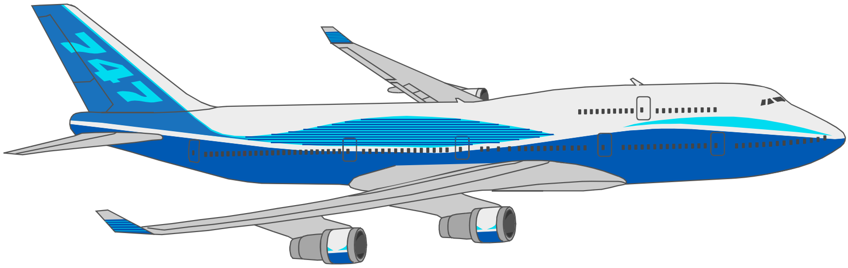

747-444/-4F6/-412
Flight Crew Operations Manual
Transaero Airlines

Document Number D6-30151-481
April 1, 2009
Revision Number: 9
Revision Date: April 1, 2013

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General

The airplanes listed in the table below are covered in this manual. The numbers distinguish data peculiar to one or more, but not all of the airplanes. Where data applies to all airplanes listed, no reference is made to individual airplane numbers.

The table permits flight crew correlation of configuration differences by Registry Number in alpha/numeric order within an operator's fleet for airplanes covered in this manual. Configuration data reflects the airplane as delivered configuration and is updated for service bulletin incorporations in conformance with the policy stated in the introduction section of this chapter.

Airplane Number is supplied by the operator. Registry Number is supplied by the national regulatory agency. Serial and Tabulation Numbers are supplied by Boeing.

Airplane Number	Registry Number	Serial Number	Tabulation Number
913	EI-XLB	26359	RM126
919	EI-XLC	27100	RM131
914	EI-XLD	26360	RM127
916	EI-XLE	26362	RM129
921	EI-XLF	27645	RM318
917	EI-XLG	29899	RM316
918	EI-XLH	27650	RM130
920	EI-XLI	27648	RM317
922	EI-XLJ	27646	RM132
038	EI-XLK	29950	RM041
039	EI-XLL	28031	RM042
040	EI-XLM	28028	RM043
041	EI-XLN	28029	RM044
042	EI-XLO	28025	RM045
006	EI-XLZ	29119	RM147
004	VP-BKJ	26638	RT784

Airplane Number	Registry Number	Serial Number	Tabulation Number
005	VP-BKL	28468	RM146
003	VP-BVR	26637	RT783
007	VQ-BHW	28959	RM081
008	VQ-BHX	28960	RM083

General

This Flight Crew Operations Manual (FCOM) has been prepared by Boeing Commercial Airplanes, Commercial Aviation Services organization. The purpose of this manual is to:

- provide operating limitations, procedures, performance, and systems information the flight crew needs to safely and efficiently operate the 747-400 airplane during all anticipated airline operations
- serve as a comprehensive reference for use during transition training for the 747-400 airplane
- serve as a review guide for use in recurrent training and proficiency checks
- provide operational data from the FAA approved airplane flight manual (AFM) to ensure legal requirements are satisfied
- establish standardized procedures and practices to enhance Boeing operational philosophy and policy

This manual is prepared for the owner/operator named on the title page specifically for the airplanes listed in the "Model Identification" section. It contains operational procedures and information which apply only to these airplanes. The manual covers the Boeing delivered configuration of these airplanes. Changes to the delivered configuration are incorporated when covered by contractual revision agreements between the owner/operator and The Boeing Company.

This manual is not suitable for use for any airplanes not listed in the "Model Identification" section. Further, it may not be suitable for airplanes transferred to other owners/operators.

Owners/operators are solely responsible for ensuring the operational documentation they are using is complete and matches the current configuration of the listed airplanes. This includes the accuracy and validity of all information furnished by the owner/operator or any other party. Owners/operators receiving active revision service are responsible to ensure modifications to the listed airplanes are properly reflected in the operational procedures and information contained in this manual.

The manual is periodically revised to incorporate pertinent procedural and systems information. Items of a more critical nature will be incorporated in operational bulletins and distributed in a timely manner. In all cases, such revisions and changes must remain compatible with the approved AFM with which the operator must comply. In the event of conflict with the AFM, the AFM shall supersede.

This manual assumes the user has previous multi–engine jet aircraft experience and is familiar with basic jet airplane systems and basic pilot techniques common to airplanes of this type. Therefore, the FCOM does not contain basic flight information considered prerequisite training.

Any questions about the content or use of this manual can be directed to:

Boeing Commercial Airplanes

Commercial Aviation Services

Attn: 747 Manager, Flight Technical Data

P. O. Box 3707, M/C 20–89

Seattle, Washington 98124–2207 USA

Email: flighttraining@boeing.com

Telephone: (206) 662-4000

Fax: (206) 662-4743

Organization

The FCOM is organized in the following manner.

Volume 1 –

- Preface – contains general information regarding the manual's purpose, structure, and content. It also contains lists of abbreviations, a record of revisions, bulletins, and a list of effective pages
- Limitations and Normal Procedures chapters cover operational limitations and normal procedures. All operating procedures are based on a thorough analysis of crew activity required to operate the airplane, and reflect the latest knowledge and experience available
- Supplementary Procedures chapter covers those procedures accomplished as required rather than routinely on each flight
- Performance Dispatch chapter contains performance information necessary for self dispatch
- Performance Inflight chapter contains performance information necessary for inflight use

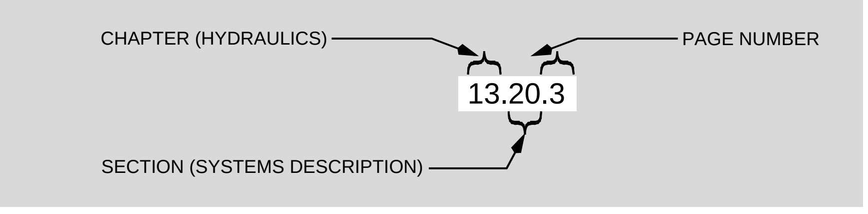
Volume 2 – Chapters 1 through 15 contain general airplane and systems information. These chapters are generally subdivided into sections covering controls and indicators and systems descriptions.

Quick Reference Handbook (QRH) – The QRH covers normal checklists, non-normal checklists, operational information, performance information necessary for inflight use on an expedited basis, and maneuvers.

Page Numbering

The FCOM uses a decimal page numbering system. The page number is divided into three fields; chapter, section, and page. An example of a page number for the hydraulics chapter follows: chapter 13, section 20, page 3.

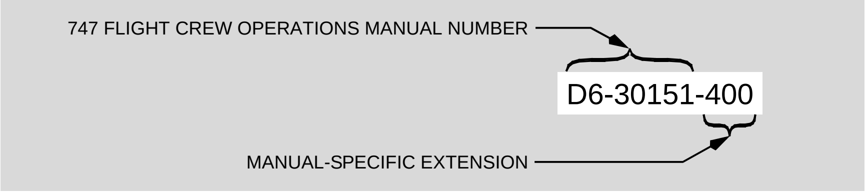
Example Page Number



Page Identification

Each page is identified by a document number and a page date. The document number is composed of the general 747 FCOM number, D6-30151–, and is followed by the manual-specific extension.

Example Page Identification



Warnings, Cautions, and Notes

The following levels of advisories are used throughout the manual and are not to be confused with EICAS messages, which are separately identified in the text.

WARNING: An operating procedure, technique, etc., that may result in personal injury or loss of life if not carefully followed.

CAUTION: An operating procedure, technique, etc., that may result in damage to equipment if not carefully followed.

Note: An operating procedure, technique, etc., considered essential to emphasize. Information contained in notes may also be safety related.

Flight Crew Operations Manual Configuration

Customer airplane configuration determines the data provided in this manual. The Boeing Company keeps a list of each airplane configuration as it is built and modified through the Service Bulletin process. The FCOM does not reflect customer originated modifications without special contract provisions.

Airplane Effectivities

Differences in airplane configuration are shown by use of airplane effectivities throughout Volumes 1 and 2, and the Quick Reference Handbook
The following rules are used to express airplane effectivities:

1. Airplane effectivities are listed in alpha-numeric order. A range of airplanes is defined by a dash, e.g. **N-MA - N-PQ** includes all "M" series airplanes and all "P" series aircraft. A comma in the effectivity range indicates a break in the range, e.g. **N-FA - N-FC, N-FE - N-FG**; that is, airplane N-FD is excluded from the range.

2. Airplane effectivities apply only to the paragraph, illustration, operational note, procedural step, etc. and to subordinate items (if any).

   Example (with subordinate items):

   N-AA - N-BB
   If FUEL BALLAST message displayed:
   CENTER L and R PUMP SWITCHES..OFF

   When jettison complete:
   FUEL JETTISON NOZZLE
   VALVE SWITCHES (Both)...OFF
   FUEL JETTISON SELECTOR...OFF

   In this example, the effectivity N-AA - N-BB applies to the first procedural step and further indented (subordinate) step only. The effectivity does not apply to the next equivalently indented step.

   The first step (If FUEL BALLAST message displayed:) is effective for airplanes N-AA - N-BB only, the second step (When jettison complete:) is effective for all airplanes:

   Example (without subordinate items):

   N-XX - N-YY
   Thrust reversers inoperative.

   Auto speedbrake deployment inoperative. When deployed manually, spoilers extend to flight position.

   Autobrake system inoperative.

In this example, the effectivity N-XX - N-YY applies to the first operational note only. The effectivity does not apply to the next two equivalently indented operational notes.

The first operational note (Thrust reverser inoperative.) is effective for airplanes N-XX - N-YY only, the next two operational notes (Auto speedbrake ...; Autobrake ...) are effective for all airplanes.

3. When airplane effectivities are stated immediately below a checklist title, the entire checklist applies to the listed airplanes only. In the following example, the FUEL STAB XFR checklist is applicable to N-XX - N-YY only:

FUEL STAB XFR

N-XX - N-YY

4. When Boeing has been notified airplanes are to be modified by service bulletin (SB), the effectivity statement will include ‘before’ and ‘after’ versions, as appropriate, in parentheses. Depending upon the modification, there may not be both a ‘before’ and an ‘after’ version.

The text before the semicolon in the parentheses lists the range of airplanes being modified. The text after the semicolon indicates the ‘before’ or ‘after’ version and briefly describes what the SB does. The following examples illustrate this:

Example (‘before’ version):

(N-AA - N-BB ; before SB, thrust reverser locks not installed)
One symmetrical pair of thrust reversers is inoperative.

"N-AA - N-BB ; before SB," means the incorporation of the SB (i.e. installation of thrust reverser locks in this example) is scheduled to begin for airplanes N-AA - N-BB. The words "before SB, thrust reverser locks not installed" indicate the associated operational note (One symmetircal pair of thrust reversers is inoperative.) applies to N-AA - N-BB until the SB has been incorporated.

Example (‘after’ version):

N-XX - N-YY
(N-AA - N-BB ; SB installs thrust reverser locks)
Thrust reversers inoperative.

For airplanes N-XX - N-YY, the SB (i.e. installation of thrust reverser locks in this example) has been incorporated. The associated operational note (Thrust reversers inoperative.) applies to N-XX - N-YY.

"N-AA - N-BB ; SB" means the incorporation of the SB (i.e. installation of reverser locks in this example) is scheduled to begin for airplanes N-AA - N-BB. The words "installs thrust reverser locks" indicate the associated operational note (Thrust reversers inoperative.) will apply to N-AA - N-BB when the SB has been incorporated.

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General

The following abbreviations may be found throughout the manual. Some abbreviations may also appear in lowercase letters. Abbreviations having very limited use are explained in the chapter where they are used.

A	
AC	Alternating Current
ACARS	Aircraft Communications Addressing and Reporting System
ACT	Active
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADP	Air Driven Pump/Air Driven Demand Hydraulic Pump
AFDS	Autopilot Flight Director System
AFM	Airplane Flight Manual (FAA approved)
AGL	Above Ground Level
ALT	Altitude
ALTN	Alternate
ANP	Actual Navigation Performance
AOA	Angle of Attack
A/P	Autopilot
APP	Approach
APU	Auxiliary Power Unit
ARPT	Airport
A/S	Airspeed
A/T	Autothrottle
ATA	Actual Time of Arrival
ATC	Air Traffic Control
ATT	Attitude
AUTO	Automatic
AUX	Auxiliary
AVAIL	Available
AVM	Airborne Vibration Monitor
AVS	Alternate Ventilation System

B	
BARO	Barometric
BAT	Battery
BRT	Bright
BTL DISCH	Bottle Discharge (fire extinguishers)
B/C	Back Course
BTB(S)	Bus Tie Breaker(s)

C	
C	Captain Celsius Center
CAS	Calibrated Airspeed
CANC/ RCL	Cancel/Recall
CB	Circuit Breaker
CG	Center of Gravity
CDU	Control Display Unit
CHKL	Checklist
CLB	Climb
CMD	Command
COMM	Communication
CON	Continuous
CONFIG	Configuration
CRZ	Cruise

D	
DA(H)	Decision Altitude (Height)
DC	Direct Current
DDG	Dispatch Deviations Guide
DEP ARR	Departure Arrival
DES	Descent
DH	Decision Height
DISC	Disconnect
DME	Distance Measuring Equipment

E	
E/D	End of Descent
EEC	Electronic Engine Control
EFIS	Electronic Flight Instrument System
EFB	Electronic Flight Bag
EGT	Exhaust Gas Temperature
EICAS	Engine Indication and Crew Alerting System
ELEC	Electrical
ELEV	Elevator
ENG	Engine
E/O	Engine Out
EPR	Engine Pressure Ratio
EXEC	Execute
EXT	Extend or External
E/E	Electrical and Electronic

F	
F	Fahrenheit
FCC	Flight Control Computer
FCTL	Flight Control
F/D or FLT DIR	Flight Director
FLPRN	Flaperon
FMC	Flight Management Computer
FMS	Flight Management System
F/O	First Officer

FPA	Flight Path Angle
FPV	Flight Path Vector
FWSOV	Firewall Shutoff Valve

G	
GA	Go–Around
GEN	Generator
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
GW	Gross Weight

H	
HDG	Heading
HDG REF	Heading Reference
HDG SEL	Heading Select
HP	High Pressure
HPA	Hectopascals

I	
IAF	Initial Approach Fix
IAN	Integrated Approach Navigation
IAP	Initial Approach Point
IAS	Indicated Airspeed
IDENT	Identification
IDG	Integrated Drive Generator
IDS	Integrated Display System
IFE	In-flight Entertainment System
IN	Inches
IND LTS	Indicator Lights
ILS	Instrument Landing System
IP	Intermediate Pressure
ISFD	Integrated Standby Flight Display

K	
K	Knots
KIAS	Knots Indicated Airspeed

L	
L	Left
LBS	Pounds
LDA	Localizer-type Directional Aid
LDG ALT	Landing Altitude
LIM	Limit
LKD	Locked
LNAV	Lateral Navigation
LWR CTR	Lower Center
LWR DSPL	Lower Display

M	
M	Mach
MAG	Magnetic
MAN	Manual
MCP	Mode Control Panel
MDA(H)	Minimum Descent Altitude (Height)
MEL	Minimum Equipment List
MIC	Microphone
MHZ	Megahertz

MIN	Minimum
MKR	Marker
MLW	Maximum Landing Weight
MMO	Maximum Mach Operating Speed
MOD	Modify
MSL	Mean Sea Level
MTOW	Maximum Takeoff Weight
MTRS	Meters
MTW	Maximum Taxi Weight
MZFW	Maximum Zero Fuel Weight

N	
NAV RAD	Navigation Radio
ND	Navigation Display
NM	Nautical Miles
NORM	Normal
N1	Low Pressure Rotor Speed
N2	High Pressure Rotor Speed (Pratt & Whitney, General Electric engines) Intermediate Pressure Rotor Speed (Rolls–Royce engines)
N3	High Pressure Rotor Speed (Rolls–Royce engines)

O	
OAT	Outside Air Temperature
OVHD	Overhead
OVRD	Override

P	
PA	Passenger Address
PASS	Passenger
PERF INIT	Performance Initialization
PF	Pilot Flying
PFD	Primary Flight Display
PM	Pilot Monitoring
PLI	Pitch Limit Indicator
PNL	Panel
POS	Position
POS INIT	Position Initialization
PRESS	Pressure
PRSOV	Pressure Regulating Shutoff Valve
PRV	Pressure Regulating Valve
PSI	Pounds Per Square Inch
PTT	Push to Talk
PVD	Para-Visual Display
PWS	Predictive Windshear

Q	
QFE	Local Station Pressure
QNE	Standard Altimeter (29.92 in/1013 HPa)
QNH	Local Station Pressure Corrected to MSL

R	
R	Right
RA	Radio Altitude Resolution Advisory
RECIRC	Recirculation
REF	Reference
RET	Retract
RF	Refill
RMI	Radio Magnetic Indicator
RSV XFER	Reserve Transfer
RTO	Rejected Takeoff
RTP	Radio Tuning Panel
RWY	Runway

S	
SAT	Static Air Temperature
S/C	Step Climb
SDF	Simplified Directional Facility
SEL	Select
SELCAL	Selective Call
SPD	Speed
STA	Station
STAB	Stabilizer
STAT	Status
STBY	Standby
STD	Standard
SYNC	Synchronous
SYS	System

T	
T or TRU	True
T or TK or TRK	Track
TA	Traffic Advisory
TACAN	Tactical Air Navigation
TAS	True Airspeed
T/C	Top-of-Climb
TCAS	Traffic Alert and Collision Avoidance System
T/D	Top of Descent
TFC	Traffic
TO	Takeoff
TO/GA	Takeoff/Go–Around
TRU	Transformer Rectifier Unit

U	
UNLKD	Unlocked
UPR DSPL	Upper Display
UTC	Coordinated Universal Time

V	
VA	Design Maneuvering Speed
VHF	Very High Frequency
VMO	Maximum Operating Speed
VNAV	Vertical Navigation
VOR	VHF Omnidirectional Range
VR	Rotation Speed

VREF	Reference Speed
VSI	Vertical Speed Indicator
VTK	Vertical Track
V/S	Vertical Speed
V1	Takeoff Decision Speed
V2	Takeoff Safety Speed

W	
WPT	Waypoint
WXR	Weather Radar

X	
X-BLD	Crossbleed
XTK	Cross Track
X FEED	Crossfeed

Z	
ZFW	Zero Fuel Weight

Revision Transmittal Letter

To: All holders of Transaero Airlines 747 Flight Crew Operations Manual, Boeing Document Number D6-30151-481.

Subject: Flight Crew Operations Manual Revision.

This revision reflects the most current information available to The Boeing Company 45 days before the subject revision date. The following revision highlights explain changes in this revision. General information below explains the use of revision bars to identify new or revised information.

Revision Record

No.	Revision Date	Date Filed	No.	Revision Date	Date Filed
0	April 1, 2009		1	October 1, 2009	
2	April 1, 2010		3	October 1, 2010	
4	April 1, 2011		5	June 10, 2011	
6	October 1, 2011		7	February 15, 2012	
8	October 1, 2012		9	April 1, 2013	

General

The Boeing Company issues FCOM revisions to provide new or revised procedures and information. Formal revisions also incorporate appropriate information from previously issued operations manual bulletins.

The revision date is the approximate date the manual is mailed to the customer.

Formal revisions include a Transmittal Letter, a new Revision Record, Revision Highlights, and a current List of Effective Pages. Use the information on the new Revision Record and List of Effective Pages to verify manual content.

Pages containing revised technical material have revision bars associated with the changed text or illustration. Editorial revisions (for example, spelling corrections) may have revision bars with no associated highlight.

The Revision Record should be completed by the person incorporating the revision into the manual.

Filing Instructions

Consult the List of Effective Pages (0.5.1). Pages identified with an asterisk (*) are either replacement pages or new (original) issue pages. Remove corresponding old pages and replace or add new pages. Remove pages marked DELETED; there are no replacement pages for deleted pages.

Be careful when inserting changes not to throw away pages from the manual that are not replaced. The List of Effective Pages determines the correct content of the manual.

Revision Highlights

Generally, revision bars are displayed adjacent to all technical and non-technical changes. However, highlights are written only for technical revisions. In some sections, the information may have been extensively rewritten for clarity; in these cases a highlight is written, but change bars may not be provided.

Chapter L - Limitations

Section 10 - Operating Limitations

Non–AFM Operational Information

L.10.2 - Revised section to correct structure/pagination errors, no content change.

Chapter NP - Normal Procedures

Section 21 - Amplified Procedures

Preflight Procedure - First Officer

NP.21.14 - Revised to reflect panel nomenclature.

Before Start Procedure

NP.21.26 - Revised to green band for consistency.

Engine Start Procedure

NP.21.28-30 - Revised to reflect panel nomenclature.

Before Taxi Procedure

NP.21.31 - Revised to reflect panel nomenclature.

NP.21.31 - Revised to green band for consistency.

Takeoff Procedure

NP.21.34,36,38,40 - Added step to enhance safety by ensuring crew does not rely solely on autothrottle to correctly set power.

Descent Procedure

NP.21.46 - Revised to add a step to check the landing distance required based on current landing conditions.

Landing Procedure - ILS

NP.21.48 - Corrected HDG SET to HDG SEL.

NP.21.49 - Added LNAV for consistency.

Landing Procedure - Instrument Approach Using VNAV

NP.21.51 - Changed the point where landing configuration is initialted to approximately 2 NM from the FAF during an approach using VNAV. This is because the point where the glide path comes alive may be too close to the FAF due to the size of the vertical RNP.

Chapter SP - Supplementary Procedures

Section 7 - Engines, APU

Engine Start Procedure - Manual Start

SP.7.4 - Revised to reflect panel nomenclature.

Section 10 - Flight Instruments, Displays

Heading Reference Switch Operation

SP.10.1 - Revised to add inforrmation about operation of the HDG reference switch in relation to the APP mode for clarity and cross-model commonality.

Section 16 - Adverse Weather

Cold Weather Operation

SP.16.3 - Deleted step not required on 747-400.

SP.16.5-6 - Revised to reflect panel nomenclature.

SP.16.5 - Revised bleed valve to bleed air to correct nomenclature.

Chapter PI - Performance Inflight

Section 10 - Pkg Model Identification

PI.ModID.10.1 - 747-400 RB211-524H2 KG FAA was added as Section 10.

Section 12 - Advisory Information

Normal Configuration Landing Distance

PI.12.1-2 - Revised reference weight and additional autobrake data has been added to the Normal Configuration Landing Distance.

Non-Normal Configuration Landing Distance

PI.12.3 - Autobrake data has been added to the Non-Normal Configuration Landing Distance in addition to a complete change in the data presentation.

Section 20 - Pkg Model Identification

PI.ModID.20.1 - 747-400 CF6-80C2B1F KG FAA was added as Section 20.

Section 22 - Advisory Information

Normal Configuration Landing Distance

PI.22.1-2 - Revised reference weight and additional autobrake data has been added to the Normal Configuration Landing Distance.

Non-Normal Configuration Landing Distance

PI.22.3 - Autobrake data has been added to the Non-Normal Configuration Landing Distance in addition to a complete change in the data presentation.

Section 25 - Gear Down

Takeoff Climb Limit

PI.25.1 - Removed footnote added to table in error.

Section 30 - Pkg Model Identification

PI.ModID.30.1 - 747-400 PW4056 KG FAA was added as Section 30.

Section 32 - Advisory Information

Normal Configuration Landing Distance

PI.32.1 - Revised reference weight and additional autobrake data has been added to the Normal Configuration Landing Distance.

Non-Normal Configuration Landing Distance

PI.32.3 - Autobrake data has been added to the Non-Normal Configuration Landing Distance in addition to a complete change in the data presentation.

