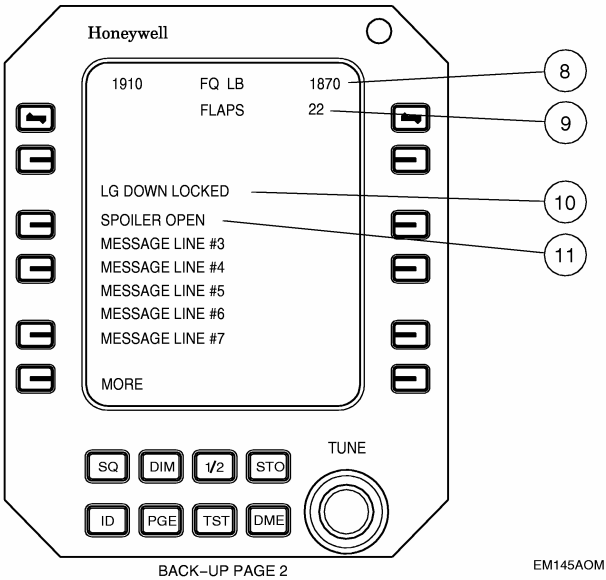



BACK–UP PAGE 1




BACK–UP PAGE 2

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## RMU ENGINE BACKUP PAGES

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SYSTEM SELECT PAGE

**1 - SYSTEM SELECT PAGE IDENTIFICATION**

- Identifies the SYS SELECT Page.
- Color: White.

**2 - COM 1 AND COM 2 BANDWIDTH SELECTION FIELD**

- Indicates the current COM 1 and COM 2 status regarding bandwidth selection. Pressing the Line Select Button beside the COM 1/COM 2 line field will toggle the receiver bandwidth from WIDE (2 digits at the right of the decimal point) to NARROW (3 digits at the right of the decimal point) or vice-versa.
- Color:
  - Cyan for COM 1 (2) BNDWD label.
  - Green for WIDE/NARROW indication.

**3 - RADIO PAGE RETURN PROMPT**

- Pressing the associated Line Select Button will return the RMU display to the RADIO Page.
- Color: Green.

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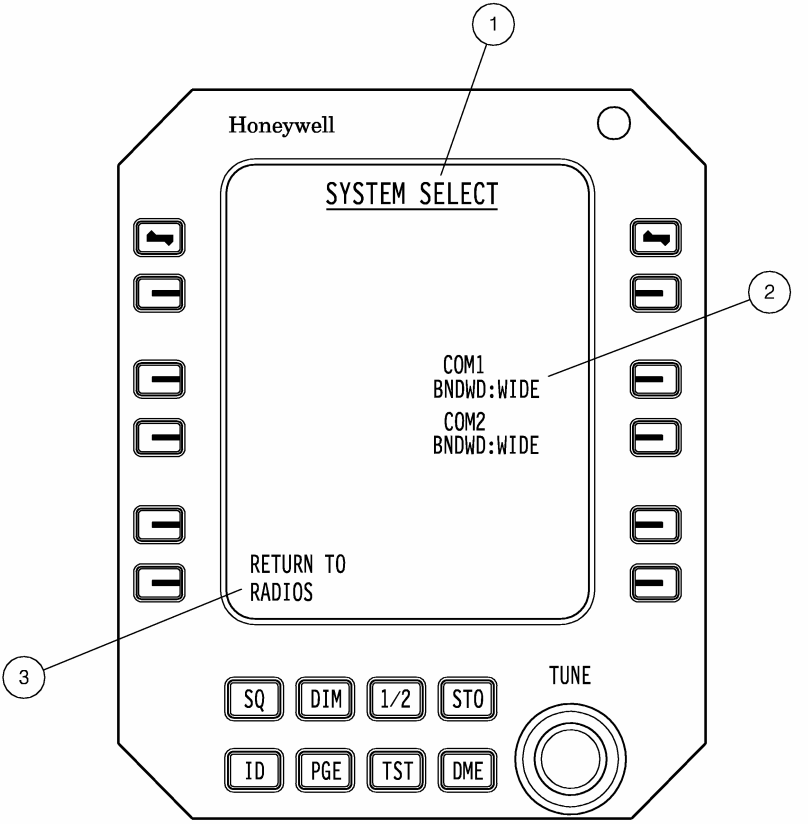


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**RMU SYSTEM SELECT PAGE**

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MAINTENANCE PAGE (POWER ON SELF-TEST)

## 1 - TEST PAGE IDENTIFICATION

- Indicates where a failure has been detected.
- Color: White.

## 2 - FAILURE SIDE IDENTIFICATION

- Indicates the side of the detected failure.
- Color: Green.

## 3 - FAILURE IDENTIFICATION

- Identifies the detected failure according to the table below.
- Color: Red.

| ERROR MESSAGE | MEANING | ACTION | DECISION |
|---|---|---|---|
| RMU ERR | One or more internal parameters were measured and found to be outside their self-test limit. | 1. Check that CDH is not in EMERG Mode.<br>2. On main tuning page, perform tuning test on all radios by setting frequency and determining that radio is operating. | If tuning test fails, the RMU is not fully operable. |
| PRI BUS | Full RMU communications with all COMs, NAVs, and cross-side RMU cannot be established on the primary bus. | 1. Check that all radio circuit breakers are on.<br>2. Check RMU ON/OFF Page for all functions ON.<br>3. Check that CDH is not in EMERG Mode.<br>4. If 1 or 2 (or 3 if installed) are sources, correct and turn RMU power off for 10 seconds. Reapply power to start new POST.<br>5. If error persists, perform on-side and cross-side tuning off all radios and activate auxiliary tuning sources to determine which functions are still available. | Any of these messages indicate that system redundancy has been reduced. |
| SEC BUS | Full RMU communications with the on-side COM and NAV cannot be established using the secondary bus. | | |
| NAV UNIT/ COM UNIT | The NAV units and/or COM units cannot fully communicate with both RMUs over primary bus and/or the on-side RMU over secondary bus. | | |



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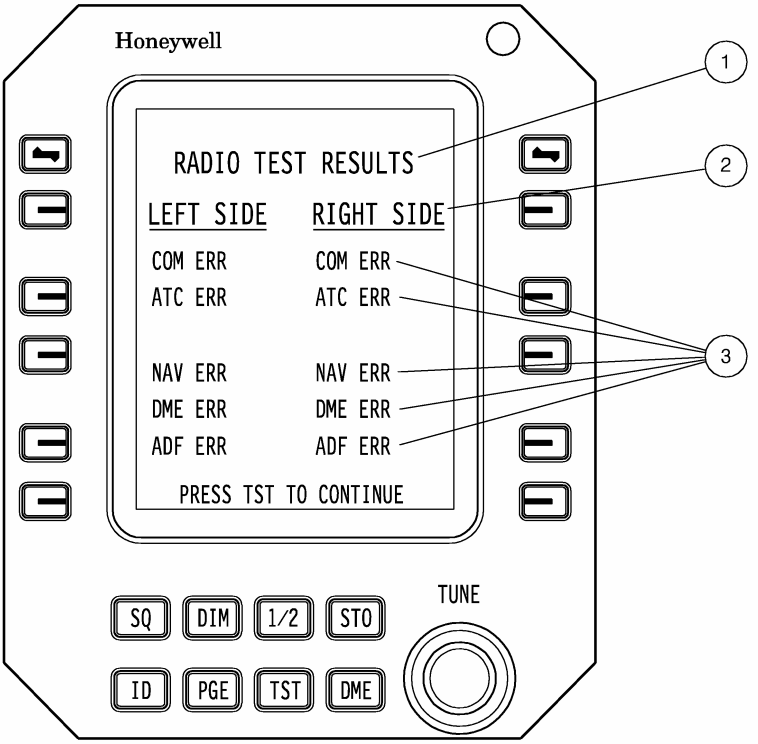


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## RMU MAINTENANCE PAGE (POWER ON SELF TEST)



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MAINTENANCE PAGE (PILOT-ACTIVATED SELF TEST)

**1 - SYSTEM TEST IDENTIFICATION**

- Indicates which unit is being tested.
- Color: Amber.

**2 - TEST RESULT INDICATION**

- Indicates whether the tested system is operating normally or not.
- Color:
  - Green for successful tests.
  - Red for unsuccessful tests.

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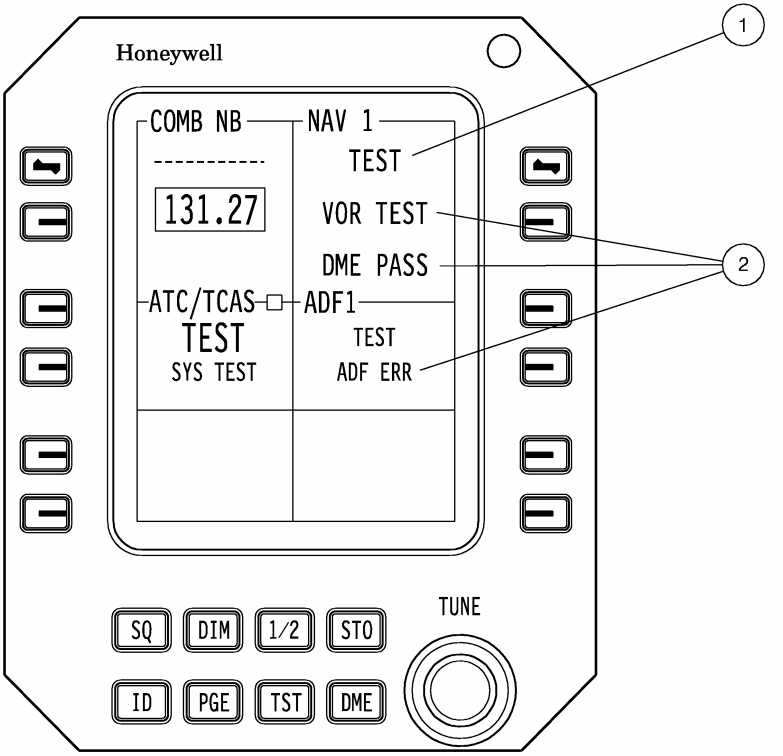


## RMU MAINTENANCE PAGE (PILOT-ACTIVATED SELF TEST)



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# TUNING BACKUP CONTROL HEAD

The Tuning Backup Control Head is a unit that provides an alternative means of tuning the NAV 2 and COM 2.

The TBCH is energized only when the AVIONICS MASTER is switched ON, and in normal operation it displays the RMU 2 NAV and COM active frequencies (NAV 2 and COM 2).

## NORMAL MODE

In the Normal Mode, the TBCH displays the RMU 2 NAV and COM active frequencies. Each time these frequencies are tuned via RMU, the TBCH display is updated automatically. The same occurs when these frequencies are tuned via TBCH, the RMU 2 NAV and COM active frequencies being also updated automatically.

It is also possible to tune the RMU 1 NAV and COM active frequencies using the RMU cross-side operational mode (see 2-18-11, page 4).

## EMERGENCY MODE

When the TBCH is set to the Emergency Mode, the Radio Management System will accept only the NAV and COM tuning via TBCH, ignoring the RMUs control.

The RMUs will recover their capability of tuning the radio frequencies only when the TBCH is set to the Normal Mode again.

## SELF TEST

After power up, the Tuning Backup Control Head performs a self-test. This test consists of saving the frequencies that the COM and NAV units are tuned to as indicated by the Radio System Bus (RSB), and then changing the frequency outputs to the COM and NAV and verifying that they have changed on the RSB. Failures are announced in the display line associated with the function as an error message followed by an error code “ERXX”, with the “XX” showing a two-digit error code.
This test is performed only on the ground, when the unit is turned on.

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## TBCH CONTROLS AND INDICATORS

### 1 - SYSTEM INSTALLATION ANNUNCIATION

- Indicates to which Radio System the Tuning Backup Control Head is connected.

### 2 - REMOTE TUNE ANNUNCIATION

- Indicates that radio is tuned from a source other than the Tuning Backup Control Head.
- Presented only when the unit is strapped for NAV only or COM only tuning.

### 3 - TUNING CURSOR

- Indicates which frequency may be changed by the Tuning Knobs.

### 4 - NAV AUDIO ON ANNUNCIATION

- Indicates that the NAV audio is selected on.

### 5 - EMERGENCY MODE ANNUNCIATION

- Indicates when the unit has been selected to the Emergency Mode, which inhibits RMU tuning capability.

**NOTE: -** This annunciation is not related to the emergency COM frequency of 121.5 MHz.

### 6 - SQUELCH ANNUNCIATION

- Indicates that the squelch is opened by the SQ Switch.

### 7 - TRANSMIT ANNUNCIATION

- Indicates that the COM transmitter is ON.

### 8 - NAV AUDIO BUTTON

- Toggles NAV audio on and off.

### 9 - SQUELCH BUTTON

- Toggles the COM squelch on and off.

### 10 - TUNING KNOBS

- Change the frequency indicated by the tuning cursor.
- Inner knob changes the frequency decimal digits in steps of 0.025 MHz for VHF and 0.050 MHz for VOR/LOC.

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On airplanes Post-Mod. SB 145-23-0003 or with an equivalent modification factory incorporated, it also changes the frequencies in the VHF sub-band that contains the 8.33 kHz spaced channels according to appropriate selection on the RMU. These frequencies are identified in voice communications by the channel names as exemplified below:

| Frequency (MHz) | Spacing | Channel Name |
|---|---|---|
| **132,0000** | **25** | **132,000** |
| 132,0000 | 8.33 | 132,005 |
| 132,0083 | 8.33 | 132,010 |
| 132,0166 | 8.33 | 132,015 |
| **132,0250** | **25** | **132,025** |
| 132,0250 | 8.33 | 132,030 |
| 132,0333 | 8.33 | 132,035 |
| 132,0416 | 8.33 | 132,040 |
| **132,0500** | **25** | **132,050** |
| 132,0... | 8.... | 132,... |

- Outer knob changes the frequency non-decimal digits in steps of 1 MHz for both VHF and VOR/LOC.

**11 - NORMAL/EMERGENCY MODE SELECTOR KNOB/BUTTON**

- When knob rotated clockwise selects normal Mode.
- When knob rotated counterclockwise selects Emergency Mode.
- On airplanes Post-Mod. SB 145-23-0003 or with an equivalent modification factory incorporated, the EMRG button toggles the Emergency mode on and off.

**12 - TRANSFER BUTTON**

- Alternately selects between the COM frequency (top) or the NAV frequency (bottom) to be connected to the Tuning Knobs.
- In the NAV only or COM only configurations, toggles the active (top) frequency with the preset (bottom) frequency. In addition, holding the button down for two seconds will remove the preset frequency and place the unit in the Direct Tuning Mode. To return to the Active/Preset Tuning Mode, hold down the transfer key for two seconds.

**13 - RADIO TUNING ANNUNCIATION**

- Identifies the frequency at the top and bottom lines.

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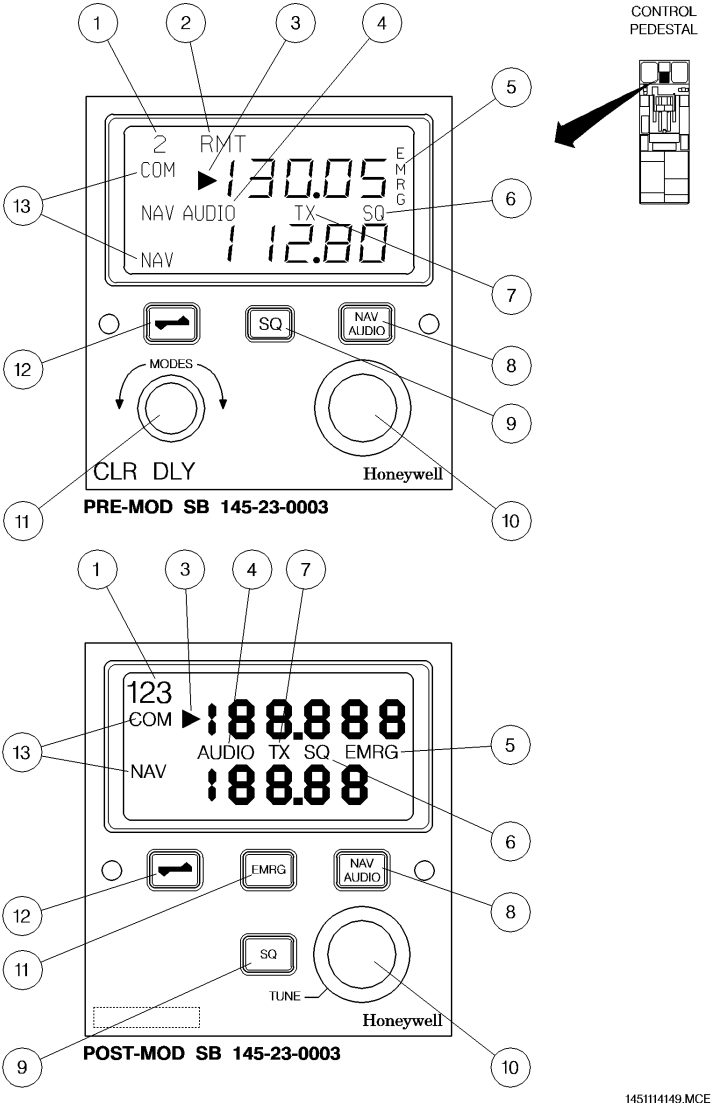


## TUNING BACKUP CONTROL HEAD

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# DIGITAL AUDIO PANEL

The EMB-145 is equipped with three individual Digital Audio Panels (DAP), one each for the captain, copilot and observer.

This unit allows each flight crew member to select an individual transceiver, the intercommunication function further permitting individual selection and audio level adjustment of the following communications equipment:

- VHF communication;
- Crew/ramp station intercommunication;
- Passenger address;
- Reception and amplification of the NAV/COM audio signals.

## NORMAL MODE

In the normal mode, each flight crew member may select one COM transceiver (VHF COM 1, VHF COM 2, VHF COM 3 or HF), the interphone function and, simultaneously, several audio receivers (COM 1, 2 and 3, HF, NAV 1 and 2, ADF 1 and 2, and DME 1 and 2).

Also, the unit may provide volume control for each radio equipment, microphone selection between Boom and Mask (Oxygen Masks), and audio output selection between Speakers and Headphones.

Other features are the capability to filter the NDB/VOR audio signals, attenuating morse code or voice signals. Finally, Normal Mode allows marker beacon audio sensitivity control, which also may silence temporarily that type of signal.

## EMERGENCY MODE

The pilot's, copilot's and observer's digital audio panels are supplied by ESS BUS 1, ESS BUS 2 and DC BUS, respectively. The emergency mode must be selected in case power supply fails to come to pilot's or copilot's digital audio panel, which does not mean that there is a fault of the supplying bus. Selecting the pilot's DAP EMER button automatically causes the pilot to be connected to COM 1 and NAV 1 and selecting the pilot's DAP EMER button automatically causes the copilot to be connected to COM 2 and NAV 2. The others buttons of the DAP that is in emergency mode will be disabled. These configurations are emergency modes that assure communication continuance. Only for the observer's DAP there is no alternative means to keep communication capability once its normal power supply is interrupted.
The interphone function will also be lost.

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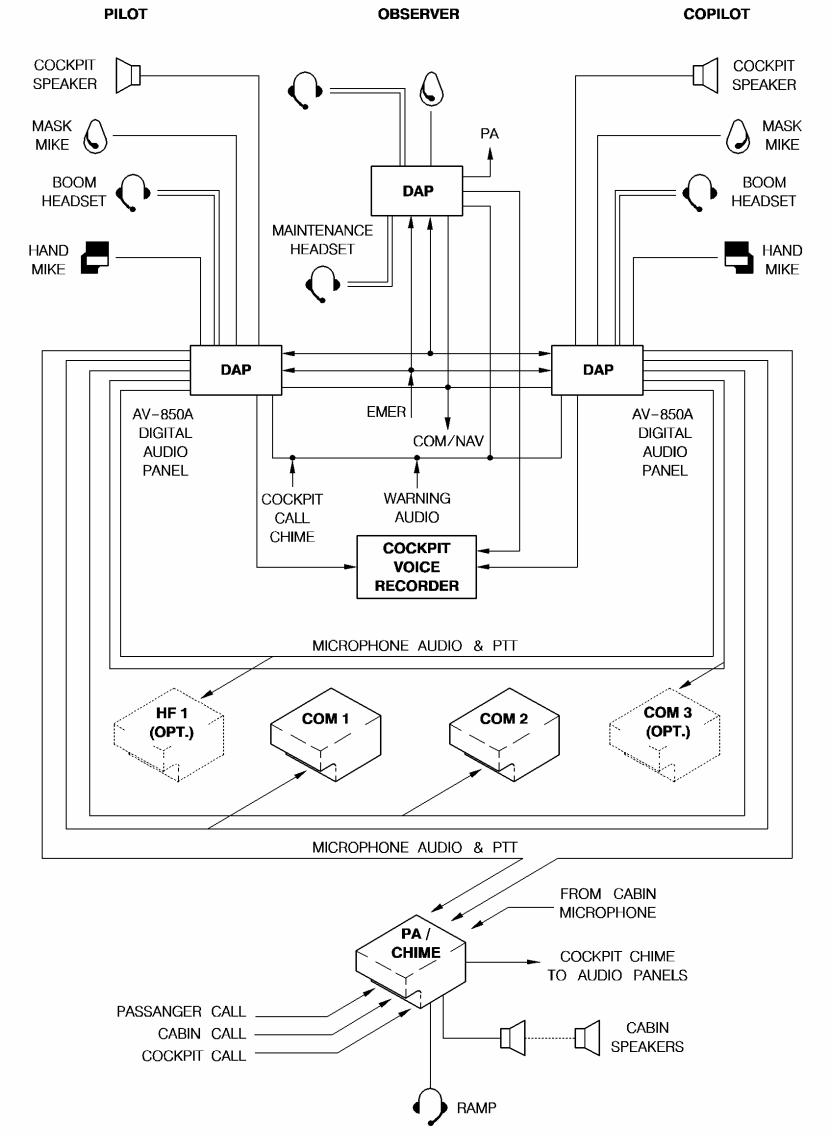
When power supply to the digital audio panel is resumed, the normal mode of operation may be reestablished by selecting any other MICROPHONE button (COM 1, 2, 3 or HF).




**COMMUNICATION SYSTEM SCHEMATIC**

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## DIGITAL AUDIO PANEL CONTROLS AND INDICATORS

### 1 - MICROPHONE SELECTOR BUTTONS

- When pressed enables transmission and reception of radio signals through the respective COM unit (COM 1, COM 2, COM 3, HF).
- Simultaneous selection of more than one microphone selector button is not possible. Pressing a different microphone selector button will cause the previously selected button to be deselected.
- A bar illuminates inside the button to indicate that it is pressed.

### 2 - AUDIO CONTROL KNOBS

- When depressed, turns on the associated COM/NAV audio.
- When rotated, provides volume control for the associated COM/NAV audio.

### 3 - PASSENGER BUTTON

- When pressed enables the crew to make the speech to the passenger cabin while simultaneously deselecting the previously selected COM transmitter.

### 4 - EMERGENCY BUTTON

- When pressed in case of interruption of power supply to the Digital Audio Panel, it automatically connects the microphone to the emergency COM mic outputs and headphone unit to COM and NAV audio.
- The captain is connected to COM 1 and NAV 1 and the copilot to COM 2 and NAV 2. Observer radio communications capability is lost.

### 5 - BOOM/MASK BUTTON

- Alternates selection between the boom (pressed) and the mask (released) microphones.

### 6 - ID/VOICE BUTTON

- When pressed (ID position), NDB and VOR audio signals are filtered in order to enhance morse code identification.
- When depressed (VOICE position), VOR/ILS audio signals are filtered in order to reduce morse code signal, enhancing the VOR/ILS voice associated messages (e.g., ATIS messages).

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**7 - HEADPHONE MASTER VOLUME CONTROL KNOB**

- Allows adjustment of headphone amplifier volume.

**8 - INTERPHONE SELECTOR KNOB**

- When depressed, enables communications between captain, copilot, observer, and ramp station via airplane interphone.
- When rotated, provides interphone volume control.

**NOTE:** To enable the interphone function the respective control wheel and observer communications switch must also be set at the HOT position.

**9 - MARKER BEACON SENSITIVITY/MUTE KNOB**

- The mute function is enabled by pressing the marker beacon sensitivity/mute knob and it is used to temporarily silence the marker beacon audio signal. The audio signal will be automatically re-enabled according the following schedule:
  - If the mute function was selected when the marker beacon audio level was above a certain threshold setting, the audio will be re-enabled 5 seconds after the audio level descends below that threshold setting.
  - If the mute function was selected when the marker beacon audio level was below that threshold setting, the audio signal will be mute during 20 seconds, and then it will be re-enabled.
- The marker beacon sensitivity/mute knob, when rotated, also controls the sensitivity of the Marker Beacon receiver.

**10 - MARKER BEACON VOLUME KNOB**

- When rotated, allows to control the marker beacon audio volume.

**NOTE:** Does not allow volume settings below a certain level in order to prevent the marker beacon audio from being adjusted too low to be heard, that the marker signal could be missed.

**11 - SIDETONE KNOB**

- This knob selects the speaker ON (depressed) or OFF (pressed). It must be pressed when the headphones are used.
- The sidetone control is made by rotating the sidetone knob, which prevents undesirable feedback of speaker sidetone audio into the transmitting microphone.

**12 - SPEAKER MASTER VOLUME CONTROL KNOB**

- When rotated, allows adjustment of speaker volume.

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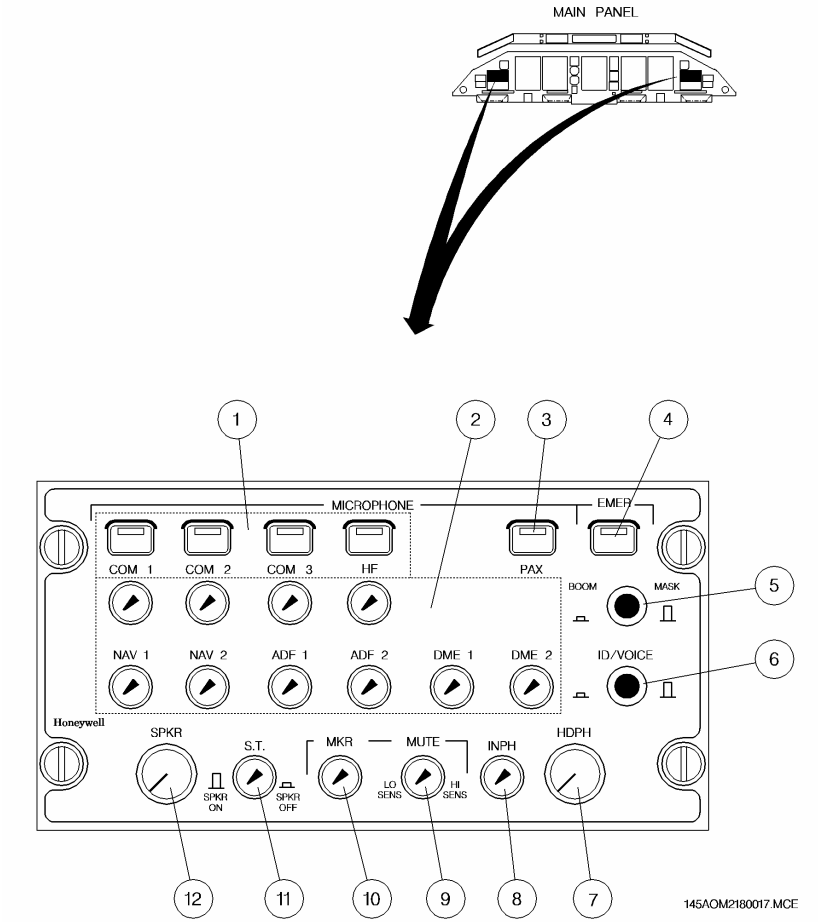


**DIGITAL AUDIO PANEL**

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## EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | CHECK XPDR | The transponder is not operational. |

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# COMMUNICATION CONTROLS AND INDICATORS

## COCKPIT

CONTROL WHEEL COMMUNICATIONS SWITCH (PTT)

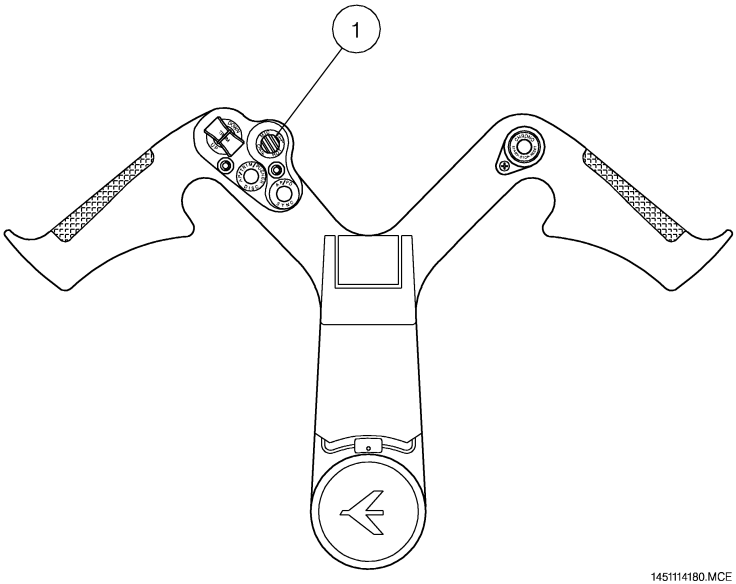
### 1 - CONTROL WHEEL COMMUNICATIONS SWITCH

PTT POSITION - Momentary position. When pressed allows VHF and HF transmissions and speech to the passengers through Passenger Address System. Releasing this button, it returns to the HOT position and VHF, HF or passenger cabin transmissions will be interrupted.

**NOTE:** For VHF transmissions, a continuous command of PTT switch is limited to 2 minutes. If the PTT switch is pressed longer than 2 minutes, the message MIC STK will be displayed on RMU, and the microphone will be disabled.

HOT POSITION - Allows communication between crew members and between crew members and ramp station.

OFF POSITION - Allows only audio reception.

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**CONTROL WHEEL**

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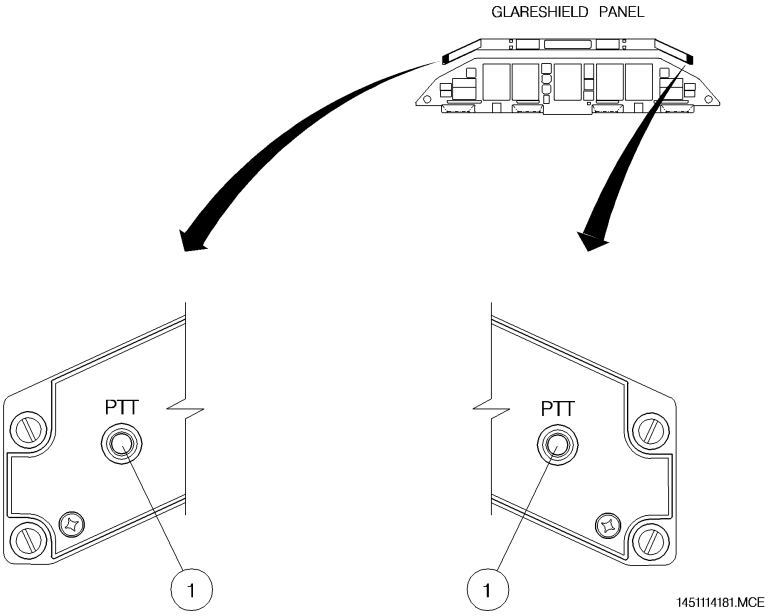
GLARESHIELD COMMUNICATION SWITCH (PTT)

**1 - GLARESHIELD MIC PTT BUTTON**

– When pressed allows VHF and HF transmission and speech to passengers through the Passenger Address System. Releasing this button will interrupt transmission.




**GLARESHIELD PANEL**

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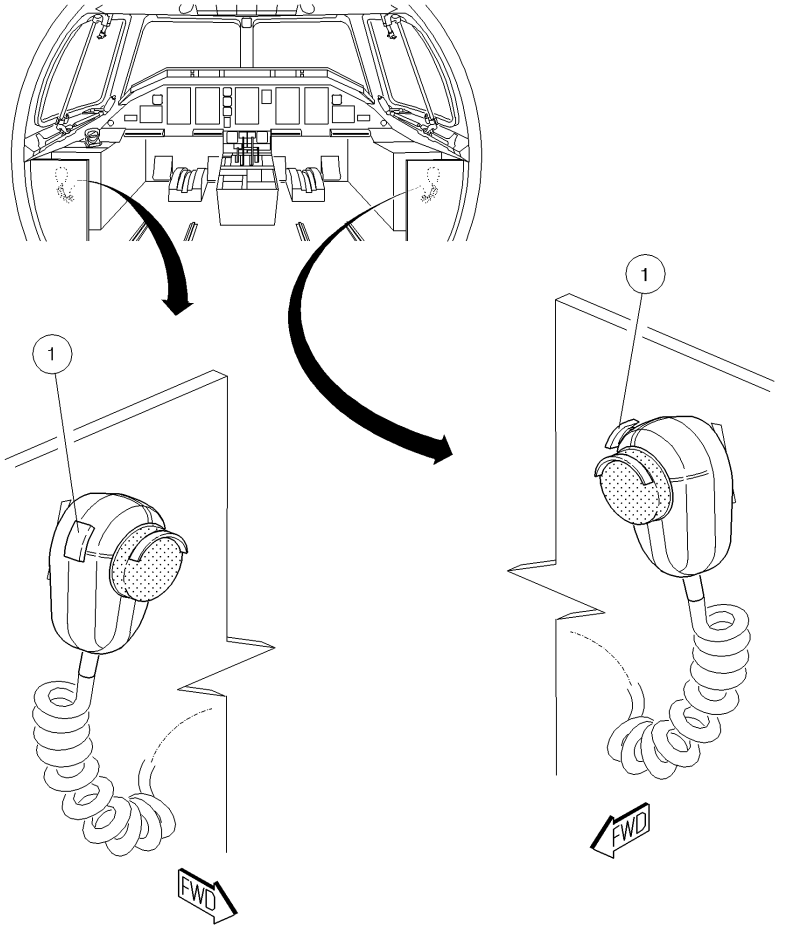
CAPTAIN AND COPILOT HAND MICROPHONE

**1 - HAND MIC PTT BUTTON**

- When pressed allows VHF and HF transmission and speech to passengers through the Passenger Address System. Releasing this button will interrupt transmission.

PILOT AND COPILOT CONSOLES

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**PILOT AND COPILOT CONSOLE**

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CAPTAIN AND COPILOT JACK PANELS

**1 - CAPTAIN AND COPILOT JACKS**

– Allows plugging-in the headphone, the boom microphone, and the hand microphone.

**2 - HEADSET ANR**

– Allows plugging-in the headphone with the Active Noise Reduction feature.

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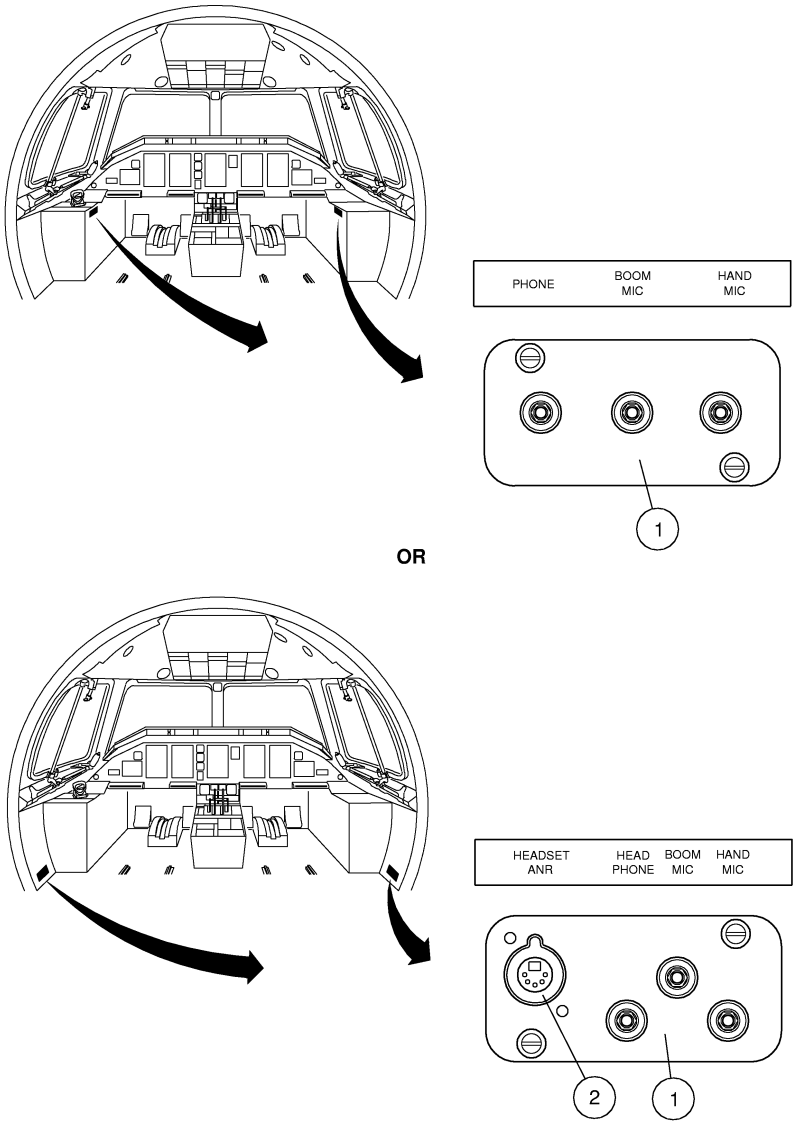


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## CAPTAIN AND COPILOT JACK PANELS

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OBSERVER JACK PANEL AND COMMUNICATION SWITCH (PTT)

**1 - BOOM JACK**

- Allows plugging-in the boom microphone.

**2 - HEADPHONE JACK**

- Allows plugging-in in the headphone.

**3 - OBSERVER MICROPHONE SWITCH**

HOT POSITION - Allows communication with crew members and ramp station.

OFF POSITION - Allows only audio reception.

PTT POSITION - Momentary position. When pressed allows VHF and HF transmissions and speech to passengers through the passenger address system. Releasing this button, it returns to the OFF position and transmissions will be interrupted, remaining only in audio reception.

**4 - HEADSET ANR**

- Allows plugging-in in the headphone with the Active Noise Reduction (ANR) feature. The Sennheiser headset model HMEC25-CAP is certified for ANR function. A switch in the headset cord activates or deactivates the active noise reduction feature. If the noise reduction feature malfunctions the headset must be used with this feature disabled.

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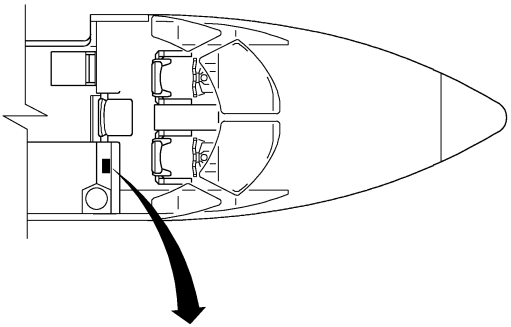
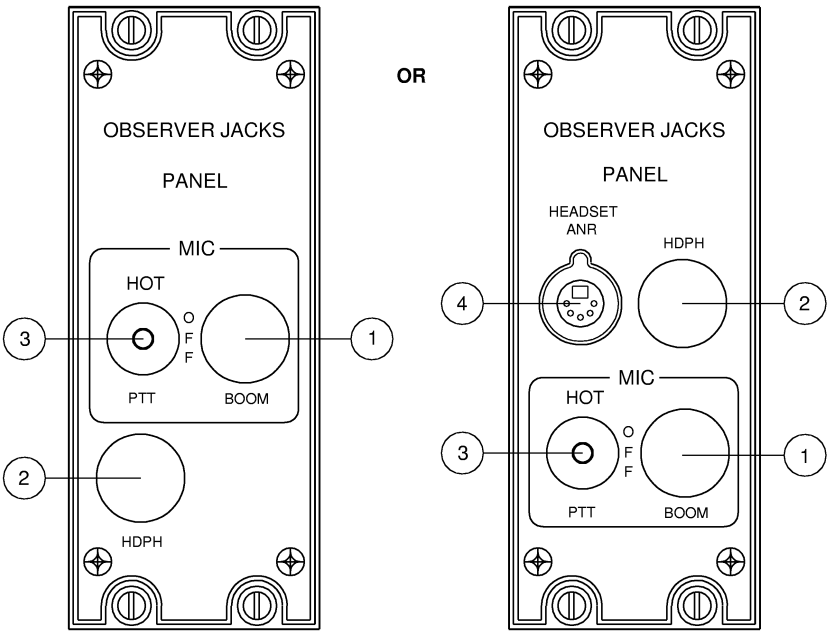
RIGHT AFT CONSOLE



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## OBSERVER JACK PANEL

## RAMP STATION

FRONT AND REAR RAMP PANELS

**1 - COCKPIT CALL BUTTON (momentary action)**

- When pressed, generates a tone in the headphones and cockpit speakers.

**2 - MICROPHONE/HEADPHONE JACK**

- Allows ramp crew to plug in a headphone and a microphone equipped with a PTT Button.

**NOTE:** Ground crew panel is linked to the Hot Mic.

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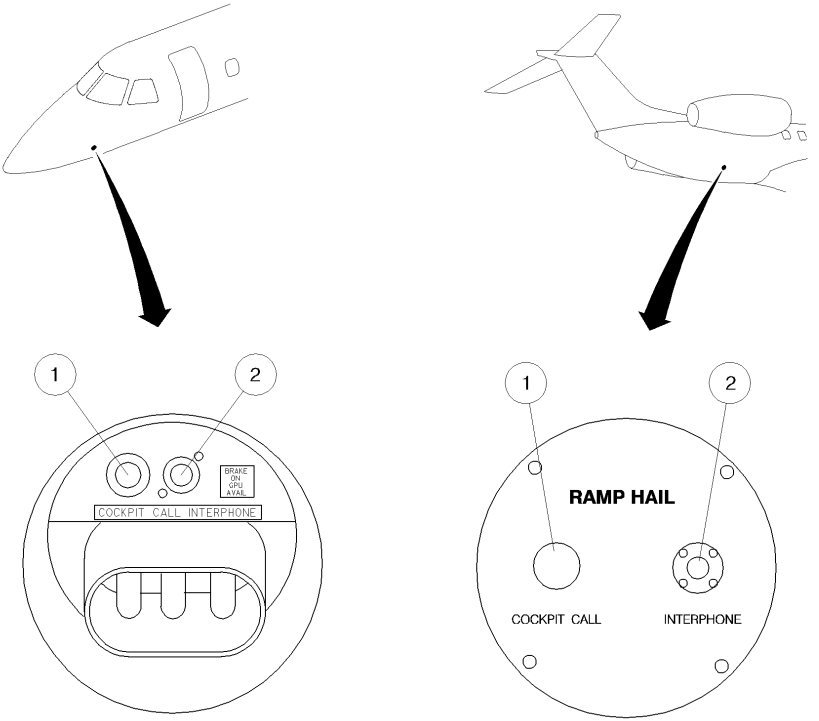


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## FRONT AND REAR RAMP PANELS

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# HF COMMUNICATION SYSTEM - HF-230

The airplane may be equipped with a HF-230 High-Frequency Communication System. All functions of the HF-230 System are controlled by the CTL-230 Control Panel located at the control pedestal.

## HF OPERATING MODES

The HF-230 High-Frequency Communications System provides the following operating modes:

AMPLITUDE MODULATION

Amplitude modulation (AM) is a transmission process in which a selected frequency (called carrier frequency) and two sidebands (frequencies above and below the carrier) are generated and transmitted. The upper sideband (USB) is the sum of the carrier frequency and the voice, while the lower sideband (LSB) is the difference between the two. The disadvantages of AM are that it occupies a wide spectrum and is inefficient in the sense that a great deal of unneeded carrier is generated, as well as redundant information in the unused sideband.

SINGLE SIDEBAND

Single sideband operation achieves the same function as AM with considerably greater efficiency. The SSB transmitter electronically eliminates most or all of the carrier wave and one of the sidebands. The major advantages of SSB (either USB or LSB) as opposed to AM are greater talking power (about eight times that of AM for a given power input), reduced power drain, longer range and conservation of the spectrum (since only one sideband is required to transmit the message).

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SUPPRESSED CARRIER AND REDUCED CARRIER

The SSB operation with the carrier frequency eliminated is referred to as single sideband suppressed carrier and is designated as the TEL SUP CAR mode in the HF-230.
If a small portion of the carrier frequency is transmitted along with the sideband, then the operation is referred to as single sideband reduced carrier. and is designated as the TEL PLT CAR mode in the HF-230.

SIMPLEX AND HALF-DUPLEX OPERATION

Simplex operation means that the transmission and reception frequencies are the same. An example of simplex operation would be communications with a control tower using a VHF COMM transceiver. Half-duplex means transmit on one frequency and reception on another frequency. All 176 of the ITU channels provided the HF-230 are permanently programmed for half-duplex operation and will normally be worked in the TEL SUP CAR mode. The 40 user programmed channels can be programmed for either simplex or half-duplex operation, and can operate in any of the available modes (AM, USB, LSB, TEL SUP CAR, or TEL PLT CAR).

**NOTE:** The use of LSB is legal for some international and off-shore communications, but is not authorized for use in the United States and most European countries.

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# HF NORMAL OPERATION

There are two types of operation:

- Discrete frequency tuning.

- Programmable channel.

## DISCRETE FREQUENCY TUNING OPERATION

In the discrete frequency mode of operation, the user may directly tune any one of 280,000 frequencies over the range of 2.0 to 29.9999 MHz.

1 - Access discrete frequency operation.

Apply power to the system by rotating the volume (V) knob clockwise from the OFF position.
With power applied to the system, ensure that the CHAN/FREQ switch is in the FREQ position.
This can be confirmed by noting that four dashes appear in the CHAN display.

2 - Enter the frequency.

Use the four frequency select knobs to enter the desired frequency in the FREQ kHz display.

3 - Select the transmission mode.

Pull out and rotate the left inner (PULL MODE) knob in either direction, to assign one of the available operating modes (USB, LSB, AM, TEL SUP CAR, or TEL PLT CAR).

4 - Tune the antenna.

Momentarily key the PTT to initiate the antenna coupler tuning cycle. A steady 1000-Hz tone will be heard in the headset or speaker while the antenna coupler is been tuned. Approximately 1 second after antenna coupler tuning cycle is completed (tuning cycle may require from 5 to 30 seconds), the 1000-Hz tone will cease, indicating that the system is ready for use on the selected frequency. Adjust volume (V) and squelch (S) controls as desired.

**NOTE: -** The discrete frequency mode always provides simplex operation (transmit and receive frequencies are the same).

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- Always key the PTT after selecting a new frequency to initiate the antenna coupler tuning cycle. If this is not done, you may experience poor reception or miss important calls.
- During operation, if the receive (R) or transmit (T) annunciators on the CTL-230 flash, this indicates that the receive or transmit (as applicable) frequency data does not match that being sent by the CTL-230. An equipment malfunction is probable and the system should be checked by maintenance personnel.

## PROGRAMMABLE CHANNEL OPERATION

In the channel mode operation, the user may select ITU and user programmed channels by their channel numbers. For user programmed channels:

1 - Access channelized operation.
Apply power to system (rotate the V knob from the OFF position), and position the CHAN/FREQ switch to the CHAN position.

2 - Rotate the left outer channel select knob until user channel 1 or 40 appears on the right side of the CHAN display. Use the right outer channel select knob to select the desired channel number within the user programmed channels.

3 - Tune the antenna.
Momentarily key the PTT to initiate antenna coupler tuning cycle. Adjust volume and squelch controls, as desired.

### THE 40 USER CHANNELS PROGRAMMING PROCEDURE

The 40 user programmable channels available in the HF-230 system can be programmed on the ground or in flight. All programmed information is stored in a nonvolatile memory and can be recalled by selecting the desired user channel number.

There are three types of channels that can be programmed:

1 - Half-duplex
The user programs two different frequencies, one for receive and one for transmit. The user also assigns one of the available operating modes (USB, LSB, AM, TEL SUP CAR, or TEL PLT CAR) to the selected channel. Half-duplex operation is available only when the HF-230 is being operated in the CHAN mode.

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2 - Simplex

The user programs the same frequency for receive and for transmit. The user also assigns one of the available operating modes (USB, LSB, AM, TEL SUP CAR, or TEL PLT CAR) to the selected channel. Simplex operation is used by ARINC, ATC (Air Traffic Control), and others.

3 - Receive-only

The user programs a frequency for reception and assigns one of the available operating modes (USB, LSB, AM, TEL SUP CAR, or TEL PLT CAR), but does not program a transmit frequency.
The transmitter and power amplifier are locked out and cannot be used when a channel has been programmed for receive-only operation.

Receive-only channels are used to listen to frequency standards (WWV) for example, time, weather, Omega status, and geophysical alert broadcasts

HALF-DUPLEX CHANNEL PROGRAMMING PROCEDURE

1 - Access channelized operation.
Apply power to the system by rotating the volume (V) knob clockwise from the OFF position. With power applied to the system, ensure that the CHAN/FREQ switch is in the CHAN position.

2 - Select the desired user channel.

Rotate the left outer channel select knob in either direction until user channel 1 or 40 appears at the right side of the CHAN display. Then use the right outer channel select knob to select the desired channel number (from 1 to 40) that you wish to program.

3 - Initiate program mode.

Press the program (PGM) button once to initiate the programming sequence. At this point, the entire display on the CTL-230 will slowly begin to blink.

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4 - Enter the receive frequency and mode of operation.

Set the desired receive frequency using the four frequency select knobs. This procedure is identical to tuning a discrete frequency which has been previously described. The receive frequency will appear in the FREQ kHz display. Next, select the desired operating mode (USB, LSB, AM, TEL SUP CAR, or TEL PLT CAR) by pulling out on the PULL MODE knob and rotating it until the appropriate mode appears in the MODE display.

5 - Store the receive frequency and mode of operation.

With the desired receive frequency and mode being displayed, press the PGM button once again to store the data. The CTL-230 display will blank for a short period of time to confirm storage.

6 - Enter and store the transmit frequency.

When the display returns, it will be blinking faster with the transmit frequency displayed (initially this is the same as the already programmed receive frequency). At this point, you have approximately 20 seconds to begin entering the desired transmit frequency. If no changes are made during the next 20 seconds, the currently displayed transmit frequency will become invalid and you will have created a receive-only channel. Set the desired transmit frequency using the four frequency select knobs. This procedure is identical to entering the receive described above. With the desired transmit frequency shown in the FREQ kHz display, press the PGM button once again to store the data.

As before, the CTL-230 display will blank for a short period of time to confirm storage. The display will then return to normal with the new channel data (channel number, mode, and receive frequency) showing.

7 - Tune the antenna.

Momentarily key the PTT to initiate the antenna coupler tuning cycle. Adjust the volume (V) and squelch (S) controls, as desired.

**NOTE:** If additional user channels are to be programmed, repeat steps 2 through 6 at this time. Ensure that you make and keep for reference a list of channel numbers, and the receive and transmit frequencies, as well as the mode of operation that are programmed on the individual channels.

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SIMPLEX CHANNEL PROGRAMMING PROCEDURE

When you program a channel for simplex operation, both the receive and the transmit frequencies will be the same. Programming a simplex channel is similar to programming a half-duplex channel, except the PGM button is pressed twice after the receive frequency and mode of operation are entered to store the frequency in both the receive and the transmit positions.

RECEIVE-ONLY CHANNEL PROGRAMMING PROCEDURE

When you program a channel for receive-only operation, only a receive frequency is entered and stored. Programming a receive-only channel is similar to programming a simplex channel except the PGM button is pressed only once after the receive frequency and mode of operation are entered. The programming sequence is then terminated without entering a transmit frequency.

Program sequence can be terminated in any one of the three ways:
- By momentarily keying the PTT.
- By positioning the CHAN/FREQ switch to FREQ and then back to CHAN.
- By waiting for the 20-second timer to run out (this is the preferred method).

THE 176 ITU CORRESPONDENCE CHANNELS OPERATION

The 176 ITU (International Telecommunication Union) public correspondence channels (and their receive and transmit frequencies) in the maritime radiotelephone network are permanently programmed in the nonvolatile memory of the CTL-230 Control. The 176 ITU channels all operate half-duplex in TEL SUP CAR (preferred) or TEL PLT CAR modes only.

Perform the following steps to operate on the ITU channels:

1 - Access channelized operation.

Apply power to the system by rotating the volume (V) knob clockwise from the OFF position.
With power applied to the system, ensure that the CHAN/FREQ switch is in the CHAN position.

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2 - Select the desired ITU channel.

Rotate the left outer channel select knob in either direction until the desired ITU band appears in the one or two left-hand digits in the CHAN display. Next use the right outer channel select knob to select the individual channel number within the ITU band (the two right-hand digits in the CHAN display.
When the ITU channel numbers have been entered, the airplane receive frequency will appear in the FREQ kHz display and the R annunciator will be illuminated.

**NOTE:** Refer to a list of the ITU maritime radiotelephone channels to see that the above incrementing and decrementing changes are consistent with the actual ITU channel numbers.

3 - Select the operating mode.

Pull out and rotate the left inner (PULL MODE) knob in either direction to select between TEL SUP CAR or TEL PLT CAR mode.
When the mode has been selected, push the knob back in.

4 - Tune the antenna.

Momentarily key the PTT to initiate the antenna coupler tuning cycle. A steady 1000-Hz tone will be heard in the headset or speaker while the antenna coupler is tuning. Approximately 1-second after completion of the antenna coupler tuning cycle (tuning cycle may require from 5 to 30 seconds), the 1000-Hz tone will cease, indicating that the system is ready for use on the selected ITU channel. Adjust volume (V) and squelch (S) controls as desired.
When transmitting, the receive frequency and R annunciator in the FREQ kHz display are replaced with the aircraft transmit frequency and a T annunciator.

FAULT INDICATION

If the antenna coupler does not tune after approximately 35 to 40 seconds, the steady 1000-Hz tone will begin to beep, indicating a fault has occurred. To clear the fault, simply rotate one of the Frequency/Channel Select Knobs away from and then back to the desired frequency or channel and initiate another tuning cycle by momentarily pressing the PTT button. The 1000-Hz tone should again be heard and then disappear at the end of the tuning cycle. If the beeping recurs, try the clearing procedure a second time. If a fault is still indicated, there is probably an equipment malfunction.

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# HF CONTROLS AND INDICATORS

## CTL-230 CONTROL PANEL

### 1 - GAS DISCHARGE DISPLAY

- Shows channel number (CHAN), mode of operation (MODE), transmit and receive frequency in kilohertz, and separate R (receive) and T (transmit) annunciators.

### 2 - CHANNEL FREQUENCY SELECT KNOBS

- Knob functions when selecting a discrete frequency

| FREQUENCY SELECT KNOB | KNOB FUNCTION |
|---|---|
| Left outer | Selects the MHz digits (2 through 29) in the FREQ kHz display. |
| Left inner (pushed in) | Selects the 100-kHz digit (0 through 9) in the FREQ kHz display. |
| Left inner (pulled out) | Rotate to select USB, AM, LSB modes. |
| Right outer | Selects the 10-kHz digit (0 through 9) in the FREQ kHz display. |
| Right inner (pushed in) | Selects the 1-kHz digit (0 through 9) in the FREQ kHz display. |
| Right inner (pulled out) | Selects the 100-Hz digit (0 through 9) in the FREQ kHz display. |

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– Knob functions when selecting a user programmed channel.

| CHANNEL SELECT KNOB | KNOB FUNCTION |
|---|---|
| Left outer | Rotate until brings up user channel number 1 or 40. If user channel 1 is being displayed, the next clockwise increment of the knob will cause ITU channel 401 to be displayed, then 601, 801, and on. User channels are designated by 1-or 2-digit channel numbers appearing at the right side of the CHAN display (the left two or three digits are blanked). |
| Left inner (pushed in or pulled out) | No effect on user channels. |
| Right outer | With user channel 1 displayed, clockwise rotation of this knob will increment through the 40 user channels one channel at a time. The next increment past user channel 40 will cause the lowest ITU channel number (401) to be called up. With user channel 40 displayed, counterclockwise rotation of the right outer knob will decrement through the user channels, 1 channel at a time. The next decrement past user channel 1 will cause the highest ITU channel number (2510) to be called up. |
| Right inner (pushed in or pulled out) | No effect on user channels. |

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– Knob functions when selecting an ITU telephone channel

| CHANNEL SELECT KNOB | KNOB FUNCTION |
|---|---|
| Left outer | This knob is used to select the ITU band (the one or two left-hand digits in the CHAN display). Clockwise rotation of the knob increments the CHAN display to the next higher ITU band and counterclockwise rotation decrements to the next lower ITU band. If ITU channel 401 is being displayed, the next clockwise increment of the knob will cause ITU channel 601 to be displayed, then 801, 1201, 1601, and 2201. Rollover occurs between the top ITU band (22 MHz) and user programmed channel number 1, and between the lowest ITU band (4 MHz) and user programmed channel number 40. |
| Left inner (pushed in) | No effect on ITU channels. |
| Left inner (pulled out) | Rotate to select between TEL SUP CAR and TEL PLT CAR models. |
| Right outer | This knob selects the individual channel number within the ITU band (the two right-hand digits in the CHAN display). If the channel number is incremented beyond the highest channel for that band, the lowest channel for the next higher band will appear.<br>For example, if ITU channel 427 is being displayed, the next clockwise increment of the knob will cause ITU channel 601 to be displayed. Likewise, decrementing below the lowest channel in a band will select the highest channel in the next lower band. |
| Right inner (pushed in or pulled out) | No effect on ITU channels |

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### 3 - PROGRAM BUTTON

- Allows the user to store frequencies in the 40 user programmed channels (refer to Programmable Channel Operation section for proper operation).

### 4 - CHANNEL/FREQUENCY SWITCH

- The channel/frequency select knobs are used to select the desired user channel or ITU telephone channel number (CHAN/FREQ switch positioned to CHAN) or the proper transmit and receive frequencies when operating in the discrete frequency mode number (CHAN/FREQ switch positioned to FREQ). The knobs are also used to enter frequencies when programming the user channels number (CHAN/FREQ switch positioned to CHAN).

### 5 - SQUELCH/TEST CONTROL

- This knob is adjusted to mute undesired background noise. The noise proper setting is made by rotating the S (squelch) knob clockwise from TST (test) position until background noise can be heard and by turning it counterclockwise until the background noise disappears or is just barely audible.
- When the S knob is in the TST position, the squelch circuit is, in effect, removed from the receiver audio circuit in the TST, maximum background noise (depending on the volume control setting) will be heard.
- Setting the squelch control too far clockwise can result in blocking out weak signals. There are times when it will be necessary to leave the squelch control in the TST position to maintain satisfactory reception. This is because of conditions relating to propagation and the ionosphere that causes the HF receiver to operate with a signal that is subject to considerable fading and which is marginally strong.

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## 6 - OFF/ CLARIFIER CONTROL

- Concentric with the volume knob, and sharing the same OFF position, the CLAR knob is used when receiving SSB signals that may be slightly off frequency.
- The CLAR knob can help eliminate unnatural sounds when receiving USB, LSB, or either of the telephone modes.
- The clarifier function does not affect AM reception, and is disabled during transmit or when the CLAR knob is set to OFF position.
- To operate the clarifier, rotate the CLAR knob clockwise from off until the centering dot is visible on the knob skirt at the mid rotation point. This is the neutral or zero shift position. From this position, the CLAR knob is adjusted clockwise or counterclockwise for the best clarity or the most natural sound of the signal being received.

**NOTE:** When the audio quality of the received SSB signal is good and natural sounding, the CLAR knob should remain in the OFF position.

## 7. OFF/VOLUME CONTROL

- Turns system off and on and controls volume. Rotating the V knob clockwise from the OFF position turns the system on. Continued clockwise rotation increases audio level. When the system is turned OFF, the discrete frequency or channel, and mode of operation displayed on the CTL-230 will be stored in nonvolatile memory and will be restored to the display the next time the system is turned on.

**NOTE:** It is recommended that the HF-230 system be turned on at least 15 minutes before use, to ensure frequency stability under varying environmental conditions.

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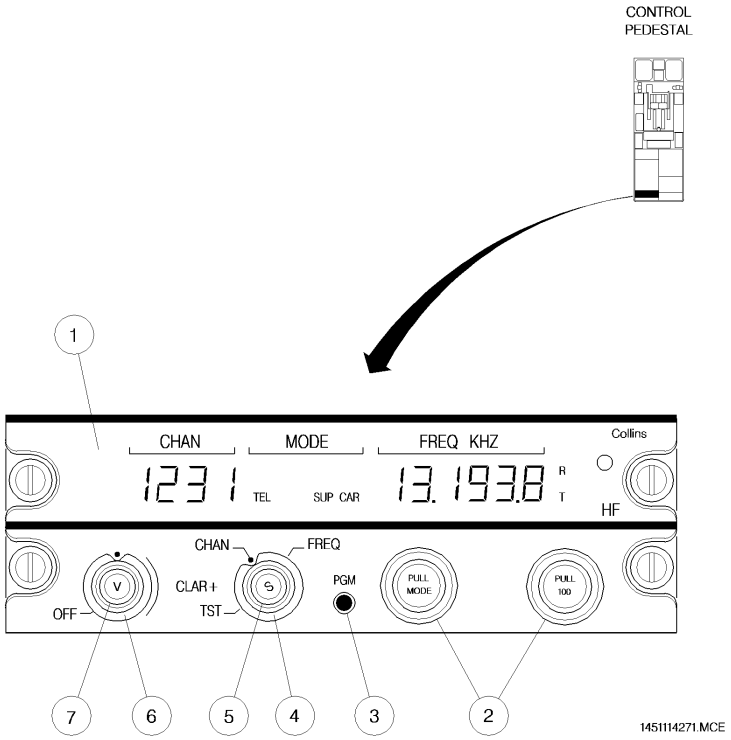


CTL-230 HF CONTROL PANEL

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# HF COMMUNICATION SYSTEM - KHF-950

The airplane may be equipped with a KHF-950 or KHF-1050 High-Frequency Communication System. All functions of the KHF-950 System are controlled by the KCU-951 or KFS-954 Control Panel located at the control pedestal. For airplanes equipped with KHF-1050, refer to section 2-18-11.

## HF OPERATING MODES

The KHF-950 High-Frequency Communications System provides the following operating modes:

AMPLITUDE MODULATION

Amplitude modulation (AM) is a transmission process in which a selected frequency (called carrier frequency) and two sidebands (frequencies above and below the carrier) are generated and transmitted. The upper sideband (USB) is the sum of the carrier frequency and the voice, while the lower sideband (LSB) is the difference between the two. The disadvantages of AM are that it occupies a wide spectrum and is inefficient in the sense that a great deal of unneeded carrier is generated, as well as redundant information in the unused sideband.

SINGLE SIDEBAND

Single sideband operation achieves the same function as AM with considerably greater efficiency. The SSB transmitter electronically eliminates most or all of the carrier wave and one of the sidebands. The major advantages of SSB (either USB or LSB) as opposed to AM are greater talking power (about eight times that of AM for a given power input), reduced power drain, longer range and conservation of the spectrum (since only one sideband is required to transmit the message).

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SUPPRESSED CARRIER AND REDUCED CARRIER (OPTIONAL)

The SSB operation with the carrier frequency eliminated is referred to as single sideband suppressed carrier and is designated as the A3J mode in the KHF-950.
If a small portion of the carrier frequency is transmitted along with the sideband, then the operation is referred to as single sideband reduced carrier, and is designated as the A3A mode in the KHF-950.

SIMPLEX, SEMI-DUPLEX AND RECEIVE-ONLY OPERATION

Simplex operation means that the transmission and reception frequencies are the same. An example of simplex operation would be communications with a control tower using a VHF COMM transceiver. Semi-duplex means transmit on one frequency and reception on another frequency.
Receive-only operation allows the system to operate as a receptor only.
The 99 user programmed channels can be programmed for either simplex, semi-duplex or receive only operation, and can operate in any of the available modes (AM, USB or LSB).

**NOTE:** The use of LSB is legal for some international and off-shore communications, but is not authorized for use in the United States and most European countries.

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# HF NORMAL OPERATION

There are two types of operation:

- Discrete frequency tuning.
- Programmable channel.

## DISCRETE FREQUENCY TUNING OPERATION

In the discrete frequency mode of operation, the user may directly tune any one of 280,000 frequencies over the range of 2.0 to 29.9999 MHz.

1 - Access discrete frequency operation.

Apply power to the system by rotating the volume (V) knob clockwise from the OFF position. Wait for about two minutes, until the system has warmed up. Until then, no frequency is displayed. Make sure that the FREQ/CHAN button is depressed, in the FREQ position. Confirm this by seeing that no channel number is annunciated in the frequency display. If the button is pressed, a momentary press unlatches it and engages FREQ (direct tune) operation.

2 - Select the transmission mode.

Press the mode button to select the transmission mode (USB, LSB or AM).

3 - Enter the frequency.

Each digit in a frequency is selected individually. The large concentric knob on the lower right of the control unit may be rotated in either direction and causes one of the displayed frequency digits to flash. This flashing “cursor” indicates which frequency digit will be changed by rotating the smaller concentric knob. Rotate the larger knob until the digit you wish to change flashes, and then select the desired number into view by rotating the smaller knob.

4 - Tune the antenna.

Momentarily key the PTT to initiate the antenna coupler tuning cycle. During the tuning process the TX annunciator will flash and the frequency numbers will blank. When the TX stops flashing and the frequency reappears , the antenna tuning cycle is complete and you are ready to transmit on the selected frequency.

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**NOTE: -** The discrete frequency mode always provides simplex operation (transmit and receive frequencies are the same).

**-** Always key the PTT after selecting a new frequency to initiate antenna tunning, otherwise you may experience poor reception or miss an important call.

## PROGRAMMABLE CHANNEL OPERATION

In the channel mode operation, the user may select user programmed channels by their channel numbers. For user programmed channels:

1 - Access channelized operation.
Apply power to system (rotate the VOLUME knob from the OFF position). Wait for about two minutes, until the system has warmed up. Until then, no frequency is displayed. Make sure that the FREQ/CHAN button is pressed, in the CHAN position.

2 - Select the channel.
Rotate the small inner concentric knob to select the desired channel number.

3 - Tune the antenna.
Momentarily key the PTT to initiate antenna coupler tuning cycle. Adjust volume and squelch controls, as desired.

THE 99 USER CHANNELS PROGRAMMING PROCEDURE

The 99 user programmable channels available in the KHF-950 system can be programmed on the ground or in flight. All programmed information is stored in a nonvolatile memory and can be recalled by selecting the desired user channel number.

There are three types of channels that can be programmed:

1 - Semi-duplex
The user programs two different frequencies, one for receive and one for transmit. The user also assigns one of the available operating modes (USB, LSB or AM) to the selected channel. Semi-duplex operation is available only when the KHF-950 is being operated in the CHAN mode.

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2 - Simplex

The user programs the same frequency for receive and for transmit. The user also assigns one of the available operating modes (USB, LSB or AM) to the selected channel. Simplex operation is used by ARINC, ATC (Air Traffic Control), and others.

3 - Receive-only

The user programs a frequency for reception and assigns one of the available operating modes (USB, LSB or AM), but leaves the transmit portion of the preset channel blank.
The transmitter and power amplifier are locked out and cannot be used when a channel has been programmed for receive-only operation.

Receive-only channels are used to listen to frequency standards (WWV) for example, time, weather, Omega status, and geophysical alert broadcasts.

SEMI-DUPLEX CHANNEL PROGRAMMING PROCEDURE

1 - Access channelized and program mode.

Apply power to the system by rotating the VOLUME (V) knob clockwise from the OFF position. Make sure that the FREQ/CHAN button is pressed, in the CHAN position. Activate the program mode by pressing the PGM switch with a pointed object.

2 - Select the desired user channel.

Rotate the inner concentric knob to select the channel number to be programmed.

3 - Select emission mode.

Use the MODE button to select emission mode (USB, LSB or AM). Press the MODE button until the desired mode appears.

4 - Enter the receive frequency.

Use the outer larger concentric knob to position the flashing “cursor” on each digit of the receive frequency and use the smaller inner knob to select the desired number in each position.

5 - Store the receive frequency and mode of operation.

Push the STO button once and the receive frequency is entered in the electronic memory. The TX annunciator will begin to flash in the display window indicating the receive frequency is stored and you are ready to program the transmit frequency.

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6 - Enter and store the transmit frequency.

Use the outer larger concentric knob to position the flashing “cursor” on each digit of the transmit frequency and use the smaller inner knob to select the desired number in each position.

7 - Store the transmit frequency.

Push the STO button again and the transmit frequency is now stored. If additional user channels are to be programmed, repeat steps 2 through 7 at this time.

8 - Exit the program mode

Press the PGM switched with pointed object.

9 - Tune the antenna.

Momentarily key the PTT to initiate the antenna coupler tuning cycle. Adjust the volume (V) and squelch (S) controls, as desired.

SIMPLEX CHANNEL PROGRAMMING PROCEDURE

When you program a channel for simplex operation, both the receive and the transmit frequencies will be the same. Programming a simplex channel is similar to programming a semi-duplex channel, except the STO button is pressed twice after the receive frequency and mode of operation are entered to store the frequency in both the receive and the transmit positions.

RECEIVE-ONLY CHANNEL PROGRAMMING PROCEDURE

1 - Access channelized and program mode.

Apply power to the system by rotating the VOLUME (V) knob clockwise from the OFF position. Make sure that the FREQ/CHAN button is pressed, in the CHAN position. Activate the program mode by pressing the PGM switch with a pointed object.

2 - Stow the cursor.

Stow the “cursor” if a frequency digit is flashing. The cursor is stowed by rotating the larger concentric knob until no frequency digit is flashing. With the cursor stowed in the program mode, the smaller inner knob is now used to select a channel number to be programmed.

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3 - Select channel number.

Use the smaller inner concentric knob to select the channel number you wish to program. Simply rotate the smaller knob until the desired channel appears on the right side of the display.

4 - Select operating mode.

Push the MODE button until the appropriate mode (USB, LSB or AM) appears in the lower part of the display window.

5 - Set the frequency.

Move the “cursor” into position by rotating the larger concentric knob, and then use the smaller concentric knob to set the desired number under each “cursor” position.

6 - Store the information.

Push the STO (store) switch with a pointed object. The information you have entered will be stored in the electronic memory. After you push the STO button, the TX annunciator will flash indicating that the frequency you have just entered is stored in the receive position, but nothing is entered in transmit. Since a receive-only is being set, ignore the flashing TX.

7 - Exit the program mode.

Press the PGM switched with pointed object. All information you have stored is locked into CHANNEL memory.

FAULT INDICATION

If the system detects a fault during transmission or during the tuning of the antenna coupler, the frequency digits on the display begin to flash. Simply key the PTT button and the automatic antenna coupler begins a new tunning cycle to clear the fault.

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# HF CONTROLS AND INDICATORS

## KCU-951 CONTROL PANEL

### 1 - FREQUENCY DISPLAY

- Displays the operation frequency, in either FREQ or CHAN mode.

### 2 - MODE DISPLAY

- Displays emission mode, transmit indicator and program mode indication.

### 3 - CHANNEL DISPLAY

- Displays the set channel. If in FREQ mode, the channel display will not show numbers.

### 4 - PHOTOCELL

- Automatically adjusts the display brightness.

### 5 - MODE SWITCH

- Selects transmission and reception mode. Momentary depression cycles the KHF-950 from upper sideband (USB) to lower sideband (LSB) to AM.

### 6 - FREQ/CHAN SWITCH

- Allows the user to select between the two methods of frequency selection. In the FREQ mode (depressed switch) the user may direct tune any of the 280,000 available frequencies, simplex operation only. In the CHAN mode (pressed switch), the user presets the transmit and receive frequencies in up to 99 available channels.

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**7 - PROGRAM SWITCH**

- Used on the 99 user-programmed channels programming.

**8 - LARGER CONCENTRIC KNOB**

- Moves the “cursor” which selects the digit of the frequency to be changed.

**9 - SMALLER CONCENTRIC KNOB**

- Increments or decrements the frequency digit under the “cursor” (flashing digit).

**10 - STORE SWITCH**

- Used to store data when programming the user programmable channels.

**11 - POWER AND VOLUME KNOB**

- Turns the system on and off and controls volume. Clockwise rotation past the first click turns the system on. Further rotation increases audio level. After turning on, the system takes about two minutes to warm up. Until then, no frequencies are displayed.

**12 - SQUELCH KNOB**

- Reduces background noises when rotated counterclockwise. Must be set by rotating the knob clockwise until background noise can be heard and then turning it counterclockwise until background noise is eliminated or barely audible.

**13 - CLARIFIER KNOB**

- Clarifier is used only in SSB communications, and is not applicable to AM mode;
- It must be used when due to off frequency ground station transmissions the audio voice quality from KHF-950 may sound unnatural;

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– To operate the clarifier, pull the knob out and rotate the knob in either direction until the audio quality is optimized. When the knob is pushed in, the clarifier has no effect. When voice quality is good and natural, the carifier knob should remain pushed in.

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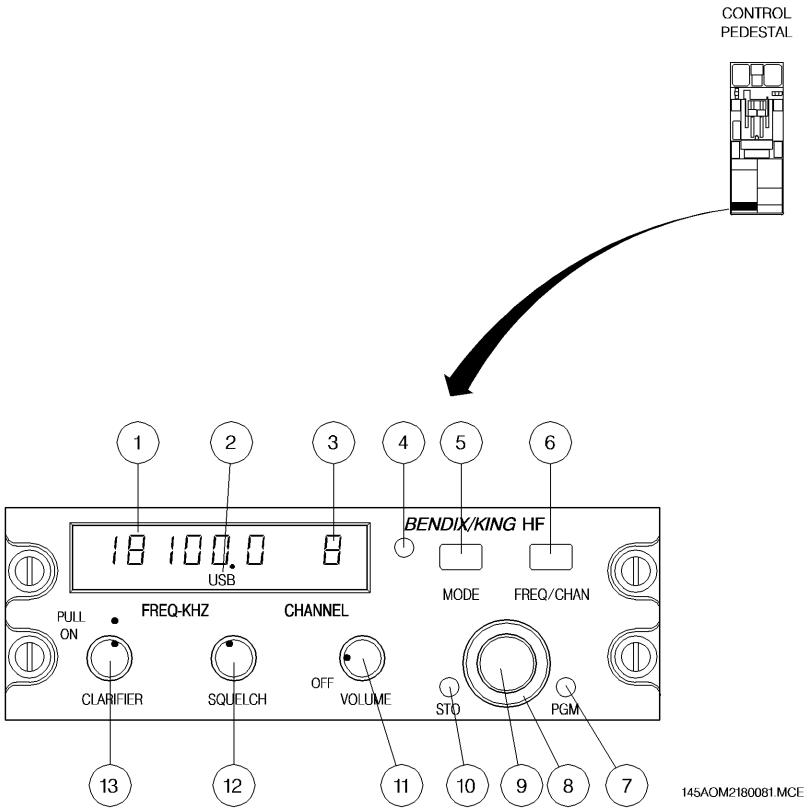


## KCU-951 CONTROL PANEL

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# HF COMMUNICATION SYSTEM - KHF-1050

The airplane is equipped with a single or DUAL KHF-1050 HF Communication System configuration.

Please refer to HF OPERATION, RMU DISPLAYS, RADIO PAGE, HF Memory Page and HF Control Page in the section 2-18-11, to get instructions regarding the KHF-1050 System Operation.

For DUAL KHF-1050 HF System Configuration, please refer to the following item in the Section: HF SELECTOR PANEL.

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# THIRD VHF COMMUNICATIONS SYSTEM

The airplane may be equipped with a third VHF Communications System. All functions of the Collins VHF-22A System are controlled by the CTL-22 VHF Control Panel located at the main panel.

The Avionics Master DC Bus 1 supplies the third VHF Communications System with a protective 5A circuit breaker.

## THIRD VHF COM CONTROLS AND INDICATORS

### 1 - ACTIVE FREQUENCY DISPLAY

- Displays the active frequency (frequency to which the equipment is tuned) and diagnostics messages.

### 2 - XFR/MEM SWITCH

- This is a 3-position, spring-loaded toggle switch.
- When held to the XFR position, the preset frequency is transferred up to the active display and the equipment retunes. The previously active frequency becomes the new preset frequency and is displayed in the lower window.
- When held to the MEM position, one of the six stacked memory frequencies is loaded into the preset display.
- Successive pushes cycle the six memory frequencies through the display.

### 3 - FREQUENCY SELECT KNOBS

- Two concentric knobs control the preset or active frequency displays.
- The large knob changes the digits to the left of the decimal point in 1 MHz steps.
- The smaller knob changes the digits to the right of the decimal point in 0.005 MHz steps.
- Numbers roll over at the upper and lower frequency limits.

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**4 - ACTIVE BUTTON**

- Push the ACT button for about 2 seconds to enable the frequency select knobs to directly retune the VHF-22A (active frequency).
- The bottom window will display dashes and the upper window will continue to display the active frequency.
- Push the ACT button a second time to return the control to the normal 2-display mode.

**5 - TEST BUTTON**

- The self-test diagnostic routine is initiated in the transceiver by pushing the TEST button.
- The active and preset display intensity will flash, modulating its brightness from minimum to maximum indicating self-test in progress.
- The active frequency display will show four dashes and the preset frequency display will show “00”.
- An audio tone will be heard from the audio system.
- At the completion of the self-test program, the display will return to its normal operation if no problem occurs.
- In case of a detected failure, “diAG” (diagnostic) letters will be displayed in the active and a 2-digit diagnostic code will be displayed in the preset display.
- Record any diagnostic codes displayed to help maintenance personnel in locating the problem.

**6 - STORE BUTTON**

- The STO button allows up to six preset frequencies to be selected and entered into the controls non-volatile memory.
- After presetting the frequency to be stored, push the STO button. The upper window displays the channel number of available memory (CH1 through CH6); the lower window continues to display the frequency to be stored. For approximately 5 seconds, the MEM switch may be used to advance through channel numbers without changing the preset display. Push the STO button a second time to commit the preset frequency to memory in the selected location. After approximately 5 seconds, the control will return to normal operation.

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**7 - POWER AND MODE KNOB**

OFF - Turns off the system.
ON - Turns on the system.
SQ OFF - Disables the receiver squelch circuits. Use this position to set volume control or, if necessary, to try to receive a very weak signal that cannot operate the squelch circuits.

**8 - ANNUNCIATORS**

- The COM control contains MEM (memory) and TX (transmit) annunciators.
- The MEM annunciator illuminates whenever a preset frequency is being displayed in the lower window.
- The TX annunciator illuminates whenever the VHF-22A is transmitting.

**9 - PRESET FREQUENCY DISPLAY**

- Displays the preset (inactive) frequency and diagnostics messages.
- The frequencies displayed on the COM control show only five of the six digits.

**10 - COMPARE ANNUNCIATOR**

- ACT momentarily illuminates when active and preset frequencies are being switched.
- ACT flashes if the actual radio frequency is not identical to the frequency shown in the active frequency display.

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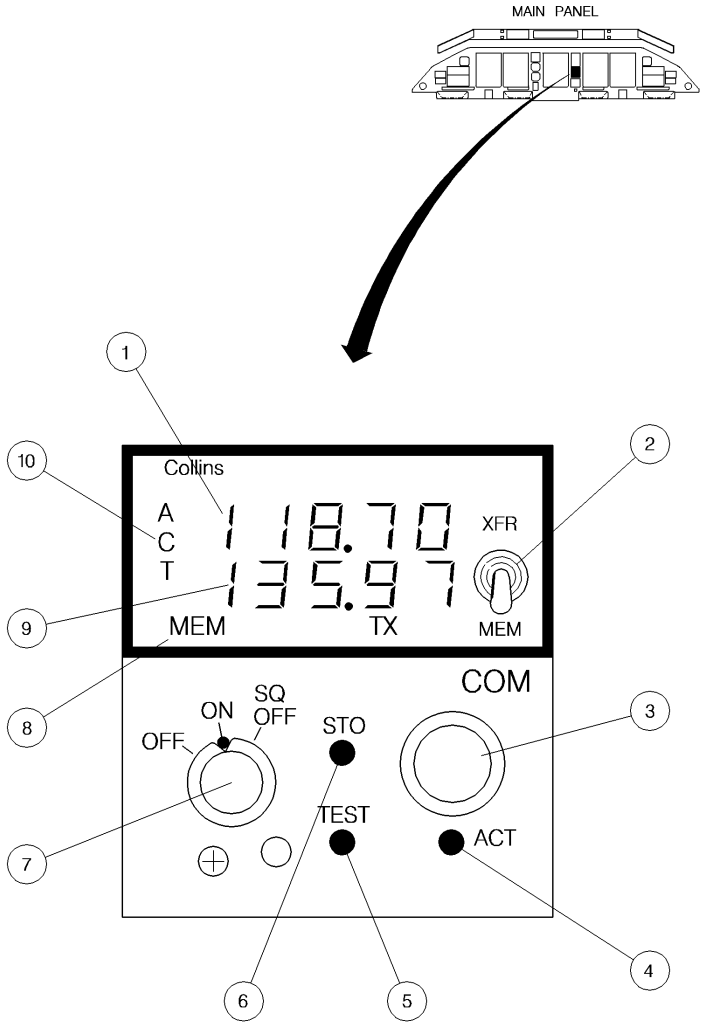


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**CTL-22 VHF CONTROL PANEL**

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# THIRD VHF NAVIGATION/COMMUNICATIONS SYSTEM

The airplane may be equipped with a third VHF Navigation/Communications System.

The third Navigation receiver is required to perform CAT-IIIa operations. It feeds the HGS with high reliability ILS data, which are compared with those received from Navigation receiver #1. In case of a miscomparison between both signals, the HGS will not be able to engage CAT-IIIa mode.

All functions of the Collins VIR-433 System are controlled by the CTL-23C VHF Control Panel located at the main panel.

The Avionics Master DC Bus 1 supplies the third VHF Navigation/Communications System with a protective 5A circuit breaker.

## THIRD VHF NAV/COM CONTROLS AND INDICATORS

### 1 - COM/NAV SWITCH

- This is a 2-position, spring-loaded toggle switch.
- In the UP position, the Frequency Select Knob will affect the COM display.
- In the DOWN position, the Frequency Select Knob will affect the NAV display.

### 2 - FREQUENCY SELECT KNOBS

- Two concentric knobs control the COM or NAV frequency displays.
- The large knob changes the three digits to the left of the decimal point in 1 MHz steps.
- The smaller knob changes the two digits to the right of the decimal point.
- Numbers roll over at the upper and lower frequency limits.

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**3 - POWER AND MODE KNOB**

OFF - Turns off the system.

STBY - For approximately 5 seconds COM and NAV frequency displays show the number 1 followed by eights and “TX” is annunciated.
- A short audio tone will be heard.
- A dimming self-test of the frequency displays is performed.
- The last COM/NAV frequencies are displayed

ON - Turns on the system.
- After turning ON, the equipment performs a test. In a few seconds a code is displayed. If the system is OK, “00” will be displayed. In case of any detected failure, a different code will be displayed. In this case, record the code displayed to help the maintenance personnel to locate the problem.

SQ OFF - Disables the VHF COM receiver squelch circuits. Use this position to set volume control or, if necessary, to try to receive a very weak signal that cannot operate the squelch circuits.

**4 - ANNUNCIATOR**

– The TX annunciator illuminates whenever the VIR-433 is transmitting.

**5 - ACTIVE NAV FREQUENCY DISPLAY**

– Displays the active Navigation (NAV) frequency (frequency to which the equipment is tuned) and diagnostics messages.

**6 - ACTIVE COM FREQUENCY DISPLAY**

– Displays the active VHF Communication (COM) frequency (frequency to which the equipment is tuned) and diagnostics messages.

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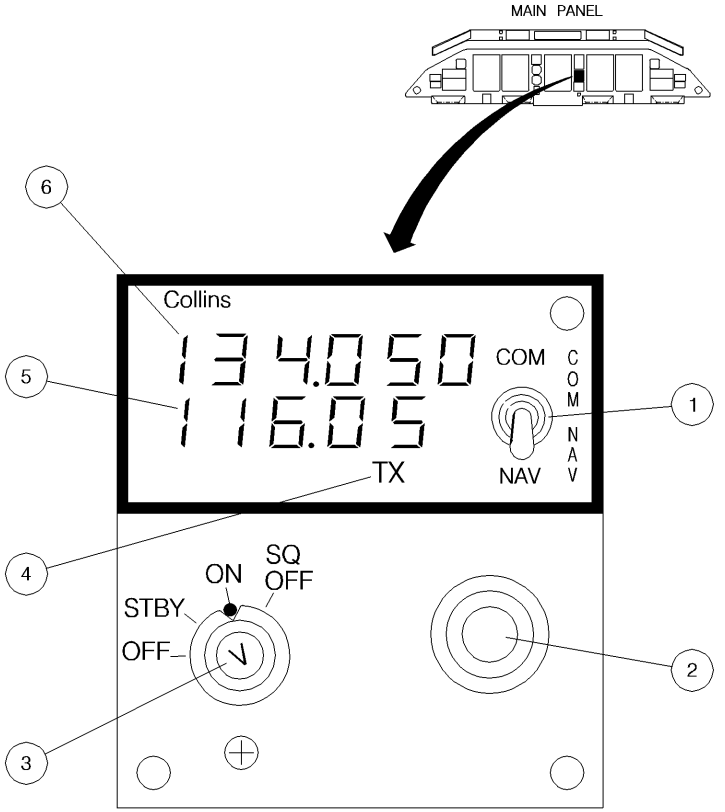


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## CTL-23C VHF CONTROL PANEL

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# THIRD VHF NAVIGATION SYSTEM

The airplane may be equipped with a third VHF Navigation System.

The third Navigation receiver is required to perform CAT-IIIa operations. It feeds the HGS with high reliability ILS data, which are compared with those received from Navigation receiver #1. In case of a miscomparison between both signals, the HGS will not be able to engage CAT-IIIa mode.

All functions of the Collins VIR-433 System are controlled by the CTL-32 VHF Control Panel located at the pedestal.

The Avionics Master DC Bus 1 supplies the third VHF Navigation System with a protective 5A circuit breaker.

## THIRD VHF NAV CONTROLS AND INDICATORS

### 1 - ACTIVE FREQUENCY DISPLAY

- Displays the active frequency (frequency to which the equipment is tuned) and diagnostics messages.

### 2 - XFR/MEM SWITCH

- This is a 3-position, spring-loaded toggle switch.
- When held to the XFR position, the preset frequency is transferred up to the active display and the equipment retunes. The previously active frequency becomes the new preset frequency and is displayed in the lower window.
- When held to the MEM position, one of the four stacked memory frequencies is loaded into the preset display.
- Successive pushes cycle the four memory frequencies through the display.

### 3 - FREQUENCY SELECT KNOBS

- Two concentric knobs control the preset or active frequency displays.
- The large knob changes the digits to the left of the decimal point in 1 MHz steps.
- The smaller knob changes the digits to the right of the decimal point in 0.05 MHz steps.
- Numbers roll over at the upper and lower frequency limits.

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**4 - ACTIVE BUTTON**

- Push the ACT button for about 2 seconds to enable the Frequency Select Knobs to directly retune the VIR-433 (active frequency).
- The bottom window will display dashes and the upper window will continue to display the active frequency.
- Push the ACT button a second time to return the control to the normal 2-display mode.

**5 - TEST BUTTON**

- The self-test diagnostic routine is initiated in the transceiver by pushing the TEST button.

**NOTE:** For the first 2 or 3 seconds immediately after the TEST button is pushed, a 2-digit diagnostic code may be displayed in the lower window, based on the conditions existing immediately before the test button was pushed. In case of any problem detected, the 2-digit diagnostic code will remain displayed in the lower window.

- The active and preset display intensity will flash modulating its brightness from minimum to maximum indicating self-test in progress.
- If no problem was found, the active frequency display will show four dashes and the preset frequency display will show “00”.
- At the completion of the self-test program, the display will return to its normal operation if no problem occurs.
- Record any diagnostic codes displayed to help maintenance personnel in locating the problem.

**6 - STORE BUTTON**

- The STO button allows up to four preset frequencies to be selected and entered into the controls non-volatile memory.
- To store a frequency, toggle the MEM switch until the upper window displays the desired channel number (CH1 through CH4); rotate de Frequency Select Knobs until the lower window displays the frequency to be stored; push the STO button twice within 5 seconds. After approximately 5 seconds, the control panel will return to the normal 2-display mode of operation.

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**7 - LIGHT SENSOR**

- The built-in light sensor automatically controls the display brightness.

**8 - POWER AND MODE KNOB**

OFF - Turns off the system.
ON - Turns on the system.

**9 - ANNUNCIATOR**

- The NAV control contains MEM (memory) annunciator.
- The MEM annunciator illuminates whenever a preset frequency is being displayed in the lower window.

**10 - PRESET FREQUENCY DISPLAY**

- Displays the preset (inactive) frequency and diagnostics messages.

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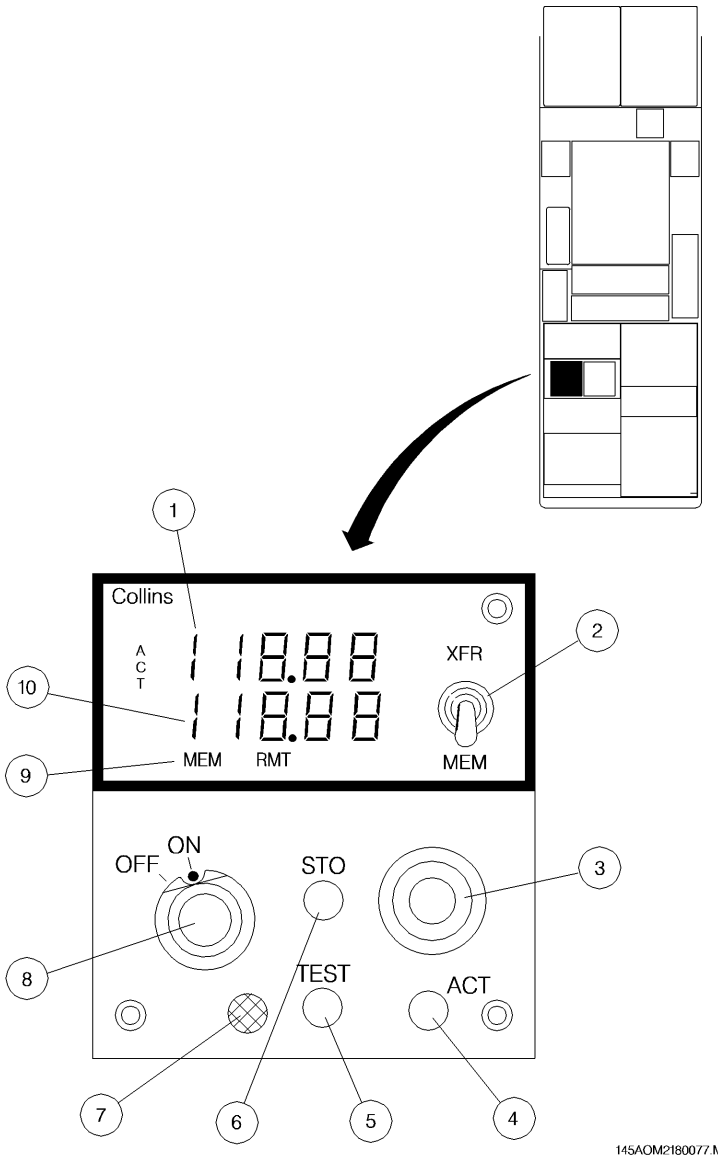


**CTL-32 VHF CONTROL PANEL**

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# THIRD VHF COMMUNICATIONS SYSTEM

The airplane may be equipped with a third VHF communications system. All functions of the Honeywell RC-833/853 System are controlled by the RMU and by the CMU, if installed.

The active frequency will appear in the third COM window of the RMU display when operating in voice mode. The desired frequency should be selected by the pilot using the RMU select knob. Communication can be established pressing the third COM button on the audio panel and the PTT button.

When in data mode, the third VHF transmits the data on the frequency selected by the CMU unit, while on the RMU's third COM window the active frequency will display "DATA".

The third VHF has a pilot-activated self-test that performs a check of individual parts. A self-test is initiated when power is supplied to the RMU.

The Avionics Master DC Bus 1A supplies the third VHF Communications System.

## THIRD VHF COM NORMAL OPERATION

In order to operate the third COM unit for voice communications, it is necessary to properly set the RMU. By pressing the PGE bezel button on the RMU, the page menu will be displayed. On the page menu the "SYS SELECT" option should be chosen. Once selected, the System Select page will be displayed containing the available COM pairs (1/2, 1/3 and 2/3), bandwidth of each COM unit and the COM3 operating mode.

After selecting the COM pair to the corresponding RMU, the change between each COM mode of the selected pair is achieved by pressing the "1/2" bezel button.

The switch between data and voice modes can be accomplished by means of the "SYS SELECT" page. The voice mode can also be entered selecting the COM3 window and turning the RMU knob. The data mode cannot be entered during a voice transmission. If a CMU is installed and connected to the third VHF, it will enter the data mode and "DATA" will be displayed in active frequency window when the third VHF starts a data transmission.

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It is possible to enter a frequency, store it, and perform a self-test using the same procedures applicable to regular COM units. The announcements also will be the same.

Should any radio component fail or a disagreement occur between the frequency selection and the subsequent transmission, the frequency or operating command will be removed from the RMU and replaced by dashes. This is an indication that the operation of that radio system is not normal.

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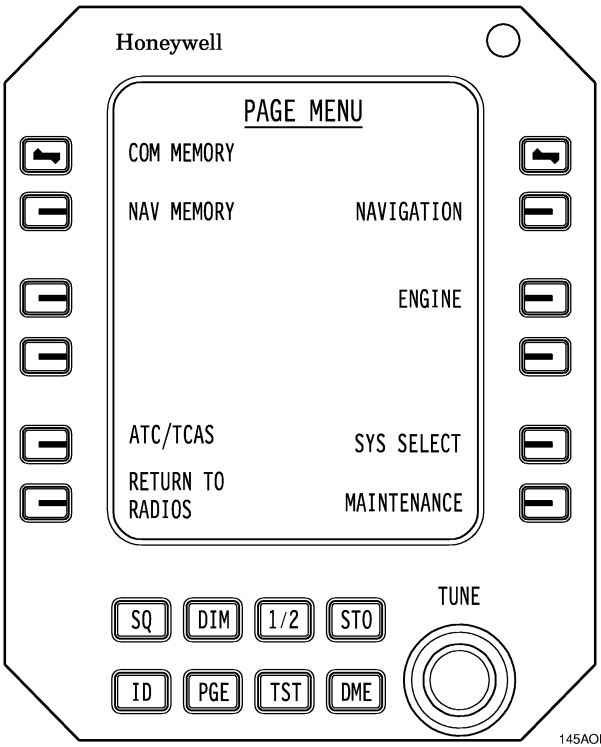


**RMU PAGE MENU**

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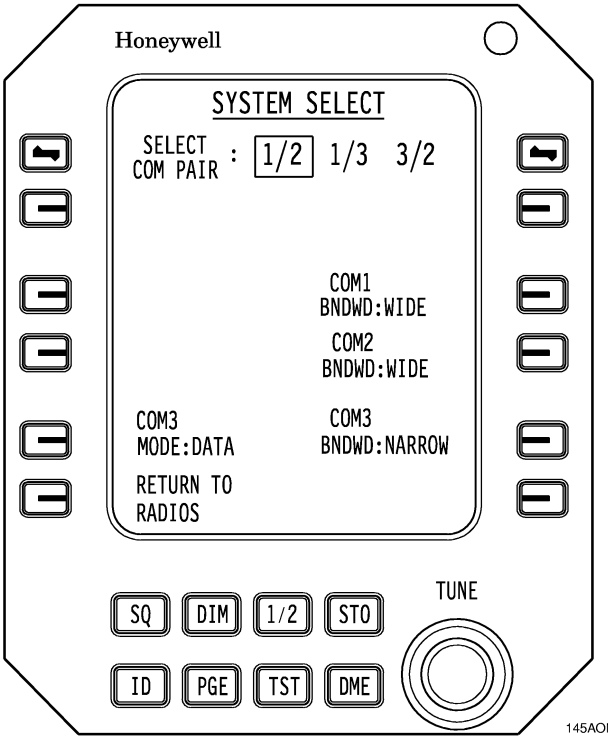


**RMU SYSTEM SELECT PAGE**

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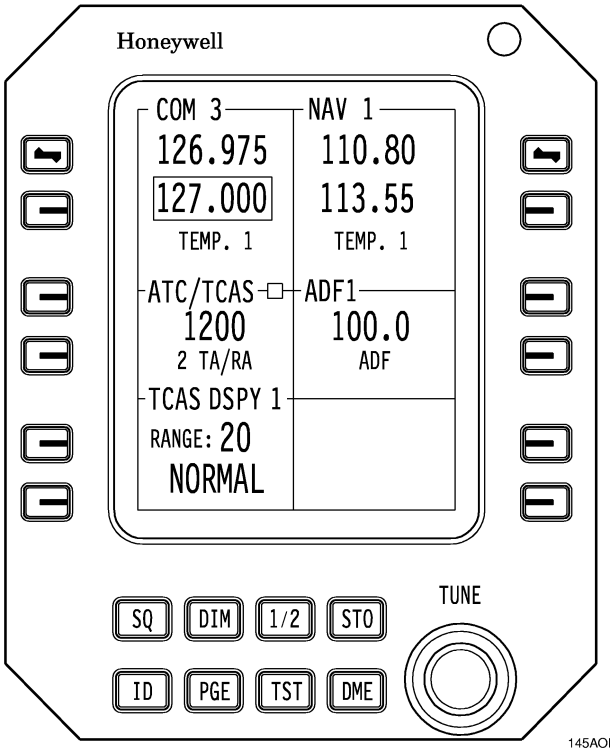


**RMU RADIO PAGE WITH THIRD VHF IN VOICE MODE**

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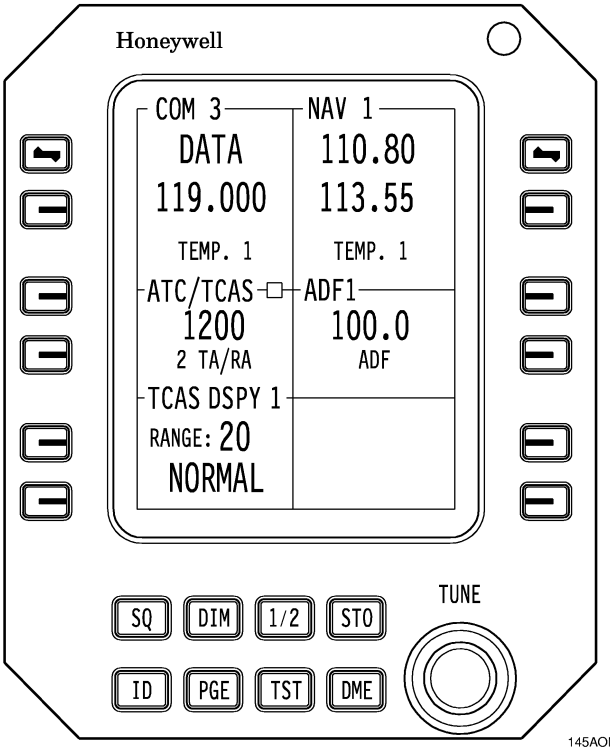


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## RMU RADIO PAGE WITH THIRD VHF IN DATA MODE

# SELCAL SYSTEM

The Ground-to-Air Selective Calling (SELCAL) System operates in conjunction with the communication radios. The SELCAL provides continuous monitoring of a pre-set frequency, eliminating the need to continuously monitor the communication frequencies by the flight crew.

The SELCAL permits ground stations, equipped with encoding equipment, to call individual airplane by transmitting a coded signal. This coded signal will activate only one SELCAL unit to respond to that particular coded signal. In this case, a SELCAL voice message is activated through the Aural Warning Unit. Once activated, the system is reset for further monitoring by pressing the SELCAL Button, located on the Main Panel, or actuating the PTT function (on Control Wheel or glareshield panel).

**NOTE: -** For some airplanes the SELCAL enables only the VHF 2 operation or only the HF operation.

**-** SELCAL will recognize the coded signal from ground stations only if the associated system (HF or VHF2) is powered on and its frequency is adjusted to the ground station frequency.

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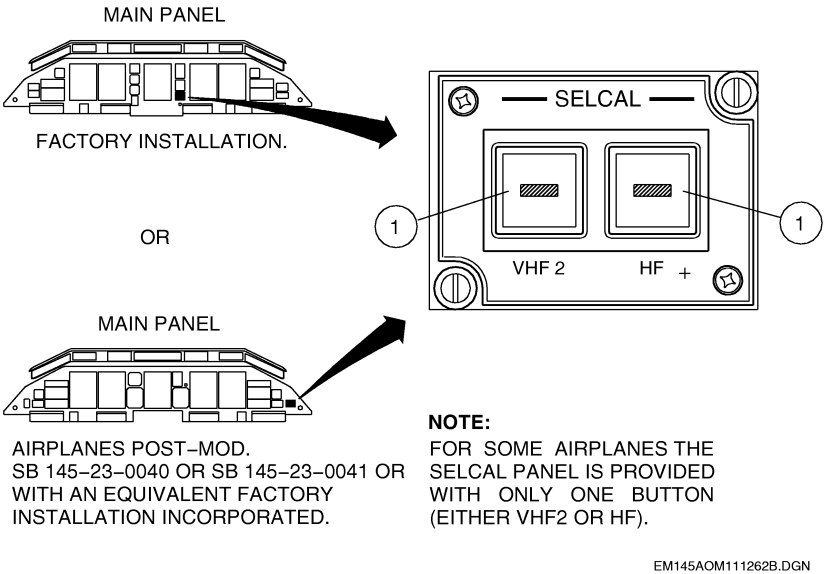
# SELCAL CONTROLS AND INDICATORS

## 1 - SELCAL BUTTON

- A striped bar illuminates inside the associated button to alert the crew that communication is desired on VHF 2 or HF. A SELCAL voice message sounds simultaneously.
- When pressed, after a system activation, the striped bar extinguishes and the system is reset.




**SELCAL PANEL**

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# AIRCRAFT COMMUNICATIONS ADDRESSING AND REPORTING SYSTEM (ACARS)

The airplane may be optionally equipped with an Aircraft Communications Addressing And Reporting System (ACARS), a UniLink UL-600. For additional information on functions and operations, refer to the manufacturer's manual.

The ACARS is an air to ground digital communication system that exchanges data with ground based service providers. The ACARS allows the flight crew to request and receive clearances, weather reports and messages, eliminating the need to transmit routine information through voice transmission. The system uses an assigned airborne VHF frequency to transmit and receive data from a ground station.

The ACARS is powered by 28 V DC from one of the Avionics Switched DC buses. Should a power supply failure occur, the ACARS will be inoperative, as there is no backup power supply to it.

The ACARS interfaces with other airplane systems and equipment as follows:

- FMS - The pilot - ACARS interface is accomplished through the FMS Control and Display Units (CDU).
- VHF - The VHF transmit and receive data with ground bases.
- Printer - provides a hard copy data printout.
- CMC - Sends maintenance information to the ACARS.
- Main Door - Automatically sends the inputs of door open/close to the ACARS.
- Parking Brake - Automatically sends the inputs of parking brake on/off to the ACARS.

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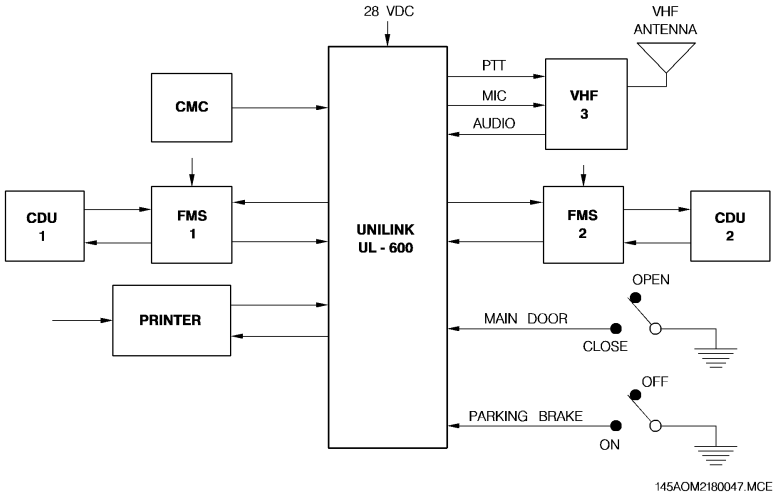


## ACARS SCHEMATIC

## ACARS OPERATION

The Aircraft Communications Addressing and Reporting System (ACARS) is controlled through the FMS Control and Display Units (CDU) located on the control pedestal aft panel. The CDU provides control functions and operating modes management for proper ACARS operation. The FMS provides default data to the ACARS. Many messages and requests have fields that are filled with FMS flight progress data, but the flight crew can modify data by overriding that value with a manual entry.

There are two types of ACARS data communications: ground to air via uplink messages and air to ground via downlink messages. Once a message is generated, it goes into transmission queue and when a clear channel is obtained, the message is transmitted.

Uplink messages are generated by Airline Operations Centers (AOC), ATC facilities or Data Link Service Providers (DSP). The message is processed by the ACARS or, when the message is addressed for a peripheral unit, is passed on. When an error free message has been received, the ACARS generates a positive transmission acknowledgment to the ground station, otherwise, a negative acknowledgment is transmitted and the ground system should retransmit the uplink message. The ACARS is capable of storing 25 blocks of uplink messages. When the message log is full the ACARS will delete the oldest read message. If the message log contains 24 unread messages, the ACARS will announce a full message log to the flight crew.

Downlink messages are generated by an occurred event or by the flight crew. The messages are sent to a DSP, which then addresses the messages to a designated AOC or ATC. ACARS transmits the message having the highest priority. The ground system also generates a positive acknowledgment for the message and transmits a confirmation to the airplane. Upon receiving positive acknowledgment, the ACARS deletes the message from the downlink queue. The ACARS is capable of queuing 70 blocks of downlink messages.

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# ACARS CONTROLS AND INDICATORS

## CONTROL DISPLAY UNIT (CDU)

### 1 - STATUS AND ERROR MESSAGES

MSG PRINTING - The printer has started printing an uplinked message.

UNABLE TO PRINT - The printer is unable to print an uplinked message.

DATA REQD - The message selected cannot be sent because the required data for downlink is not available.

QUEUE FULL - The message cannot be sent because the downlink buffer is full.

UNABLE TO SEND - The transmission of a message has been manually initiated but the UniLink unit has determined that the message cannot be delivered to a ground system.

### 2 - LINE SELECT BUTTONS

– There are five line selection buttons on each side of the Control Display Unit (CDU) that provide selection of submodes within major modes when in an indexed display.

### 3 - SEND PROMPT

– When the Send prompt is pressed, the message goes into queue for transmission and the status of the message appears above the SEND prompt. The message status are:

  – QUEUED - when the message is in the log.
  – SENDING - when the message is being sent.
  – SENT - when the message has been sent.

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**4 - ENTER**

– The ENTER Button places the cursor over the first data entrance field when the cursor is parked off the page and stores input data.

**5 - UNILINK ADVISORIES**

– The bottom left line select button on each ACARS page is reserved for ACARS advisories. ACARS advisories notify the crew of ACARS activity that may require user action and simplify procedures. Only one advisory will be displayed at a time in order of priority. Activation, when required, is accomplished by pressing the line selecting button. The ACARS Advisories, in the order of priority are:

FAIL - A new failure has been detected or has been reported to ACARS and has not yet been displayed on the status page.

ACKNOWLEDGE - The uplinked message being displayed requires crew acknowledgment. Activation will send an acknowledgment message to the ground.

SELCAL - A SELCAL request has been made. Activation will display the SELCAL page.

NEW MSG - A new message has been uplinked. Activation will access the latest unread message.

**6 - PREV/NEXT BUTTONS**

– PREV - Changes the current page to the previous page.
– NEXT - Changes the current page to the next page.

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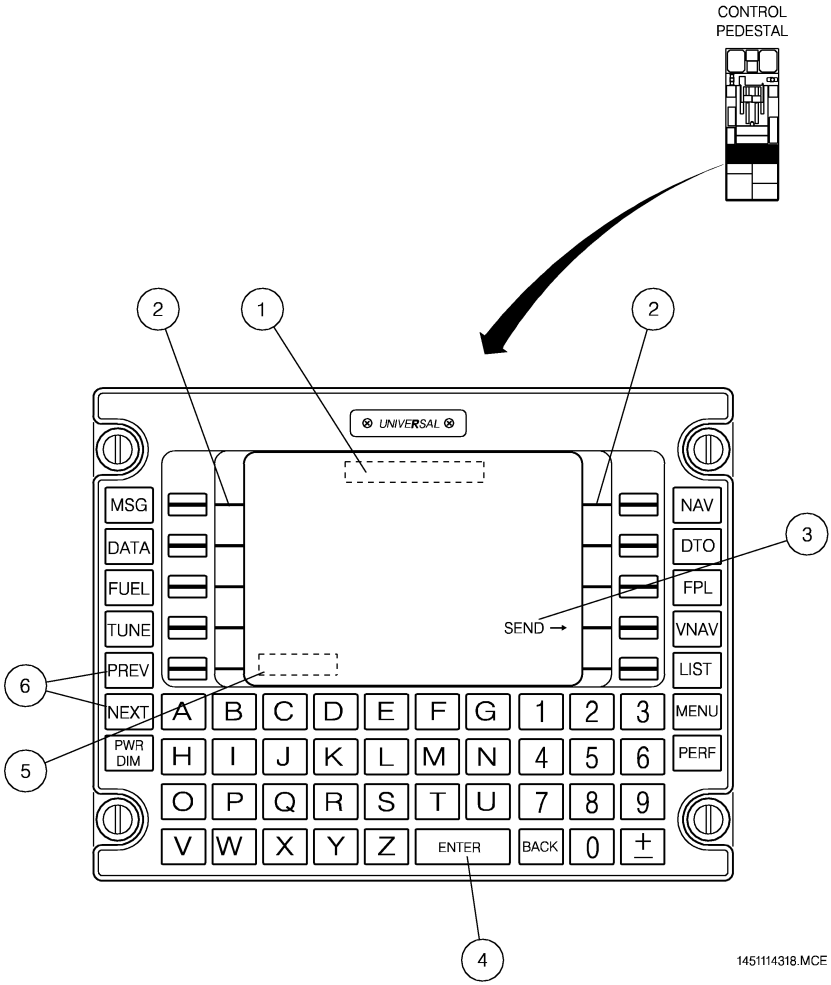


## ACARS FMS CONTROL PANEL

## ACARS PRINTER CONTROLS AND INDICATORS

The ACARS may be optionally equipped with a Printer. The Printer will provide a hard copy printout of data collected by the ACARS including uplinked printer messages. For additional information on functions and operations, refer to the manufacturer's manual.

### 1 - PAPER ADVANCE

- When pressed, advances paper.

### 2 - SELF-TEST

- When pressed, produces a test pattern, comprising full character complement of printer, and activates both external aural/visual alert functions. If button is pressed and held, printer will successively print 40-, 60-, 80-column test patterns. Otherwise, each time button is pressed printer will print next test pattern in sequence.

### 3 - POWER ON

- A green light indicator illuminates when power is on.

### 4 - ALERT RESET

- Will reset the aural/visual alert function and causes Printer Busy indicator to go out.

### 5 - PRINTER BUSY

- An amber indicator illuminates upon receipt of first text character and will remain on until the paper has advanced three lines beyond tear-off edge. The indicator will flash continuously after paper advance until the reset button is depressed.

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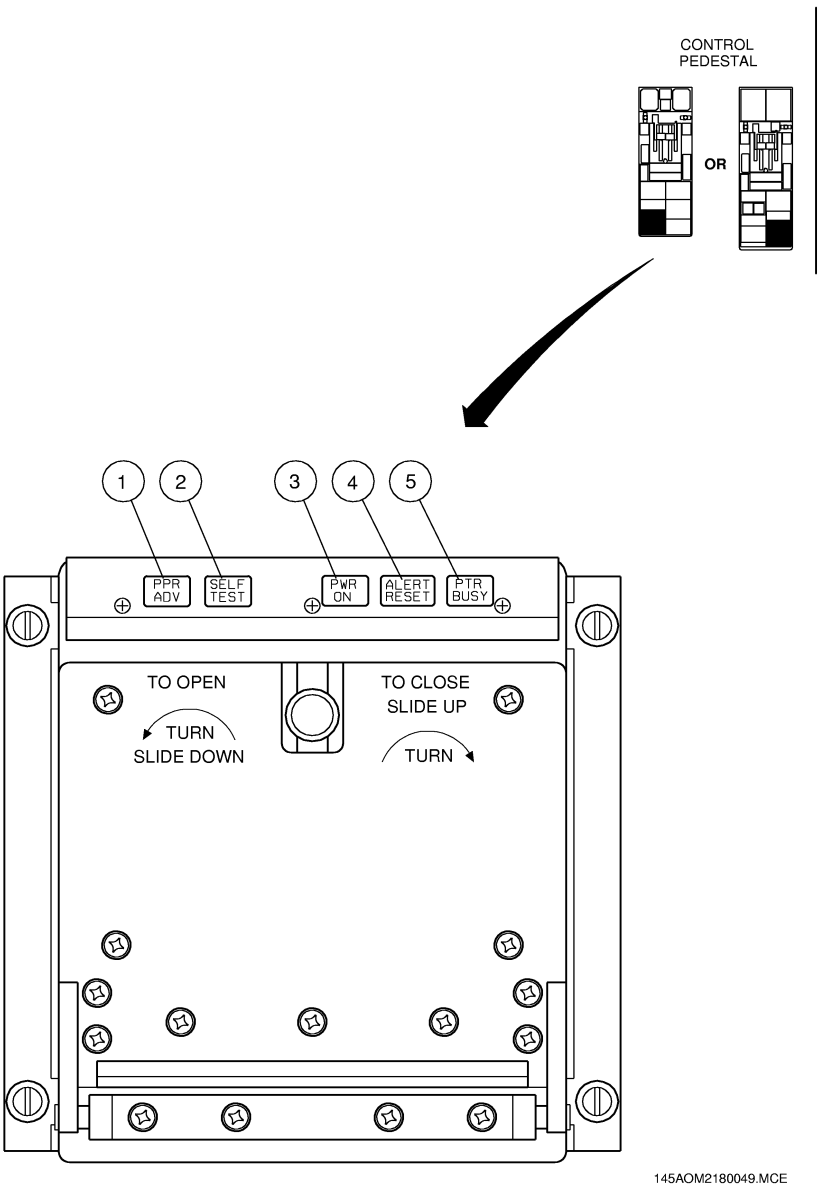


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# HONEYWELL MARK III COMMUNICATIONS MANAGEMENT UNIT (CMU)

The airplane may optionally be equipped with Honeywell's Mark III Communications Management Unit (CMU). Additional information on functions and operations can be obtained in the manufacturer's manual.

The Mark III Communications Management Unit (CMU) is an airborne communications router that supports data link service access between the following aircraft data link applications and their corresponding ground service providers:

- Aeronautical Operational Communication (AOC)/Airborne Flight Information System (AFIS).
- Controller Pilot Data Link Communication (CPDLC).
- Automatic Dependent Surveillance (ADS).

The CMU is based on ARINC Characteristic 758 and can be upgraded, by software download, to an Aeronautical Telecommunications Network (ATN) router when protocols and application infrastructure are available to support Communications, Navigation and Surveillance/Air Traffic Management (CNS/ATM) data link applications. The CMU provides an Aeronautical Radio, Inc. (ARINC) 724B compatible data link router through which all character-oriented data are transmitted to and from the ground Aircraft Communications Addressing and Reporting System (ACARS) network.

There are several levels of user interfacing. The CMU´s operational crew interface is provided through a Control Display Unit (CDU), printer, and data loaders.

Access to the ground network is provided via several ACARS air-ground sub-networks listed below:

- Satellite Communications (SATCOM).
- Very High Frequency (VHF).
- High Frequency (HF).
- Mode-S (future).
- Ultrahigh Frequency (UHF) (future).

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The CMU functions as a router, with growth capacity as a gateway and an end system for hosting data link applications. As a gateway, the CMU can implement future protocols and provide the appropriate protocol conversions to support airborne systems whose architectures do not allow updates to future communication protocols but host the data link applications.

Currently, the CMU is compliant with ARINC 758 level 0, which means that the CMU is able to perform ACARS functions. The other ARINC 758 levels will be available in the equipment as soon as the software upgrades are released by the manufacturer.

The CMU is powered by the Avionic Switched DC Bus 1B.

The CMU interfaces with other airplane systems and equipment through the following equipments:

| | |
|---|---|
| – FMS | The pilot → CMU interface is accomplished through the Honeywell FMS (NZ-2000) Control and Display Units (CDU). It may be utilized with single or dual FMS installation. |
| – VHF #3 | Transmit and receive data with ground bases. |
| – Printer | Provides a hard copy data printout. |
| – Portable Data Loader | Used to upload and to download information, customized configurations and messages. |
| – CMC | Sends maintenance information to the ACARS. |
| – OOOI | Used to inform if the airplane is in one of the following situations: OUT - parking brake released and doors closed; OFF - airplane lift-off (Weight Off Wheels); ON - airplane has landed (Weight On Wheels); IN - parking brake applied and doors opened. |

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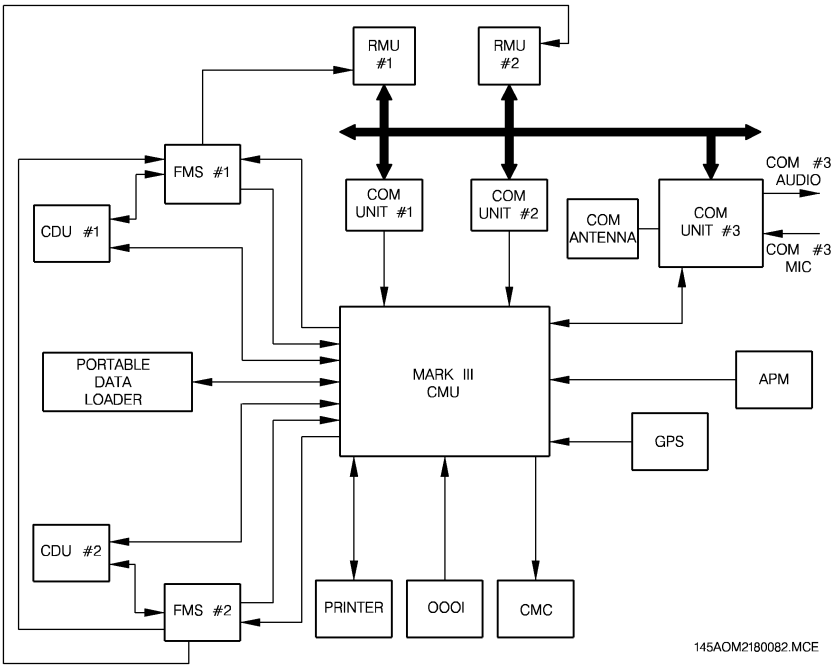


## CMU ARCHITETURE

## CMU NORMAL OPERATION

Pilot interface is accomplished through the FMS Control and Display Unit (CDU). Data is entered in any field highlighted by a cursor. Generally, when accessing a FMS page, the cursor will park off the page. Selecting the ENTER key will place the cursor over the first enterable field on the page. Data is then entered into the field with the alphanumeric keys.

In some situations, flight progress and related data from the FMS will prefill into the field but it is possible to change that data by overriding that value with a manual data entry.

When SEND is pressed, the message goes into a queue for transmission. If the aircraft is flying over a region or is grounded at an airport not covered by a DSP (Data Link Service Provider) reception or transmission of messages to or from a ground station will not be successful.

Communications are eased by the use of the Main Menu page and several submenus to quickly access each function or service available.

## CMU ABNORMAL OPERATION

The CMU has a Built-In Test (BIT) function that contains a continuous monitor and self-test monitor. The continuous monitor function monitors critical system parameters and record faults found during normal operation.

The self-test monitor function is activated upon command from the system controller, external discrete input, front test panel switch, maintenance computer or a power-up event. The self-test monitor will exercise various system functions, record faults found, and annunciate the results of the test.

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# CMU CONTROLS AND INDICATORS

## CONTROL DISPLAY UNIT (CDU)

### 1 - LINE SELECT BUTTONS

– There are four line selection buttons on each side of the Control Display Unit (CDU) that provide selection of submodes within major modes when in an indexed display.

### 2 - PREV/NEXT BUTTONS

- PREV - Changes the current page to the previous page.
- NEXT - Changes the current page to the next page.

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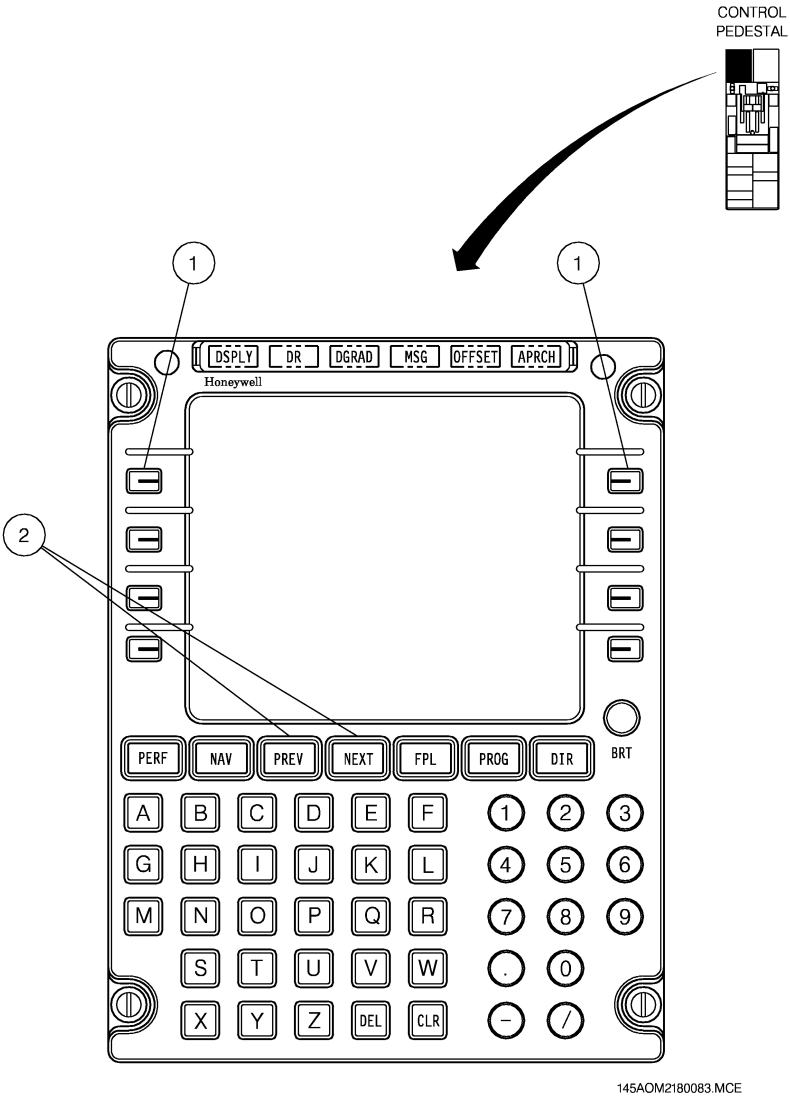


**CMU FMS CONTROL PANEL**

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## PRINTER CONTROLS AND INDICATORS

The CMU may be optionally equipped with a Printer. The Printer will provide a hard copy printout of data collected by the CMU including uplinked printer messages. For additional information on functions and operations, refer to the manufacturer's manual.

**1 - PAPER ADVANCE**

- When pressed, advances paper.

**2 - SELF-TEST**

- When pressed, it produces a test pattern, comprising full character complement of printer, and activates both external aural/visual alert functions. If button is pressed and held, printer will successively print 40-, 60-, 80-column test patterns. Otherwise, each time the button is pressed, printer will print the
- next test pattern in sequence.

**3 - POWER ON**

- A green light indicator illuminates when power is on.

**4 - ALERT RESET**

- Will reset the aural/visual alert function and causes Printer Busy indicator to go out.

**5 - PRINTER BUSY**

- An amber indicator illuminates upon receipt of first text character and will remain on until the paper has advanced three lines beyond tear-off edge. The indicator will flash continuously after paper advance until the reset button is depressed.

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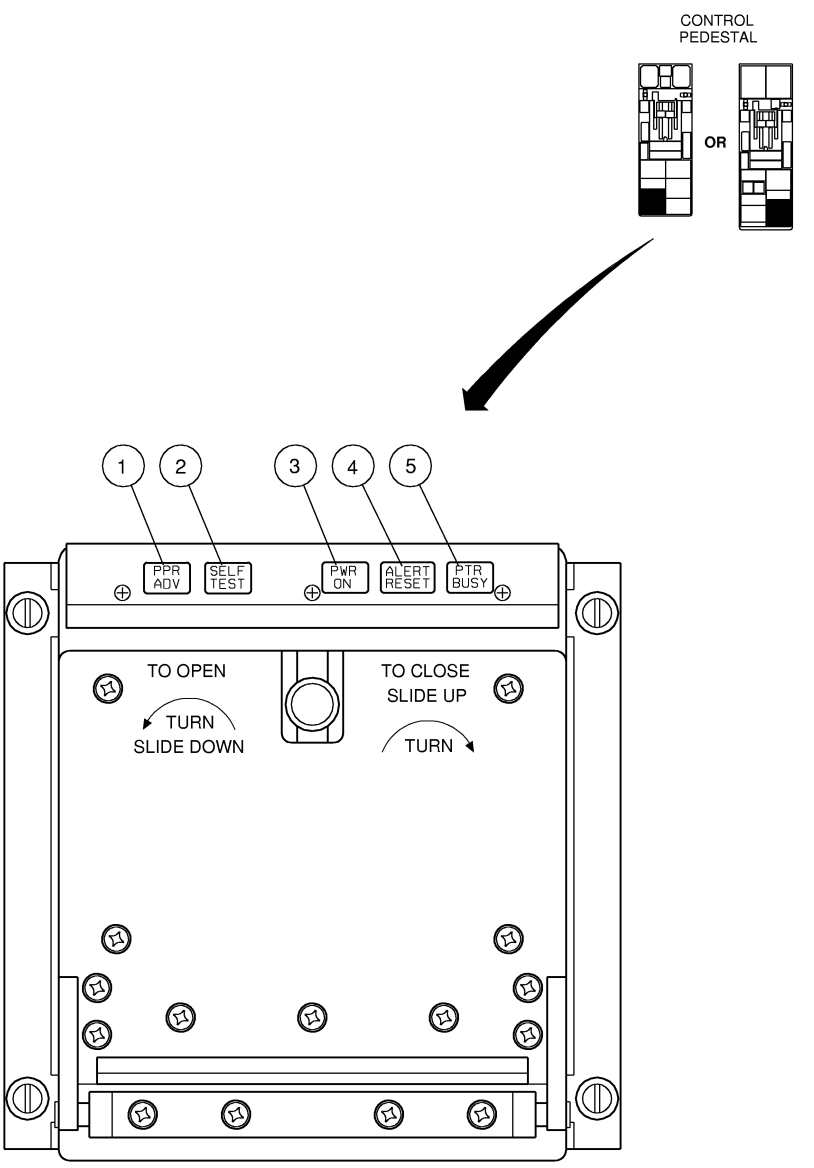


**PRINTER PANEL**

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# COCKPIT VOICE RECORDER

The Solid State Cockpit Voice Recorder System records all audio signals transmitted and received by the crew members via the Digital Audio Panels, and any audible noise in the cockpit, through an area microphone installed below the standby compass.

The CVR is in operation whenever the essential DC Bus 2 is energized, storing the last 2 hours of recorded information in a solid state crash survivable memory unit. Any data older than 2 hours is automatically overwritten by the most recent audio inputs.

A crash impact switch cuts off power to the CVR immediately after experiencing a 5 G impact in order to preserve the recorded data.

The CVR also incorporates an Underwater Locator Beacon (ULB). Powered by a dedicated battery, the ULB starts transmitting an acoustic signal in the 37.5 kHz frequency once it senses contact with water, thus easing wreckage site location of a submerged airplane. The signal is transmitted during approximately 30 days.

A signal from the captain's clock allows timing correlation between CVR and FDRS.

## SELF TEST

When the TEST button is pressed the unit performs a functional self-test to verify the integrity of the system. A successful self-test results in a one-second activation of the status LED on the control panel and a two-second tone (800 Hz for Honeywell equipment and 620 to 660 Hz for L3 equipment) that may be heard from a headphone plugged to the CVR control panel jack. If a failure is detected during the test, the status LED will not be activated and the aural tone will not be heard.

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## ERASE FUNCTION

Previously recorded CVR data may be made unavailable if the ERASE button on the CVR control panel is pressed, provided the airplane is on the ground and with the parking brake applied. In this case, only the CVR manufacturer (for Honeywell equipment) will be able to recover the “erased” data.

When the ERASE button is pressed (for 2 seconds for L3 equipment), a two-second 400 Hz tone may be heard from a headphone plugged to the CVR control panel jack, confirming that the erase command was successful.

## COCKPIT VOICE RECORDER CONTROLS AND INDICATORS

**1 - ERASE BUTTON**

- Erases previously recorded data from the crash survivable memory.
- Function is available only on the ground, with the parking brake applied.

**2 - TEST BUTTON**

- Tests system integrity.
- A successful self-test results in a one second activation of the status LED.
- In case of failure, the status LED on the control panel is not activated.

**3 - HEADPHONE JACK**

- Allows plugging a headphone to monitor the test tone, the erase tone and recorded audio signals.

**4 - STATUS LED**

- Illuminates during one second to indicate a successful test.

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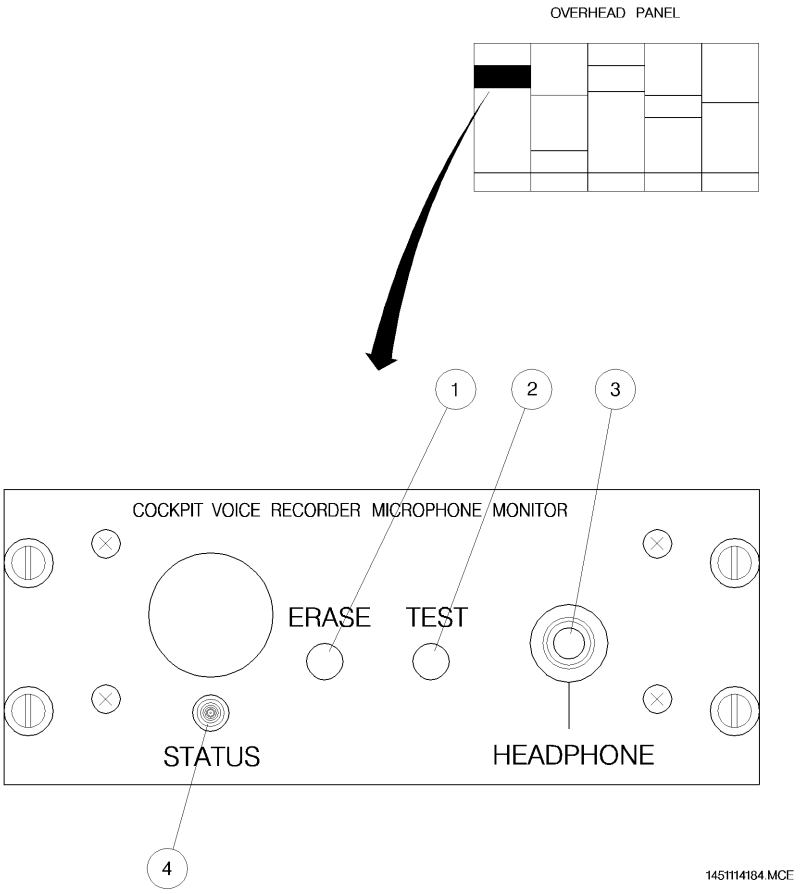


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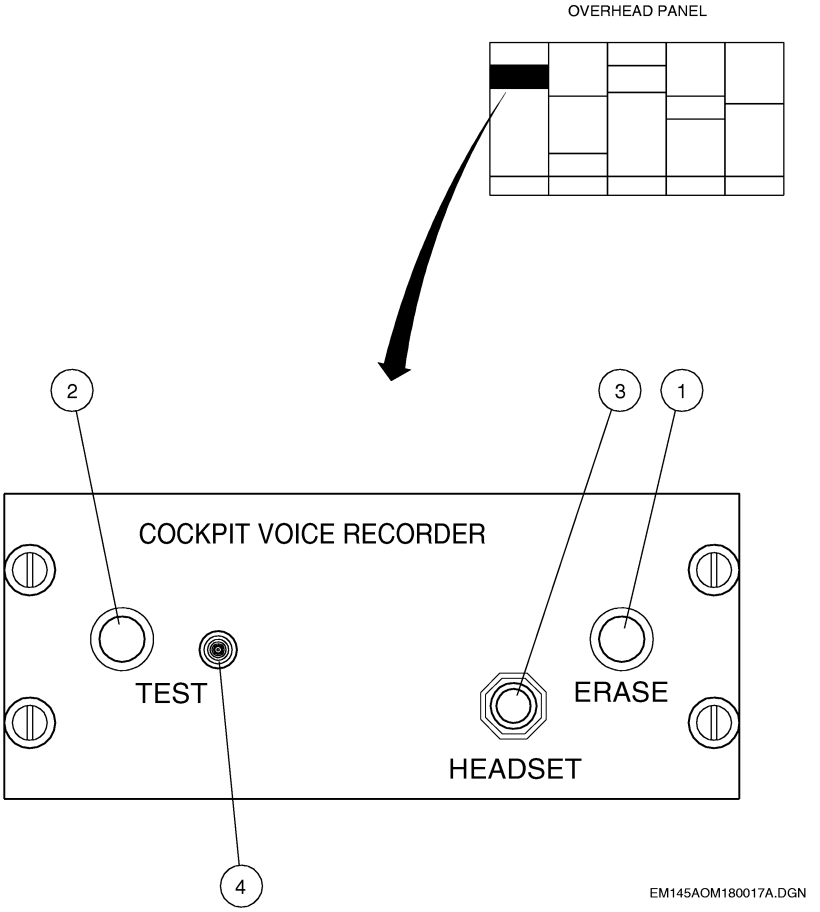
## HONEYWELL COCKPIT VOICE RECORDER PANEL




## L3 COCKPIT VOICE RECORDER PANEL

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# PASSENGER ADDRESS SYSTEM

The Passenger Address System (PAS) provides communication between cockpit and flight attendants, and announcements from cockpit or flight attendants to the passenger cabin.

The PAS also interfaces with the audio entertainment and prerecorded announcement systems to provide music and safety briefing/flight information through the passenger loudspeakers.

The following functions are available through the PAS:

- Voice announcement transmission (speech) to the PAX cabin.
- Call function from captain, copilot and observer to flight attendant and vice-versa through chime tone.
- Call function from passenger to attendant, through chime tone.
- Chime tone for NO SMOKING and FASTEN SEAT BELTS signals.
- Interface to boarding music and passenger briefing.

The PAS component responsible for sending/receiving signals to/from cockpit, attendant handsets, and for passenger entertainment and prerecorded announcement systems is the Passenger Address Amplifier (PAA), located in the airplane electronic compartment.

The PAA establishes the priority among the input signals from the several sources and then drives these signals to the proper cabin loudspeakers. The PAA also provides the logic for generation of the aural and visual annunciators, chimes for attendant, passenger and cockpit calls, and for NO SMOKING and FASTEN SEAT BELTS signals.

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# PASSENGER ADDRESS OPERATING MODES

## MUTED MODE

The Muted Mode is automatically selected during power up and when no other mode is selected. In this mode there will be no chimes, no lights and no microphones enabled during power up or power supply transients.

## PILOT-TO-PASSENGER MODE

The Pilot-to-Passenger Mode is enabled by momentarily pressing the Passenger Button, labeled PAX, on the Digital Audio Panel. When this mode is enabled the captain, copilot or observer may transmit announcements to the passengers, by pressing the respective PTT/HOT-MIC switches. The priority of the transmission through the system is the following: captain, copilot, observer. There are no chimes in this mode.

## ATTENDANT-TO-PASSENGER MODE

The Attendant-to-Passenger Mode is enabled by pressing the PA Button in the Attendant Handset. When this mode is enabled the flight attendant may transmit announcements to the passengers, by pressing the Attendant Handset PTT. If the PAX Button is selected on the Digital Audio Panel in the cockpit, besides listening the attendant announcements in the cockpit speaker or headphones, the pilots and observer take priority over the attendant announcements.

Some airplanes have a knob installed in the main panel or in the control pedestal which allows to adjust the volume of the PA announcements in the flight deck.

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# PASSENGER ADDRESS CONTROLS AND INDICATORS

## INTERPHONE CONTROL UNIT

### 1 - CABIN BUTTON

- Allows interphone communication between pilots and flight attendant.
- Generates a “ding-dong” chime through the Passenger Address Amplifier and illuminates the PILOT light on the Attendant’s Call Panel.
- A striped bar illuminates inside the button to indicate that it is pressed.

### 2 - CABIN EMERGENCY BUTTON

- Provides the same functions as the Cabin Button, except that it illuminates the Pilot Emergency Light, labeled EMER PILOT, on the Attendant’s Call Panel.
- A striped bar illuminates inside the button to indicate that it is pressed.

### 3 - BACKUP INTERPHONE BUTTON

- Allows interphone communication between pilots and attendant, in case of normal mode failure.
- Illuminates CABIN and CAB EMERG buttons on the ICU, and PILOT and EMERG PILOT annunciators on the Attendant’s Call Panel.
- A striped bar illuminates inside the button to indicate that is pressed.

### 4 - FLIGHT ATTENDANT CALL BUTTON

- Generates a chime in the passenger address, to call a flight attendant.
- During backup operation generates a tone in the chime located in the passenger cabin ceiling, near the emergency exits.

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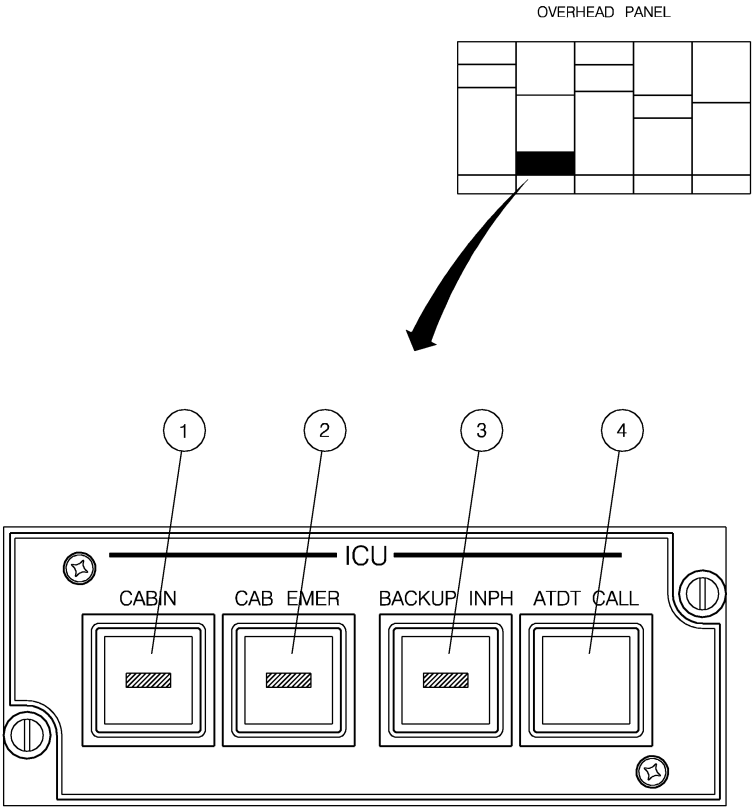


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## INTERPHONE CONTROL UNIT

## ATTENDANT HANDSET

### 1 - PRESS TO TALK BUTTON

- When pressed allows flight attendant to address the passengers, or communicate with the other flight attendant station or pilots, depending on the channel selected.

### 2 - BUTTONS AND ANNUNCIATORS

- When pressed and according to the selected channel it allows the flight attendant to address the passengers (PA), or to communicate with the other attendant station (ATTD) or pilots (PILOT and EMER PILOT). The associated annunciator illuminates to indicate which button is pressed.
- Annunciator colors:
  - ATTD, PILOT and PA: green.
  - EMER PILOT: red.

### 3 - BACKUP INTERPHONE BUTTON

- When pressed, establishes a permanent communication between pilots and flight attendant, in case of normal mode failure.
- When pressed, BKUP INPH, EMER PILOT, and PILOT annunciators of the station which commanded the backup mode remains illuminated.
- BKUP INPH annunciator is amber.

ATTENDANT'S CALL PANEL

Refer to Section 2-2 – Equipment and Furnishings.

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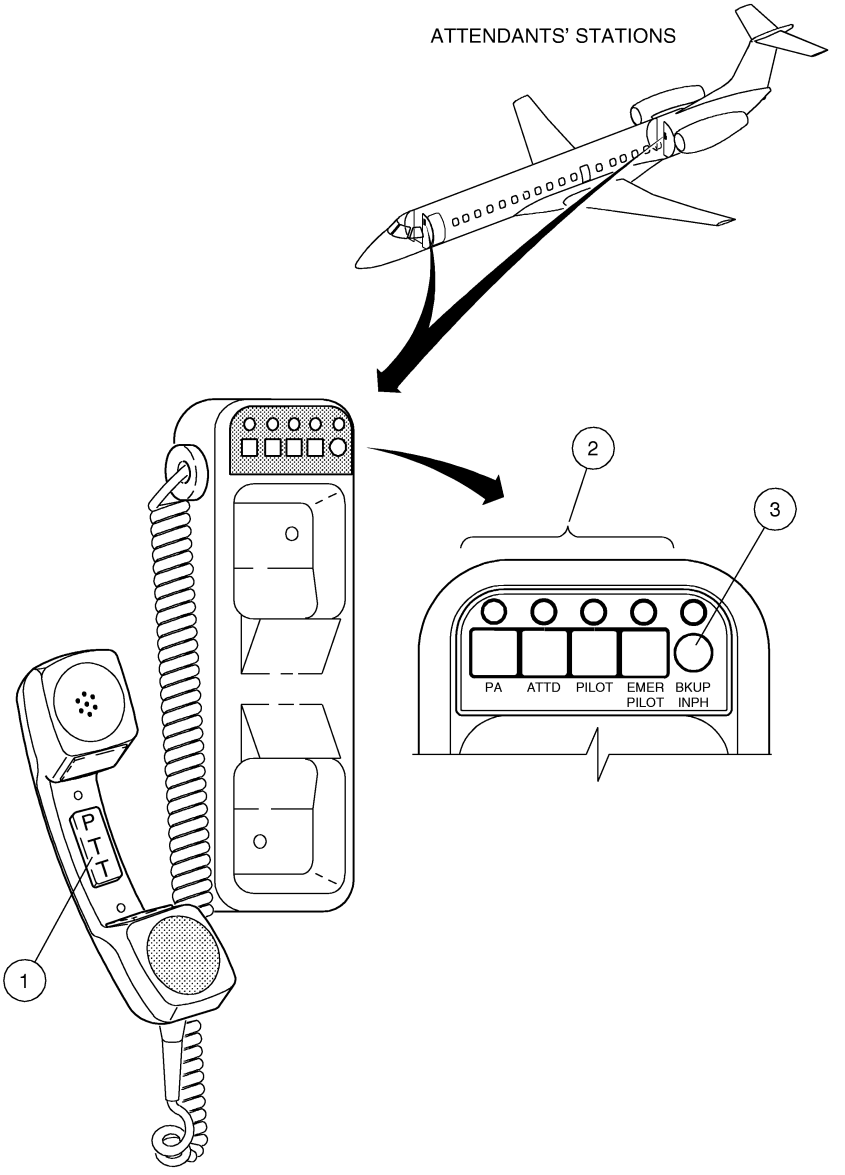


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## ATTENDANT HANDSET

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# SATCOM SYSTEM

## INTRODUCTION

The airplane may be equipped with a TT-3000 Series Aero-M SATCOM, that is capable of performing global communication through the INMARSAT satellite network. The system provides one channel voice 4800 BPS AMBE coding, fax 2400 BPS on 2 wire RJ-11 type interface, circuit mode data 2400 BPS, and can be interfaced with a PC via a RS-232 serial port for data communication.

**NOTE:** The information presented in this manual has the purpose of assisting the user to perform basic operations on the SATCOM system. For advanced operation refer to the manufacturer's user manual.

## SATCOM OPERATION

When the Aero-M system is powered-up, after a short pause the handset will display the initialization page.

Once that has ocurred, the display will shift to the Wait for GPS page. This means that the system is acquiring GPS (Global Positioning System) satellite signals and determining the systems position.

The display will then shift to the Wait for NCS (Network Coordinating Station) page, indicating that the system is attempting to logon to a satellite network and acquire a bulletin board.

Finally, the display will then shift to the Logon Display and the user is now ready to proceed with Pre-Operational Requirements.

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## PRE-OPERATIONAL REQUIREMENTS

Before attempting to initiate or receive a call, the user must verify that the Aero-M System has logged on to the satellite network. There are two indications that the system has power applied and the system has logged onto the satellite network:

- Both the left and green handset LED indicators will be illuminated and the signal strength indicator will display a measurement;
- The Aero-M logon display will appear in the handset display.

The top line of the display will indicate which Ocean Region Satellite is in use followed by a colon. This will be:

- AORW : Atlantic Ocean Region West Satellite;
- AORE : Atlantic Ocean Region East Satellite;
- POR : Pacific Ocean Region Satellite;
- IOR : Indian Ocean Region Satellite.

**NOTE:** The Aero-M system requires the user to determine the ocean region in which the aircraft is currently located. The user must enter the user menu and setup the system for that ocean region.

SELECTION OF OCEAN REGION SATELLITE

From Logon display, or Wait for NCS display, enter Area Menu, by pressing "2nd" and "3" keys. The "∗" indicates the current ocean region selected. Scroll through menu to the correct region, using the "↓" key. Select correct ocean region pressing the "OK" key.

The display will revert to Wait to NCS page and when NCS is acquired the display will return to Logon Display with the new ocean region used.

After the colon, the display will indicate what Land Earth Station (LES) is in use for routing your calls. If the LCD display is on another display, you can always return to the Logon display by pressing the "Exit" key repeatedly to step back from MENU operation. Many functions require starting from the Logon display.

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## OPERATION

This section contains information on types of calls and procedures for dialing and completing calls.