Section 35 - Alternate Mode EEC

Alternate Mode EEC

PI.35.1 - Deleted by configuration

Chapter 1 - Airplane General, Emergency Equipment, Doors, Windows

Section 10 - Dimensions

Principal Dimensions

1.10.1 - Deleted unnecessary title.

Section 40 - Systems Description

Exterior Lighting

1.40.1 - Added exterior lighting list to reflect taxi lights installed.

Chapter 2 - Air Systems

Section 10 - Controls and Indicators

Air Conditioning

2.10.1 - Corrected panel temperature selector text.

2.10.4 - Deleted (TEMP) from callout text to reflect nomenclature.

ECS Synoptic Display

2.10.27 - Deleted "Indication" for consistency.

2.10.27 - Added Callout 10 previously omitted.

Chapter 4 - Automatic Flight

Section 10 - Controls and Indicators

Autothrottle Disconnect and TO/GA Switches

4.10.19 - Revised bullet; incorrectly written in previous revision.

Section 30 - EICAS Messages

Automatic Flight EICAS Messages

4.30.1 - Revised spacing for clarity.

Chapter 5 - Communications

Section 10 - Controls and Indicators

Control Wheel Microphone/Interphone Switch

5.10.11 - Revised text for consistency with no change to technical content.

5.10.11 - Revised paragraph to clarify switch is latched in INT position.

Call Panel

5.10.18 - Revised paragraph to clarify pushing the reset switch will display DIRECTORY when scrolling through the directory.

Section 30 - Interphone Systems

Flight Interphone System

5.30.2 - Deleted sentence for accuracy; FLT call indication does not reset after 30 second delay.

Section 33 - ATC Datalink

XXXX Position Report Page

5.33.45 - Deleted "airspeed"; 2R displays Mach.

5.33.46 - Deleted bullet; reference to "ATC connection" not applicable to AOC.

Chapter 7 - Engines, APU

Section 20 - Engine System Description

Autostart

7.20.14 - Corrected spelling error.

Engine Ignition

7.20.15 - Corrected spelling error.

Chapter 8 - Fire Protection

Section 30 - EICAS Messages

EICAS Alert Messages

8.30.1-2 - Corrected spelling error.

Chapter 9 - Flight Controls

Section 10 - Controls and Indicators

Stabilizer Trim Controls

9.10.3 - Revised text for consistency with no change to technical content.

Aileron and Rudder Trim Controls

9.10.6 - Revised text for consistency with no change to technical content.

Yaw Damper Controls

9.10.6 - Revised text for consistency with no change to technical content.

Speedbrake Lever

9.10.8 - Revised text for consistency with no change to technical content.

Flap Controls

9.10.10 - Revised text for consistency with no change to technical content.

Surface Position Indication

9.10.14 - Revised text for consistency with no change to technical content.

Section 20 - System Description

Pilot Controls

9.20.1 - Revised text for consistency with no change to technical content.

Stabilizer Trim

9.20.4-5 - Revised text for consistency with no change to technical content.

Aileron and Spoiler Roll Control

9.20.7 - Revised text for consistency with no change to technical content.

Rudder Control and Trim

9.20.9 - Revised text for consistency with no change to technical content.

Ground Spoilers

9.20.12 - Revised text for consistency with no change to technical content.

9.20.12 - Deleted text "for a rejected takeoff" for consistency with QRH procedure.

Flap Indications

9.20.15 - Revised text for consistency with no change to technical content.

Section 30 - EICAS Messages

EICAS Alert Messages

9.30.2 - Revised text for consistency with no change to technical content.

Chapter 10 - Flight Instruments, Displays

Section 10 - Controls and Indicators

Cathode Ray Tube

10.10.9 - Added, "with flaps up" for clarity.

Chapter 11 - Flight Management, Navigation

Section 20 - Navigation Systems Description

IRS Alignment

11.20.4 - Changed "Alignment" to "Realignment" to clarify the description of a fast alignment performed following an initial full alignment.

11.20.5 - Revised for cross model consistency.

Section 31 - Flight Management System Operation

Preflight

11.31.2 - Deleted "ROUTE or"; recommended resolution of a discontinuity is to use the LEGS page.

Approach

11.31.2 - Revised paragraph; incorrectly written in previous revision.

Operational Notes

11.31.3 - Revised paragraph for cross model consistency.

Approach

11.31.33 - Deleted, "next logical"; unnecessary wording.

Section 40 - FMC Preflight

Route Page 1/X

11.40.27 - Changed "Title line" to "Line title" for consistency with 11.10.

Menu Page

11.40.61 - Added sentence for clarity.

Section 41 - FMC Takeoff and Climb

Climb Page

11.41.3 - Revised; added "ACT" and "CLB" to show climb phase is active, moved E/O title to E/O description.

RTE X LEGS Page

11.41.8 - Callout revised for clarity.

Direct/Intercept Course

11.41.10 - Changed "line data" to "data line"; consistent with 11.10.

E/O CLB Page

11.41.21 - Added Callout 1, Page Title, for consistency; re-numbered callouts.

Section 42 - FMC Cruise

All Engine Cruise

11.42.2 - Deleted "or two"; only one engine out data is available.

11.42.3 - Revised; added "ACT" and "CRZ" to show cruise phase active, moved E/O titles to E/O description.

Engine Out Cruise

11.42.7 - Paragraph revised for clarity.

11.42.8 - Revised; added "ACT" to show cruise phase is active.

RTA Progress Page 3/3

11.42.36 - Made datalink one word.

Section 43 - FMC Descent and Approach

Descent Page

11.43.3 - Revised; added "ACT" and "DES" to show descent phase is active.

Arrivals Page - VFR Approaches

11.43.19 - Revised Arrival Page - VFR Approaches for clarity.

Section 60 - EICAS Messages

FMC Alert Messages

11.60.5 - Corrected misspelling.

Chapter 12 - Fuel

Section 20 - System Description

Operation With Fuel in Center Wing Tank

12.20.14 - Revised sentence for clarity.

12.20.14 - Revised note to clarify ground operation of the EICAS message.

Section 30 - EICAS Messages

EICAS Alert Messages

12.30.2 - Revised table for grammatical corrections, no content change.

12.30.6 - Revised message logic for clarity.

Chapter 13 - Hydraulics

Section 20 - System Description

Fluid Supply

13.20.2 - Added content to describe the HYDIM module process.

Chapter 14 - Landing Gear

Section 30 - EICAS Messages

EICAS Memo Messages

14.30.2 - Revised the table to align columns and rows, no content change.

Chapter 15 - Warning Systems

Section 10 - Controls and Indicators

Ground Proximity Panel

15.10.15 - Corrected nomenclature.

Section 20 - System Description

Crew Alertness Monitor

15.20.13 - Corrected Crew Alertness Monitor description.

Alerts Inhibited Before Engine Start and After Shutdown

15.20.39 - Corrected nomenclature.

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*	15.20.39	April 1, 2013
	15.20.40-50	October 1, 2012
	15.30.1	October 1, 2012
*	15.30.2-4	April 1, 2013
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* = Revised, Added, or Deleted

General

The Boeing Company issues Flight Crew Operations Manual Bulletins to provide important information to flight crews prior to the next formal revision of the Flight Crew Operations Manual. The transmitted information may be of interest to only specific Operators or may apply to all Operators of this model airplane. Each bulletin will vary.

Bulletins are dated and numbered sequentially. Each bulletin identifies airplanes affected by the bulletin. Absence of airplane effectivity indicates the bulletin applies to all airplanes in an Operator's fleet. When appropriate, the next formal Flight Crew Operations Manual revision will include an updated bulletin record page to reflect current bulletin status.

Bulletin status is defined as follows:

- In Effect (IE) – the bulletin contains pertinent information not otherwise covered in the Flight Crew Operations Manual. The bulletin remains active and should be retained in the manual
- Incorporated (INC) – the bulletin operating information has been incorporated into the Flight Crew Operations Manual. However, the bulletin remains active and should be retained in the manual
- Cancelled (CANC) – the bulletin is no longer active and should be removed from the Flight Crew Operations Manual. All bulletins previously cancelled are no longer listed in the Bulletin Record.

The person filing a new or revised bulletin should amend the Bulletin Record as instructed in the Administrative Information section of the bulletin. When a bulletin includes replacement pages for the Flight Crew Operations Manual or QRH, the included pages should be filed as instructed in the Flight Crew Operations Manual Information section of the bulletin.

Number	Subject	Date	Status
TRX-2	EICAS Advisory Message NO AUTOLAND	April 1, 2009	IE
TRX-3 R2	Triple Flap Control Unit (FCU) Failure	February 15, 2012	IE
TRX-4 R2	Flight Deck Display Unit Blanking Anomaly	February 15, 2012	IE
TRX-5	Erroneous ATC Message Downlink Anomaly	April 1, 2009	IE
TRX-6	FMC Performance Predictions Anomaly	April 1, 2009	IE
TRX-7	Potential Sequential Loss of Multiple Hydraulic Systems	April 1, 2009	IE
TRX-8	Landing Gear Configuration Warning Anomaly	April 1, 2009	IE
TRX-9	Honeywell Flight Management Computer Anomaly	April 1, 2009	IE
TRX-10	Hand microphone use with flight deck PC power outlets	April 1, 2009	IE
TRX-11	Takeoff Configuration Warnings In Flight	April 1, 2009	IE
TRX-12 R2	FCOM Update - Horizontal Stabilizer Tank (HST) Automatic Fuel Pump Shutoff	February 15, 2012	IE
TRX-14 R2	General Electric (GE) CF6-80C2 Engine Flameout Mitigation	February 15, 2012	IE
TRX-15	Uncommanded Turns When LNAV is in Use	November 1, 2010	IE
TRX-16 R2	New Core Ice Shedding Procedure When Operating in Freezing Fog	February 15, 2012	INC

Number	Subject	Date	Status
TRX-17 R1	Fuel System Configuration - FR HiTemp Fuel Pumps	February 15, 2012	IE
TRX-19 R1	Nuisance EICAS Caution Message >FMC RUNWAY DIS	February 15, 2012	IE
TRX-20 R1	EICAS Caution Message >FMC RUNWAY DIS Alerting	February 15, 2012	IE
TRX-21	Nuisance EICAS Message WINDSHEAR SYS	February 15, 2012	IE
TRX-22	Look-ahead Terrain Alerting Display Anomalies	February 15, 2012	IE
TRX-23	Revised Cold Weather Operations Supplementary Procedure for Cold-Soaked Engine	July 24, 2013	INC

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Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-2

IssueDate: April 1, 2009

Airplane Effectivity: (SB changes VP-BKJ, VP-BVR)

Subject: EICAS Advisory Message NO AUTOLAND

Reason: To inform flight crews of the possible loss of all autopilot capability if the EICAS advisory message NO AUTOLAND displays.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

An anomaly in the flight control system can cause simultaneous failure of both Stab Trim/Rudder Ratio Modules (SRMs). This condition displays the EICAS advisory message NO AUTOLAND, which is inhibited on the ground until engine start. With a failure of both SRMs, the autopilots cannot be engaged.

Operator action suggested in Boeing Service Letter 747-SL-22-027 corrects the flight control system anomaly described in this bulletin.

Operating Instructions

If the NO AUTOLAND message displays after engine start and prior to takeoff, contact maintenance to determine autopilot capability.

WARNING: If maintenance action involves engaging an autopilot on the ground to test autopilot capability, ensure the autopilot is disengaged before taxi.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-2 as "In Effect" (IE) .

This bulletin will be cancelled after Boeing has been notified all affected airplanes in your fleet have been modified as recommended in 747-SL-22-027.

CS3 2733

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-3 R2

IssueDate: February 15, 2012

Airplane Effectivity: EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Subject: Triple Flap Control Unit (FCU) Failure

Reason: To inform flight crews of the effects of failure of all three FCUs.

Revised to provide replacement QRH pages.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin does not apply to affected airplanes modified by Boeing Service Bulletin 747-27A2386.

An operator recently experienced in-flight failure of all three FCUs. Engineering investigation has revealed malfunction of a leading edge flap position switch circuit can result in failure of all three FCUs with the following indications:

- the EICAS caution message FLAPS CONTROL displays
- primary and secondary flap control and position indication displays are inoperative
- the alternate control mode remains operative, however the expanded flap position indication does not display.

Additionally, the following other systems are affected:

- autopilots are inoperative
- flight director command bars may not display on the PFD
- flap maneuvering speeds do not display on the PFD
- outboard ailerons unlock
- engine idle is limited to approach idle

- stick shaker (stall warning) margins are reduced due to reversion to a simplified maneuvering schedule
- GPWS warning “TOO LOW FLAPS” occurs at low altitude unless the Ground Proximity Flap Override switch is selected to OVRD.

The FLAPS CONTROL non-normal checklist has been revised to accommodate the additional information provided in this bulletin.

Incorporation of Service Bulletin 747-27A2386 installs upgraded FCUs to prevent failure of all three FCUs caused by malfunction of a leading edge flap position switch circuit.

Operating Instructions

If the EICAS message FLAPS CONTROL displays, accomplish the respective FLAPS CONTROL non-normal checklist.

NOTE: the 20 knot crosswind limit for landing has been removed from the revised checklist.

Administrative Information

This bulletin replaces bulletin TRX-3 R1 dated June 10, 2011. Discard TRX-3 R1. Revise the Bulletin Record to show TRX-3 R1 “Cancelled” (CANC).

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-3 R2 as "In Effect" (IE) .

This bulletin will be cancelled after Boeing has been notified all affected airplanes in your fleet have been modified by SB 747-27A2386.

CS3 2944

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-4 R2

IssueDate: February 15, 2012

Airplane Effectivity: EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Subject: Flight Deck Display Unit Blanking Anomaly

Reason: To provide flight crews with recommended action in the event all flight deck display units go blank in flight.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin does not apply to airplanes modified by Service Bulletin 747-31-2368.

An operator reported two instances of all six flight deck display units blanking in flight. In the first instance, the flight crew elected to land with the display units blank. In the second, the flight crew cycled EFIS/EICAS Interface Unit (EIU) circuit breakers and restored display unit operation. The cause of this anomaly remains under investigation.

In the unlikely event all six display units blank, cycling Left and Center EIU circuit breakers may recover the display units.

For well-documented reasons, Boeing has long discouraged cycling circuit breakers in normal operations. However, in rare, specific cases such as this, cycling circuit breakers has no adverse effect on equipment or airplane operation, and may be necessary to restore system operation.

Operating Instructions

If all six flight deck display units go blank during flight, open Left and Center EIU circuit breakers, labeled EIU L and EIU C at P7-1 panel locations F-9 and F-10 respectively, for at least five seconds. Reset circuit breakers and record the time and flight deck effects in the airplane log.

Administrative Information

This bulletin replaces bulletin TRX-4 R1 dated June 10, 2011. Discard TRX-4 R1. Revise the Bulletin Record to show TRX-4 R1 “Cancelled” (CANC).

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-4 R2 as "In Effect" (IE) .

This bulletin will be cancelled after Boeing has been notified all affected airplanes in your fleet have been modified by Service Bulletin 747-31-2368.

CS3 3242

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-5

IssueDate: April 1, 2009

Airplane Effectivity: All Airplanes

Subject: Erroneous ATC Message Downlink Anomaly

Reason: To inform flight crews of an ATC datalink anomaly that may result in downlink of erroneous messages to ATC.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin applies to airplanes with the ATC datalink function activated.

Boeing has received operator reports of erroneous messages downlinked to ATC via the FMC ATC datalink function. Erroneous messages were transmitted when the downlink process was initiated from the right CDU.

The anomaly occurs when the left and right FMCs fail to synchronize correctly. When the synchronization fails, the right FMC will miss a change in ATC message status and display incorrect page data. As a result, initiating a message from the right CDU may downlink information different than actually displayed on the right CDU. The most common occurrence of the anomaly results in the left CDU displaying a clearance that has been previously accepted, and the right CDU displaying "REQUEST VOICE CONTACT". The anomaly can be readily detected on the ATC LOG page because left and right CDU data will be different.

Some flight crews have used the flight deck printer in an attempt to determine which CDU information is correct. The printer will respond to the right FMC data, even when a print message is activated on the left CDU. As a result, the printer is an unreliable means to determine which CDU information is correct.

Boeing has confirmed in all cases, information displayed on the left CDU is correct.

Operating Instructions

If both left and right CDUs are selected to the same datalink page and display different data during ATC datalink operations, initiate downlinks from the left CDU only.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-5 as "In Effect" (IE) .

This condition is temporary until the system is modified. This bulletin will be revised to include Service Bulletin information when available.

CS3 3273

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-6

IssueDate: April 1, 2009

Airplane Effectivity: All Airplanes

Subject: FMC Performance Predictions Anomaly

Reason: To inform flight crews of an FMC performance predictions anomaly.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has confirmed operator reports of erroneous performance predictions following execution of the ABEAM PTS function on the FMC LEGS Page. When OAT values have been previously entered in the ALT/OAT field at line-select key 5R on a waypoint WIND Page and the ABEAM PTS function is subsequently selected after a "direct-to" flight plan modification, the OAT value on the WIND Page erroneously changes to 0-degrees. After execution, fuel predictions are erroneously recalculated based upon 0-degrees instead of the previously-entered value for the respective cruise altitude. Operators have reported display of the INSUFFICIENT FUEL alert level scratch pad message with the fuel prediction values being much lower than originally planned. Additionally, there are no flight deck annunciations or alerts to indicate an OAT value on the WIND Page has erroneously changed.

Operating Instructions

Following selection and prior to executing the ABEAM PTS function, verify the OAT value on the respective WIND Page. If necessary, enter the airplane altitude and the indicated Static Air Temperature (SAT) from PROGRESS Page 2 into the ALT/OAT field for the next route waypoint. This OAT entry will propagate to all down-track waypoints. Following entry of the SAT value into the ALT/OAT field and execution of the route modification, FMC fuel predictions should be near those obtained from the flight plan.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-6 as "In Effect" (IE) .

The corrective action for the anomaly described in the bulletin is still under investigation. This bulletin will be revised to include Service Bulletin information when available.

CS3 3644

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-7

IssueDate: April 1, 2009

Airplane Effectivity: All Airplanes

Subject: Potential Sequential Loss of Multiple Hydraulic Systems

Reason: This is a reissue of TRX-7, dated October 2, 2006. The purpose of this reissue is to remind flight crews that the non-normal checklists associated with the careted EICAS messages HYD QTY LOW 4 and >HYD QTY LOW 1 contain procedural steps and these checklists should be done when needed.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Two operators have reported loss of fluid from multiple hydraulic systems. The leaks sequentially affected system 4, then 1, then 2, then the brake accumulator.

Boeing has determined the condition is caused by an unannunciated failure preventing a brake metering valve from returning to the null position, combined with a hydraulic leak in the brake system downstream of the antiskid shuttle valve. The brake leak rate must be below 0.1 gallons per minute or the hydraulic brake fuses will set and stop the fluid loss. Each hydraulic system has enough fluid to last at least 35 minutes before failure once the >HYD QTY LOW message is shown.

Hydraulic system 3 is not associated with the brake system and is not affected by this failure combination. Additionally, if the hydraulic fluid loss does not originate with hydraulic system 4, the sequential failure of multiple hydraulic systems is very unlikely to occur.

Once system pressure is removed, the leak may automatically shift to the next hydraulic system. In the revised checklists, turning off the hydraulic pumps of the affected system, and depressurizing the system(s) at quantity low, retains the remaining fluid in those systems for configuring the airplane during approach, and for braking during landing rollout.

Operating Instructions

If the >HYD QTY LOW 4 or >HYD QTY LOW 1 message is shown in flight, do the non-normal checklists.

The current guidance in the QRH for careted messages states “Acaret symbol > precedes all EICAS alert messages where the associated checklist is informational, has no procedural steps, or the action is obvious (such as Overspeed). The checklist titles also have the caret symbol to agree with the EICAS alert message. The flight crew does not need to refer to the checklists for EICAS alert messages preceded with caret symbols.” However, the new checklists for >HYD QTY LOW 4 and >HYD QTY LOW 1 are included in the QRH for the careted messages and flight crews are required to do the appropriate checklist steps when needed.

If the HYD PRESS SYS 4 caution message is shown in addition to the >HYD QTY LOW 4 advisory message, do the HYD PRESS SYS 4 checklist.

Flight Crew Operations Manual Information

The caret will be removed from the >HYD QTY LOW 4 and >HYD QTY LOW 1 messages during the next available IDS software update, currently scheduled for release in November 2008.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-7 as "In Effect" (IE) .

This bulletin will be cancelled after the IDS software has been released and Boeing is notified that all affected airplanes in your fleet have the updated IDS software installed.

CS3 3717

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company **Seattle, Washington 98124-2207**	747-400

Number: TRX-8

IssueDate: April 1, 2009

Airplane Effectivity: All Airplanes

Subject: Landing Gear Configuration Warning Anomaly

Reason: To inform flight crews the landing configuration gear warning system may not provide an alert to the flight crew when flaps are set at 20 degrees or less for landing.

> Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin does not apply to airplanes modified by Service Bulletin 747-31-2410.

The Modular Avionics and Warning Electronics Assembly (MAWEA) has exhibited an anomaly during the flight test program. While the MAWEA consistently provides the required landing gear configuration warnings at the normal landing flap settings of 25 or 30 degrees, flight testing has determined with flaps set at 20 degrees, landing gear up, radio altitude (RA) less than 800 feet, and one or more thrust lever resolver angle (TRA) less than 55 degrees, the landing gear configuration warning (EICAS warning message CONFIG GEAR, siren and master warning light) is annunciated intermittently. As a result, flight crews may not receive the gear warning under all required conditions.

To ensure the “TOO LOW GEAR” GPWS voice annunciation is available as a backup for the CONFIG GEAR warning message, the AFM is being revised to add the following requirement: “Mode 4 of the GPWS must be determined to be operational before takeoff by verifying that a GND PROX SYS status message is not displayed on EICAS before engine start, and a GND PROX SYS advisory message is not displayed on EICAS after engine start and before takeoff.” The AFM will also be revised to add a new Flaps Drive non-normal procedure.

Even though landing with flaps 20 or above is unlikely, it is possible a flaps 20 or less landing may be required under certain failure conditions of the flap drive system. Accordingly, a CAUTION is being added to the FLAPS DRIVE non-normal checklist to advise flight crews of the anomaly described in this bulletin.

Operating Instructions

Comply with the AFM GPWS mode 4 requirements described above.

If the EICAS caution message FLAPS DRIVE displays, accomplish the FLAPS DRIVE non-normal checklist.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-8 as "In Effect" (IE) .

This bulletin will be cancelled after Boeing has been notified all affected airplanes in your fleet have been modified by Service Bulletin 747-31-2410.

CS3 3870

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-9

IssueDate: April 1, 2009

Airplane Effectivity: All Airplanes

Subject: Honeywell Flight Management Computer Anomaly

Reason: To inform flight crews of a Honeywell FMC anomaly that incorrectly deletes a speed constraint.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has confirmed operator reports of a Honeywell FMC anomaly that incorrectly deletes a speed constraint. Some SIDs are designed to limit turn radius to maintain clearance with other traffic or restricted airspace. Some of these procedures also have an AT-OR-ABOVE altitude restriction inconjunction with the speed constraint. Typically, the airplane will be required to limit speed until passing the respective waypoint as well as climb above the altitude constraint. In these procedures, VNAV will incorrectly delete the speed constraint prior to reaching the waypoint if the altitude constraint has been satisfied. When this happens, VNAV will command speed to accelerate to ECON speed (or SEL speed) prior to reaching the constrained waypoint. This anomaly exists on all Boeing 747 / 757 / 767 / 777 airplanes equipped with the Honeywell FMC.

Honeywell is aware of this anomaly and has planned changes for the 747-8.

Operating Instructions

To prevent exceeding a speed restriction when accompanied by an AT-OR-ABOVE altitude constraint, use speed intervention (enter speed constraint in the MCP Speed Window) until the constrained waypoint is sequenced. After passing the waypoint, select VNAV as desired.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-9 as "In Effect" (IE) .