GROUND CALLS

All ground-to-air calls must be placed as international calls. Each INMARSAT Satellite has an assigned three digit code that is, for all practical purposes, the country code for the satellite. It is necessary to first dial the international access code that is used in your country, followed by the satellite country code and the number issued by the Ground Service Provider for the Airborne Earth Station (AES). In some countries, call routing by the Public Switched Telephone Network can be routed to the “870” country code. “870” is the Single Network Access Code (SNAC). SNAC is a special country code that contacts the Network Coordinating Station for INMARSAT Aero-M services and automatically routes the call to the satellite that Airborne Earth Station is logged on to.

In countries where calls do not route to 870, it is necessary to manually include the appropriate country code for the INMARSAT Satellite that is serving the Airborne Earth Station. If the incorrect satellite/country code is dialed, an automatic response will inform that the station you are calling is not currently logged onto this ocean region. If you are sure the AES is logged on to a satellite, you can redial the number using another satellite country code in order to contact the AES.

Country codes for the INMARSAT Satellites:

| AREA / OCEAN REGION | | INTERNATIONAL ACCESS CODE |
|---|---|---|
| Single Network Access Code | SNAC | 870 |
| Atlantic Ocean Region East | AORE | 871 |
| Pacific Ocean Region | POR | 872 |
| Indian Ocean Region | IOR | 873 |
| Atlantic Ocean Region West | AORW | 874 |

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VOICE CALLS

- Receiving calls

  If a handset is receiving a call, the handset will ring and the Yellow Ring LED will flash. To establish a connection the user can either press the Toggle Hook key (key 5 on HANDSET KEY FUNCTIONS figure) or lift handset from cradle. When a connection has been established the Yellow Ring Led will be illuminated.

- Standard telephone calls

  Dial a telephone number by entering call prefixes, country and area codes and number, then press the “#” key or the Toggle Hook key (key # 5 on HANDSET KEY FUNCTIONS figure) in the handset keypad. To finish the call press the the Toggle Hook key (key # 5 on HANDSET KEY FUNCTIONS figure).

- Calls from handset #2 (2-wire auxiliary handset)

  Handset #2 can initiate short code, service code , handset to handset, as well as standard telephone calls. Follow the procedures described for handset #1 to initiate these types of calls from handset #2.

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# SATCOM CONTROLS AND INDICATORS

The TT-3000 Series Aero-M SATCOM System uses the TT-5621A Handset as the main user interface. The handset contains a keypad with 21 separate function keys, a 2X12 character Liquid Crystal Display (LCD), four indicator LEDs, and a volume control.

The handset allows the user to:

- Navigate the user menu;
- Place and receive calls;
- Save and recall phonebook entries;
- Configure system parameters;
- View phone log;
- Monitor system operations;
- View system errors as they occur.

## HANDSET KEYS FUNCTIONS

The handset keypad consists of 21 keys (12 numeric and nine function keys). These keys are designed to perform multiple functions, that are dependent on the selected mode.

The handset has three modes that determine the function of the keys:

- Normal mode: keys perform their primary functions;
- Alpha mode: keys perform alphanumeric functions;
- 2nd mode: keys perform their alternate functions.

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The following table lists all the keys and defines their functions:

| | MODE | | |
|---|---|---|---|
| Figure Number | NORMAL | ALPHA | 2nd |
| 1 | Accept selection | | |
| 2 | Toggles handset audio mode | | |
| 3 | Enable alpha mode | Disable alpha mode | Delete entry |
| 4 | Move one selection up | | Edit entry |
| 5 | Toggle hook | | |
| 6 | Move one selection down | | Mute |
| 7 | 3 | | |
| 8 | 2 | | |
| 9 | 6 | | |
| 10 | 5 | | |
| 11 | 9 | | |
| 12 | 8 | | |
| 13 | # | | |
| 14 | 0 | | |
| 15 | * | | |
| 16 | 7 | | |
| 17 | 4 | | |
| 18 | 1 | - ? ! , . : " ' $ ( ) + / 1 | Access user menu |
| 19 | Enable 2nd mode | Enable 2nd mode | Disable 2nd mode |
| 20 | Delete/Back space one character / Delete display (hold 2 seconds) | | Insert entry |
| 21 | Exit menu / Cancel selection | | |

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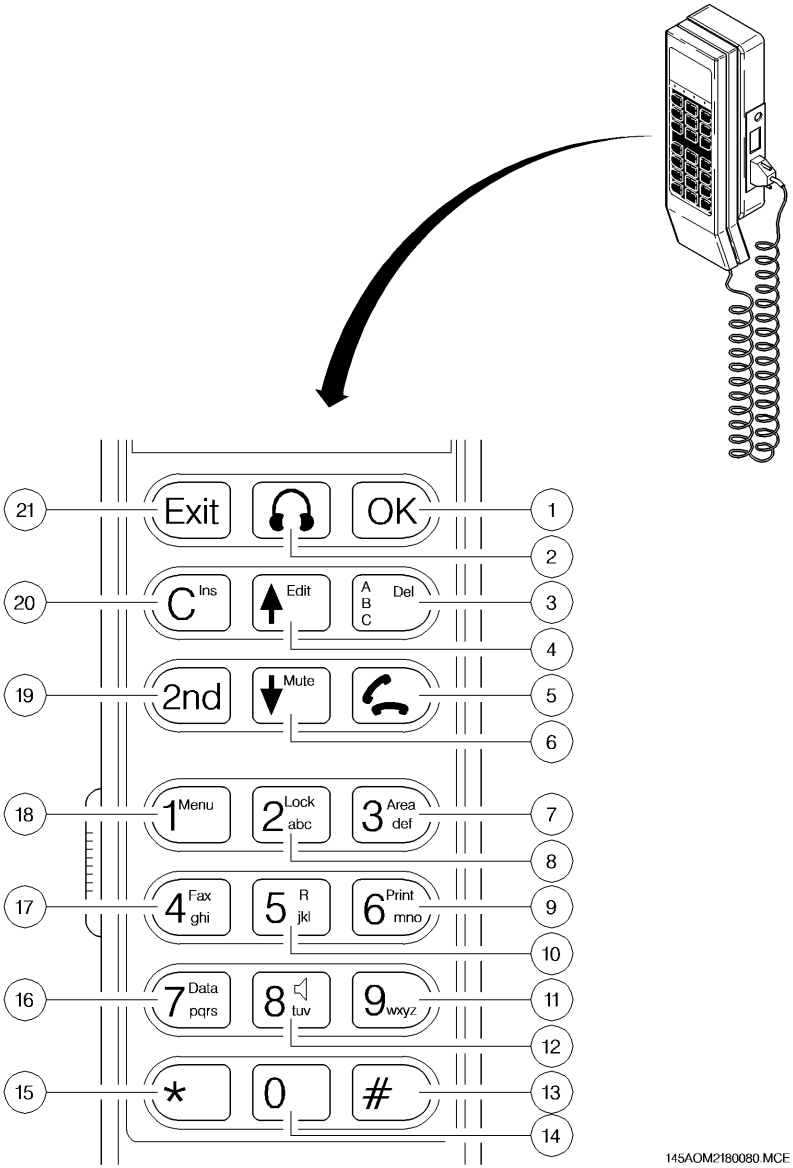


**HANDSET KEYS**

## HANDSET LCD DISPLAY

The handset uses a LCD to display all data. The LCD is a 2X12 character alphanumeric display. Aditionally, the LCD will display ten symbols to indicate operating status and alert the user of any errors that may occur. The following table lists all display symbols, referring to the figure in the next page, and defines their meaning.

| FIGURE NUMBER | NAME | DESCRIPTION |
|---|---|---|
| 1 | More entries above flag | Indicates that additional entries are available above and can be displayed by pressing the “Edit” key |
| 2 | New AES messages flag | A recorded MES message for the SDU/SIM is waiting at the LES |
| 3 | Signal strength indicator | Indicates the strength of the signal being received by the system. |
| 4 | Hook off flag | Indicates that a call is in progress |
| 5 | Speaker active flag | The speaker in the cradle is active |
| 6 | Toggle field flag | Indicates that pressing “↑” or “↓” keys can change the current selection |
| 7 | Alpha mode flag | Indicates that the “Del” key was pressed and the alpha mode is active. The next key pressed will perform its alpha mode function |

Continued

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| FIGURE NUMBER | NAME | DESCRIPTION |
|---|---|---|
| 8 | Security enabled flag | Indicates that the handset has been locked and can only be accessed by entering a valid PIN code. |
| 9 | 2nd mode flag | Indicates the “2nd” key was pressed and the 2nd mode is active. The next key pressed will perform its alternate function. |
| 10 | More entries below flag | Indicates that additional entries are available below and can be displayed by pressing the “↓” key . |

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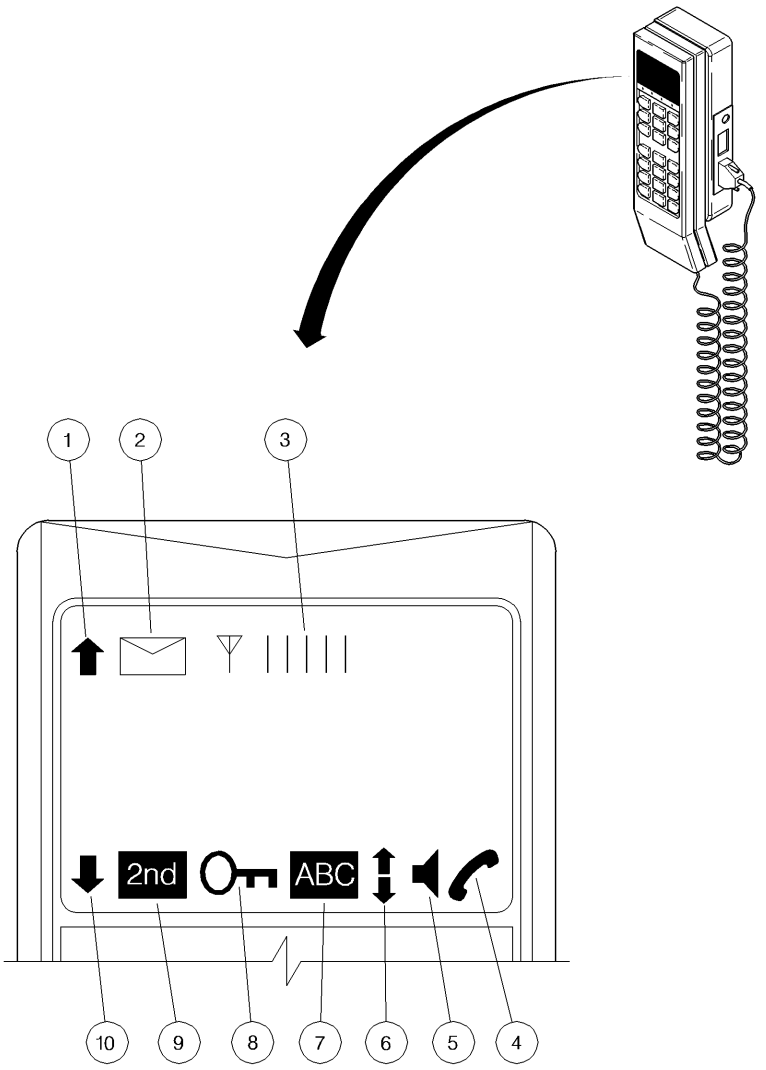
The figure below shows all the symbols found on the handset display.

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**HANDSET DISPLAY**

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## HANDSET LED INDICATORS

The handset user four colored LEDs as indicators. These LEDs alert the user of the following indications:

| FIGURE NUMBER | LED | DESCRIPTION |
|---|---|---|
| 1 | Left Green | Indicates power to handset |
| 2 | Right Green | System is logged or is logging into the satellite network. When on, the antenna strength indicator will show a measurement |
| 3 | Yellow | When on, indicates call in progress, the LED will flash when a call is received |
| 4 | Red | Illuminates when an error has occurred in the system |

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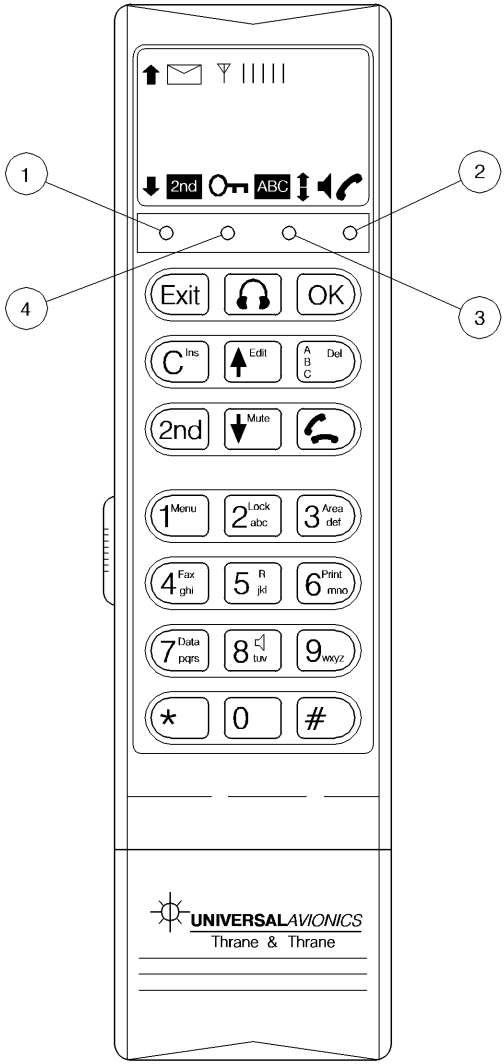


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## HANDSET LED INDICATORS

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# ATTITUDE AND HEADING REFERENCE SYSTEM (AHRS)

On EMB-145/135 airplanes, the equipment responsible for generating attitude and heading data is the Attitude and Heading Reference System (AHRS). Optionally the AHRS may be replaced by the Inertial Reference System (IRS) that, aside generating attitude and heading data, may still provide position information to the Flight Management System (FMS).

There are two types of AHRS installed on EMB-145/135 airplanes: the AH-800 and the AH-900.

Regardless of version, the airplane is equipped with two identical and independent units, identified as AHRS 1 and AHRS 2.

The interface of the AHRS with other systems and equipment of the airplane is the following:

- Air Data Computers (ADC 1 and ADC 2): The AHRS 1 and AHRS 2 receive true airspeed information from the ADC 1 and ADC 2 respectively, to improve the precision of the computed navigation data.
- Integrated Computers (IC1 and IC2): The AHRS 1 and AHRS 2 provide pitch, roll and heading information to the respective PFD, and heading information to the respective MFD, through the IC-600s. Data is transmitted separately to both sides, to ensure that single IC failure does not compromise the data path.
- Radio Management Units (RMU 1 and RMU 2): The AHRS 1 provides heading information to both RMUs via DAU 2.
- Autopilot System: The AHRS 1 provides pitch, roll and acceleration information to the Autopilot System via IC-600-1.
- Weather Radar: The AHRS 2 provides attitude information to the Weather Radar for antenna stabilization.
- Flight Management System (FMS): The AHRS provides attitude and heading information to the FMS.
- EGPWS/GPWS: The AHRS 1 provides attitude and heading information to the EGPWS/GPWS.

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- Stall Protection System (SPS): The AHRS provides attitude rate variation and vertical acceleration information to the SPS.
- Integrated Standby Instrument System (ISIS): the AHRS 1 provides heading information to the ISIS.
- Windshear Detection And Escape Guidance System: The AHRS 1 provides attitude rate variation and vertical acceleration information to the windshear computer.
- Flight Data Recorder (FDR): The AHRS 1 provides attitude and heading information to the FDR via DAU 2 and IC-600.

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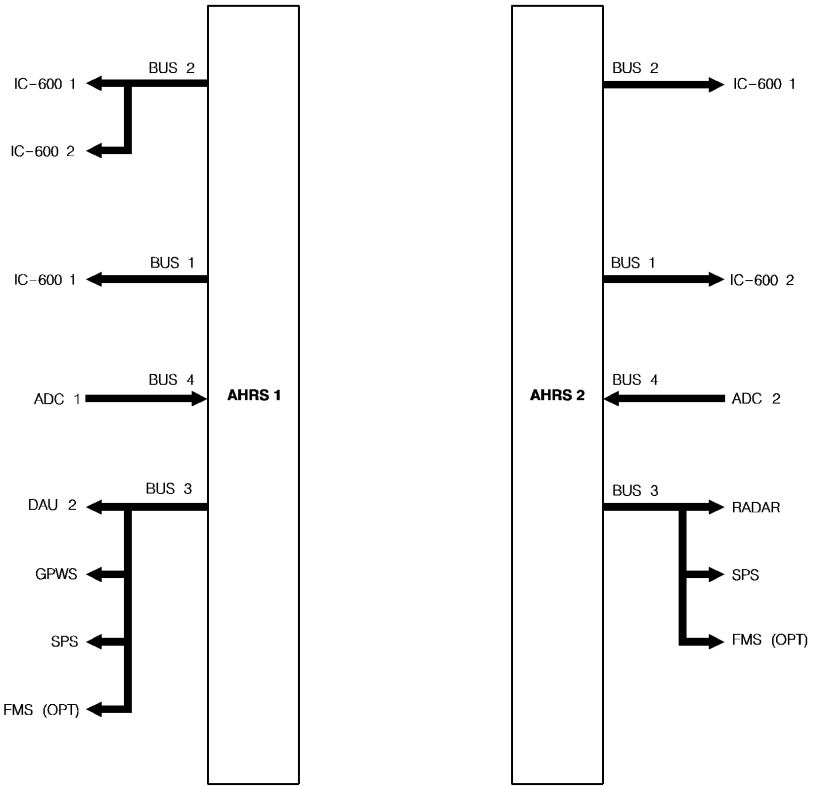


## AHRS SCHEMATIC

## AH-800 AHRS VERSION

Each AH-800 AHRS consists of an Attitude and Heading Computer (AHC), a Magnetic Flux Detector Unit (MFDU), a Memory Module and an AHRS Control Panel.

Each AHC uses two 28 VDC power inputs, one for normal power (primary source) and other for backup power (airplane batteries). The AHC 1 primary power source is the Essential DC Bus 1 and its backup power source is the Backup Essential Bus. The AHC 2 primary power source is the DC Bus 2 and its backup power source is the Backup Bus 2. If the AHC loses the primary power, it automatically transfers to backup power.

When the AHC operates solely on backup power, it will operate for 40 minutes.

ATTITUDE AND HEADING COMPUTER (AHC)

The major component of the AHRS is the AHC. The AHC contains three single axis interferometer fiber optic gyros (IFOG) mounted along the principal axis of the unit to measure the airplane angular motion. The signals processed and generated by the IFOGs as well as the information of attitude, heading and airplane axis accelerations are transmitted by the AHC in digital format to the airplane systems and equipment interfaced with the AHRS. In addition, the AHC provides excitation, current feedback control and signal demodulation interfaces to the flux detector.

MAGNETIC FLUX DETECTOR UNIT (MFDU)

The AHRS uses the wing tip mounted MFDU as long term magnetic reference. The flux detector senses the horizontal component of the earth magnetic field and provides continuous magnetic heading reference to the AHC. The heading reference is processed by the AHC to compute an inertial stabilized magnetic heading output.

MEMORY MODULE

The memory module is used to store the AHC mounting tray alignment coefficients, flux valve compensation coefficients and discrete data (orientation, source/destination identifier and interface digital buses).

AHRS CONTROL PANEL

The AHRS control panel allows canceling the magnetic field distortion as well as selecting the Directional Gyro (DG) or Slaved (SLVD) Modes.

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## AH-800 OPERATING MODES

The AHRS has six fundamental operating modes, which are described below.

– **Initialization mode:** The Initialization Mode is entered upon power up of the system. During the operation in this mode the AHRS performs self-tests to determine the condition of its components (sensors, AHC, power supply, etc). Furthermore the AHRS performs a first order leveling process to determine pitch and roll, and further slaves the magnetic heading to the flux valve. At the end of the Initialization Mode the system enters the Full Performance Mode, unless the crew selects the DG Mode or the system detects a lack of input, in this case reverting automatically to the Basic Mode.

– **Full Performance Mode:** The Full Performance Mode (slaved) is the standard system operating configuration. When operating in this mode, the TAS input from the ADC is used in the vertical channel (pitch and roll) to produce a Schuler tuned erection loop for pitch and roll attitude, and the flux valve is used as a continuous heading reference.

**NOTE:** When switched from DG to SLVD (Full Performance Mode) the system performs automatic synchronization to the flux valve.

– **DG Mode:** The DG Mode, which causes the heading channel to operate as a free non-slaved gyro, is selected by the flight crew and is used when operating in charted areas of unreliable magnetic heading or in case of a failure in the flux valve.

– **Basic Mode:** The Basic Mode is entered automatically by the system if the TAS becomes invalid. AHRS attitude output in this mode is corrected by a simple first-order erection loop similar to that of a conventional vertical gyro.

– **Test Mode:** The Test Mode is to be operated mainly by the ground personnel during maintenance procedures. This mode is activated through a switch located in the maintenance panel behind the pilot seat when the airplane is on the ground. During the test, the system verifies the outputs for proper operation of the data channels, interconnections and indications.

– **Maintenance Mode:** The Maintenance Mode is used for maintenance purposes only.

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## AH-800 EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | AHRS 1 (2) OVERHEAT | The associated AHRS computer is overheated. |
| ADVISORY | AHRS 1 (2) BASIC MODE | The TAS input signal from the ADC has been lost in the associated AHRS. |

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## AH-800 CONTROLS AND INDICATORS

AHRS CONTROL PANEL

### 1 - AHRS MODE SELECTOR SWITCH

DG - Selects the Directional Gyro Mode. In this condition the AHRS heading channel operates as a free non-slaved gyro.

SLVD - The AHRS operates slaved to the flux valve, which will provide a continuous heading reference.

### 2 - SLEWING SWITCH

CW - Allows selection, in the clockwise direction, of the desired heading to which the gyro will be slaved when the AHRS is not slaved to the magnetic heading of the flux valve (DG Mode selected).

CCW - Allows selection, in the counter-clockwise direction, of the desired heading to which the gyro will be slaved when the AHRS is not slaved to the magnetic heading of the flux valve (DG Mode selected).

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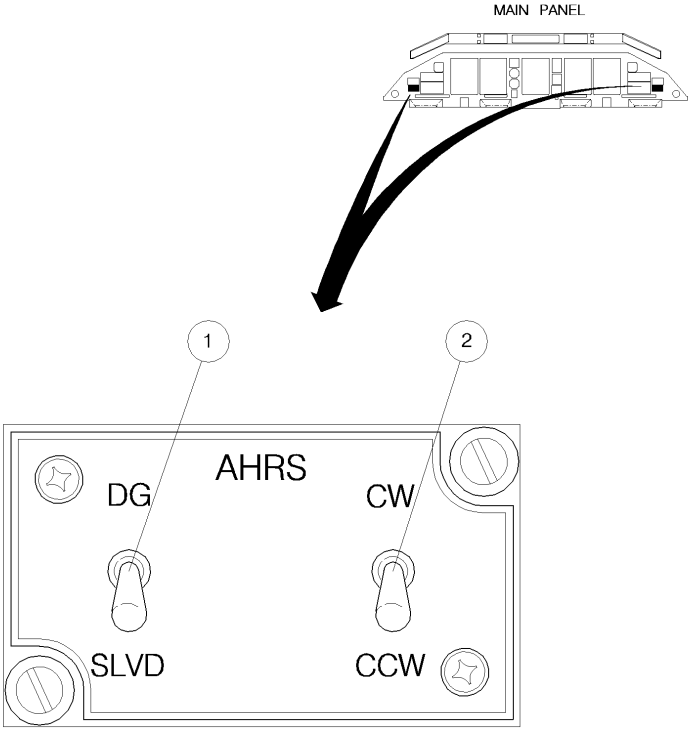


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**AHRS CONTROL PANEL (AH-800 VERSION ONLY)**

## AH-900 AHRS VERSION

The AH-900 AHRS version is basically an attitude and heading reference system that senses linear motion and angular rates through inertial sensors. Heading orientation is also obtained through the inertial sensors, dispensing the magnetic flux detectors.

Each AHRS consists of one Attitude and Heading Reference Unit, the AHRU 1 and AHRU 2, located in the forward electronics compartment.

There are no cockpit control panels.

ATTITUDE AND HEADING REFERENCE UNIT (AHRU)

The Attitude and Heading Reference Unit contains three laser gyros and three accelerometers that are mounted on each of the three axis inside of the AHRU, which it uses to measure inertial motion.

The AHRU requires initialization data from the Flight Management System (FMS) and Air Data Computer (ADC). From inertial measurements, initialization data, and air data inputs, the AHRU performs the calculations necessary to provide heading and attitude data to the airplane.

Each AHRU uses two 28 VDC power inputs, one for normal power (primary source) and the other for backup power (airplane batteries). The AHRU 1 primary power source is the Essential DC Bus 1 and its backup power source is the Backup Essential Bus. The AHRU 2 primary power source is the DC Bus 2 and its backup power source is the Backup Bus 2. If the AHRU loses primary power, it automatically transfers to backup power.

When the AHRU operates solely on backup power, it will operate for 40 minutes and the AHRS 1 (2) ON BATT advisory message will be presented on the EICAS.

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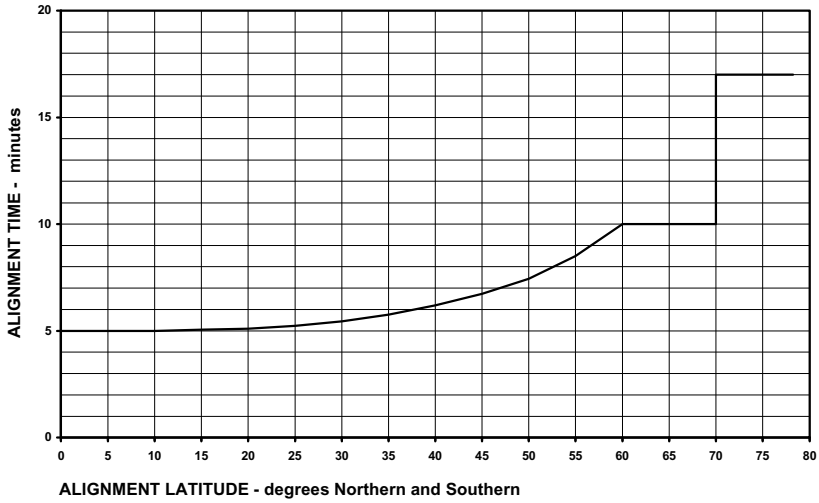
## AH-900 OPERATING MODES

ALIGNMENT MODE

The alignment mode initiates when the airplane is energized. The AHRU aligns its reference axis to the local vertical and true north, and estimates the horizontal earth rate components to compute latitude. The latitude at which the AHRU is aligned affects the alignment time. The relationship between alignment time and latitude is shown in the chart below.




The airplane must remain stationary during alignment (AHRS 1 (2) ALN advisory message presented on the EICAS). If the AHRU detects excessive airplane motion (AHRS 1 (2) EXC MOTION advisory message is presented on the EICAS), it starts an automatic full realignment 30±1 seconds after the motion stops. Normal passenger-loading or cargo-loading activities should not cause excessive airplane motion condition.

**NOTE:** To complete the alignment, the AHRU requires a valid input of the airplane's present position (latitude and longitude) from the FMS or optionally through the MFD 1. The present position input through MFD 1 bezel is possible only in airplanes equipped with EICAS 18.5 and on.

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If the present position is not entered during the normal alignment time, the AHRS 1 (2) ALN FAULT caution message will be displayed on the EICAS. For airplanes equipped with EICAS 18.5 and on, the AHRS 1 (2) NO PPOS or ARHS 1-2 NO PPOS advisory messages will be displayed on it. The AHRU will not enter the NAV mode until it receives a valid position input.

The AHRU accepts multiple entries of latitude and longitude, which means that various positions may be stored. This feature allows the pilot to select the current position previously stored, instead of enter it again.

A new position entry writes over the previous entry. More than one entry may be necessary to confirm, update or correct the position. This occurs because the AHRU does not accept new position inputs until 2 seconds after the previous input or new position input that has more than 1 degree of disagreement from the stored latitude/longitude from the last power down from the NAV mode.

The AHRU conducts a position-compare test on latitude and longitude immediately after each data has been entered. The AHRU uses only the latest entry for its test calculations. To pass the test, the entered data must compare within 1 degree of the stored latitude/longitude from the last power down from the NAV mode. If the test fails, the AHRS 1 (2) ALN FAULT caution message is presented on the EICAS.

For airplanes equipped with EICAS 18.5 and on, whenever the airplane is on the ground and the AH-900 is in align mode, the MAP/PLAN label on MFD 1 main menu changes to PPOS INIT. By selecting PPOS INIT, the operator will access the Present Position Initialization menu, and will be able to set the present- position coordinates with the data set knob or confirm the stored one. The coordinates are sent to the AH-900 computer when the ENT bezel button is pressed.

No attitude and heading data is displayed during align mode.

NAVIGATION MODE

The AHRU enters the NAV mode from the align mode. In the NAV mode, the AHRU uses the last valid position data entered during the align mode as its initial present position, and updates the present position based only on inertial data while it remains in the NAV mode. The AHRU algebraically adds computed magnetic variation from a magnetic variation topographical map (MAGVAR) to true heading and true track to produce magnetic heading and track magnetic angle. The magnetic heading and magnetic tracking angle outputs are set to no computed data (NCD) inside a northern and southern latitude cutout area.

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ATTITUDE MODE

The attitude mode is the AHRU's reversionary mode. It is automatically entered by the AHRU if power is lost in flight, and it provides a quick attitude restart: during the first 20 seconds in the attitude transitional mode, the AHRU enters the erect attitude transitional mode. In this transitional mode the AHRS 1 (2) ALN advisory message is displayed on the EICAS and the AHRU computes a new level axis set. The aircraft must be held steady, straight and level until the AHRS 1 (2) ALN message extinguishes.

When operating in the attitude mode the AHRS 1 (2) ATT MODE advisory message is presented on the EICAS. In this mode, attitude outputs are not as accurate as when operating in the NAV mode, and magnetic heading is not available.

For airplanes equipped with EICAS 18 and on, the AH-900 must be initialized with magnetic heading. In this case the operator needs to know the airplane's magnetic heading. Whenever the airplane is in the air and the AH-900 is in attitude mode, a menu bezel button annunciates MHDG INIT on the pilot's MFD. The AHRS 1 (2) NO MAG HDG or AHRS 1-2 NO MAG HDG advisory messages will be displayed on the EICAS. By selecting MHDG INIT, the operator will access the Magnetic Heading Initialization menu, and will be able to set the magnetic heading with the data set knob. The magnetic heading data is sent to the AH-900 computer when the ENT bezel button is pressed. The associated EICAS messages are cleared.

POWER-DOWN MODE

The AHRU enters the power-down mode automatically when the system detects an "end-of-flight" event. In this mode, the AHRU will transfer the last calculated position and other AHRS parameters to its non-volatile memory.

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## AH-900 EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | AHRS 1 (2) OVERHEAT | The associated AHRS is overheated. |
| | AHRS 1 (2) ALN FAULT | The associated AHRS did not complete the alignment phase successfully. |
| | AHRS 1 (2) FAIL | The associated AHRS has failed. |
| ADVISORY | AHRS 1 (2) ATT MODE | The associated AHRS is in the attitude mode. |
| | AHRS 1 (2) ALN | The associated AHRS is in the alignment phase. |
| | AHRS 1 (2) ON BATT | The associated AHRS is being powered by the airplane batteries. |
| | AHRS 1 (2) EXC MOTION | The associated AHRS detected excessive motion during the alignment phase. |
| | AHRS 1 (2) NO PPOS | The present position has not been set. |
| | AHRS 1-2 NO PPOS | The present position has not been set. |
| | AHRS 1 (2) NO MAG HDG | Magnetic heading has not been set. |
| | AHRS 1-2 NO MAG HDG | Magnetic heading has not been set. |

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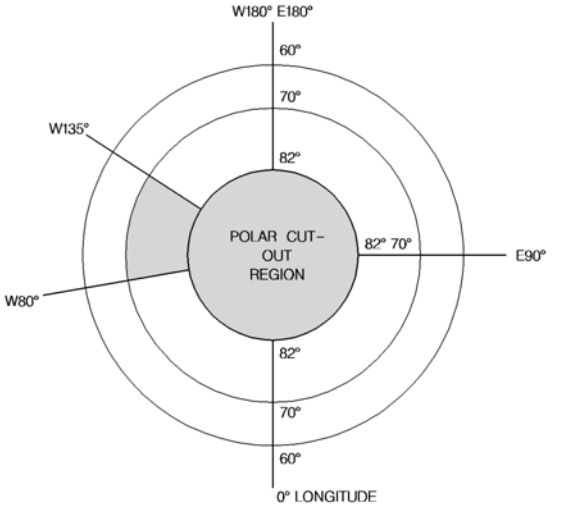
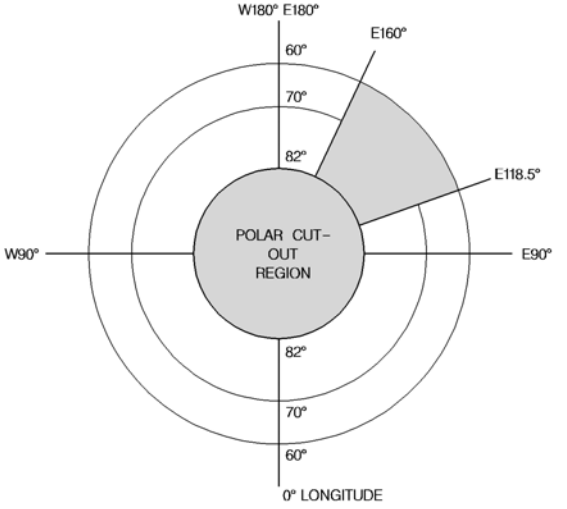



**NORTHERN LATITUDE CUTOUT**




**SOUTHERN LATITUDE CUTOUT**

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## MAGNETIC VARIATION LATITUDE CUTOUTS (AH-900 ONLY)

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# AHRS INDICATIONS ON THE PFD

## ELECTRONIC ATTITUDE DIRECTOR INDICATOR (EADI)

### 1 - ATTITUDE SPHERE

- Color:
  - Sky: blue.
  - Ground: brown.

### 2 - ROLL SCALE

- Color: White
- Range: 360 degrees.
- Resolution: 10, 20, 30 and 60 degrees for left and right roll attitudes.
- Fixed pointers (unfilled triangles) are located at zero degrees and 45 degrees (LH and RH).

### 3 - ROLL POINTER

- Color: White.
- Provides the roll angular indication against the roll scale.

### 4 - EXCESSIVE PITCH CHEVRONS

- Color: Red
- Marks –45 and 65 degrees pitch up, and 35, 50 and 65 degrees pitch down.

### 5 - PITCH SCALE

- Color: White.
- Range: 0 to 90 degrees (pitch up and pitch down).
- Marks:
  - Pitch up: 0, 5, 10, 15, 20, 25, 30, 40, 60 and 90 degrees.
  - Pitch down: 5, 10, 15, 20, 25, 30, 45, 60 and 90 degrees.

### 6 - GROUND/SKY REFERENCE EYEBROW

- Color: Blue or brown.
- The eyebrow provides a quick ground/sky reference for attitudes where the horizon line is out of the display.

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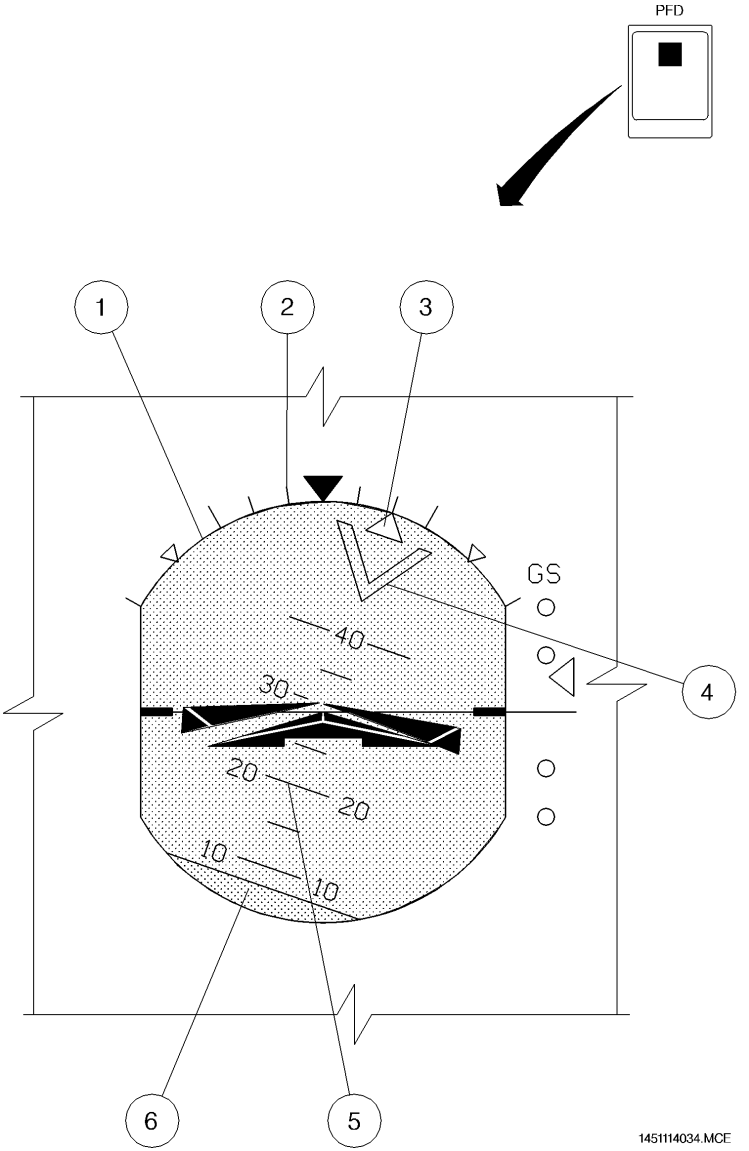


## ELECTRONIC ATTITUDE DIRECTOR INDICATOR

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## ATTITUDE DECLUTTER

When there is an excessive attitude situation, certain indicators are removed in order to declutter the PFD.

Excessive attitude situation occurs when roll attitude is greater than 65 degrees, or pitch attitude greater than 30 degrees nose up or 20 degrees nose down.

In this case, the following symbology shall be removed from the display:

– Flight Director couple arrow,
– Low Bank limit arc,
– Flight Director command bars,
– Vertical Deviation scale, pointer and label,
– Radio Altitude digits, label and box,
– Marker beacons indicators,
– Decision Height digits and labels,
– Selected Airspeed bug and indicators,
– Vertical Speed bug and indicators,
– Selected Altitude bug, indicators and box,
– All failure flags associated with the items listed above,
– The Heading, Radio Altitude, LOC, GS, and ILS comparison monitor displays

The PFD indicators will be restored when both conditions below are met:

– Roll attitude less than 63 degrees left and right.
– Pitch less than 28 degrees nose up and greater than 18 degrees nose down.

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## ELECTRONIC HORIZONTAL SITUATION INDICATOR (EHSI)

### 1 - COMPASS CARD DISPLAY

May be displayed in the Full Compass or Arc formats, selected via the Display Control Panel (see section 2-18-40).

- Color: white.
- Range: 360 degrees.
- Resolution: 5 degrees.

### 2 - HEADING LUBBER LINE (FULL COMPASS FORMAT)

- Color: White.
- Provides the current heading reading against the heading scale.

### 3 - CURRENT HEADING DIGITAL DISPLAY (ARC FORMAT)

- Color:
  - Open box: white
  - Digits: white
- Range: 0 to 360 degrees.
- Resolution: 1 degree.

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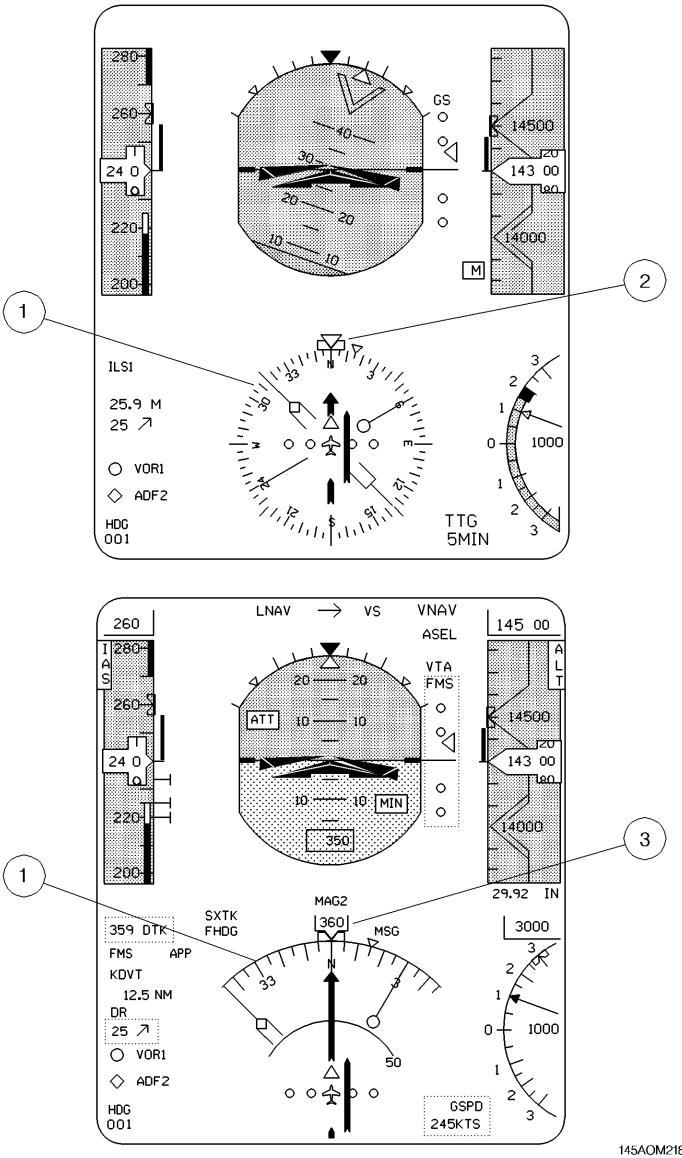


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## EHSI - FULL COMPASS AND ARC FORMATS

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## COMPARISON MONITORS

### 1 - ATTITUDE COMPARISON MONITOR DISPLAY

- Label: ROL, PIT or ATT.
- Color: Amber.
- If roll information deviates by more than 6 degrees between PFD 1 and PFD 2, a ROL comparison monitor will be displayed inside the attitude sphere.
- If pitch information deviates by more than 5 degrees between PFD 1 and PFD 2, a PIT comparison monitor will be displayed in the upper-left portion of the attitude sphere.
  Simultaneous activation of the both pitch and roll comparison monitors will be announced by an ATT label displayed in the upper-left portion of the attitude sphere, in the same field of the ROL and PIT comparison monitors.

### 2 - ATTITUDE FAILURE DISPLAY

- Removal of the pitch scale and roll pointer.
- Coloring the attitude sphere all blue.
- A red ATT FAIL label is displayed on the top center of the attitude sphere.

### 3 - ATTITUDE SOURCE ANNUNCIATION

- Label: ATT1 for AHRS 1 and ATT2 for AHRS 2.
- Color: Amber when one AHRS supplies both sides or both AHRS are supplying cross-side.
- Annunciations are removed when both AHRS are supplying on-side PFDs.

### 4 - HEADING SOURCE ANNUNCIATION

- Label:
  - MAG1 or MAG2 when AHRS heading source is magnetic.
  - DG1 or DG2 when AHRS heading source is the directional gyro.
- Color:
  - For MAG: amber when the same AHRS is supplying both sides or both AHRS are supplying cross-side.

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  - For DG: - amber when the same AHRS is supplying both sides.
    - white when both AHRS are supplying on-side.
- When both AHRS are supplying on-side, annunciation is removed.
- If a heading source becomes invalid the heading source annunciation will refer to the invalid heading source, HDG1 or HDG2, as applicable.

**5 - HEADING COMPARISON MONITOR DISPLAY**

- Color: Amber.
- Label: HDG
- Activated when a difference of 6 degrees between both PFDs is detected and airplane roll is less than 6 degrees.
- For airplane rolls greater than 6 degrees, annunciation will be displayed if the difference between both PFDs is greater than 12 degrees.
- The HDG threshold will be restored to 6 degrees if airplane roll is less than 5 degrees for 90 seconds. Otherwise, a 12 degrees HDG threshold will be maintained.

**6 - HEADING FAILURE DISPLAY**

- Digital heading bug symbol is removed and a red HDG FAIL annunciation is displayed on the PFD and MFD compass cards.
- The bearing pointers, map display, To/From, selected heading bug, drift angle, selected course/track and course deviation displays will be removed.
- Heading source annunciation will be HDG 1 or HDG 2.
- Heading select and course select/desired track digital display will be replaced by amber dashes.

**NOTE:** In case of heading splits, check if there sources for magnetic interference near the airplane. If this is cause for the problem, the heading split should disappear during the taxi.

**7 - COURSE DEVIATION FAILURE**

- Pointer is removed.
- Red X displayed over the scale.

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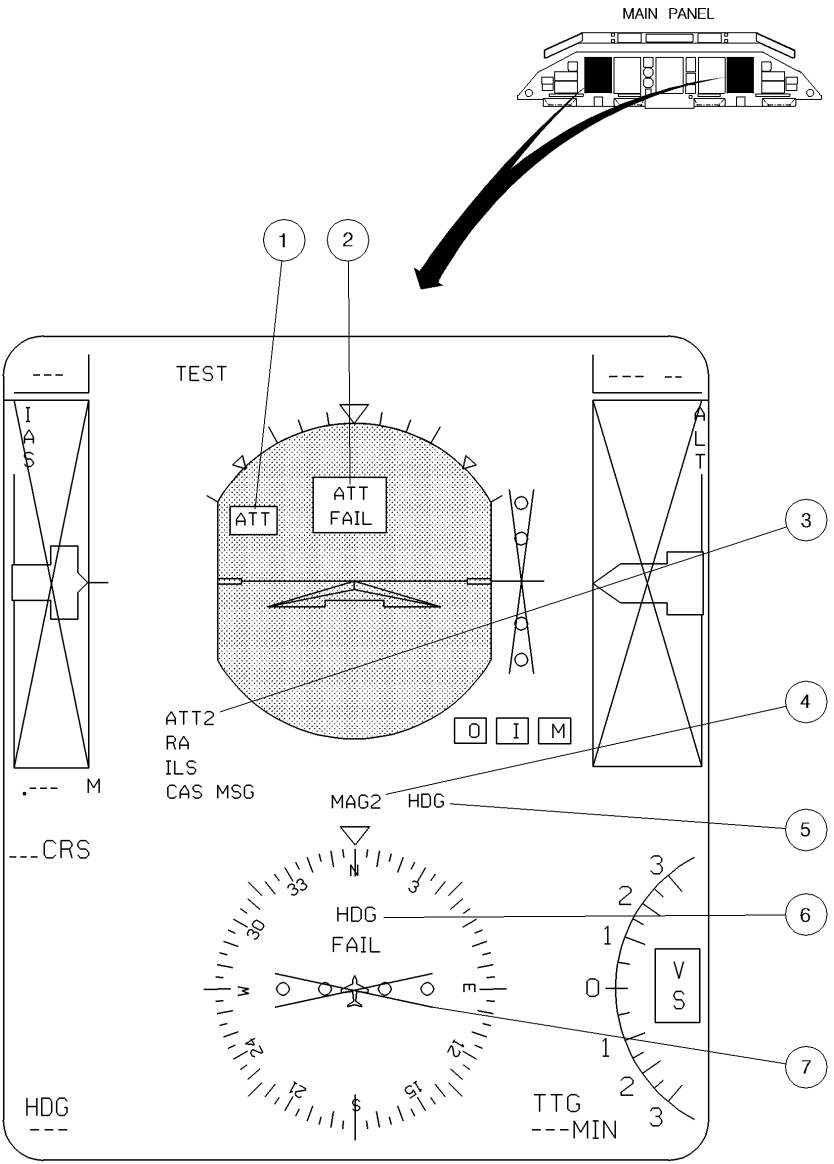


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## AHRS FAIL INDICATION ON THE PFD (BOTH AH-800 AND AH-900)

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# INERTIAL REFERENCE SYSTEM (IRS)

As a replacement for the Attitude and Heading Reference System (AHRS), the EMB-145/135 airplane family may be equipped with two identical and independent Inertial Reference Systems (IRS). Aside replacing AHRS functions, the dual IRS installation is used as an additional navigation sensor for the FMS, and it may also provide accurate attitude and heading data to the Head-Up Guidance System (HGS), when this equipment is installed.

Another possibility for HGS-equipped airplanes is the installation of a single IRS tailored for that equipment, while PFDs, MFDs and RMUs receive information from two AHRS.

Basically, the IRS provides attitude and heading reference data for the airplane displays and navigation data for the FMS by sensing linear motion and angular rates through inertial sensors.

The IRS interface with the airplane's systems and equipment is as follows:

- Air Data Computers (ADC 1 and ADC 2): The IRS 1 and IRS 2 receive altitude, altitude rate and true airspeed information from the ADC 1 and ADC 2 respectively, to improve the precision of computed navigation data.
- Integrated Computers (IC1 and IC2): The IRS 1 and IRS 2 provide pitch, roll and heading information to the respective PFD, and heading information to the respective MFD, through the IC-600s. Data is transmitted separately to both sides, to ensure that a single IC failure does not compromise the data path.
- Radio Management units (RMU 1 and RMU 2): the IRS 1 provides heading information to both RMUs via DAU 2.
- Autopilot System: The IRS 1 provides pitch, roll and acceleration information to the Autopilot System via IC-600-1.
- Weather Radar: The IRS 2 provides attitude information to the Weather Radar for antenna stabilization.
- Flight Management System (FMS): The IRS provides attitude, heading and navigation information to the FMS. The IRS receives position, magnetic heading, UTC time and date from the FMS.
- EGPWS/GPWS: The IRS 1 provides attitude and heading information to the EGPWS/GPWS.

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- Stall Protection System (SPS): The IRS provides attitude rate variation and vertical acceleration information to the SPS.
- Integrated Standby Instrument System (ISIS): The IRS 1 provides heading information to the ISIS.
- Head-Up Guidance System HGS: The IRS 1 (or the dedicated IRS) provides acceleration, speed, attitude, heading and wind information to the HGS.
- Windshear Detection And Escape Guidance System: The IRS 1 provides attitude rate variation and vertical acceleration information to the windshear computer.
- Flight Data Recorder (FDR): The IRS 1 provides attitude and heading information to the FDR via DAU 2 and IC-600.

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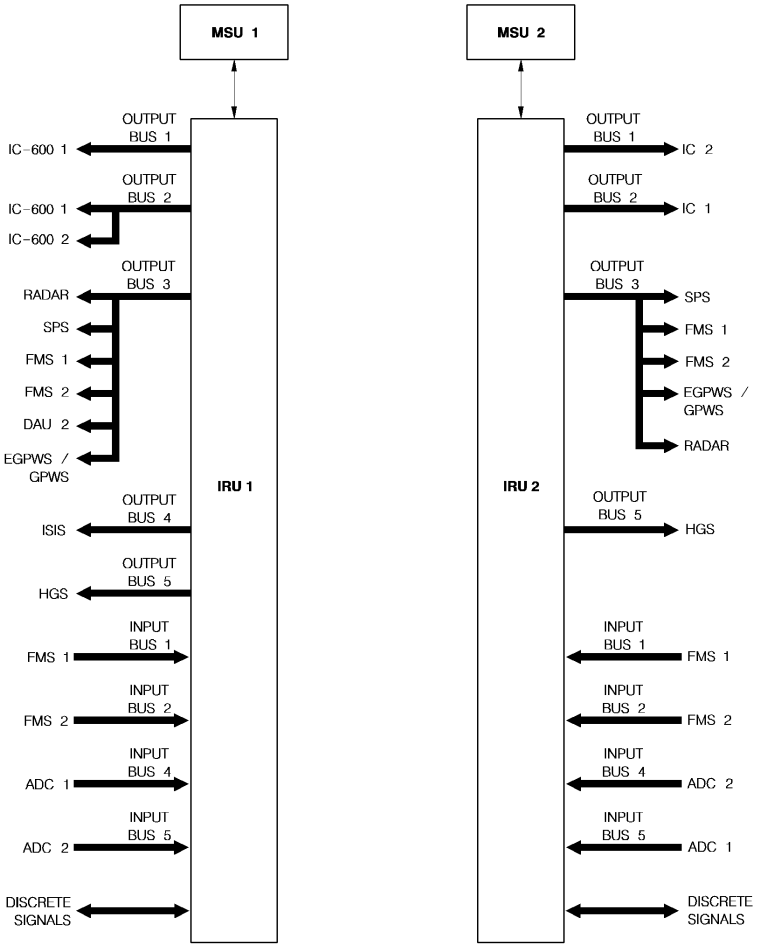


## IRS INTERFACES WITH OTHER SYSTEMS

## INERTIAL REFERENCE SYSTEM COMPONENTS

Each IRS consists of an Inertial Reference Unit (IRU) and a Mode Select Unit (MSU).

Each IRU uses two 28 VDC power inputs, one for normal power (primary source) and the other for backup power (airplane batteries). The IRU 1 primary power source is the Essential DC Bus 1 and its backup power source is the Backup Essential Bus. The IRU 2 primary power source is the DC Bus 2 and its backup power source is the Backup Bus 2. If the IRU loses the primary power, it automatically switches to backup power.

When the IRU operates solely on backup power, it will operate for 40 minutes and the ON BATT annunciator on the Mode Selector Unit will illuminate. Airplanes equipped with EICAS 17 onwards will also present the IRS 1 (2) ON BATT advisory message on the EICAS.

INERTIAL REFERENCE UNIT (IRU)

The Inertial Reference Unit contains three laser gyros and three accelerometers that are mounted on each of the three axis inside the IRU, which it uses to measure inertial motion.

The IRU requires initialization data from the Flight Management System and Air Data Computer. From the inertial measurements, initialization data, and air data inputs, the IRU performs the calculations necessary to provide position, velocity, heading and attitude data to the airplane.

The IRUs are located in the forward electronics compartment.

MODE SELECTOR UNIT (MSU)

The Mode Selector Unit is a cockpit-mounted control panel that provides mode selection, status indication and test initialization for the associated IRU. It has a four-position mode select switch and status and fault annunciators.

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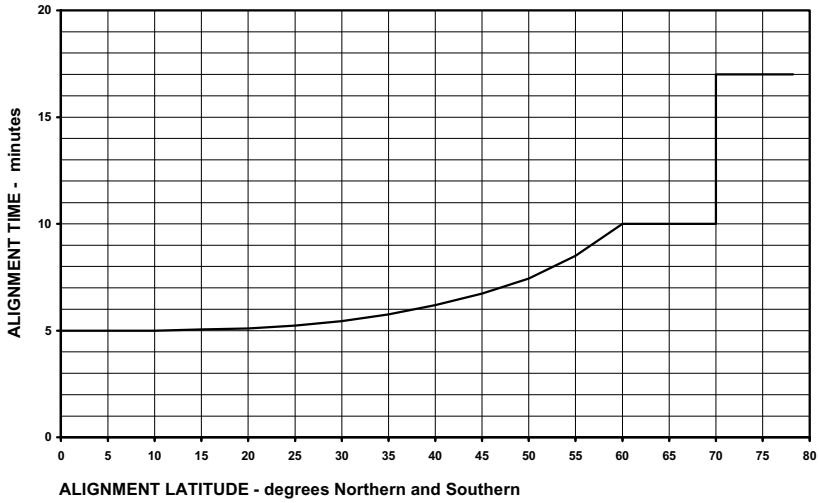
# IRS OPERATING MODES

The IRS operating modes may be selected by setting the MSU mode select switch to the desired mode. Under certain conditions the IRU may automatically revert to specific modes and sub-modes.

## ALIGNMENT MODES

MSU SET FROM OFF TO ALIGN OR NAV

In the alignment mode, the IRU aligns its reference axis to the local vertical and true north, and estimates the horizontal earth rate components to compute latitude. The latitude at which the IRU is aligned affects the alignment time. The relationship between alignment time and latitude is shown in the chart below.




The airplane must remain stationary during alignment, while the MSU ALIGN annunciator is lit and IRS 1 (2) ALN advisory message presented on the EICAS (only for airplanes equipped with EICAS 17 onwards). If the IRU detects excessive airplane motion (IRS 1 (2) EXC MOTION advisory message is presented, on airplanes equipped with EICAS 17 and on), it starts an automatic full realignment 30±1 seconds after the motion stops. Normal passenger-loading or cargo-loading activities should not cause an excessive airplane motion condition.

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**NOTE:** To complete the alignment, the IRU requires a valid input of the airplane's present position (latitude and longitude) from the FMS.

If the present position is not entered during the normal alignment time, the MSU ALIGN annunciator flashes and the IRS 1 (2) ALN FAIL caution message (only for airplanes equipped with EICAS 17 onwards) will be presented on the EICAS. The IRU will not complete the alignment phase and/or will not enter the NAV mode until it receives a valid position input from the FMS.

The IRU accepts multiple entries of latitude and longitude. More than one entry may be necessary to confirm, update or correct the position. However, the IRU does not accept new position inputs until 2 seconds after the previous input. A new position entry overwrites the previous entry, and the IRU uses only the latest entry for its calculations. The IRU conducts a position comparison test on latitude and longitude immediately after each data has been entered. To pass the test, the entered data must compare within 1 degree of the stored latitude/longitude from the last power down from the NAV mode. If the test fails, the MSU ALIGN annunciator flashes and an IRS 1 (2) ALN FAIL caution message (only for airplanes equipped with EICAS 17 onwards) will be presented on the EICAS.

No attitude and heading is displayed during align mode.

MSU SET FROM NAV TO ALIGN OR NAV TO ALIGN AND BACK TO NAV (TO BE USED ON THROUGH FLIGHTS):

This command will revert the IRU to the align down-mode, which zeroes residual velocity errors accumulated during the previous navigation mode operation. The fine leveling process of the align mode is reactivated, and heading accuracy is updated. When the IRU enters the align down-mode, the ALIGN annunciator illuminates and an IRS 1 (2) ALN advisory message is presented on the EICAS (only for airplanes equipped with EICAS 17 onwards).

The airplane must be stationary (ground speed less than 20 knots) during the align down-mode otherwise an automatic full realignment will begin in 30 seconds after an excessive aircraft motion stops.

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AUTOMATIC NAVIGATION REALIGNMENT (ANR):

The ANR is entered automatically and concurrently with normal mode operations, when the IRU senses that the airplane has completed a “no motion period” (between 7.5 and 15 minutes, as a function of latitude). In the ANR sub-mode, the IRU applies corrections by zeroing velocities, resetting the attitude platform, and correcting heading errors accumulated during the previous navigation mode operation. When the IRU enters the ANR sub-mode, the ALIGN annunciator illuminates and an IRS 1 (2) ALN advisory message is presented on the EICAS (only for airplanes equipped with EICAS 17 onwards).

**NAVIGATION MODE**

The IRU enters the NAV mode after completing its alignment when the IRU MSU switch is set to NAV. In the NAV mode, the IRU uses the last valid position data entered during the align mode or align down-mode as its initial present position and updates the present position based only on inertial data while it remains in the NAV mode. The IRU algebraically adds computed magnetic variations from a magnetic variation topographical map (MAGVAR) to true heading and true track to produce magnetic heading and track magnetic angle. The magnetic heading and magnetic tracking angle outputs are set to no computed data (NCD) inside a northern and southern latitude cutout area.

**ATTITUDE MODE**

The attitude mode is the IRU’s reversionary mode. It is automatically entered by the IRU if it experiences in-flight loss of power, or it may be selected by the crew if the FAULT annunciator lights and an IRS 1 (2) FAIL caution message is presented on the EICAS (only on airplanes equipped with EICAS 17 onwards), indicating a critical fault, that invalidates all outputs.

**CAUTION:** THE MSU SWITCH MUST NOT BE SET TO ATTITUDE MODE INADVERTENTLY. IF THIS OCCURS ON THE GROUND, IT IS NECESSARY TO SET THE MSU SWITCH TO OFF FOR AT LEAST 3 SECONDS, THEN BACK TO ALIGN OR NAV. IF ATTITUDE MODE IS SET IN-FLIGHT, IT IS NOT POSSIBLE TO RECOVER THE NAV MODE.

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This mode provides a quick attitude restart: during the first 20 seconds the IRU enters the erect attitude transitional mode. In this transitional mode the IRU computes a new level axis set. The airplane must be held steady, straight and level until the MSU ALIGN annunciator extinguishes itself and an IRS 1 (2) ALN advisory message (only for EICAS 17 onwards) disappears from the EICAS.

When operating in the attitude mode the IRS 1 (2) ATT MODE caution message (only for airplanes equipped with EICAS 17 onwards) is presented on the EICAS. In this mode, attitude outputs are not as accurate as when operating in the NAV mode, and magnetic heading must be entered periodically through the FMS Control Display Unit.

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**POWER-OFF MODE**

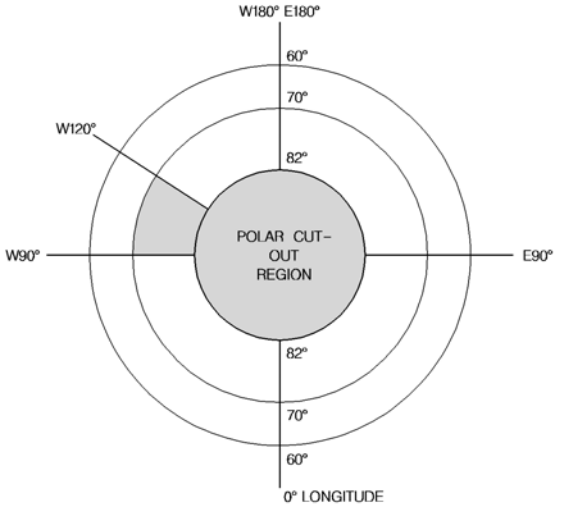
The IRU enters the power-down mode when the MSU switch is set to OFF and remains in that position for 3 seconds (to prevent inadvertent selection). After that, power continues for 10 to 15 seconds to transfer the last calculated latitude and longitude and other IRS parameters to its non-volatile memory. The ALIGN annunciator illuminates when the IRU is in the power-down mode (and an IRS 1 (2) ALN advisory message is presented on the EICAS, for airplanes equipped with EICAS 17 onwards).

**NOTE:** The airplane must not be de-energized before the ALIGN annunciator light extinguishes.

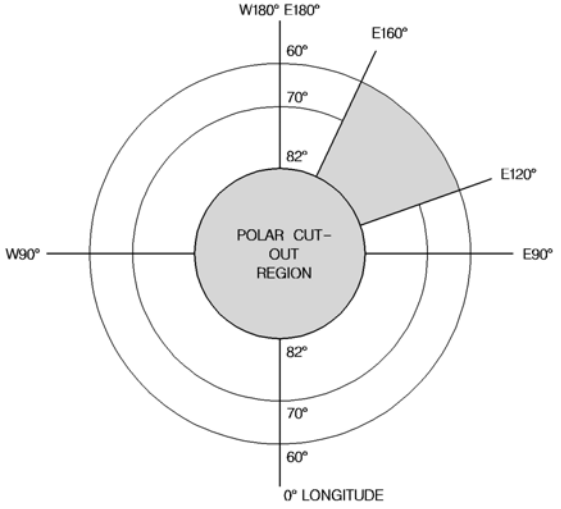
De-energizing the airplane before the ALIGN annunciator extinguishes itself (and an IRS 1 (2) ALN advisory message is removed from the EICAS, on airplanes equipped with EICAS 17 onwards) may interrupt the transferring process of the IRU's last calculated position and other IRS parameters to its non-volatile memory, which will affect the next alignment.

**TEST MODE**

The test mode is selected by pressing the MSU test switch. The test mode can be selected in either the align mode or the NAV mode without affecting basic IRS function. The test mode is inhibited in the attitude mode and in the NAV mode when aircraft ground speed exceeds 20 knots.




**NORTHERN LATITUDE CUTOUT**




**SOUTHERN LATITUDE CUTOUT**

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## MAGNETIC VARIATION LATITUDE CUTOUTS

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# IRS OPERATING PROCEDURES

## POWER-ON AND ALIGNMENT

– Check the MSU switch set to OFF.
– After energizing the airplane press the AVIONICS MASTER Buttons.
– Set the MSU switch to ALIGN or NAV. ALIGN annunciator illuminates. (ON BATT and NO AIR annunciators may illuminate briefly). On airplanes equipped with EICAS 17 onwards, an IRS 1 (2) ALN advisory message is displayed on the EICAS.
– Through the FMS initial position page, accept one of the present position options.
– Wait for completion of alignment. When selecting NAV directly, the IRU automatically enters the NAV mode after successful completion of alignment.

## NAVIGATION MODE ENTRY

– If the MSU switch was set to NAV, make sure that the ALIGN annunciator goes out and an IRS 1 (2) ALN advisory message disappears from the EICAS (on airplanes equipped with EICAS 17 onwards).
– If the MSU switch is set to ALIGN, set the MSU switch to NAV when the NAV RDY annunciator lights.
– The IRU outputs inertial data to all displays and systems.

## ALIGNMENT DOWNMODE ("FAST ALIGNMENT" - to be used on through flights)

– The airplane must be stationary.
– Pull the MSU switch out of NAV detent and set it from NAV to ALIGN. The ALIGN annunciator will illuminate and an IRS 1 (2) ALN advisory message displayed on the EICAS (on airplanes equipped with EICAS 17 onwards).
– If the IRU position is the same as the known position, set MSU switch to NAV after the ALIGN annunciator illuminates (and an IRS 1 (2) ALN advisory message is presented on the EICAS, on airplanes equipped with EICAS 17 onwards). The IRU automatically enters NAV mode after 30 seconds.
– If the IRU position is different from the known position, re-initialize the IRU with a new position entry through the FMS CDU.

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## ATTITUDE MODE SELECTION

The following procedure applies to the selection of the ATT mode after the FAULT annunciator has illuminated (and an IRS 1 (2) FAIL caution message is presented on the EICAS, on airplanes equipped with EICAS 17 onwards):

- Set the MSU switch to ATT.
- If the FAULT annunciator extinguishes itself, the ALIGN annunciator will illuminate for 20 seconds (and an IRS 1 (2) ALN advisory message is presented on the EICAS, on airplanes equipped with EICAS 17 onwards).
- Hold the airplane steady, straight and level until the ALIGN annunciator extinguishes itself (and an IRS 1 (2) ALN advisory message disappears from the EICAS, on airplanes equipped with EICAS 17 onwards).
- Initialize the IRU with magnetic heading through the FMS CDU.
- Update heading periodically through the FMS CDU.
- When operating in the attitude mode the IRS 1 (2) ATT MODE caution message (only for airplanes equipped with EICAS 17 onwards) is presented on the EICAS.

**CAUTION:** WHEN OPERATING IN THE ATTITUDE MODE, ATTITUDE OUTPUTS ARE NOT AS ACCURATE AS WHEN OPERATING IN THE NAV MODE, AND MAGNETIC HEADING MUST BE ENTERED PERIODICALLY, THROUGH THE FMS CDU.

## POWER DOWN

- Set the MSU switch to OFF. The ALIGN annunciator illuminates (and an IRS 1 (2) ALN advisory message is presented on the EICAS, on airplanes equipped with EICAS 17 onwards).
- After the ALIGN annunciator extinguishes itself (and an IRS 1 (2) ALN advisory message is removed from the EICAS, on airplanes equipped with EICAS 17 onwards), de-energize the airplane.

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## IRS EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | IRS 1 (2) OVERHEAT | The associated IRS is overheated. |
| | IRS 1 (2) ALN FAULT | The associated IRS did not complete the alignment phase successfully. |
| | IRS 1 (2) FAIL | The associated IRS has failed. |
| ADVISORY | IRS 1 (2) ALN | The associated IRS is in the alignment phase or the IRU mode select switch is set at ALIGN position. |
| | IRS 1 (2) ON BATT | The associated IRS is being powered by the airplane batteries. |
| | IRS 1 (2) EXC MOTION | The associated IRS detected excessive motion during the alignment phase. |
| | IRS 1 (2) ATT MODE | The associated IRS is selected to attitude mode. |

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# IRS CONTROLS AND INDICATORS

## MSU CONTROL PANEL

### 1 - TEST SWITCH

TEST – When the TEST switch is pressed the IRU enters the self-test sub-mode.

### 2 - ANNUNCIATORS

ALIGN – Indicates that the IRU is in the align mode. A flashing ALIGN annunciator indicates that latitude/longitude was not accepted by the IRU.

FAULT – Indicates an IRU fault.

ON BATT – Indicates that the IRU is being powered by the airplane batteries.

BATT FAIL – Indicates that the airplane batteries are incapable of sustaining IRS operation on backup power operation.

NAV RDY – Indicates that alignment is complete, if the MSU switch is set to ALIGN.

NO AIR – Indicates that cooling air is inadequate to cool the IRU.

### 3 - MODE SELECTOR SWITCH

- OFF: the IRU circuitry is OFF. However, when the IRU is operating and the MSU switch is moved from another position to OFF, there will be a delay of 3 seconds before the IRU starts the power-down routine, in order to prevent its inadvertent selection.
- ALIGN: once this mode is selected the IRU starts the full alignment or alignment down-mode. ALIGN annunciator is ON and an IRS 1 (2) ALN advisory message is presented on the EICAS (only for airplanes equipped with EICAS 17 onwards).
- NAV: there is a detent in the NAV position. The switch must be pulled out of the detent to be moved to another position.
- ATT: if the MSU switch is placed at this position, after 2 seconds (time delay incorporated to prevent inadvertent selection of the ATT mode) the IRU enters the erect attitude sub-mode for 20 seconds, during which the ALIGN annunciator illuminates. Then the IRU enters the attitude mode. On airplanes equipped with EICAS 17 onwards, the IRS 1 (2) ATT MODE caution message will be presented on the EICAS. On the ground, the MSU switch must be set to OFF for at least 3 seconds before the ALIGN or NAV mode can be re-established.

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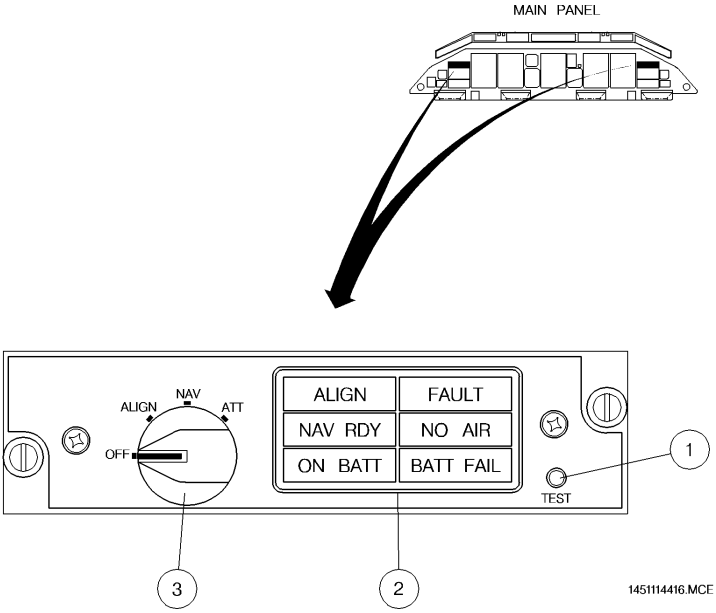


## IRS MODE SELECTOR UNIT

# IRS INDICATIONS ON THE PFD

## ELECTRONIC ATTITUDE DIRECTOR INDICATOR (EADI)

### 1 - ATTITUDE SPHERE

- Color:
  - Sky: blue.
  - Ground: brown.

### 2 - ROLL SCALE

- Color: White
- Range: 360 degrees.
- Resolution: 10, 20, 30 and 60 degrees for left and right roll attitudes.
- Fixed pointers (unfilled triangles) are located at zero degrees and 45 degrees (LH and RH).

### 3 - ROLL POINTER

- Color: White.
- Provides the roll angular indication against the roll scale.

### 4 - EXCESSIVE PITCH CHEVRONS

- Color: Red
- Marks –45 and 65 degrees pitch up, and 35, 50 and 65 degrees pitch down.

### 5 - PITCH SCALE

- Color: White.
- Range: 0 to 90 degrees (pitch up and pitch down).
- Marks:
  - Pitch up: 0, 5, 10, 15, 20, 25, 30, 40, 60 and 90 degrees.
  - Pitch down: 5, 10, 15, 20, 25, 30, 45, 60 and 90 degrees.

### 6 - GROUND/SKY REFERENCE EYEBROW

- Color: Blue or brown.
- The eyebrow provides a quick ground/sky reference for attitudes where the horizon line is out of the display.