This bulletin will be incorporated in a future revision of your Flight Crew Operations Manual.

CS3 3944

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company **Seattle, Washington 98124-2207**	747-400

Number: TRX-10

IssueDate: April 1, 2009

Airplane Effectivity: 747 airplanes with PC power installed in the flight deck.

Subject: Hand microphone use with flight deck PC power outlets

Reason: To inform flight crews of a new restriction on using the flight deck PC power outlets when the hand microphone is used.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received customer complaints of interference when using hand held microphones both on the ground and in flight. Investigation has shown interference may be caused by items plugged into the PC power outlets on the flight deck. Any item plugged into a PC power outlet, whether turned on or not, can cause interference. AC 91-21.1B prohibits the use of items that cause interference with communications.

Boeing is issuing placards that state: “WHEN USING HAND MIC REMOVE PWR CORD FROM OUTLETS”.

Operating Instructions

Remove any power cords from all flight deck PC power outlets before using a hand microphone.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-10 as "In Effect" (IE) .

This condition is temporary until the system is modified. This bulletin will be revised to include Service Bulletin information when available.

CS3 4131

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-11

IssueDate: April 1, 2009

Airplane Effectivity: VP-BKJ, VP-BVR

Subject: Takeoff Configuration Warnings in Flight

Reason: To advise flight crews of the possibility of nuisance configuration warnings in cruise.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Several operators have reported nuisance configuration warnings while in cruise. The EICAS warning messages >CONFIG FLAPS and/or >CONFIG STAB were displayed indicating the airplane was not in a takeoff configuration. The EICAS messages were accompanied by the aural caution alert.

Boeing has determined the condition is caused by an anomalous radio altitude signal which indicates an altitude less than zero feet with either the flaps not in a takeoff setting or the stabilizer not trimmed in the takeoff range. The Modular Avionics and Warning Electronics Assembly (MAWEA) air/ground logic composition is being modified to ensure that the takeoff warnings can only occur when the airplane is on the ground. The takeoff configuration warning will remain active in flight until one of the following occurs:

- The system is “reset” by cycling power (the MAWEA power supply “A” and “B” circuit breakers are pulled and reset) or,
- The airplane pitch attitude is momentarily increased above +5 degrees.

Operating Instructions

This bulletin does not apply to affected airplanes modified by SB 747-31-2224.

Boeing recommends against cycling circuit breakers to resolve nuisance or system fault conditions. Therefore, should a configuration warning occur while the airplane is in flight, Boeing recommends the airplane be maneuvered to +5 degrees pitch to satisfy the logic which eliminates the warning. In cruise flight, the airplane pitch attitude is approximately 2 to 3 degrees, therefore, only 2 to 3 degrees pitch change is necessary. Prior to accomplishing the maneuver, crews are cautioned to ensure coordination with ATC and that conditions permit the required maneuvering.

This maneuver can be accomplished manually by disconnecting the autopilot and pitching the airplane through +5 degrees, then back to level flight. Crews should use slow, smooth and deliberate control inputs.

The maneuver may also be accomplished on autopilot using the following technique:

- Select V/S and approximately 2000 fpm rate of climb.
- As the airplane approaches 5 degrees pitch attitude, select -500 fpm rate of descent. Ensure the airplane will reach a pitch attitude of 5 degrees before the descent portion of the maneuver is commenced.
- As the airplane begins to descend, reselect VNAV or other desired pitch mode.

Flight crews should expect nominal altitude gains of approximately 300 feet when accomplishing this maneuver. The maneuver may also be accomplished in conjunction with a change in cruise altitude, such as a step climb.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-11 as "In Effect" (IE) .

This bulletin will be cancelled after Boeing is notified all affected airplanes in your fleet have been modified by Service Bulletin 747-31-2224.

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-12 R2

IssueDate: February 15, 2012

Airplane Effectivity: EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX

Subject: FCOM Update - Horizontal Stabilizer Tank (HST) Automatic Fuel Pump Shutoff

Reason: To describe the HST automatic fuel pump shutoff system and supporting Integrated Display System (IDS) software update (IDS-506/IDS-508).

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin applies to airplanes modified by Service Bulletin 747-28A2262.

Emergency AD 2002-24-52 kept in effect previously-imposed restrictions on center wing tank override/jettison and HST transfer/jettison pump operation. The restrictions are intended to prevent explosive fuel vapors from coming in contact with a potentially damaged fuel pump by keeping pump inlets covered with fuel. To provide EICAS message-based crew procedures as an alternate method of compliance with AD 2002-24-52, Boeing initially developed IDS-503 software.

In a continuing effort to improve fuel system operation, Boeing Service Bulletin 747-28A2262 incorporates the following fuel system upgrades:

- Time delay logic to automatically shut off HST transfer/jettison pumps
- Updated IDS software (IDS-506/IDS-508) to support the auto shutoff feature

HST Pump Automatic Shutoff

Both transfer/jettison pumps in the HST are allowed to run briefly without pressure output after all HST fuel has transferred, but must be shut off by the flight crew immediately upon display of the new EICAS advisory message FUEL PRES STB L, R. If a Stabilizer Tank Pump switch is not selected OFF after approximately 14 seconds of continuous low pressure operation, the respective pump is commanded off.

IDS-506/IDS-508

This version of IDS software is an upgrade to support retrofit of the HST pump auto shutoff feature. For airplanes being upgraded from IDS-503, the EICAS message structure is revised as described in the table below.

IDS-506 EICAS Message Changes with HST Auto Shutoff Activated

Message	Level	Change	Notes
>FUEL LO STAB L, R	Advisory	Deleted	1
FUEL PRES STAB L, R	Caution	Deleted	1
>FUEL PMP STB L, R	Advisory	Logic Revision	2
FUEL PRES STB L, R	Advisory	New	3
RADIO TRANSMIT	Advisory	Logic Revision	4
SPEEDBRAKE ARMED	Memo	New	5

Note 1. Not required for HST pump zero-pressure operation with automatic pump shutoff incorporated.

Note 2. Displays when HST fuel quantity is 500 kgs or more, airplane established in cruise (less than 5 degrees pitch) for at least 10 minutes, and respective Stabilizer Tank Pump switch is OFF.

Note 3. Replaces FUEL LO STAB L, R and FUEL PRES STAB L, R

Note 4. Unrelated to fuel system messages. Caret removed from message; introduces new non-normal checklist.

Note 5. Unrelated to fuel system messages changes, but included with the software update.

Flight Crew Operations Manual Information

The new EICAS advisory message FUEL PRES STB L, R is briefly described above and in more detail in its non-normal checklist condition statement.

Revisions to existing normal procedures and non-normal checklists are described below:

CLIMB AND CRUISE PROCEDURE - revised to reflect reference to the new EICAS message FUEL PRES STB L, R.

FUEL JETTISON - Revised procedure to add reference to the new EICAS message FUEL PRES STB.

>FUEL LO STAB L, R - Revised checklist effectvity to indicate procedure applies only to airplanes with IDS software versions prior to IDS-506/IDS-508.

>FUEL PMP STB L, R - Revised procedure based on message logic to distinguish between airplanes with IDS-506/IDS-508 software and airplanes with earlier software versions.

FUEL PRES STAB L, R - Revised checklist effectvity to indicate procedure applies only to airplanes with IDS software versions prior to IDS-506/IDS-508.

FUEL PRES STB L,R - New checklist for airplanes with IDS-506/IDS-508 software and HST pump auto shutoff activated.

Administrative Information

This bulletin replaces bulletin TRX-12 R1 dated June 10, 2011. Discard TRX-12 R1. Revise the Bulletin Record to show TRX-12 R1 “Cancelled” (CANC).

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-12 R2 as "In Effect" (IE) .

This bulletin will be incorporated in a future revision of your Flight Crew Operations Manual.

Intentionally
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Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-13

IssueDate: October 1, 2010

Airplane Effectivity: (SB changes VQ-BHW, VQ-BHX)

Subject: Engine Bleed Air Shutoff Anomaly

Reason: To inform flight crews a system fault can result in the shutoff of all engine bleed air.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin does not apply to airplanes modified by Boeing Service Bulletin 747-36A2136.

An operator recently reported shutoff of bleed air from all engines during flight. Investigation revealed a single fault in the Air Supply Control Test Unit (ASCTU) can result in closure of all engine bleed air valves and illumination of all Engine Bleed Air OFF lights. In the reported incident the fault was intermittent. When the fault was removed, low-pressure bleed air became available and all Engine Bleed Air OFF lights extinguished. Cycling the Engine Bleed Air Switches recovered normal engine bleed air.

With this fault the BLEED 1, 2, 3 and 4 messages do not display. With bleed air shut off to all using systems, the following indications will be observed:

- air conditioning packs shut down and PACK 1, PACK 2, and PACK 3 messages display (pressurization is gradually lost)
- air driven hydraulic pumps (ADPs) will be unpowered and respective HYD PRESS DEM messages display when ADPs are commanded to run
- when flaps are selected, leading and trailing edge flaps operate in the secondary mode (the FLAPS PRIMARY message displays)

- wing and nacelle anti-ice systems are inoperative
- thrust reversers are inoperative
- The >TRIM AIR OFF message displays.

Depending upon environmental conditions, cabin and flight deck temperatures can rise quickly. If necessary (passenger/combi), remove as many sources of heat as possible by:

- turning off all in-flight entertainment systems
- turning off all galleys
- closing all window shades to block sunlight.

After descent to safe altitude, increase airflow throughout the airplane by:

- opening both outflow valves
- opening the smoke evacuation port
- if heat becomes excessive (passenger/combi), opening a cabin door 1 and a cabin door 4 or door 5.

The PACK 1, 2, 3 non-normal checklist has been revised to accommodate the conditions of this anomaly.

Operating Instructions

If the EICAS messages PACK 1, PACK 2, and PACK 3 display simultaneously, accomplish the revised PACK 1, 2, 3 non-normal checklist.

Flight Crew Operations Manual Information

The PACK 1, 2, 3 non-normal checklist will be restored to its original configuration after Boeing has been notified all affected airplanes in your fleet have been modified by SB 747-36A2136.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-13 as "Incorporated" (INC) .

This Operations Manual Bulletin will be cancelled after Boeing has been notified all affected airplanes in your fleet have been modified by Service Bulletin 47-36A2136.

CS3 2911

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-14 R2

IssueDate: February 15, 2012

Airplane Effectivity: EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Subject: General Electric (GE) CF6-80C2 Engine Flameout Mitigation

Reason: To provide flight crews with updated background information on engine flameout events in visible moisture with TAT below 10°C in the vicinity of convective weather systems, and to provide revised operating instructions.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing and General Electric (GE) are investigating several CF6-80C2 engine flameout events which have occurred on various airplane models since 1991. Investigation of weather, flight data, and pilot reports associated with these events suggest the flameout events have occurred at altitudes with Static Air Temperature (SAT) above 0°C in the vicinity of convective weather systems. Boeing and GE believe ice accumulated aft of the fan during a descent or deceleration may have been shed and ingested into the engine when the thrust levers were subsequently advanced.

Boeing and GE investigations conclude the airplanes most likely encountered ice crystals lifted by convective activity prior to the engine flameout. At very cold temperatures near thunderstorms the airplane can encounter visible moisture made up of high concentrations of small ice crystals. These ice crystals do not cause weather radar returns. Flight crews have reported deviating around strong weather radar returns when the flameout events have occurred. Flight crews have also reported rain on the windshield when the outside air temperature was too cold for liquid water to exist. Boeing attributes this to ice crystals that melt upon impact with the heated windshield, giving the appearance of rain. These types of ice crystals do not accumulate on cold aircraft surfaces.

Flight crew reports and airplane data have shown airplane TAT indication may erroneously indicate 0°C for a period of time just prior to engine flameout. This anomalous behavior is due to ice crystals partially blocking the probe and is not cause for engine flameout, but is a confirmation ice crystals were present.

The Operating Instructions contained in this bulletin use nacelle anti-ice, wing anti-ice and pack high flow operation. Increased bleed air extraction from the engine causes the combustor to operate at a higher fuel-to-air ratio, which reduces the probability of flameout. In some engine flameout events, nacelle anti-ice was already on. Boeing and GE understand that the Operating Instructions contained in this bulletin may not prevent all flameout events. However, increased engine bleed air extraction does provide a large increase in the margin to flameout.

These engine flameout events typically occur when the airplane is leveling off at an intermediate altitude. ATC permitting, make a continuous descent at idle thrust, which decreases exposure time to the ice crystal condition and potential engine flameout.

If an engine flameout occurs, the Electronic Engine Control (EEC) attempts to relight the engine when it detects N2 below 50% or rapid decrease in N2. Engines accelerate to idle very slowly at high altitudes. In some of these events, it has taken 120 seconds or more to reach commanded thrust levels. This may be incorrectly interpreted by the flight crew as an engine that is still flamed out instead of an engine already in the process of relighting. If N2 is steadily increasing and EGT remains within limits, the start is progressing normally. In all events investigated, affected engines successfully started, including some outside the in-flight start envelope. If N2 is steadily increasing and EGT remains within limits following a single engine flameout, the flight crew need not accomplish the ENG FAIL followed by the ENGINE IN-FLIGHT START checklist. The MULTIPLE ENGINE FLAMEOUT/STALL checklist should be accomplished for multiple engine flameout events.

Use of wing anti-ice at altitudes above 22,000 feet has not been included in the operating instructions to ensure no adverse impact on airplane systems that utilize engine bleed air.

Entering the TAI/ON ALT on the DESCENT FORECAST page adjusts the VNAV path calculation for approach idle conditions with nacelle anti-ice on.

Operating Instructions

When TAT is at or below 10°C in visible moisture with engine thrust reduced for a descent or a speed reduction even with SAT less than -40°C:

CAUTION: Do not operate nacelle or wing anti-ice when TAT is above 10°C

PACK HIGH FLOW switch ....ON

NACELLE ANTI-ICE switches/selectors ....ON

[Increases bleed-air extraction to improve engine flameout margin.]

At or below 22,000 feet:

WING ANTI-ICE switch/selector ....ON

[Increases bleed-air extraction to improve engine flameout margin.]

During flight in Instrument Meteorological Conditions (IMC), avoid flying directly above significant amber or red depicted map weather radar regions. Use of the weather radar gain and tilt functions ar recommended to assess weather radar return reflectivity.

During airplane descent and ATC permitting, attempt a continuous descent at idle thrust to decrease exposure to ice crystal conditions.

Nacelle and wing anti-ice may be selected OFF (or AUTO, as installed) when the conditions described above no longer exist and are not required for existing flight conditions.

Administrative Information

This bulletin replaces bulletin TRX-14 R1 dated April 1, 2011. Discard TRX-14 R1. Revise the Bulletin Record to show TRX-14 R1 “Cancelled” (CANC).

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-14 R2 as "In Effect" (IE) .

This condition remains under investigation. This bulletin remains in effect until further notice.

CS3 3484

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Flight Crew Operations Manual Bulletin for Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-15

IssueDate: November 1, 2010

Airplane Effectivity: All Airplanes

Subject: Uncommanded Turns When LNAV is in Use

Reason: To inform flight crews of the possibility of the airplane turning prior to the active waypoint when LNAV is in use.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received several reports of uncommanded turns when LNAV is in use. This condition has been reported on 757, 767, 747-400 and 777 airplanes. When an uncommanded turn occurs, the TO (active) waypoint was observed on the FMC CDU to have prematurely sequenced. In some cases, the ND correctly showed the TO waypoint in front of the airplane, but the waypoint symbol's color was white (indicating inactive) instead of magenta (indicating active). No inputs to the FMC were reported to have been in progress at the time of the turns. The condition was usually resolved by performing a DIRECT TO to the waypoint that had prematurely sequenced.

Boeing has been unable to identify the cause of this uncommanded turn condition. Attempts to duplicate it in the lab have so far been unsuccessful.

Operating Instructions

Should an uncommanded turn occurs when using LNAV, select HDG SEL to follow the flight plan, then perform a DIRECT TO to the waypoint that had prematurely sequenced. Reengage LNAV as desired.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-15 as "In Effect" (IE) .

This condition is under investigation. This bulletin remains in effect until further notice.

This bulletin will be revised to include information about the service bulletin that resolves the condition when that information becomes available.

CS3 4604

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-16 R2

IssueDate: February 15, 2012

Airplane Effectivity: EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Subject: New Core Ice Shedding Procedure When Operating in Freezing Fog

Reason: To inform flight crews of a special ice shedding procedure that can be used in freezing fog conditions.

Revised to correct figure 1and typographical errors.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Introduction

Operators exposed to freezing fog who wish to minimize the risk of unplanned engine removals associated with ice damage to the engine core may use a new, optional core ice shedding procedure. The borescope inspection requirements following exposure to freezing fog in the Aircraft Maintenance Manual (AMM) remain in effect.

Background Information

Boeing has received reports of internal engine damage on RB211-524 powered 747-400 airplanes. The damage occurred after extended idle thrust operation in freezing fog. In freezing fog, ice can build up in the core of the engine as well as on the fan blades.

Analysis has shown the current RB211-524 ground engine ice shedding procedure, which requires operation at 60% N1 for 10 seconds every 60 minutes, is adequate for shedding fan blade ice accumulations but may not always shed core ice accumulations in freezing fog conditions.

Analysis has also shown extended exposure to freezing fog conditions below -13°C can create ice accumulations impractical or impossible to shed using ground run-up procedures. The use of engine anti-ice on the ground will not prevent ice accumulations on the fan blades or in the core of the engine. An engine that experiences freezing fog on taxi in to the gate will not shed the ice when the engine is shut down in cold temperatures. For this reason, the total engine running time of taxi in and taxi out, including warm up and cool down times, in freezing fog must be considered.

A new, optional core ice shedding procedure has been developed for operations in freezing fog. This procedure does not apply to operations in snow, hail, sleet, freezing rain, or freezing drizzle. These condition have a larger water particle size that does not cause ice accumulation in the core of the engine.

Boeing and Rolls Royce recommend using the new, optional core ice shedding procedure any time total taxi time in freezing fog (FZFG as reported in the METAR) exceeds 30 or 45 minutes, dependent on ambient air temperature, when visibility is 900 feet (300 meters) RVR or less as reported in the METAR. In freezing fog, inbound flight crews must make a log book entry of the total number of minutes taxiing in when visibility is 300 meters RVR or less so the subsequent outbound flight crew can calculate the total taxi time in these conditions.

The new, optional core ice shedding procedure for operations in freezing fog is summarized in Figure 1.

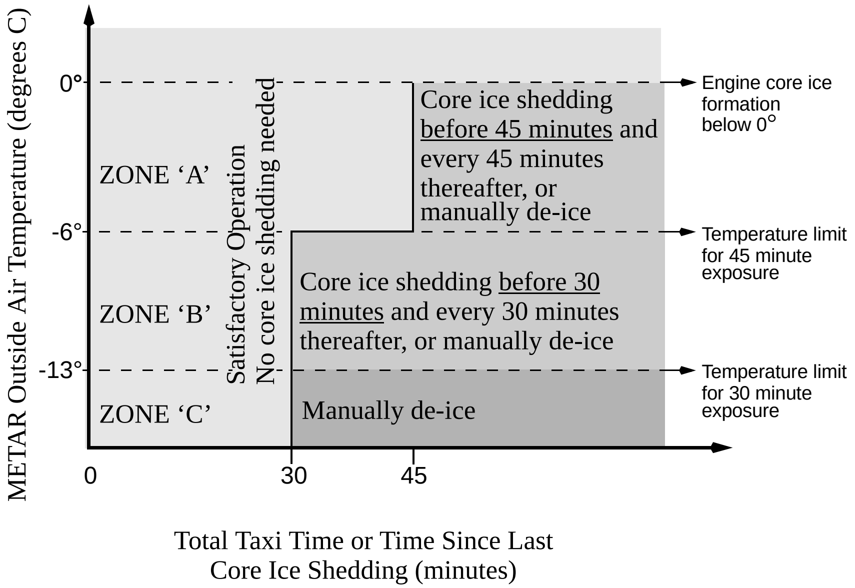

Figure 1

Operating Instructions

Flight crews may use the new, optional core ice shedding procedure for RB211-524 engines when freezing fog (FZFG) with visibility of 900 feet (300 meters) RVR or less is reported in the METAR to minimize compressor damage.

Note: If taxi in on the previous flight occurred in freezing fog and the temperature stayed below freezing, the taxi in time from the previous flight must be included in the total time. If the engine is considered free of ice before engine start, only the taxi out time should be included in the total time. The engine is considered free of ice before engine start if:

- the engine has been manually de-iced, or
- the engine has been visually inspected per the AMM, or
- the core ice shedding procedure was conducted within 5 minutes of engine shutdown after taxi in.

If the subsequent takeoff cannot be accomplished within 45 minutes total taxi time for a OAT of 0°C to -6°C, or 30 minutes for an OAT of -7°C to -13°C, accomplish the new core ice shedding procedure to clear the ice from the engine core. The core ice shedding procedure should be accomplished at intervals no greater than every 30 or 45 minutes, dependent on OAT, before takeoff.

For an OAT of -14°C or below, if the subsequent takeoff cannot be accomplished within 30 minutes total taxi time, manual de-icing is needed. To avoid manual de-icing requirements, operators are encouraged to work with airport authorities to limit or eliminate exposure to extended taxi times when freezing fog conditions exist.

If the subsequent takeoff can be accomplished within 45 minutes total taxi time for an OAT of 0°C to -6°C, or 30 minutes total taxi time for an OAT of -7°C or below, the new core ice shedding procedure does not need to be done.

CAUTION: As with all engine run-ups, precautions must be taken for:

- jet blast up to 600 feet (200 meters) behind the aircraft
- snow and ice at the edge of the taxiway that can be ingested by the engines
- slippery taxi surfaces
- airport noise restrictions

In Figure 1 above, determine the Zone (A, B, or C). For the applicable Zone, accomplish an ice shedding run-up to the % N1 for either of the times shown in Table 1below.

Note: 66% N1 maximum is recommended to prevent engine vibration damage and to respect the takeoff configuration warning that may annunciate at 70% N1.

Run-up Time	30 secs	60 secs
Zone A, 0°C to -6°C See Note 1 (Fuel used, all engine)	60% N1 (170 lbs)	50% N1 (275 lbs)
Zone B, -7°C to -13°C See Note 2 (Fuel used, all engine)	Not Available	66% N1 (425 lbs)
Zone C, -14°C or below	Manually de-ice	

Table 1

Note 1: During taxi, if the temperature falls below -6°C, accomplish an immediate run-up and continue to use the procedure for Zone A. If an immediate run-up cannot be accomplished, use the procedure for Zone B.

Note 2: During taxi, if the temperature falls below -13°C, accomplish an immediate run-up and continue to use the procedure for Zone B. If an immediate run-up cannot be accomplished, use the procedure for Zone C.

In all cases, accomplish the Nacelle Anti-Ice Operation - On the Ground supplementary procedure before brake release for takeoff.

Administrative Information

This bulletin replaces bulletin TRX-16 R1 dated January 7, 2011. Discard TRX-16 R1. Revise the Bulletin Record to show TRX-16 R1 “Cancelled” (CANC).

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-16 R2 as "In Effect" (IE) .

This bulletin will be incorporated in a future revision of your Flight Crew Operations Manual.

CS3 4652

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Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-17 R1

IssueDate: February 15, 2012

Airplane Effectivity: EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI- XLJ

Subject: Fuel System Configuration - FR HiTemp Fuel Pumps

Reason: To describe the new FR HiTemp fuel pumps.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin applies to airplanes modified by Service Bulletin 747- 28A2258.

Emergency AD 2002-24-52 kept in effect restrictions previously imposed on center wing tank (CWT) override/jettison and horizontal stabilizer tank (HST) transfer/jettison pump operation. The restrictions are intended to prevent explosive fuel vapors from coming in contact with a potentially damaged fuel pump by keeping CWT and HST pump inlets covered with fuel. To provide EICAS message-based crew procedures as an alternate method of compliance (AMOC) with AD 2002-24-52, Boeing developed IDS-503 software.

In support of continuing efforts to enhance safety and improve fuel system operation, Boeing has made new FR HiTemp fuel pumps available for retrofit in airplanes delivered with Hydro-Aire pumps.

The FR HiTemp fuel pumps improve fuel system operation by eliminating the potential fuel vapor ignition source caused in the past by potentially-damaged Hydro-Aire pumps. The new pumps are installed in the following fuel tanks:

- all main tanks (both main pumps in each tank)
- CWT and main tanks 2 and 3 (both override/jettison pumps in each tank)
- HST - passenger airplanes only (both transfer/jettison pumps).

While the FR HiTemp pump design adds a new level of safety to fuel system operation, CWT and HST pumps remain restricted to operating only when immersed in fuel. This restriction will remain in effect until dry operation of the new pump design is authorized by the FAA. Therefore, operating procedures for CWT and HST pumps are unchanged from those currently in effect with IDS-503 and later versions of IDS software.

Because the new pumps are not certified for operation with Jet B or JP-4 fuels, use of those fuels is prohibited.

Operating Instructions

For airplanes modified by Boeing Service Bulletin 747-28A2258, the use of Jet B and JP-4 fuels is prohibited.

Administrative Information

This bulletin replaces bulletin TRX-17 dated April 1, 2011. Discard TRX-17. Revise the Bulletin Record to show TRX-17 “Cancelled” (CANC).

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-17 R1 as "In Effect" (IE) .

This bulletin will be incorporated in a future revision of your Flight Crew Operations Manual.

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-19 R1

IssueDate: February 15, 2012

Airplane Effectivity: EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Subject: Nuisance EICAS Caution Message >FMC RUNWAY DIS

Reason: To direct flight crews to disable GPS updating to prevent nuisance display of the EICAS caution message >FMC RUNWAY DIS.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin applies to airplanes with EICAS caution message >FMC RUNWAY DIS activated.

The EICAS caution message >FMC RUNWAY DIS displays when the airplane position or heading is not lined up within specified limits of the active FMC departure runway and takeoff thrust is applied. GPS updating is required to enable sensing of position errors; heading errors will trigger the message even if GPS updating is disabled.

At certain airports not compliant with WGS-84 standards, the >FMC RUNWAY DIS message may display when takeoff thrust is applied and the airplane is on the active FMC departure runway. Under these conditions, the navigation database runway position that is not compliant with WGS-84 differs from the GPS airplane position enough to trigger display of the message.

Disabling GPS updating on the POS REF Page 2/3 (Line Select Key 5R) inhibits position error sensing to preclude nuisance display of the >FMC RUNWAY DIS message. The message will still display if a heading error is detected.

Operating Instructions

Disable GPS updating on the POS REF Page 2/3 before takeoff from airports not compliant with WGS-84. Enable GPS on the POS REF Page 2/3 after takeoff.

Note: Operator will designate affected airports applicable to their operations.

Administrative Information

This bulletin replaces bulletin TRX-19 dated June 10, 2011. Discard TRX-19. Revise the Bulletin Record to show TRX-19 “Cancelled” (CANC).

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-19 R1 as "In Effect" (IE) .

This condition is temporary until the system is modified. This bulletin will be revised to include Service Bulletin information when available.

CS3 3254

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-20 R1

IssueDate: February 15, 2012

Airplane Effectivity: EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Subject: EICAS Caution Message >FMC RUNWAY DIS Alerting

Reason: To direct flight crews to disable GPS updating to prevent nuisance display of the EICAS caution message >FMC RUNWAY DIS.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

This bulletin applies to airplanes with EICAS caution message >FMC RUNWAY DIS activated.

The EICAS caution message >FMC RUNWAY DIS displays when the airplane position or heading is not lined up within specified limits of the active FMC departure runway and takeoff thrust is applied. GPS updating is required to enable sensing of position errors; heading errors will trigger the message even if GPS updating is disabled.

On a recent test flight the EICAS Caution message >FMC RUNWAY DIS failed to display when the airplane was lined up on a parallel runway approximately 1000 feet from the FMC departure runway. The message displayed correctly when first tested at this location, then failed to display on another test at the same location approximately 20 minutes later.

Subsequent investigation indicates that the lack of consistent alerting was caused by variability of an overly conservative GPS parameter used in the FMC. The following table shows the approximate probability of a valid >FMC RUNWAY DIS message being displayed at various distances from the departure runway.

Distance (feet)	400	600	800	1000	1200
Probability of alert	10%	50%	78%	92%	97%

As an example, the parallel runways at San Francisco (KSFO) are spaced about 800 feet apart. The current system will only provide an alert about 78% of the time if takeoff power is applied when lined up on the wrong parallel runway.

The >FMC RUNWAY DIS message can also be triggered when the airplane heading differs by more than 30 degrees from the departure runway heading when takeoff power is applied. This portion of the >FMC RUNWAY DIS alert functions as intended and provides reliable alerting.

Operating Instructions

Flight crews should be aware of the design limitations of the >FMC RUNWAY DIS message. The message may not display for errors in airplane lateral position from the departure runway. If the message is displayed it should be considered valid.

Administrative Information

This bulletin replaces bulletin TRX-20 dated June 10, 2011. Discard TRX-20. Revise the Bulletin Record to show TRX-20 “Cancelled” (CANC).

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-20 R1 as "In Effect" (IE) .

This condition is under investigation. This bulletin remains in effect until further notice.

CS3 3404

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-21

IssueDate: February 15, 2012

Airplane Effectivity: EI-XLZ

Subject: Nuisance EICAS Message WINDSHEAR SYS

Reason: To inform flight crews of predictive windshear system operational conditions that can cause the subject message to be displayed.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Flight testing and customer reports have confirmed that a nuisance WINDSHEAR SYS EICAS advisory message will occur for approximately 30 seconds under the following conditions:

- WXR has not been selected ON at any time since electrical power up, and
- one or more engines are above 60% N1 and the indicated airspeed is increasing.

This applies to the Allied Signal weather radar system with the Predictive Windshear function activated. The message will extinguish approximately 30 seconds after appearing.

Operating Instructions

This bulletin applies to affected airplanes until modified by AlliedSignal Service Bulletin M-4508 (RTA-48-34-97) Revision 1.

To prevent the message from occurring, select the weather radar system ON prior to takeoff. The weather radar may then remain ON or be turned OFF as desired for the remainder of the flight. After this, consider any WINDSHEAR SYS EICAS advisory message or WINDSHEAR alert as valid.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-21 as "In Effect" (IE) .

This Operations Manual Bulletin will be cancelled after Boeing is notified all affected airplanes in your fleet have been modified by AlliedSignal Service Bulletin M-4508 (RTA-48-34-97) Revision 1.

CS3 2763

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-22

IssueDate: January 23, 2012

Airplane Effectivity: (EI-XLZ)

Subject: Look-Ahead Terrain Alerting Display Anomalies

Reason: To inform flight crews of display anomalies associated with GPWS look-ahead terrain alerting.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

During a GPWS look-ahead terrain CAUTION or WARNING, terrain display data may be positioned inaccurately on the ND.

At ND ranges of 40 NM or greater, solid amber or solid red terrain data displays at an erroneous distance ahead of the airplane symbol. The error increases as the ND range selection is increased and can be up to 20 NM at the 160 NM range setting. Dotted red, dotted amber, and dotted green terrain data display correctly. Only solid amber (look-ahead terrain CAUTION active) and solid red terrain (look-ahead terrain WARNING active) data displays are affected.

In addition, display of solid amber and solid red terrain data may be delayed by 2 or 3 display sweeps after the initial terrain alert. Once displayed, solid terrain data may be removed on a subsequent display sweep.

Honeywell has modified Enhanced Ground Proximity Warning Computer (EGPWC) software to correct this condition as described in Boeing Service Letter 747-SL-34-105.

Operating Instructions

This bulletin applies to affected airplanes until modified by Honeywell EGPWC Service Bulletins 36(R1) and 41, or Boeing Service Bulletin 747-34-2705.

The terrain data display is intended to serve as a situational awareness tool only. It does not provide the accuracy or fidelity on which to solely base terrain avoidance maneuvering decisions.

In the event of a look-ahead terrain CAUTION or WARNING, accomplish the appropriate Terrain Avoidance Maneuver in the Non-Normal Maneuvers chapter of the QRH.

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-22 as "In Effect" (IE) .

This Operations Manual Bulletin will be cancelled after Boeing is notified all affected airplanes in your fleet have been modified by Honeywell EGPWC Service Bulletins 36(R1) and 41, or Boeing Service Bulletin 747-34-2705.

CS3 2864

Flight Crew Operations Manual Bulletin
for
Transaero Airlines

The Boeing Company
Seattle, Washington 98124-2207

747-400

Number: TRX-23

IssueDate: July 24, 2013

Airplane Effectivity: EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Subject: Revised Cold Weather Operations Supplementary Procedure for Cold-Soaked Engines

Reason: To prevent flight crews from motoring or starting a cold-soaked engine until Maintenance has warmed the engines.

Information in this bulletin is recommended by The Boeing Company, but may not be FAA approved at the time of writing. In the event of conflict with the FAA approved Airplane Flight Manual (AFM), the AFM shall supersede. The Boeing Company regards the information or procedures described herein as having a direct or indirect bearing on the safe operation of this model airplane.

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

The Hydro-Mechanical Units (HMUs) in GE CF6-80C2 engines are being modified. Current HMUs use fluorosilicone seals for all fuel-to-air locations. The fluorosilicone seals cause delays and cancellations due to leakage caused by compression set after extended exposure to hot fuel. These are being replaced with fluorocarbon seals. The fluorocarbon seals will have superior resistance to compression set, but have less capability at extremely low temperatures. Consequently, an HMU heating procedure is added to prevent leakage under extremely low temperatures.

Since flight crews will not know which seals are on particular engines, the HMU warm-up operating instructions below are being added to the Adverse Weather - Cold Weather Operations Supplementary procedure for all 747-400 airplanes with CF6-80C2 engines..

Operating Instructions

Do the normal Engine Start Procedure with the following consideration:.

If the engine has been cold-soaked for more than four hours at ambient temperatures below -30 degrees C, do not start or motor the engine. Maintenance personnel should do appropriate procedures for adverse weather heating of the engine fuel system components.

Flight Crew Operations Manual Information

The table below lists the pages attached to this bulletin. Remove existing pages corresponding to the pages listed below and replace them with the attached pages.

Page	Date
SP.16.3-4	July 24, 2013

Administrative Information

Insert this bulletin behind the Bulletin Record page in Volume 1 of your Flight Crew Operations Manual. Amend the Bulletin Record to show bulletin TRX-23 as "Incorporated" (INC) .

This bulletin will be cancelled in the next revision of your Flight Crew Operations Manual.

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status to the 747 Manager, Flight Technical Data through the Service Requests application on the MyBoeingFleet home page.

CS3-5329

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General

This chapter contains:

- Airplane Flight Manual (AFM) operational information
- Non-AFM operational information.

Information is included if:

- operationally significant
- required by FAA Airworthiness Directive
- required by another regulatory requirement

Information is not included if it is:

- incorporated into FCOM normal, supplementary, or non-normal procedures, with a few exceptions
- shown on a placard, display, or other marking

Operational information listed in this chapter that must be memorized (memory items) are marked with a (#) symbol. They meet the following criterion - flight crew access by reference can not assure timely compliance, e.g.c severe turbulence penetration speeds. They need only be memorized to the extent that compliance is assured. Knowing the exact wording of the limitation is not required.

Assuming that the remaining items are available to the flight crew by reference, they do not need to be memorized.

Airplane General

Operational Limitations

Runway slope	+/- 2%

VQ-BHW, VQ-BHX

#Maximum Takeoff and Landing Tailwind Component	10 knots

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

#Maximum Takeoff and Landing Tailwind Component	15 knots

Maximum Operating Altitude	45,100 feet pressure altitude

#Maximum Takeoff and Landing Altitude	9,500 feet pressure altitude
#Maximum speed operating in Reduced Vertical Separation Minimum (RVSM) Airspace	0.90 Mach

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Note: Maximum takeoff tailwind component 10 knots with takeoff weights greater than 375,574 kgs.

Non–AFM Operational Information

#The turbulent air penetration speed is 290 to 310 KIAS/.82 to .85M, whichever is lower.

The maximum takeoff and landing crosswind is 30 knots (not limiting).

Do not operate HF radios during refueling operations.

#Do not operate the weather radar in a hangar or within 50 feet of any fuel spill.

Note: The hangar restriction does not apply to the weather radar test mode.

Altitude Display Limits for RVSM Operations

Standby altimeters do not meet altimeter accuracy requirements of RVSM airspace.

The maximum allowable in flight difference between Captain and First Officer altitude displays for RVSM operations is 200 feet.

The maximum allowable on-the-ground altitude display differences for RVSM operations are:

Field Elevation	Max Difference Between Captain & F/O	Max Difference Between Captain or F/O & Field Elevation
Sea Level to 5,000 feet	35 feet	75 feet
10,000 feet	40 feet	75 feet

Door Mounted Power Assists and Escape Slides

Main and upper deck door emergency power assists and evacuation slide systems must be armed with the mode select lever in the AUTOMATIC position prior to taxi, takeoff, and landing whenever passengers are carried in the respective area.

Flight Deck Security Door

Verify that an operational check of the Flight Deck Access System has been accomplished according to approved procedures once each flight day.

Weight Limitations

Maximum Taxi Weight

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

386,914 Kilograms

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

395,986 Kilograms

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

397,800 Kilograms

Maximum Takeoff Weight

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

385,553 Kilograms

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

394,625 Kilograms

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

396,893 Kilograms

Maximum Landing Weight

285,763 Kilograms

Maximum Zero Fuel Weight

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

242,671 Kilograms

Maximum Zero Fuel Weight

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

244,939 Kilograms

Air Systems

Cabin Pressurization

Maximum differential pressure (relief valves)	9.4 psi
Maximum allowable cabin pressure differential for takeoff and landing	0.11 psi

Autoflight

AFDS

#Use of aileron trim with autopilot engaged is prohibited.

The autopilot must not be engaged below a minimum engage altitude of 250 feet AGL after takeoff.

The autopilot must be disengaged before the airplane descends more than 50 feet below the MDA unless it is coupled to an ILS glideslope and localizer or in the go–around mode.

For single channel ILS approaches, the autopilot must be disengaged before the airplane descends below 100 feet AGL.

Automatic Landing

#Maximum allowable wind speeds when landing weather minima are predicated on autoland operations:

VQ-BHW, VQ-BHX

#Headwind	25 knots
#Tailwind	10 knots
#Crosswind	25 knots

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

#Headwind	25 knots
#Tailwind	15 knots
#Crosswind	25 knots

#The maximum glideslope angle is 3.25 degrees.

#The minimum glideslope angle is 2.5 degrees.

Automatic landings may be made with flaps 25 or 30 only.

Communications

VHF Radio Voice Communications

EI-XLB, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

EI-XLB, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW
With an operational ACARS system, the use of center VHF radio is not approved for ATC voice communications.

VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX
Do not use the center VHF radio for ATC voice communications.

VHF Frequency Limitation

EI-XLC, EI-XLE, EI-XLG, EI-XLH, EI-XLK

Do not use the center VHF radio on 120.000 MHz or 120.005 MHz as the required means of communication. If frequencies 120.000 MHz or 120.005 MHz are required, left VHF radio and right VHF radio communication systems must be operational for dispatch.

HF Radios

VQ-BHW, VQ-BHX

If one HF radio is selected for transmission, deselect the other HF radio on all audio control panels to prevent audio interference.

ACARS (As installed)

The ACARS is limited to the transmission and receipt of messages which will not create an unsafe condition if the message is improperly received, such as the following conditions:

- the message or parts of the message are delayed or not received,
- the message is delivered to the wrong recipient, or
- the message content may be frequently corrupted.

However, Pre-Departure Clearance, Digital-Automatic Terminal Information Service, Oceanic Clearances, Weight and Balance, and Takeoff Data messages can be transmitted and received over ACARS if they are verified per approved operational procedures.

Air Traffic Control Datalink

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKL

ATC clearance data received through the FMC which can only be viewed on the flight deck printer must be independently verified with the originating ground station.

Engines, APU

Engine Oil System

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Oil temperature must be greater than 50 degrees C before advancing thrust levers to takeoff power.

Engine Oil System

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- #Minimum oil temperature for starting: -30 degrees C

Engine Fuel System

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
The maximum tank fuel temperature for Jet A, Jet A–1, or JP–5 is 54°C (130°F).

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
The maximum tank fuel temperature for Jet A, Jet A–1, JP–5, or JP-8 is 54°C (130°F).

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
The maximum tank fuel temperature for Jet B or JP-4 is 43°C (110°F).

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
In-flight tank fuel temperature must be maintained at least 3°C above the fuel freezing point of the fuel being used. The use of Fuel System Icing Inhibitor additives does not change the minimum fuel tank temperature limit.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Tank fuel temperature prior to takeoff must not be less than -43°C (-46°F) or 3°C above the fuel freezing point temperature, whichever is higher. In-flight tank fuel temperature must be maintained at least 3°C above the fuel freezing point of the fuel being used. The use of Fuel System Icing Inhibitor additives does not change the minimum fuel tank temperature limit.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Tank fuel temperature prior to takeoff must not be less than -40°C (-40°F) or 3°C above the fuel freezing point temperature, whichever is higher. In-flight tank fuel temperature must be maintained at least 3°C above the fuel freezing point of the fuel being used. The use of Fuel System Icing Inhibitor additives does not change the minimum fuel tank temperature limit.

Engine Ignition

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Continuous ignition must be on encountering:

- heavy rain
- severe turbulence
- volcanic ash
- icing conditions
- standing water or slush on runway

Note: Continuous ignition is automatically provided when nacelle anti–ice is on.

Reverse Thrust

#Intentional selection of reverse thrust in flight is prohibited.

#Backing the airplane with use of reverse thrust is prohibited.

Flight Management, Navigation

QFE Selection

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

QFE operations are prohibited.

VNAV Selection

Non-AFM Operational Information

#If leveling off within 2000 feet after changing altimeter setting from QNE to QNH, or QNH to QNE, do not use VNAV to execute the level-off if QNH is less than 29.70 in/1006 hPa. After the level-off is complete, VNAV may be re-engaged.

Airplane Structure

Flight Controls

Avoid rapid and large alternating control inputs, especially in combination with large changes in pitch, roll, or yaw (e.g. large side slip angles) as they may result in structural failure at any speed, including below V_A.

Flap Operation

Do not extend flaps above 20,000 feet.

Non-AFM Operational Information

Use of speedbrakes in flight with flaps extended past 20 is not recommended.

Warning Systems

GPWS - Look-Ahead Terrain Alerting

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

Do not use the terrain display for navigation.

The use of look-ahead terrain alerting and terrain display functions is prohibited within 15 nm of takeoff, approach or landing at an airport or runway not contained in the GPWS terrain database. Refer to Honeywell Document 060-4267-000 for airports and runways contained in the installed GPWS terrain database.

TCAS

Pilots are authorized to deviate from their current ATC clearance to the extent necessary to comply with a TCAS II resolution advisory (RA).

Normal Procedures — Chapter NP

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General

This chapter gives:

- an introduction to the normal procedures philosophy and assumptions
- step by step normal procedures

Normal Procedures Philosophy and Assumptions

Normal procedures verify for each phase of flight that:

- the airplane condition is satisfactory
- the flight deck configuration is correct

Normal procedures are done on each flight. Refer to the Supplementary Procedures (SP) chapter for procedures that are done as needed, for example the adverse weather procedures.

Normal procedures are used by a trained flight crew and assume:

- all systems operate normally
- the full use of all automated features (LNAV, VNAV, autoland, autopilot, and autothrottle)

Normal procedures also assume coordination with the ground crew before:

- hydraulic system pressurization, or
- flight control surface movement, or
- airplane movement

Normal procedures do not include steps for flight deck lighting and crew comfort items.

Normal procedures are done by memory and scan flow. The panel illustration in this section shows the scan flow. The scan flow sequence may be changed as needed.

Configuration Check

It is the crew member’s responsibility to verify correct system response. Before engine start, use lights or indications to verify each system's condition or configuration.

If there is an incorrect configuration or response:

- verify that the system controls are set correctly

- check the respective circuit breaker as needed. Maintenance must first determine that it is safe to reset a tripped circuit breaker on the ground
- test the respective system light as needed

Before engine start, review the EICAS alert messages and status display. If there are unexpected messages:

- check the Dispatch Deviations Guide (DDG) or the operator equivalent to decide if the condition has a dispatch effect
- decide if maintenance is needed

If, during or after engine start, there is an alert message:

- do the respective non-normal checklist (NNC)
- on the ground, check the DDG or the operator equivalent

After engine start, EICAS alert messages are the primary means of alerting the flight crew to non-normal conditions or incorrect configurations.

After engine start, there is no need to check status messages. Any message that has an adverse affect on safe continuation of the flight appears as an EICAS alert message.

Crew Duties

Preflight and postflight crew duties are divided between the captain and first officer. Phase of flight duties are divided between the Pilot Flying (PF) and the Pilot Monitoring (PM).

Each crewmember is responsible for moving the controls and switches in their area of responsiblity:

- The phase of flight areas of responsibility for both normal and non-normal procedures are shown in the Area of Responsibility illustrations in this section. Typical panel locations are shown.
- The preflight and postflight areas of responsibility are defined by the “Preflight Procedure - Captain” and “Preflight Procedure - First Officer”.

The captain may direct actions outside of the crewmember’s area of responsibility.

The general PF phase of flight responsibilities are:

- taxiing
- flight path and airspeed control
- airplane configuration
- navigation

The general PM phase of flight responsibilities are:

- checklist reading
- communications
- tasks asked for by the PF
- monitoring taxiing, flight path, airspeed, airplane configuration, and navigation

PF and PM duties may change during a flight. For example, the captain could be the PF during taxi but be the PM during takeoff through landing.

Normal procedures show who does a step by crew position (C, F/O, PF, or PM):

- in the procedure title, or
- in the far right column, or
- in the column heading of a table

The mode control panel is the PF’s responsibility. When flying manually, the PF directs the PM to make the changes on the mode control panel.

The captain is the final authority for all tasks directed and done.

Control Display Unit (CDU) Procedures

Before taxi, the captain or first officer may make CDU entries. The other pilot must verify the entries.

Make CDU entries before taxi or when stopped, when possible. If CDU entries must be made during taxi, the PM makes the entries. The PF must verify the entries before they are executed.

In flight, the PM usually makes the CDU entries. The PF may also make simple, CDU entries when the workload allows. The pilot making the entries executes the change only after the other pilot verifies the entries.

During high workload times, for example departure or arrival, try to reduce the need for CDU entries. Do this by using the MCP heading, altitude, and speed control modes. The MCP can be easier to use than entering complex route modifications into the CDU.

Autopilot Flight Director System (AFDS) Procedures

The crew must always monitor:

- airplane course
- vertical path
- speed

When selecting a value on the MCP, verify that the respective value changes on the flight instruments, as applicable.