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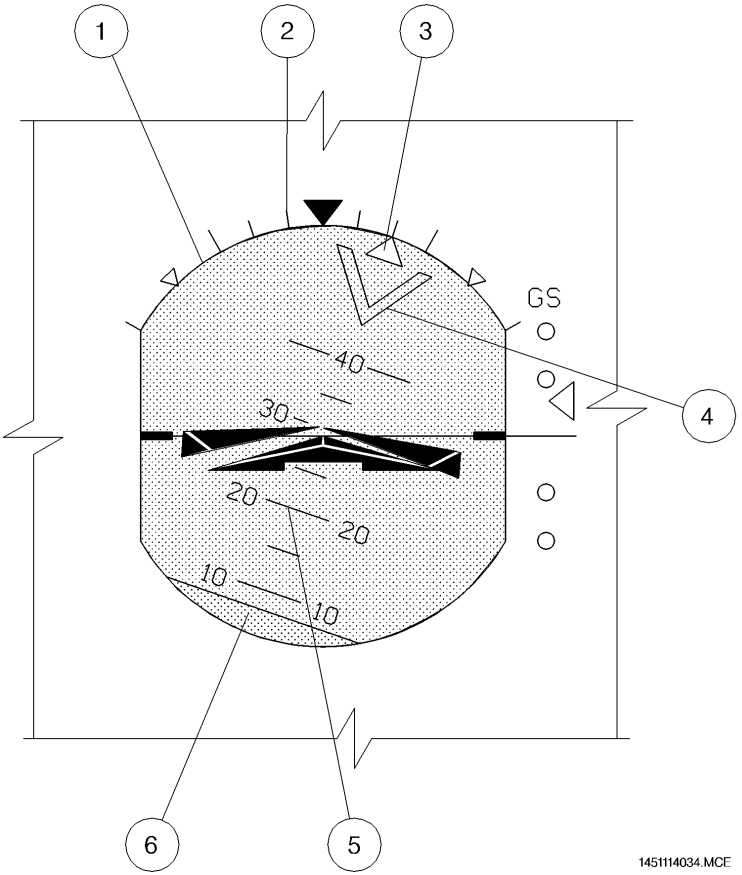


## ELECTRONIC ATTITUDE DIRECTOR INDICATOR

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## ATTITUDE DECLUTTER

When there is an excessive attitude situation, certain indicators are removed in order to declutter the PFD.

Excessive attitude situation occurs when roll attitude is greater than 65 degrees, or pitch attitude greater than 30 degrees nose up or 20 degrees nose down.

In this case, the following symbology shall be removed from the display:

– Flight Director couple arrow,
– Low Bank limit arc,
– Flight Director command bars,
– Vertical Deviation scale, pointer and label,
– Radio Altitude digits, label and box,
– Marker beacons indicators,
– Decision Height digits and labels,
– Selected Airspeed bug and indicators,
– Vertical Speed bug and indicators,
– Selected Altitude bug, indicators and box,
– All failure flags associated with the items listed above,
– The Heading, Radio Altitude, LOC, GS, and ILS comparison monitor displays

The PFD indicators will be restored when the two conditions below are met:

– Roll attitude less than 63 degrees left and right.
– Pitch less than 28 degrees nose up and greater than 18 degrees nose down.

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## ELECTRONIC HORIZONTAL SITUATION INDICATOR (EHSI)

### 1 - COMPASS CARD DISPLAY

May be displayed in the Full Compass or Arc formats, selected via the Display Control Panel (see section 2-18-40).

- Color: white.
- Range: 360 degrees.
- Resolution: 5 degrees.

### 2 - HEADING LUBBER LINE (FULL COMPASS FORMAT)

- Color: White.
- Provides the current heading reading against the heading scale.

### 3 - CURRENT HEADING DIGITAL DISPLAY (ARC FORMAT)

- Color:
  - Open box: white
  - Digits: white
- Range: 0 to 360 degrees.
- Resolution: 1 degree.

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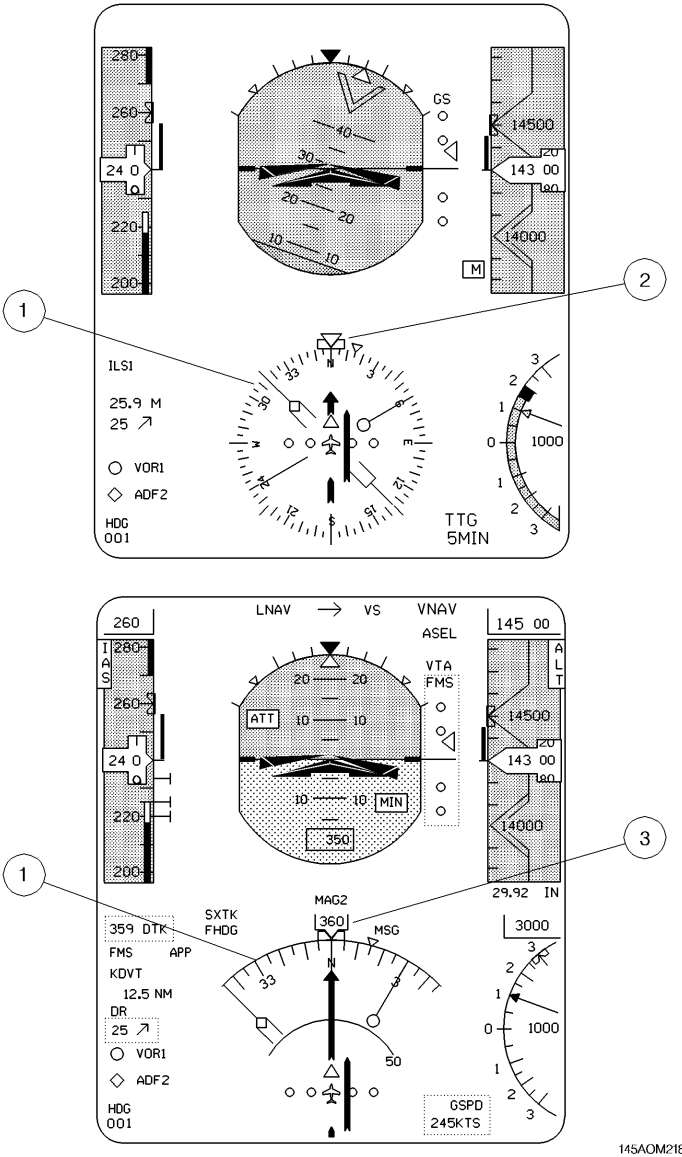


## EHSI - FULL COMPASS AND ARC FORMATS

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## COMPARISON MONITORS

### 1 - ATTITUDE COMPARISON MONITOR DISPLAY

- Label: ROL, PIT or ATT.
- Color: Amber.
- If roll information deviates by more than 6 degrees between the PFD 1 and PFD 2, a ROL comparison monitor will be displayed inside the attitude sphere.
- If pitch information deviates by more than 5 degrees between the PFD 1 and PFD 2, a PIT comparison monitor will be displayed in the upper-left portion of the attitude sphere.
  Simultaneous activation of the both pitch and roll comparison monitors will be announced by an ATT label displayed in the upper-left portion of the attitude sphere, in the same field of the ROL and PIT comparison monitors.

### 2 - ATTITUDE FAILURE DISPLAY

- Removal of the pitch scale and roll pointer.
- Coloring the attitude sphere overall blue.
- A red ATT FAIL label is displayed on the top center of the attitude sphere.

### 3 - ATTITUDE SOURCE ANNUNCIATION

- Label: ATT1 for IRS 1 and ATT2 for IRS 2.
- Color: Amber when one AHRS supplies both sides or both IRS are supplying cross-side.
- Annunciations are removed when both IRS are supplying on-side PFDs.

### 4 - HEADING SOURCE ANNUNCIATION

- Label:
  - MAG1 or MAG2 when cross-side IRS source is selected.
- Color:
  - For MAG: amber when the same IRS is supplying both sides or both IRS are supplying cross-side.
- When both IRS are supplying on-side, annunciation is removed.
- If a heading source becomes invalid the heading source annunciation will refer to the invalid heading source, HDG1 or HDG2, as applicable.

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**5 - HEADING COMPARISON MONITOR DISPLAY**

- Color: Amber.
- Label: HDG
- Activated when a difference of 6 degrees between both PFDs is found and the airplane roll is less than 6 degrees.
- For airplane rolls greater than 6 degrees, annunciation will be displayed if the difference between both PFDs is greater than 12 degrees.
- The HDG threshold will be restored to 6 degrees if the airplane roll is less than 5 degrees for 90 seconds. Otherwise, a 12 degrees HDG threshold will be maintained.

**6 - HEADING FAILURE DISPLAY**

- Digital heading bug symbol is removed and a red HDG FAIL annunciation is displayed on the PFD and MFD compass cards.
- The bearing pointers, map display, To/From, selected heading bug, drift angle, selected course/track and course deviation displays will be removed.
- Heading source annunciation will be HDG 1 or HDG 2.
- Heading select and course select/desired track digital display will be replaced by amber dashes.

**7 - COURSE DEVIATION FAILURE**

- Pointer is removed.
- Red X displayed over the scale.

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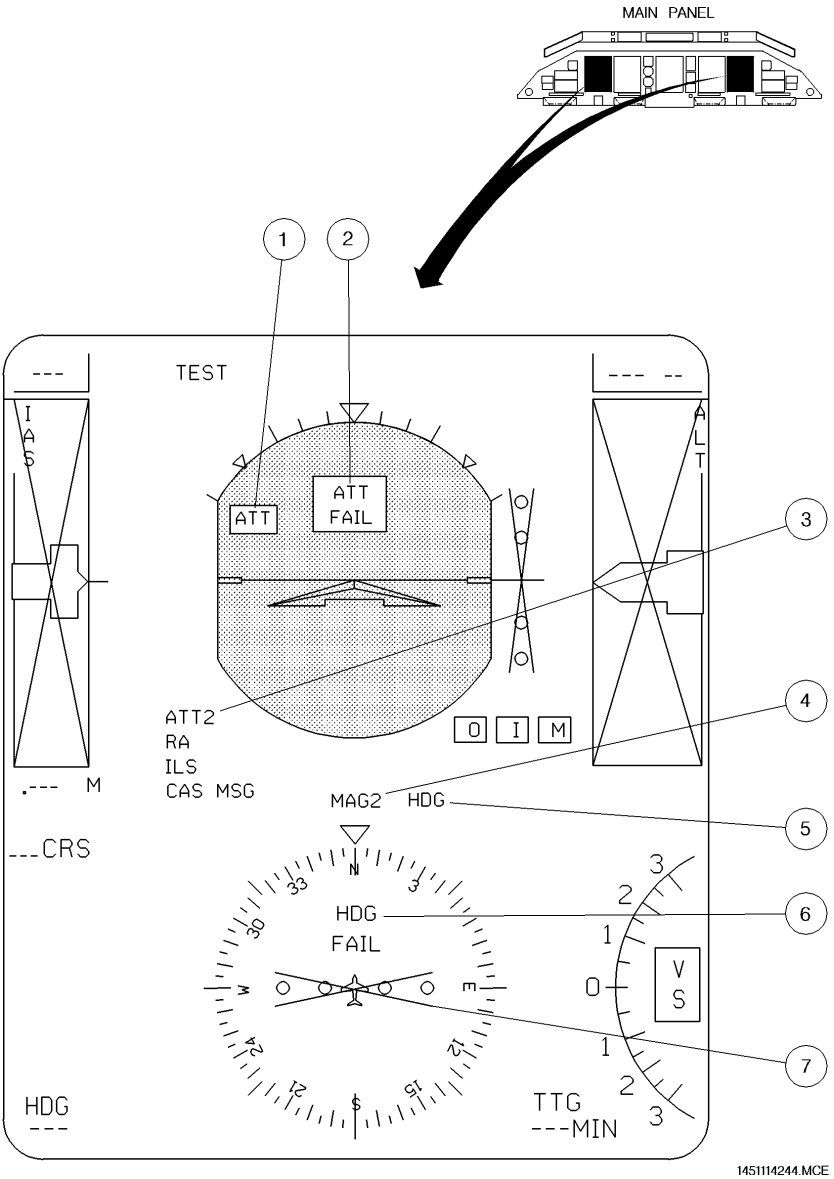


**IRS FAIL INDICATION ON THE PFD**

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# FLIGHT MANAGEMENT SYSTEM

The FMZ 2000 Flight Management System (FMS) controls a complete range of navigation functions. Its primary purpose is to provide high accuracy in long range lateral and vertical navigation. The system may be installed with a single or dual configuration. Should the airplane have a dual configuration, each unit can provide navigation data to the other unit. For additional information on functions and operation, refer to the manufacturer's manual.

The FMS is mainly composed of the following components:

- Control Display Unit (CDU).
- Navigation Computer (NZ).
- Data Loader (DL) or Portable Data Transfer Unit (PDTU).

The FMS operates in the following situations: Oceanic, Remote, North Atlantic Minimum Navigation Performance Specification Airspace, Enroute, Terminal, Non-Precision Approach and Required Navigation Performance 10.

The FMS interfaces with the followings systems and equipment:

- GPS sensor(s), ADC 1 and 2 - The GPS receives satellite data through the passive GPS antenna, processing and blending collected data with ADC data and sends the resulting information to the FMS computer.
- AHRS/IRS 1 and 2 - Provides the necessary data to compute wind and for Dead Reckoning Mode, when the subsystem is not capable of navigating by itself.
- MFD and PFD - The FMS provides data for display navigation guidance on the PFD and navigation map data on the MFD.
- RMU 1 and 2 - The RMU interfaces with the FMS computer to control the operating frequencies, modes and channels of the various radios. For the dual configuration, each RMU supplies each respective on-side NZ.
- COM 1 and 2, NAV 1 and 2 - The FMS includes a radio-tuning page on which the pilot can manually select the VHF NAV and COM frequencies. Only the NAV frequency is fed back to the FMS computer for verification of the tuning action. COM 1 and 2 interface with FMS through the RMUs. The FMS can also automatically select the NAV radio frequencies. The FMS tune function for tuning communication frequencies with 8.33 kHz frequency spacing is available only for the Honeywell NZ5.2 FMS software version.
- The FMS also provides latitude and longitude to TCAS.

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– The Control Display Unit (CDU), located on the control pedestal, provides control functions management and operating modes for proper FMS operation. The EMB-145 should have two types of FMZ 2000 CDU installed, CD-810, CD-820, or CD-830. In dual FMS configuration, the intermix operation is not recommended.

– The CD-810 CDU is equipped with a Cathodic Ray Tube (CRT). The CD-820 and CD-830 CDU are equipped with a full-color Liquid Crystal Display (LCD) and contains nine lines, being the first a title line and the ninth the scratchpad.

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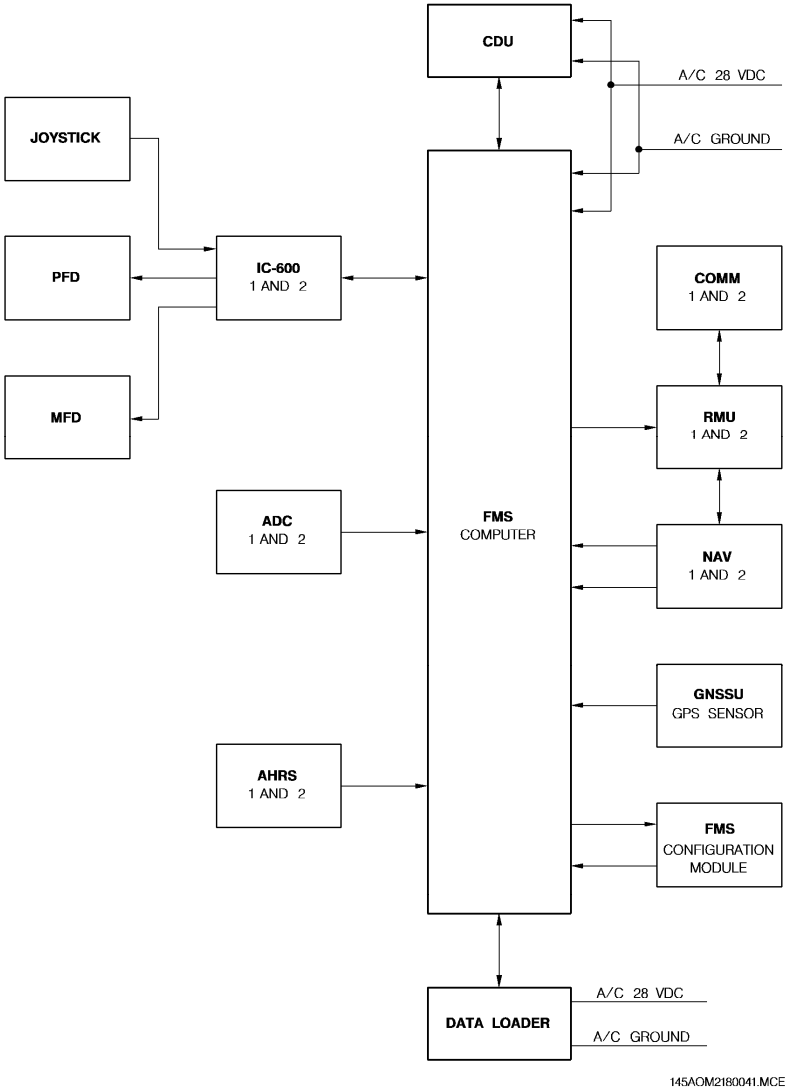


## FMS SCHEMATIC



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# FMS OPERATING MODES

## FMS FUNCTIONS

NAVIGATION

The navigation function computes the airplane position and velocity for all phases of flight. The navigation priority modes, based on sensor accuracy, are as follows:

– GPS
– DME/DME
– VOR/DME
– IRS (if installed)

The GPS is the most accurate sensor. When the GPS is in use, the other sensors are still monitored for position differences, but they do not contribute to FMS position, unless the GPS becomes inaccurate, unavailable or is manually deselected. In this case, the FMS automatically tunes the DME/DME in order to provide position. When DME/DME is not accurate, the VOR/DME is selected.

On airplanes equipped with dual Inertial Reference System (IRS), replacing the AHRS, the IRS is used as a primary navigation sensor when other navaid are not available.

If all position sensors and radios are lost, the FMS shifts to Degrade Mode (DGRAD) and in approximately 2 minutes it enters the Dead Reckoning Mode (DR). In this mode, the position is calculated using the last known airplane position. The ground speed and track are estimated with AHRS/IRS heading, ADC TAS and the last known wind data.

The dual FMS configuration (NZ5.2 software version and on) may operate with dual IRS and dual GPS providing four long-range navigation sensors. The sensors status may be accessed in the NAV INDEX 1/2 page.

In this configuration, on-side FMS outputs and flight plan information are available to the opposite-side FMS through an interconnecting bus.

The automatic tuning is made through the rmu for computing an optimum position. The fms also includes a radio-tuning page on which the pilot can manually select vhf nav, com, adf and transponder frequencies. The nz5.2 software version and on has the capability of tuning communication frequencies in the 8.33 khz channel spacing.

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FLIGHT PLANNING

The flight planning function computes the active flight plan with both lateral and vertical definition.

When the FMS long-range navigation is selected, the flight director command bars will provide the visual command to bank the airplane to the desired track.

The VNAV is applicable only for the descent path and it is not coupled to the flight director, being only a reference information displayed on the PFD glide slope scale.

Additionally, the navigation computer can be programmed by the operator to automatically fly different types of holding patterns.

DATA BASE

The database contains worldwide coverage of navaids, airways, departure procedures, approach procedures, Standard Terminal Arrival Routes (STARs), airports and runways. This information is updated every 28 days. The database can also store up to 200 pilot-defined flight plans and waypoints, which are only updated when changed by the pilot.

In single configuration, the Data Loader (DL) is used to update the Database, transferring data to and from the Navigation Computer. In this configuration, this unit can be installed on the left lateral console, close to the pilot's mask stowage box.

In dual configuration, the Portable Data Transfer Unit (PDTU) is used to reload entire information package at each update by using a 3 $^{1}/_{2}$" floppy disk.

NAVIGATION DISPLAY

A multiple waypoints map, based on the airplane's present position, can be displayed on the MFD. It comprises the Waypoints connected by white lines defining a pre-planned route, and also navaids and airports.

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## FMS MODES

The dual FMS configuration provides four operating modes that may be accessed through the FMS MAINTENANCE 1/3 page:

DUAL MODE

In this mode, the following information is automatically transferred to the cross-side FMS: flight plan, performance data, waypoints defined by the pilot, flight plans created in one system and radio tuning.

**NOTE:** For the proper operation in DUAL mode it is necessary to use the same software version, same NAV and CUSTOM data bases and same settings for both systems in the Configuration Modules. The initial position difference between both systems shall not be more than 10 NM.

INITIATED TRANSFER MODE

In this mode the flight plan and performance data entry will only be transferred to the cross-side FMS through the prompt command available in the last page of the ACTIVE FLT PLAN pages. Waypoints defined by the pilot, created flight plans and radio tuning are automatically transferred to the cross-side FMS.

**NOTE:** For the proper operation in INITIATED TRANSFER mode it is necessary to use the same software version, same NAV and CUSTOM data bases and same settings for both systems in the Configuration Modules. The initial position difference between both systems shall not be more than 10 NM.

INDEPENDENT MODE

In this mode, only the radio tuning is automatically transferred to the cross-side FMS.

**NOTE:** To operate in the INDEPENDENT mode, it is necessary to use the same software version and same settings in the Configuration Modules. If any of these requirements is not accomplished, the system automatically passes for the possible operating mode. For instance, if only the CUSTOM database differs in both systems, the operating mode automatically switches from DUAL to INDEPENDENT.

SINGLE MODE

no information is exchanged between both systems.

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# FMS CONTROLS AND INDICATORS

## CONTROL DISPLAY UNIT (CDU)

### 1 - ANNUNCIATORS

The CD-810 CDU has the annunciator lights directly above the display and the CD-820 and CD-830 CDU has the annunciators on the top of LCD display.

- Colors:
  - White: indicating advisory annunciation.
  - Amber: indicating alerting annunciation.

| | |
|---|---|
| DSPLY (White) | Illuminates when the CDU displays a page that is not relative to the current airplane lateral or vertical flight path. This annunciator is not shown on the PFD. |
| DR (Amber) | Illuminates when a radio updating loss occurs, as well as all other position sensors, for a period longer than 2 minutes. |
| DGRAD (Amber) | Illuminates when the FMS cannot guarantee the position accuracy for the present phase of the flight. |
| MSG - (CD-810 and CD-820)<br>FMS MSG - (CD-830)<br>(White) | Illuminates when there is a message (advisory or alert) on the scratchpad. The annunciator turns off when the message is cleared from the scratchpad. |
| OFFSET (White) | Illuminates when a lateral offset path has been entered in the FMS. The annunciator turns off when the offset is removed. |

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| | |
|---|---|
| APRCH (White) | Illuminates when the FMS is selected as navigation source and the following conditions are valid: a non-precision instrument approach has been activated from the navigation database, the airplane position is between 2 NM outside the final approach fix and the missed approach point, the DGRAD must be off and FMS using approved sensors for non-precision approach. |

**NOTE:** The FMS transmits all the annunciators to the PFD, except the DSPLY annunciator, so the pilot must not trust only on the FMS CDU for checking the FMS system status.

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**2 - LINE SELECT BUTTONS**

- There are four line select buttons on each side of the CDU that provide the following functions:
  - Select submodes within major modes when in an indexed display.
  - Used as direct access to the other FMS modes when in a non-indexed display.
  - Enter data to the scratchpad.

**3 - BRIGHTNESS CONTROL KNOB/BUTTON**

- Used to manually control the brightness of the display.
- After using this knob, the photo sensors are activated and maintain the brightness level through a wide range of lighting conditions. In CD-820 and CD-830 CDU the brightness is adjusted pressing the Bright/Dim button, so a control bar will be displayed in the scratchpad.
- The brightness can be adjusted so that, during daylight conditions, the display cannot be seen.

**4 - MODE BUTTONS**

| | |
|---|---|
| PERF | Displays the performance pages. |
| NAV | Displays the NAV index pages. |
| ATC | NOT AVAILABLE. |
| FPL | It may be used to display the first page of the active flight plan, if the flight plan was previously entered, to manually create a flight plan, to select a stored flight plan and to create a flight plan for storage. |
| PROG | Displays the first progress page, the current status of the flight. |
| DIR | Displays the active flight plan with the DIRECT and INTERCEPT prompts. |
| MENU (CD-830 ) | Display the MENU pages. |

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**5 - ALPHANUMERIC BUTTONS**

- Consist of alphabet letters, the numbers 0 through 9, a decimal, a dash and a slash. It is used to enter inputs to the FMS. In the CD-820 and CD-380 a SP (Space) key is used to insert a space following a character in the scratchpad, and a +/- (Plus/Minus) key will result in a - being entered, changing to + in a subsequent press.
- The alphanumeric keys make entries only on the scratchpad.

**6 - FUNCTIONS BUTTONS**

| | |
|---|---|
| PREV | Changes the current page to the previous page. |
| NEXT | Changes the current page to the next page. |
| CLR | Clears alphanumeric entries in the scratchpad or a scratchpad message. |
| DEL | Works together with line select buttons in order to delete waypoints and other items displayed on the CDU. This button is inhibited when a message is displayed. |

The CD-820 has five function buttons directly above the LCD display that will not work if pressed. The following messages will be displayed in the scratchpad:

| | |
|---|---|
| VIDEO | VIDEO NOT AVAILABLE. |
| GRAPHIC | GRAPHIC NOT AVAILABLE. |
| ATC | ATC NOT AVAILABLE. |
| BACK | BACK COMPLETE. |
| FN | FN NOT AVAILABLE. |

The CD-830 has a different layout from the CD-820. The function keys are re-arranged. It includes:

- The function keys “BACK” and “FN” are always accessible, meanwhile “VIDEO” and “GRAPHIC” were moved to the submenu in the key “MENU”;
- The line select keys (LSKs) are soft keys on touch screen display;
- The keys that were not available in CD-820 are the same as the ones in CD-830.

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## 7 - SCRATCHPAD

- It is the working area, located on the bottom line of the display, where the pilot can enter data and/or verify data before line selecting the data into its proper position.
- Data is retained on the scratchpad throughout all mode and page changes.
- The scratchpad also provides advisory and alerting messages to be displayed.

The colors on the CD-820 and CD-830 are designed to highlight important information. Color assignments are coordinated as much as possible with other displays. See below the parameters associated to each color:

| | |
|---|---|
| Vertical | Cyan (Blue) |
| Atmospheric Data | Cyan (Blue) |
| Lateral | Green |
| FROM Waypoint | Yellow |
| TO Waypoint | Magenta |
| Prompts and Titles | White |
| Flight Plan Names | Orange |
| Index Selections | Green |

## 8 - TOUCH SCREEN (If applicable)

For airplanes equipped with Control Display Unit CD-830, the display of the CDU is touch sensitive.

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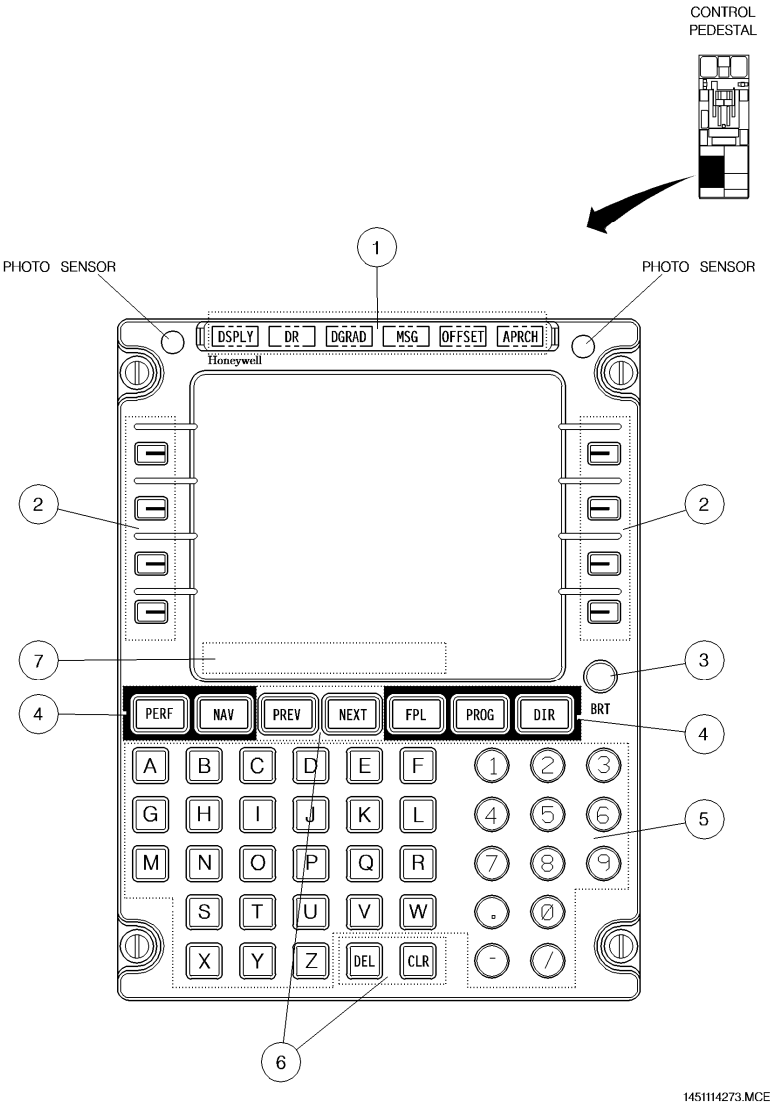


**FMZ 2000 FMS CD-810 CONTROL PANEL**

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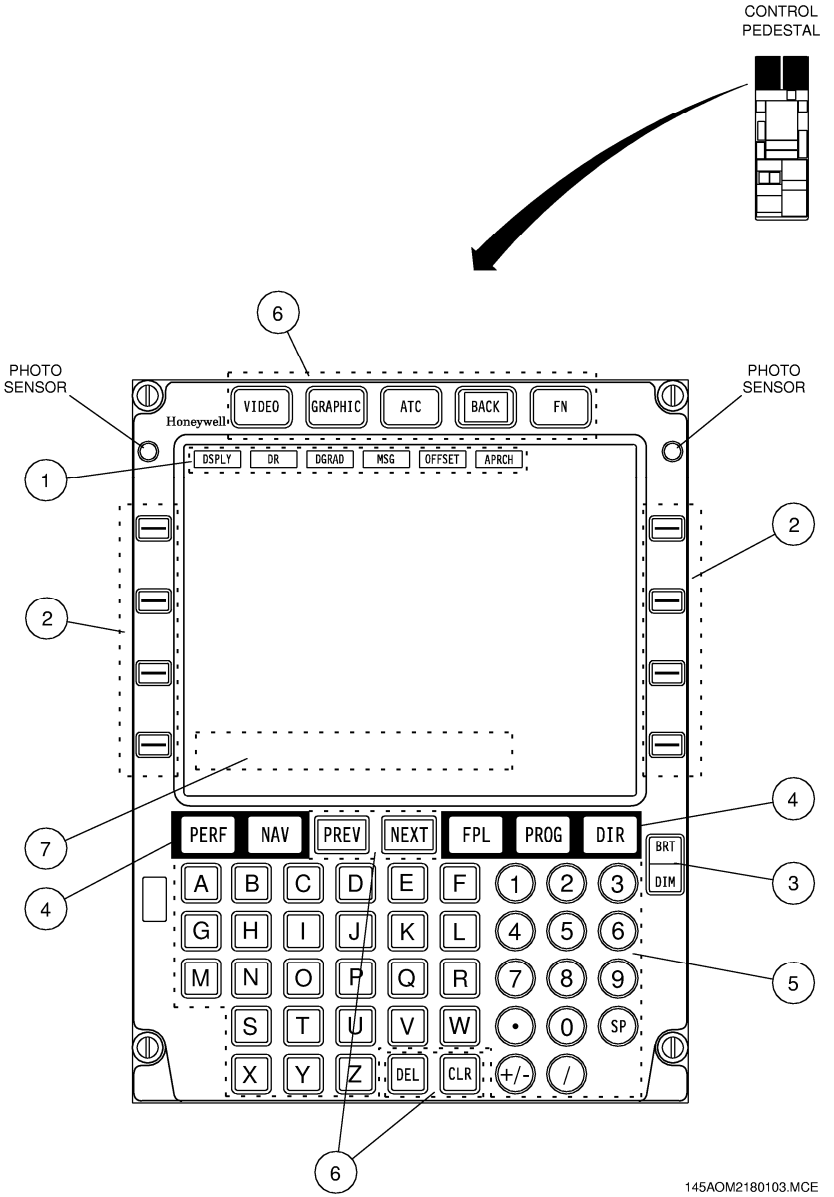


**FMZ2000 FMS CD-820 CONTROL PANEL**

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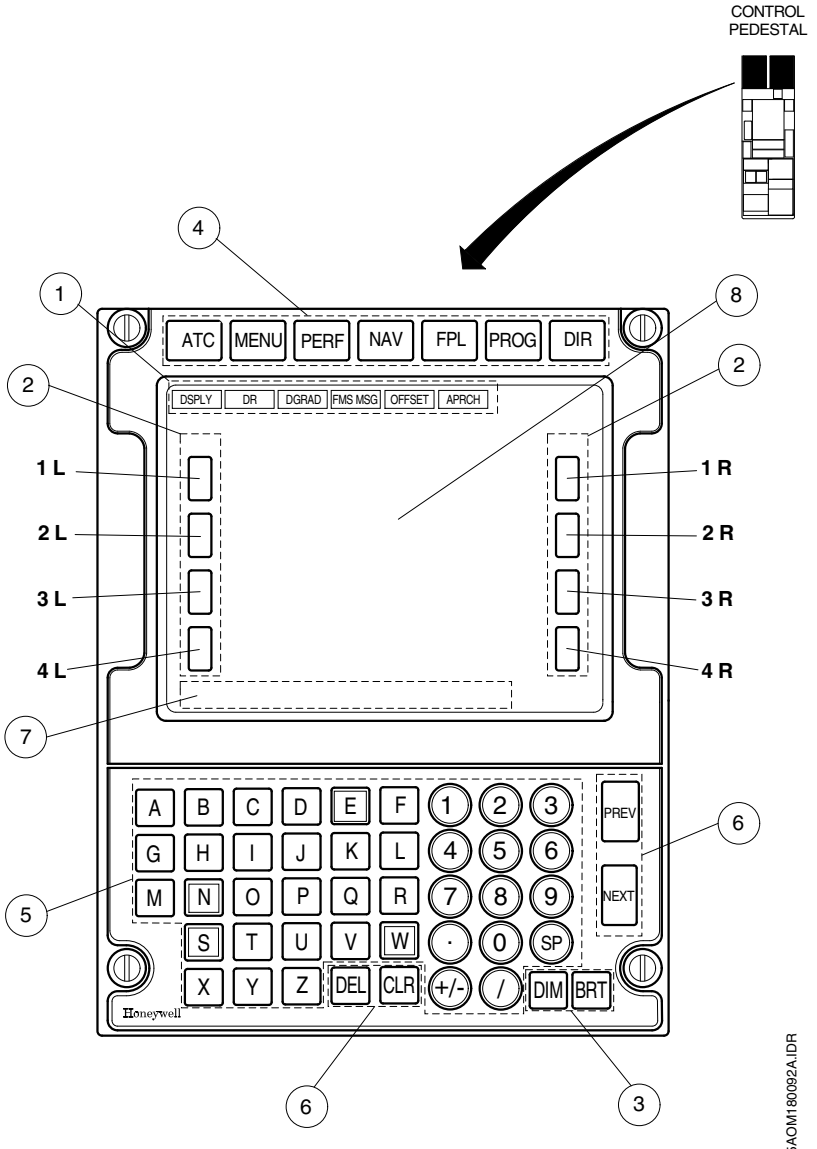


**FMZ2010 FMS CD-830 CONTROL PANEL**



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## JOYSTICK (OPTIONAL)

The joystick functions are available through the joystick controller that is located on the control pedestal and through the selection of the MFD JSTK menu.

When the MFD joystick menu is selected, the joystick controller is available to control the Designator Symbol movement on the MFD FMS flight plan.

JOYSTICK OPERATION

On power-up, the designator is co-located with the present flight plan waypoint position.

If MAP mode is selected, moving the joystick controller, will cause the Designator Symbol to be displayed in blue color with a broken line which moves in the same direction from its last waypoint position.

If PLAN mode is selected, moving the joystick controller, the flight plan moves to the opposite direction from its last position, while the Designator Symbol remains fixed at the center of the plan format.

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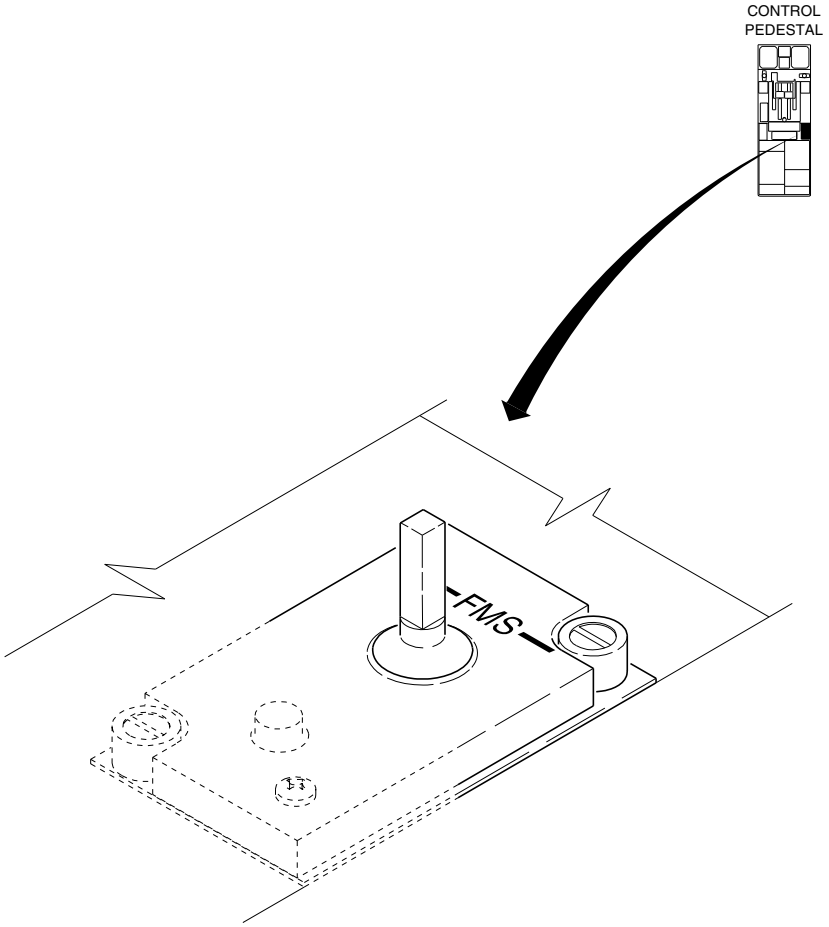


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## JOYSTICK CONTROLLER



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JOYSTICK MENU BUTTONS FUNCTION AT MAP MODE

- SKIP ("SKP") button: Skips the designator to the position of the next waypoint in the flight plan in case of the designator is co-located with a plan waypoint. Otherwise, the designator broken line tail skips to the next waypoint in the flight plan.
- RECALL ("RCL") button: Positions the designator at the present position of the airplane and removes the designator box from the display in case of the designator is co-located with the flight plan waypoint. Otherwise, the designator is positioned over the waypoint from which the designator line is extended and the designator line is removed from the display.
- ENTER ("ENT") button: The latitude and longitude coordinates of the designator are transmitted to the selected FMS scratchpad as a requested waypoint.

JOYSTICK MENU BUTTONS FUNCTION AT PLAN MODE

- SKIP ("SKP") button: Positions the flight plan so the next waypoint is displayed over the designator in case of the designator is co-located with a flight plan waypoint. Otherwise, skips the tail of the designator line to the next waypoint in the flight plan.
- RECALL ("RCL") button: Positions the designator at the present position of the airplane and removes the designator box from the display in case of the designator is co-located with a flight plan waypoint. Otherwise, it positions the designator over the waypoint from which the designator line is extended and removes the designator line from the display.
- ENTER ("ENT") button: The latitude and longitude coordinates of the designator are transmitted to the selected FMS scratchpad as a requested waypoint.

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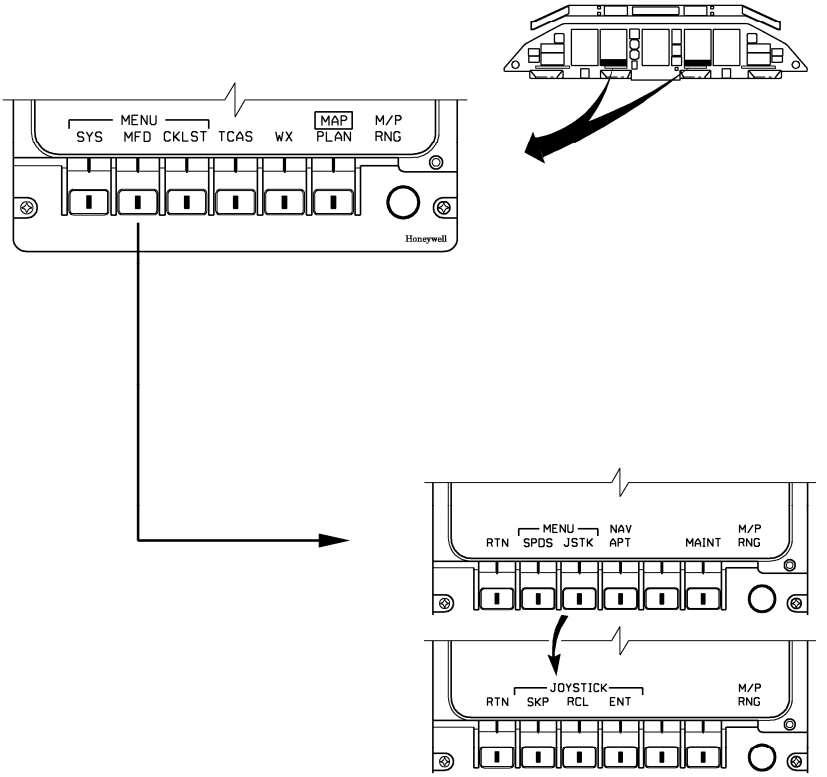


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## MFD JOYSTICK MENU



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# FLIGHT MANAGEMENT SYSTEM

The UNS-1K Flight Management System (FMS) controls a complete range of navigation functions. Its primary purpose is to provide high accuracy in long range lateral and vertical navigation. The system may be installed with a single or dual configuration. Should the airplane have a dual configuration, each unit can provide navigation data to the other unit. For additional information on functions and operation, refer to the manufacturer's manual.

The FMS is mainly composed of four components:

– Control Display Unit (CDU).
– Navigation Computer Unit (NCU).
– Data Transfer Unit (DTU).
– Configuration Module (CM).

The FMS operates in the following situations: Oceanic, Remote, North Atlantic Minimum Navigation Performance Specification Airspace, Enroute, Terminal, Non-Precision Approach and Required Navigation Performance 10.

The FMS interfaces with the followings systems and equipment:

– GPS sensor(s), ADC 1 and 2 - The GPS receives satellite data through the passive GPS antenna, processing and blending collected data with ADC data and sends the resulting information to the FMS computer.
– AHRS/IRS 1 and 2 - Provides the necessary data to compute the wind and for Dead Reckoning Mode, when the subsystem is not capable of navigating by itself.
– MFD and PFD - The FMS provides data for display navigation guidance on the PFD and navigation map data on the MFD.
– RMU 1 and 2 - The RMU interfaces with the FMS computer to control the operating frequencies, modes and channels of the various radios. For the dual configuration, each RMU supplies each respective on-side NCU.
– COM 1 and 2, NAV 1 and 2 - The FMS includes a radio-tuning page on which the pilot can manually select the VHF NAV and COM frequencies. Only the NAV frequency is fed back to the FMS computer for verification of the tuning action. COM 1 and 2 interface with FMS through the RMUs. The FMS can also automatically select the NAV radio frequencies.
– The FMS also provides latitude and longitude to TCAS.

The Control Display Unit (CDU), located on the control pedestal, provides control functions management and operating modes for proper FMS operation.

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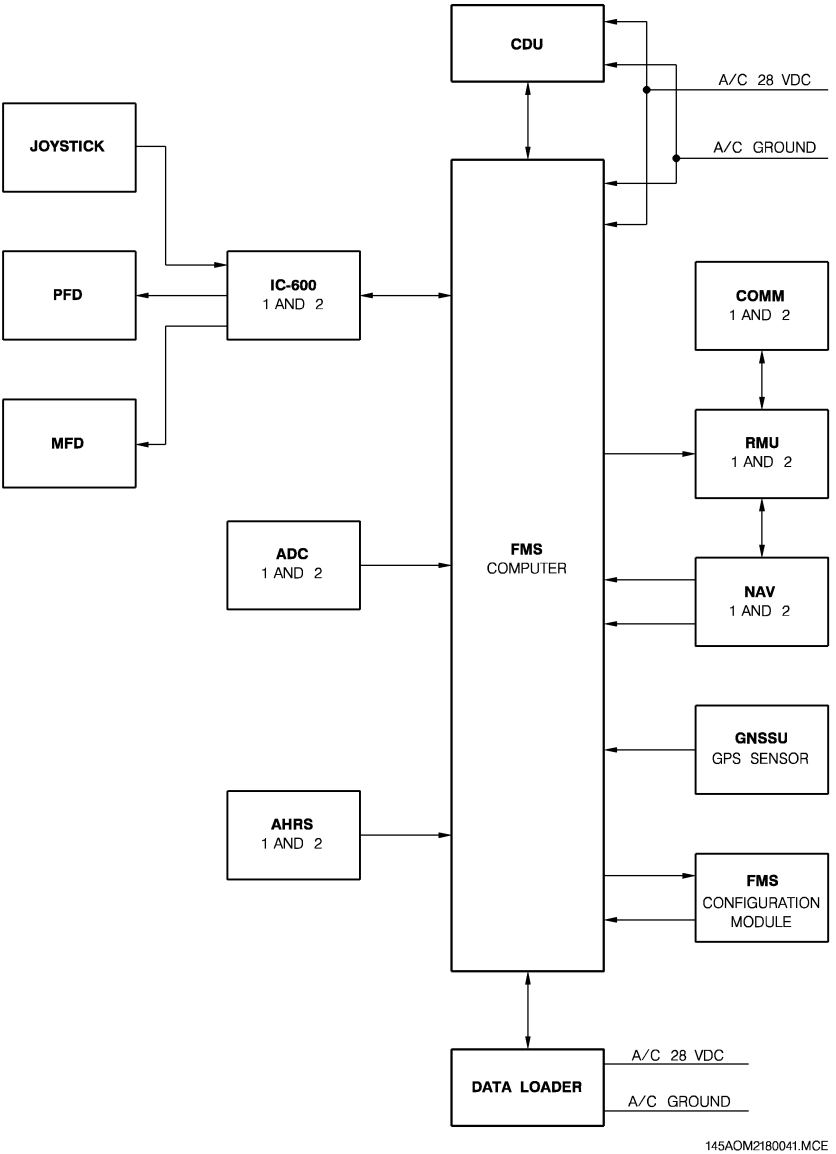


## FMS SCHEMATIC

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## FMS OPERATING MODES

NAVIGATION

The navigation function computes the airplane position and velocity for all phases of flight. The navigation priority modes, based on sensor accuracy, are as follows:

– GPS
– DME/DME
– VOR/DME
– IRS (if installed)

The GPS is the most accurate sensor. When the GPS is in use, the other sensors are still monitored for position differences, but they do not contribute to FMS position, unless the GPS becomes inaccurate, unavailable or is manually deselected. In this case, the FMS automatically tunes the DME/DME in order to provide position. When DME/DME is not accurate, the VOR/DME is selected.

The GPS DESELECT message may be displayed on the CDU scratchpad during the flight, which will cause the FMS to enter into DME/DME mode. Two different scenarios can explain the GPS sensor being deselected.

1. In a multi-sensor configuration, the GPS position is monitored the same as DME-DME, IRS and Loran C sensor in relation to the average of all sensors currently selected. A position difference greater than 50 NM or a divergence at greater than 50 kt in relation to the FMS position or speed will cause automatic deselection of the GPS from the position solution. In this case, the sensor monitor has determined that the specified GPS data is unreasonable and has deselected the sensor for use in navigation.
2. The GPS DESELECT message can also occur when flying on a poor DME coverage area. Flying on a poor DME region will cause a rapid positioning of DME compared to GPS, inducing the GPS deselecting.

Based on this information, when facing a GPS DESELECT event, the flight crew should verify the condition of both GPS and DME sensors in order to determine the root cause of the scratchpad message.

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If the event was caused by the GPS sensor (satellite signal, GPS' antenna or receptor), the pilot should monitor HIL (Horizontal Integrity Limit in NM) on GPS STATUS Page (1/4) and when it meets phase of flight accuracy, reselect GPS. The GPS integrity monitor is defined for three phases of flight, each with a specified Alarm Limit and Time to Alarm, as showed in the table below:

| Phase of Flight | Alarm Limit | Time to Alarm |
|---|---|---|
| Enroute | 2.0 NM | 27 seconds |
| Terminal | 1.0 NM | 7 seconds |
| Approach | 0.3 NM | 7 seconds |

Otherwise, if the GPS was deselected due to a poor DME environment and the pilot has verified that the HIL value is within the limit for the respective phase of flight, it will be necessary to first manually deselect the DME through DME STATUS Page (1/1) and then reselect the GPS on GPS STATUS Page (1/4).

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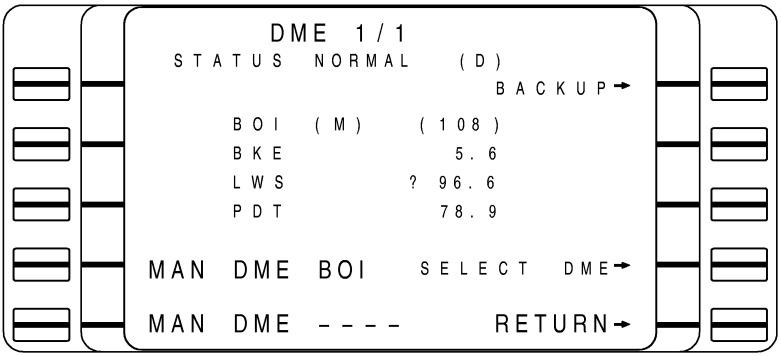


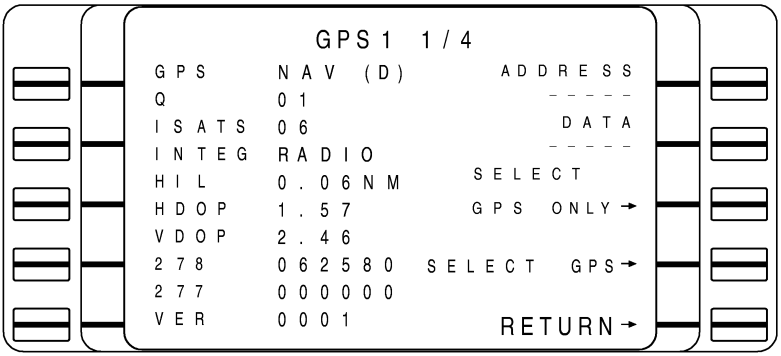


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**CDU SCREEN**

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On airplanes equipped with dual Inertial Reference System (IRS), replacing the AHRS, the IRS is used as a primary navigation sensor when other navaid are not available.

The dual FMS configuration may operate with dual IRS and dual GPS, providing four long-range navigation sensors.

In this configuration, on-side FMS outputs and flight plan information are available to the opposite-side FMS through an interconnecting bus.

The automatic tuning is made through the RMU for computing an optimum position. The FMS also includes a radio-tuning page on which the pilot can manually select VHF NAV, COM, ADF and transponder frequencies.

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FLIGHT PLANNING

The flight planning function computes the active flight plan with both lateral and vertical definition.

When the FMS long-range navigation is selected, the flight director command bars will provide the visual command to bank the airplane to the desired track.

The VNAV is applicable only for the descent path and it is not coupled to the flight director, being only a reference information displayed on the PFD glide slope scale.

Additionally the navigation computer can be programmed by the operator to automatically fly different types of holding patterns.

DATA BASE

The database contains worldwide coverage of navaids, airways, departure procedures, approach procedures, Standard Terminal Arrival Routes (STARs), airports and runways. The database can also store up to 200 pilot-defined flight plans and waypoints, which are only updated when changed by the pilot.

The database must be updated every 28 days through a 3 ½" floppy or ZIP disk inserted in the Data Transfer Unit (DTU).

NAVIGATION DISPLAY

A multiple waypoints map, based on the airplane's present position, can be displayed on the MFD. It comprises the Waypoints connected by white lines defining a pre-planned route, and also navaids and airports.

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# FMS CONTROLS AND INDICATORS

## CONTROL DISPLAY UNIT (CDU)

The CDU provides information to the flight crew through a 4-inch liquid crystal display in full color, which is put in action by an alphanumeric and function keyboard.

### 1 - ANNUNCIATORS

Six annunciators are scheduled to alert the crew about flight plan status and sequencing.

MSG (Yellow) - This message appears when a new message is generated.

WPT (Yellow) - Indication concerning Lateral waypoint alert when steady. A flashing indication announces a Vertical waypoint flight plan angle alert.

SXTK (Amber) - Indication concerning FMS selected crosstrack mode.

FMS HDG (White) - This label indicates that the FMS is in heading mode.

FMS APPR (White) - Indication concerning approach mode.

**NOTE:** GPS INTEG (White) - A fault is detected or RAIM is not available with the possibility of functioning DME.

### 2 - LINE SELECT BUTTONS

There are five line select keys on each side of the CDU to position the cursor. It is used with the alphanumeric buttons to input data and pressing ENTER completes the entry.

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## 3 - MODE SELECT BUTTONS

NAV - Displays the navigation function pages. This mode normally contains two pages, but when another NAV mode is selected there are two or more pages available by pressing the PREV or NEXT button.

DTO - Displays the DTO (Direct to) function.

FPL - Displays the Flight Plan pages or stored arrivals and routes.

VNAV - Provides access to the VNAV function.

LIST - Provides a list of options appropriated to input data.

MENU - Displays a list of alternate formats or options for FUEL, FPL, or TUNE.

PERF - Displays Performance pages. The first page PERF 1/1 provides a synopsis of pertinent in-flight performance information.

DATA - Provides information concerning the FMS, NAV Data Base and operating attached sensors, as well as their status.

FUEL - Displays all fuel management functions.

TUNE - Provides access to the TUNE function.

## 4 - FUNCTION BUTTONS

MSG - Displays the activated message when the MSG annunciation appears on display.

PWR DIM - Turns on and off the FMS and provides the dimming function.

PREV - Changes the current page to the previous page.

NEXT - Changes the current page to the next page.

BACK - Deletes an alphanumeric entry, if over it, and serves as backspace function.

ENTER - Stores input data each time it is pressed. It is required for all data entries.

## 5 - ALPHANUMERIC BUTTONS

Consist of alphabet letters, the numbers 0 through 9 and a +/- button. They are used to enter inputs to the FMS.

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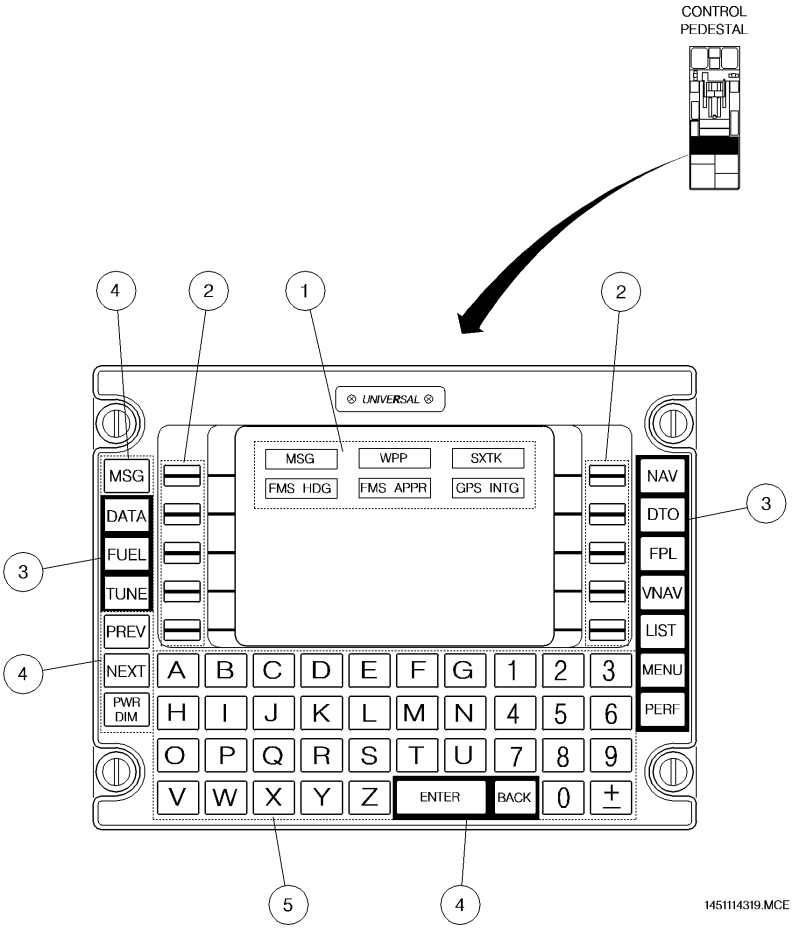


**UNS-1K FMS CONTROL PANEL**

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## JOYSTICK (OPTIONAL)

The joystick functions are available through the joystick controller that is located on the control pedestal and through the selection of the MFD JSTK menu.

When the MFD joystick menu is selected, the joystick controller is available to control the Designator Symbol movement on the MFD FMS flight plan.

JOYSTICK OPERATION

On power-up, the designator is co-located with the present flight plan waypoint position.

If MAP mode is selected, moving the joystick controller, will cause the Designator Symbol to be displayed in blue color with a broken line which moves in the same direction from its last waypoint position.

If PLAN mode is selected, moving the joystick controller, the flight plan moves to the opposite direction from its last position, while the Designator Symbol remains fixed at the center of the plan format.

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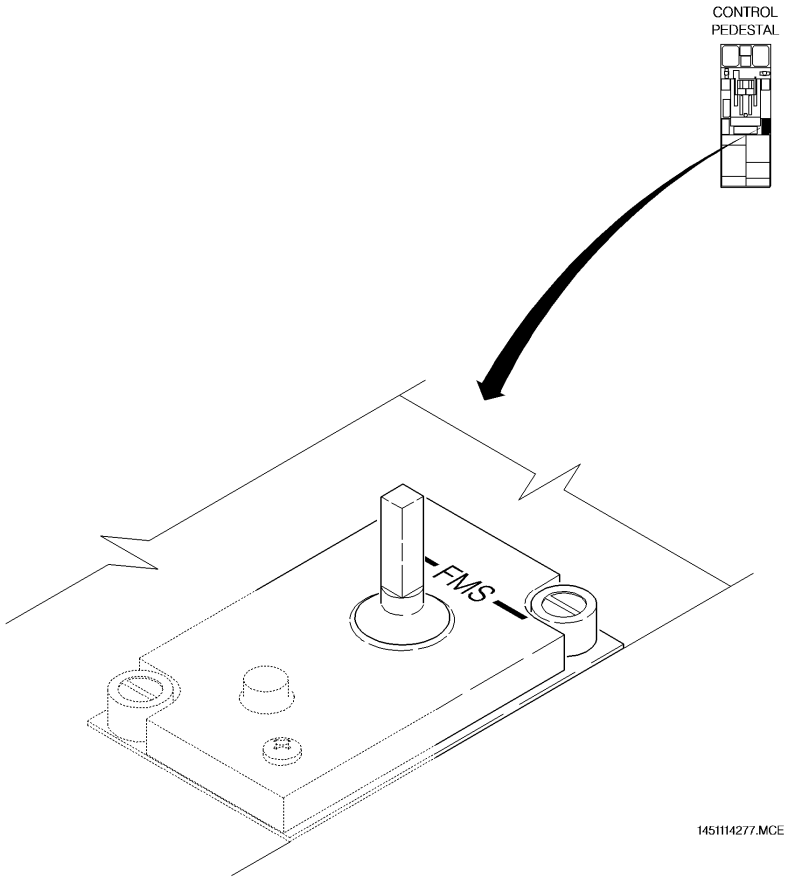


## JOYSTICK CONTROLLER

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JOYSTICK MENU BUTTONS FUNCTION AT MAP MODE

- SKIP ("SKP") button: Skips the designator to the position of the next waypoint in the flight plan in case of the designator is co-located with a plan waypoint. Otherwise, the designator broken line tail skips to the next waypoint in the flight plan.
- RECALL ("RCL") button: Positions the designator at the present position of the airplane and removes the designator box from the display in case of the designator is co-located with the flight plan waypoint. Otherwise, the designator is positioned over the waypoint from which the designator line is extended and the designator line is removed from the display.
- ENTER ("ENT") button: Confirms the waypoint desired location.

JOYSTICK MENU BUTTONS FUNCTION AT PLAN MODE

- SKIP ("SKP") button: Positions the flight plan so the next waypoint is displayed over the designator in case of the designator is co-located with a flight plan waypoint. Otherwise, skips the tail of the designator line to the next waypoint in the flight plan.
- RECALL ("RCL") button: Positions the designator at the present position of the airplane and removes the designator box from the display in case of the designator is co-located with a flight plan waypoint. Otherwise, it positions the designator over the waypoint from which the designator line is extended and removes the designator line from the display.
- ENTER ("ENT") button: Confirms the waypoint desired location.

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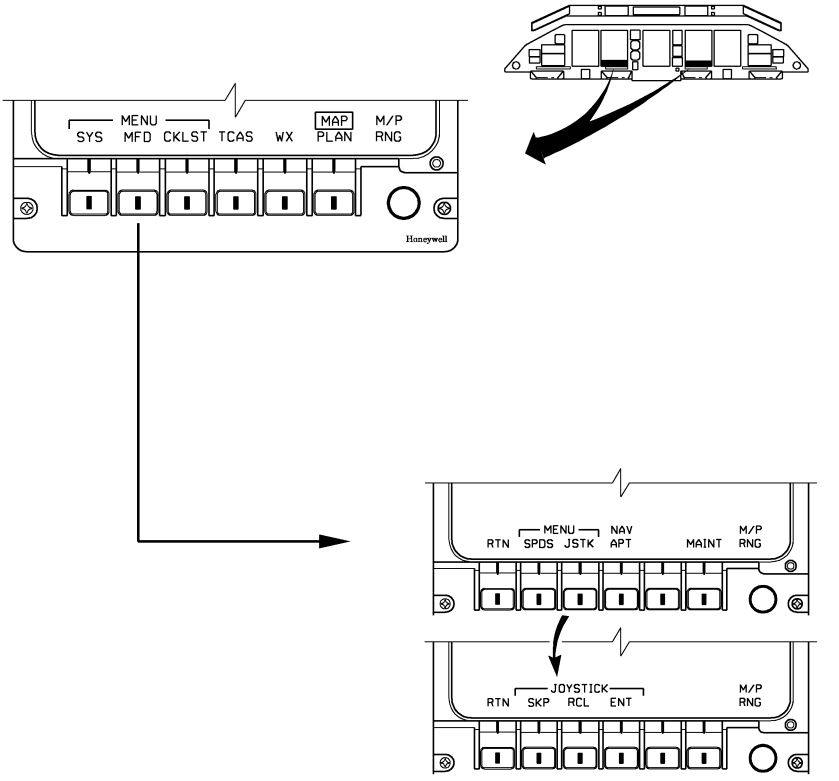


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## MFD JOYSTICK MENU

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# FLIGHT MANAGEMENT SYSTEM

The FMZ 2010 Flight Management System (FMS) operates with the FMS NZ6.1.1 software, indicated on its NAV IDENT page. The FMS NZ6.1.1 controls a complete range of navigation functions. The primary purpose of a Flight Management System (FMS) is to manage navigation sensors to produce a composite lateral position and provide lateral flight path guidance together with performance predictions for trip planning. For additional information on functions and operation, refer to the manufacturer's manual.

The FMS consists of the following components:

- NZ-2010 Navigation Computer (NZ),
- IM-803 Configuration Module,
- Control Display Unit (CDU), and
- Data Loader (DL).

The FMS operates in the following situations: Oceanic, Remote, North Atlantic Minimum Navigation Performance Specification Airspace, Enroute, Terminal, Non-Precision Approach, and Required Navigation Performance.

The FMS interfaces with the followings systems and equipment:

- GPS sensor(s) - The GPS receives satellite data through the active GPS antenna, and provides Latitude, Longitude, and ground speed for FMS navigation.
- ADC 1 and 2 - Air data computer provides barometric altitude and Airspeed to FMS computer.
- AHRS 1 and 2 - Provides latitude, longitude, ground speed, and Heading information for FMS Navigation, FMS wind computation and for FMS Dead Reckoning Mode.
- VOR and DME radios - provides track angle to VOR stations and Distance to DME stations, allowing FMS to compute navigation data.
- MFD and PFD - The FMS provides Navigation guidance on the PFD HSI, when FMS is selected as Navigation Source on DC-550 panel, and also next waypoint, Distance to waypoint and Lateral Flight Plan on navigation MAP data on the MFD.

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- RMU 1 and 2 - The RMU interfaces with the FMS computer to control the operating frequencies, modes, and channels of the various radios. For the dual configuration, each RMU supplies each respective on-side NZ.
- COM 1 and 2, NAV 1 and 2 - The FMS includes a radio-tuning page on which the pilot can manually select the VHF NAV and COM frequencies. Only the NAV frequency is fed back to the FMS computer for verification of the tuning action. COM 1 and 2 interface with FMS through the RMUs. The FMS can also automatically select the NAV radio frequencies.
- The FMS also provides latitude and longitude to TCAS and EGPWS.

The Control Display Unit (CDU), located on the control pedestal, provides control functions management and operating modes for proper FMS operation.

The FMS Part Number may be identified following the steps below:

1. Push the NAV key to access the NAV INDEX 1/2 page.
2. Push NEXT to access the NAV INDEX page 2/2.
3. Push the MAINTENANCE key to access the maintenance page.
4. Push NEXT key twice to access the Return to Service Page.
5. Read the FMS PN according to the following table.

| FMS PN | RELATED FMS PN OBTAINED VIA RETURN TO SERVICE PAGE |
|---|---|
| 7018879-03046 | FMS_NZ_GEN18001 |

Some additional features available for airplanes with FMS NZ6.1.1 software version are:

- Custom database changes: The custom database consists of pilot-defined waypoints and stored flight plans. In which up to 1000 pilot-defined waypoints can be stored. The pilot can store commonly flown routes using the pilot-defined flight plan procedure. It can retain up to 3000 flight plans with a total of 45000 waypoints (whichever comes first). Each flight plan with the maximum of 100 waypoints.

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- Automated Holding to Altitude (HA) leg sequencing: It removes the need to manually sequence an HA leg when achieves an HA altitude constraint. It adds to the streamlining of auto sequencing for all FMS leg types. When the airplane achieves the HA altitude constraint, the FMS deletes the holding pattern, resulting in an immediate exit of the holding pattern. It is possible to delete the hold manually from the flight plan before entering the pattern. Manually exit is inhibited when in the pattern.
- Enroute holding procedures: It allows the flight crew to select a published holding procedure from the database or insert a manual hold into the flight plan at any enroute waypoint. When the crew selects a hold at an enroute waypoint, the FMS determines if there is a database defined hold at that waypoint. When a hold is defined at that waypoint, it is possible to select the database hold or a default hold. If there is no database hold, the FMS shows the default hold and it is possible to change before inserting it into the flight plan. If multiple patterns exist for a particular fix, all are displayed on the page and the crew chose the one to be activated.
- Navigation database changes: It allows the inclusion of circling approaches and Multi-RNAV runways, i.e., multiple approaches with the same guidance RNAV to the same runway are annotated with an alphabetical suffix beginning at the end of the alphabet and working backwards for subsequent procedures.
- Circling approaches: Added to the navigation database and applicable to all runways at an airport. It is allowed to change the runway subsequently without having to reselect the circling approach. When a runway is selected with a circling approach and the runway is the missed approach point, the FMS use the higher altitude constraint of the missed approach point rather than the runway altitude.
- RNP Settings Page: Display and modify the RNP values and is accessed through RNP on PROGRESS 2/3 PAGE. It is possible to the crew to entry the RNP values for each phase of flight or a manual override RNP value.

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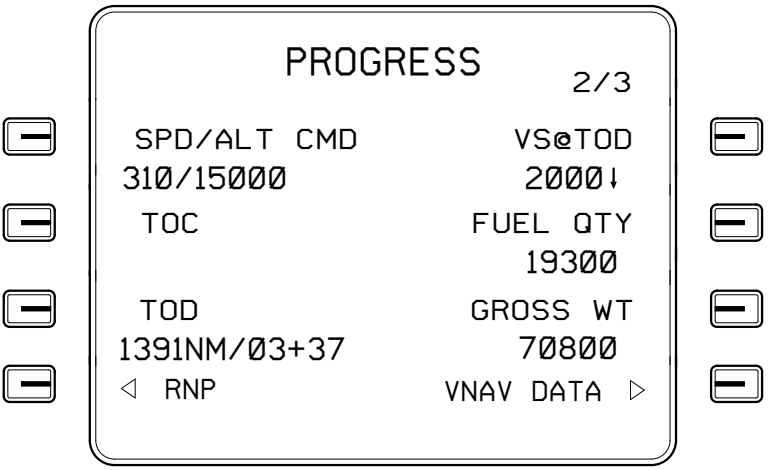
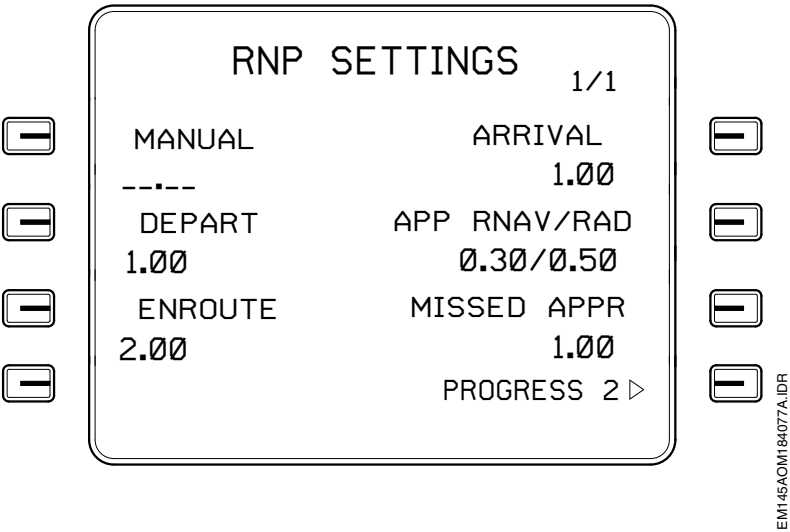



**PROGRESS 2/3 PAGE WITH RNP**




**RNP SETTINGS PAGE**

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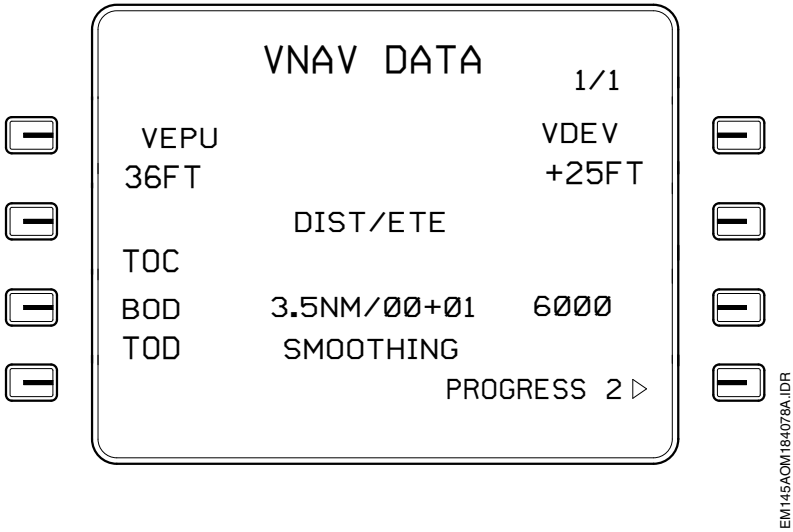
– VNAV Data: Displays vertical data for the entire flight (Vertical deviation, TOC, BOD, TOD distance, ETE, and altitude). For airplanes Post-Mod. SB145-34-0125, temperature compensation is available when Baro-VNAV is enabled. It is accessed through VNAV DATA on PROGRESS 2/3 PAGE.




**VNAV DATA PAGE**

– Vectors to Final: Allows the flight crew to comply with ATC-directed vectoring in the terminal area by removing unneeded approach waypoints from the flight plan.

When vector operations are being conducted and LNAV is armed, the FMS computes a capture point as the first intersection of the current track from the selected heading with the flight plan to determine the TO and FROM waypoints (flight plan cleanup).

When armed, LNAV engages the intercept course with the airplane within normal capture range of the inbound course to the active waypoint.

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When a vectored approach transition is selected, the FMS creates an approach consisting of an intercept leg leading to the FAF and removes any legs existing in the approach before the FAF. Only the approach legs before the FAF are removed, the departure, cruise, and arrival legs remain in the flight plan.

If there is no published approach transition and the initial fix of the approach is the FAF, there is no course available for leg construction. In this condition, the course field is dashed, and pilot entry is required.

The vectored approach transition is the default selection on the APPROACH TRANS page.