The crew must verify manually selected or automatic AFDS changes. Use the FMA to verify mode changes for the:

- autopilot
- flight director
- autothrottle

During LNAV and VNAV operations, verify all changes to the airplane's:

- course
- vertical path
- thrust
- speed

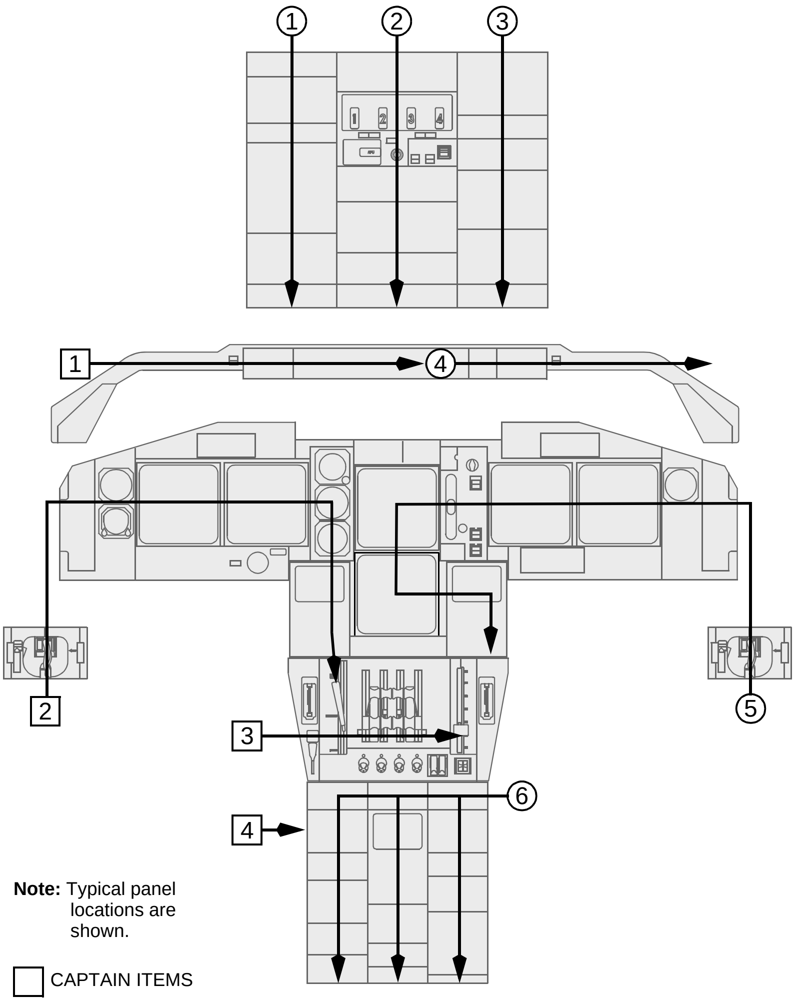
Announcing changes on the FMA and thrust mode display when they occur is a good CRM practice.

Scan Flow and Areas of Responsibility

The scan flow and areas of responsibility diagrams shown below are representative and may not match the configuration(s) of your airplanes.

The scan flow diagram provides general guidance on the order each flight crew member should follow when doing the preflight and postflight procedures. Specific guidance on the items to be checked are detailed in the Normal Procedures. For example, preflight procedure details are in the Preflight Procedure - Captain, and Preflight Procedure - First Officer.

Preflight and Postflight Scan Flow

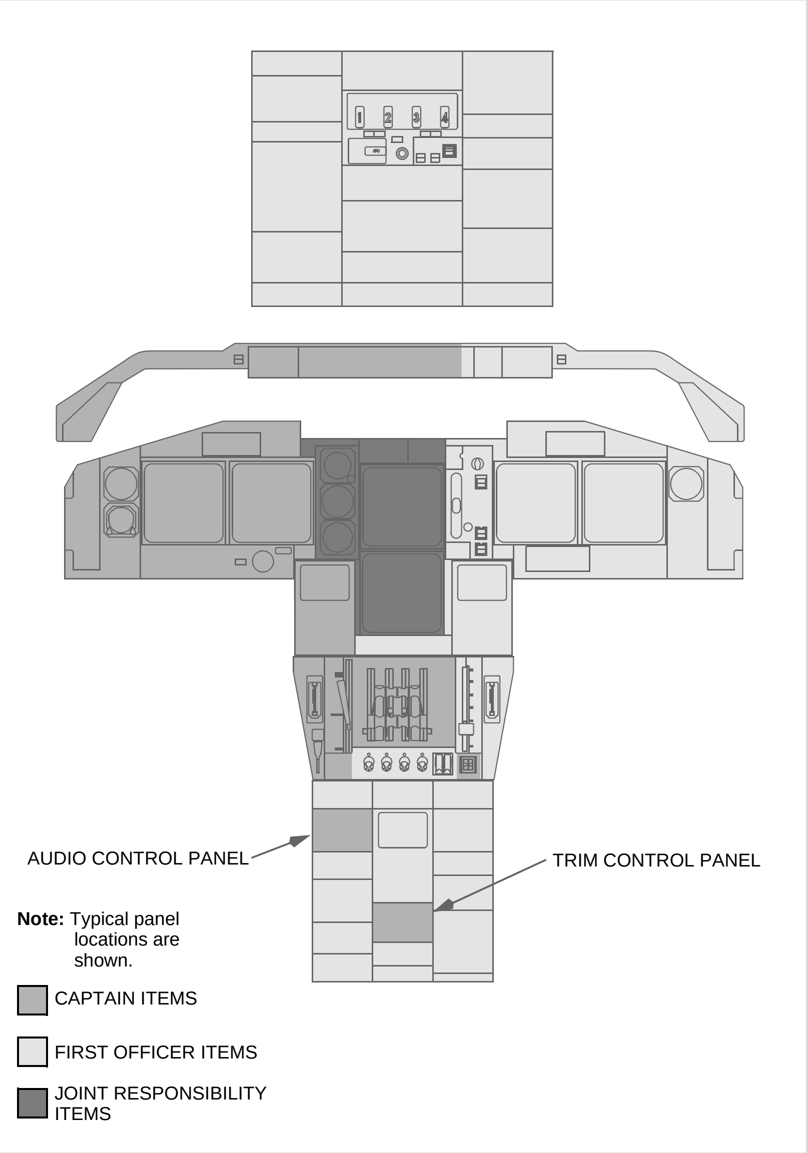


Note: Typical panel locations are shown.

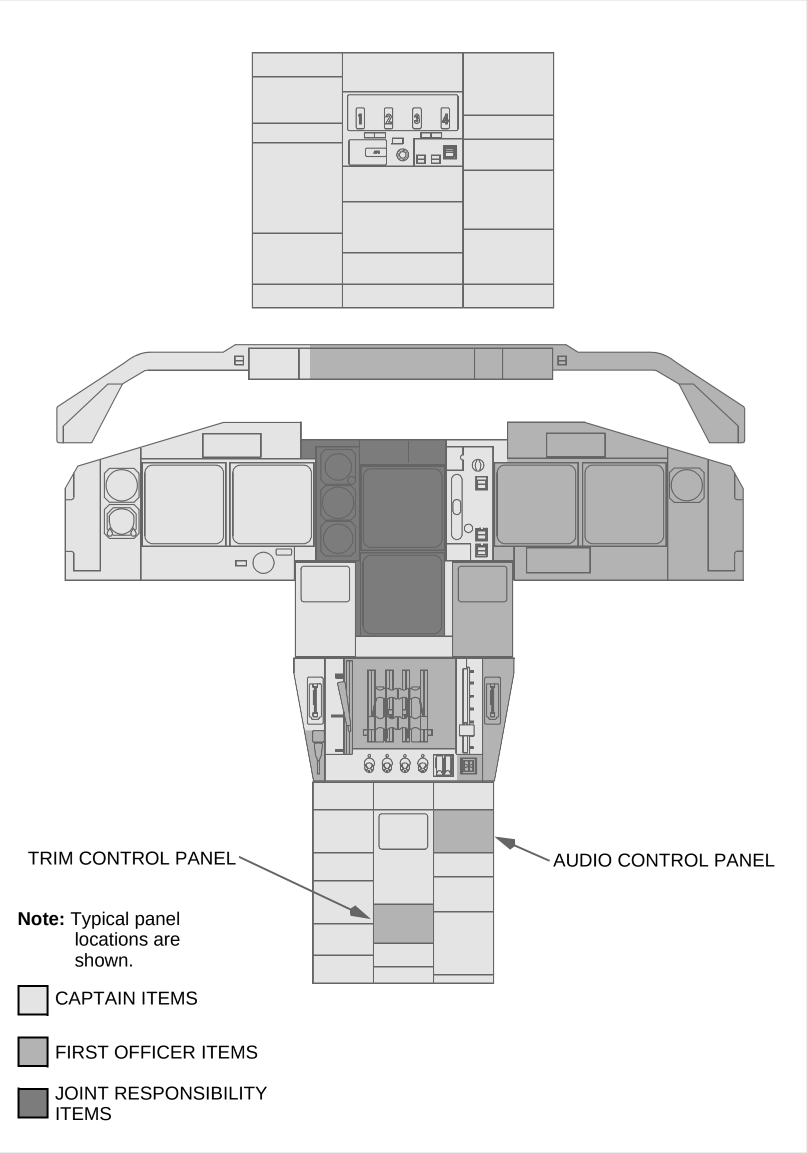
☐ CAPTAIN ITEMS

○ FIRST OFFICER ITEMS

Areas of Responsibility - Captain as Pilot Flying or Taxiing



Areas of Responsibility - First Officer as Pilot Flying or Taxiing



Intentionally
Blank

Preliminary Preflight Procedure - Captain or First Officer

The Preliminary Preflight Procedure assumes that the Electrical Power Up supplementary procedure is complete.

IRS mode selectors ....OFF, then NAV

The UNABLE RNP message may show until IRS alignment is complete.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
VOICE RECORDER switch ....As needed

STATUS display .... Check

Verify that only expected messages are shown.

Verify that the following are sufficient for flight:

- oxygen pressure
- hydraulic quantity
- engine oil quantity

Do the remaining actions after a crew change or maintenance action.

Maintenance documents .... Check

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
FLIGHT DECK ACCESS SYSTEM switch................. Guard closed

Circuit breakers .... Check

Emergency equipment .... Check

Fire extinguisher - Checked and stowed

Crash axe - Stowed

Emergency escape devices - Stowed

Other needed equipment - Checked and stowed

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Hatch .... Closed and locked

Smoke evacuation handle .... Check

Overhead maintenance panel .... Guards closed

The split system breaker OPEN light may be illuminated.

Verify that all other lights are extinguished.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

APU START SOURCE switch .... TR

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

CARGO CONDITIONED AIR FLOW RATE selector .... As needed

With cargo - LO or HI

Without cargo - OFF

Circuit Breakers ....Check

Parking brake .... As needed

Set the parking brake if brake wear will be checked during the exterior inspection.

CDU Preflight Procedure - Captain and First Officer

Start the CDU Preflight Procedure anytime after the Preliminary Preflight Procedure. The Initial Data and Navigation Data entries must be complete before the flight instrument check during the Preflight Procedure. The Performance Data entries must be complete before the Before Start Checklist.

The captain or first officer may make CDU entries. The other pilot must verify the entries.

Enter data in all the boxed items on the following CDU pages.

Enter data in the dashed items or modify small font items that are listed in this procedure. Enter or modify other items at pilot's discretion.

Failure to enter enroute winds can result in flight plan time and fuel burn errors.

Initial data ....Set

IDENT page:

Verify that the MODEL is correct.

Verify that the ENGINES are correct.

Verify that the navigation database ACTIVE date range is current.

POS INIT page:

Verify that the time is correct.

Enter the present position on the SET IRS POS line. Use the most accurate latitude and longitude.

Navigation data ....Set

RTE page:

Enter the route.

EI-XLF, EI-XLJ, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Enter the FLIGHT NUMBER.

Activate and execute the route.

DEPARTURES page:

Select the runway and departure routing.

Execute the runway and departure routing.

Verify that the route is correct on the RTE pages. Check the LEGS pages as needed to ensure compliance with the flight plan.

Verify or enter correct RNP for departure.

NAV RADIO page:

Tune the navigation radios, as needed.

Performance data ....Set

PERF INIT page:

CAUTION: Do not enter the ZFW into the GR WT boxes. The FMC will calculate performance data with significant errors.

Enter the ZFW.

Verify that the FUEL on the CDU, the dispatch papers, and EICAS agree.

Verify that the fuel is sufficient for flight.

Verify that the GR WT on the CDU and the dispatch papers agree.

THRUST LIM page:

Select an assumed temperature, or a fixed derate takeoff, or both as needed.

Select a full or a derated climb thrust as needed.

TAKEOFF REF page:

CG - Enter

Select or enter the takeoff V speeds.

Verify that the takeoff V speeds on both CDUs agree. If the speeds disagree, re-enter the takeoff V speeds.

Note: If any changes are made to the CDU entries, verify that the takeoff V speeds on both CDUs and PFDs agree. If the speeds disagree, re-enter the takeoff V speeds.

Exterior Inspection

Before each flight the captain, first officer, or maintenance crew must verify that the airplane is satisfactory for flight.

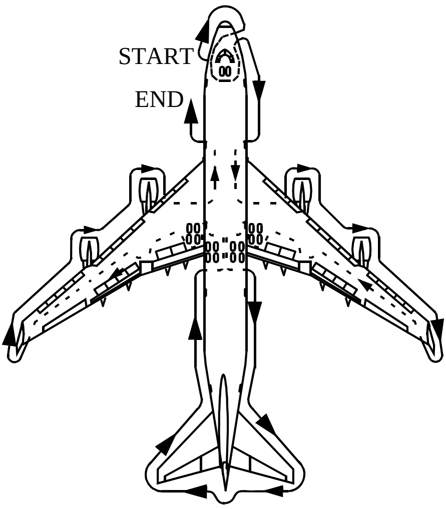
Items at each location may be checked in any sequence.

Use the detailed inspection route below to check that:

- the surfaces and structures are clear, not damaged, not missing parts and there are no fluid leaks
- the tires are not too worn, not damaged, and there is no tread separation
- the gear struts are not fully compressed
- the engine inlets and tailpipes are clear, the access panels are secured, the exterior is not damaged, and the reversers are stowed
- the doors and access panels that are not in use are latched
- the probes, vents, and static ports are clear and not damaged
- the skin area adjacent to the pitot probes and static ports is not wrinkled
- the antennas are not damaged
- the light lenses are clean and not damaged

For cold weather operations see the Supplementary Procedures.

Inspection Route



Left Forward Fuselage

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Nose

Radome .... Check

Diverter strips - Secure

Windshield wipers .... Against stops

TAT probes .... Check

Nose Wheel Well

Tires and wheels .... Check

Gear strut and doors .... Check

Exterior lights .... Check

Nose wheel steering assembly .... Checked

Nose wheel steering lockout pin .... As needed

Gear pins .... As needed

Main electrical and electronic (E/E) compartment door .... Secure

Right Forward Fuselage

Probes, sensors, ports, vents, and drains (as applicable)................Check

Doors and access panels (not in use).. Latched

Negative pressure relief doors ....Closed

Oxygen pressure relief green disc .... In place

Right Wing Root, Pack, and Lower Fuselage

Probes, sensors, ports, vents, and drains (as applicable)................Check

Exterior lights ....Check

Pack inlet and pneumatic access doors .... Secure

Fuel measuring sticks .... Flush and secure

Leading edge flaps ....Check

Number 3 and 4 Engines

Access panels .... Latched

Probes, sensors, ports, vents, and drains (as applicable)................Check

Fan blades, probes, and spinner ....Check

Strut midspar fuse pins alignment stripes ....Check

A minimum of 1/2 of each stripe must align. A stripe is on the inboard and outboard side of each strut.

Thrust reversers .... Stowed

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Popout pin - Check

Exhaust area and tailcone ....Check

Fuel measuring sticks .... Flush and secure

Right Wing and Leading Edge

Access panels .... Latched

Leading edge flaps ....Check

Fuel measuring sticks ....Flush and secure

Wing Surfaces .... Check

Fuel tank vent .... Check

Right Wing Tip and Trailing Edge

Navigation and strobe lights .... Check

Static discharge wicks .... Check

Fuel jettison nozzle .... Check

Ailerons and trailing edge flaps .... Check

Right Wing and Body Gear

Tires, brakes and wheels .... Check

Verify that the wheel chocks are in place as needed.

If the parking brake is set, the brake wear indicator pins must extend out of the guides.

Gear strut, actuators, and doors .... Check

Hydraulic lines ....Secure

Gear pins ....As needed

Wheel wells .... Check

APU FIRE CONTROL handle .... In

Right Aft Fuselage

Doors and access panels (not in use) ....Latched

Negative pressure relief door ....Closed

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Outflow valve .... Check

Tail

Navigation and strobe lights. .... Check

Vertical stabilizer and rudder .... Check

Static ports .... Check

Horizontal stabilizer and elevator .... Check

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Fuel measuring sticks .... Flush and secure

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Fuel tank vent .... Check

APU exhaust outlet .... Check

Static discharge wicks .... Check

Left Aft Fuselage

Doors and access panels (not in use) .... Latched

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Outflow valve .... Check

Left Body and Wing Gear

Tires, brakes and wheels .... Check

Verify that the wheel chocks are in place as needed.

If parking brake is set, the brake wear indicator pins must extend out of the guides.

Gear strut, actuators, and doors .... Check

Hydraulic lines .... Secure, no leaks

Gear pins .... As needed

Wheel wells .... Check

Left Wing Tip and Trailing Edge

Ailerons and trailing edge flaps .... Check

Fuel jettison nozzle .... Check

Static discharge wicks .... Check

Navigation and strobe lights .... Check

Left Wing and Leading Edge

Wing Surfaces .... Check

Fuel tank vent .... Check

Fuel measuring sticks ....Flush and secure

Leading edge flaps .... Check

Access panels ....Latched

Number 1 and 2 Engines

Exhaust area and tailcone .... Check

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Thrust reversers ....Stowed

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Popout pin - Check

Strut midspar fuse pins alignment stripes .... Check

A minimum of 1/2 of each stripe must align. A stripe is on the inboard and outboard side of each strut.

Fuel measuring sticks ....Flush and secure

Fan blades, probes, and spinner .... Check

Left Wing Root, Pack, and Lower Fuselage

Fuel measuring sticks ....Flush and secure

Probes, sensors, ports, vents, and drains (as applicable) .... Check

Exterior lights .... Check

Pack inlet and pneumatic access doors ....Secure

Leading edge flaps .... Check

Positive pressure relief doors ....Closed

Preflight Procedure - First Officer

The first officer normally does this procedure. The captain may do this procedure if needed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

ELT switch ....Guard closed

ELECTRONIC ENGINE CONTROL switches .... NORM

Verify that the ALTN lights are extinguished.

Electrical panel ....Set

STANDBY POWER selector - AUTO

UTILITY power switches - ON

Verify that the OFF lights are extinguished.

BATTERY switch - ON

Verify that the OFF light is extinguished.

BUS TIE switches - AUTO

Verify the ISLN lights are extinguished.

GENERATOR CONTROL switches - ON

Verify that the OFF lights are illuminated.

Verify that the GENERATOR DISCONNECT DRIVE lights are illuminated.

APU selector (if needed) ....START, then ON

Do not allow the APU selector to spring back to the ON position.

Verify that the APU generator 1 and APU generator 2 AVAIL lights are illuminated.

APU GENERATOR 1 switch - Push

Verify that the ON light is illuminated.

APU GENERATOR 2 switch - Push

Verify that the ON light is illuminated.

HYDRAULIC panel..Set

DEMAND pump selectors - OFF

Verify that the hydraulic SYS FAULT lights are illuminated.

Verify that the demand pump PRESS lights are illuminated.

ENGINE pump switches - ON

Verify that the engine pump PRESS lights are illuminated.

EMERGENCY LIGHTS switch ....Guard closed

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

CAPTAIN'S AUDIO SYSTEM switch ....NORM

OBSERVER'S AUDIO SYSTEM switch ....NORM

SERVICE INTERPHONE switch .... OFF

FUEL TRANSFER MAIN 1 AND 4 switch .... Off

Fire Panel ....Set

Engine fire switches - In

BTL A DISCH and BTL B DISCH lights - Extinguished

APU BTL DISCH light - Extinguished

APU fire switch - In

CARGO FIRE DISCH light - Extinguished

CARGO FIRE ARM switches - Off

Verify that the FWD and AFT lights are extinguished.

Engine START panel ....Set

START switches - In

Verify that the Engine start lights are extinguished.

STANDBY IGNITION selector - NORM

CONTINUOUS IGNITION switch - Off

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

AUTO IGNITION selector - SINGLE

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

AUTO IGNITION selector - 1 or 2

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
AUTO IGNITION selector - NORM

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
AUTOSTART switch - ON

FUEL JETTISON panel .... Set

Fuel jettison selector - OFF

Fuel jettison NOZZLE valve switches - Off

Verify that the VALVE lights are extinguished.

Fuel panel .... Set

All X FEED valve switches - On

Verify that the VALVE lights are extinguished.

All fuel pump switches - Off

Verify that the main pump PRESS lights are illuminated.

VP-BVR
(VP-BKJ ; before SB, main pump 3 aft not modified for APU fuel feed)
Verify that the main 2 aft pump PRESS light is extinguished when APU is running.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
(VP-BKJ ; SB modifies main pump 3 aft for APU fuel feed)
Verify that the main 2 and 3 aft pump PRESS lights are extinguished when APU running.

Verify that the override 2 and 3 pumps and center pumps PRESS lights are extinguished.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Verify that the stabilizer pump PRESS lights are extinguished.

Anti-ice panel .... Set

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
NACELLE ANTI-ICE switches - AUTO

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
NACELLE ANTI-ICE switches OFF

Verify that the VALVE lights are extinguished.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
WING ANTI-ICE switch - AUTO

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
WING ANTI-ICE SWITCH - OFF

Verify that the VALVE light is extinguished.

Windshield protection panel .... Set

WINDOW HEAT switches - ON

Verify that the INOP lights are extinguished.

Windshield WIPER selectors - OFF

Lighting panel .... Set

LANDING light switches - OFF

RUNWAY TURNOFF light switches - OFF

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
TAXI lights switch - OFF

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; system installed by STC)
VIDEO CONTROL CENTER
COMPARTMENT POWER switch .... ON

Note: Do not push the PASSENGER OXYGEN switch. The switch causes deployment of the passenger oxygen masks.

PASSENGER OXYGEN switch .... Guard closed

YAW DAMPER switches .... ON

INOP lights remain illuminated until first IRU aligns.

CABIN ALTITUDE panel .... Set

LANDING ALTITUDE switch - AUTO

Outflow valve manual switches - Off

Cabin Altitude AUTO SELECTOR - NORM

ECS panel .... Set

PASSENGER TEMPERATURE selector - AUTO

FLIGHT DECK TEMPERATURE selector - AUTO

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
CARGO TEMPERATURE selector - AUTO

ZONE SYS FAULT light - Extinguished

TRIM AIR switch - ON

UPPER and LOWER RECIRCULATION fan switches - ON

AFT CARGO HEAT switch - Off

EQUIPMENT COOLING selector - NORM

HIGH FLOW switch - Off

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
GASPER switch - ON

EI-XLC, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
HUMIDIFIER switch - ON

Bleed air panel .... Set

Pack SYS FAULT light - Extinguished

PACK control selectors - NORM

LEFT and RIGHT ISOLATION valve switches - On

Verify that the VALVE lights are extinguished.

Engine bleed air SYS FAULT lights - Extinguished

APU bleed air switch - ON

Verify that the VALVE light is extinguished.

ENGINE BLEED air switches - ON

Lighting panel .... Set

BEACON light switch - OFF

NAVIGATION light switch - As needed

STROBE light switch - OFF

WING light switch - OFF

LOGO light switch - As needed

Note: Secondary images might occur on the flight deck windows during night operations.

FLIGHT DIRECTOR switch .... ON

Select the status display.

EFIS control panel .... Set

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ
MINIMUMS reference selector - RADIO or BARO

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
MINIMUMS reference selector - DH or MDA

MINIMUMS selector - Set decision height or altitude reference

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
FLIGHT PATH VECTOR switch - As needed

METERS switch - As needed

BAROMETRIC reference and BAROMETRIC selectors - Set

Select INCHES or HECTOPASCALS.

Set local altimeter setting.

VOR/ADF switches - As needed

ND mode selector - MAP

ND CENTER switch - As needed

ND range selector - As needed

ND TRAFFIC switch - As needed

WEATHER RADAR switch - Off
Verify that the weather radar indication is not shown on the ND.

Map switches - As needed

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
PVD .... ON and check

Oxygen .... Test and set

Oxygen mask - Stowed and doors closed

Crew oxygen pressure - Check EICAS

Note oxygen pressure.

RESET/TEST switch - Push and hold

Verify that the yellow cross shows momentarily in the flow indicator.

EMERGENCY/TEST selector - Push and hold

While continuing to hold the RESET/TEST switch down, push the EMERGENCY/TEST selector for 10 seconds. Verify that the yellow cross appears continuously in the flow indicator.

Verify that the crew oxygen pressure does not decrease more than 100 psig.

If the oxygen cylinder valve is not in the full open position, pressure can:
- decrease rapidly, or
- decrease more than 100 psig, or
- increase slowly back to normal

Release RESET/TEST switch and EMERGENCY/TEST selector. Verify that the yellow cross no longer shows in the flow indicator.

Normal/100% selector - 100%

Crew and passenger oxygen pressure - Check EICAS

Verify that the pressure is adequate for dispatch.

SOURCE SELECT panel .... Set

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
FLIGHT DIRECTOR source selector - R

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
FLIGHT DIRECTOR / PVD source select - R

NAVIGATION source selector - FMC R

EIU source selector - AUTO

IRS source selector - R

AIR DATA source selector - R

Clock ....Set

CRT select panel ....Set

LOWER CRT selector - NORM

INBOARD CRT selector - NORM

Accomplish the Initial Data and Navigation Data steps from the CDU Preflight Procedure and ensure IRS alignment is complete before checking flight instruments.

Flight instruments .... Check

Verify that the flight instrument indications are correct.

Verify that only the following flags are shown:
- TCAS OFF if the ND TFC switch is pushed
- NO VSPD until takeoff V-speeds are selected

Verify that the flight mode annunciations are correct:
- autothrottle mode is blank
- roll mode is TO/GA
- pitch mode is TO/GA
- AFDS status is FD

Display the map mode

GND PROXIMITY panel..Set

Ground PROX light - Extinguished

Ground proximity FLAP OVERIDE switch - Off

Ground proximity CONFIGURATION GEAR OVERRIDE switch - Off

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ
GROUND PROXIMITY TERRAIN OVERRIDE switch - Off

Landing gear panel .... Set

Landing gear lever - Down

ALTERNATE FLAPS selector - Off

Alternate flaps ARM switch - Off

ALTERNATE GEAR EXTEND switches - Off

CRT BRIGHTNESS controls .... As needed

EIU selector .... AUTO

HEADING reference switch .... NORM

FMC master selector L

EICAS display .... Check

Upper EICAS display - Check

Verify that the primary engine indications display existing conditions.

Verify that no exceedance is shown.

Lower EICAS display - Check

Secondary ENGINE indications - Check

Verify that the secondary engine indications display existing conditions.

Verify that no exceedance is shown.

Select the status display

Status messages - Check

Left radio tuning panel .... Set

Verify that the OFF light is extinguished.

Center radio tuning panel .... Set

Verify that the OFF light is extinguished.

Observer audio control panel .... As needed

Weather radar panel .... Set

Passenger signs ....Set

NO SMOKING selector - AUTO or ON

SEATBELTS selector - AUTO or ON

AUTOBRAKES selector ....RTO

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
Emergency evacuation COMMAND switch ....ARM

Right radio tuning panel ....Set

Verify that the OFF light is extinguished.

First officer's audio control panel..As desired

Transponder panel ....Set

WARNING: Do not place objects between pilot's seat and aisle stand. Injury can occur when the seat is adjusted forward.

Seat ....Adjust

Position the seat for optimum eye reference.

Rudder pedals ....Adjust

Adjust to permit full rudder pedal and brake application.

Accomplish the PREFLIGHT checklist on the captain's command.

Preflight Procedure - Captain

The captain normally does this procedure. The first officer may do this procedure if needed.

Note: Secondary images might occur on the flight deck windows during night operations.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
PVD ....ON and check

EFIS control panel ....Set

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ
MINIMUMS reference selector - RADIO or BARO

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

MINIMUMS reference selector - DH or MDA

MINIMUMS selector - Set decision height or altitude reference

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

FLIGHT PATH VECTOR switch - As needed

METERS switch - As needed

BAROMETRIC reference and BAROMETRIC selectors - Set

Select INCHES or HECTOPASCALS.

Set local altimeter setting.

VOR/ADF switches - As needed

ND mode selector - MAP

ND CENTER switch - As needed

ND range selector - As needed

ND TRAFFIC switch - As needed

WEATHER RADAR switch - Off

Verify that the weather radar indication is not shown on the ND.

Map switches - As needed

Mode control panel .... Set

FLIGHT DIRECTOR switch - ON

AUTOTHROTTLE ARM switch - ARM

BANK LIMIT selector - AUTO

Autopilot DISENGAGE bar - Up

Oxygen .... Test and set

Select the status display

Oxygen mask - Stowed and doors closed

Crew oxygen pressure - Check EICAS

Note oxygen pressure.

RESET/TEST switch - Push and hold

Verify that the yellow cross appears momentarily in the flow indicator.

EMERGENCY/TEST selector - Push and hold

While continuing to hold the RESET/TEST switch down, push the EMERGENCY/TEST selector for 10 seconds. Verify that the yellow cross appears continuously in the flow indicator.

Verify that the crew oxygen pressure does not decrease more than 100 psig.

If the oxygen cylinder valve is not in the full open position, pressure can:

- decrease rapidly, or
- decrease more than 100 psig, or
- increase slowly back to normal

Release RESET/TEST switch and EMERGENCY/TEST selector. Verify that the yellow cross no longer appears in the flow indicator.

Normal/100% selector - 100%

Crew and passenger oxygen pressure - Check EICAS

Verify that the pressure is adequate for dispatch.

SOURCE SELECT panel ....Set

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

FLIGHT DIRECTOR source selector - L

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

FLIGHT DIRECTOR / PVD source select - L

NAVIGATION source selector - FMC L

EIU source selector - AUTO

IRS source selector - L

AIR DATA source selector - L

Clock...Set

RMI .... Check

VOR/ADF selectors - As desired

Magnetic Heading - Correct

CRT select panel .... Set

INBOARD CRT selector - NORM

LOWER CRT selector - NORM

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
ALTERNATE EFIS selector - As desired

Accomplish the Initial Data and Navigation Data steps from the CDU Preflight Procedure and ensure IRS alignment is complete before checking flight instruments.

Flight instruments .... Check

Verify that the flight instrument indications are correct.

Verify that only the following flags are shown:
- TCAS OFF if the ND TFC switch is pushed
- NO VSPD until takeoff V-speeds are selected

Verify the flight mode annunciations are correct:
- autothrottle mode is blank
- roll mode is TO/GA
- pitch mode is TO/GA
- AFDS status is FD

Display the map mode.

Standby instruments .... Check

Attitude indicator caging control - Pull and release

Verify that the attitude indicator is correct and no flags are shown.

ILS selector - OFF

Verify that the airspeed indications are correct.

Set the standby altimeter.

SPEEDBRAKE lever .... DN

Reverse thrust levers .... Down

Forward thrust levers .... Closed

Flap lever .... Set

The flap position indicator does not show when the flaps are up.

Set the flap lever to agree with the flap position.

PARKING BRAKE .... Set

Verify that the PARK BRAKE SET message shows.

Note: Do not assume that the parking brake will prevent airplane movement. Accumulator pressure can be insufficient.

FUEL CONTROL switches .... CUTOFF

FUEL CONTROL switch fire warning lights .... Extinguished

STABILIZER TRIM cutout switches .... Guard closed

ALTERNATE STABILIZER TRIM switches .... Neutral

Captain’s audio control panel .... As needed

WARNING: Do not place objects between pilot’s seat and aisle stand. Injury can occur when the seat is adjusted.

Seat .... Adjust

Position seat for optimum eye reference.

Rudder pedals .... Adjust

Adjust to permit full rudder pedal and brake application.

Call “PREFLIGHT CHECKLIST”.

Before Start Procedure

Start the Before Start Procedure after papers are on board.

Flight deck door .... Closed and locked F/O

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Verify that the flight deck door LKD light is illuminated.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Verify that the LOCK FAIL light is extinguished.

Do the CDU Preflight Procedure - Performance Data steps before completing this procedure.

CDU display .... Set C, F/O

Normally the PF selects the TAKEOFF REF page.

Normally the PM selects the LEGS page.

MCP .... Set C

When selecting a mode/value on the MCP, verify the corresponding display changes on the flight instruments or FMA, as appropriate.

IAS/MACH selector - Set V2

Arm LNAV as needed.

Arm VNAV.

Initial heading or track - Set

Initial altitude - Set

Taxi and Takeoff briefings .... Complete C, F/O

The pilot who will do the takeoff does the taxi and takeoff briefings.

Exterior doors .... Verify closed F/O

If pushback is needed:

Verify that the nose gear steering is locked out.

Start clearance .... Obtain C, F/O

Obtain a clearance to pressurize hydraulic systems.

Obtain a clearance to start the engines.

HYDRAULIC panel .... Set F/O

WARNING: If the tow bar is connected, do not pressurize the hydraulic systems until the nose gear steering is locked out. Unwanted tow bar movement can occur.

Note: Pressurize number 4 system first to prevent fluid transfer between systems.

Hydraulic demand pump 4 selector - AUX

Verify that the SYS FAULT light is extinguished.

Verify that the PRESS light stays illuminated.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Hydraulic demand pump 1 selector - AUX

Verify that the SYS FAULT light is extinguished.

Verify that the PRESS light stays illuminated.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
Hydraulic demand pump 1 selector - AUX

Verify that the SYS FAULT light is extinguished.

Verify that the PRESS light stays illuminated.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
Hydraulic demand pump 2 and 3 selectors - AUTO

Verify that the SYS FAULT lights are extinguished.

Verify that the PRESS lights are extinguished.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Hydraulic demand pump 1, 2, and 3 selectors - AUTO

Verify that the SYS FAULT lights are extinguished.

Verify that the PRESS lights are extinguished.

Fuel panel .... Set F/O

All MAIN tank FUEL PUMP switches - ON

Verify that the PRESS lights are extinguished.

If there is 7,700 kgs or more of fuel in the center wing tank:

CENTER FUEL PUMP switches - ON

Verify PRESS lights extinguished.

BEACON light switch ....BOTH F/O

RECALL switch ....Push F/O

Verify that only the expected alert messages are shown.

If FUEL TANK/ENG message shows:

Verify that:
- the fuel quantity in tank 2 is less than or equal to tank 1, or
- the fuel quantity in tank 3 is less than or equal to tank 4, or
- the fuel quantity in tank 2 is less than or equal to tank 1 plus 500 kgs and that the fuel quantity in tank 3 is less than or equal to tank 4 plus 500 kgs

OVERRIDE pumps 2 (both) switches - Off

OVERRIDE pumps 3 (both) switches - Off

CROSSFEED valve 1 and 4 switches - Off

CANCEL switch .... Push F/O

Verify messages cancelled

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Trim ....____ Units, zero, zero C

Stabilizer trim - ___ UNITS

Set the trim for takeoff.

Check that the trim is in the green band.

Aileron trim - 0 units

Rudder trim - 0 units

Call “BEFORE START CHECKLIST.” C

Do the BEFORE START checklist. F/O

Pushback or Towing Procedure

The Engine Start procedure may be done during pushback or towing.

Establish communications with ground handling personnel. C

CAUTION: Do not hold or turn the nose wheel tiller during pushback or towing. This can damage the nose gear or the tow bar.

CAUTION: Do not use airplane brakes to stop the airplane during pushback or towing. This can damage the nose gear or the tow bar.

Transponder ....As needed F/O

At airports where ground tracking is not available, select STANDBY. At airports equipped to track airplanes on the ground, select an active transponder setting, but not a TCAS mode.

Set or release parking brake as directed by ground handling personnel. C

When pushback or towing is complete:

Verify that the tow bar is disconnected. C

Verify that the nose gear steering is not locked out. C

Engine Start Procedure

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Select the secondary engine indications. F/O

PACK control selectors ....SET F/O

Set two or three packs off. To start two engines at the same time, it may be necessary to set three packs off.

Start sequence..Announce C

Call “START ___ ENGINE” C

Engine START switch .... Pull F/O

FUEL CONTROL switch ....RUN C

Verify that the oil pressure increases. C, F/O

Verify that there is N1 rotation and an oil pressure indication by idle N2. C, F/O

After the engine is stabilized at idle, start the other engines.

Autostart does corrective steps for:

- no EGT rise
- a hot start
- a hung start

Do the ABORTED ENGINE START checklist for one or more of the following abort start conditions:

- there is no N1 rotation by idle N2
- the fuel control switch is in RUN, the engine RPM is low, and the Autostart switch is off
- the oil pressure indication is not normal by the time the engine is stabilized at idle

Engine Start Procedure

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Select the secondary engine indications. F/O

PACK control selectors.. SET F/O

Set two or three packs off. To start two engines at the same time, it may be necessary to set three packs off.

Start sequence ....Announce C

Call “START ___ ENGINE” C

Engine START switch ....Pull F/O

FUEL CONTROL switch ....RUN C

Verify that the oil pressure increases by idle N3. C, F/O

After the engine is stabilized at idle, start the other engines.

Autostart does corrective steps for:

- no EGT rise
- a hot start
- a hung start
- no N1 rotation

Do the ABORTED ENGINE START checklist for one or more of the following abort start conditions:

- the oil pressure indication is not normal by the time the engine is stabilized at idle
- the fuel control switch is in RUN, the engine RPM is low, and the Autostart switch is off

Engine Start Procedure

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Select the secondary engine indications.		F/O
PACK control selectors	SET	F/O
Set two or three packs off..		
Start sequence	Announce	C
Call "START ___ ENGINE."		C
Engine “START” switch	Pull	F/O
Verify that the N2 RPM increases.		F/O
Verify that the oil pressure increases.		C, F/O

At maximum motoring (no increase for five to ten seconds) and a minimum of the fuel-on indicator:

FUEL CONTROL switch	RUN	C
Verify that the EGT increases and stays below the EGT limit.		C, F/O

After the engine is stabilized at idle, start the other engines.

Do the ABORTED ENGINE START checklist for one or more of the following abort start conditions:

- the EGT does not increase by 20 seconds after the fuel control switch is moved to RUN
- there is no N1 rotation by 40% N2
- the EGT quickly nears or exceeds the start limit
- the N2 is not at idle by 2 minutes after the fuel control switch is moved to RUN
- the oil pressure indication is not normal by the time the engine is stabilized at idle

Before Taxi Procedure

APU selector .... OFF		F/O
Hydraulic demand pump selectors .... AUTO		F/O
NACELLE ANTI-ICE switches ....As needed		F/O
AFT CARGO HEAT switch ....As needed		F/O
PACK control selectors .... NORM		F/O
Select the status display.		F/O

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Trim .... Set — C

Check trim for freedom of movement and set:

Stabilizer trim - ___ UNITS

Set the trim for takeoff.

Verify that the trim is in the green band.

Aileron trim - 0 units

Rudder trim - 0 units

Verify that the ground equipment is clear. — C, F/O

Call “FLAPS___” as needed for takeoff. — C

Flap lever .... Set takeoff flaps — F/O

Flight controls .... Check — C

Make slow and deliberate inputs, one direction at a time.

Move the control wheel and the control column to full travel in both directions and verify:

- freedom of movement
- that the controls return to center
- correct flight control movement on EICAS display.

Hold the nose wheel tiller during rudder check to prevent undesired nose wheel movement.

Move the rudder pedals to full travel in both directions and verify:
- freedom of movement
- that the rudder pedals return to center
- correct flight control movement on the EICAS display

Blank the lower EICAS display. F/O

Transponder.. As needed F/O

At airports where ground tracking is not available, select STANDBY. At airports equipped to track airplanes on the ground, select an active transponder setting, but not a TCAS mode.

Recall ....Check C, F/O

Verify that only expected alert messages shown.

Update changes to the taxi briefing, as needed. C or PF

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Do not advance the thrust lever until oil temperature is -10 degrees C or greater.

Call “BEFORE TAXI CHECKLIST.” C

Do the BEFORE TAXI checklist. F/O

Before Takeoff Procedure

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Engine warm up requirements:
- engine oil temperature must be above the bottom of the temperature scale

Engine warm up recommendations:
- run the engines for at least 3 minutes
- use a thrust setting normally used for taxi operations

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Engine warm up requirements:

- engine oil temperature must be above the lower amber band before takeoff

Engine warm up recommendations (there is no need to delay the takeoff for these recommendations:

- when the engines have been shut down more than 2 hours:
  - run the engines for 5 minutes
  - when the taxi time is expected to be less than 5 minutes, start the engines as early as feasible
  - use a thrust setting normally used for taxi operations

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Engine warm up requirements:

- when the engines have been shut down more than 1.5 hours:
  - run the engines for at least 5 minutes
- when the engines have been shut down less than 1.5 hours:
  - run the engines for at least 3 minutes
- use a thrust setting normally used for taxi operations
- engine oil temperature must be above the lower amber band before takeoff

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Pilot Flying	Pilot Monitoring
	Notify cabin crew to prepare for takeoff. Verify that the cabin is secure.
The pilot who will do the takeoff updates changes to takeoff briefing as needed.	
Set the weather radar display as needed.	
Call “BEFORE TAKEOFF CHECKLIST.”	Do the BEFORE TAKEOFF checklist.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

Pilot Flying	Pilot Monitoring
	Notify cabin crew to prepare for takeoff. Verify that the cabin is secure.
The pilot who will do the takeoff updates changes to takeoff briefing as needed.	
Set the weather radar display as needed. Set the terrain display as needed.	
Call “BEFORE TAKEOFF CHECKLIST.”	Do the BEFORE TAKEOFF checklist.

Takeoff Procedure

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Pilot Flying	Pilot Monitoring
Before entering the departure runway, verify that the runway and runway entry point are correct.	
	When entering the departure runway, set the STROBE light switch to ON. Use other lights as needed. Position transponder mode selector to TA/RA.
Verify that the brakes are released. Align the airplane with the runway.	
Verify that the airplane heading agrees with the assigned runway heading.	
	When cleared for takeoff, set the inboard LANDING lights switches to ON.
Advance the thrust levers to approximately 70% N1. Allow the engines to stabilize.	
Push the TO/GA switch.	
Verify that the correct takeoff thrust is set.	
	Monitor the engine instruments throughout takeoff. Call out any abnormal indications. Adjust takeoff thrust before 80 knots as needed. During strong headwinds, if the thrust levers do not advance to the planned takeoff thrusts, manually advance the thrust levers before 80 knots. Call “THRUST SET.”
After takeoff thrust is set, the captain’s hand must be on the thrust levers until V1.	
Monitor airspeed. Maintain light forward pressure on the control column.	Monitor airspeed indications and call out any abnormal indications.
Verify 80 knots and call “CHECK”.	Call “80 KNOTS”.

Pilot Flying	Pilot Monitoring
Verify V1 speed.	Call “V1”.
At VR rotate toward 15° pitch attitude. After liftoff, follow F/D commands.	At VR, call “ROTATE”. Monitor airspeed and vertical speed.
Establish a positive rate of climb.	
	Verify a positive rate of climb on the altimeter and call “POSITIVE RATE”.
Verify a positive rate of climb on the altimeter and call “GEAR UP”.	
	Set the Landing Gear lever to UP.
Above 400 feet radio altitude, call for a roll mode as needed.	Select or verify the roll mode. Verify VNAV engaged.
Verify that climb thrust is set.	
Verify acceleration at the acceleration height. Call “FLAPS____” according to the flap retraction schedule.	
	Position Flap lever as directed.
Engage the autopilot when above the minimum altitude for autopilot engagement.	
	After flap retraction is complete: • Set the Nacelle Anti-Ice switches to AUTO. • Set the Landing Gear lever OFF after landing gear retraction is complete. • Verify air conditioning packs operating.
Call “AFTER TAKEOFF CHECKLIST”.	
	Do the AFTER TAKEOFF checklist.

EI-XLK

Pilot Flying	Pilot Monitoring
Before entering the departure runway, verify that the runway and runway entry point are correct.	
	When entering the departure runway, set the STROBE light switch to ON. Use other lights as needed. Position transponder mode selector to TA/RA.
Verify that the brakes are released. Align the airplane with the runway.	
Verify that the airplane heading agrees with the assigned runway heading.	
	When cleared for takeoff, set the inboard LANDING lights switches to ON.
Advance the thrust levers to approximately 1.10 EPR. Allow the engines to stabilize.	
Push the TO/GA switch.	
Verify that the correct takeoff thrust is set.	
	Monitor the engine instruments throughout takeoff. Call out any abnormal indications. Adjust takeoff thrust before 80 knots as needed. During strong headwinds, if the thrust levers do not advance to the planned takeoff thrusts, manually advance the thrust levers before 80 knots. Call “THRUST SET.”
After takeoff thrust is set, the captain’s hand must be on the thrust levers until V1.	
Monitor airspeed. Maintain light forward pressure on the control column.	Monitor airspeed indications and call out any abnormal indications.
Verify 80 knots and call “CHECK”.	Call “80 KNOTS”.
Verify V1 speed.	Call “V1”.

Pilot Flying	Pilot Monitoring
At VR rotate toward 15° pitch attitude. After liftoff, follow F/D commands.	At VR, call “ROTATE”. Monitor airspeed and vertical speed.
Establish a positive rate of climb.	
	Verify a positive rate of climb on the altimeter and call “POSITIVE RATE”.
Verify a positive rate of climb on the altimeter and call “GEAR UP”.	
	Set the Landing Gear lever to UP.
Above 400 feet radio altitude, call for a roll mode as needed.	Select or verify the roll mode. Verify VNAV engaged.
Verify that climb thrust is set.	
Verify acceleration at the acceleration height. Call “FLAPS____” according to the flap retraction schedule.	
	Position Flap lever as directed.
Engage the autopilot when above the minimum altitude for autopilot engagement.	
	After flap retraction is complete: • Set the Landing Gear lever OFF after landing gear retraction is complete. • Verify air conditioning packs operating.
Call “AFTER TAKEOFF CHECKLIST”.	
	Do the AFTER TAKEOFF checklist.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Pilot Flying	Pilot Monitoring
Before entering the departure runway, verify that the runway and runway entry point are correct.	
	When entering the departure runway, set the STROBE light switch to ON. Use other lights as needed. Position transponder mode selector to TA/RA.

Pilot Flying	Pilot Monitoring
Verify that the brakes are released. Align the airplane with the runway.	
Verify that the airplane heading agrees with the assigned runway heading.	
	When cleared for takeoff, set the inboard LANDING lights switches to ON.
Advance the thrust levers to approximately 1.10 EPR. Allow the engines to stabilize.	
Push the TO/GA switch.	
Verify that the correct takeoff thrust is set.	
	Monitor the engine instruments throughout takeoff. Call out any abnormal indications. Adjust takeoff thrust before 80 knots as needed. During strong headwinds, if the thrust levers do not advance to the planned takeoff thrusts, manually advance the thrust levers before 80 knots. Call “THRUST SET.”
After takeoff thrust is set, the captain’s hand must be on the thrust levers until V1.	
Monitor airspeed. Maintain light forward pressure on the control column.	Monitor airspeed indications and call out any abnormal indications.
Verify 80 knots and call “CHECK”.	Call “80 KNOTS”.
Verify V1 speed.	Call “V1”.
At VR rotate toward 15° pitch attitude. After liftoff, follow F/D commands.	At VR, call “ROTATE”. Monitor airspeed and vertical speed.
Establish a positive rate of climb.	
	Verify a positive rate of climb on the altimeter and call “POSITIVE RATE”.
Verify a positive rate of climb on the altimeter and call “GEAR UP”.	
	Set the Landing Gear lever to UP.