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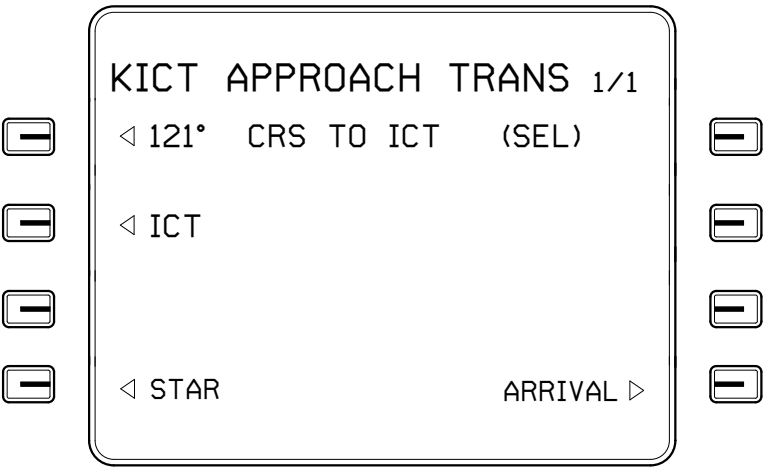


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**APPROACH TRANS PAGE WITH INCLUSION OF VECTORED APPROACH**

When vector operations are being conducted in TERM area with the FAF not sequenced, the ACT VECTORS displays and FLY VECTORS TO INTERCEPT displays as the FROM waypoint.



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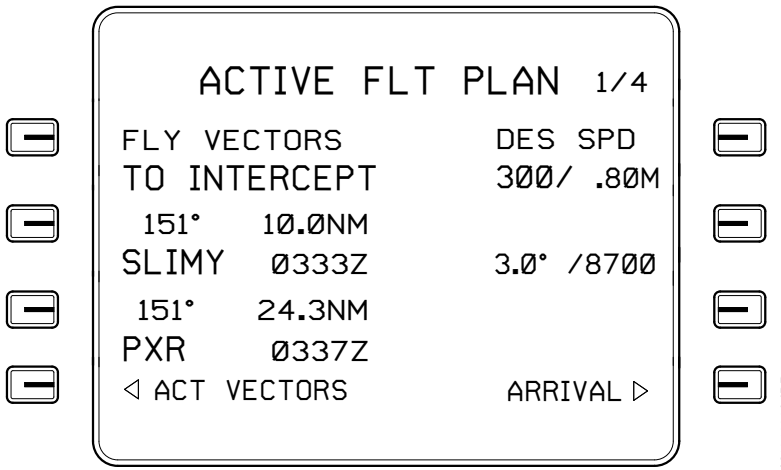


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**ACTIVE FLIGHT PLAN PAGE WITH FLY VECTORS TO INTERCEPT AS THE FROM WAYPOINT**

If a vectored approach transition is selected during preflight, FLY VECTORS TO INTERCEPT is inserted as a segment into the flight plan immediately prior to the FAF.

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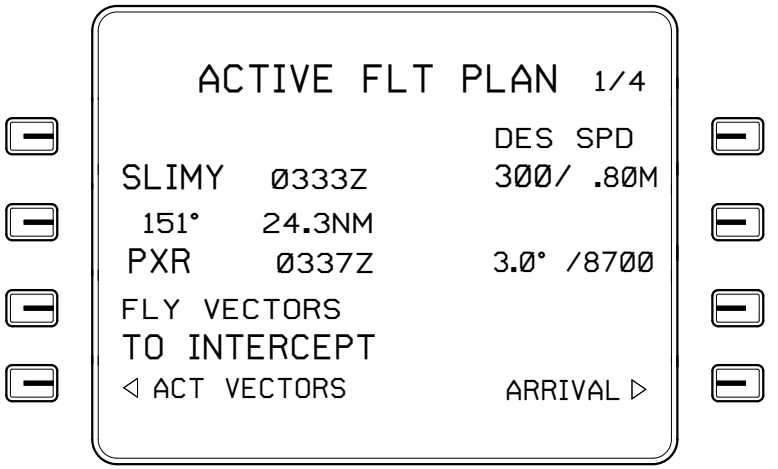


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**ACTIVE FLIGHT PLAN PAGE WHEN A VECTORED APPROACH TRANSITION IS SELECTED DURING PREFLIGHT**

Selecting the ACT VECTORS makes the FLY VECTORS TO INTERCEPT the FROM waypoint and results in LNAV to drop.

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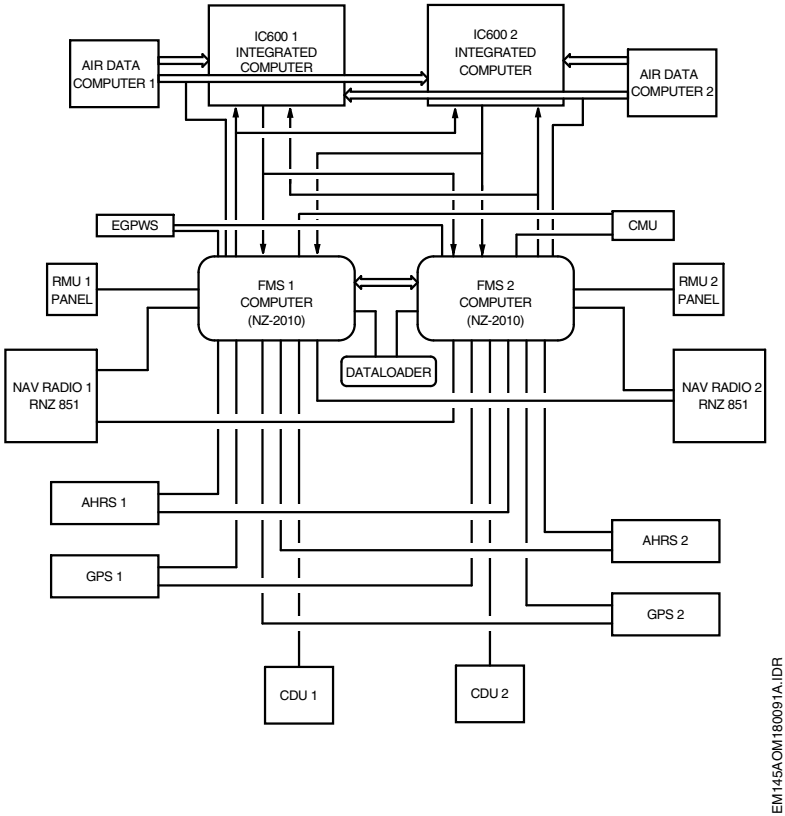


**FMS SCHEMATIC**

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# FMS OPERATING MODES

## FMS FUNCTIONS

NAVIGATION

The position determination function computes the airplane position and velocity for all phases of flight. The FMS receives navigation data from various sensors on board the airplane. The priority of the navigation modes is as follows:

– GPS,
– DME/DME,
– VOR/DME, and
– IRS.

The GPS is the most accurate sensor. When GPS is in use, the other sensors are still monitored for position differences, but they do not contribute to FMS position, unless the GPS becomes inaccurate, unavailable, or is manually deselected. In this case, the FMS automatically tunes the DME/DME in order to provide position. When DME/DME is not accurate, the VOR/DME is selected.

If all position sensors and radios are lost, the FMS shifts to Degrade Mode (DGRAD) and in approximately 2 minutes it enters the Dead Reckoning Mode (DR). In this mode, the position is calculated using the last known airplane position. The ground speed and track are estimated with AHRS heading, ADC TAS and the last known wind data.

The lateral navigation (LNAV) function of the FMS calculates navigation information relative to selected geographical points. The pilot can define flight plan routes worldwide. The system outputs information and steering signals that show the pilot or flight guidance system (FGS/Autopilot/Flight Director) how to guide the airplane along the desired route. Routes are defined from the present position of the airplane to a destination waypoint along a great circle route or through a series of great circle legs defined by intermediate waypoints.

The vertical navigation (VNAV) provides vertical guidance with steering targets to FGS to guide the airplane in the vertical profile. A deviation scale for the VNAV is located on the PFD, on the same place where the glide slope scale.

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For airplanes Post-Mod. SB145-34-0125, the FMZ2010 with the FMS NZ6.1.1 software also provides the functions: barometric-vertical navigation (Baro-VNAV) and Localizer Performance with Vertical guidance (LPV) operations. The application of the service bulletin by itself does not allow their usage without operational approval and training as required by airworthiness authority.

FLIGHT PLANNING

The flight planning function computes the active flight plan with both lateral and vertical definition.

The navigation computer has the ability to store and retrieve information of navaids and earth reference points such as airports, navaids, intersections, runways and routes. This information is stored in a database, which is updated every 28 days from a USB drive via the data loader. A reserved area of the internal database memory is used to store up to 1000 pilot-defined waypoints, which are only updated when changed in memory by the operator.

The operation of saving a Flight Plan may prevent the Speed Intervention function on the FMS, depending on how many waypoints on all Flight Plans have been stored in the Custom Database.

DATABASE

The database contains worldwide coverage of navaids, airways, departure procedures, approach procedures, Standard Terminal Arrival Routes (STARs), airports and runways. This information is updated every 28 days.

FMS MODES

The dual FMS configuration provides four operating modes that may be accessed through the FMS MAINTENANCE 1/3 page:

DUAL MODE

In this mode, the following information is automatically transferred to the cross-side FMS: flight plan, performance data, waypoints defined by the pilot, flight plans created in one system and radio tuning.

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INITIATED TRANSFER MODE

In this mode the flight plan and performance data entry will only be transferred to the cross-side FMS through the prompt command available in the last page of the ACTIVE FLT PLAN pages. Waypoints defined by the pilot, created flight plans and radio tuning are automatically transferred to the cross-side FMS.

INDEPENDENT MODE

In this mode, only the radio tuning is automatically transferred to the cross-side FMS.

**NOTE:** To operate in the INDEPENDENT mode, it is necessary to use the same software version and same settings in the Configuration Modules. If any of these requirements is not accomplished, the system automatically passes for the possible operating mode. For instance, if only the CUSTOM database differs in both systems, the operating mode automatically switches from DUAL to INDEPENDENT.

SINGLE MODE

No information is exchanged between both systems.

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# FMS CONTROLS AND INDICATORS

## CONTROL DISPLAY UNIT (CDU)

TEXT COLORS

The colors are designed to highlight important information. Color assignments are coordinated as much as possible with other displays. See below the parameters associated to each color:

| | |
|---|---|
| Vertical | Cyan (Blue) |
| Atmospheric Data | Cyan (Blue) |
| Lateral | Green |
| FROM Waypoint | Yellow |
| TO Waypoint | Magenta |
| Prompts and Titles | White |
| Flight Plan Names | Orange |
| Index Selections | Green |

### 1 - ANNUNCIATORS

The annunciators are located on the top of the LCD display.

- Colors:
  - White: indicating advisory annunciation.
  - Amber: indicating alerting annunciation.

| | |
|---|---|
| DSPLY (White) | Illuminates when the CDU displays a page that is not relative to the current airplane lateral or vertical flight path. This annunciator is not shown on the PFD. |
| DR (Amber) | Illuminates when a radio updating loss occurs, as well as all other position sensors, for a period longer than 2 minutes. |
| DGRAD (Amber) | Illuminates when the FMS cannot guarantee the position accuracy for the present phase of the flight. |

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| | |
|---|---|
| MSG - (CD-810 and CD-820)<br>FMS MSG - (CD-830) (White) | Illuminates when there is a message (advisory or alert) on the scratchpad. The annunciator turns off when the message is cleared from the scratchpad. |
| OFFSET (White) | Illuminates when a lateral offset path has been entered in the FMS. The annunciator turns off when the offset is removed. |
| APRCH (White) | Illuminates when the FMS is selected as navigation source and the following conditions are valid: a non-precision instrument approach has been activated from the navigation database, the airplane position is between 2 NM outside the final approach fix and the missed approach point, the DGRAD must be off and FMS using approved sensors for non-precision approach. |

**NOTE:** The FMS transmits all the annunciators to the PFD, except the DSPLY annunciator, so the pilot must not trust only on the FMS CDU for checking the FMS system status.

## 2 - LINE SELECT BUTTONS

There are four line select buttons on each side of the CDU that provide the following functions:

- Select submodes within major modes when in an indexed display,
- Used as direct access to the other FMS modes when in a non-indexed display, and
- Enter data to the scratchpad.

For airplanes equipped with Control Display Unit CD-830, the Line Select Buttons are touch-sensitive keys. The feedback to the touch is the display of a cyan highlight round the button. The selection of the button only occurs when the touch and the lift off are from the same area.

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## 3 - BRIGHTNESS CONTROL BUTTON

- Used to manually control the brightness of the display.
- To adjust the brightness, press up or down the Bright/Dim button, and a control bar is displayed in the scratchpad.
- The brightness can be adjusted so that, during daylight conditions, the display cannot be seen.

## 4 - GROUP OF FUNCTIONS BUTTONS

| | |
|---|---|
| PERF | Displays the performance pages. |
| NAV | Displays the NAV index pages. |
| FPL | Displays the first page of the active flight plan when the flight plan was previously entered. Also used to create a flight plan manually, to select a stored flight plan, and to create a flight plan for storage. |
| PROG | Displays the first progress page, the status of the flight. |
| DIR | Start the DIRECT-TO Function and displays the FLPN page with the prompts for the PATTERN and INTERCEPT functions. |
| ATC (FANS) | If interface is installed, it displays the ATC pages.<br>If not installed, it returns a message that the function is not available. |
| VIDEO (CD-820) | Returns a scratchpad message that the function is not available. |
| GRAPHIC (CD-820) | Returns a scratchpad message that the function is not available. |
| BACK (CD-820) | Displays the last page that was selected when that page is available. |

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| | |
|---|---|
| FN (CD-820) | When a special function is defined by the FMS, this function is shown in reverse video (magenta) as an annunciator under the FN function key. Press FN to perform the function when the annunciator is shown. When a special function is not defined by the FMS, the area directly under the FN function key is empty. Pressing FN when no annunciator is shown returns a message that FN is not available. |
| MENU (CD-830) | Displays the MENU pages. |

**5 - ALPHANUMERIC BUTTONS**

– Consist of alphabet letters, the numbers 0 through 9, a decimal, and a slash. It is used to enter inputs to the FMS. A SP (Space) key is used to insert a space following a character in the scratchpad, and a +/- (Plus/Minus) key will result in a - being entered, changing to + in a subsequent press.

– The alphanumeric keys make entries only on the scratchpad.

**6 - EDITION BUTTONS**

| | |
|---|---|
| PREV | Changes the current page to the previous page. |
| NEXT | Changes the current page to the next page. |
| CLR | Clears alphanumeric entries in the scratchpad or a scratchpad message. |
| DEL | Works together with line select buttons in order to delete waypoints and other items displayed on the CDU. This button is inhibited when a message is displayed. |

**7 - SCRATCHPAD**

– It is the working area, located on the bottom line of the display, where the pilot can enter data and/or verify data before line selecting the data into its proper position.

– Data is retained on the scratchpad throughout all mode and page changes.

– The scratchpad also displays advisory and alerting messages.

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## 8 - TOUCH SCREEN (If applicable)

For airplanes equipped with Control Display Unit CD-830, the display of the CDU is touch-sensitive.

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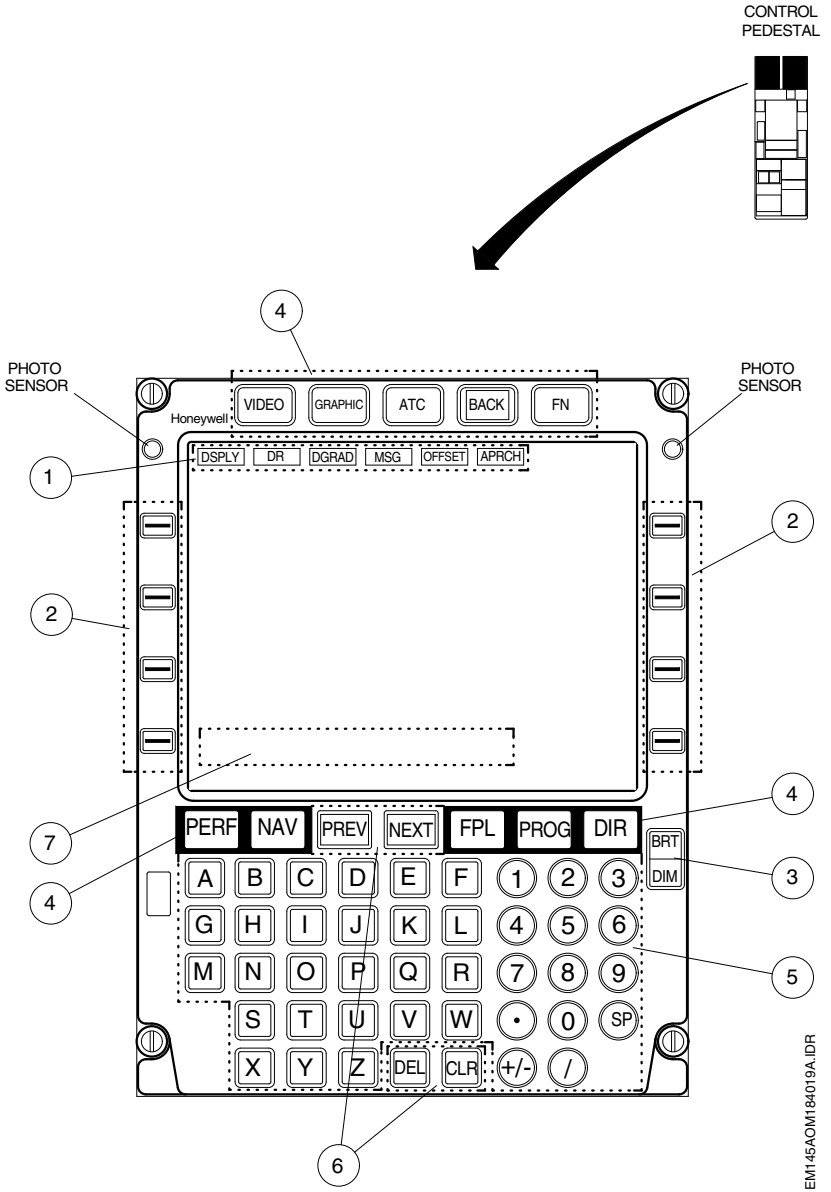


**FMZ2010 FMS CD-820 CONTROL PANEL**



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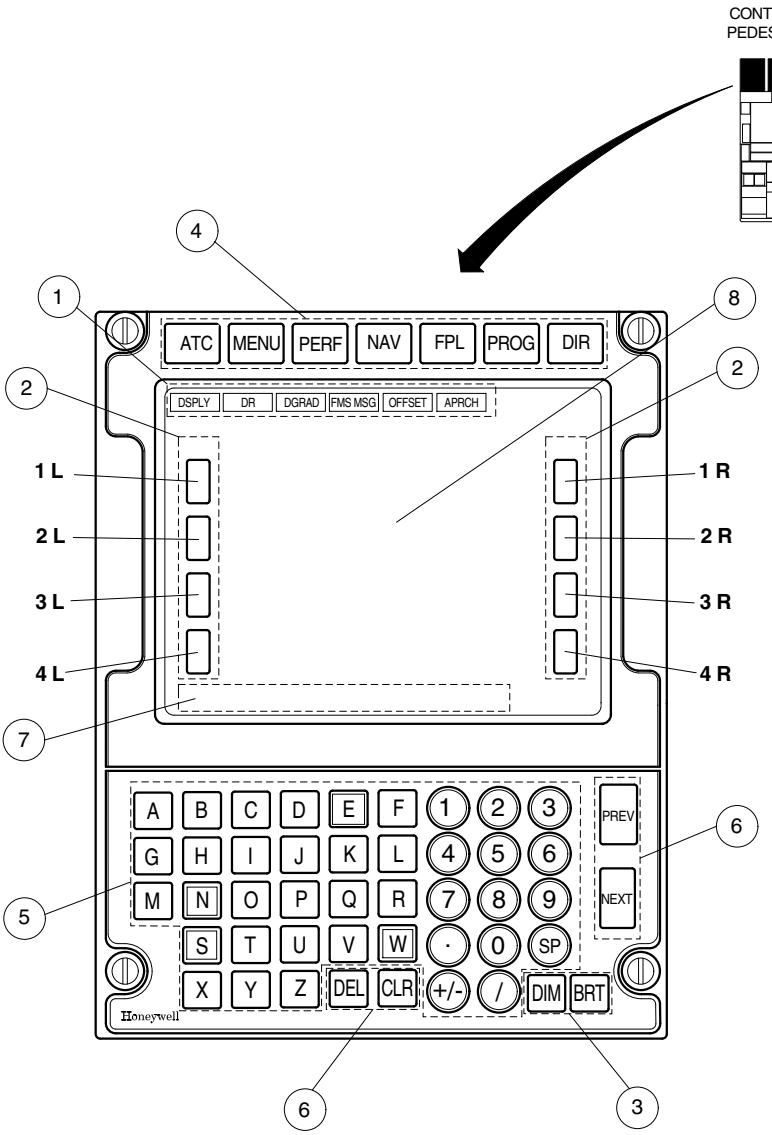


**FMZ2010 FMS CD-830 CONTROL PANEL**



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## JOYSTICK (OPTIONAL)

The joystick functions are available through the joystick controller that is located on the control pedestal and through the selection of the MFD JSTK menu.

When the MFD joystick menu is selected, the joystick controller is available to control the Designator Symbol movement on the MFD FMS flight plan.

### JOYSTICK OPERATION

On power-up, the designator is co-located with the present flight plan waypoint position.

If MAP mode is selected, moving the joystick controller, will cause the Designator Symbol to be displayed in blue color with a broken line which moves in the same direction from its last waypoint position.

If PLAN mode is selected, moving the joystick controller, the flight plan moves to the opposite direction from its last position, while the Designator Symbol remains fixed at the center of the plan format.

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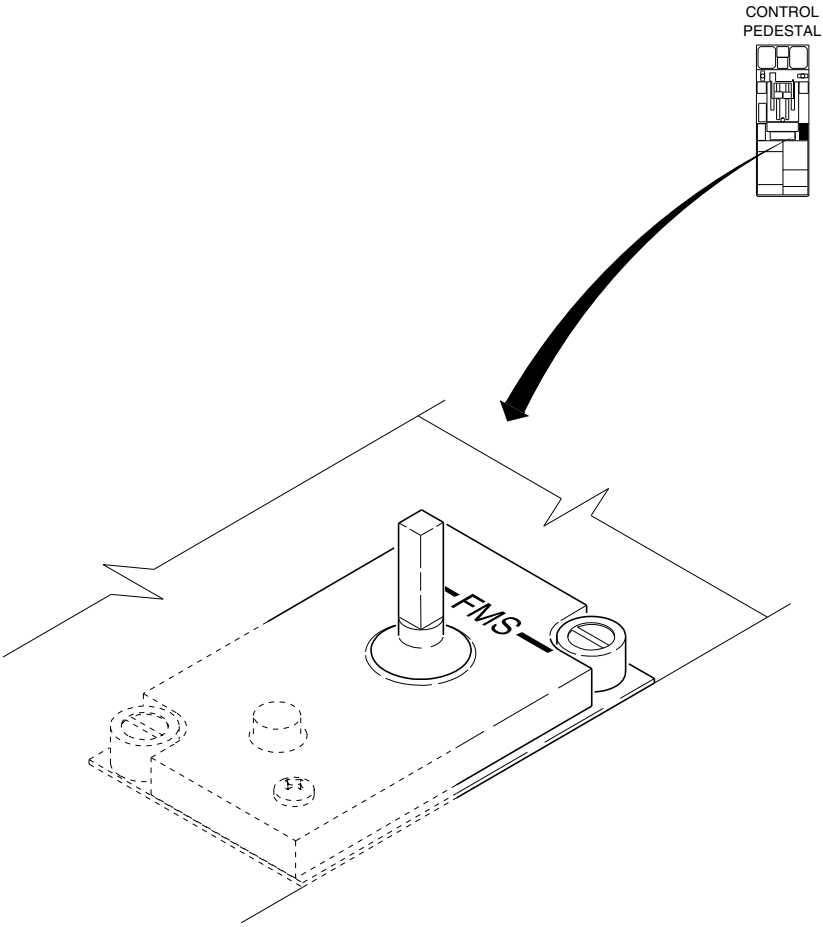


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## JOYSTICK CONTROLLER

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JOYSTICK MENU BUTTONS FUNCTION AT MAP MODE

- SKIP ("SKP") button: Skips the designator to the position of the next waypoint in the flight plan in case of the designator is co-located with a plan waypoint. Otherwise, the designator broken line tail skips to the next waypoint in the flight plan.
- RECALL ("RCL") button: Positions the designator at the present position of the airplane and removes the designator box from the display in case of the designator is co-located with the flight plan waypoint. Otherwise, the designator is positioned over the waypoint from which the designator line is extended and the designator line is removed from the display.
- ENTER ("ENT") button: The latitude and longitude coordinates of the designator are transmitted to the selected FMS scratchpad as a requested waypoint.

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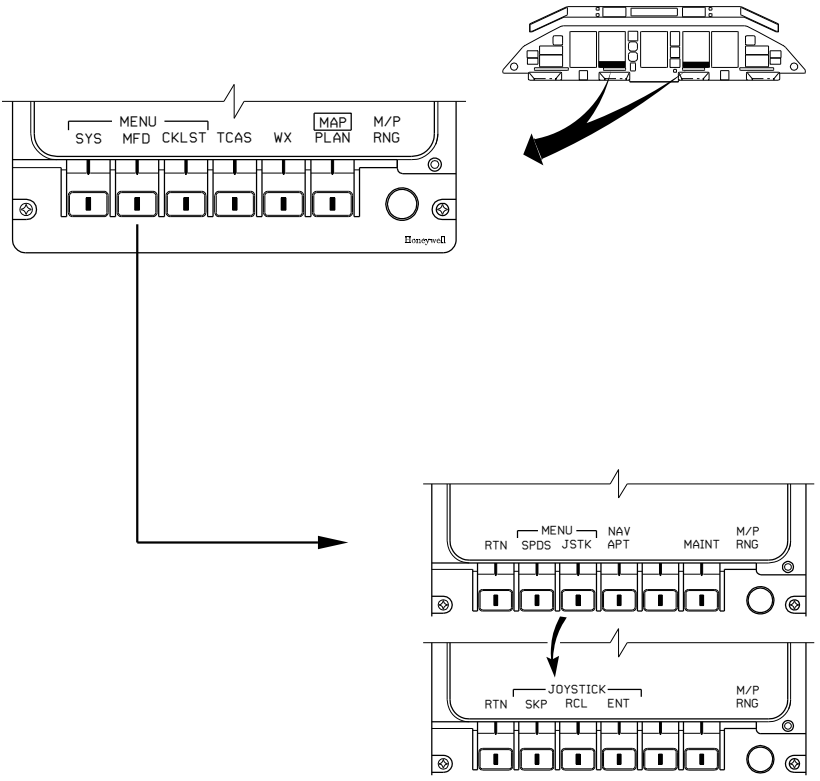


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## MFD JOYSTICK MENU



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# NAVIGATION DISPLAYS

The navigation data provided by the Radio Management System and Flight Management System are displayed to the crew through the PFDs, MFDs and RMUs.

ADF and/or VHF NAV bearings and VHF NAV or FMS CDI (Course Deviation Indicator) are displayed on the PFD in an Electronic Horizontal Situation Indicator (EHSI). The EHSI navigation sources as well as the display format (Full Compass or Arc) may be selected by the crew via the Display Control Panel (DCP).

Several other navigation data are also presented on the PFDs: GS (Glide Slope) pointer, DME distance, Ground Speed/Time-to-go, marker beacon indicators, wind intensity and direction vector, etc.

The MFDs present Weather Radar, TCAS and the route selected on the FMS. Additional information is also presented on the MFD: wind intensity and direction vector, TAS, Time-to-go, etc.

The RMUs NAV Backup Page also present the EHSI, in the Arc format only (see section 2-18-11).

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# DISPLAYS CONTROLS AND INDICATORS

## DISPLAY CONTROL PANEL (DCP)

### 1 - DISPLAY FORMATS SELECTOR BUTTON

- Pressing the FULL/WX Button alternates the EHSI presentation on the PFD between Full Compass format and Arc format.
- In Arc format the Weather Radar Display is also presented whenever the Weather Radar is operating.

### 2 - GROUND SPEED AND TIME-TO-GO SELECTOR BUTTON

- Pressing the GSPD/TTG Button alternates the respective information on the PFD between ground speed and time-to-go.

### 3 - ELAPSED TIME SELECTOR BUTTON

- The first actuation enters the Elapsed Time Mode on the PFD respective field. The subsequent actuation provides the following sequence of control: RESET - ELAPSED TIME - STOP - REPEAT.

### 4 - NAVIGATION SOURCES SELECTOR BUTTON

- Provides the selection of the VHF NAV (VOR, ILS and MLS) as navigation source for the EHSI. If the VHF NAV is already selected, pressing the NAV Button selects the opposite VHF NAV as navigation source for the on-side EHSI. Pressing the NAV Button once again will restore the normal operation: VHF NAV 1 information presented on the PFD 1 and VHF NAV 2 information presented on the PFD 2.

### 5 - FMS SOURCE SELECTOR BUTTON (OPTIONAL)

- Provides the selection of the FMS as navigation source for the EHSI.
- On airplanes equipped with dual FMS, pressing the FMS Button for the second time selects the opposite FMS as navigation source for the on-side EHSI (and for the on-side MFD MAP). Pressing the FMS Button once again will restore the normal operation: FMS 1 information presented on the PFD 1 (and MFD 1) and FMS 2 information presented on the PFD 2 (and MFD 2).

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**6 - BEARING SELECTOR KNOB**

OFF: The associated PFD bearing pointers are disabled.

NAV 1 (2): Selects the respective VHF NAV as source for the associated bearing pointer.

ADF: Selects the respective ADF as source for the associated bearing pointer.

FMS: Selects the FMS as source for the associated bearing pointer.

**7- DECISION HEIGHT SETTING AND IC-600 TEST KNOB**

- Provides the Radio Altimeter (RA) decision height setting.
- When pressed on ground provides the IC-600 and RA test activation. Refer to Section 2-4 – Crew Awareness for further information on test function and Section 2-17 – Flight Instruments for further information on decision height setting and RA test in flight.

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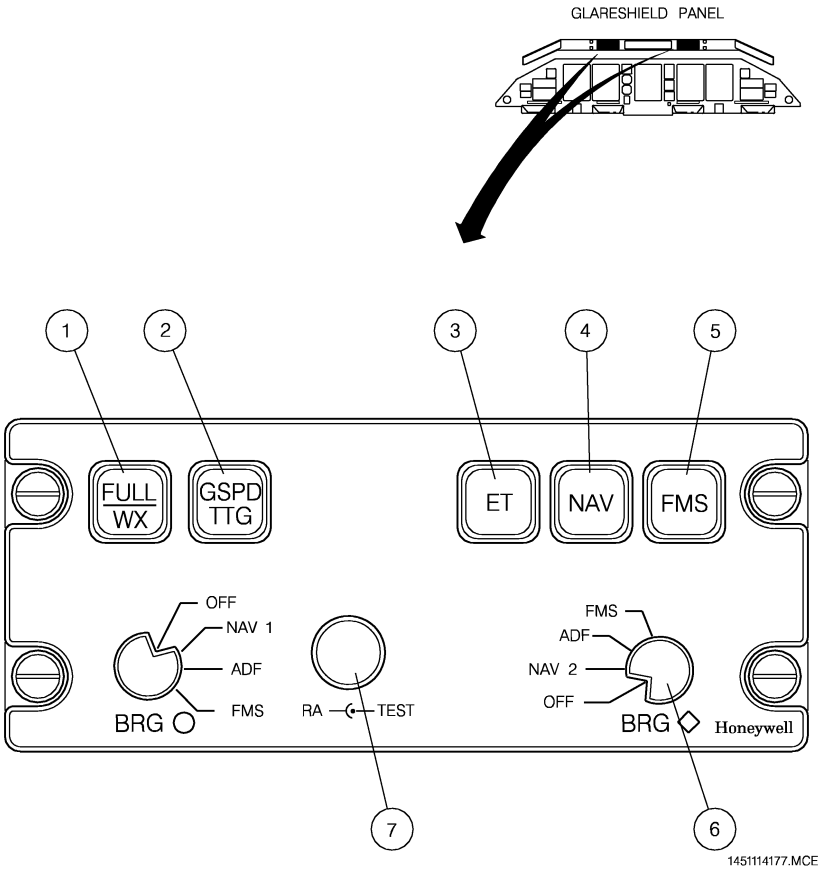


**DISPLAYS CONTROL PANEL**

## FMS SOURCE SELECTION ON THE MFD

As explained on the Display Control Panel (DCP) description (see section 2-18-40), pressing the FMS Button on that panel selects the FMS as navigation source for the PFD and MFD.

On airplanes equipped with dual FMS, pressing the FMS Button (on the Display Control Panel) for the second time selects the opposite side FMS as navigation source for the on-side EHSI (and for the on-side MFD MAP). Pressing the FMS Button once again will restore the normal operation: FMS 1 information presented on the PFD 1 (and MFD 1) and FMS 2 information presented on the PFD 2 (and MFD 2).

However, on airplanes equipped with dual FMS it is possible to select the opposite side FMS as MFD navigation source even if the FMS is not selected as navigation source for the PFD.

In this case, pressing the MFD Bezel Button adjacent to the MFD SRC label (presented on the MFD submenu), the on-side MFD will display the opposite side FMS data. This label is not presented if the FMS is already selected as navigation source for the PFD.

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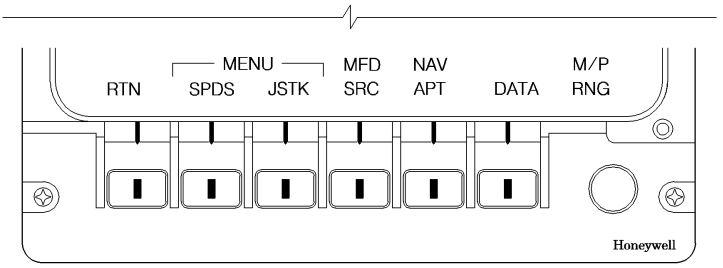


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## CROSS-SIDE FMS SOURCE SELECTION ON THE MFD

## ADF, VHF NAV AND DME INDICATIONS ON THE PFD

### 1 - VERTICAL DEVIATION DISPLAY

- Color:
  - Scale: white
  - GS Pointer: - green
    - yellow if the same source is supplying both sides.
  - GS label: green.
- For glide slope presentation the pointer will be parked up or down of the deviation display when the deviation exceeds the external dots.
- Glide slope information will be displayed when SRN NAV is selected for display and tuned to LOC is active.

### 2 - MARKER BEACON DISPLAY

- Color:
  - O label: cyan.
  - M label: amber.
  - I label: white.
  - Box: white.
- An O, an M or an I flashing annunciation is displayed when the outer marker, the middle marker or the inner marker is detected, respectively.
- A beacon box surrounding the MB flashing annunciations will be shown when a SRN is displayed, tuned-to-localizer is active and a marker is also active.

### 3 - BEARING POINTER

- Color:
  - Cyan for Bearing 1
  - White for Bearing 2
- Circle coded for #1 source {VOR 1, ADF (for single installation) or ADF 1 (for dual installation)}.
- Diamond coded for #2 source {VOR 2, ADF (for single installation) or ADF 2 (for dual installation)}.
- Pointer is removed if the selected source signal is invalid.

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**4 - TO/FROM POINTER**

- Color: White.
- Displayed towards the nose or the tail of the airplane to indicate, respectively, "TO" or "FROM" the navigation aid.

**5 - DME FIELD**

- Displays Ground Speed, Time-to-go, and Elapsed Time.
- GROUND SPEED DISPLAY
  - Color: Digits: green.
    GSPD label: white.
  - Range: 0 to 550 KIAS.
  - Resolution: 1 KIAS.
- TIME TO GO DISPLAY
  - Color: Digits: the same of the NAV source color.
    TTG label: white.
  - Range: 0 to 399 min.
  - Resolution: 1 minute.
- ELAPSED TIME
  - Color:
  - Digits: green.
    ET label: green.
  - Range: 00:00 to 09:59 h.
  - Resolution: Displayed in the format minutes: seconds (for less than one hour), and hours (minutes for more than one hour).

**6 - COURSE DEVIATION SCALE**

- Color: White.

**7 - COURSE DEVIATION BAR**

- Color:
  - Green: when the source is the on-side VOR.
  - Yellow: when the source is the cross-side VOR.
- Indicates against the course deviation scale, the difference between the selected course and the VOR bearing.

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**8 - BEARING SOURCE ANNUNCIATIONS**

- Label: VOR1, VOR2, ADF1 or ADF2.
- Color:
  - Cyan for Bearing 1
  - White for Bearing 2
- Circle coded for #1 source {VOR 1, ADF (for single installation) or ADF 1 (for dual installation)}.
- Diamond coded for #2 source {VOR 2, ADF (for single installation) or ADF 2 (for dual installation)}.
- Indicates the current source of input to the bearing pointers.
- Source annunciation will be retained on the PFD, even in case of an invalid bearing signal.

**9 - DME HOLDING AND DISTANCE ANNUNCIATION**

- Color:
  - Digits: green.
  - NM label: white.
  - H label: amber.
- Range:
  - Short Range NAV: 0 to 300 NM.
- Resolution: 0.1 NM.
- When the DME hold is active an H label is displayed on the RH of the DME distance digital readout. In this condition the H label replaces the distance NM label.

**10 - COURSE DEVIATION NAV SOURCE ANNUNCIATION**

- Label: VOR1, VOR2, ILS1, ILS2 or FMS (optional)
- Color:
  - Yellow: when the same source is selected for both sides or is supplying cross-side.
  - Green: when both sides present on-side sources, even if they are different.

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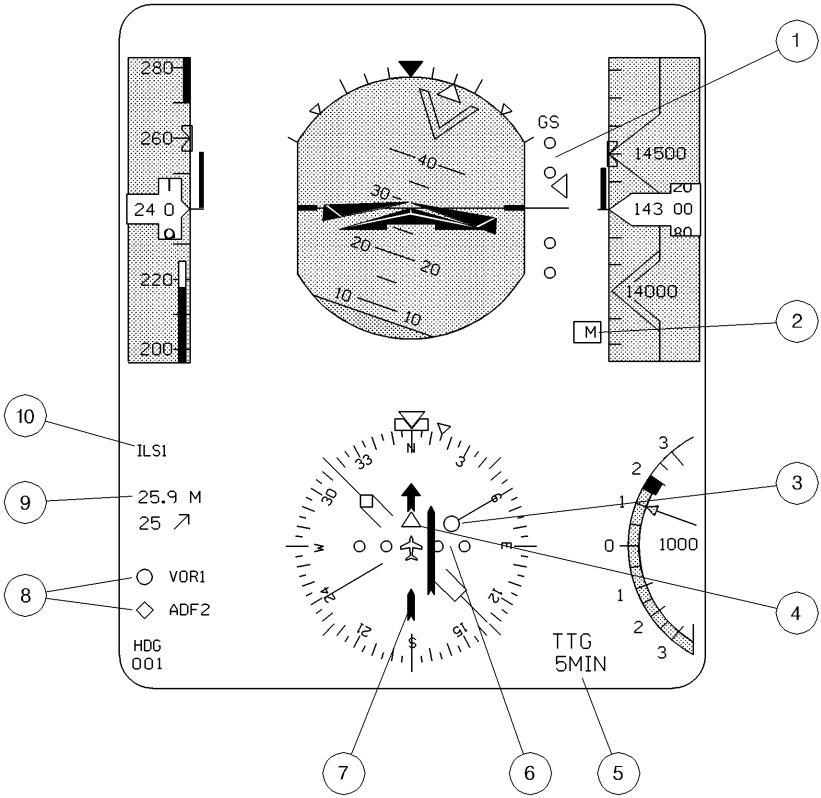


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## ADF, VHF NAV AND DME INDICATIONS ON THE PFD (EHSI IN FULL COMPASS FORMAT)

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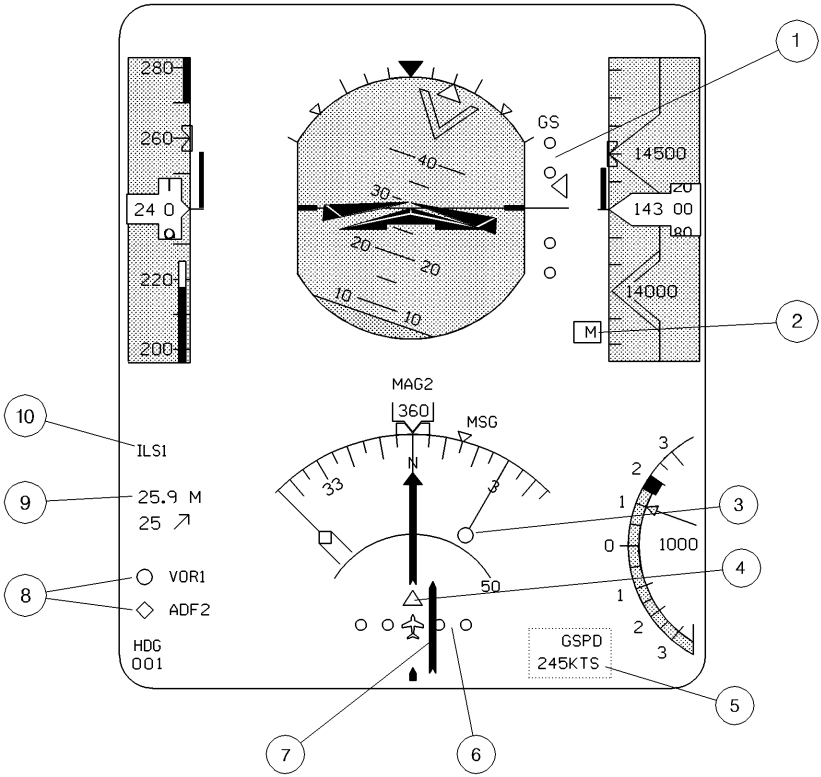


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## ADF, VHF NAV AND DME INDICATIONS ON THE PFD (EHSI IN ARC FORMAT)

## FMS INDICATION ON THE PFD

### 1 - VERTICAL ALERT ANNUNCIATION

- Label: VTA
- Color: Amber
- The VTA is displayed when the vertical alert bit is received from the FMS.

### 2 - VERTICAL DEVIATION DISPLAY

- When the FMS VNAV is selected the Vertical Deviation is activated.
- The Vertical Deviation Display indicates the vertical deviation between the airplane and the selected vertical path.
- Label: FMS
- Color: Amber
  - The FMS label and the scale are white.
  - If the FMS is the navigation source for only one side, the pointer will be magenta, otherwise it will be amber.

### 3 - MESSAGE ANNUNCIATION

- Label: MSG
- Color: Amber
- The MSG is displayed when a message is available on the FMS Panel.

### 4 - GROUND SPEED/TIME TO GO DATA

- Label: GSPD for Ground Speed.
  TTG for Time To Go.
- Color: Labels and units are white.
  - For single configuration, if the FMS is the navigation source for only one side, the GSPD and TTG readouts will be magenta, otherwise, they will be amber.
  - For dual configuration, if each FMS is the navigation source of the respective side, the GSPD and TTG readouts will be magenta. Otherwise, they will be amber.
- The Ground Speed unit is knots (KTS) and the Time To Go unit is minutes (MIN).
- The resolution of the digital values is 1 unit.
- For invalid values, the digits will be replaced with three amber dashes.

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**5 - DRIFT ANGLE BUG**

- Color: Magenta.
- The Drift Angle Bug rotates around the compass card, providing the reading of the airplane tracking.

**6 - COURSE DEVIATION BAR**

- Color: If the FMS is the navigation source for only one side, the Course Deviation Bar will be magenta, otherwise, it will be amber.

**7 - TO/FROM POINTER**

- Color: White.

**8 - BEARING POINTER**

- Color: Cyan for Bearing 1 (circle shaped).
  White for Bearing 2 (diamond shaped).

**9 - BEARING SOURCE ANNUNCIATIONS**

- Color: Cyan for Bearing 1 (circle shaped).
  White for Bearing 2 (diamond shaped) in single FMS configuration.
  In dual configuration there will be an indication if FMS 1 or 2 is being used.

**10 - WIND VECTOR DISPLAY**

- Color: Magenta.
- A single vector shows the direction of the wind relative to the airplane symbol. The digits indicate the wind intensity in knots.

**11 - DEGRADE MODE/DEAD RECKONING MODE/WAYPOINT ANNUNCIATIONS**

- Label: DGRAD for Degrade Mode (single FMS configuration only)
  DR for Dead Reckoning mode.
  WPT for waypoint.
- Color: Amber
- WPT is lit when the airplane is approaching the next waypoint.

**12 - DISTANCE DISPLAY**

- Color:
  - In single configuration, if the FMS is the navigation source for only one side, the distance readout will be magenta. Otherwise, it will be amber.
  - In dual configuration, if each FMS is the navigation source of the respective side, the distance readout will be magenta, otherwise it will be amber.
  - The unit is white.
  - The distance unit is nautical miles (NM).

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**13 - TO WAYPOINT SYMBOL**

- Label: Waypoint identifier name (Ex: KDVT).
- Color: Magenta. For dual configuration, when using cross-side information, the color is amber.
- In the sequence established, the TO waypoint is the next one from the current airplane position.

**14 - APPROACH/TERMINAL AREA ANNUNCIATIONS**

- Label: APP for Approach.
  TERM for Terminal Area.
- Color: Cyan.
- When APP is displayed it indicates that the FMS is in the flight approach phase and also can indicate that the lateral deviation scaling has been set to approach scale factor.
- In the APP mode the deviation indicator sensitivity and FMS tracking gains are increased.
- The TERM annunciator is displayed when the airplane enters in the terminal area or when the lateral deviation scaling has been set to the enroute scale factor.
- Priority is given to the APP message.

**15 - FMS SOURCE ANNUNCIATION**

- Label: FMS.
- Color:
  - For single configuration, if the FMS is the navigation source for only one side, the FMS label will be magenta. Otherwise, it will be amber.
  - For dual configuration, if each FMS is the navigation source for the respective side, the FMS label will be magenta, otherwise it will be amber.
- FMS is displayed only when a single source is installed.

**16 - HEADING ANNUNCIATION**

- Label: HDG SEL (For dual FMS configuration).
- Color: White. For dual configuration, if each FMS is the navigation source for the respective side the color will be white, otherwise it will be amber.

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**17 - SELECTED COURSE/DESIRED TRACK ANNUNCIATIONS AND READOUTS**

- Label: DTK for Desired Track.
  CRS for Selected Course.
- Color:
  - For single configuration, if the FMS is the navigation source for only one side, the CRS label will be green and DTK will be magenta. Otherwise, both labels will be amber.
  - For dual configuration, if each FMS is the navigation source for the respective side, the CRS and DTK labels will be magenta. Otherwise they will be amber.
  - The readouts will have the same color as the CRS and DTK annunciations.
- DTK is displayed when the FMS is the selected navigation source.

**18 - CROSSTRACK ANNUNCIATION**

- Label: SXTK
- Color:
  - For single configuration, if the FMS is the navigation source for only one side the label will be magenta, otherwise it will be amber.
  - For dual configuration: The color will be ever amber.
- SXTK is displayed to indicate that the airplane is off track.

**19 - CAPTURED LATERAL MODE**

- Refer to Section 2-19 - Autopilot.

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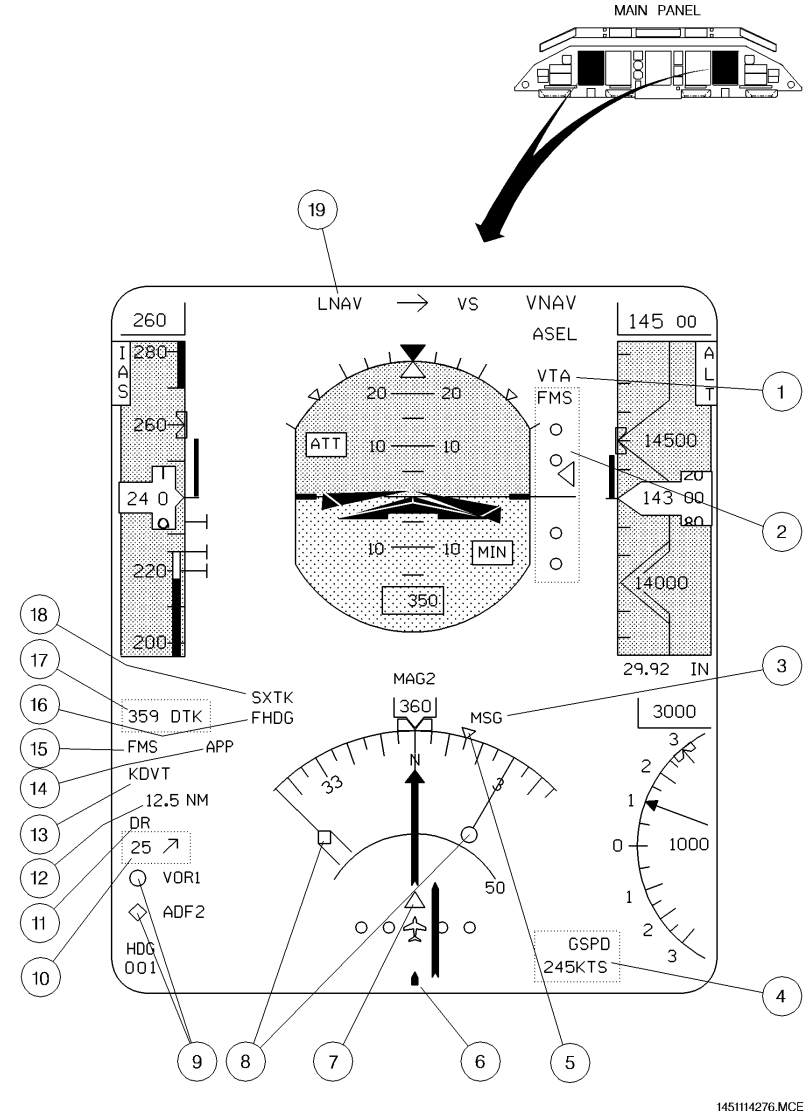


**FMS INDICATION ON THE PFD**

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## FMS INDICATION ON THE MFD

### 1 - FMS SOURCE ANNUNCIATION

- Label: FMS for single configuration.
  FMS1 or FMS2 for dual configuration.
- Color:
  - Magenta: when the source is the on-side FMS.
  - Yellow: when the source is the cross-side FMS.

### 2 - DRIFT ANGLE BUG

- Color:
  - Magenta: when the source is the on-side FMS.
  - Yellow: when the source is the cross-side FMS.
- The Drift Angle Bug rotates around the compass card, providing the reading of the airplane tracking.

### 3 - WAYPOINT SYMBOL

- Label: Waypoint identifier name (Ex: KDVT).
- Color: All Waypoints are white except the TO waypoint.
- Waypoint is displayed as a four pointed star at the geographical locations, referenced to the current present position, where the selected transitions of the flight plan occur.
- A maximum of 10 Waypoints can be displayed, including the FROM waypoint.
- A navigation aid or airport can also be located on the flight plan at a transition point and is accounted in the maximum allowable number of Waypoints.

### 4 - AIRPORT ANNUNCIATION

- Label: APT.
- Color: Cyan.
- Appears when an airport symbol is shown along the route.

### 5 - NAVAID ANNUNCIATION

- Label: NAV.
- Color: Cyan for single or green for dual configuration.
- Appears when a navaid symbol is shown along the route.

### 6 - DESIGNATOR RANGE AND BEARING READOUT

- Color: Cyan.
- The range readout indicates the distance between the airplane and the Designator Symbol.
- The bearing readout bearing location of the Designator Symbol related to the airplane position.

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**7 - TO WAYPOINT SYMBOL**

- Color:
  - Magenta: when the source is the on-side FMS.
  - Yellow: when the source is the cross-side FMS.
- In the sequence established, the TO Waypoint is the next one from the current airplane position.

**8 - LATERAL DEVIATION DISPLAY**

- Color: White.
- Right after the values there is a letter which may be L or R standing for Left and Right respectively.

**9 - WIND VECTOR DISPLAY**

- Color:
  - Magenta: when the source is the on-side FMS.
  - Yellow: when the source is the cross-side FMS.
- A single vector shows the direction of the wind relative to the airplane symbol. The digits indicate the wind intensity in knots.

**10 - DESIGNATOR SYMBOL**

- Color:
  - Same color of the Waypoint: If the Designator is co-located with a connected Waypoint.
  - Cyan: If it is not connected.
- The Designator symbol is displayed as an unfilled rectangle applied in two distinct methods: co-located with a Waypoint or positioned with the joystick.
- Designator will not be displayed if it represents the current position.

**11 - TO WAYPOINT DATA ANNUNCIATIONS**

- It is composed of the annunciators and presented as follows:
  - Identification.
  - Distance in nautical miles (NM).
  - Time to the TO Waypoint in minutes (MIN).voyeur
- Color:
  - For single FMS configuration the identification is magenta. The distance and the time are white.
  - For dual FMS configuration the identification, distance and time are magenta, when the source is the on-side FMS, or yellow, when the source is the cross-side FMS

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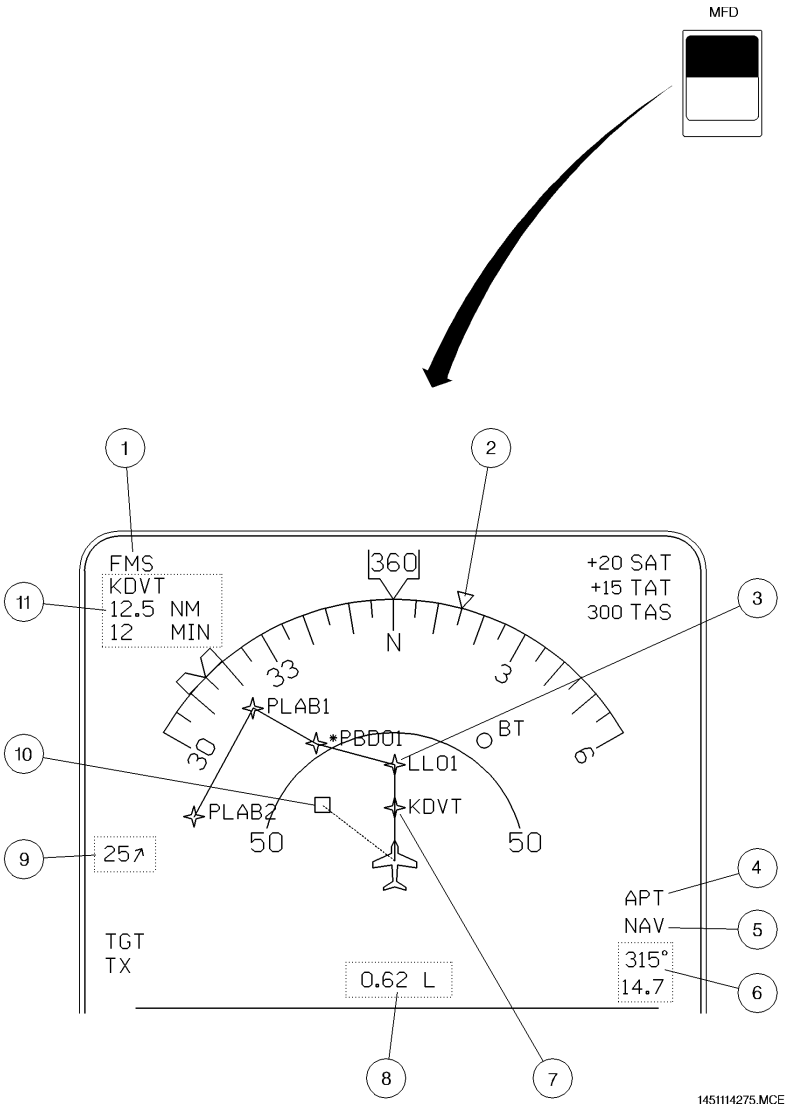


**FMS INDICATION ON THE MFD**

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# WEATHER RADAR SYSTEM

The airplane may be equipped with P-660 or P-880 weather radar models and 12 inch antenna. For additional information on functions and operations, refer to the manufacturer's manual.

The weather radar system is designed for detection and analysis of precipitation in storms along the flight path of the airplane. The system provides the flight crew with visual indications regarding turbulence content (P-880 only) and rainfall intensity.

Precipitation intensity level is displayed in four bright colors (magenta, red, yellow and green) contrasted against a deep black background on the PFDs' and MFDs' radar mode field. Magenta represents the heaviest rainfall intensity while green indicates the lightest.

The radar may also be used for ground mapping. When operating in ground mapping mode, prominent landmarks are displayed, which allows identification of coastlines, mountainous regions, cities or even large structures.

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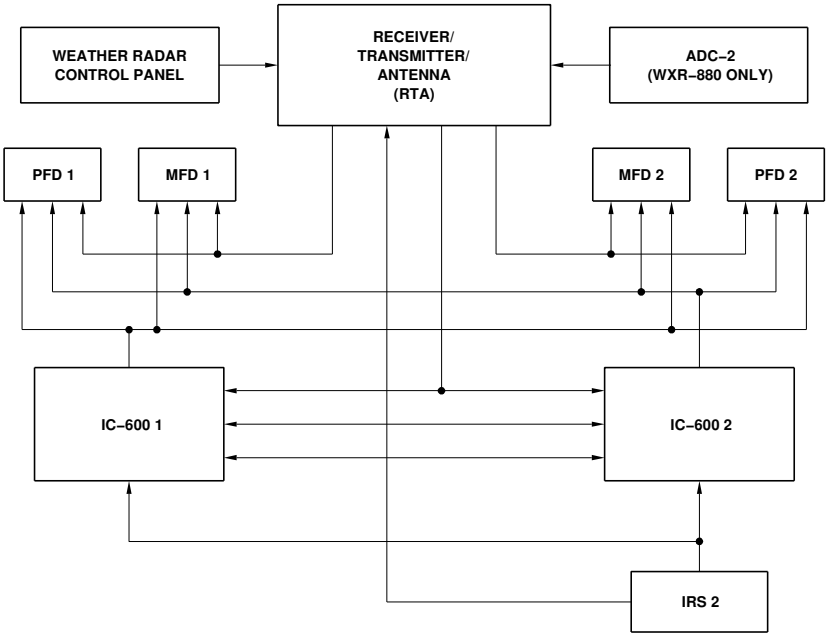
# GENERAL

The weather radar system consists of an integrated Receiver/Transmitter/Antenna unit (RTA) and a dedicated control panel. The RTA transmits and receives on the X-band radio frequency. The RTA processes radar echoes received by the antenna. The scan-converted data are displayed on PFDs' and MFDs' radar mode field.

The weather radar system run on 28 V DC powered by one of the Avionics Switched DC Buses. Should a power supply failure occur, the weather radar system will become inoperative, as there is no backup power source for this system.

The weather radar interfaces with other airplane systems and equipment as presented in the schematic diagram below.




**WEATHER RADAR SCHEMATIC**

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# WEATHER RADAR NORMAL OPERATION

The weather radar is controlled through the weather radar control panel and via the MFD Bezel Buttons. The weather radar control panel provides control functions and operating modes management for proper weather radar operation. The weather radar control panel may be located on the control pedestal forward panel or on the glareshield panel. Some airplanes may optionally be equipped with two weather radar control panels.

## INTERPRETING WEATHER RADAR IMAGES

The weather radar is a water detector. It is calibrated to best see water in its liquid form and with an ideal raindrop diameter. The weather radar can see rain, wet snow, wet hail and dry hail (depending on its diameter). The radar can not see water vapor, ice crystals and small dry hail.

At higher altitudes, there is less humidity in the air and consequently there is less water condensation. It means that heavy precipitation and dense cells are less likely to occur. As a result, flight level 200 (FL200) is defined as "FREEZING LEVEL", i.e., presence of water in its liquid form is not forecast above this level. However, CBs and other phenomena may push humidity and water, sometimes supercooled water, to higher altitudes due to convective activity.

**WARNING: DRY HAIL CAN BE PREVALENT AT HIGHER ALTITUDES. SINCE ITS RADAR REFLECTIVE RETURN IS POOR, IT MAY NOT BE DETECTED.**

Use increased gain when flying near storm tops in order to display the normally weaker returns that could be associated with hail.

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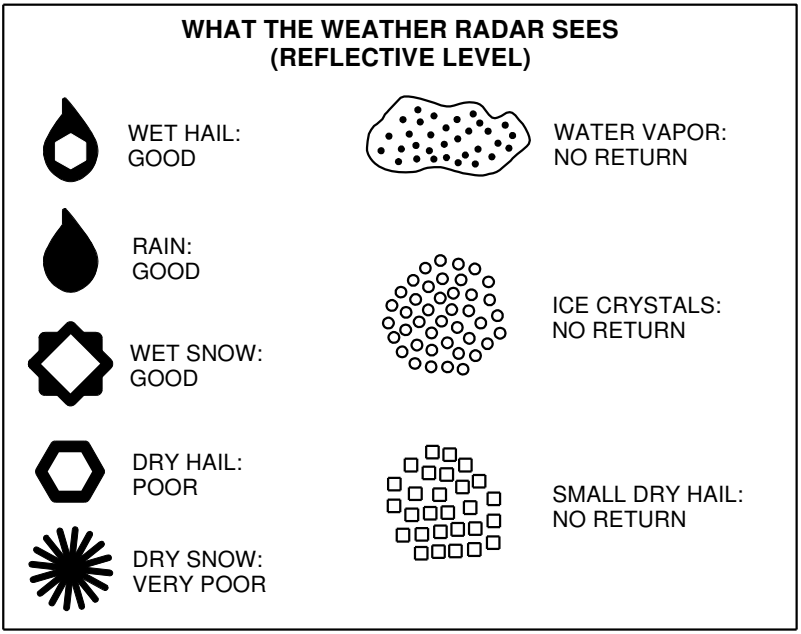


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## RADAR WARM UP PERIOD

When power is first applied to the radar, a period of 40 to 100 seconds is required to allow its magnetron to warm up. The radar displays the WAIT message on the PFDs' and MFDs' radar mode field and does not transmit or perform an antenna scan. After the completion of warm-up period, the radar automatically become operational in the selected mode or goes to forced standby (FSBY) if the airplane is on the ground.

## GROUND OPERATION PRECAUTIONS

If the radar system is to be operated in any mode other than standby or forced standby while the airplane is on the ground, the following precautions should be taken:

- Direct nose of airplane so that antenna scan sector is free of large metallic objects such as hangars or other airplanes for a distance of 30 meters (100 feet).The antenna must be tilted fully upwards.
- Avoid using the weather radar during airplane refueling or within 30 meters (100 feet) of any other airplane undergoing refueling operations.
- Avoid using the weather radar if personnel are standing too close to the 270° forward sector of airplane.

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# WEATHER RADAR OPERATING MODES AND FUNCTIONS

## TEST MODE (TST)

After the radar warm-up period is over, the TEST mode may be selected. A special test pattern made up of color bands is displayed. A series of green/yellow/red/magenta/white bands indicate that the signal to color conversion circuits are operating normally. A 100-mile range is automatically selected. A green TEST label will be displayed on the PFDs' and MFDs' radar mode field.

When the airplane is on the ground and the TEST mode is entered, the first page always includes RADAR OK or RADAR FAIL to indicate the current state of the radar, as follows:

RADAR OK: indicates that no faults were found and the radar is ready for service. It is combined with the END OF LIST page.

RADAR FAIL: indicates a radar fault.

During the weather radar test, several fault messages may be presented to the crew. The POC (Power On Counter), aside recording an existing fault, also stores fault information from previous power-on cycles. However, if the first page announces "RADAR OK", the radar is ready for service.

## STANDBY MODE (SBY)

The standby mode should be selected any time it is desired to keep the system powered without transmitting. When SBY mode is selected the WX radar remains in a ready state, with the antenna scan motionless and stowed in a tilt-up position. In addition, the transmitter is inhibited and the display memory is erased.

For airplanes equipped with dual control panel, placing only one controller in SBY does not shut the transmitter OFF. Instead, the no-SBY controller governs radar operation. If both controllers are placed in SBY, the transmitter is shut OFF.

In standby mode a STBY label is displayed on the PFDs' and MFDs' radar mode field.

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## FORCED STANDBY MODE (FSBY)

The FSBY is an automatic, non-selectable radar mode, that forces the radar into standby when the airplane is on the ground (weight-on-wheels logic) regardless of the selected active radar mode. This is a safety feature that inhibits the transmitter on the ground to eliminate X-band microwave radiation hazards. In FSBY mode, the transmitter and the antenna scan are both inhibited, memory is erased and a FSBY label is displayed on the PFDs' and MFDs' radar mode field.

The forced standby mode may be overridden on the ground by pushing the STAB button 4 times in 3 seconds.

**CAUTION:** IF FSBY MODE IS OVERRIDEN ON THE GROUND AND ANY RADAR ACTIVE MODE IS SELECTED, THE TRANSMITTER IS TURNED ON. THE RADAR MUST NOT BE OPERATED UNDER THIS CONDITION WHILE REFUELING, NEAR FUEL SPILLS OR PEOPLE.

## WEATHER DETECTION MODE (WX)

The WX mode is used to detect areas of severe weather. This will allow the pilots to avoid dangerous weather conditions and possible turbulence areas. WX may be used on the ground, often prior to takeoff, in order to monitor the weather in the immediate vicinity. In this case, the forced standby mode may be overridden.

In WX Mode, the weather radar system is fully operational and all internal parameters are set for enroute weather detection. A WX label is displayed on the PFDs' and MFDs' radar mode field.

The levels and colors associated with the storm category are as follows:

| LEVEL | COLOR | RAINFALL CATEGORY |
|---|---|---|
| 4 | Magenta | Extreme/Intense |
| 3 | Red | Very Strong/Strong |
| 2 | Amber | Moderate |
| 1 | Green | Moderate/Weak |
| 0 | Black | Weak |

## RAIN ECHO ATTENUATION COMPENSATION TECHNIQUE FUNCTION (REACT or RCT)

The REACT is a sub mode of the weather detection mode and when selected activates three separate but related functions:

- **Attenuation Compensation** - Storms with high rainfall rates can attenuate the radar energy making it impossible to see a second cell hidden behind the first cell.

  In the REACT mode, the radar incorporates a function that automatically adjusts receiver gain by an amount equal to the amount of attenuation, i.e., the greater the amount of attenuation, the higher the receiver gain and thus, the more sensitive the receiver.

- **Cyan REACT Field** - Since there is a maximum limit to receiver gain, strong targets (high attenuation levels) cause the receiver to reach its maximum gain value and weather targets can no longer be calibrated. The point where red level weather target calibration is no longer possible is highlighted by changing the background field from black to cyan.

  Cyan areas should be avoided. Any target detected inside a cyan area should be considered very dangerous. All targets in the cyan field are displayed as a magenta-colored 4$^{th}$ level precipitation.

- **Shadowing** - This is an operating technique similar to the Cyan REACT Field. To use the shadowing technique, tilt the antenna down until the ground is being painted just in front of the storm cell(s). An area characterized by no ground returns behind the storm cell has the appearance of a shadow. The cell that produces radar shadowing is a very strong and dangerous cell and should be avoided by 20 NM.

## FLIGHT PLAN MODE (FP)

When the Flight Plan Mode is selected a singular display of navigation data and a FLTPLAN label are presented on the PFDs' and MFDs' radar mode field. The radar is put in standby and there is no radar data displayed in this mode.

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## GROUND MAPPING MODE (GMAP)

This mode is used to alert the flight crew regarding hazards caused by ground targets. This is especially useful in areas of rapidly changing terrain, such as mountainous regions. In this mode the system is fully operational and all internal parameters are set to enhance returns from ground targets.

The TILT control should be turned down until the desired amount of terrain is displayed. The degree of down-tilt depends upon airplane altitude and the selected range. Receiver characteristics are altered to provide equalization of ground-target reflection versus range. The selection of calibrated GAIN will generally provide the desired mapping display. If required, variable gain may be used to reduce the level of strong returns.

In the ground mapping mode a GMAP label is displayed on the PFDs' and MFDs' radar mode field, and the color scheme is changed to cyan, yellow and magenta. Cyan represents the least reflective return, yellow is a moderate return and magenta represents the most highly reflective target return.

For airplanes equipped with dual control panels, it is possible to have one pilot working the GMAP while the other one is using the regular WX mode.

**CAUTION:** WEATHER TYPE TARGETS ARE NOT CALIBRATED WHEN THE RADAR IS IN THE GMAP MODE. THEREFORE, THE PILOT SHOULD NOT USE THE GMAP MODE FOR WEATHER DETECTION.

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**TURBULENCE DETECTION FUNCTION (TRB) (P-880 MODEL ONLY)**

When this mode is selected, the radar processes return signals in order to determine if a turbulence condition is present. Areas of potentially hazardous turbulence are displayed as white. Any areas shown as turbulence should be avoided.

Turbulence detection function may only be engaged in the WX mode and at selected ranges of 50 NM or less. When the TRB function is active, a T letter will be displayed on the PFDs' and MFDs' radar mode field.

**CAUTION:** ALTHOUGH TURBULENCE MAY EXIST WITHIN ANY STORM CELL, WEATHER RADAR CAN ONLY DETECT TURBULENCE IN AREAS OF RAINFALL.

**TARGET ALERT (TGT)**

Target alert is selectable in all but the 300-mile range. When selected, target alert monitors for red or magenta weather beyond the selected range and 7.5° on either side of the airplane's heading. If such weather is detected within the monitored area and outside the selected range, the target alert annunciation TGT label changes from a green armed condition to an yellow TGT alert condition on the PFDs' and MFDs' radar mode field. This annunciation advises the flight crew that potentially hazardous targets lie directly in front and outside of the selected range. When this warning is received, the flight crew should select longer ranges to view the questionable target.

The target alert is inactive within the selected range. Selecting target alert forces the system to calibrate gain, and turns off the variable gain mode. Target alert can only be selected in WX and FP modes.

**NOTE:** Keep TGT alert enabled when using short ranges. This allows the issuing of an alert if a new storm cell develops ahead of the airplane's flightpath.

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**ANTENNA STABILIZATION (STAB or STB)**

The antenna is normally pitch and roll-stabilized by using attitude information from the AHRS or IRS. Momentarily pushing the STAB (or STB) button disables antenna stabilization and an amber “STAB” annunciation label is presented on the PFDs’ and MFDs’ radar mode field.

**RECEIVER GAIN (GAIN)**

The GAIN knob is a rotary control and push/pull switch that controls radar receiver gain. Two gain modes are available: calibrated or variable.

**Calibrated**: When the GAIN knob is pushed in, receiver gain is preset and calibrated, which is the normal mode of operation. In calibrated gain, the rotary function of the GAIN knob is disabled.

**Variable (VAR):** When the GAIN knob is pulled out, the system enters the variable gain mode. Variable gain is used for additional weather analysis and for ground mapping. In the WX mode, variable gain can increase receiver sensitivity over the calibrated level to show very weak targets or can be reduced below the calibrated level to eliminate weak returns. In the GMAP mode, variable gain is used to reduce the level of strong returns from ground targets.

Rotation of the knob counter-clockwise reduces receiver sensitivity. Rotating clockwise increases receiver sensitivity until its maximum. A digital readout and gain setting label are displayed on the PFDs’ and MFDs’ radar mode field.

**NOTE:** When REACT or TGT modes are selected, the system will be forced into calibrated gain.

**CAUTION:** VARIABLE GAIN MAY BE USED ONLY FOR SHORT PERIODS OF TIME. DO NOT LEAVE THE RADAR IN VARIABLE GAIN SINCE SIGNIFICANT WEATHER TARGETS MAY NOT BE DISPLAYED.

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## TILT

Tilt management is crucial to the safe operation of weather radar. If improperly managed, weather targets can be missed or underestimated. Proper tilt management demands that tilt be changed continuously.

To find the best tilt angle after the airplane is airborne, adjust the TILT antenna downward until a few ground targets are visible at the edge of the display. The table below gives the approximate tilt settings for minimal ground target display for different altitudes and ranges. If the altitude changes or a different range is selected, adjust the tilt control as required to minimize ground returns.

When flying at high altitudes, tilt downward frequently to avoid flying above storm tops. When in low altitude or approaching for landing, tilt management must be performed manually, with the radar beam vertically sweeping from up to down to avoid flying above or below a storm line.

During takeoff, the radar must be adjusted to a minimum range scale, with a horizontal RH and LH scan and with the antenna positioned upwards (climbing angle).

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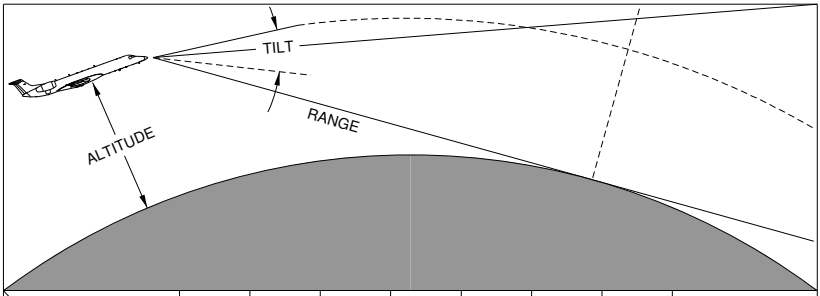


| RANGE SCALE – nm / ALTITUDE – ft | 5 | 10 | 25 | 50 | 100 | 200 | 300 | LINE OF SIGHT – nm |
|---|---|---|---|---|---|---|---|---|
| 40000 | (TILT LIMITED REGION) | | –12 | –4 | –1 | +1 | (LINE OF SIGHT LIMITED REGION) | 246 |
| 35000 | | | –10 | –3 | 0 | +1 | | 230 |
| 30000 | | | –8 | –2 | 0 | +1 | | 213 |
| 25000 | | | –6 | –1 | +1 | | | 195 |
| 20000 | | | –4 | 0 | +1 | | | 174 |
| 15000 | | –11 | –2 | +1 | +2 | | | 151 |
| 10000 | | –6 | 0 | +2 | +2 | | | 123 |
| 5000 | –5 | –1 | +2 | +2 | | | | 87 |
| 4000 | –4 | 0 | +2 | +3 | | | | 78 |
| 3000 | –2 | +1 | +3 | +3 | | | | 67 |
| 2000 | 0 | +2 | +3 | +3 | | | | 55 |
| 1000 | +2 | +3 | +3 | | | | | 39 |

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**TILT SETTINGS FOR MINIMAL GROUND TARGET DISPLAY (12 inch antenna)**

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The next figure helps to visualize the relationship between tilt angle, flight altitude and selected range. It shows the distance above and below airplane altitude that is illuminated by the radar during level flight with 0° tilt (high altitude) and a low altitude situation, with antenna adjusted for 2.8° up-tilt.