Pilot Flying	Pilot Monitoring
Above 400 feet radio altitude, call for a roll mode as needed.	Select or verify the roll mode. Verify VNAV engaged.
Verify that climb thrust is set.	
Verify acceleration at the acceleration height. Call “FLAPS____” according to the flap retraction schedule.	
	Position Flap lever as directed.
Engage the autopilot when above the minimum altitude for autopilot engagement.	
	After flap retraction is complete: • Set the Nacelle Anti-Ice switches to AUTO. • Set the Landing Gear lever OFF after landing gear retraction is complete. • Verify air conditioning packs operating.
Call “AFTER TAKEOFF CHECKLIST”.	
	Do the AFTER TAKEOFF checklist.

EI-XLL, EI-XLM, EI-XLN, EI-XLO

Pilot Flying	Pilot Monitoring
Before entering the departure runway, verify that the runway and runway entry point are correct.	
	When entering the departure runway, set the STROBE light switch to ON. Use other lights as needed. Position transponder mode selector to TA/RA.
Verify that the brakes are released. Align the airplane with the runway.	
Verify that the airplane heading agrees with the assigned runway heading.	
	When cleared for takeoff, set the inboard LANDING lights switches to ON.

Pilot Flying	Pilot Monitoring
Advance the thrust levers to approximately 1.10 EPR. Allow the engines to stabilize.	
Push the TO/GA switch.	
Verify that the correct takeoff thrust is set.	
	Monitor the engine instruments throughout takeoff. Call out any abnormal indications. Adjust takeoff thrust before 80 knots as needed. During strong headwinds, if the thrust levers do not advance to the planned takeoff thrusts, manually advance the thrust levers before 80 knots. Call “THRUST SET.”
After takeoff thrust is set, the captain’s hand must be on the thrust levers until V1.	
Monitor airspeed. Maintain light forward pressure on the control column.	Monitor airspeed indications and call out any abnormal indications.
Verify 80 knots and call “CHECK”.	Call “80 KNOTS”.
Verify V1 speed.	Verify the automatic V1 callout or call “V1”.
At VR rotate toward 15° pitch attitude. After liftoff, follow F/D commands.	At VR, call “ROTATE”. Monitor airspeed and vertical speed.
Establish a positive rate of climb.	
	Verify a positive rate of climb on the altimeter and call “POSITIVE RATE”.
Verify a positive rate of climb on the altimeter and call “GEAR UP”.	
	Set the Landing Gear lever to UP.
Above 400 feet radio altitude, call for a roll mode as needed.	Select or verify the roll mode. Verify VNAV engaged.
Verify that climb thrust is set.	

Pilot Flying	Pilot Monitoring
Verify acceleration at the acceleration height. Call “FLAPS____” according to the flap retraction schedule.	
	Position Flap lever as directed.
Engage the autopilot when above the minimum altitude for autopilot engagement.	
	After flap retraction is complete: • Set the Landing Gear lever OFF after landing gear retraction is complete. • Verify air conditioning packs operating.
Call “AFTER TAKEOFF CHECKLIST”.	
	Do the AFTER TAKEOFF checklist.

Flap Retraction Schedule

Takeoff Flaps	At Speedtape “Display”	Select Flaps
20	“10” “5” “1” “UP”	10 5 1 UP
10	“5” “1” “UP”	5 1 UP
Above 309,000 kgs, limit bank angle to 15° with flaps up until reaching UP + 20 knots.		

Climb and Cruise Procedure

Complete the After Takeoff Checklist before starting the Climb and Cruise Procedure.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

Pilot Flying	Pilot Monitoring
	Above 10,000 feet, position Inboard Landing Light switches OFF.
	Set the passenger signs as needed.
At transition altitude, set and crosscheck the altimeters to standard.	
	When the FUEL LOW CTR L or R message is shown and the tank quantity is approximately 3,200 kgs in climb (pitch 5° or greater), set both Center L and R Pump switches off.
	When the FUEL OVD CTR L or R message is shown and the tank quantity is 1,800 kgs or more in cruise (pitch less than 5°), set both Center L and R Pump switches ON.
	When the FUEL LOW CTR L or R message is shown and the tank quantity is approximately 1,300 kgs in cruise (pitch less than 5°), set both Center L and R Pump switches off.
	When the FUEL TANK/ENG message is shown and the fuel quantity in tank 2 is less than or equal to tank 1 or tank 3 is less than or equal to tank 4, set both Override Pumps 2 switches off, both Override Pumps 3 switches off, and crossfeed valve 1 and 4 switches off.
	Before the top of descent, modify the active route as needed for the arrival and approach. Verify or enter the correct RNP for arrival.

VP-BKJ, VP-BKL, VP-BVR
(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; before SB, stab fuel auto-shutoff not installed)

Pilot Flying	Pilot Monitoring
	Above 10,000 feet, position Inboard Landing Light switches OFF.
	Set the passenger signs as needed.
At transition altitude, set and crosscheck the altimeters to standard.	
	When the FUEL LOW CTR L or R message is shown and the tank quantity is approximately 3,200 kgs in climb (pitch 5° or greater), set both Center L and R Pump switches off.
	When the FUEL OVD CTR L or R message is shown and the tank quantity is 1,800 kgs or more in cruise (pitch less than 5°), set both Center L and R Pump switches ON.
	When the FUEL PMP STB L message is shown and the tank quantity is 1,600 kgs or more, set Stabilizer Tank L Pump switch ON.
	When the FUEL PMP STB R message is shown and the tank quantity is 1,000 kgs or more, set Stabilizer Tank R Pump switch ON.
	When the FUEL LO STAB L message is shown and the tank quantity is approximately 1,200 kgs, set Stabilizer Tank L Pump switch off.
	When the FUEL LO STAB R message is shown and the tank quantity is approximately 600 kgs, set Stabilizer Tank R Pump switch off.
	When the FUEL LOW CTR L or R message is shown and the tank quantity is approximately 1,300 kgs in cruise (pitch less than 5°), set both Center L and R Pump switches off.

Pilot Flying	Pilot Monitoring
	When the FUEL TANK/ENG message is shown and the fuel quantity in tank 2 is less than or equal to tank 1 or tank 3 is less than or equal to tank 4, set both Override Pumps 2 switches off, both Override Pumps 3 switches off, and crossfeed valve 1 and 4 switches off.
	Before the top of descent, modify the active route as needed for the arrival and approach. Verify or enter the correct RNP for arrival.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; SB installs stab fuel auto-shutoff)

Pilot Flying	Pilot Monitoring
	Above 10,000 feet, position Inboard Landing Light switches OFF.
	Set the passenger signs as needed
At transition altitude, set and crosscheck the altimeters to standard.	
	When the FUEL LOW CTR L or R message is shown and the tank quantity is approximately 3,200 kgs in climb (pitch 5° or greater), set both Center L and R Pump switches off.
	When the FUEL OVD CTR L or R message is shown and the tank quantity is 1,800 kgs or more in cruise (pitch less than 5°), set both Center L and R Pump switches ON.
	When the FUEL PMP STB L or R message is shown and the tank quantity is 500 kgs or more, set both Stabilizer Tank L and R Pump switches ON.

Pilot Flying	Pilot Monitoring
	When the FUEL PRES STB L or FUEL PRES STB R message is shown and tank quantity is 900 kgs or less, set both Stabilizer Tank L and R Pump switches off. Under some conditions, fuel may be left in the stabilizer tank. If after approximately 5 minutes there is fuel still indicated in the stabilizer tank, the crew may turn the stabilizer pumps back on to transfer this fuel. Turn both pumps off at the first FUEL PRES STB message.
	When the FUEL LOW CTR L or R message is shown and the tank quantity is approximately 1,300 kgs in cruise (pitch less than 5°), set both Center L and R Pump switches off.
	When the FUEL TANK/ENG message is shown and the fuel quantity in tank 2 is less than or equal to tank 1 or tank 3 is less than or equal to tank 4, set both Override Pumps 2 switches off, both Override Pumps 3 switches off, and crossfeed valve 1 and 4 switches off.
	Before the top of descent, modify the active route as needed for the arrival and approach. Verify or enter the correct RNP for arrival.

Descent Procedure

Start the Descent Procedure before the airplane descends below the cruise altitude for arrival at destination.

Complete the Descent Procedure by 10,000 feet MSL.

Pilot Flying	Pilot Monitoring
Review all alert messages.	Recall and review all alert messages.
Verify VREF on the APPROACH REF page.	Enter VREF on the APPROACH REF page.
Set the RADIO/BARO minimums as needed for approach.	

Pilot Flying	Pilot Monitoring
	Set the NAV RADIO page for the approach.
	Set the AUTOBRAKES selector to the needed brake setting.
	Check landing performance.
Do the approach briefing.	
Call “DESCENT CHECKLIST.”	Do the DESCENT checklist.

Approach Procedure

The Approach Procedure is normally started at transition level.

Complete the Approach Procedure before:

- the initial approach fix, or
- the start of radar vectors to the final approach course, or
- the start of a visual approach

Pilot Flying	Pilot Monitoring
	Set the passenger signs as needed.
	At or above 10,000 feet MSL, set the inboard landing light switches to ON.
At transition level, set and crosscheck the altimeters.	
Update changes to the arrival and approach procedures, as needed. Update the RNP, as needed.	
Update the approach briefing as needed.	
Call “APPROACH CHECKLIST.”	Do the APPROACH checklist.

Flap Extension Schedule

Current Flap Position	At Speedtape “Display”	Select Flaps	Command Speed for Selected Flaps
UP*	“UP”	1	“1”
1	“1”	5	“5”
5	“5”	10 or 20 **	“10” or “20”**
10	“10”	20	“20”
20	“20”	25 or 30	(VREF 25 or VREF 30) + wind additives
*Above 309,000 kgs, use UP + 20 knots.			
**Flaps 10 and Command Speed “10” are optional.			

Landing Procedure - ILS

EI-XLZ, VP-BKJ, VP-BVR
(VP-BKL ; SB inhibits glide slope capture before localizer capture)

Pilot Flying	Pilot Monitoring
	Notify cabin crew to prepare for landing. Verify that the cabin is secure.
Call "FLAPS __" according to the flap extension schedule.	Set the flap lever as directed.
When on localizer intercept heading: • verify that the ILS is tuned and identified • verify that the LOC and G/S pointers are shown	
Arm the APP mode.	
Note: When using LNAV to intercept the final approach course, LNAV might parallel the localizer without capturing it.	
Use LNAV, HDG SEL or HDG HOLD to intercept the final approach course, as needed.	
Verify that the localizer is captured.	
	Call "GLIDE SLOPE ALIVE."
At glideslope alive, call: • "GEAR DOWN" • "FLAPS 20"	Set the landing gear lever to DN. Set the flap lever to 20.
Set the speedbrake lever to ARM.	
At glideslope capture, call "FLAPS __" as needed for landing.	Set the flap lever as directed.
Set the missed approach altitude on the MCP.	
Call "LANDING CHECKLIST."	Do the LANDING checklist.
At final approach fix or OM, verify the crossing altitude.	
Monitor the approach. Verify the autoland status at 500 feet AGL.	

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
(VP-BKL ; before SB, glide slope capture not inhibited before localizer capture)

Pilot Flying	Pilot Monitoring
	Notify cabin crew to prepare for landing. Verify that the cabin is secure.
Call “FLAPS __” according to the flap extension schedule.	Set the flap lever as directed.
When on localizer intercept heading: • verify that the ILS is tuned and identified • verify that the LOC and G/S pointers are shown	
Arm the APP mode.	
WARNING: When using LNAV to intercept the final approach course, LNAV might parallel the localizer without capturing it. The airplane can then descend on the glide slope with the localizer not captured.	
Use LNAV, HDG SEL or HDG HOLD to intercept the final approach course, as needed.	
Verify that the localizer is captured.	
	Call “GLIDE SLOPE ALIVE.”
At glideslope alive, call: • “GEAR DOWN” • “FLAPS 20”	Set the landing gear lever to DN. Set the flap lever to 20.
Set the speedbrake lever to ARM.	
At glideslope capture, call “FLAPS __” as needed for landing.	Set the flap lever as directed.
Set the missed approach altitude on the MCP.	
Call “LANDING CHECKLIST.”	Do the LANDING checklist.
At final approach fix or OM, verify the crossing altitude.	
Monitor the approach. Verify the autoland status at 500 feet AGL.	

Landing Procedure - Instrument Approach Using VNAV

Use the autopilot during the approach to give:

- autopilot alerts and mode fail indications
- more accurate course and glide path tracking
- lower RNP limits

This procedure is not authorized using QFE.

Pilot Flying	Pilot Monitoring
	Notify cabin crew to prepare for landing. Verify that the cabin is secure.
Call “FLAPS __” according to the flap extension schedule.	Set the flap lever as directed.
The recommended roll modes for the final approach are: • for a RNAV or GPS approach use LNAV • for a LOC-BC, VOR, or NDB approach use LNAV • for a LOC, SDF, or LDA approach use LNAV or LOC	
	Verify that the VNAV glide path angle is shown on the final approach segment of the LEGS page.
When on the final approach course intercept heading for LOC, LOC-BC, SDF, or LDA approaches: • verify that the localizer is tuned and identified • verify that the LOC pointer is shown	
Arm the LNAV or LOC mode.	
WARNING: When using LNAV to intercept the localizer, LNAV might parallel the localizer without capturing it. The airplane can then descend on the VNAV path with the localizer not captured.	
Use LNAV, HDG SEL or HDG HOLD to intercept the final approach course as needed.	
Verify that LNAV is engaged or that the localizer is captured.	

Pilot Flying	Pilot Monitoring
Approximately 2 NM before the final approach fix and after ALT, VNAV PTH, or VNAV ALT is annunciated: • verify that the autopilot is engaged • set DA(H) or MDA(H) on the MCP • select or verify VNAV • select or verify speed intervention	Approximately 2 NM before the final approach fix, call "APPROACHING GLIDE PATH."
Call: "GEAR DOWN" "FLAPS 20"	 Set the landing gear lever to DN. Set the flap lever to 20
Set the SPEEDBRAKE lever to ARM.	
Beginning the final approach descent, call "FLAPS __" as needed for landing.	Set the flap lever as directed.
Call "LANDING CHECKLIST."	Do the LANDING checklist.
When at least 300 feet below the missed approach altitude, set the missed approach altitude on the MCP.	
At the final approach fix, verify the crossing altitude and crosscheck the altimeters.	
Monitor the approach.	
If suitable visual reference is established at MDA(H), DA(H), or the missed approach point, disengage the autopilot in accordance with regulatory requirements, and disconnect theautothrottle at the same time. Maintain the glide path to landing.	

Go-Around and Missed Approach Procedure

Pilot Flying	Pilot Monitoring
At the same time: • push the TOGA switch • call “FLAPS 20”	Set the flap lever to 20.
Verify: • the rotation to go-around attitude • that the thrust increases	
	Verify that the thrust is sufficient for the go-around or adjust as needed.
Verify a positive rate of climb on the altimeter and call “GEAR UP”.	Verify a positive rate of climb on the altimeter and call “POSITIVE RATE”. Set the landing gear lever to UP.
Above 400 feet radio altitude, select a roll mode.	Verify that the missed approach altitude is set.
Verify that the missed approach route is being tracked.	
At acceleration height, select FLCH or VNAV. If FLCH is selected, set speed to the maneuvering speed for the planned flap setting. If VNAV is selected: • select speed intervention as needed • set speed to the maneuvering speed for the planned flap setting	
Call “FLAPS ___” according to the flap retraction schedule.	Set the flap lever as directed.
After flap retraction to the planned flap setting, if FLCH was selected, push the THRUST switch.	
Verify that climb thrust is set.	
Verify that the missed approach altitude is captured.	
	Set the landing gear lever OFF after landing gear retraction is complete.
Call “AFTER TAKEOFF CHECKLIST.”	Do the AFTER TAKEOFF checklist.

Landing Roll Procedure

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Pilot Flying	Pilot Monitoring
Verify that the thrust levers are closed. Verify that the SPEEDBRAKE lever is UP.	Verify that the SPEED BRAKE lever is UP. Call "SPEEDBRAKES UP." If the SPEEDBRAKE lever is not UP, call "SPEEDBRAKES NOT UP."
Monitor the rollout progress.	
Verify correct autobrakes operation.	
WARNING: After the reverse thrust levers are moved, a full stop landing must be made. If an engine stays in reverse, safe flight is not possible.	
Without delay, move the reverse thrust levers to the interlocks and hold light pressure until the interlocks release.	Verify that the forward thrust levers are closed. When all REV indications are green, call "REVERSERS NORMAL." If there is no REV indication(s) or the indications(s) stays amber, call "NO REVERSER(S) ENGINE NUMBER ___" or "NO REVERSERS".
Apply reverse thrust as needed.	
By 60 knots, start movement of the reverse thrust levers to be at the reverse idle detent before taxi speed.	Call "60 KNOTS".
After the engines are at reverse idle, move the reverse thrust levers full down.	
Before taxi speed, disarm the autobrakes. Use manual braking as needed.	
Before turning off the runway, disconnect the autopilot.	

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Pilot Flying	Pilot Monitoring
Verify that the thrust levers are closed. Verify that the SPEEDBRAKE lever is UP.	Verify that the SPEED BRAKE lever is UP. Call "SPEEDBRAKES UP." If the SPEEDBRAKE lever is not UP, call "SPEEDBRAKES NOT UP."
Monitor the rollout progress.	
Verify correct autobrakes operation.	
WARNING: After the reverse thrust levers are moved, a full stop landing must be made. If an engine stays in reverse, safe flight is not possible.	
Without delay, move the reverse thrust levers to the interlocks and hold light pressure until the interlocks release.	Verify that the forward thrust levers are closed. When all REV indications are green, call "REVERSERS NORMAL." If there is no REV indication(s) or the indications(s) stays amber, call "NO REVERSER(S) ENGINE NUMBER ___" or "NO REVERSERS".
Apply reverse thrust as needed.	
By 70 knots, start movement of the reverse thrust levers to be at the reverse idle detent before taxi speed.	Call "70 KNOTS".
After the engines are at reverse idle, move the reverse thrust levers full down.	
Before taxi speed, disarm the autobrakes. Use manual braking as needed.	
Before turning off the runway, disconnect the autopilot.	

After Landing Procedure

Start the After Landing Procedure when clear of the active runway.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Engine cool down recommendations:

- run the engines for at least 3 minutes
- use a thrust setting normally used for taxi operations

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Engine cool down requirement:

- run the engines for at least 90 seconds
- use a thrust setting no higher than that normally used for taxi operations

Engine cool down recommendations:

- run the engines for at least 5 minutes
- use a thrust setting no higher than that normally used for taxi operations

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Engine cool down recommendations:

- run the engines for at least 1 minute
- use a thrust setting no higher than that normally used for taxi operations

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Pilot Flying	Pilot Monitoring
The captain moves or verifies that the SPEEDBRAKE lever is DOWN.	
	Set the APU selector to START, then ON, as needed. Do not allow the APU selector to spring back to the ON position.
	Set the exterior lights as needed.
Set the weather radar to off.	
	Set the AUTOBRAKES selector to OFF.

Pilot Flying	Pilot Monitoring
	Set the flap lever to UP.
	Set the transponder mode selector as needed. At airports where ground tracking is not available, select STANDBY. At airports equipped to track airplanes on the ground, select an active transponder setting, but not a TCAS mode.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Pilot Flying	Pilot Monitoring
The captain moves or verifies that the SPEEDBRAKE lever is DOWN.	
	Set the APU selector to START, then ON, as needed. Do not allow the APU selector to spring back to the ON position.
	Set the NACELLE ANTI-ICE switches ON, if needed.
	Set the exterior lights as needed.
Set the weather radar to off.	
	Set the AUTOBRAKES selector to OFF.
	Set the flap lever to UP.
	Set the transponder mode selector as needed. At airports where ground tracking is not available, select STANDBY. At airports equipped to track airplanes on the ground, select an active transponder setting, but not a TCAS mode.

Shutdown Procedure

Start the Shutdown Procedure after taxi is complete.

Parking brake .... Set   C or F/O

Verify that the PARK BRAKE SET message is shown.

Electrical power .... Set   F/O

If APU power is needed:

Verify that the APU generator 1 and APU generator 2 AVAIL lights are illuminated.

APU GENERATOR 1 switch - Push

Verify that the ON light is illuminated

APU GENERATOR 2 switch - Push

Verify that the ON light is illuminated

If external power is needed:

Verify that the external power 1 or external power 2, or both, AVAIL lights are illuminated.

EXTERNAL POWER 1 or EXTERNAL POWER 2, or both, switches - Push

Verify that the respective ON light is illuminated.

Hydraulic demand pump 4 selector ....AUX F/O

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

If pushback or towing is needed:

Hydraulic demand pump 2, 3 selectors .... OFF F/O

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

If pushback or towing is needed:

Hydraulic demand pump 1 selectors ....AUX F/O

Hydraulic demand pump 2, 3 selectors .... OFF F/O

If parked (pushback or towing is not needed):

Hydraulic demand pump 1, 2, 3 selectors .... OFF F/O

FUEL CONTROL switches .... CUTOFF C

If pushback or towing is needed:

Establish communications with ground handling personnel. C

WARNING: If the nose gear steering is not locked out, any change to hydraulic power with the tow bar connected can cause unwanted tow bar movement.

Verify that the nose gear steering is locked out.

CAUTION: Do not hold or turn the nose wheel tiller during pushback or towing. This can damage the nose gear or the tow bar.

CAUTION: Do not use airplane brakes to stop the airplane during pushback or towing. This can damage the nose gear or the tow bar.

Set or release the parking brake as directed by ground handling personnel. C

When parked (pushback or towing is complete):

Hydraulic demand pump 1 selector ....OFF F/O

SEATBELTS selector ....OFF F/O

Fuel pump switches ....OFF F/O

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
NACELLE and WING ANTI-ICE switches ....OFF F/O

BEACON light switch ....OFF F/O

FLIGHT DIRECTOR switches ....OFF C, F/O

Status messages ....Check F/O

Record shown status messages in maintenance log.

Transponder mode selector .... STANDBY F/O

After wheel chocks are in place:

Parking brake ....Release C

Hydraulic demand pump 4 selector ....OFF F/O

APU selector .... As needed F/O

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Flight deck door .... Unlock F/O

Call “SHUTDOWN CHECKLIST.” C

Do the SHUTDOWN checklist. F/O

Secure Procedure

IRS mode selectors	OFF	F/O
EMERGENCY LIGHTS switch	OFF	F/O
AFT CARGO HEAT switch	OFF	F/O
PACK control selectors	OFF	F/O

Call “SECURE CHECKLIST.” C

Do the SECURE checklist. F/O

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Supplementary Procedures — Chapter SP
Introduction — Section 05

General

This chapter contains procedures (adverse weather operation, engine crossbleed start, and so on) accomplished as required rather than routinely performed on each flight. Systems tests are described in the System Description chapter of the applicable system.

Note: System tests are not normally a flight crew action.

Procedures accomplished in flight, or those that are an alternate means of accomplishing normal procedures (such as manual engine start), are usually accomplished by recall. Infrequently used procedures, not normally accomplished (such as engine crossbleed start) are usually accomplished by reference.

Supplementary procedures are provided by section. Section titles correspond to the related chapter title for the system being addressed except for the Adverse Weather section.

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Flight Deck Door Access System Test

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Flight Deck Access System switch .... Guard closed

Flight Deck Door .... Open

Flight Deck Door Lock selector .... AUTO

Emergency access code .... Enter

ENT key .... Push

Verify alert sounds.

Verify AUTO UNLK light illuminates.

Flight Deck Door Lock selector .... DENY

Verify AUTO UNLK light extinguishes.

Flight Deck Door Lock selector .... UNLKD

Flight Deck Access System switch .... OFF

Verify LOCK FAIL light illuminates.