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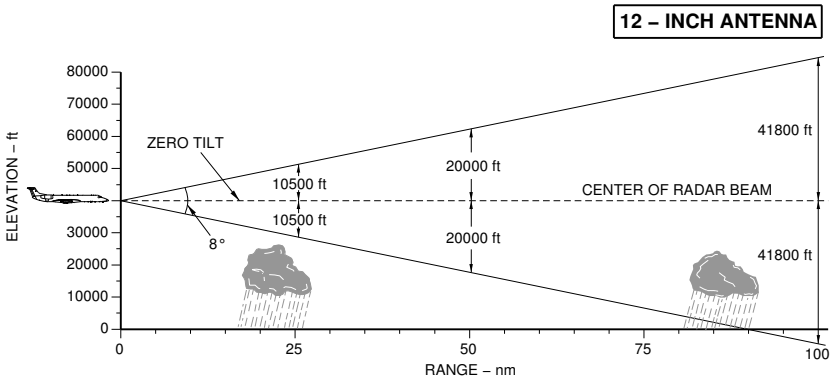
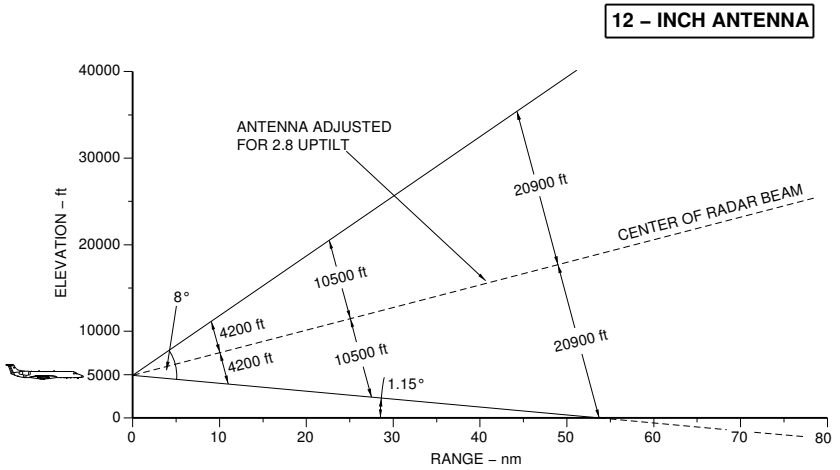



**RADAR BEAM ILLUMINATION HIGH ALTITUDE**




**RADAR BEAM ILLUMINATION LOW ALTITUDE**

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**ALTITUDE COMPENSATED TILT (ACT) (P-880 MODEL ONLY)**

In ACT, the antenna tilt is automatically adjusted with regard to the selected range and airplane altitude. ACT adjusts the tilt to show a few ground targets at the edge of the display. The TILT knob can be used for fixed offset corrections of up to 2°.

**NOTE:** Proper tilt management demands that tilt be changed continuously, even in airplanes equipped with ACT.

**SLAVE (SLV) (DUAL CONTROL PANEL ONLY)**

For airplanes equipped with dual weather radar control panels, one controller can be slaved to the other by selecting OFF on that controller only. This condition is annunciated by the illumination of SLV on the control panel. The slave mode allows one controller to set the radar modes for both sides. In the slave mode, the PFDs and MFDs radar information are identical and simultaneously updated.

**NOTE:** In the slaved condition, both control panels must be set to off before the radar system turns off.

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## RADOME

The radome is the primary factor behind degraded weather radar performance. The problems affecting the radome are as follows:

- A water film over the radome's surface when flying in rain.
- Greased radome.
- Cracked radome.
- Holes caused by lightning strike/electrostatic discharges.
- Excessive application of antistatic paint.

**Water Film Over The Radome's Surface:** When flying in rain, there is indication that at some specific altitudes and speeds a water film is formed on the radome, altering the weather radar indications. The radar display may disappear or turn red. To avoid this problem, there is a hydrophobic coating product named Cytonix® that can be applied to the radome surface.

**Greased Radome:** The presence of grease or dirt over the radome's surface also impairs radar transmission. These should be reported immediately to maintenance personnel for cleaning or corrective action.

**Electrostatic Discharges:** Static electricity influences radar performance. The right bonding is necessary. Bonding is accomplished through two metallic meshes that link the radome's metallic bulkhead (diverters) to the airplane's airframe. It is important to make sure that they are in good condition and not painted. If both the metallic meshes and screws are painted, this will isolate the static power generated in the radome, resulting in electrical discharges that will follow towards the radar antenna and/or generate noise in the audio system.

**Cracked Radome:** Small holes caused by electrostatic discharges, minor damage to structure or paint can cause water infiltration in the radome's honeycomb composite structure. It can result in significant radar signal attenuation, distortion and in some cases, can cause dark spots on the radar screen.

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## WEATHER RADAR BEHAVIOR

Depending on the airplane radar controller configuration (single or dual), the WX Controller position and the adjustment between MFD bezel #1 or #2, the weather radar system behavior can be summarized as follows:

- For airplanes equipped with Single Radar Controller Configuration:

| | WX Controller | Adjustment through | MFD #1 Indication | MFD #2 Indication |
|---|---|---|---|---|
| **#1** | STDBY | MFD Bezel #1 | Terrain map image matches local ARC Range setting | Terrain map image matches local ARC Range setting |
| **#2** | WX | | | |
| **#3** | STDBY | MFD Bezel #2 | Terrain map image is copied from MFD #2, disregarding local ARC Range setting | |
| **#4** | WX | | | |

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– For airplanes equipped with Dual Radar Controller Configuration, the system behavior can be summarized as follows:

| | **WX Controller #1 (LH side)** | **WX Controller #2 (RH side)** | **MFD #1 Indication** | **MFD #2 Indication** |
|---|---|---|---|---|
| **#1** | STDBY | OFF | Terrain map image and ARC Range setting work independently through MFD Bezel #1 and #2 | |
| **#2** | STDBY | WX | | |
| **#3** | WX | OFF | | |
| **#4** | WX | STDBY | | |
| **#5** | OFF | WX | Terrain map image is copied from MFD #2, disregarding local ARC Range setting | Terrain map image matches local ARC Range setting |
| **#6** | OFF | STDBY | | |

**NOTE:** The mentioned characteristic is only valid for the Terrain Map image and does not affect the EGPWS functions.

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# WEATHER RADAR CONTROLS AND INDICATORS

## WEATHER RADAR CONTROL PANEL

### 1 - RANGE SELECT BUTTONS

- Allow selection of the radar's operating range, from 5 to 300 NM full scale in WX, REACT, or GMAP mode. In FP mode, additional ranges of 500 and 1000 NM are available. In test mode the range is automatically set to 100 NM.
- The up-arrow button selects increasing ranges, while the down-arrow button selects decreasing ranges. Upon reaching maximum or minimum range, further pushing of the button causes the range to rollover to minimum or maximum range, respectively.

### 2 - TURBULENCE DETECTION FUNCTION BUTTON (P-880 Model Only)

- Alternate pressings turns on or off the radar's turbulence detection function.
- Function can be used only in WX or RCT mode, with selected range of 50 NM or less.

### 3 - STABILIZATION FUNCTION BUTTON

- When momentarily pressed, disables antenna stabilization function. The STAB OFF annunciator will illuminate on the control panel.
- On the ground, after warm-up period, pressing the STB button four times within 3 seconds will inhibit the forced standby (FSBY) function.

### 4 - SLAVE ANNUNCIATOR (Dual Control Panels Only)

- Illuminates to indicate that one controller is slaved to the other.

### 5 - TARGET ALERT CONTROL BUTTON

- Alternate pressing selects or cancels the target alert feature.
- Selectable only in the WX and FP Modes.

### 6 - SECTOR SCAN BUTTON (SECT)

- When momentarily pressed, selects either the radar's normal 12 sweeps per minute for a 120° full scan or the faster update 24 sweeps per minute for a 60° sector scan.

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**7 - ANTENNA TILT CONTROL KNOB**

- The TILT knob is a rotary control that allows manual control of the antenna's tilt angle. Clockwise rotation tilts the beam upward 0° to +15°. Counter-clockwise rotation tilts beam downward 0° to –15°. A digital readout of the antenna tilt angle is displayed on the MFD.
- The range between +5° and -5° is expanded for setting ease.

**ALTITUDE COMPENSATED TILT (PULL ACT) (P-880 Model Only)**

- Pulling out the TILT knob activates the auto tilt control, which automatically readjusts tilt between ± 2° based on changes in barometric altitude and/or selected range.

**8 - RADAR MODES CONTROL KNOB**

OFF - Turns off the weather radar.

SBY - Selects the weather radar standby operating mode.

WX - Selects the weather radar detection operating mode.

RCT - Selects the REACT function (P-880 Model only).

GMAP - Selects the weather radar ground mapping operating mode.

FP - Selects the weather radar flight plan operating mode.

TST - Selects the weather radar test mode.

**9 - GAIN CONTROL KNOB**

- Allows receiver gain control.
- When pushed in, receiver gain is preset and calibrated. Rotary function of the GAIN knob is disabled
- When pulled out, sets receiver gain to variable (VAR) mode.

**10 - RAIN ECHO ATTENUATION COMPENSATION TECHNIQUE FUNCTION BUTTON (P-660 Model Only)**

- When pressed (momentarily), enables the REACT.
- REACT is always selected in test mode.
- REACT is available in all modes except MAP.

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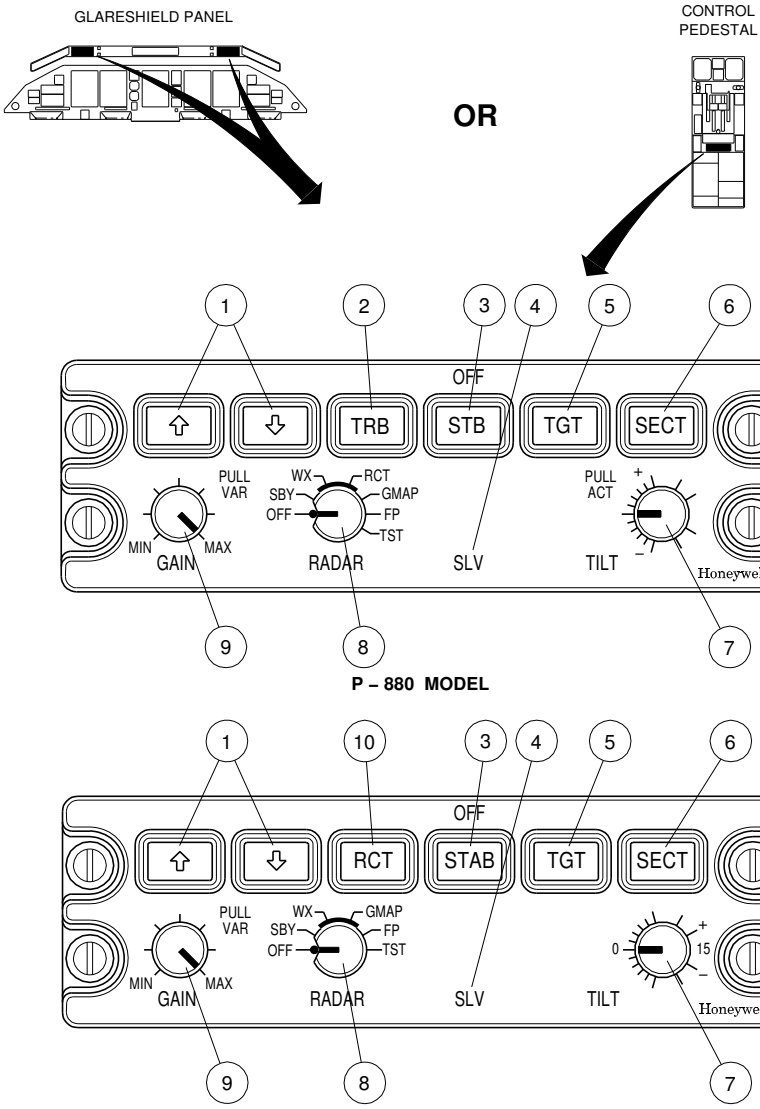


**NOTE:** THE AIRPLANE MAY BE OPTIONALLY EQUIPPED WITH TWO WEATHER RADAR CONTROL PANELS LOCATED ON THE GLARESHIELD PANEL.

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## WEATHER RADAR CONTROL PANEL

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## MFD BEZEL PANEL

### 1 - WEATHER RADAR DISPLAY SELECTOR BUTTON

- Alternate pressing of the weather radar display selector button allows the weather radar to be displayed or removed from the MFD. Control of all other weather radar functions is accomplished by the radar control panel. When the weather radar is selected, the WX label on the MFD menu, above this button, will be highlighted by a white box.
- The weather radar can only be selected for display in map format. If the weather radar is selected with plan format already selected on the MFD, it will force the display to revert to map format.

### 2 - MAP/PLAN FORMATS CONTROL BUTTON

- Alternate pressing of the map/plan formats control button will cause the MFD to toggle between map and plan formats. A white box around will highlight the selected MFD format.
- If the weather radar is displayed on the MFD and the plan format is selected, the weather radar will be removed from the display. However, if the MFD map format is selected again, the weather radar display will be restored on the MFD.

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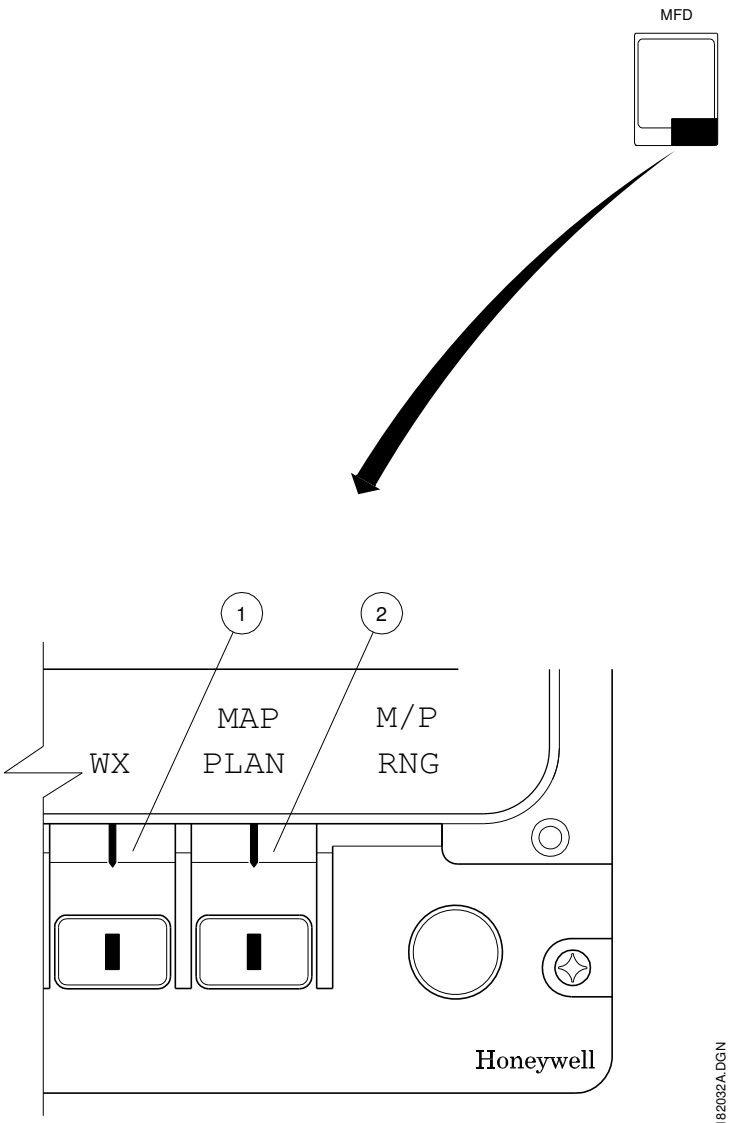


**MFD BEZEL PANEL**

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## WEATHER RADAR DISPLAY ON THE PFD AND MFD

### 1 - ANTENNA POSITION INDICATOR (API)

- Color: Amber.
- The API is displayed as an arc at the current range outer limit.
- Indicates the radar antenna alternate sweep position and provides a picture bus activity indication.

### 2 - WEATHER RADAR PATCH

- Indicates an area of radar reflection.
- Color:
  - Magenta: high intensity reflection.
  - Red: medium-high intensity reflection.
  - Yellow: medium intensity reflection.
  - Green: low intensity reflection.

### 3 - WEATHER RADAR TURBULENCE INDICATION (P-880 Model Only)

- Indicates an area of detected turbulence.
- Color: white.

### 4 - WEATHER RADAR REACT INDICATION

- Indicates an area where radar receiver gain compensation has reached its maximum value.
- Color: cyan.

### 5 - WEATHER RADAR RANGE ARC VALUE

- Color: white.
- Indicates half of the radar range selected in the weather radar control panel.

### 6 - WEATHER RADAR ANTENNA TILT ANGLE DISPLAY

- Color: green.
- Range: –15 to +15°.
- Resolution: 1°.

### 7 - WEATHER RADAR TARGET MODE AND ALERT ANNUNCIATION

- Color:
  - TGT label: green or amber.
  - VAR label: amber.
- The VAR label will be displayed in the same field as that used for TGT annunciation to indicate a variable gain indication. Priority is given to TGT annunciation.

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## 8 - WEATHER RADAR MODES ANNUNCIATION DISPLAY

– Indicates the selected mode in the weather radar control panel.

| DISPLAY | | MODE DESCRIPTION |
|---|---|---|
| ANNUNCIATION | COLOR | |
| STAB | AMBER | Stabilization off. |
| TGT | GREEN | Target alert enable. |
| TGT | AMBER | Target alert enable and level 3 WX return detected in the forward 15° of antenna scan. |
| VAR | AMBER | Variable gain. |
| WX | GREEN | Normal WX ON and selected for display. |
| WX | AMBER | Invalid WX control bus. |
| TX | GREEN | WX is transmitting but not selected for display, or in STBY or FSTBY. |
| TX | AMBER | WX is transmitting and weight on wheels indicates on ground, but not selected for display, or in STBY and FSTBY. |
| WAIT | GREEN | Warm up period of approximately 40 to 100 seconds. |
| STBY | GREEN | Normal standby. |
| FSBY | GREEN | Forced standby. |
| TEST | GREEN | Test mode and no faults. |
| FAIL | AMBER | Test mode and faults. |
| RCT | GREEN | Normal WX with REACT. |
| FPLN | GREEN | Flight plan mode. |
| GMAP | GREEN | Ground map mode. |
| GCR | AMBER | Normal WX with ground clutter reduction. |
| R/T | GREEN | WX with REACT and turbulence. |
| WX/T | GREEN | Normal WX with turbulence. |

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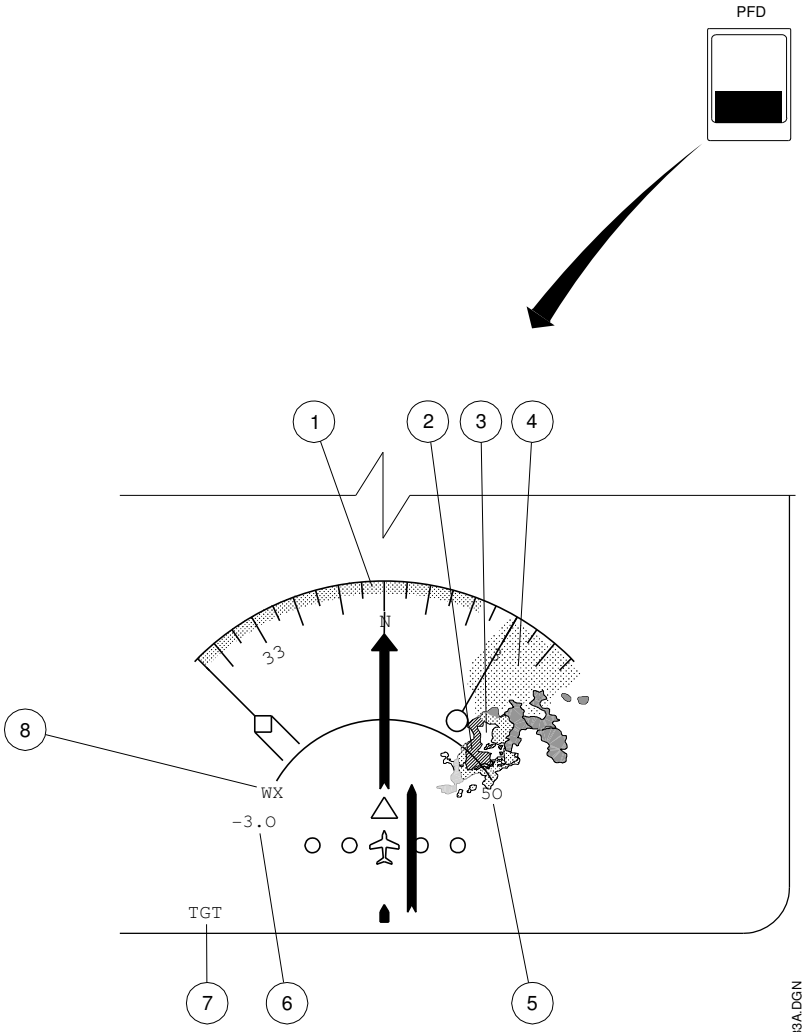


**WEATHER RADAR DISPLAY ON PFD**

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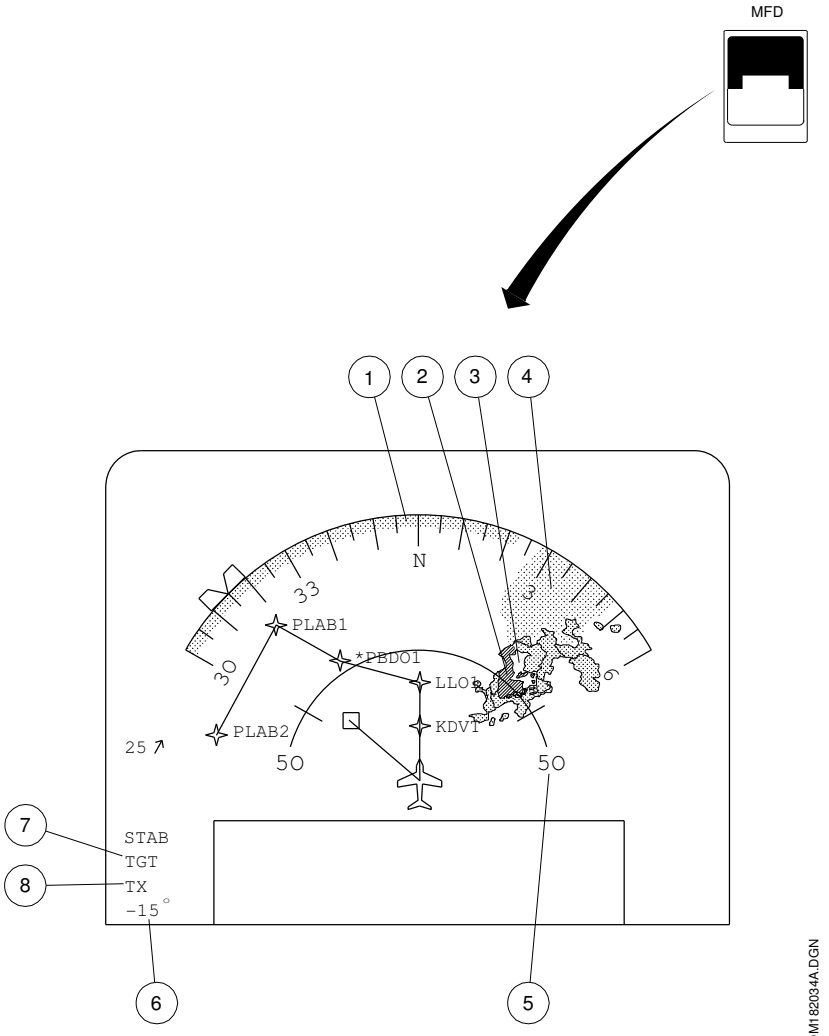


**WEATHER RADAR DISPLAY ON MFD**

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# LIGHTNING SENSOR SYSTEM (LSS)

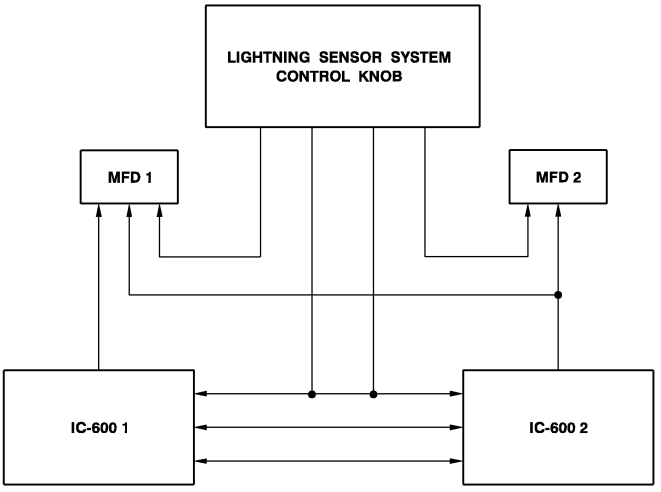
The P-880 Weather Radar Model may be optionally equipped with a Lightning Sensor System (LSS). For additional information on functions and operations, refer to the LSZ-850 Lightning Sensor System Pilot's Handbook.

The Lightning Sensor System is designed to detect and locate areas of lightning activity, in a 100-nautical-mile radius around the aircraft, and to give the operator a visual display of its position and rate-of-occurrence on the MFDs.

The Lightning Sensor System is inhibited on the ground and during HF transmission (HF PTT), being powered by one of the 28 V DC Avionics Switched DC Buses. Should a power supply failure occur, the Lightning Sensor System will be inoperative, as there is no backup power to it.

The Lightning Sensor System interfaces with other airplane systems and equipment as follows:

– MFDs - The LSS provides lightning activity data to the MFDs.
– IC-600s - Signals between the LSS and the IC-600s are transmitted through a Serial Data Bus.




**LIGHTNING SENSOR SYSTEM SCHEMATIC**

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# LSS OPERATION

The Lightning Sensor System is controlled through a dedicated control knob, located on the Weather Radar Control Panel. The Lightning Sensor System Control knob provides control functions and operating modes management for proper Lightning Sensor System operation.

The Lightning Sensor System detects both visible and invisible high energy electromagnetic discharges (lightning), indicating areas of turbulent activity and displaying such information on the MFDs.

The Lightning Sensor System may be operated with the Weather Radar System turned on or off. If the Weather Radar is turned off, the LSS Range Selection is done through the MFDs knobs.

When power is first applied to the system, a self-test is automatically performed and, in the event of failure, an amber LX/F will be displayed on the MFDs. The LSS also performs self-calibration each time the system is turned on. The green LX/C annunciation is removed after calibration is completed. Strong interfering signals outside the aircraft, or equipment malfunction may prevent the calibration of the system, in which case the ¨C¨ will not be removed from the display. If the ¨C¨ is removed after takeoff, this means that only outside interference was preventing calibration. In this case the LSS should be switched off and set back to LX mode to force recalibration for greater accuracy. If the ¨C¨ persists after takeoff, a test should be performed.

## LSS OPERATING MODES AND FUNCTIONS

STANDBY MODE (STBY)

When the Standby Mode is selected, no lightning data is shown on the MFDs. However, the receiving and processing equipment is active and lightning strikes are being counted and accumulated into areas.

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LIGHTNING DETECTION MODE (LX)

When operating in Lightning Detection Mode, the Lightning Sensor System is fully operational and lightning strikes are collected, processed, and displayed.

The LSS shows areas of lightning activity with white lightning symbols, which represents the center of a circular area with a radius of nine nautical miles. Three different lightning symbols are used to represent three different lightning rates-of-occurrence within each 18-mile diameter cycle.

Because of the large variation in lightning electromagnetic discharge, sometimes the system can not determine, within its occurring criteria, lightning bearing and distance. Rather, only the bearing is measured. Activity that only provides bearing information is presented in magenta lightning symbols near the outer range marks.

When operating the LSS with the Radar in STBY Mode, 360º of data is displayed.

A green LX will be displayed on normal operation.

Lightning Sensor Display symbology is as follows:

| LEVEL | LIGHTNING CATEGORY |
|---|---|
| 1 | white headless lightning symbol |
| 2 | white single-headed lightning symbol |
| 3 | white double-headed lightning symbol |
| ALERT | magenta headless lightning symbol |

CLEAR/TEST MODE (CLR/TST)

When the Clear/Test mode is selected, all lightning rate symbols are erased from the display and a special pattern is displayed to allow verification of the Lightning Sensor System operation.
The Test must be accomplished by selecting 50 NM or a greater display range and the CLR/TST Mode. The LSS CLR/TST Mode can be selected in any radar mode.
In the event of a failure, an amber LXmn will be displayed, where mn is a failure code, which will help the technician in troubleshooting the system.
When CLR/TST mode is selected, a green LX/CL is displayed on the MFDs and, after three seconds, LX/CL is replaced by LX/T.

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# LSS CONTROLS AND INDICATORS

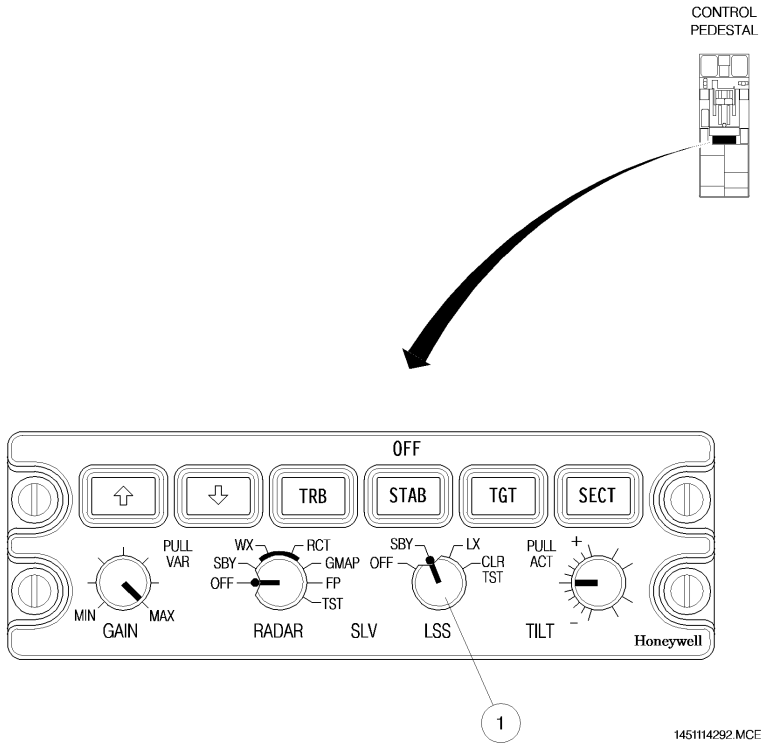
## 1- LIGHTNING SENSOR SYSTEM CONTROL KNOB

OFF - Turns off the Lightning Sensor System.

SBY - Selects the Lightning Sensor System Standby Mode.

LX - Selects the Lightning Sensor System Detection Operating Mode.

CLR/TST- Selects the Lightning Sensor System Test Mode.




**WEATHER RADAR CONTROL PANEL WITH LSS**

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## LIGHTNING SENSOR SYSTEM DISPLAY ON THE MFD

### 1 - LEVEL 1 LIGHTNING ACTIVITY INDICATION

- Color: White
- Indicates the center of an 18-mile diameter area of lightning activity with 1 strike every 2 minutes.

### 2 - LEVEL 2 LIGHTNING ACTIVITY INDICATION

- Color: White
- Indicates the center of an 18-mile diameter area of lightning activity with 2 strikes every 2 minutes.

### 3 - LEVEL 3 LIGHTNING ACTIVITY INDICATION

- Color: White
- Indicates the center of an 18-mile diameter area of lightning activity with 3 strikes every 2 minutes.

### 4 - LEVEL 4 (ALERT) LIGHTNING ACTIVITY INDICATION

- Color: Magenta
- Indicates only the bearing of lightning activity, without determining the distance.

### 5 - LIGHTNING SENSOR SYSTEM MODES AND FAULTS ANNUNCIATION DISPLAY

- Indicates, above the Weather Radar annunciation display, the selected mode in the Lightning Sensor System Control Knob .

| DISPLAY | | MODE DESCRIPTION |
|---|---|---|
| ANNUNCIATION | COLOR | |
| LX/OFF | GREEN | LX Power is off. |
| LX | AMBER | LX Power is on and LX Communication Bus is Inactive. |
| LXmn | AMBER | LX Fault Code Enabled. |
| LX/F | AMBER | LX Fault |
| STBY | GREEN | LX Standby |
| LX/CL | GREEN | LX Clear |
| LX/T | GREEN | LX Test Mode |
| LX/I | GREEN | LX Antenna Inhibit |
| LX/C | GREEN | LX Auto Calibrate |
| LX | GREEN | LX Normal |

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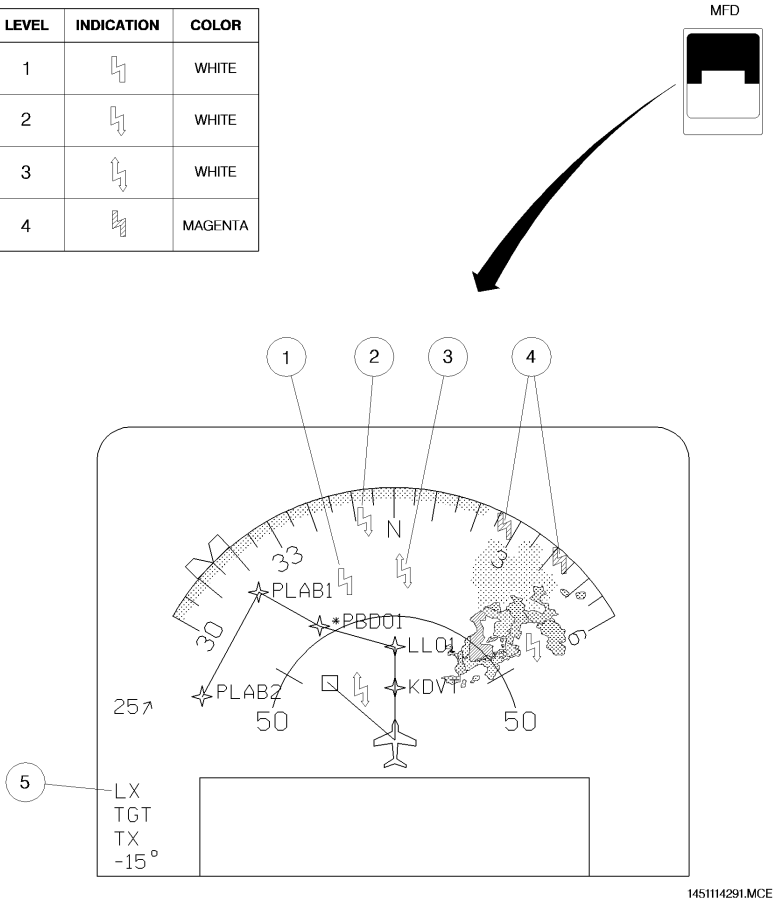
| LEVEL | INDICATION | COLOR |
|---|---|---|
| 1 | | WHITE |
| 2 | | WHITE |
| 3 | | WHITE |
| 4 | | MAGENTA |

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## LIGHTNING SENSOR SYSTEM DISPLAY ON MFD

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# BAROMETRIC VERTICAL NAVIGATION (BARO-VNAV) (AIRPLANES POST-MOD. SB145-34-0125)

Vertical Navigation is an advisory only function in the FMS to aid the pilot during descents. With Baro-VNAV, the VNAV is coupled to the autopilot and flight director and provides vertical navigation targets to the Flight Guidance Computer (FGC). The Baro-VNAV provides vertical guidance for all phases of flight.

The VNAV function activates when the following conditions are met:

- Each FMS Position initialized,
- Performance initialized,
- Flight plan closed by entering the destination waypoint as the last waypoint in the flight plan,
- Altitude Preselect set,
- FMS as the primary source of navigation, and
- VNV pushbutton pressed.

## BARO-VNAV COMPONENTS

The main components of the VNAV feature are the following:

- Flight Guidance Controller (GC-550),
- Integrated Computer (IC-600), and
- Flight Management System (FMS).

The selection of VNV pushbutton on the Flight Guidance Controller, arms the VNAV and, when it is already engaged, disengages the VNAV. Selection of VS, ALT, or SPD vertical submodes and go-around also disengages the VNAV.

**NOTE:** The VNAV engages automatically if already armed and the conditions for engagement are satisfied.

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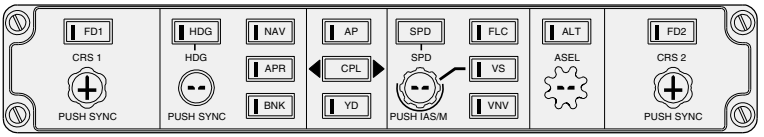


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## GUIDANCE CONTROLLER PANEL (GC-550) WITH "VNV" BUTTON

The Flight Director uses the existing Flight Guidance Computer Vertical Mode control logic with the following targets and information supplied by the FMS:

- VNAV submode,
- Altitude targets,
- Airspeed/mach targets, and
- Vertical speed/angle targets.

The FMS determines which targets the FGC will fly. The FMS CDU and the PFD display the VNAV information.

For VNAV operation, at least one ADC and one IRS data must be valid.

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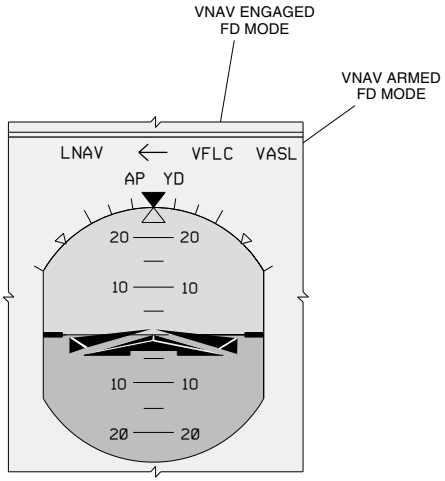
# VNAV INDICATIONS

The indications related to VNAV are displayed on the PFD, MFD, EICAS, and CDU.

## PFD INDICATIONS

The following figures show the indications on the PFD.




**VNAV ARMED AND ENGAGED ON PFD**

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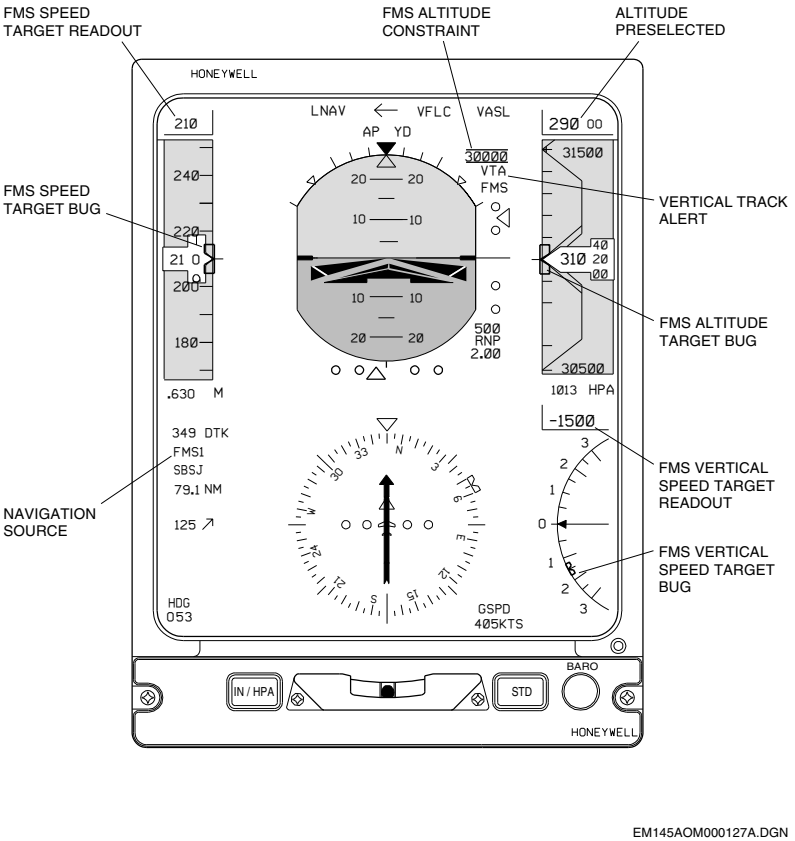


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## FMS TARGET BUGS AND READOUTS

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The annunciation related to the VNAV on PFD is displayed in white for "VNAV Armed Mode" and magenta for "VNAV Engaged Mode". When VNAV is engaged, the speed target readout is also presented in magenta and its control is done by the FMS, not by the Speed Knob.

The altitude preselected is set via ASEL Knob on Guidance Controller Panel.

Altitude constraints are "AT", "AT or ABOVE", or "AT or BELOW". They are displayed in Magenta and in ft, with up to five digits and resolution of one foot. They are defined according to Navigation database procedures or flight crew commands on CDU. When the flight crew plan to be at a certain altitude or have a limitation at, below or above a certain altitude. The altitude constraint is not displayed in the PFD when it is equal to the preselector altitude.

A vertical track alert (VTA) is issued anytime the FMS commands a vertical track change. A VTA is issued 60 seconds before changing from level flight to either a climb or descent. When the airplane is completing a climb or descent, the vertical alert is issued 1000 ft before the level-off altitude. A vertical alert is not issued when the level-off altitude is equal to the preselected altitude. When the VTA (Amber) indication is displayed in the PFD, the VTA aural alert is also activated. The VTA aural alert consists in a single C chord.

The altitude alert is activated 1000 ft before the FMS altitude constraint, when this altitude is equal to the altitude constraint. The altitude alert consists in a double C chord.

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The following table contains the type of altitude constraints, descriptions, and indications on the PFD.

| ALTITUDE CONSTRAINT | VNAV COMMAND | INDICATION ON PFD (I.E. 10000 ft) |
|---|---|---|
| AT | Fly to a specific altitude | 10000 |
| AT or ABOVE | Fly to a specific altitude or higher, not below | 10000 |
| AT or BELOW | Fly to a specific altitude or below, not higher | 10000 |
| WINDOW Constraint (during climb) | Fly to a specific range of altitude, not higher than upper limit, nor below lower limit | 10000 |
| WINDOW Constraint (during descent) | | 10000 |

**NOTE:** WINDOW Constraints can not be manually input on the flight plan, but they are present in specific departure procedures and SID, and also in specific approach procedures and STAR.

The FMS vertical deviation indication represents the deviation in feet from the airplane current position to the planned descent path. It has two dots above and two dots below the center mark. When the pointer is above the center mark, it indicates that the airplane is below the path. When the pointer is below the center mark, it indicates that the airplane is above the path.

The FMS Vertical Deviation Scale Factor changes as function to the FMS Phase on Flight Plan, according to the following table.

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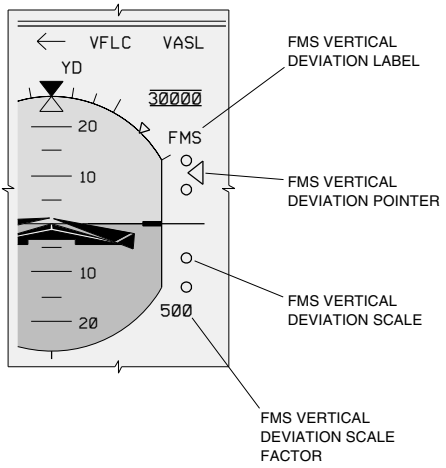
| FMS PHASE ON FLIGHT PLAN | FMS VERTICAL DEVIATION SCALE FACTOR (ft) |
|---|---|
| Approach | 150 |
| Other Phases | 500 |

The vertical deviation scale factor is the deviation related to two dots.

For instance, when the scale factor is 500 ft and the pointer is on the second dot above the center mark, the airplane is 500 ft below the planned descent path.

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## FMS VERTICAL DEVIATION INDICATION

### EICAS

In the condition of VNAV failure, the CAS message "VERTICAL MODE OFF" (caution) is displayed. If already on final approach, the flight crew needs to perform a missed approach procedure.

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**CDU**

The scratchpad messages related to the VNAV are shown in the following table:

| SCRATCHPAD MESSAGE | CONDITION |
|---|---|
| PERF-VNAV NOT AVAILABLE | Any of the PERFORMANCE INIT data is incomplete and VNAV armed is attempted. This message is displayed only in air. |
| RESET ALT SEL? | The FMS is commanding a change of altitude, but the altitude selector has not been reset. The airplane cannot change altitude until the selector has been reset. |
| UNABLE NEXT ALT | If the airplane is unable to meet the altitude constraint. |
| VERT DIR OVER MAX ANG | The angle computed during a VERTICAL DIRECT TO exceeds the limit (6°). |
| VERT DIR UNDER MIN ANG | The angle computed during a VERTICAL DIRECT TO is under the limit (1°). |

The altitude constraint indications on the CDU are the following:

- An entry of 10000A (letter "A" following the altitude) indicates AT or ABOVE,
- An entry of 10000B (letter "B" following the altitude) indicates AT or BELOW, and
- An entry of 10000 (no letter following the altitude) indicates AT.

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# VNAV SUBMODES

## VNAV ARM (VNAV)

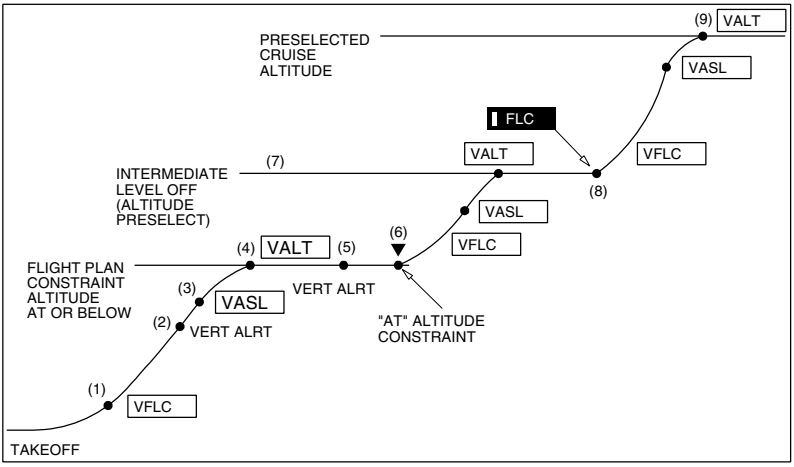
VNAV ARM becomes the active mode when the "VNV" button is pressed and the conditions for VNAV engagement are set. Using the position and altitude data, the FMS determines when to capture and which VNAV submode is correct. While in the armed mode, the FMS does not vertically control the airplane.

## VNAV FLIGHT LEVEL CHANGE (VFLC)

In this mode, the Flight Guidance Computer (FGC) follows the FMS speed target readout, controlling the pitch of the airplane for both climb and descent.

When in other modes of VNAV, a transition to VFLC is made by setting the altitude preselector to other than current altitude and pressing the FLC button on the Guidance Controller Panel.

The elements of a VNAV climb profile are the following:

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**VNAV CLIMB PROFILE**

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An example of a VNAV climb profile consists of the following:

- VNAV is engaged in a VFLC airspeed climb after takeoff (1).
- 1000 ft before reaching the constraint altitude, a VTA is given (2).
- The flight guidance computer changes to VASL to capture the altitude constraint (3).
- The flight guidance computer changes to VALT at the constraint altitude (4).
- One minute before the constrained lateral waypoint is reached, a VTA is issued indicating an automatic climb begins at the waypoint.The altitude preselector is set higher than the constraint altitude (5).
- The FMS directs the Flight Guidance Computer to change to VFLC as the waypoint is passed (6).
- The flight guidance computer performs a normal level off at the intermediate altitude preselector changing from VFLC to VASL to VALT with the normal 1000 ft selector alert (7).
- ATC clearance is received to the cruise altitude and the selector is dialed to the cleared altitude. The "FLC" button is pushed to resume the climb (8).
- The flight guidance computer performs a normal level off at the cruise altitude changing from VFLC to VASL to VALT with the normal 1000 ft selector alert and the speed command changes to the cruise value (9).

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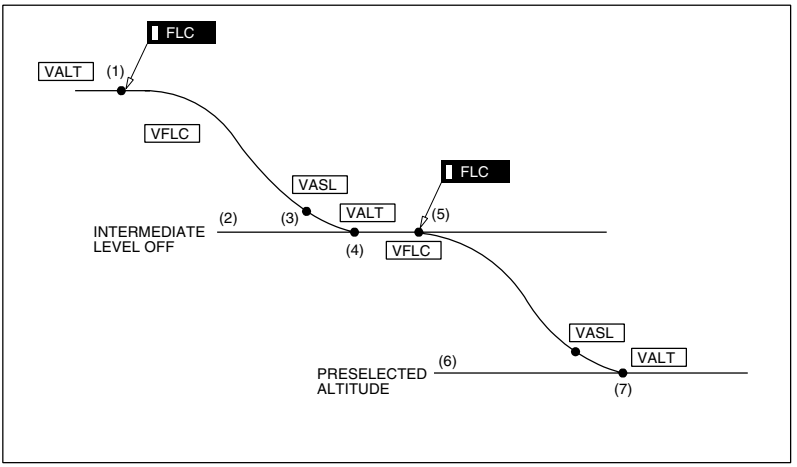
The elements of a VNAV FLC (IAS or MACH hold) descent profile are the following:

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## VNAV FLIGHT LEVEL CHANGE DESCENT

A VFLC descent can be engaged at any time by using the following:

- From cruise altitude (1), dial down the altitude preselector to the ATC cleared altitude (2).
- Press "FLC" if already engaged in a VNAV mode or "VNV" if not already in VNAV. The flight guidance computer changes to VFLC and begins a descent (1).
- 1000 ft before the altitude preselected (2) is reached, the normal altitude alert is issued, and the flight guidance computer does a normal level off switching from VFLC to VASL (3) to VALT (4).
- An ATC clearance (5) is received to a lower altitude and the altitude preselector is lowered (6). "FLC" is pressed (5) and the airplane begins a descent.
- 1000 ft before the altitude preselector (6), the normal altitude alert is issued and the flight guidance computer does a normal level off switching from VFLC to VASL to VALT (7).

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– Excessive descent rate may be achieved if the programmed descent speed is higher than current cruise speed. Pilots must use the engine thrust to control the initial rate of descent.

**VNAV ALTITUDE CAPTURE (VASL)**

This mode is used to level the airplane at the VNAV supplied altitude target. The altitude target is either an altitude constraint or the altitude preselector setting. Preselector Altitude modification while in VASL results in a Flight Director Mode transition to VALT.

**VNAV ALTITUDE HOLD (VALT)**

This mode is the same as altitude hold. The FGC maintains altitude by controlling pitch. When VNAV is disengaged while in VALT, and lateral mode is not ROL, the flight director mode becomes PITCH HOLD, not altitude hold.

**VNAV PATH (VPTH)**

In this mode, VNAV controls the airplane along a geometric path downward to a waypoint altitude constraint. The path angle is either an FMS computed value, procedure specified, or pilot entered. The airplane is not going to fly below the altitude preselected.

VPTH default descent angle is part of performance initialization. However, after the angle is displayed for each waypoint, it is possible to the flight crew to change it as required, from 1 to 6 degrees.

The LNAV must be engaged for VPTH to be operational.

A VNAV path descent engages from VALT when the altitude preselector has been dialed down before the TOD point is reached.

The VNAV path descent mode is used to descend to a new flight level at a calculated or prescribed angle (from 1 to 6 degrees).

The VNAV angle is always displayed on CDU for path descents.

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The path is always followed, except when the airplane speed approaches the following:

- $V_{MO}/M_{MO}$,
- Landing gear or flap placard speed, or
- $V_{REF}$.

VNAV tries to satisfy both the altitude preselector and the waypoint constraint altitude. However, VNAV never flies through the altitude preselector.

When using VPTH and a missed approach is executed, it is necessary to reset the altitude preselector to the missed approach altitude.

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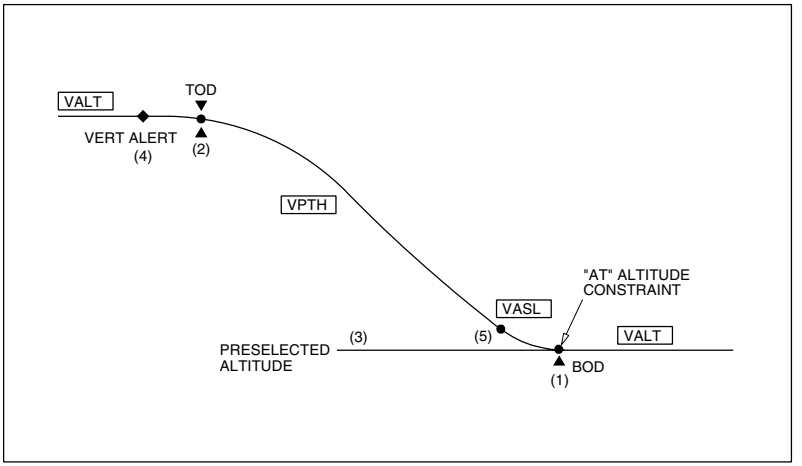
The steps of a VNAV path descent profile are the following:

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**VNAV PATH DESCENT PROFILE**

- An altitude constraint is entered at a waypoint (1).
- The FMS calculates an angle and TOD (2) for the path descent.
- The altitude preselector is set to the ATC cleared altitude (3).
- One minute before reaching the TOD, a VTA is issued (4) and the vertical deviation scale is displayed on the EFIS. If the altitude preselector is not at a lower altitude, the message "RESET ALT SEL?" is displayed on the FMS CDU.
- At the TOD, the flight guidance computer changes from VALT to VPTH and begins a descent (2).
- The flight guidance computer does a normal level off changing from VPTH to VASL (5) to VALT (1).

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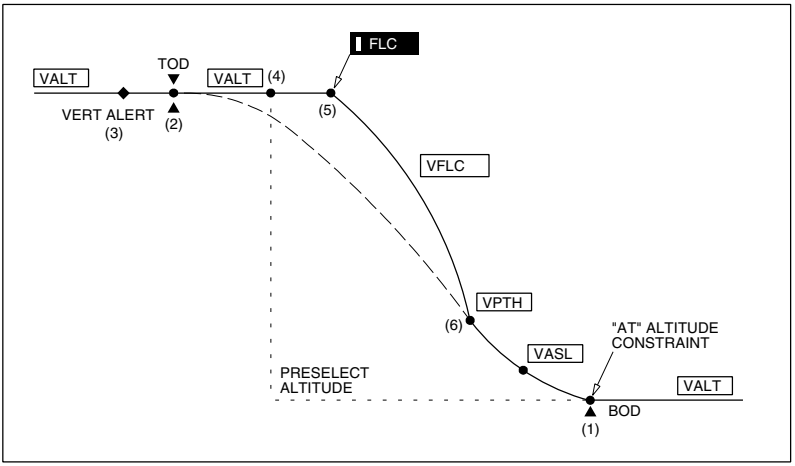
The scenario of a VNAV late path descent occurs when ATC has not given descent clearance by the time the TOD is reached. The steps are the following:

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**VNAV LATE PATH DESCENT**

- An altitude constraint is entered at a waypoint (1).
- The FMS calculates an angle and TOD (2) for the path descent.
- One minute before reaching the TOD, a VTA is issued (3) and the vertical deviation scale is displayed on the PFD.
- If the altitude preselector is not at a lower altitude, the message "RESET ALT SEL?" is displayed.
- When past the TOD and more than 500 ft above the path, the flight guidance computer remains in VALT.
- The altitude preselector is then set (4) to the ATC cleared altitude.
- Pressing the "FLC" button (5) begins descent.

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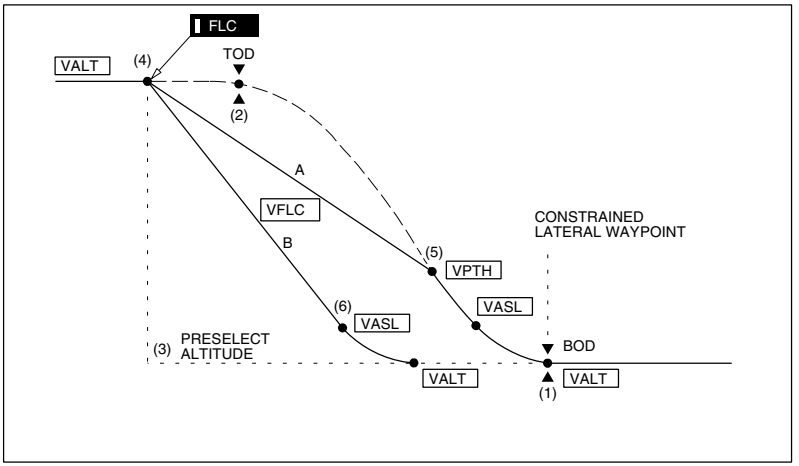
- The FMS issues a mode request to the Flight Director from to VALT to VFLC to begin the descent once engine thrust is reduced sufficiently. The descent rate in VFLC mode is governed by engine thrust and descent speed target (as specified in the Performance Initialization page). If the airplane is less than 500 ft from the path when the "FLC" button is pushed, the FMS switches directly to VPTH mode.
- When the path intercept criteria are satisfied the FMS issues a mode request to the flight director to change from VFLC mode to VPTH mode and continues the descent along the path (6).
- The flight guidance computer does a normal level off switching from VPTH to VASL and finally to VALT (1).

VNAV EARLY DESCENT TO CAPTURE PATH

An early descent to capture a path scenario occurs when ATC instructs a descent before the established TOD point is reached. The steps are the following:

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**VNAV EARLY DESCENT TO CAPTURE PATH**

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- An altitude constraint is entered at a waypoint (1).
- The FMS calculates an angle and TOD (2) for the path descent.
- The altitude preselector is set to the ATC cleared altitude (3).
- Pressing the "FLC" button (4) starts the descent.
- The FMS issues a mode request to the Flight Director from VALT to VFLC and begins to descend once engine thrust is reduced sufficiently. The descent rate in VFLC is governed by engine thrust and speed target (as specified in the Performance initialization pages).
- If the airplane is less than 500 ft from the path when the "FLC" button is pressed, the FMS changes directly to VPTH mode.
  - VFLC path "A" is followed when the airplane descent rate is relatively small (engine thrust is nearly proportional to the thrust required to maintain level flight at target airspeed).
    - Path intercept criteria are satisfied; the FMS issues a mode request to the flight director to switch from VFLC to VPTH mode and continues descending along the path (5).
  - VFLC path "B" is followed when the airplane descent rate is high (engine thrust is low relative to the thrust required to maintain level flight at target airspeed);
    - Path intercept criteria are not satisfied, the FMS continues descending in FLC mode until VASL is captured (6).
- A normal level off is performed changing from a VPTH or VFLC to VASL and finally to VALT (1).

## VERTICAL DIRECT-TO

A vertical direct-to is performed to an altitude constraint at a waypoint in the flight plan and is used for climbs and descents. The altitude constraint must be in the flight plan before the vertical DIRECT-TO is executed. The airplane does not respond to the vertical DIRECT-TO unless the altitude selector is properly set above for climbs and below for descents.

When VNAV is engaged, the VNAV submode changes to VFLC for climbs or to VPTH for descents. All altitude constraints between the airplane and the selected constraint are removed from the flight plan. No lateral changes are made to the flight plan.

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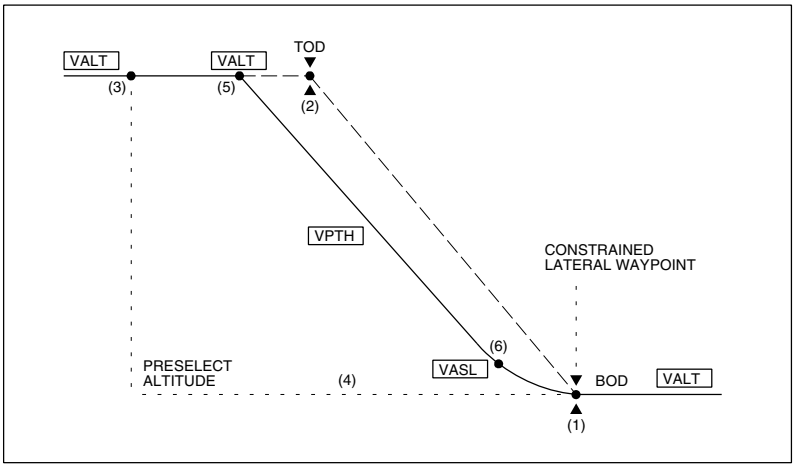
The steps for VNAV early path descent using vertical DIRECT-TO are the following:

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## VNAV EARLY PATH DESCENT USING VERTICAL DIRECT-TO

- An altitude constraint is entered at a waypoint (1).
- The FMS calculates an angle and TOD (2) for the path descent.
- The altitude preselector is set (3) to the ATC cleared altitude (4).
- A vertical direct-to is performed (5) to the constrained waypoint (1).
- The FMS calculates the new descent path angle and the flight guidance computer transitions to VPTH.
- The calculated angle is limited from 1 to 6 degrees. When the actual angle is less than 1 or greater than 6 degrees, the FMS starts a descent to intercept the limiting angle of 1 or 6 degrees.
- The flight guidance computer does a normal level off, changing from VPTH to VASL (6) to VALT (1).

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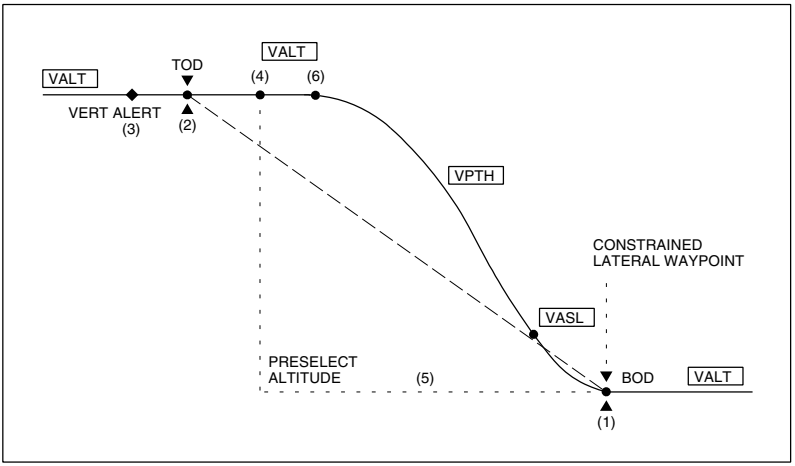
A VNAV late path descent using vertical DIRECT-TO scenario occurs when a descent clearance is not received before the TOD is reached. The steps are the following:

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**VNAV LATE PATH DESCENT USING VERTICAL DIRECT-TO**

- An altitude constraint is entered at a waypoint (1).
- The FMS calculates an angle and TOD (2) for the path descent.
- One minute before reaching the TOD, a VTA is issued (3) and the vertical deviation scale is displayed on the PFD.
- If the altitude preselector is not at a lower altitude, the message "RESET ALT SEL?" is displayed on the FMS CDU.
- At the TOD (2), the flight guidance computer remains in VALT and remains level through the TOD.
- The altitude preselector is set (4) to the ATC cleared altitude (5).
- A vertical DIRECT-TO is performed (6) to the constrained waypoint (1).
- The FMS calculates the angle and the flight guidance computer transitions to VPTH.
- The flight guidance computer does a normal level off, changing from VPTH to VASL to VALT (1).

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## VNAV VERTICAL GLIDE PATH (VGP)

The Vertical Glide Path (VGP) permits crew management of the altitude preselector during FMS managed non-precision approaches. Lateral and Vertical guidance are provided to the runway threshold or missed approach point, whichever occurs first.

VGP mode is armed by pressing the approach "APR" button on the Flight Guidance Controller Panel and the following conditions occur:

- FMS1 or FMS2 selected as the primary navigation source on the Master Flight Director,
- An FMS-based approach has been selected in the active flight plan,
- The FMS is not in dead reckoning (DR) mode,
- A NDB angle to the MAP exists,
- Altitude and angle constraint values from the NAV DB have not been changed,
- When there is an altitude constraint on the Final Approach Fix (FAF), the airplane must be in ALT HOLD at the FAF altitude,
- No DIRECT-TO the MAP has been executed,
- FMS is not in degraded state of operation,
- Vertical path intercept occurs, and
- The airplane is within 50 NM of the destination.

VGP mode is captured when the following conditions occur:

- The VGP mode is armed,
- LNAV is active,
- The airplane, when holding, must be established on the inbound course to the FAF,
- The active waypoint is the FAF or along track distance to the FAF is less than 5 NM,
- The airplane is able to capture the final approach slope, and
- With a course reversal hold leg (HF) on the FAF, the airplane must be established inbound to the FAF and be exiting the hold.

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VGP is not captured until LNAV and VNAV are captured.

Preselector Altitude modification is permitted while "VGP" is captured. When it is modified while "VGP" is armed, it results in a transition to VASL (VNAV equivalent of ASEL) and ultimately VALT.

While VNAV respects the altitude preselector and levels off appropriately at the value set in the altitude preselector window, when "VGP" is engaged and the airplane descends, the FD ignores the preselected altitude (if below current altitude) and continues the descent to the runway. Then it is possible to set the preselector altitude to the missed approach altitude.

Descents in the VGP mode allow the flight crew to set the altitude preselector to the missed approach altitude without affecting the descent path.

VGP mode is automatically canceled when any of the VGP arming conditions is no longer true. A scratchpad message "VGP UNAVAILABLE" is displayed when the "APR" button is pressed and the arming criterion mentioned previously is not met. The message is self-clearing when the FAF is sequenced.

## VNAV AND HOLDING OR ORBIT PATTERNS

There are some special considerations for holding and orbits during VNAV operation:

- When the holding or orbit pattern is entered while in VFLC, the airplane remains in VFLC and continues the climb or descent.
- When the holding or orbit pattern is entered while in VALT, the airplane remains in VALT.
- When a present position (PPOS) holding pattern is entered while in a path descent (VPTH), the VNAV changes to VFLC while in holding.

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- Path descents are not used during holding pattern operations. When the hold is entered while in VPTH, VNAV changes to VALT. To continue the descent, the pilot must manually select VFLC.
- If VNAV is engaged while executing a holding pattern course reversal on an approach, VNAV operates with VS targets (VPTH or VGP) to satisfy altitude constraints.
- Once established inbound on the final approach course, VNAV disregards the holding altitude constraint.
- VNAV guidance is provided in holding patterns and procedure turns to arrive at the Final Approach Fix (FAF) on the final approach descent path.

## GO-AROUND OPERATIONS (MISSED APPROACH PROCEDURE)

The Go-Around is initiated through the TO/GA buttons on the throttles. If either button is pushed, the following sequence occurs:

- FMS outputs the missed approach waypoints to the EFIS.
- The FD vertical engaged mode cancels VNAV mode and transitions to the GA mode.
- The FD lateral engaged mode transitions to ROL (Wings Level) and LNAV arm unless:
  - Radar Altitude < 200 ft (LNAV arm is delayed until RA > 200 ft), or
  - LNAV is already the active lateral mode (if LNAV is previously engaged, it remains engaged upon GA activation).
- Once engaged, the ROL mode remains as the active mode until the LNAV captured logic is satisfied. If the current heading is divergent to the FMS flight plan, the pilot must change the airplane heading manually to intercept the FMS flight plan.

**NOTE:** When LNAV arms and the FMS is set or it is manually set as the primary source of navigation, the LNAV engages as soon as the engagement criteria are satisfied.

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## SPEED COMMAND

The FMS is capable of controlling the airplane speed during departure, climb, cruise, descent, approach, and go-around.

The Speed Command manages the airplane speed under the following methods:

- Automatic: The FMS automatically changes the speed command throughout the flight to accommodate airplane configuration and phase of flight,
- Waypoint Speed Constraint: The FMS changes the speed command to cross a waypoint at a specified speed constraint, and
- Speed Intervention: Allows the pilot to enter into the FMS a specified speed to fly. While flying the specified speed, the FMS continues to provide Speed Protection.

## SPEED PROTECTION

The FMS provides two types of speed protection:

- Speed Reversion: Automatic transition from VPTH to VFLC.
- Latched Speed: Automatic transitions from one submode of VNAV to another.

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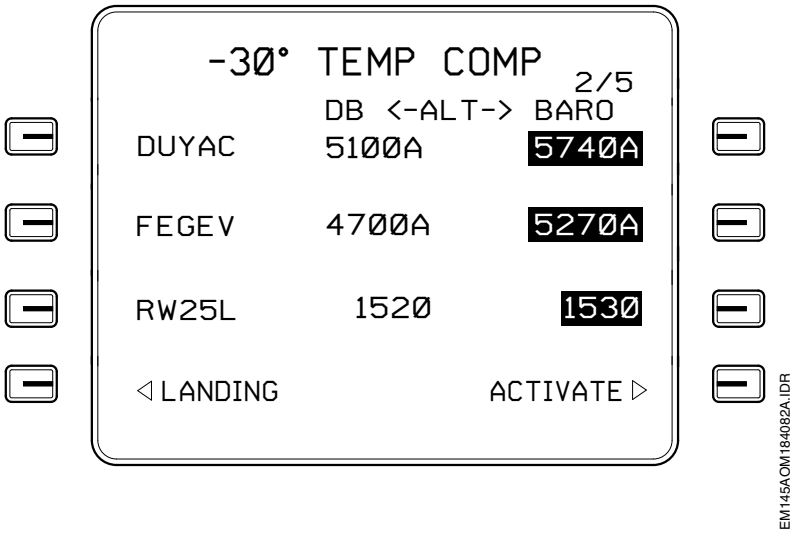
## TEMPERATURE COMPENSATION

With Baro-VNAV, the FMS includes the Temperature Compensation function. It provides temperature compensated VNAV altitudes during operations in nonstandard temperatures. When a vertical path is defined using barometric altitude, the FMS supplies temperature compensation capability for the altitude constraints. It is available for all the waypoints in departure, approach, approach transitions, and missed approach segments of the flight plan.

The flight crew must compensate for temperature effects on minimum altitude or decision altitude. If temperature compensation is not activated, the flight crew must adhere to temperature limits of the procedure.

**NOTE:** Before employing temperature compensation, the flight crew must coordinate the use of the feature with ATC. Failure to do so could result in a loss of vertical separation with other traffic.




**TEMP COMP PAGE**

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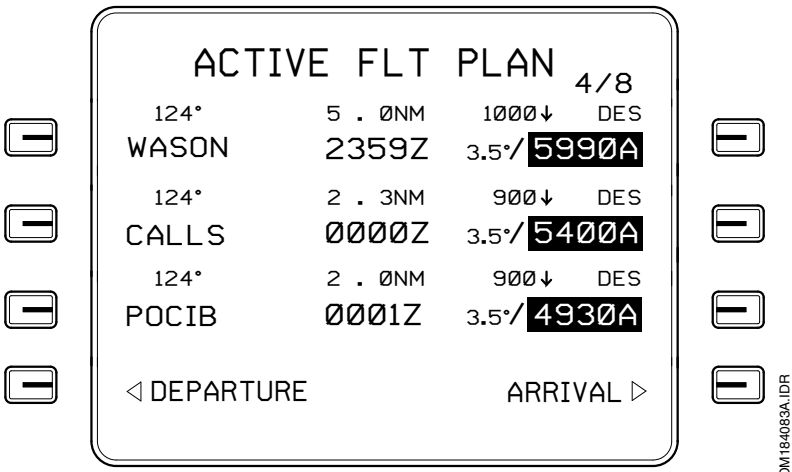
The TEMP COMP page list the waypoints in the flight plan that has altitude temperature correction applied. All the waypoints in departure, approach, approach transitions, and missed approach segments of the flight plan are included on this page.

The altitudes in the BARO column lists the corresponding temperature compensated altitude values. If a waypoint does not have a navigation database altitude constraint, the DB and BARO fields are blank. Temperature compensation is activated by pushing 4R (ACTIVATE) on the TEMP COMP page. When temperature compensation is active, the temperature compensated altitudes are displayed in reverse video on the ACTIVE FLT PLAN pages.




**ACTIVE FLT PLAN PAGE WITH TEMPERATURE COMPENSATED ALTITUDE CONSTRAINTS**

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# REQUIRED NAVIGATION PERFORMANCE (RNP)

RNP operation is the ability of the airplane navigation system to monitor the navigation performance it achieves and inform the crew if the requirement is not met during an operation. The FMS receives navigation data from various sensors on board the airplane and chooses the sensors providing the most accurate airplane position. The sensors used by the FMS are listed in priority order as follows: GPS, DME-DME, and VOR-DME. In case of sensor failure, the FMS will automatically switch to the next available sensor following the priority order as described.

The FMS includes pages where the flight crew can set and/or monitor the progress of RNP parameters and new messages for RNP operations, which will be displayed on CDU scratchpad together with an amber annunciation "MSG" on the PFD.

The user interface is achieved through system controls (CDU scratchpad), alerting functions (PFD, CDU) ), and for airplanes Post-Mod. SB145-34-0125 also indications on PFD. These functions provide the means for system initialization, flight planning and progress monitoring, active guidance control, and presentation of navigation data for flight crew situational awareness.

## RNP INDICATIONS

The RNP functionality includes indications on FMS CDU scratchpad. For airplanes Post-Mod. SB145-34-0125 there are indications also on the PFD.

### FMS CDU INDICATIONS AND ALERTS

The FMS provides the following RNP alerts and advisories on the CDU scratchpad and triggers the MSG annunciation on PFD:

– DEGRADE Alert – The degrade annunciation will be triggered when the EPU reaches a value higher than the RNP. The indication DGRAD is lit on CDU. For airplanes Post-Mod. SB145-34-0125 the PFD displays the DGR indication in amber.

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– UNABLE RNP Alert – The UNABLE RNP message is displayed and the DEGRADE annunciator is lighted when EPU is higher than RNP or when horizontal integrity limit (i.e., RAIM) receiver autonomous integrity monitoring is higher than the integrity alarm limit.

The maximum time required for the FMS to annunciate Degrade and Unable RNP alerts is based on the phase of flight. These times are described on the following table:

| PHASE OF FLIGHT | TIME TO ALARM |
|---|---|
| Approach | 6 seconds |
| Departure/Arrival/Missed Approach | 6 seconds |
| Enroute | 24 seconds |
| Remote | 54 seconds |

– UNABLE RNP NEXT WP Alert – This message alerts the crew that the current EPU exceeds the RNP required at the next waypoint.

– PILOT RNP CANCEL NEXT WP Alert – The alert PILOT RNP CANCEL NEXT WP is displayed when the pilot entered (i.e., manual) RNP is automatically canceled. This occurs when the airplane is within the waypoint sequence alert distance and the RNP on the next leg is less than the current, pilot entered RNP.

– PILOT RNP CANCELED Alert – The alert PILOT RNP CANCELLED is displayed when the active waypoint has a smaller RNP than the pilot entered RNP.

– GPS RAIM ABOVE LIMIT Alert – The alert GPS RAIM ABOVE LIMIT is displayed when global positioning system (GPS) is required and the RAIM value is above the limit.

**NOTE:** The FMS does not provide an indication to the crew of an excessive lateral (cross-track) deviation. Lateral deviation is not considered in the display of the RNP integrity alert. It is the pilot's responsibility to monitor lateral deviation and take appropriate action to ensure the airplane follows the flight plan with minimal error.

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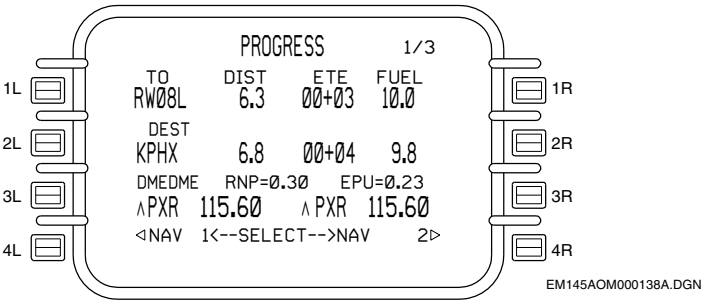


**FMS PROGRESS WITH RNP INFORMATION**

## RNP OPERATION

The RNP value used by the system is based on the following priority order:

- Manual entry,
- Navigation database specified, or
- Phase of flight default.

The RNP number can be manually entered on FMS by accessing the SET RNP page. If a valid manually entered RNP value is higher than the RNP value for the current phase of flight results in display of the CONFIRM ENTRY reverse video prompt at CDU.

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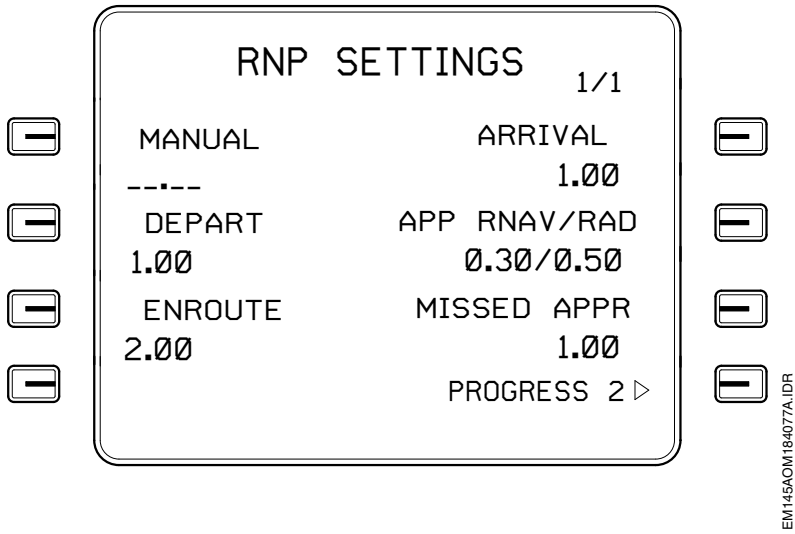


**RNP SETTINGS PAGE**

The default values for each phase of flight are:

- Departure = 1.0
- En route = 2.0
- Arrival = 1.0
- Approach = 0.3
- Missed approach = 1.0
- Oceanic/remote = 2.0

When the crew entries a manual override RNP value, it is retained until the flight plan is cleared, or completed, unless automatically canceled or manually deleted. When there is no entry, dashes are displayed.

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**PFD INDICATIONS (AIRPLANES POST-MOD. SB145-34-0125)**

**RNP Label:** The RNP label is displayed always in white on PFD whenever the RNP indications are displayed.

**Lateral Deviation Scale Factor:** The Lateral Deviation Scale Factor (RNP value) represents a designation for the navigational performance accuracy required (for example, RNP 0.3, RNP 1.0, and so on) at any given time. It is displayed in magenta on PFD under normal conditions. The Lateral Deviation Scale Factor is provided by the FMS or entered manually. When the Lateral Deviation Scale factor is invalid, it is displayed as four amber dashes.

**Lateral Deviation Scale:** The lateral deviation scale consists of one centered tick mark and two dots on each side of the center tick mark and is displayed in white under normal conditions. The center tick mark represents the center of the airplane desired track. The two dots represent the lateral deviation in NM in relation to the lateral deviation scale factor (for instance, 2x dots = 1x RNP).

**Lateral Deviation Pointer:** The Lateral Deviation Pointer represents the current airplane lateral deviation in relation to the central tick mark. The pointer is displayed as a magenta "triangle" that moves in relation to the center tick mark to the right or to the left corresponding to the airplane lateral deviation. The FMS also sets the course deviation indicator (CDI) sensitivity based on the RNP value. The CDI is set such that two dots of cross track deflection are equal to the RNP value.

**Estimated Positioning Uncertainty (EPU):** The EPU is a measure in NM which conveys the current position estimation performance. The EPU is not an estimate of the actual error, but a defined statistical indication of potential error. The EPU is displayed graphically on PFD as magenta horizontal lines and winglets attached to the lateral deviation pointer. The initial position of the winglets is the center of the lateral deviation pointer and it expands to the left and right or retracts as the EPU value increases or decreases. The Lateral Deviation Pointer and EPU move as a group to the left or right in accordance to the airplane lateral deviation in NM. If EPU is invalid, the Lateral Deviation Pointer is displayed as a red X.

**Vertical Deviation Scale Factor:** The Vertical Deviation Scale Factor indicates the airplane vertical current position relative to the desired track and is displayed in magenta every time the vertical deviation scale is displayed.

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**Vertical Deviation Scale:** The Vertical Deviation Scale is displayed in magenta on the PFD in feet. It is only displayed when the airplane enters into any path descending modes. With engaged VNAV mode the vertical deviation scale reference is displayed in amber and flash in the condition of deviation exceedance. Vertical scaling changes according to the phase of flight, according to the following table.

| PHASE OF FLIGHT | VERTICAL DEVIATION SCALE |
|---|---|
| Approach | 75 ft/dot |
| Ground<br>Departure<br>Airborne<br>Enroute<br>Oceanic/Remote<br>Arrival<br>Missed Approach | 250 ft/dot |

**FMS POS Monitor:** The FMS position comparison monitor provides an indication to the flight crew that there is a difference between the pilot and copilot FMS present position. The FMS position monitor is activated when the FMS position difference in nautical miles exceeds the RNP value. The FMS POS annunciation is displayed in amber on PFD.

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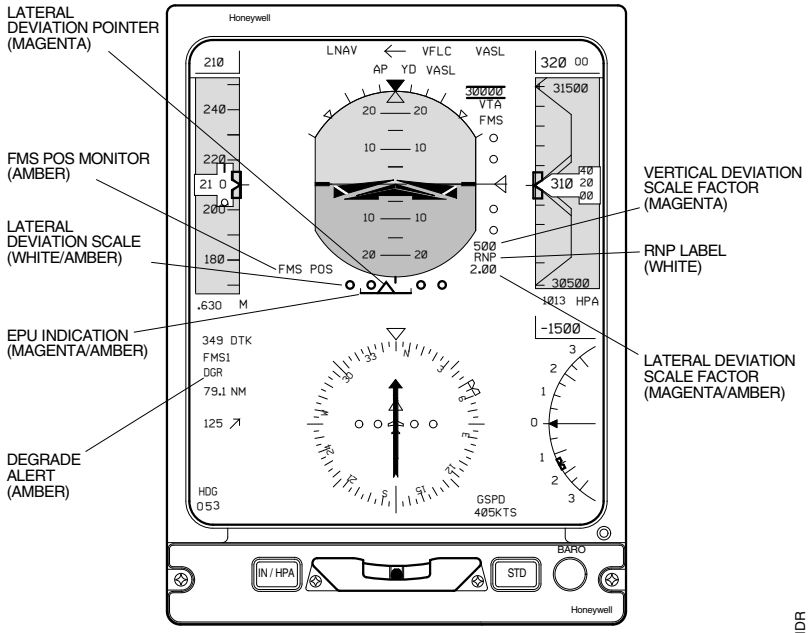
The RNP indications on PFD are illustrated in the following figure:




**RNP INDICATIONS ON PFD**

**Exceedance Indications:** When the EPU value is higher than the current applicable RNP value, the Lateral Deviation Scale, Lateral Deviation Scale Factor, EPU, and Lateral Deviation Pointer turn into amber and flashes for 5 seconds than become steady on PFD.

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An example of exceedance condition and indication in the following figures:

RNP = 1.0, EPU = 0.5, LAT DEV = 0.3

RNP = 1.0, EPU = 1.0, LAT DEV = 0

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**RNP SYMBOLOGY IN NORMAL AND EPU EXCEEDANCE CONDITIONS**

The same indications return to the original colors when the exceedance condition is not present anymore.

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# LOCALIZER PERFORMANCE WITH VERTICAL GUIDANCE (LPV) (AIRPLANES POST-MOD. SB145-34-0125)

Localizer Performance with Vertical Guidance (LPV) are approach procedures based on SBAS (Satellite-Based Augmentation System), also known by WAAS (Wide Area Augmentation System).

SBAS is intended to enable airplane to rely on GPS for all phases of flight, including precision approaches to any airport within its coverage area.

When LPV approach mode is active, the SBAS-enabled GPSs calculate the path deviations (lateral and vertical axes) which are displayed on the PFD.

The lateral and vertical deviation data for LPV approaches are the angular deviations of the airplane from the glide path for the approach defined by the Final Approach Segment (FAS) data block. The angular deviation is calculated from the Runway Threshold to simulate the angular deviation provided by an ILS glideslope. The FMS uses the lateral and vertical deviation data provided by the GPS to compute the lateral and vertical steering commands necessary for the guidance to capture and track the LPV path.

## LPV APPROACH LOADING

The LPV approach information is stored in the FMS Navigation Database (NDB) and is selected through FMS CDU.

When an LPV approach is available for a runway, the FMS indicates the SBAS/LPV approach in the CDU ARRIVAL page by displaying:

- The SBAS Channel,
- The Selected Approach Reference ID, and
- The ACTIVATE prompt.

The flight crew shall load the LPV approach to be flown and press the VNV button then press the APR button on guidance controller (GC-550) to arm and perform the LPV approach.

Once active, the LPV indications (status, lateral and vertical deviations) are removed only by performing a Go-Around or proceeding to land.

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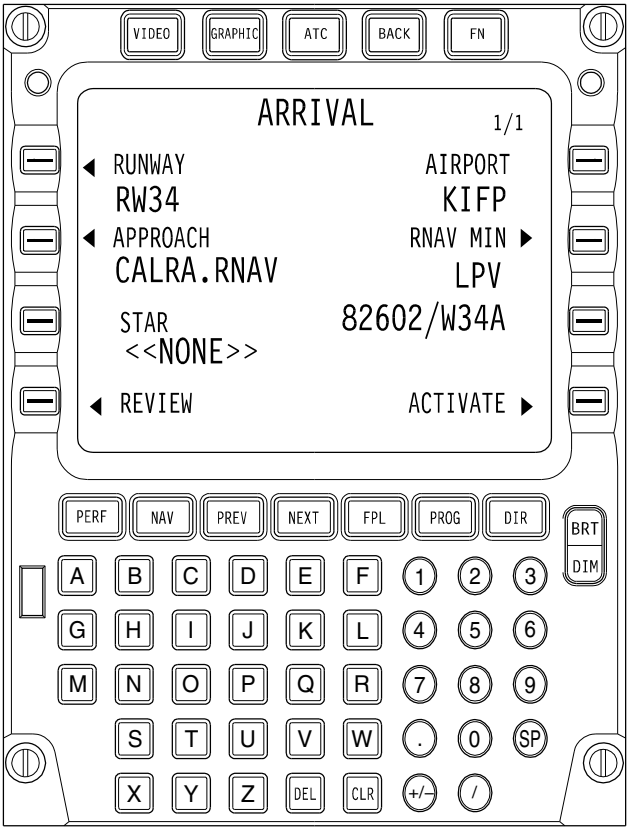


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**CDU ARRIVAL PAGE**

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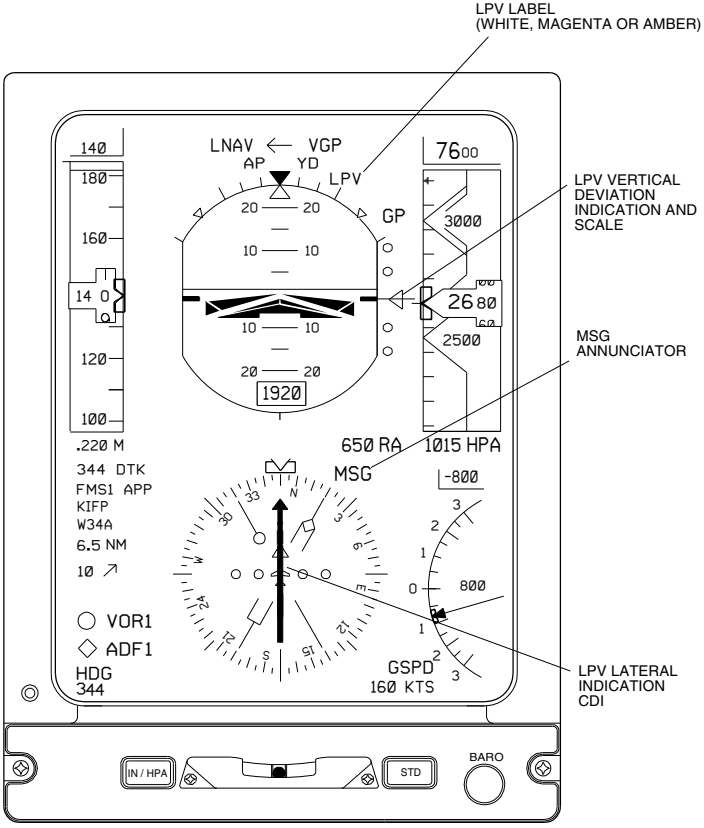
# LPV INDICATIONS

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**LPV INDICATIONS ON PFD**

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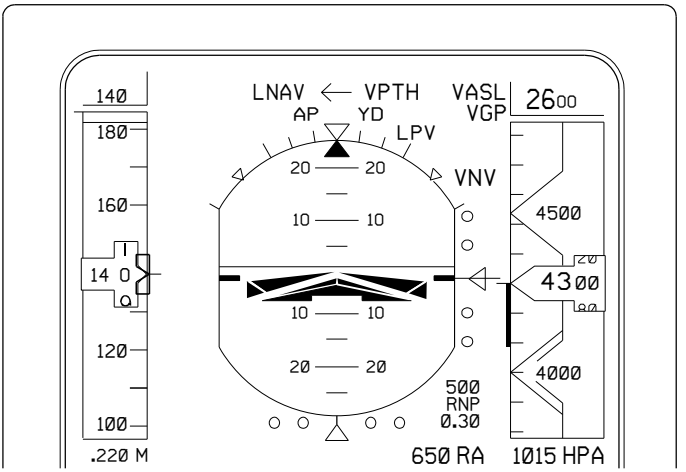
## LPV ARMED ANNUNCIATION

The LPV Approach Annunciation "LPV" is displayed in White, indicating LPV Armed, when the airplane is within 30 NM of the destination. No crew action is required in this mode.

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**LPV ARMED ANNUNCIATION**

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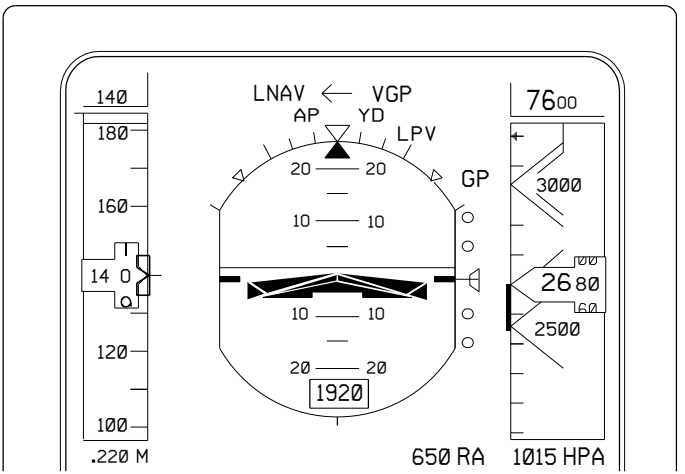
## LPV ACTIVE ANNUNCIATION

The LPV Approach Annunciator "LPV" is displayed in magenta, on PFD indicating LPV is active when the FMS sets the Approach annunciator approximately 2 NM before the Final Approach Fix (FAF). The magenta "LPV" annunciation flashes for 5 seconds and then remains steady.The LPV active indication alert the flight crew that the computed lateral and vertical deviations for the final approach segment are provided by the SBAS sensor.

When the LPV is Active, all RNP symbology (when applicable) is removed from the PFD.

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**LPV ACTIVE ANNUNCIATION**

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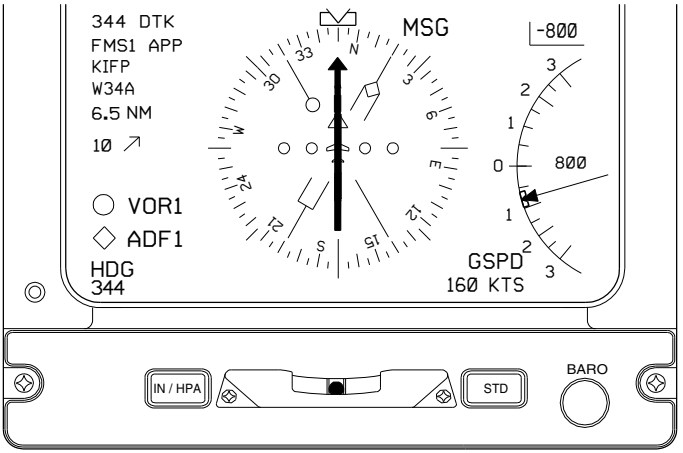
## FINAL APPROACH SEGMENT (FAS) DATA BLOCK

The Airport Identifier, Approach Reference ID, and the distance to the Runway Threshold are displayed in magenta when LPV is active, and positioned below the FMS APP annunciation in the lower left portion of the PFD.

The Channel Identifier is not displayed on the PFD. It is only presented in the arrival page in the CDU.

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**FAS APPROACH AND AIRPORT IDENTIFIER**

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## LPV UNAVAILABLE ANNUNCIATION

The LPV Approach Annunciator "LPV" is displayed in Amber on the PFD to indicate that the LPV approach is unavailable. When the LPV mode is unavailable, the annunciator turns Amber and flashes for 10 seconds and then remains steady. The Flight Director changes to basic mode (ROL and PIT).

If LPV status transitions to "Unavailable", the system displays the vertical deviation scale with a red-X, regardless of FMS vertical deviation data validity.

**NOTE:** Due to the system architecture, when the LPV becomes unavailable, the LPV amber indication and vertical deviation with Red-X may not be displayed (LPV indication is removed and Vertical deviation shows the Baro-VNAV linear deviations), however the flight director changes to basic mode.

If LPV is Unavailable on the Coupled PFD, AFCS disallows guidance panel selection of the APR or VNV buttons by the flight crew in order to prevent re-entry into VNAV.

When the "LPV" is unavailable, the flight crew needs to reload an approach with non-LPV minima. If already on approach, the flight crew needs to perform a missed approach.

It is possible to select the FMS1/GPS1 or FMS2/GPS2 as source for the Flight Director Guidance using the CPL pushbutton on the Guidance Controller Panel (GC-550). However, LPV indications will not be displayed if the navigation source is copied (FMS2 is selected on PFD1 or FMS1 is selected on PFD2).

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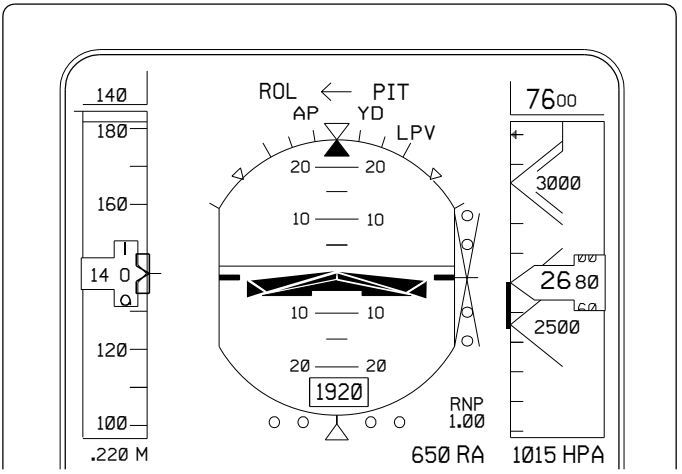


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## LPV UNAVAILABLE ANNUNCIATION ON PFD

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## LPV ALERTS AND ADVISORY MESSAGES

The following LPV Alerts/Advisory CDU scratchpad messages illuminate the "MSG" annunciator on the PFD. The conditions that generate the scratchpad messages are the following:

- **LPV UNAVAIL-USE LNV/VNV:** The LPV UNAVAIL-USE LNV/VNV message is displayed in white in the CDU scratchpad when:
  - The Approach Mode is "LPV Approach", and
  - All GPS are reporting SBAS invalid.

  The flight crew must select and use an approach with non-LPV minimum. If already on approach, perform a missed approach.

- **LPV UNAVAIL-LPV LOAD-1:** The LPV UNAVAIL-LPV LOAD-1 message is displayed in white in the CDU scratchpad when all the following conditions are met:
  - FAS data block message from FMS is not received by GPS (FAS data block transmission from FMS not successful).

  The flight crew must select and use an approach with non-LPV minimum. If already on approach, perform a missed approach.

- **LPV UNAVAIL-LPV LOAD-2:** The LPV UNAVAIL-LPV LOAD-2 message is displayed in white in the CDU scratchpad when either of the following conditions are met:
  - The SBAS Service Provider ID in the FAS Data Block does not match the SBAS Service Provider ID from the source selected GPS receiver, and
  - The Channel ID in the FAS Data Block does not match the Channel ID from the source selected GPS receiver.

  The flight crew may try to reload the approach a second time. If second try is not successful, select and use an approach with non-LPV minimum. If already on approach, perform a missed approach.

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### MISSED APPROACH FOLLOWING AN LPV APPROACH

During an LPV approach, a missed approach is selected by pressing the GA button or selecting the missed approach prompt on the CDU.

The following takes place when a missed approach is initiated:

- The FMS becomes the source for lateral and vertical deviation indications,
- The LPV approach status display is removed and;
- The FAS data block is cleared from memory.

### LPV INACTIVE STATUS

When an LPV approach is inactive, no "LPV" annunciation is displayed on the PFD. LPV inactive provides indication to the crew that the LPV approach is either not loaded (if an LPV approach was not selected on the CDU), or that the distance to destination for the loaded LPV approach is greater than 30 NM.

If, for any reason, the LPV is operationally not available or operationally not allowed to be used, the pilot will need to select RNAV MIN at Line Select Key (LSK) 2R, and then select a different type for the approach with non-LPV minima.

## EGPWS MODE 5 ALERTING

An EGPWS Mode 5 alerting for the LPV Approach is also generated in case of an excessive downward vertical deviation within the mode 5 alerting window.

## LPV MISCOMPARE MONITORS

The LPV system incorporate lateral and vertical deviation miscompare monitor that will check for miscomparisons between displayed deviation data on each PFD, where a miscompare results in an amber alert message on the PFD.

If either the LPV lateral deviation or the LPV vertical deviation miscompare monitor trip, the annunciation GPS in amber will be displayed in the same location as the existing LOC/GS/ILS indications on the PFD (for the localizer/glideslope comparison monitors).

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# HEAD-UP GUIDANCE SYSTEM (HGS)

The HGS is an electronic and optical system that generates and displays information in the pilot's forward field of view. This displayed information is derived from the airplane's instruments and sensors. The system provides information during all flight phases, including low visibility takeoff, approach and landing in Category IIIa limits. For additional information on functions and operations, refer to the manufacturer's manual.

HGS symbology has been optimized for full flight routine use and provides speed, altitude, heading, navigation data, wind speed and direction, flight path and other information to the pilot, in symbolic format, that is superimposed on the pilot's view. The HGS also provides guidance cues for low-visibility takeoff and CAT IIIa approach and landing operations, reducing delayed takeoffs and/or landing diversions due to reduced visibility conditions.

The HGS provides the following display functions:

- Primary Flight Display (PFD), which is similar in form and function to the existing PFD on the airplane's main panel;
- Category IIIa approach display which provides HGS-calculated approach and flare guidance;
- Approach display that repeats the airplane Flight Director guidance during CAT I and CAT II approaches;
- Visual approach display for use during a VFR approach;
- Low-visibility takeoff display, with all the symbology required for this mode of operation;
- Test display available for Test Mode.

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The HGS interfaces with the following airplane systems and equipment:

- Inertial Reference System (IRS 1) for primary attitudes, heading, body acceleration, body rates, vertical speed and ground speed;
- Attitude and Heading Reference System (AHRS 2) or IRS 2 for comparison with IRS 1 data;
- One or two Global Positioning Systems (GPS) for ground speed and true track data;
- Two Air Data Computers (ADC) for barometric altitude and airspeed data;
- Two VHF/NAV receivers for ILS data plus a third (ILS 3) to serve as a monitor;
- Two Radar Altimeters (RA) for altitude above ground data and decision height selection;
- Flight Guidance System (FGS) for Flight Director command signals from the Honeywell PRIMUS 1000 system;
- FGS Control Panel for selected course, heading, airspeed, vertical speed and altitude settings;
- Distance Measurement Equipment (DME) for distance from station data;
- One or two Automatic Direction Finding (ADF) sensors for bearing to station;
- Traffic Alert and Collision Avoidance System (TCAS) for resolution advisory data;
- Ground Proximity Warning System (GPWS or EGPWS) for windshear and terrain warning data;
- One or two Flight Management Systems (FMS) for LNAV and VNAV data;
- Stall Protection Computer (SPC) for AOA data.

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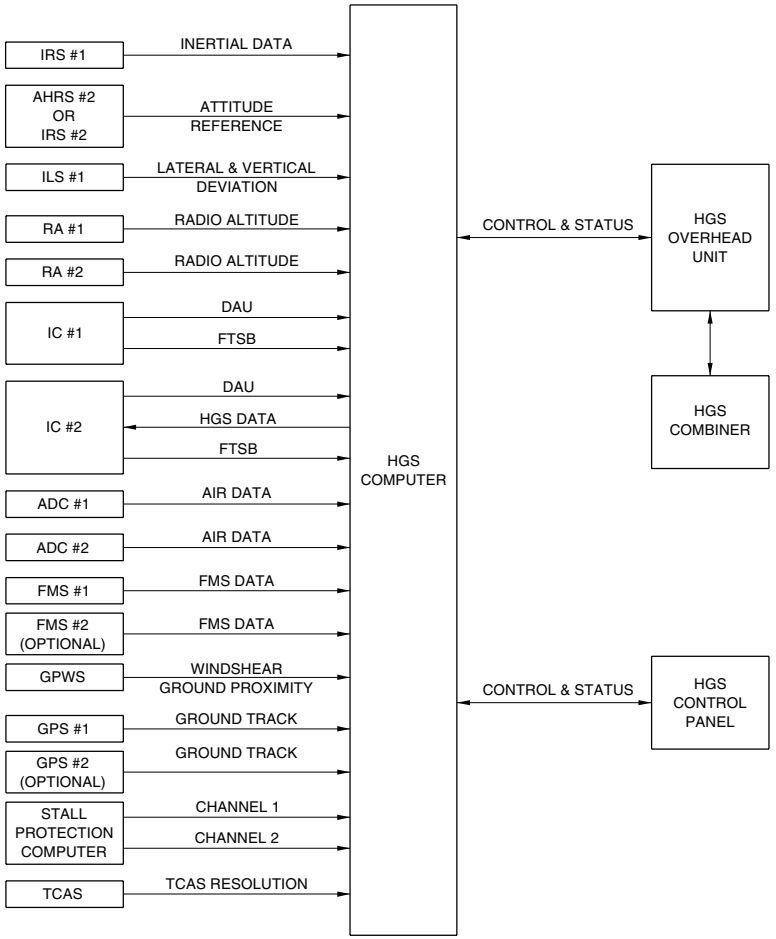


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## HGS INTERFACES WITH OTHER SYSTEMS

# HGS COMPONENTS

## HGS COMPUTER

The HGS Computer receives input signals from other airplane sensors and generates a symbology set that is transmitted to the Overhead Unit. The displayed symbology depends on the selected mode of operation. During AIII mode approaches, the HGS Computer monitors the approach performance and displays appropriate messages to the pilot and on the Primary Flight Displays (PFD).

The HGS Computer is located in the forward avionics bay and is powered by the DC Bus 1.

## HGS CONTROL PANEL (HCP)

The HCP is used for setting glideslope angle, runway length and elevation, and for selecting HGS active and standby modes of operation. It also provides an indication of the system's ability to provide Cat IIIa guidance.

Powered by the DC Bus 1, the HCP is located in the center pedestal and is available to both pilots.

Display luminescence is controlled automatically and based on existing ambient light. An ambient light sensor mounted on the front panel of the HCP measures the ambient light conditions and provides the necessary input to the internal circuits that control the display luminescence.

## OVERHEAD UNIT (OHU)

The OHU generates flight symbology on a cathode ray tube (CRT) and optically projects the symbology onto the Combiner. The OHU is located above the pilot's head in a position that provides the proper spatial relationship in relation to the Combiner and the airframe. This relationship permits various symbols, such as the artificial horizon, to overlay the corresponding features of the outside scene.

The OHU is powered by the DC Bus 1.

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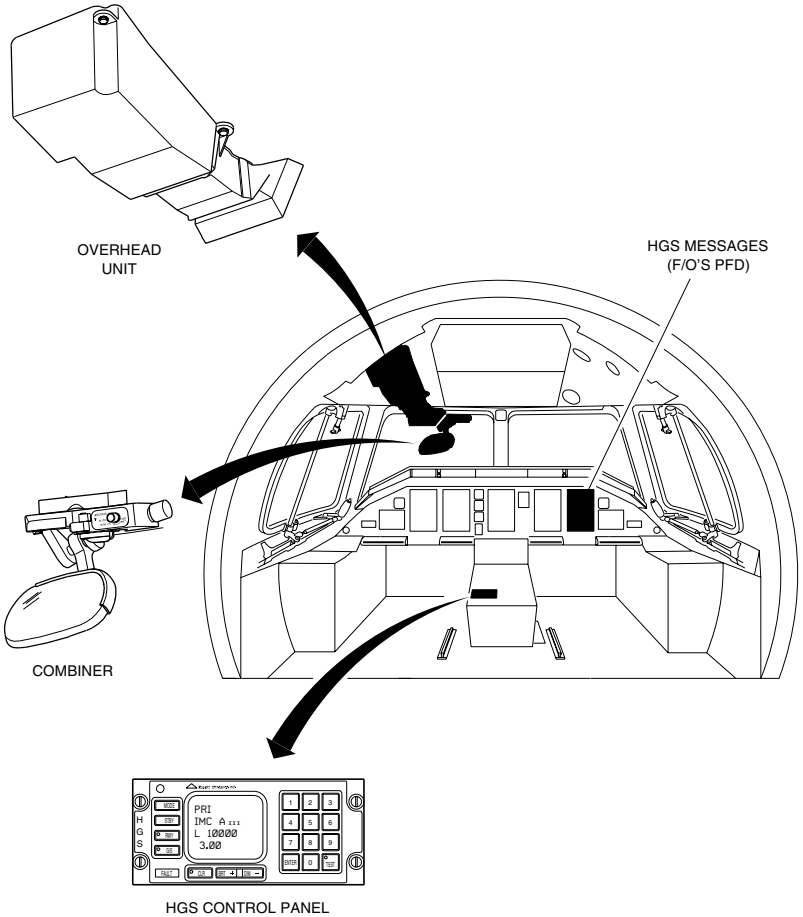


HGS CONTROL PANEL

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## HGS COMPONENTS

## COMBINER

The Combiner is a reflective optical element which visually combines displayed flight symbology with the pilot's view through the airplane windscreen by reflecting the symbology image projected from the OHU, permitting the system symbols to overlay the corresponding features of the outside world.

It is provided with the means to adjust symbology brightness and selecting a manual or automatic mode of brightness control. The Combiner is attached to upper sill beam structure of the left forward windscreen.

The Combiner has three positions: stowed, operating, and breakaway:

- Stowed: when the HGS is not in use, the Combiner may be stowed out of the pilot's field of view. To stow the Combiner, press the release lever, grasp the Combiner by the edges and rotate it aft and up to the stow position.
- Operating: when conducting HGS operations, the Combiner is placed in the detented operating position. Press the release lever and rotate the Combiner to the operating (detent) position.
- Breakaway: when in the operating position, the Combiner has a breakaway feature that allows the Combiner to rotate toward the windscreen if there is a sudden deceleration of the airplane. To move the Combiner from the breakaway position, press the release lever and pull the Combiner back to the operating or stow position.

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# HGS MODES OF OPERATION

The HGS has four operational modes: Primary (PRI), Instrument Meteorological Conditions (IMC), Visual Meteorological Conditions (VMC) and AIII approach (used for CAT IIIa operations).

These modes can be selected at any time with the exception of AIII which is available only after ILS capture.

**PRIMARY MODE**

The HGS Primary (PRI) mode can be used during all flight phases, from takeoff to landing. This mode allows low-visibility takeoff operations, all enroute operations, and approaches to CAT I or II minimums using FGS Flight Director guidance.

The HGS Primary mode display is very similar to the Primary Flight Display (PFD) thus easing the Pilot's transition from flying under head-down instruments condition to head-up flying. The Primary mode display includes the following symbolic information:

- Airplane Reference (boresight) symbol;
- Pitch - scale and horizon relative to boresight;
- Roll - scale and horizon relative to boresight;
- Heading - horizon, HSI and digital heading display;
- Speeds - CAS (tape), vertical speed, ground speed, speed error tape;
- Altitudes - barometric altitude (tape), digital radio altitude;
- Flight Path (inertial);
- Flight Path acceleration;
- Slip/Skid Indicators;
- FGS Flight Director (F/D) guidance cue and modes;
- Flight Director armed and capture modes;
- Navigation data - ILS, VOR, DME, FMS, marker beacons;
- Wind - speed and direction;
- Selected parameters - course, heading, airspeed and altitude;
- Miscompare Annunciations and Failure Flags.

When the airplane is on the ground, several symbols are removed or replaced in order to provide guidance for the Low Visibility Takeoff. After takeoff rotation has been reached, the full, in-flight set of symbols is restored.

The Primary mode can be selected at the HCP or by pressing the throttle go-around button during any mode of operation.

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LOW-VISIBILITY TAKEOFF

The Primary mode includes special symbology used for a low-visibility guided takeoff that provides guidance information that supplements visual runway centerline tracking and enhances situational awareness.

The low-visibility takeoff display and Ground Roll Guidance Cue are automatically provided to the pilot once the following conditions have been established:

- Primary mode selected;
- IRS in NAV mode;
- All NAV receivers tuned to same ILS frequency;
- Runway length set between 6000 and 13500 ft;
- Selected heading bug set to runway heading;
- Selected course set to runway heading or approach course.

**NOTE:** Misleading/removal of the guidance is not annunciated. Safe operation in this condition was demonstrated and is predicated on the pilot's ability to see external visual references.

**AIII MODE**

The HGS AIII mode is designed for precision, manual ILS approach and landing operations to CAT IIIa minimums. Additionally, the AIII mode can be used for CAT II approaches.

During a Category IIIa approach, the HGS monitors its capability to provide accurate guidance and airplane deviation from the desired approach path. If this monitor indicates that the system is incapable to provide accurate guidance, it is removed from the display and a capability loss indication is annunciated. If the monitor indicates that the airplane is on an unacceptable approach path, the HGS displays a clear indication that a go-around should be performed.

The AIII display is de-cluttered by removing the altitude and airspeed tape displays and replacing with digital values in order to maximize visibility. The HSI is also removed, with raw ILS data (localizer and glideslope deviation) being displayed in proximity to the flight path group around the center of the display. In the AIII mode, guidance information is shown as a circular cue whose position is calculated by the HGS.

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Prior to an ILS capture, the ability of the HGS to calculate and display AIII approach guidance is indicated when "AIII" is displayed on the right half of the HCP Standby display line. This display indicates that the HGS' equipments and related sensors are operating normally and in the correct mode, with the flight deck configuration ready for the approach. The system conditions that must be met in order to achieve AIII capability include:

- IRS in NAV mode;
- AHRS 2 in Full Performance mode;

  **NOTE:** AHRS is not applicable in case of dual IRS installation.
- All reversion selections in NORMAL position;
- All NAV receivers tuned to same ILS frequency;
- Basic attitude (pitch, roll, heading) data from dual sources within defined limits;
- All sensors/input data valid and no HGS BIT faults present.
- Radio altitude greater than 500 ft;
- Glideslope set between -2.50° and -3.00°.

AIII mode becomes available for selection when the above listed conditions are satisfied and the Approach On Course (AOC) logic law is met. Approach On Course logic depends on the following conditions:

- Flight Director Lateral Capture Mode indicates LOC and FD Vertical Capture mode indicates GS;
- No Localizer and Glideslope deviation for a period of 5 seconds;
- Difference between IRS Magnetic Track and the Selected Course 1 less than 15°.

When AOC logic is satisfied and all required systems are operating properly, the HGS will automatically annunciate on the Combiner and HCP that the AIII mode is available for selection. This is indicated by "AIII" flashing on the Combiner in the upper left portion and an "AIII" displayed on the left half of the HCP Standby line.

The AIII mode must be selected before the airplane descends below 500 ft above the runway elevation. If not selected, the "AIII" indication will be reverted to "IMC". The flashing "AIII" on the Combiner will disappear.

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Once AIII mode is active, any sensor or equipment condition that results in a loss of AIII capability causes a boxed "NO AIII" status to flash for five seconds on the Combiner and on the HCP MODE line. An amber “AIII” indication is displayed on the F/O’s PFD.

If either the AIII capability is lost ("NO AIII" status) or the airplane approach or flare performance does not ensure a safe touchdown within the required touchdown zone, the HGS provides an "APCH WARN" (Approach Warning) annunciation on the Combiner and a red “APCH WARN” indication on the F/O's PFD. An approach out-of-tolerance condition by itself will result in the "APCH WARN" annunciations, but will not cause the loss of AIII status. If a "APCH WARN" annunciation is displayed in low-visibility conditions, a missed approach procedure must be performed.

Flare initiation is indicated with the FLARE annunciation on the Combiner display and on the F/O’s PFD. The flare maneuver is designed to transition the airplane from approach attitude to touchdown attitude while maintaining positioning and performance requirements that meet touchdown criteria for CAT IIIa landings. This includes continuing to track the runway localizer and establishing an acceptable touchdown sink rate while refraining from long landings. In order to reduce the longitudinal touchdown distance, an “IDLE” annunciation is displayed on the Combiner while the F/O’s PFD alerts the crew to adjust thrust settings.

Following touchdown, the display changes to remove unnecessary symbology in order to assist the landing rollout. This includes changing the localizer symbol to the Ground Localizer Scale and Index. The centerline is tracked while the airplane is decelerated to exit the runway.

**IMC MODE**

The IMC mode allows FGS Flight Director approaches to be flown in the same approach display format as the HGS AIII approach mode. Altitude and airspeed data are displayed as digital values and raw navigation data is displayed in close proximity to the Flight Path group.

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For an IMC approach, the display information is the same as in the AIII mode except:

- The guidance cue is derived from the FGS and is removed from the display at 90 feet Radio Altitude (CAT II) or 150 feet AGL (CAT I);
- Flight director modes are displayed;
- The IMC mode is annunciated;
- No approach monitoring or flare guidance is provided by the HGS. However, flare cues (" + + ") are displayed to alert the pilot.

The IMC mode may be used during any conventional Flight Director approach that is approved for the basic airplane or the operator's Operations Specification (e.g., a CAT I Flight Director ILS approach).

The IMC mode is an alternate approach mode primarily intended for autopilot flight director approaches. Flight director guidance is displayed in IMC mode as long as the flight director pitch and roll commands are valid.

Once on the ground, the Ground Localizer Scale and Index is displayed as in the Primary mode.

**VMC MODE**

The VMC mode is intended for visual approach operations. No guidance is displayed in this mode. The VMC mode is intended to enhance the visual approach operation by allowing the pilot to establish and maintain the airplane on the proper glide path to the runway without reference to a ground based landing system (ILS, VASI, etc.). In a VMC mode approach, Flight Path is used to control the approach to the runway visually. This is particularly beneficial during nighttime approaches or approaches with poor visual cues.

The VMC mode provides approach symbology in the same format as the AIII and IMC modes, however, navigation data is not displayed.

Flare and landing in the VMC mode is accomplished by using normal visual procedures. Between 55 feet and 10 feet, the flare cue symbols " + " are displayed above the Flight Path symbol wings.

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## COMBINER ALIGNMENT

During an IMC or VMC approach, it is expected that the final approach will be completed visually. The proper mechanical alignment of the Combiner is critical during visual operations. The Combiner's operating position is monitored by a Combiner Alignment Detector (CAD) to determine if the Combiner is within allowable position tolerances while in the IMC or VMC mode. If its position is outside specified tolerances, an "ALIGN HUD" annunciation is displayed on the Combiner. For Combiner alignment, push it forward slightly out of the operating position and allow the Combiner to return to its position. Alternatively, apply slight pressure either fore or aft on the Combiner until the annunciation is removed.

## UNUSUAL ATTITUDE

The HGS Unusual Attitude display is designed to aid the pilot in recognition of and recovery from unusual attitude situations. The Unusual Attitude (UA) symbology is automatically activated or deactivated based upon the attitude of the airplane. When activated, the UA display replaces the currently selected operation mode symbology. The UA display is not annunciated on the HCP, that continues to display the currently selected operational mode which will be re-activated once the airplane is returned to a normal attitude.

The UA symbology is automatically activated under any of the following conditions.

- The FGS changes to the unusual attitude display mode;
- Pitch angle less than -20º or greater than +30º;
- Roll angle less than -65º or greater than +65º.

## TCAS RESOLUTION ADVISORY

TCAS Resolution Advisories (RA) alert the pilot regarding conflicting air traffic by indicating a potential threat (Preventive Advisory) or threats that require a vertical evasive maneuver (Corrective Advisory) in order to maintain safe vertical separation. The HGS provides TCAS Resolution Advisories from the TCAS computer that correspond with the indications displayed on the head down Traffic Advisory/Vertical Speed Indicator (TA/VSI).

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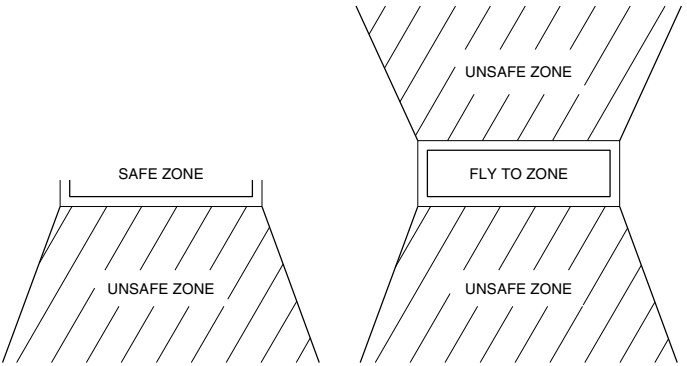
TCAS Resolution Advisory symbols are added to the symbology set defined by the HGS active mode. A double-line bracket or box, laterally aligned with the Flight Path symbol, identifies the safe (fly to) zone. Angled lines extending from the corners of the unsafe side of the bracket or box identify the unsafe zone. Whenever the airplane flight path is in an unsafe zone, the angled lines flash on and off until the Flight Path is positioned within the safe zone.

Preventive Advisories are displayed on the HGS as a double-line bracket with two angled lines extending from the corners on the unsafe side of the bracket. The Preventive Advisories do not require any action be taken by the crew to alter the flight path of the airplane, but indicate an unsafe zone.

Corrective Advisories are displayed on the HGS as a double-line box and require as immediate vertical evasive maneuver. The advisory command is to climb or descend until the Flight Path is positioned within the box (fly to zone) or remains on the safe side of the box.

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**TCAS SAFE/UNSAFE ZONES**

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## HGS EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| CAUTION | HGS FAIL | Failure in the HGS system. |
| ADVISORY | AIII NOT AVAIL | The AIII approach mode is not available. |

## HGS CAPABILITY TEST

This test verifies the HGS capability to perform the AIII mode.

To execute this test, press the TEST button on the HCP and select the first option “HGS CAPABILITY” in the HGS TEST MENU displayed on the Combiner. In case of no AIII capability detected, the faults will be displayed on the Combiner.

If the system is capable of performing the AIII mode, “AIII” is displayed on the left side of the Combiner while “NO CAPABILITY FAULTS DETECTED” is displayed on the right side.

## HGS CONTROLS AND INDICATORS

### HGS CONTROL PANEL (HCP)

#### 1 - NUMERICAL KEYPAD

- Used to enter runway (length, elevation) and glideslope data.

#### 2 - DISPLAY SCREEN

- Displays, from the top to bottom:
  - The active HGS (PRI, IMC, VMC or AIII) mode.
  - The selected standby mode.
  - The selected runway length or elevation.
  - The selected angle for approach.

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**3 - AMBIENT LIGHT SENSOR**

- Senses the lighting conditions around the control panel and maintains the display screen intensity set by the BRT+ and DIM- keys.

**4 - HGS OPERATIONS MODE SELECTOR BUTTON**

- Selects the mode of operation shown on the standby display line as the active mode.

**5 - STANDBY MODE SELECTOR BUTTON**

- Shows available modes.

**6 - RUNWAY DATA ENTRY SELECTOR BUTTON**

- Activates Runway Data Entry mode to enter the runway elevation or length.

**7 - GLIDESLOPE DATA ENTRY SELECTOR BUTTON**

- Activates the Glideslope Data Entry mode to enter the glideslope angle.

**8 - FAULT ANNUNCIATOR LAMP**

- Indicates a fault in the critical processing path detected by the HGS' built-in test (BIT) function.

**9 - CLEAR FUNCTION SELECTOR BUTTON**

- Press to clear symbology from Combiner display. Press again to display symbology. During data entry, button is used as backspace and in the TEST mode, used to navigate the displayed menus.

**10 - DISPLAY SCREEN INTENSITY CONTROLS**

- The BRT+ button increases display intensity and the DIM- button decreases intensity.

**11 - ENTER BUTTON**

- Used to enter desired runway and glideslope values. In TEST mode, selects items in the Test Menu.

**12 - HGS TEST BUTTON**

- With the airplane on the ground, starts or stops HGS test functions and displays.

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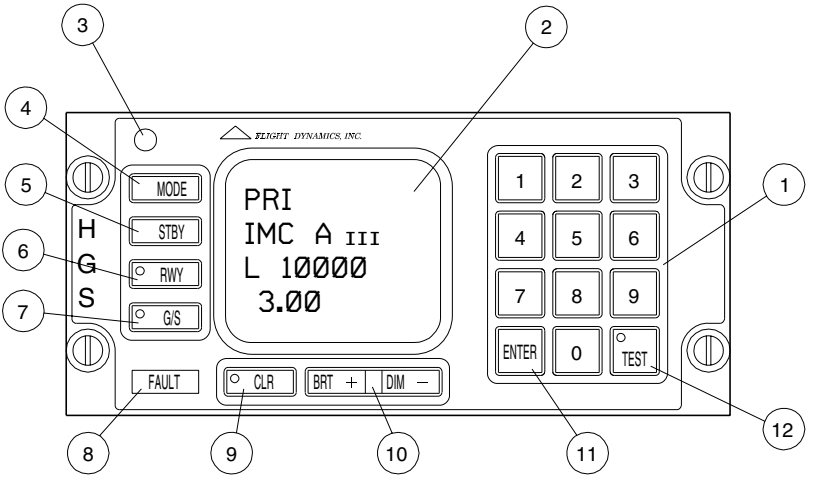


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## HGS CONTROL PANEL (HCP)

### COMBINER

**1 - BRIGHTNESS CONTROL KNOB**

- Press the knob in to select MANUAL brightness mode.
  - Rotating the knob clockwise increases display intensity. Rotating counterclockwise decreases display intensity. In this mode the intensity remains constant at the level selected by the pilot.
- Pull the knob out to select AUTOMATIC brightness mode.
  - The pilot adjusts display to desired brightness level as described above and OHU automatically changes it to maintain a constant contrast ratio.

**2 - RELEASE LEVER**

- Press the Release Lever to unstow Combiner.

**3 - AMBIENT LIGHT SENSOR**

- Monitors the external lighting conditions to the Automatic Brightness Control.

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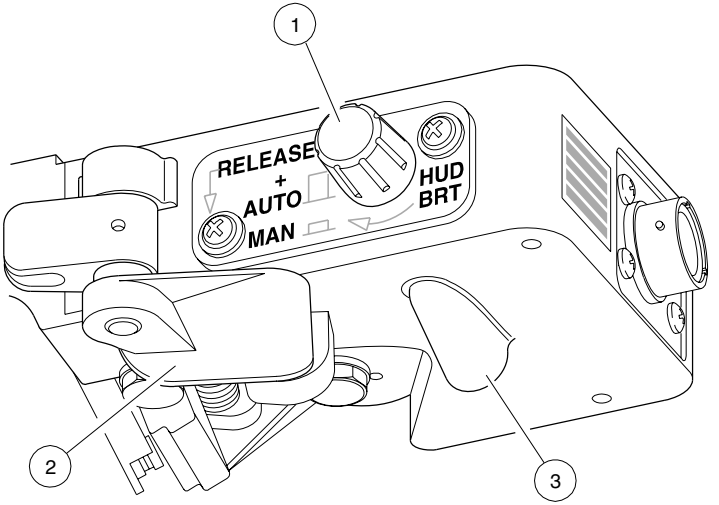


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## COMBINER CONTROLS AND SENSORS

### FAULTS AND ANNUNCIATIONS

Failure Flags are displayed for invalid sensor statuses and miscompares between certain similar parameters. These are generally indicated by boxed annunciations for the affected parameters, and in the case of a failure, the removal of all symbols related to the fault.

Flags are provided for the following failures, miscompares or alternate data sources:

**NOTE:** For dual IRS system configuration, the AHRS2 references below would be replaced by IRS2.

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**ADC1 (2)** - Indicates the selected ADC source. “ADC1” indicates that ADC1 is selected as both Pilot’s and Copilot’s ADC source. “ADC2” indicates that ADC2 is selected as the Pilot’s ADC source. Positioned in upper left portion of the display.

**ALT** - **Horizontal Indication**. Indicates Barometric Altitude failure. Indicated by boxed characters replacing the Altitude Scale in Primary Mode, and replacement of Digital Altitude readout in digital modes.

**ALT** - **Vertical Indication**. Indicates Barometric Altitude miscompare. Indicated by boxed characters vertically positioned at the upper right portion of the altitude scale in Primary Mode. In all other modes, boxed “ALT” is vertically positioned at the right side of the display.

**ATT/ROL/PIT** - Indicates IRS / AHRS2 Pitch or Roll miscompare, or a AHRS1 / AHRS2 Attitude miscompare. Indicated by boxed “PIT”, “ROL”, or “ATT” characters respectively, beneath the left side of the roll scale.

**ATT FAIL** - Indicates IRS Pitch or Roll (Attitude) failure or AHRS2 Pitch/Roll failure. Indicated by boxed characters on the upper portion of the display.

**FD FAIL** - Indicates Flight Director failure. Positioned in the top center portion of the display.

**G/S** - Indicates Glideslope Deviation failure. Indicated by boxed characters vertically aligned, replacing the Vertical Deviation Scale and Index.

**GS** - Indicates Glideslope miscompare. Indicated by boxed characters to the right of the display center.

**HDG** - Indicates IRS / AHRS2 Heading miscompare or AHRS1 / AHRS2 Heading miscompare. Indicated by boxed characters in the lower left portion of the display.

**HDG FAIL** - Indicates IRS Heading failure or AHRS2 Heading failure. Indicated by boxed characters in the lower center portion of the display. In Primary mode, this flag is positioned in the center of the HSI.

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**IAS** - **Horizontal Indication**. Indicates Computed Airspeed failure. Indicated by boxed characters replacing the Airspeed Scale in Primary Mode, and replacing the Digital Airspeed in digital modes.

**IAS** - **Vertical Indication**. Indicates Computer Airspeed miscompare. Indicated by boxed characters vertically positioned at the top left portion of the airspeed scale in Primary Mode. In all other modes, boxed “IAS” is vertically positioned at the left side of the display.

**LOC/FMS/VOR** - Indicates Lateral Deviation failure. Indicated by boxed characters “LOC”, “FMS”, or “VOR”, corresponding to the selected navigation source, in the lower center of the display.

**LOC COMP** - Indicates Ground Roll Localizer miscompare, during a low-visibility takeoff. Indicated by boxed characters and removal of the ground localizer pointer.

**LOC/ILS** - Indicates Localizer miscompare. Indicated by boxed characters in the lower left portion of the display.

**RA** - **Center**. Indicates all Radio Altitude failure.

**RA** - **Lower Left Portion**. Indicates Radio Altitude miscompare. Indicated by boxed characters in the lower left portion of the display.

**RA1** - Radio Altitude source is RA1 and RA2 is failed. Indicated by boxed characters in the lower left portion of the display.

**RA2** - Radio Altitude source is RA2 and RA1 is failed. Indicated by boxed characters in the lower left portion of the display.

**RWY LEN** - Indicates Runway Length Out of Range. Indicated by boxed characters displayed beneath the Runway Length for five seconds.

**SG1 (2)** - Indicates the Symbol Generator Source selected. “SG1” indicates that SG1 is selected as both Pilot’s and Copilot’s SG source. “SG2” indicates that SG2 is selected as the Pilot’s SG source. Positioned in upper left portion of the display.

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**TCAS FAIL** - Indicates TCAS failure. Indicated by boxed characters displayed in the lower center portion of the display.

**NOTE:** In case the operating Transponder fails, the "TCAS FAIL" flag will not be displayed on the Combiner.

**VNAV** - Indicates Vertical Deviation failure. Indicated by boxed characters "VNAV" (Vertical Navigation) replacing the vertical deviation scale.

**VS** - Indicates Vertical Speed failure. Indicated by boxed characters replacing the Vertical Speed Data.

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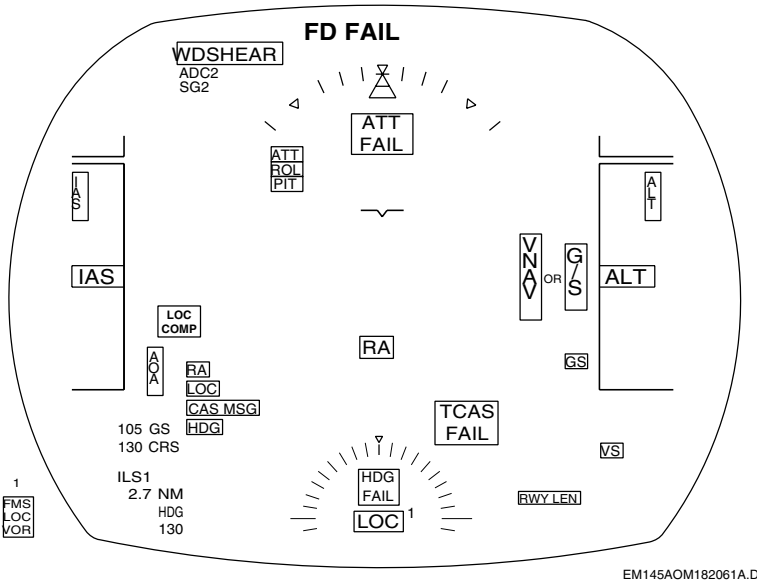


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**FAILURE FLAGS AND DATA MISCOMPARE INDICATIONS**

# IDENTIFICATION FRIEND OR FOE SYSTEM (IFF)

The Mode-S/IFF Transponder System integrates military IFF functions and civilian Mode-S/ATCRBS surveillance functions into a single system.

The IFF system is a cooperative surveillance system designed to classify airborne targets as friendly or hostile. It employs ground-based and airborne interrogations and transponders.

A key feature of the Mode-S system that distinguishes it from ATCRBS is that each airplane is assigned a unique address code. Using this unique code, interrogations can be directed to a particular airplane and replies can be positively identified. Channel interference is minimized because a sensor can limit its interrogations to targets of interests. By proper timing of interrogations, replies from closely spaced airplane can be received without mutual interference.

The Mode-S/IFF Transponder System consists of the following major components: one Mode-S transponder, one Mode-S/IFF transponder, Mode-S/IFF control panel, one selector panel and top and bottom antennas.

The transponder is capable of receiving/transmitting signals through any one antenna, thus inhibiting the shadow effect caused by the airplane structure while maneuvering. The reply signal provides an identity, an altitude, an identification position, or an emergency message. The Mode-S/IFF transponder operates in Mode 1, 2, 3/A, C and S, the system receiving interrogations on 1030 MHz and transmitting on 1090 MHz.

Avionics Master DC Bus 2A powers the Mode S/IFF transponder and there is a 7.5 A circuit breaker for power wiring protection. The Mode-S/IFF Transponder System will not operate in the event of either a failure in the control panel or in the event of an electrical/generator failure.

The transponder reply-transmit capability is disabled when the system is in STANDBY mode. The Weight-On-Wheels (WOW) circuitry disables the ATCRBS' transponder reply capability while the airplane is on the ground. However, the air/ground switch does not disable Mode-S transponder replies and airplane status is included in the Mode-S/IFF transponder reply data.

For airplanes Post-Mod. SB 145-34-0089 or SB 145BAF-34-0006 or equipped with an equivalent modification factory incorporated, the Mode S Elementary Surveillance Transponder transmits the following parameters:

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- Airplane Identification (Call Sign);
- Transponder Capability Report;
- Flight Status (airborne/on the ground);
- Pressure Altitude (minimum resolution: 100 ft (Gillham's code) or 25 ft as provided by the source).

This facilitates an increase in the safety and efficiency of the ATM (Air Traffic Management) operations.

For airplanes equipped with Mode S Enhanced Surveillance Transponder (Post-Mod. SB 145-34-0096 or Post-Mod. SB 145BAF-34-0007 or equipped with an equivalent modification factory incorporated), in addition to the characteristics of the Mode S Elementary, the following Downlink Airplane Parameters (DAP) are transmitted automatically to be used by the ground Air Traffic Management:

- Magnetic Heading;
- Indicated Airspeed and/or Mach Number;
- Vertical Rate;
- Roll Angle;
- True Airspeed;
- True Track Angle;
- Ground Speed;
- Selected Altitude.

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## SELECTOR PANEL

The selector panel, on the main control panel, provides the means for the flight crew to select either the Mode-S on transponder 1 or the Mode-S/IFF transponder, according to mission requirements at that particular moment.

The Mode-S/IFF transponder will be used normally in the mission area.

### 1 - IFF POSITION

Selects the Mode-S/IFF transponder. All indications on the RMU pages are related to the transponder 1 system and TCAS functions will be dashed. In this case all TCAS II operations is made through the Mode-S/IFF control panel.

### 2 - XPDR POSITION

Selects the Mode S transponder. Both Mode-S/IFF transponder unit and Mode-S/IFF control panel are turned off.

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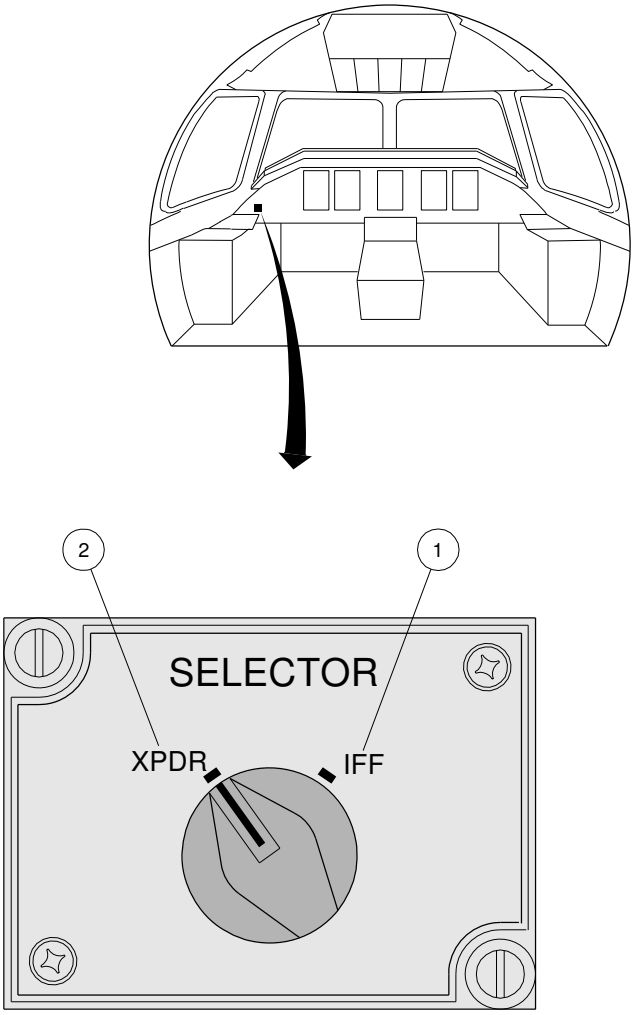


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**TRANSPONDER SELECTOR KNOB**

# IFF TRANSPONDER CONTROLS AND INDICATORS

The Mode-S/IFF control panel is located on the control pedestal and allows the selection of the Mode-S/IFF transponder operation modes (Off, Standby, Normal and Emergency), selection of interrogation and reply modes (1, 2, 3/A, C and S), and selection of codes.

## 1 - DISPLAY SELECT ROTARY KNOB

The Mode-S/IFF control panel has a six position rotary knob to select the different display modes.

MODE 1: Selecting “1” with the DPL SEL knob enables Mode 1 display and keypad entry mode.

MODE 2: Selecting “2” with the DPL SEL knob enables Mode 2 display and keypad entry mode.

MODE 3/A: Selecting “3A” with the DPL SEL knob enables the Mode 3/A display and keypad entry mode.

MODE S: Selecting “S” with the DPL SEL knob enables the Mode S display and keypad entry mode.

FLIGHT ID: Selecting “FLT ID” with the DPL SEL knob enables FLIGHT ID display and keypad entry mode.

The Mode-S Airplane Identification Subfield (AIS) allows the operator to select the airplane Flight ID to be downlinked as part of Downlink Format (DF) message 20 and 21 from the control panel. The Mode S Flight ID is typically the airplane flight number or airplane registration number.

STAT: Messages from the transponder are displayed on the LCD only if the STAT position in the DPL SEL knob is selected. Transponder messages have he lowest priority after transponder failure indications. When a new transponder message is received by the control panel, the “GO” annunciator illuminates.

## 2 - ALPHA-NUMERIC CHARACTER LCD

The Mode-S/IFF control panel has an eight alphanumeric character, liquid crystal display. The display has white characters on a black background.

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### 3 - GO ANNUNCIATOR

The Mode-S/IFF control panel has a dead front green light GO annunciator to indicate no failures in the system or to indicate a new transponder message has been received by the control panel.

### 4 - NO-GO ANNUNCIATOR

The Mode-S/IFF control panel has a dead front amber light NO-GO warning annunciator to indicate system failure.

### 5 - TEST BUTTON

The TCAS/IFF control panel is provided with a momentary push-button test to activate the System Functional Test.

The Mode-S/IFF Transponder System test may be accomplished with the Mode/TCAS rotary knob in the TA or TA/RA position and pressing the TEST push button. In addition, the TCAS is tested when the test is performed.

Pressing the TEST push button the Mode-S/IFF control panel starts a lamp test, turning all front panel's LCD indicators segments on. Additionally, a control panel self-test is performed when the TEST push button is pressed for more than five seconds.

### 6 - MASTER CONTROL KNOB

The Master Control knob has OFF, STBY, NORM, and EMER positions. A mechanical interlock prevents inadvertent switching to either EMER or OFF positions.

OFF: In the OFF position all primary power supplies are removed from the system, except control and lighting circuits.

STANDBY: In the STBY position the system disables the transponder reply transmit (Modes 1, 2, 3/A, C, and S). STBY is typically engaged on the ground to prevent unnecessary RF traffic. It is disengaged just prior to takeoff and engaged again upon landing.

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NORMAL: The NORM position enables the transponder to respond to all proper modes (1, 2, 3/A, C, and S), as well as TCAS TA and TA/RA interrogations, if selected.

EMERGENCY: The EMER position enables transponder modes 1, 2, 3/A, and S to reply with an emergency code automatically, irrespective of settings of the MODE/TCAS rotary knob. Modes 1, 2, and 3/A automatically respond with a military emergency. Mode 3/A replies is changed to code 7700.

**7 - MODE/TCAS ROTARY KNOB**

The MODE/TCAS rotary knob has six positions (OFF, 3A, C, S, TA, and TA/RA) that enables the different modes of operation and allows for selection of TCAS functions.

OFF: Disables the Modes 3/A, C and S.

MODE 3/A: When Mode 3/A is enabled, replies to Mode 3/A interrogations and Mode C framing pulses are enabled.

Mode 3/A control is provided for pilot or operator selection of 4096 response codes. Code selection range is 0000 to 7777, inclusive. When the EMER mode is enabled, the Mode 3/A military emergency code 7700 shall be displayed. The Mode 3/A code remains at 7700 as long as the Master Control knob is in EMER position.

MODE C: When Mode C is enabled, the system replies to valid Mode C interrogations. The mode C control disables or enables the Air Data Source input to the transponder.

MODE S: This control function enables/disables Mode S operation. When mode S is enabled, the system replies to valid ATCRBS/Mode S All-call and mode S interrogations.

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TCAS TA: This TCAS control function enables TA operation only. The TA ONLY Mode-S enables the TCAS computer, in conjunction with the Mode S/IFF transponder, to provide traffic advisories. The TA Mode is electrically tied to the Mode S enable (ON) mode. The system automatically selects this mode when the airplane is flying under 1000 feet above ground level.

TCAS TA/RA: The TCAS TA/RA Mode S enables the TCAS computer, in conjunction with the mode-S/IFF transponder, to provide traffic and resolution advisories. TA/RA is electrically tied to the Mode S enable (ON) mode. This is the normal operation mode, supplying full TCAS coverage.

**8 - CODE ENTRY KEYPAD**

There are 12 push-button keys in the keypad.

**9 - TCAS HORIZONTAL RANGE ROTARY KNOB**

The TCAS range control allows the pilot to select traffic advisory horizontal display range in nautical miles. This control function gives the pilot the option of selecting four possible ranges: 6, 12, 20, 40 NM.

**10 - TCAS VERTICAL RANGE ROTARY KNOB**

This knob provides the operator with the capability to select an altitude range, in relation to the airplane, for traffic display on the MFD.

ABV Mode: Range limits are 9900 ft above and 2700 ft below airplane.

BLW Mode: Range limits are 9900 ft below and 2700 ft above airplane.

NORM Mode: The display range is 2700 ft above and below the airplane.

**NOTE:** If the TCAS does not receive the altitude limit information from the transponder, the default altitude limit presented will be 7000 ft instead of 9900 ft.

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### 11 - IDENT MIC/OFF SWITCH

The Mode-S/IFF control panel has a two-position locking lever toggle switch. The control provides the means to activate Ident function remotely by keying the operator's microphone (MIC position) or pressing the front panel IDNT push-button switch (OFF position).

### 12 - IDNT PUSH-BUTTON

A control panel function is supplied for enabling Identification of Position (I/P) operation, either directly by the operator or remotely by keying the operator's microphone. Momentarily pressing the IDNT button control causes the ATCRBS reply and/or Mode S Uplink (UF)-4 and UF-5 replies to contain a Special Position Identifier (SPI) as an identifier to the ground. The SPI supplies the ground station with more positive identification of airplane position. This is typically activated upon verbal command of the Air Traffic Controller. The IDNT control is a momentarily activated button to inhibit continuous selection. When pressure is removed from the momentary button, the IDNT control returns to the OFF position.

### 13 - LOAD PUSH-BUTTON

The LOAD push-button is used to transmit a completed code display on the LCD.

### 14 - MODE 1/2 ROTARY KNOB

OFF: Disables Modes 1 and 2.

MODE 1: Enables Mode 1 operation. Mode 1 control is provided for pilot or operator selection of 32 response codes. Code selection range is 00 to 73, inclusive.

MODE 2: Enables Mode 2 operation. Mode 2 control is provided for pilot or operator selection of 4096 response codes. Code selection range is 0000 to 7777, inclusive.

MODE 1+2: Enables Modes 1 and 2 operation.

### 15 - MODE 4 CONTROL SWITCHES AND KNOB

The Mode 4 operation controls are disabled for this airplane.

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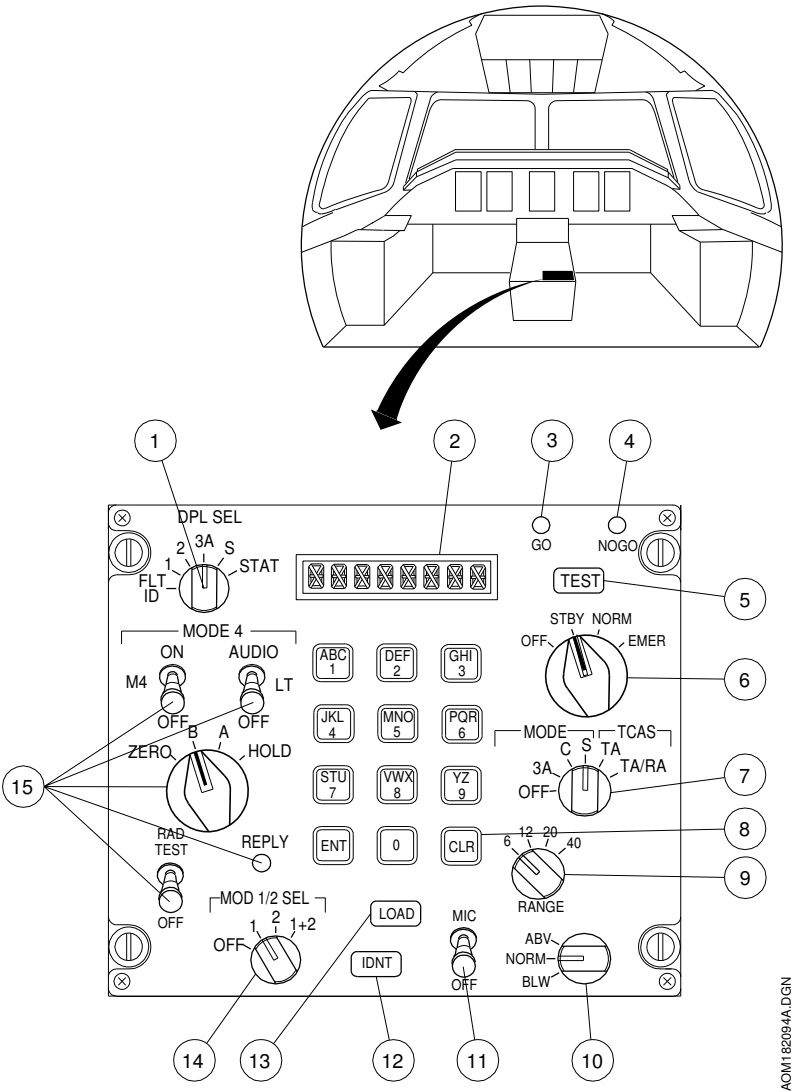


**MODE S/IFF TRANSPONDER CONTROL PANEL**

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# AUTOMATIC DEPENDENT SURVEILLANCE - BROADCAST (ADS-B) OUT

## INTRODUCTION

**NOTE:** ADS-B OUT information is applicable only to airplanes Post-Mod. SB 145-34-0118 or Post-Mod. SB 145DGR-34-0002 or equipped with an equivalent modification factory incorporated.

The use of ADS-B Out provides accurate information and frequent updates to airspace users and controllers. It supports improved use of airspace, reduced ceiling restrictions, visibility restrictions, improved surface surveillance, and enhanced safety through the conflict management.

ADS-B Out is a function of the transponder that allows broadcast of information provided by the following sources:

- ADC: Airspeed, Barometric Pressure Setting and Altitude, Vertical Rate;
- GPS: Latitude, Longitude, East and North Velocity, GNSS Altitude and Track angle (Compliant with TSO-C145 and TSO-C146);
- IC-600: Selected Altitude;
- IRS: Magnetic Heading;
- TCAS: Active Resolution Advisories, Multiple Threat Encounter, TCAS Operational Status, Threat Identity Data (Altitude, Bearing, Range and Identifier);
- RMU: Call Sign/Flight ID, Emergency Code, Surveillance Status;
- Strap Module: Emitter Category, ICAO address, Aircraft Length and Width;
- Transponder: Navigation Accuracy Category (Position and Velocity), Altitude and Vertical Rate Sources, Airspeed Type (IAS or TAS), Track Angle or Heading, TCAS Resolution Advisory Active.

The ADS-B Out is automatically active whenever the transponder is not in standby mode or not failed.

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The ADS-B Out functionality does not change the existing transponder functions, such as Mode A/C, Mode S, Mode S Elementary Surveillance, and Mode S Enhanced Surveillance. The flight crew interfaces with the transponder remain unchanged with the addition of ADS-B Out function.

The ADS-B OUT function may be degraded or unavailable in case of GPS outages, GPS fail or transponder fail. The RMU ATC/TCAS CONTROL page and MAIN TUNING page provide the ADS-B OUT function status.

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# CONTROLS AND INDICATORS

## RMU ATC/TCAS CONTROL PAGE

### 1 - ADS-B STATUS

- NORMAL (white): GPS data is received on the active transponder.
- FAIL (yellow): No GPS data is received on the active transponder.
- DEGRADED(yellow): GPS navigation integrity or accuracy parameters do not meet ADS-B standards, as recognized by the active transponder.

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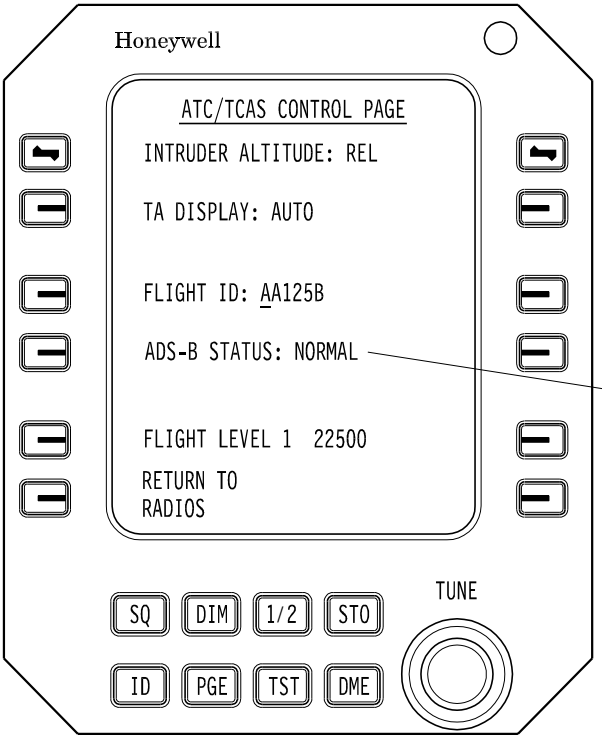


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**RMU ATC/TCAS CONTROL PAGE**

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## RMU RADIO PAGE - ATC/TCAS WINDOW

### 1 - ADS-B STATUS

- ATC ERR (yellow): Annunciation of transponder squitter failure, which indicates that it has an impaired or failed Mode S ability to function in an airborne TCAS.
- ADS-B FAIL (yellow): No GPS data is received on the active transponder.
- ADS-B DGR (yellow): GPS navigation integrity or accuracy parameters do not meet ADS-B standards, as recognized by the active transponder.

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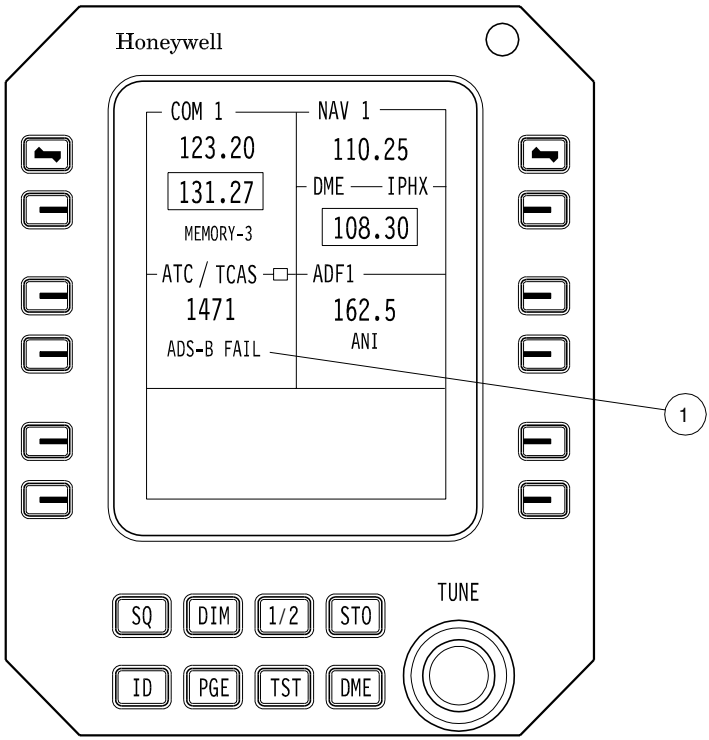


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**RMU RADIO PAGE**

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# SECTION 2-19

# AUTOPILOT


| | Block | Page |
|---|---|---|
| General | 2-19-05 | 01 |
| Automatic Flight Control System | 2-19-05 | 02 |
| Flight Guidance System | 2-19-05 | 04 |
| Flight Director | 2-19-05 | 04 |
| Autopilot | 2-19-05 | 04 |
| Flight Director Modes | 2-19-10 | 01 |
| Lateral Modes | 2-19-10 | 01 |
| Heading Hold Mode | 2-19-10 | 01 |
| Heading Select Mode (HDG) | 2-19-10 | 02 |
| VOR NAV Mode (VOR) | 2-19-10 | 03 |
| VOR Approach Mode (VAPP) | 2-19-10 | 04 |
| Localizer Mode (LOC/BC) | 2-19-10 | 04 |
| LNAV Mode | 2-19-10 | 05 |
| Vertical Modes | 2-19-10 | 06 |
| Pitch Hold Mode | 2-19-10 | 06 |
| Altitude Hold Mode (ALT) | 2-19-10 | 06 |
| Altitude Preselect Mode (ASEL) | 2-19-10 | 07 |
| Flight Level Change Mode (FLC) | 2-19-10 | 07 |
| Speed Hold Mode (SPD) | 2-19-10 | 11 |
| Vertical Speed Hold Mode (VS) | 2-19-10 | 12 |
| Glide Slope Mode (GS) | 2-19-10 | 13 |
| Go Around Mode | 2-19-10 | 13 |
| Windshear Escape Guidance Mode | 2-19-10 | 15 |
| Autopilot Disengagement | 2-19-10 | 16 |
| EICAS Messages | 2-19-15 | 01 |
| Controls and Indicators | 2-19-15 | 01 |
| Flight Guidance Controller | 2-19-15 | 01 |
| Pitch and Turn Controller | 2-19-15 | 05 |
| Control Wheel | 2-19-15 | 07 |
| Thrust Levers | 2-19-15 | 09 |
| Display Controller (DC-550) | 2-19-15 | 10 |
| PFD Indicators | 2-19-15 | 13 |
| EICAS Indicators | 2-19-15 | 19 |


User: fhherna0f - Printed By myTechCare - Nov 21/24 - 00:45:44

Category II Approach ..... 2-19-20 ..... 01
Category II Conditions ..... 2-19-20 ..... 01
Localizer Excessive Deviation Warning ..... 2-19-20 ..... 02
Glideslope Excessive Deviation Warning ..... 2-19-20 ..... 02
Controls and Indicators ..... 2-19-20 ..... 03
PFD Indicators ..... 2-19-20 ..... 03

User: fhherna0f - Printed By myTechCare - Nov 21/24 - 00:45:44

# GENERAL

The Primus 1000 (P-1000) Automatic Flight Control System (AFCS) is a fully integrated, fail passive three-axis flight control system which incorporates lateral and vertical guidance, yaw damper and automatic pitch trim functions.

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# AUTOMATIC FLIGHT CONTROL SYSTEM

The Automatic Flight Control System (AFCS) consists of dual IC-600s, autopilot servos, a flight guidance controller (GC-550), a pitch and turn controller (PC-400) and a display controller (DC-550), as follows:

– IC-600 computer - The primary component of the Automatic Flight Control System (AFCS). Controls the symbol generator, monitors, flight director and autopilot. Only the IC-600 #1 incorporates the autopilot functions.

– FLIGHT GUIDANCE CONTROLLER (GC-550) - Consists of a panel that allows control of both Flight Director systems and autopilot functions. The GC-550 provides means for engaging the autopilot and the yaw damper, selecting the flight director modes and the flight director coupling. The Flight Guidance Controller also provides the means for the remote selection of course, heading, vertical speed target, indicated airspeed target, Mach targets and preselected altitude.

– PITCH AND TURN CONTROLLER (PC-400) - Consists of a panel with a Turn Control Knob and a Pitch Control Wheel. These controls allow the pilot to manually maneuver the airplane with the autopilot engaged.

– DISPLAY CONTROLLER PANEL (DC-550) - The DC is used to select various features on the PFD. These include Horizontal Situation Indicator (HSI) formats, navigation sources, weather display and bearing pointer selection.

The Automatic Flight Control System interfaces with the following systems:

– ATTITUDE AND HEADING REFERENCE SYSTEM (AHRS): provides pitch, roll and acceleration information to the autopilot system via IC-600-1.

– INERTIAL REFERENCE SYSTEM (IRS): provides pitch, roll and acceleration information to the autopilot system via IC-600-1.

– RADIO MANAGEMENT SYSTEM: provides navigation data to the IC-600, including short range navigation data, VOR bearings, ILS approach data, marker beacon tone detection and transmission, DME features and ADF.

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- AIR DATA COMPUTERS (ADCs): supply pressure altitude, barometrically corrected altitude, true airspeed, calibrated airspeed, vertical speed, Mach number, static air temperature and total air temperature to both IC-600.
- RADIO ALTIMETER SYSTEM: provides radio altitude, low altitude awareness and decision height information on the PFD.
- STALL PROTECTION SYSTEM: provides sensitive, visual and aural indications of an impending stall. If a stall condition is near to occur, the system actuates the stick shaker, disengages the autopilot and, if necessary, actuates the stick pusher.
- ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS/GPWS): receives, from IC-600-1, the glideslope deviation, localizer deviation, selected decision height, selected course, packed discrete and selected terrain range.
- ELECTRONIC FLIGHT INSTRUMENT SYSTEM (EFIS): present information to the flight crew. Consists of two Primary Flight Displays (PFD), two multi function displays (MFD) and one EICAS display.
- HORIZONTAL STABILIZER CONTROL UNIT (HSCU): provides, to both IC-600 #1 and #2, the horizontal stabilizer position. It also receives, from IC-600 #1, the autopilot command, when the autopilot is engaged, and the amount of trim demanded.
- AURAL WARNING UNIT (AWU): receives signal from the autopilot, generates the appropriate messages and tones and send the audio signal to the Audio Digital System, which routes the messages to the speakers.
- FLAP ELECTRONIC CONTROL UNIT (FECU): moves the inboard and outboard flap panels and sends flap position signal to the autopilot system.
- FLIGHT MANAGEMENT SYSTEM (FMS): provides high accuracy in long range lateral navigation.

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# FLIGHT GUIDANCE SYSTEM

The Flight Guidance System may perform three separate functions: the Flight Director, Autopilot and Autopilot Monitoring.

## FLIGHT DIRECTOR

The Flight Director function provides pitch and roll attitude commands based on data from a variety of sensors, including attitude, heading, air data, radio altimeter, navigation and pilot inputs. These attitude commands are sent to the PFD for pilot display, to the autopilot for automatic airplane control and to the autopilot monitors.

## AUTOPILOT

The autopilot provides yaw stabilization and follows pitch and roll attitude commands from the flight director.

The autopilot/yaw damper monitors continuously check autopilot functions and operation. In case of failure, they are capable of disengaging the autopilot and yaw damper, independent of the autopilot processor hardware.

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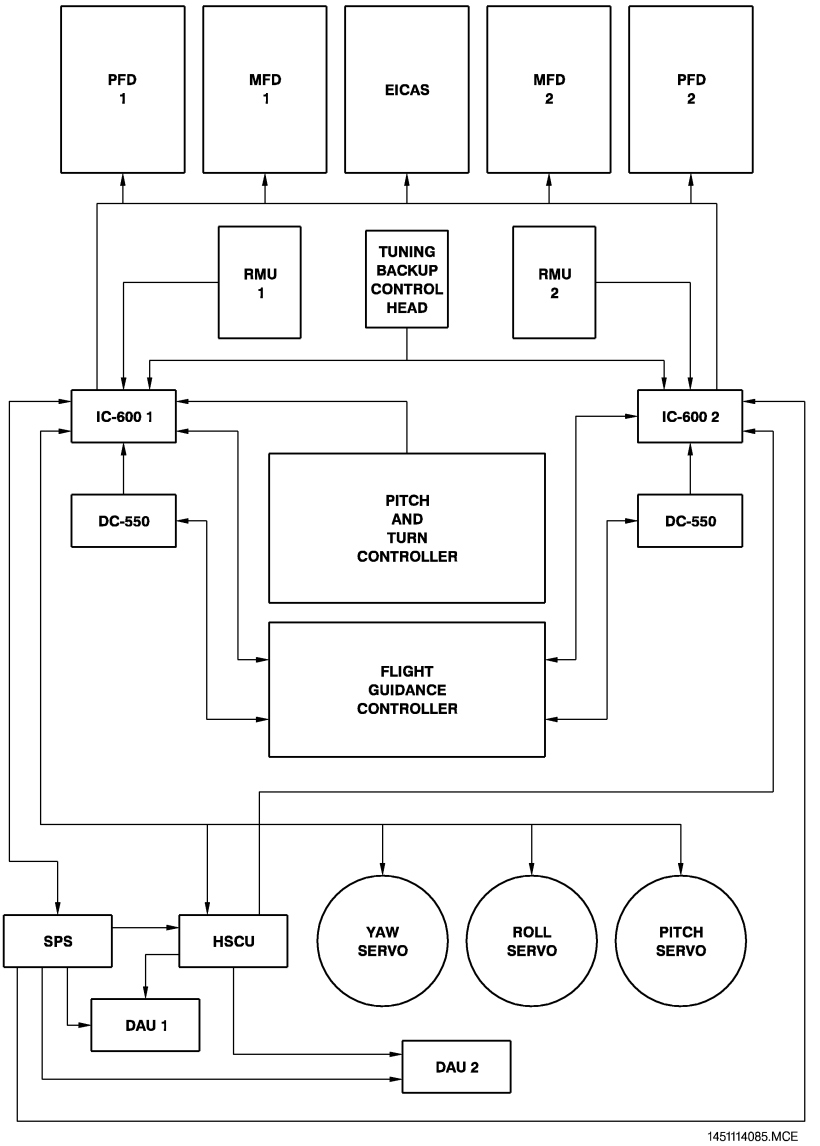


## AUTOFLIGHT SYSTEM SCHEMATIC

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# FLIGHT DIRECTOR MODES

Flight Director mode selection is accomplished through the Flight Guidance Controller. Each mode selector button is illuminated for the armed and captured mode. Also, each active mode is annunciated on the PFD display and this annunciation makes the distinction between armed and captured modes. The various modes may be divided into two categories: Lateral and Vertical modes.

## LATERAL MODES

Lateral modes are those modes related to heading or roll control. They normally provide commands based on navigation sources.

### HEADING HOLD MODE

Heading Hold mode is the default Flight Director mode when no other lateral mode is selected. The Heading Hold mode provides roll commands to maintain the heading at the moment of mode engagement. Once this mode is selected, the heading reference is established one second after the system detects a bank angle of less than 6º. A bank angle command of 0° is used (wings level) until the heading reference is established.

The ROL green label is displayed on the PFD to indicate the mode is engaged. Only the pilot's side primary heading is used by this mode. If this data is invalid, the Wings Level submode is used.

The Heading Hold mode is divided into Roll Hold submode, Turn Knob submode and Wings Level submode.

ROLL HOLD SUBMODE

The Roll Hold submode is entered from Heading Hold mode, with the autopilot engaged, by using the Touch Control Steering Button (TCS) to manually fly the airplane to a bank angle greater than 6°. The system maintains the bank angle at the time the TCS button is released. Roll Hold submode may be canceled by either manually flying the airplane to less than 6° with the TCS button, by moving the Turn Control Knob out of detent or by selecting another lateral mode. This mode is annunciated on the PFD by the ROL green label.

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TURN KNOB SUBMODE

The Turn Knob submode allows the pilot to generate a roll attitude command manually with the Turn Control Knob. Moving the Turn Control Knob out of detent, with the autopilot engaged, cancels all other lateral modes including Heading Hold mode in both Flight Directors.

When the Turn Control Knob is out of detent, the autopilot will maintain a roll attitude proportional to the displacement of the knob. The autopilot will revert back to Heading Hold mode when the turn knob is placed in the detent position. Turn Knob submode is annunciated on the PFD by the ROL green label when out of detent and the autopilot is engaged. When the autopilot is disengaged and the Turn Control Knob is out of detent, the TKNB label is displayed in the PFD and the autopilot engagement is inhibited.

WINGS LEVEL SUBMODE (Airplanes equipped with EICAS 16 and on)

The Wings Level submode provides a roll command of 0º. This mode is active in the Go Around mode, Windshear mode or if the primary heading data is invalid. Therefore, this mode is available even if either attitude source is invalid. This mode is annunciated on the PFD by the ROL green label.

**HEADING SELECT MODE (HDG)**

The HDG mode is selected by pressing the HDG button on the flight guidance controller or by arming LOC, VOR, VAPP, or BC. This mode allows the Flight Director to track the EHSI heading bug, as set by the heading select knob. The Heading Select mode is annunciated on the PFD by the green HDG label.

The mode will be inhibited by the following conditions:

- Turn Control Knob out of detent with autopilot engaged.
- Displayed heading invalid.

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The mode will be canceled if any of the following conditions occur:

- Pressing the HDG button.
- Changing the displayed heading source on the PFD.
- LOC & BC mode capture.
- VOR & VAPP capture.
- Pressing the Go Around button.

LOW BANK MODE

The Low Bank mode allows the pilot to select reduced bank angle for the HDG mode. Bank angle limit will be reduced from 27° to 14° whenever this mode is active. The mode is selected by pressing the BNK button in the Flight Guidance Controller. This mode is annunciated only while the Heading Select mode is active, but remains selected if Heading Select mode is deactivated, being reactivated and annunciated if Heading mode is selected again. The Low Bank mode is automatically selected when climbing above 25000 ft and automatically canceled when descending below 24750 ft.

**VOR NAV MODE (VOR)**

The VOR NAV mode allows automatic capture and tracking of both inbound and outbound VOR radials. The VOR mode is selected by pressing the NAV button in the Flight Guidance Controller, with VOR selected on the PFD. Upon selection of VOR NAV mode, the HDG select mode will automatically be engaged. This triggers the green HDG annunciation on the PFD in conjunction with an armed white VOR NAV annunciation, also on the PFD.

At the proper time, based on course error and beam deviation, the capture of VOR mode will cancel the HDG selected mode.

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The mode will be canceled or inhibited if any of the following conditions occur:

- Pressing the NAV button.
- Selecting VAPP or HDG modes.
- Changing the displayed NAV source on the PFD.
- Changing the displayed heading source on the PFD.
- When the displayed heading is invalid.
- When the displayed NAV source is invalid for more than 5 seconds.
- Pressing the Go Around Button.
- Turn Control Knob out of detent with autopilot engaged.

**VOR APPROACH MODE (VAPP)**

The VOR Approach mode provides the same capabilities as the VOR NAV mode, with higher gain for operation close to the station.

It is recommended to select VAPP mode only on the final approach segment. Therefore, the outbound segment should be flown using some other mode.

This mode is selected by pressing the APR button on the Flight Guidance Controller, with VOR displayed on the PFD. This mode is canceled or inhibited by the same conditions as the VOR NAV mode.

Selecting VOR Approach mode, the HDG select mode will automatically be engaged providing the green HDG annunciation on the PFD in conjunction with the armed VOR approach and white NAV annunciation, also on the PFD.

**LOCALIZER MODES (LOC/BC)**

The Localizer Modes allow automatic capture and tracking of localizer transmitters. Both front course (LOC) and back course (BC) approaches are supported.

The back course approach operates similar to the front course approach, except that the beam deviation is inverted, allowing the system to approach the runway 180° from the front-course.

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Select the Localizer mode by pressing the NAV or APR buttons on the flight guidance controller with ILS as the selected navigation source. In this case, the HDG select mode is automatically selected and the localizer is armed. On an ILS approach, when the localizer is armed and the APR button is pressed, the Glide Slope is also armed.

The localizer mode captures are based on course error and beam deviation. At the point of capture, the current armed mode (LOC or BC) is selected and locked, while HDG select mode is canceled. The LOC mode capture or BC mode capture is annunciated on the PFD by a green LOC or green BC label, respectively.

After captured, the mode will be canceled or inhibited if any of the following conditions occur:

- Pressing the NAV or APR buttons.
- Selecting HDG mode.
- Changing the displayed NAV source on the PFD.
- Changing the displayed heading source on the PFD.
- When the displayed heading is invalid.
- When the displayed NAV source is invalid for more than 5 seconds.
- When the displayed Glide Slope deviation is invalid for more than 5 seconds, with GS mode captured.
- When the on-side attitude is invalid.
- When the selected air data source is invalid.
- Pressing Go Around button.
- Turn Control Knob out of detent with autopilot engaged.

**LNAV MODE**

The LNAV mode allows the Flight Director to capture and track the roll steering signal from the long range navigation system (FMS/GPS).

With FMS selected on the PFD, select LNAV mode by pressing the NAV button on the Flight Guidance Controller. This mode will automatically engage HDG select mode, triggering a green HDG annunciation on the PFD in conjunction with a white LNAV annunciation, also on the PFD.

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The mode will be canceled or inhibited if any of the following conditions occur:

- Pressing the NAV button.
- Selecting HDG mode.
- Changing the displayed NAV source on the PFD.
- Changing the displayed heading source on the PFD.
- When the displayed heading is invalid.
- When the lateral steering command is invalid.
- Pressing the Go Around button.
- Turn Control Knob out of detent with autopilot engaged.

## VERTICAL MODES

Vertical modes are those modes related to pitch control. Due to the necessity of maintaining the wings leveled during Go Around, this vertical maneuver may also be considered as a lateral mode.

### PITCH HOLD MODE

The Pitch Hold mode is the default mode that controls the airplane when no other Flight Director mode is selected.

The Pitch Hold mode is synchronized to the existing pitch attitude and provides an error signal to the command bars and autopilot function.

By pressing the Touch Control Steering Button (TCS), the pilot may manually change the pitch attitude and then allow the system to resynchronize to the new attitude when the button is released.

Should the autopilot be engaged and the Flight Director is in the pitch hold mode, pitch attitude reference can be changed by rotating the pitch control wheel on the pitch and turn controller.

The pitch control wheel allows continuous variable rates and amplitudes of the pitch reference. A PIT label is displayed on the PFD to indicate mode engaged.

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## ALTITUDE HOLD MODE (ALT)

The Altitude Hold mode generates an altitude error signal from a reference altitude and provides a pitch command, which allows the autopilot to maintain altitude.

The Altitude Hold mode is selected by pressing the ALT button on the Flight Guidance Controller or can also be activated automatically by the altitude preselect mode. This mode is annunciated on the PFD by the ALT label.

The mode will be canceled or inhibited if any of the following conditions occur:

- Pressing the ALT button.
- Selecting VS, FLC, or SPD modes.
- Glide slope capture.
- When the air data is invalid.
- Pressing the Go Around Button.
- Pitch control wheel moved with autopilot engaged.

## ALTITUDE PRESELECT MODE (ASEL)

The Altitude Preselect mode provides means for the system to climb or descend to a predetermined altitude and then level off and maintain the preselected altitude.

Preselected altitude is set through the ASEL knob on the Flight Guidance Controller and is displayed on the top right corner of the PFD. This mode is annunciated by the white ASEL label on the PFD.

Pitch Hold, Speed Hold or Vertical Speed Hold must be used to climb or descend towards the preselected altitude or Flight Level Change (FLC).

The ASEL mode will arm automatically if the airplane climbs or descends towards a preselected altitude. The ASEL mode will automatically capture and cancel any existing mode at the appropriate point based on preselected altitude error and vertical speed. The system will automatically switch to altitude hold mode after the airplane has leveled off at the selected altitude.

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The mode will be canceled and/or inhibited if any of the following conditions occur:

- Changing the preselected altitude.
- Selecting ALT, VS, FLC, or SPD modes.
- Glide slope capture.
- When the air data is invalid.
- Pressing the Go Around Button.

## FLIGHT LEVEL CHANGE MODE (FLC)

The Flight Level Change mode (FLC) provides means of climbing or descending to a preselected altitude at a pre-programmed schedule.

When the preselected altitude is above the current altitude and the flight level change mode is selected, the Flight Director provides a speed command at the predetermined climb speed schedule. When the preselected altitude is below the current altitude and FLC is selected, the FD provides a command to descend at a determined rate of descent. The PFD will display the current IAS, Mach or vertical speed bug as appropriate and the target speed can be adjusted only by deselecting the flight level change mode.

As the airplane approaches the preselected altitude, the Flight Director will cycle among ASEL ARM, ASEL CAP, and ALT HOLD to capture the preselected altitude.

The following protections are provided with this mode:

- Maximum normal and longitudinal acceleration: 0.1 G.
- Maximum airspeed: $V_{MO}$ or $M_{MO}$.
- System will maintain the preselected altitude.

The Flight Level Change mode may be activated by selecting an altitude and pressing the FLC button in the Flight Guidance Controller. This mode is annunciated on the PFD by the CLB label, when following the IAS/MACH climb profile, or by the DES label when following a vertical descent profile of –2000 ft/min.

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The mode will be canceled or inhibited if any of the following conditions occur:

- Pressing the FLC button.
- Changing the preselected altitude.
- Selecting ALT, VS, FLC, or SPD modes.
- Glide slope capture.
- When the air data is invalid.
- Pressing the Go Around Button.

DESCENT RATE SCHEDULE:

For EICAS versions up to 13:

The descent rate schedule is –2000 ft/min.

For EICAS versions 14 and on:

From 37000 ft to 12000 ft, the descent rate schedule is –2000 ft/min.

From 12000 ft to 10000 ft the descent rate schedule is –2000 ft/min to –1000 ft/min.

From 10000 ft and below the descent rate schedule is –1000 ft/min.

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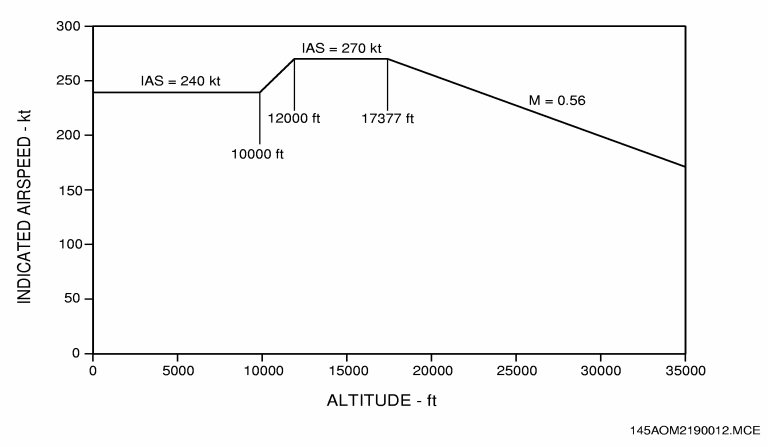
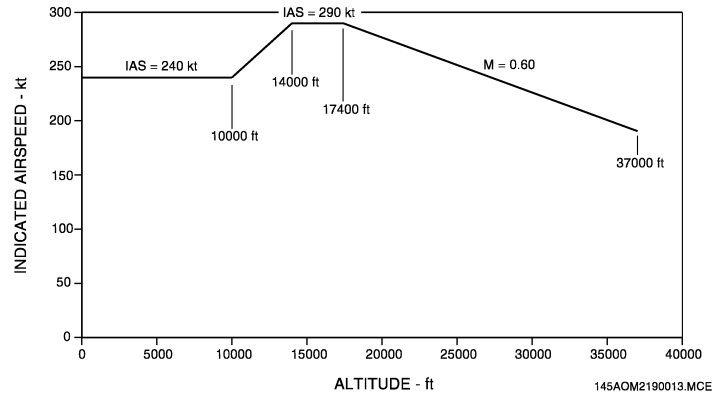
CLIMB RATE SCHEDULE:

For climb rate schedule see the chart below:

EMB-145 (All models except EMB-145 XR)




EMB-145 XR Model

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## SPEED HOLD MODE (SPD)

The Speed Hold mode is used to maintain airspeed or Mach number while flying to a new altitude. Indicated airspeed should be used below 25000 ft and Mach number above 25100 ft.

The Speed Hold mode is also designed to provide overspeed and underspeed protections.

Speed hold mode is selected by pressing the SPD button on the Flight Guidance Controller. This mode is annunciated on the PFD by the SPD label, when maintaining IAS, or by the MACH label when maintaining Mach number. Selection of Speed Hold mode cancels other vertical modes, except the altitude preselect arm mode and Glide Slope arm mode.

Speed Hold mode is automatically selected when the FLC button is pressed and the preselected altitude is above the current altitude.

Different Speed Target can be selected by using the Speed Set knob in the Flight Guidance Controller. Pressing the SPD knob allows the pilot to toggle between IAS target and MACH target to set airspeed.

The following protections are provided with this mode:

- Maximum normal acceleration: 0.1 G.
- Maximum normal acceleration on entering overspeed: 0.3 G.
- Maximum airspeed: $V_{MO}$ or $M_{MO}$.
- Minimum airspeed: Shaker actuation speed.
- System will maintain the preselected altitude and airspeed.

The mode will be canceled or inhibited if any of the following conditions occur:

- Pressing the SPD button.
- Selecting ALT, VS, or FLC modes.
- Altitude preselect capture.
- Glide slope capture.
- When air data is invalid.
- Pressing the Go Around Button.

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An altitude pre-selector overshoot may occur when the following conditions are applied:

- SPD mode engaged and;
- Autopilot disengaged and;
- Relative delay to follow the Flight Director at initial descent and;
- Descent rate greater than 6000 ft/min.

**VERTICAL SPEED HOLD MODE (VS)**

The Vertical Speed hold mode is used to maintain or to make changes to the vertical speed. The Vertical Speed hold mode ranges from –6000 to +6000 ft/min, with a resolution of 100 ft/min.

The Vertical Speed Hold mode is selected by pressing the VS button on the Flight Guidance Controller or automatically, when FLC button is pressed and the preselected altitude is below the current altitude. This mode is annunciated on the PFD by the VS label.

Selection of this mode cancels other vertical modes, except the altitude preselect arm and Glide Slope arm.

Vertical speed may be changed by using the Speed Set knob, on the flight guidance controller.

The following protections are provided with this mode:

- Maximum airspeed: $V_{MO}$.
- Minimum airspeed: Shaker actuation speed.

The mode will be canceled or inhibited if any of the following conditions occur:

- Pressing the VS button.
- Selecting ALT, SPD, or FLC modes.
- Altitude preselect capture.
- Glide slope capture.
- When air data is invalid.
- Pressing the Go Around Button.

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## GLIDE SLOPE MODE (GS)

The Glide Slope mode allows automatic capture and tracking to Glide Slope transmitters. Select Glide Slope mode by pressing the APR button with ILS as a navigation source.

Selecting Glide Slope mode automatically arms GS (in conjunction with LOC). The PFD will display a white localizer LOC and a white Glide Slope GS annunciation. The localizer mode capture will occur with a green LOC annunciation on the PFD. The Glide Slope mode capture, with a green GS annunciation on the PFD, will occur only after Localizer mode has been captured.

After captured, the GS mode will be canceled or inhibited if any of the following conditions occur:

- Pressing the APR or NAV buttons.
- Lost Localizer mode.
- Selecting ALT, SPD, VS, or FLC modes.
- Glide slope deviation invalid for a period greater than 5 seconds.
- Pressing the Go Around Button.

## GO AROUND MODE

The Go Around mode may be engaged only at radio altitudes below 2500 ft, or below 15000 ft pressure altitude for an invalid Radio Altimeter signal. This feature is provided to protect against inadvertent Go Around selections during cruise.

While this mode is engaged, the Speed knob is inhibited.

The airspeed bug is displayed on the airspeed tape on the PFD and a pitch limit indicator is displayed on the EADI. If the Stall Protection Computer signal becomes invalid, the pitch limit indicator is removed.

The Go Around mode is divided into two submodes. The Takeoff Submode is engaged by pressing the Go Around button when the airplane is on the ground (weight on wheels), or in flight up to 400 ft Radio Altitude after the takeoff. Anytime after this, pressing the Go Around button engages the Go Around Submode.

The Go Around submode, as well as the Vertical Speed Control knob, is inhibited while Takeoff Submode is engaged.

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TAKEOFF SUBMODE

The Takeoff submode provides Wings Level and fixed pitch up attitude command indicated by the Flight Director command bars on the EADI. The pitch angle is the same as described in Takeoff - Normal Procedures (1-02-40).

This submode is annunciated by the ROL label and TO label, both on the PFD, and it is canceled if any of the following conditions occur:

- The TCS button is pushed.
- The ALT, SPD, VS, or FLC mode is selected.
- Transition to capture Altitude Preselect mode occurs.
- Air data computer source selection is changed.

If the autopilot is selected with the Takeoff submode engaged, this submode drops into Pitch Hold mode and synchronizes to the current attitude. This submode does not couple to the autopilot, which may be used after climbing above the airplane Minimum Engagement Height (MEH).

A Pitch Limit Indicator (PLI) is displayed on the EADI sphere when the margin prior to the stick shaker set point is lower than or equal to 10°. In the case of an invalid Stall Protection Computer signal, the PLI will be biased out of view and an amber AOA annunciation is displayed on the PFD.

GO AROUND SUBMODE

The Go Around Submode should be selected once the decision to discontinue the approach has been taken. Although commanding a nose up attitude, the need to maintain wings leveled causes this submode to incorporate both lateral and vertical modes features.

The autopilot may be coupled to the Go Around Submode above the Minimum Use Height (MUH). However, the crew is not alerted in case of coupling this submode below the MUH.

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This submode is annunciated by the ROL label and GA label, both on the PFD, and it is canceled if any of the following conditions occur:

- Glide slope capture.
- The ALT, SPD, VS, or FLC mode is selected.
- Transition to capture Altitude Preselect mode occurs.
- Air data computer source selection is changed.

Once a positive rate of climb has been achieved, this submode commands a pitch angle of 10° nose up. If transition to Speed Hold Mode occurs, IAS mode annunciator replaces the GA mode annunciator.

Transition from Go Around Submode to Speed Hold Mode automatically occurs:

- If, at anytime, the speed is lower than 1.23 VS. In this case, 1.23 VS is targeted, replacing the pre-selected speed target. If this speed can not be maintained, altitude is held.
- If, 20 seconds after Go Around engagement, the speed is higher than 170 KIAS. In this case, 170 KIAS is targeted, replacing the pre-selected speed target.
- If, 20 seconds after Go Around engagement, the speed is up to 5 kt higher or lower than the pre-selected speed target, which, in this case, is maintained.

The Go Around Submode ignores a pre-selected altitude below the airplane, and a pre-selected altitude above the airplane is captured if it is higher than the Go Around submode engagement altitude plus 400 ft (pressure altitude). This feature is provided to avoid the airplane leveling off if the pilot has not readjusted the pre-selected altitude to the new missed approach altitude.

**WINDSHEAR ESCAPE GUIDANCE MODE**

The Windshear Escape Guidance mode is provided in order to recover from a windshear situation.

For further information on windshear detection and escape guidance system, refer to Section 2-4 – Crew Awareness.

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# AUTOPILOT DISENGAGEMENT

The autopilot is intentionally disengaged through the Autopilot Engage/Disengage button or through the quick disconnect button on the control wheel (normal disengagement). It may also disengage due to an autopilot failure (abnormal disengagement).

A voice message "AUTOPILOT" is generated when the autopilot disengages. It may be canceled according to the following associated conditions, when pilots intentionally disconnect the autopilot (normal disengagement):

| Associated Conditions | Cancellation |
|---|---|
| Above 2500 ft radio altitude with a valid Radio Altimeter signal. | Self canceled. |
| Below 2500 ft radio altitude with a valid Radio Altimeter signal. | Pressing the Autopilot Quick Disconnect Button twice. |
| Invalid Radio Altimeter signal. | Pressing the Autopilot Quick Disconnect Button twice. |

The autopilot abnormal disengagement triggers the voice message "AUTOPILOT" in all altitudes. The crew may cancel it by pressing the Autopilot Quick Disconnect Button twice.

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# EICAS MESSAGES

| TYPE | MESSAGE | MEANING |
|---|---|---|
| WARNING | AUTOPILOT FAIL | Autopilot has failed and has been automatically disengaged. |
| CAUTION | AUTO TRIM FAIL | Automatic pitch trim has failed. |
| | AP ELEV MISTRIM | A pitch mistrim condition exists. |
| | AP AIL MISTRIM | A roll mistrim condition exists. |
| | LATERAL MODE OFF | Inadvertent loss of the Lateral Flight Director mode. |
| | VERTICAL MODE OFF | Inadvertent loss of the Vertical Flight Director mode. |
| | YAW DAMPER FAIL | Yaw Damper has failed and has been automatically disengaged. |

# CONTROLS AND INDICATORS

## FLIGHT GUIDANCE CONTROLLER

**NOTE:** All the mode selector buttons described below are illuminated to indicate whether the associated mode is armed or captured.

### 1 - FLIGHT DIRECTOR BUTTON

- Allows the Flight Director bars to be displayed on the associated PFD.

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## 2 - LATERAL MODE SELECTOR BUTTONS

- Select lateral operating modes of the autoflight system, as follows:
  - HDG: selects heading hold and heading select modes.
  - NAV: selects VOR NAV mode and allows selection of LOC/BC and LNAV modes.
  - APR: selects VOR approach mode and allows selection of LOC/BC and GS modes.
  - BNK: selects Low Bank submode.

## 3 - AUTOPILOT ENGAGE BUTTON

- Pressed once engages the autopilot and the yaw damper. Pressed again, disengages the autopilot only, keeping the yaw damper engaged.

## 4 - VERTICAL MODE SELECTOR BUTTONS

- Select vertical operating modes of the autoflight system, as follows:
  - SPD: selects Speed Hold mode.
  - FLC: selects Flight Level Change mode.
  - VS: selects Vertical Speed hold mode.
  - ALT: selects Altitude Hold mode.

## 5 - ALTITUDE PRESELECT KNOB

- Allows preselection of altitude in 100 ft increments.

## 6 - COURSE SELECTOR KNOB

- Allows selection of course in 1° increments.
- Pressing the knob synchronizes the selected course to the VOR bearing.

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### 7 - VERTICAL SPEED CONTROL KNOB AND IAS/M SELECTOR BUTTON

- Pressing the knob toggles between the speed modes MACH and IAS.
- When in SPD mode, rotation of this knob allows selection of indicated airspeed in one-knot increments or Mach Number in 0.01 increments.
- When in VS mode, rotation of this knob allows selection of vertical speed in 100 ft/min increments.

### 8 - YAW DAMPER ENGAGE BUTTON

- Pressed once, engages only the Yaw Damper. Pressed again disengages the yaw damper and the autopilot, if it is engaged.

### 9 - AUTOPILOT COUPLE BUTTON

- Allows the pilot's or copilot's Flight Director commands to control the autopilot. The couple button can be pressed with the autopilot engaged or disengaged. However, if the Flight Director is switched, the modes will drop out and the autopilot will remain engaged (if already engaged) and revert to basic autopilot mode (pitch and roll).

### 10- HEADING SELECT KNOB

- Allows selection of heading in 1° increments.
- Pressing this knob synchronizes the heading selection to the current displayed heading.

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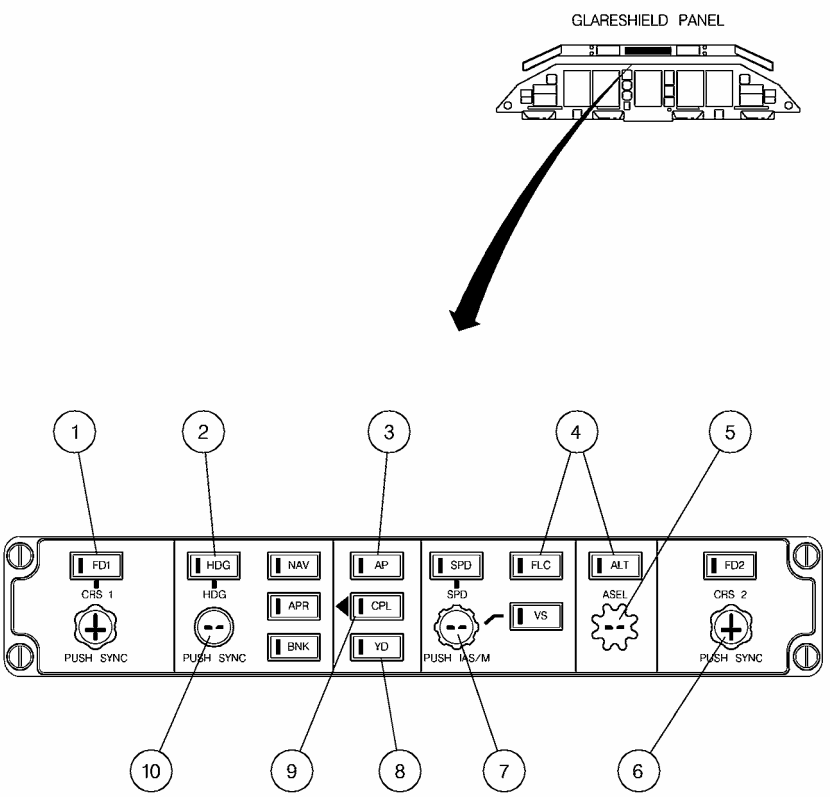


**FLIGHT GUIDANCE CONTROLLER**

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# PITCH AND TURN CONTROLLER

## 1 - PITCH CONTROL WHEEL

- Manually controls the pitch when the autopilot is engaged and the Pitch Hold mode is selected.
- Pitch control wheel operation is inhibited if any vertical mode, except the Pitch Hold mode, is selected in the Flight Director.

## 2 - TURN CONTROL KNOB

- Manually controls the roll attitude when the autopilot is engaged.
- The control has a center detent position at the wings leveled position. The control remains at the current position when released.

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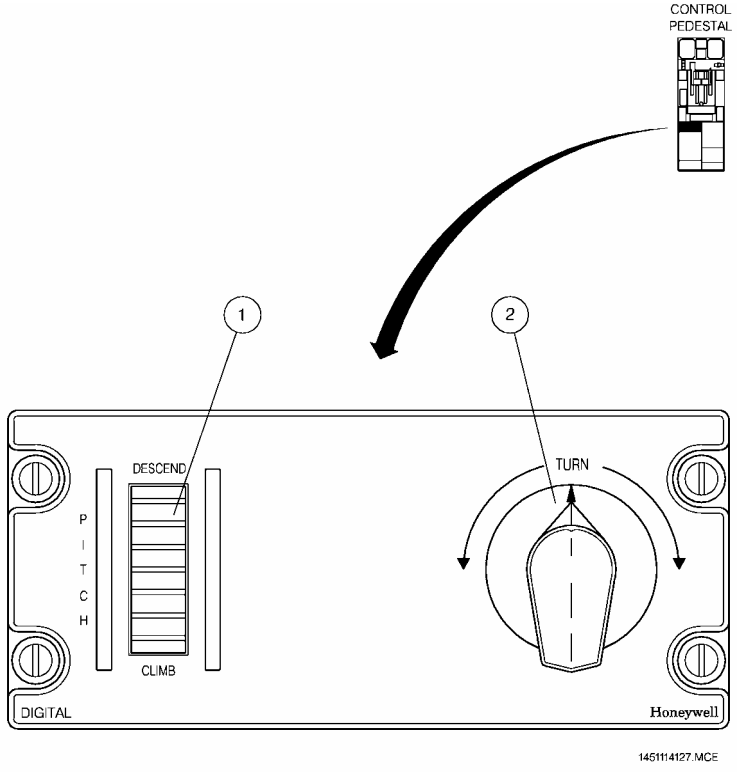


**PITCH AND TURN CONTROLLER**

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# CONTROL WHEEL

## 1 - TOUCH CONTROL STEERING BUTTON (TCS)

- Allows manual maneuvering of the airplane without disengaging the autopilot. The airplane may be maneuvered to any desired pitch attitude while the TCS button is pressed. When the button is released, the following occurs:
  - Primary servos reengage.
  - The computer synchronizes itself to the new pitch attitude and vertical mode and maintain it.
  - Lateral control is returned to the previously selected lateral mode (return to the lateral mode is filtered to prevent rapid maneuvers).
- After glide slope capture in APR mode with the autopilot engaged, if the TCS button is pressed and released, the autopilot will resume the controls and turn the airplane to the ILS center beam.

## 2 - QUICK DISCONNECT BUTTON

- Provides the means to disengage autopilot and yaw damper.
- The pilot's and copilot's buttons are interconnected to allow autopilot cancellation from either seat.
- For Post-Mod. SB 145-22-0001 airplanes or airframes S/N 145001 through 145003, 145041 and on, if the autopilot is disengaged and the button is pressed, the voice message AUTOPILOT will be canceled in 2 seconds.

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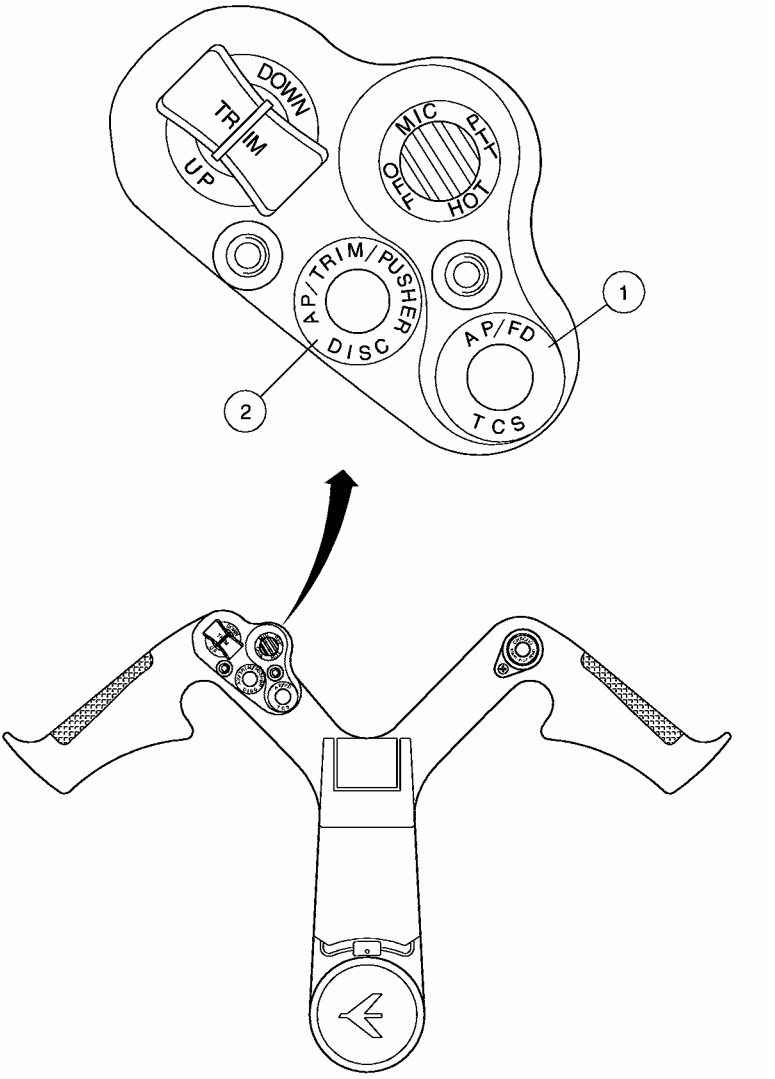


**CONTROL WHEEL**

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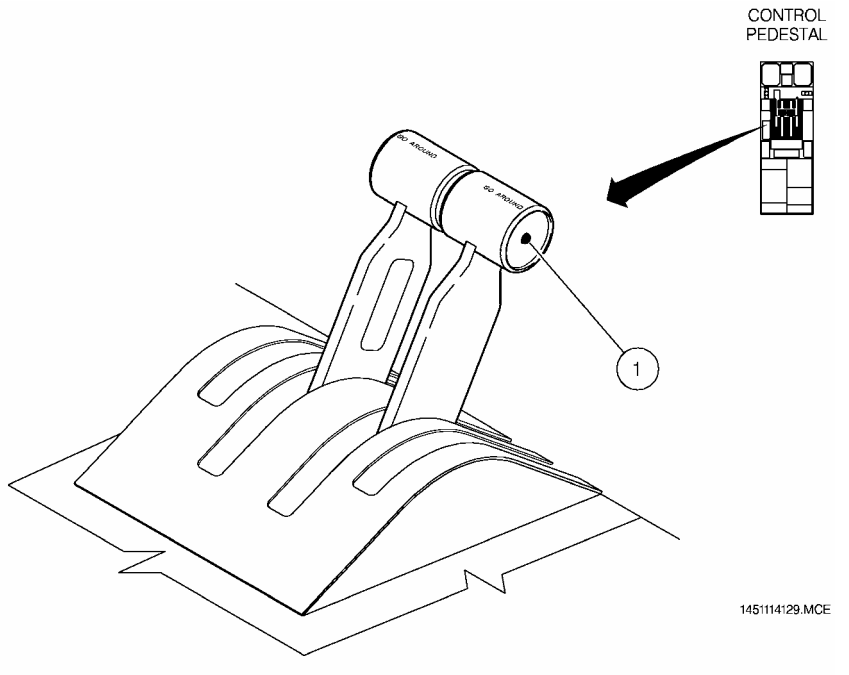
# THRUST LEVERS

## 1 - GO AROUND BUTTON

- Selects the Go Around mode (Takeoff submode, Go Around Speed Target submode and Windshear mode).
- The button also forces the Flight Director into either the Go Around mode or the Windshear mode, depending on the windshear signal.




**THRUST LEVERS**

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# DISPLAY CONTROLLER (DC-550)

## 1 - NAVIGATION SOURCES SELECTOR BUTTON

- Provides the selection of the VHF NAV (VOR, ILS and MLS) as navigation source for the EHSI. If the VHF NAV is already selected, pressing the NAV Button selects the opposite VHF NAV as navigation source for the on-side EHSI. Pressing the NAV Button once again will restore the normal operation: VHF NAV 1 information presented on the PFD 1 and VHF NAV 2 information presented on the PFD 2.

## 2 - FMS SOURCE SELECTOR BUTTON (OPTIONAL)

- Provides the selection of the FMS as navigation source for the EHSI.
- On airplanes equipped with dual FMS, pressing the FMS Button for the second time selects the opposite FMS as navigation source for the on-side EHSI (and for the on-side MFD MAP). Pressing the FMS Button once again will restore the normal operation: FMS 1 information presented on the PFD 1 (and MFD 1) and FMS 2 information presented on the PFD 2 (and MFD 2).

## 3 - BEARING SELECTOR KNOB

OFF: The associated PFD bearing pointers are disabled.

NAV 1 (2): Selects the respective VHF NAV as source for the associated bearing pointer.

ADF: Selects the respective ADF as source for the associated bearing pointer.

FMS: Selects the FMS as source for the associated bearing pointer.

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## 4 - DECISION HEIGHT SETTING AND IC-600 TEST KNOB

- Provides the Radio Altimeter (RA) decision height setting.
- When pressed on ground provides the IC-600 and RA test activation. Refer to Section 2-4 – Crew Awareness for further information on test function and Section 2-17 – Flight Instruments for further information on decision height setting and RA test in flight.

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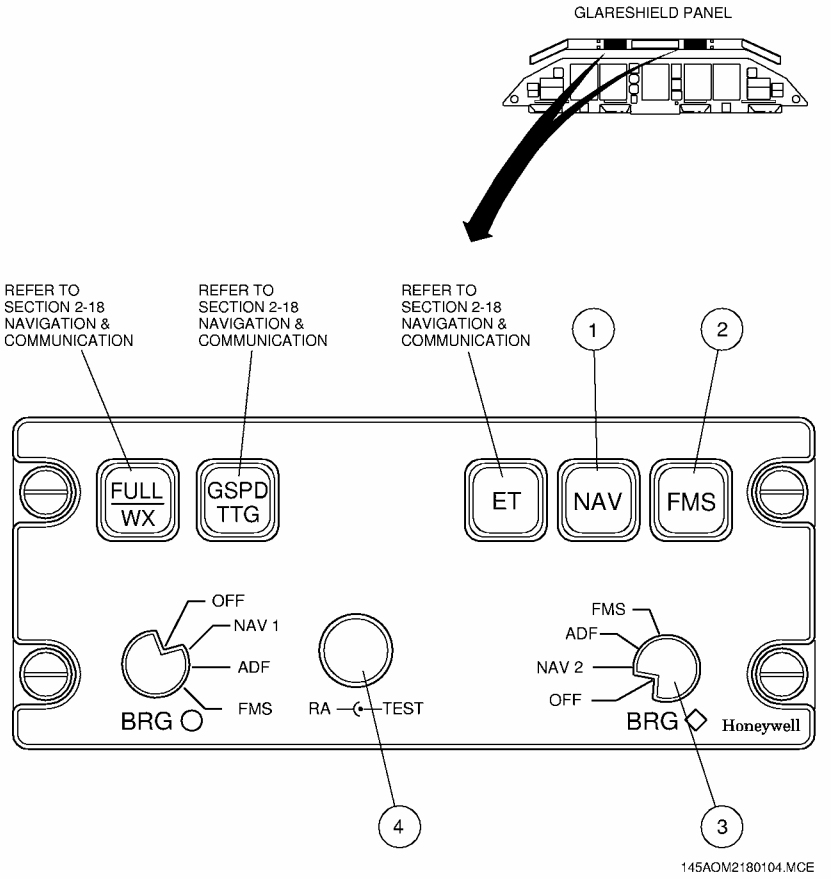


**DISPLAY CONTROLLER PANEL (DG-550)**

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# PFD INDICATORS

### 1 - ARMED LATERAL MODE (WHITE)

- Indicates which lateral mode is armed.
- The mode annunciation is removed if the Flight Director fails.

### 2 - CAPTURED LATERAL MODE (GREEN)

- Indicates which lateral mode is captured.
- The mode annunciation is removed and an amber FD FAIL is displayed in case of Flight Director failure.

### 3 - AUTOPILOT MESSAGE FIELD

- Indicates autopilot status.
- Messages are mutua
- lly exclusive and therefore only one message can be displayed at a time.
- The following messages may be displayed:

| MESSAGE | COLOR | MEANING |
|---|---|---|
| AP | Green | Autopilot engaged. |
| AP TEST | | Autopilot test mode is active immediately after power up. |
| TCS | White | TCS submode is engaged (autopilot is engaged). |
| TKNB | Amber | Turn control knob is out of detent position (autopilot is disengaged). |
| AP | | When the autopilot is normally disengaged, the green AP annunciation turns amber and flashes for 5 seconds, then extinguishes. |
| AP | Red | If the autopilot is engaged and a failure occurs, the green AP annunciation turns red and flashes for 5 seconds, then becomes steady. The AP annunciation appears in conjunction with the AUTOPILOT FAIL message on the EICAS and is removed when the autopilot is disengaged through the Quick Disconnect Button. |

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**4 - FLIGHT DIRECTOR COUPLE ARROW**

- Indicates which Flight Director the autopilot is coupled to.
- The mode annunciation is removed if the Flight Director fails.

**5 - YAW DAMPER ENGAGED ANNUNCIATION**

- Color:
  - Green: indicates the yaw damper is engaged.
  - Amber: when the yaw damper is normally disengaged the annunciation flashes for 5 seconds and then extinguishes itself.
    If the yaw damper is engaged and a failure occurs, the annunciation flashes for 5 seconds then becomes steady until it is disengaged through the Quick Disconnect Button.

**6 - CAPTURED VERTICAL MODE (GREEN)**

- Indicates which vertical mode is captured.
- The mode annunciation is removed if the Flight Director fails.

**7 - MODE TRANSITION ANNUNCIATOR**

- Each transition is annunciated by a box around the mode that is being transitioned. The box will highlight the new mode for 5 seconds and then disappear.

**8 - ARMED VERTICAL MODE (WHITE)**

- Indicates which vertical mode is armed.
- The mode annunciation is removed if Flight Director fails.

**9 - ALTITUDE PRESELECT DISPLAY**

- Ranges from –900 to 45000 ft with a resolution of 100 ft.
- The digits and bug are cyan and the box is white. They become amber 1000 ft prior to reaching the preselected altitude. Once the airplane is within 250 ft of the preselected altitude, the box returned to white. If the airplane exceeds the preselected altitude by more than 250 ft, the box turns amber.
- Large digits display hundreds, thousands and tens of thousands. Smaller digits, which are always zeros, display tens and ones.

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- The bug moves according to the digital altitude preselect value.
- If the preselected altitude value is not within the displayed range of the altitude scale, the bug will stay at the respective end of scale, half-visible and unfilled.

### 10 - COMMAND BAR AND AIRPLANE SYMBOL

- Color: magenta.
- Indicates pitch and roll Flight Director commands.
- Command bar is removed if the Flight Director fails or if the opposite side Flight Director selected source or tuned frequency is different.

**NOTE:** The command bar and airplane symbol may be presented in either V-bar or cross-bar formats, depending on operator selection.

### 11 - SELECTED HEADING BUG

- Color: magenta.
- Displayed full time on the PFD, unless when the PFD is in arc format.
- When setting the selected heading value, the bug will move around the heading scale.

### 12 - VERTICAL SPEED TARGET DISPLAY

- Color: cyan.
- Ranges from 0 to 9900 ft/min with a resolution of 100 ft/min.
- Displayed only when Vertical Speed Hold mode is selected in either Flight Director.

### 13 - SELECTED HEADING DIGITAL READOUT

- Color:
  - Digits: cyan.
  - Label: white.
- Indicates the heading selected through the Flight Guidance Controller panel.

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## 14 - GS/LOC/ILS COMPARISON MONITOR DISPLAYS

- Label: GS, LOC or ILS.
- Color: amber.
- Glide Slope comparison monitor (GS label) is displayed while in GS CAP and below 2500 ft if there is a difference of 0.7 dot deviation between the PFDs indication. If the radio altitude output is invalid, the monitor will then be activated by GS CAP only.
- Localizer comparison monitor (LOC label) is displayed while in approach mode, below 2500 ft if there is a difference of 0.5 dot deviation between the PFDs indication. If the radio altitude output is invalid, the monitor will then be activated by GS CAP only.
- ILS comparison monitor display is annunciated when both GS and LOC comparison monitors are displayed simultaneously.

## 15 - AOA INDICATION

- Color: amber.
- Indicates loss of PLI indication due to an invalid Stall Protection Computer signal.

## 16 - OVERSPEED/UNDERSPEED WARNING DISPLAY

- Color: amber.
- Label: MAX SPD for overspeed condition.
  MIN SPD for underspeed condition.
- Activated by the Flight Director.
- Remains displayed as long as the condition exists.

## 17 - INDICATED AIRSPEED/MACH TARGET DISPLAY

- Color: digits are cyan and box is white.
- Ranges from 80 KIAS to $V_{MO}$ with a resolution of 1 KIAS or from 0.2 Mach to $M_{MO}$ with a resolution of 0.01 Mach.
- Displayed full time.
- Bug moves according to the indicated airspeed/Mach target value set.
- If the indicated airspeed/Mach value is not within the displayed range of the airspeed scale, the bug will stay at the respective end of the scale, half-visible and unfilled.

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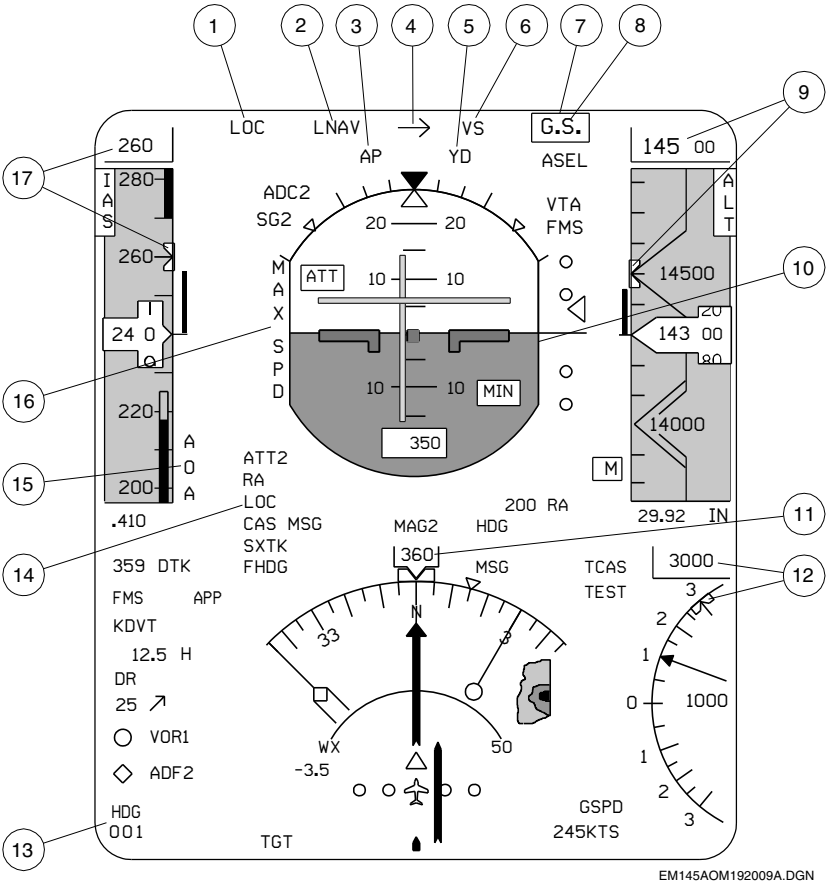


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**PFD INDICATORS (CROSS-BAR FORMAT)**

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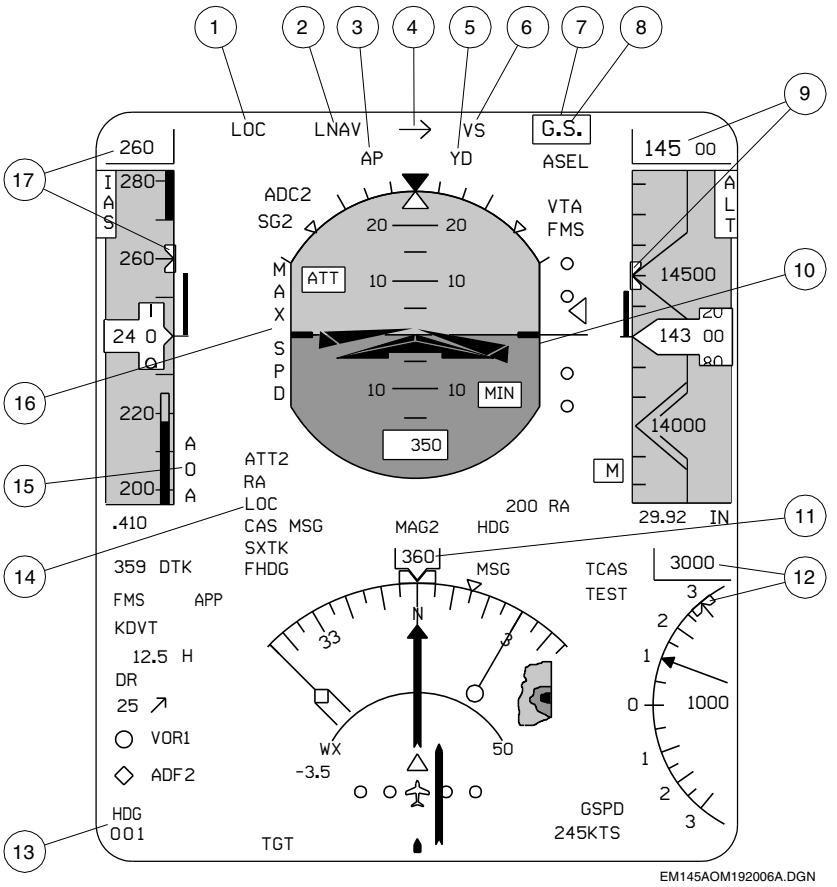


**PFD INDICATORS (V-BAR FORMAT)**

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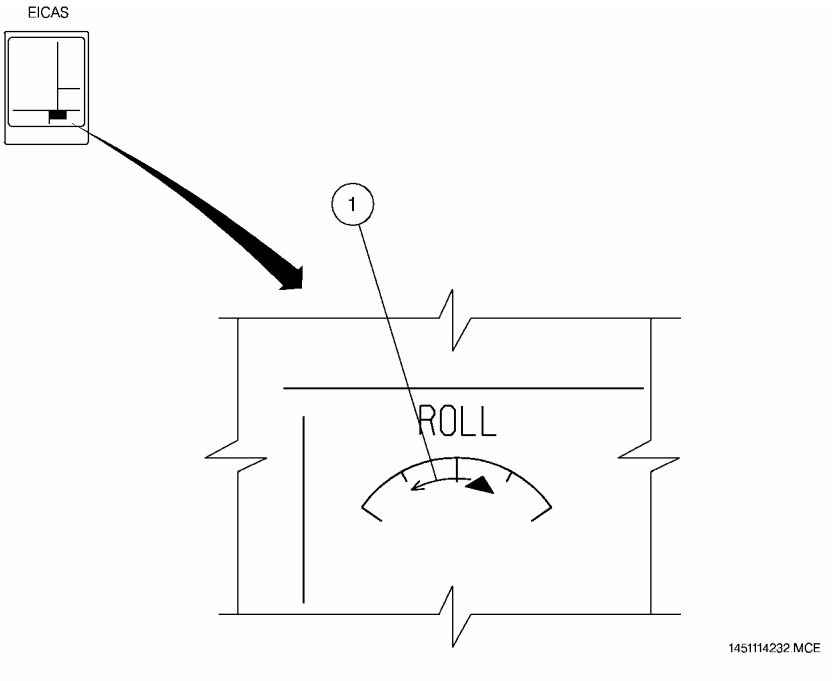
# EICAS INDICATORS

## 1 - ROLL MISTRIM ANNUNCIATION

- Color: amber.
- Indicates that a roll mistrim exists, which may cause an abrupt roll command at the time the autopilot is disengaged.
- Direction of arrow indicates the side the roll trim must be commanded to eliminate the condition.
- It is displayed in conjunction with the AP AIL MISTRIM message on the EICAS.




**ROLL MISTRIM ANNUNCIATION**

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# CATEGORY II APPROACH (OPTIONAL)

The IC-600 may be optionally equipped with a Category II checklist logic warning which is automatically activated whenever the Decision Height is selected between 80 and 200 ft through the RA knob on the Display Control Panel.

## CATEGORY II CONDITIONS

The required conditions to obtain a Cat II valid conditions are:

- Radio Altimeter indication valid on both PFDs.
- Radio altitude above 80 ft (80 ft is included for EICAS version 20.7).
- Flaps 22°.
- NAV 1 on pilot's side and NAV 2 on copilot's side, both tuned to the same frequency.
- An active approach mode selected above 1000 ft AGL.
- Both Flight Directors operational (command bars visible).
- Attitude and heading valid on both PFDs.
- Glide slope and localizer deviation valid on both PFDs.
- No reversions (SG, AHRS, IRS or ADC) modes selected on both PFDs.
- Valid airspeed and barometric altitude on both PFDs.
- No comparison monitors are tripped (attitude, heading, airspeed, barometric altitude, localizer, glide slope and radio altitude) on both PFDs.
- No back course selected.
- Autopilot engaged (not required for EMB-135 and EMB-145 XR models).
- Cat II Decision Height setting on both Display Control Panels (greater than 80 ft and less than 200 ft - 80 ft is included for EICAS version 20.7).

**NOTE:** For EMB-135 and EMB-145 XR models the CAT II approaches are allowed using either the Autopilot or Flight Director for guidance**.**

If all conditions are met, a green CAT 2 annunciation is displayed on the PFDs. If any of the required conditions for establishing CAT 2 goes invalid, the green CAT 2 will be replaced by flashing amber CAT 2 annunciation. It will flash for ten seconds and then go steady.

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**NOTE:** For airplanes Pre-Mod. SB 145-31-0022, equipped with EICAS version 16.5, the CAT 2 annunciator may remain green even with the Autopilot disengaged. Once the CAT 2 limitations have not changed, before performing CAT 2 approaches on the mentioned airplanes, the flight crew must check the green CAT 2 annunciation and also confirm if the Autopilot is engaged.

**LOCALIZER EXCESSIVE DEVIATION WARNING**

The Localizer Excessive Deviation Warnings are active when CAT II is valid. It is triggered between 500 ft and 80 ft of Radio Altimeter height, when the ILS lateral deviation is greater than 1/3 dot. The pilots will be alerted by:

- The lateral deviation bar on the EHSI are changed from green to amber.
- The lateral deviation scale changing from white to amber and flashing with a duty cycle of 0.5 second on followed by a 0.5 second off.

**NOTE:** The on-side excessive deviation warning is also displayed when the cross-side system has detected an excessive deviation.

**GLIDESLOPE EXCESSIVE DEVIATION WARNING**

The Glideslope Excessive Deviation Warnings are active when CAT II is valid. It is triggered between 500 ft and 80 ft of Radio Altimeter height, when the ILS vertical deviation is greater than one dot or when the glideslope deviation warning is invalid for more than five seconds. The pilots will be alerted by:

- The GS pointer on the EADI changing from green to amber.
- The GS scale on the EADI changing from white to amber and flashing with a duty cycle of 0.5 second on followed by 0.5 second off.

**NOTE:** The on-side excessive deviation warning is also displayed when the cross-side system has detected an excessive deviation.

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# CONTROLS AND INDICATORS

## PFD INDICATORS

### 1 - CAT 2 ANNUNCIATION

- Indicates the Cat II condition.
- Label: CAT 2.
- Color:
  - Normal condition: green.
  - Abnormal condition: amber.

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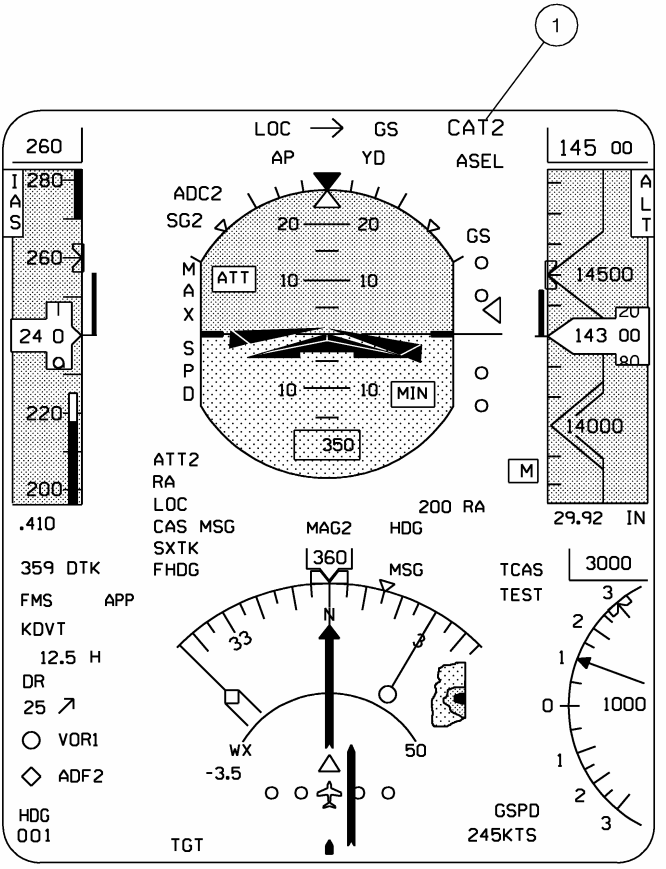


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**PFD INDICATORS**

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