Flight Deck Access System switch .... Guard closed

Verify LOCK FAIL light extinguishes.

Oxygen Mask Microphone Test

FLIGHT INTERPHONE TRANSMITTER Selector .... MIC

SPEAKER Selector .... ON

RESET/TEST Switch .... Push and hold

EMERGENCY/TEST Selector .... Push and hold

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

PUSH-TO-TALK Switch .... INT

Simultaneously push the Push-to-Talk switch, EMERGENCY/TEST selector, and the RESET/TEST switch.

Verify oxygen flow sound is heard through the flight deck speaker.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

BOOM/OXY Switch ....OXY

Simultaneously push the BOOM/OXY switch, EMERGENCY/TEST selector, and the RESET/TEST switch.

Verify oxygen flow sound is heard through the flight deck speaker.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

PUSH-TO-TALK Switch ....Release

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

BOOM/OXY Switch ....Release

EMERGENCY/TEST Selector ....Release

RESET/TEST Switch ....Release

SPEAKER Selector .... As needed

Air Conditioning Packs

APU-to-Pack Takeoff

After engine start:

LEFT and RIGHT ISOLATION valve switches - OFF

Leave APU running to supply air to pack 2.

Before takeoff:

PACKS 1 and 3 control selectors - OFF

After takeoff:

PACK control selector (One only) - NORM

After engine thrust is reduced from takeoff to climb, position one Pack Control selector to NORM.

PACK control selector (Remaining pack) - NORM

When cabin pressurization stabilizes, position remaining Pack Control selector to NORM.

LEFT and RIGHT ISOLATION valve switches - ON

APU selector - OFF

Packs Off Takeoff

Before takeoff:

PACK Control selectors - OFF

After takeoff:

PACK Control selector (One only) - NORM

After engine thrust is reduced from takeoff to climb and prior to reaching 3,000 feet above field elevation, position one Pack Control selector to NORM.

PACK control selectors (Remaining packs) - NORM

When cabin pressurization stabilizes, position remaining Pack Control selectors to NORM.

Ground Conditioned Air Use

Before connecting ground conditioned air:

PACK control selectors - OFF
Prevents pack operation if bleed air is supplied to the airplane.

RECIRCULATION FANS switches - OFF
Allows conditioned air unit to operate at maximum efficiency.

After disconnecting ground conditioned air:

PACK control selectors - NORM

RECIRCULATION FANS switches - ON

High Cabin Temperatures During Cruise

If cabin temperatures stabilize above target temperatures during cruise:

HIGH FLOW switch - ON
High flow setting increases fuel flow approximately 1%.

When temperatures return to target temperatures:

HIGH FLOW switch - OFF

Landing Airport Elevation Between 8,000 Feet and 10,000 Feet

Before start:

Landing Altitude switch....................MAN
Verify MAN displayed after landing altitude on Primary EICAS.

Landing Altitude selector....................8,000 feet

Before descent:

Landing Altitude switch....................AUTO
Verify AUTO displayed after landing altitude on Primary EICAS.

AFDS

AFDS Operation

FLIGHT DIRECTOR switches ....ON

Verify FD pitch and roll bars display.

If autopilot desired:

AUTOPILOT engage switch ....Push

Verify CMD displays on AFDS status.

Heading Hold

If airplane position north of 82° N latitude (or north of 70° N between 80° W and 130° W) or south of 82° S latitude (or south of 60° S between 120° E and 160° E):

HEADING reference switch.. TRUE

HEADING HOLD switch..Push

Verify HDG HOLD displays on flight mode annunciation.

Heading Select

If airplane position north of 82° N latitude (or north of 70° N between 80° W and 130° W) or south of 82° S latitude (or south of 60° S between 120° E and 160° E):

HEADING reference switch.. TRUE

HEADING SELECT switch ....Push

Verify HDG SEL displays on flight mode annunciation.

HEADING selector..Rotate

Set desired heading in HDG window.

Altitude Hold

ALTITUDE HOLD switch ....Push

Verify ALT displays on flight mode annunciation.

Flight Level Change, Climb or Descent

ALTITUDE selector ....Rotate

Set desired altitude in ALT window.

FLCH switch .... Push

Verify FLCH SPD displays on flight mode annunciation.

IAS/MACH selector ....Rotate

Set desired speed in IAS/MACH window.

Vertical Speed, Climb or Descent

ALTITUDE selector ....Rotate

Set desired altitude in ALT window.

VERTICAL SPEED switch .... Push

Verify V/S displays on PFD.

VERTICAL SPEED selector ....Rotate

Set desired vertical speed in VERT SPD window.

If climb desired:

Select climb thrust limit on CDU THRUST LIM page.

Autothrottle Operation

To activate or reactivate an autothrottle mode:

AUTOTHROTTLE ARM switch ....ARM

If pitch mode TO/GA:

TO/GA switch ....Push

Verify THR REF displays on flight mode annunciation.

If pitch mode ALT, V/S, G/S, or no pitch mode:

SPEED switch ....Push

Verify SPD displays on flight mode annunciation.

To set desired airspeed:

IAS/MACH selector .... Rotate

Set desired speed in IAS/MACH window.

If FLCH desired:

FLCH switch ....Push

Pitch mode changes unless G/S and LOC captured. Verify THR, IDLE, or HOLD displays on flight mode annunciation.

If VNAV desired:

VNAV switch ....Push

Pitch mode changes when in V/S or ALT. Verify THR REF, THR, SPD, IDLE, or HOLD displays on flight mode annunciation.

If TO/GA is desired:

TO/GA switch ....Push

Pitch and roll modes change to TO/GA. Verify THR or THR REF displays on flight mode annunciation.

If pitch mode is VNAV PTH, VNAV ALT, VNAV SPD, or FLCH SPD:

AUTOTHROTTLE ARM switch..............................OFF, then ARM

Verify THR REF, THR, SPD, IDLE, or HOLD displays on flight mode annunciation.

Instrument Approach Using Vertical Speed (V/S)

Note: Autopilot use is recommended until suitable visual reference is established.

Note: If required to remain at or above the MDA during the missed approach, missed approach must be initiated at least 50 feet above MDA.

Recommended roll modes:

- RNAV, GPS, LOC-BC, VOR or NDB approach: LNAV or HDG SEL
- LOC, SDF, or LDA approach: LOC or LNAV

Note: When using LNAV to intercept a localizer, LNAV might parallel the localizer without capturing it. Use HDG SEL or HDG HOLD to intercept the final approach course, if needed.

Ensure appropriate navaids (VOR, LOC, or NDB) are tuned and identified prior to commencing the approach.

RNP appropriate for approach (if required) .... Verify/Enter

Allows appropriate alerting to occur if ANP exceeds RNP.

Before descent to MDA(H):

MCP altitude .... Set

Set the first intermediate altitude constraint or MDA(H). When the current constraint is assured, the next constraint may be set prior to ALT engaged to achieve continuous descent path.

If constraints or MDA(H) do not end in zero zero (00) (for example, 1820), set MCP ALTITUDE window to the closest 100 foot increment below the constraint.

At descent point:

V/S switch .... Push

Verify V/S mode annunciates.

Desired V/S .... Set

Set desired V/S to descend to MDA(H). Use a V/S that results in no level flight segment at MDA(H).

Approximately 300 feet above MDA(H):

MCP altitude .... Set Missed Approach Altitude

At MDA(H)/missed approach point:

If suitable visual reference is not established, execute missed approach.

After suitable visual reference is established:

A/P Disengage switch .... Push

Disengage autopilot in accordance with regulatory requirements.

A/T Disconnect switch .... Push

Disconnect autothrottle when disengaging the autopilot.

Circling Approach

Note: Autopilot use is recommended until intercepting the landing profile.

MCP Altitude selector .... Set

If the MDA(H) does not end in zero zero (00) (for example, 1820), set MCP ALTITUDE window to the closest 100 foot increment below the MDA.

Accomplish an instrument approach and establish suitable visual reference.

At MDA(H):

ALT HOLD switch (if required) .... Push

Enables level off at MDA(H). Verify ALT mode annunciates.

MCP altitude selector .... Set Missed Approach Altitude

HDG SEL switch .... Push

Verify HDG SEL mode annunciates.

Intercepting the landing profile:

Autopilot disengage switch .... Push

Autothrottle disconnect switch .... Push

Aircraft Communications Addressing and Reporting System (ACARS) (As installed)

The following procedures are one means which may be used to verify Pre-Departure Clearance, Digital-Automatic Terminal Information Service, Oceanic Clearances, Weight and Balance and Takeoff Data messages transmitted over ACARS.

Pre-Departure Clearance

The flight crew shall manually verify (compare) the filed flight plan versus the digital pre-departure clearance and shall initiate voice contact with Air Traffic Control if any question/confusion exists between the filed flight plan and the digital pre-departure clearance.

Digital-Automatic Terminal Information Service

The flight crew shall verify the D-ATIS altimeter setting numeric and alphabetical values are identical. If the D-ATIS altimeter setting numeric and alphabetical values are different, the flight crew must not accept the D-ATIS altimeter setting.

Oceanic Clearances

The flight crew shall manually verify (compare) the filed flight plan versus the digital oceanic clearance and initiate voice contact with Air Traffic Control if any questions/confusion exists between the filed flight plan and the digital oceanic clearance.

Weight and Balance

The flight crew shall verify the Weight and Balance numeric and alphabetical values are identical. If the Weight and Balance numeric and alphabetical values are different, the flight crew must not accept the Weight and Balance data.

Takeoff Data

The flight crew shall verify the Takeoff Data numeric and alphabetical values are identical. If the Takeoff Data numeric and alphabetical values are different, the flight crew must not accept the Takeoff Data message.

Intentionally
Blank

Electrical Power Up

The following procedure is accomplished to permit safe application of electrical power.

BATTERY switch .... ON

Verify OFF light extinguished.

STANDBY POWER selector .... AUTO

Hydraulic DEMAND pump selectors .... OFF

Windshield WIPER selectors .... OFF

ALTERNATE FLAPS selector .... OFF

Landing gear lever .... DN

Flap position indication and flap lever .... Agree

Electrical power .... Establish

BUS TIE switches – AUTO

If external power desired:

External power 1 and/or
external power 2 AVAIL lights – Illuminated

EXTERNAL POWER 1 and/or
EXTERNAL POWER 2 switches – Push

Verify ON light(s) illuminated.

If APU power desired:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
APU Start Source switch - TR

APU selector – START, then ON

Position APU selector back to ON position. Do not allow APU selector to spring back to ON position.

APU generator 1 and
APU generator 2 AVAIL lights - Illuminated

APU GENERATOR 1 switch - Push

Verify ON light illuminated.

APU GENERATOR 2 switch - Push

Verify ON light illuminated.

Electrical Power Down

This procedure assumes the Secure procedure is complete.

APU switch and/or EXTERNAL POWER switch(es)......................OFF

STANDBY POWER selector ....OFF

When APU has completed shutdown cycle:

BATTERY switch – OFF

Standby Power Test

Airplane must be on ground with all busses powered.

STANDBY POWER selector ....BAT

Verify EICAS advisory messages BAT DISCH MAIN and BAT DISCH APU display. Messages may take up to 3 minutes to display.

STANDBY POWER selector .... AUTO

Verify BAT DISCH MAIN and BAT DISCH APU messages no longer display.

Engine Continuous Ignition

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Continuous ignition must be on when operating in:

- moderate to heavy rain
- hail or sleet
- moderate to severe turbulence
- volcanic ash
- upon entering icing conditions

Use standby ignition if continuous ignition is not available.

To manually select continuous ignition:

CONTINUOUS IGNITION switch .... ON

Confirm CON IGNITION ON memo message is displayed.

Engine Crossbleed Start

Verify the area behind the airplane is clear of equipment and personnel prior to increasing thrust on operating engine.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Do not advance the thrust lever until oil temperature is -10 degrees C or greater.

Thrust lever (operating engine) .... Advance

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Advance Thrust lever to approximately 70% N2.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Advance Thrust lever to approximately 70% N3.

Accomplish normal engine start.

Engine Ground Pneumatic Start

Duct pressure .... Observe

Observe duct pressure is a minimum of 30 PSI (less 1 PSI per 1,000 feet of pressure altitude).

Accomplish normal engine start.

Engine Start Procedure - Manual Start

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Select the secondary engine indications.		F/O
PACK control selectors	SET	F/O
Set two or three packs off.		
Start sequence	Announce	C
AUTOSTART switch	Off	F/O
Call “START ___ ENGINE”		C
Engine START switch	Pull	F/O
Verify that the N2 RPM increases.		F/O
Verify that the oil pressure increases.		C, F/O
At the fuel-on indicator:		
FUEL CONTROL switch	RUN	C
Verify that the EGT increases and stays below EGT limit.		C, F/O
After the engine is stable at idle:		
If autostart is operative:		
AUTOSTART switch	ON	F/O

The autostart switch may stay OFF between manual starts when more than one engine is to be started manually.

After the engine is stabilized at idle, start the other engines.

Do the ABORTED ENGINE START checklist for one or more of the following abort start conditions:

- the EGT does not increase by 25 seconds after the fuel control switch is moved to RUN
- there is no N1 rotation by idle N2
- the EGT quickly nears or exceeds the start limit
- N2 does not stabilize at idle
- the oil pressure indication is not normal by the time the engine is stabilized at idle

Engine Start Procedure - Manual Start

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Select the secondary engine indications. F/O

PACK control selectors ....SET F/O

Set two or three packs off.

Start sequence..Announce C

AUTOSTART switch .... Off F/O

Call “START ___ ENGINE” C

Engine START switch .... Pull F/O

Verify that the N3 RPM increases. F/O

When N3 is at 25%, or (if 25% is not possible), at maximum motoring:

FUEL CONTROL switch ....RUN C

Verify that the EGT increases and stays below EGT limit. C, F/O

After the engine is stablilized at idle:

If autostart is operative:

AUTOSTART switch... ON F/O

The autostart switch may stay OFF between manual starts when more than one engine is to be started manually.

After the engine is stabilized at idle, start the other engines.

Do the ABORTED ENGINE START checklist for one or more of the following abort start conditions:

- the EGT does not increase by 30 seconds after the fuel control switch is moved to RUN
- there is no N1 rotation by idle N3
- the EGT quickly nears or exceeds the start limit
- the N3 does not stabilize at idle
- the oil pressure is not normal by the time the engine is stabilized at idle

Engine/APU/Cargo Fire/Overheat Test

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

FIRE/OVERHEAT TEST switch .... Push and hold

Note: EICAS warning message FIRE WHEEL WELL may momentarily display.

Observe:

EICAS warning message >TEST IN PROG displays.

Fire bell sounds.

Master WARNING lights illuminate.

Engine Fire Warning lights illuminate.

APU Fire Warning light illuminates.

Fuel Control switch Fire Warning lights illuminate.

CARGO FIRE FWD and AFT Warning lights illuminate.

EICAS warning message >FIRE TEST PASS displays.

FIRE/OVERHEAT TEST switch .... Release

Engine/APU/Cargo Fire/Overheat Test

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

FIRE/OVERHEAT TEST ENGINE switch .... Push and hold

Observe:

Fire bell sounds.

Master WARNING lights illuminate.

Engine Fire Warning lights illuminate.

Fuel Control switch Fire Warning lights illuminate.

EICAS warning message FIRE ENG displays and EICAS advisory message DET FIRE/OHT is not displayed.

FIRE/OVERHEAT TEST
ENGINE switch ....Release

FIRE/OVERHEAT TEST
ENGINE/APU/CARGO switch .... Push and hold

Note: EICAS warning message FIRE WHEEL WELL may momentarily display.

Observe:

EICAS warning message >TEST IN PROG displays.

Fire bell sounds.

Master WARNING lights illuminate.

Engine Fire Warning lights illuminate.

APU Fire switch illuminates.

Fuel Control switch Fire Warning lights illuminate.

CARGO FIRE FWD and AFT lights illuminate.

EICAS warning message >FIRE TEST PASS displays.

FIRE/OVERHEAT TEST
ENGINE/APU/CARGO switch ....Release

Squib Test

Squib TEST 1 switch .... Push

Observe:

Engine squib lights illuminate.

APU squib light illuminates.

Cargo squib lights illuminate.

Squib TEST 2 switch .... Push

Observe:

Engine squib lights illuminate.

APU squib light illuminates.

Cargo squib lights illuminate.

Intentionally
Blank

Heading Reference Switch Operation

Use TRUE when operating in regions where true referencing is needed. Use NORM in all other regions.

HDG reference switch .... NORM or TRUE

Note: If using HDG SEL and the HDG reference switch position is changed, the AFDS roll mode will change to HDG HOLD. HDG SEL can be reselected.

Note: If the HDG reference switch position must be changed for an approach, it must be changed before the APP mode is armed.

If the HDG reference switch position is changed after the APP mode is armed:

- The AFDS roll mode will not change from HDG SEL to HGD HOLD
- The AFDS will not follow the MCP-selected heading
- LOC and FAC capture, and tracking performance may be degraded
- Exiting the APP mode restores normal operation of the HDG reference switch and the AFDS. APP mode can be reselected.

PVD Check

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

PVD switch .... Push

Observe PVD display.

PVD display .... RIGHT, LEFT, STOP

Display shutters when not within localizer coverage, or when ILS not tuned.

QFE Operation

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Use this procedure when ATC altitude assignments are referenced to QFE altimeter settings.

Note: Do not use LNAV or VNAV.

Altimeters .... Set

Set altimeters to QFE when below transition altitude/level.

Note: If the QFE altimeter setting is beyond the range of the altimeters, QNH procedures must be used with QNH set in the altimeters.

CDU .... Set

Select QFE on the APPROACH REF page. Set for departure and again for arrival.

Departure or Destination Airport Not in the FMC Navigation Database

When departing from or landing at an airport that is not in the FMC navigation database, the following items are affected:

- Cabin pressurization schedule
- Availability of departure, arrival, and approach procedures in the FMC
- Automatic tuning of VOR, DME, and ILS radios for departure, arrival, and approach procedures
- Format of altitudes and flight levels on the ND and CDU
- Barometric transition altitude alerts (amber display and box) on the PFD

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

- Landing altitude reference bar (white/amber bar) on the PFD altitude tape
- Touchdown zone indicator (amber crosshatched area) on the PFD altitude tape

Use the following procedures when departing from or landing at an airport that is not in the FMC navigation database.

Departure Airport Not in the FMC Navigation Database

CDU Preflight Procedure - Captain and First Officer

RTE key .... Push

If ORIGIN contains an ICAO identifier:

The following steps clear the ORIGIN and erase the previous route.

INIT REF key .... Push

<INDEX .... Select

<IDENT .... Select

Inactive date range .... Select

ACTIVE date range .... Select

Transfers the inactive navigation database to the ACTIVE line and removes the previously entered route.

Clear the NAV DATA OUT OF DATE scratchpad message.

Inactive date range .... Select

ACTIVE date range .... Select

Transfers the inactive navigation database to the ACTIVE line.

Verify the ACTIVE date range is current.

RTE key .... Push

Leave ORIGIN blank.

DEST .... Enter

Route .... Enter

LEGS key .... Push

Enter the latitude and longitude of the departure airport as the first waypoint on the route.

ACTIVATE and execute the route.

VNAV key .... Push

Displays the CLB page.

TRANS ALT .... Enter

NAV RAD key .... Push

Departure navaid frequency and CRS (as needed) .... Enter

LDG ALT switch .... MAN

LDG ALT selector .... Rotate to set the departure airport altitude

Reduces crew workload in the event of a return to the departure airport.

Do **not** accomplish the following checklist:

LANDING ALT

After engine start, cancel the LANDING ALT message.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

Note: The landing altitude reference bar (white/amber bar) is not shown on the PFD altitude tape.

Note: The touchdown zone indicator (amber crosshatched area) is not shown on the PFD altitude tape.

When no longer needed, delete the departure navaid frequency and CRS.

Before Descent

LDG ALT switch .... AUTO

The FMC sets the destination altitude automatically.

VNAV key .... Push

NEXT PAGE key .... Push

FORECAST> .... Select

Displays the DESCENT FORECAST page.

TRANS LVL .... Enter

Overwrites the manually entered departure airport transition altitude.

Destination Airport Not in the FMC Navigation Database

CDU Preflight Procedure - Captain and First Officer

The following steps can also be done in flight:

LEGS key .... Push

Enter the latitude and longitude of the destination airport as the final waypoint on the route.

Enter a speed/altitude constraint for the final waypoint. The speed constraint should be the planned approach speed and the altitude constraint should be the destination airport elevation.

ACTIVATE (if needed) and execute the route.

Before Descent

VNAV key .... Push

NEXT PAGE key .... Push

FORECAST> .... Select

Displays the DESCENT FORECAST page.

TRANS LVL ....Enter

LDG ALT switch ....MAN

LDG ALT selector .... Rotate to set the destination airport altitude

Do **not** accomplish the following checklist:

LANDING ALT

Cancel the LANDING ALT message.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

Note: The landing altitude reference bar (white/amber bar) is not shown on the PFD altitude tape during approach.

Note: The touchdown zone indicator (amber crosshatched area) is not shown on the PFD altitude tape during landing.

Note: The ARRIVALS page is not available for the destination airport.

Before Approach

NAV RAD key .... Push

Destination navaid frequency and CRS (as needed) ....Enter

ND mode selector .... As needed

Select APP, VOR or MAP based on the type of approach to be flown.

IRS Fast Realignment

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

A fast realignment may be accomplished when the combined operating time from the last full IRS alignment to the expected next destination arrival time does not exceed 18 hours.

VQ-BHW, VQ-BHX

A fast realignment may be accomplished when the combined operating time from the last full IRS alignment to the expected next destination arrival time does not exceed 15 hours when the origin airport is between 76°32.0’ north latitude and 76°32.0’ south latitude; or,10 hours when the origin airport is between 76°32.0’ north or south latitude and 81°36.0’north or south latitude.

IRS Mode selectors .... ALIGN

CDU .... Set

Enter present position on SET IRS POSITION line of position initialization page.

IRS Mode selectors .... NAV

IRS High Latitude Alignment

A high latitude alignment must be accomplished when the latitude of the origin airport is greater than 70°12.0’ and less than 78°15.0’.

IRS Mode selectors .... OFF, then ALIGN

The IRS Mode selectors must remain in ALIGN for a minimum of 17 minutes.

CDU .... Set

Enter present position on SET IRS POSITION line of position initialization page.

IRS Mode selectors .... NAV

Navaid Inhibit

Note: GPS position updates should be used during all approaches in which the FMC database and approach procedures are referenced to the WGS-84 reference datum. GPS updates should be inhibited for approach operations not based on WGS-84, unless other appropriate procedures are used. GPS position updates should be used for all other operations, unless a specific state requires the use of other update provisions within their airspace (e.g., to accomodate a non-WGS reference datum).

PROG key .... Push

POS REF> .... Select
Shows the POS REF 2/3 page.

To inhibit GPS updates:

GPS NAV INHIBIT> .... Select
Verify ENABLE shows.

To inhibit VOR/DME updates:

INIT REF key> .... Push

<INDEX .... Select

NAV DATA> .... Select
Shows the REF NAV DATA page.

VOR/DME NAV INHIBIT> .... Select
Verify ENABLE shows.
Verify ALL shows in 5L and 5R.

Note: DME/DME updates are operable.

To inhibit a navaid (for one or two navaids):

INIT REF key> .... Push

<INDEX .... Select

NAV DATA> .... Select
Shows the REF NAV DATA page.

Enter the navaid identifier in the scratchpad.

NAVAID INHIBIT (4L or 4R) .... Enter

To inhibit a VOR (for one or two VORs):

INIT REF key> .... Push

<INDEX .... Select

NAV DATA> .... Select
Shows the REF NAV DATA page.

Enter the VOR identifier in the scratchpad.

VOR INHIBIT INHIBIT (5L or 5R) .... Enter

Weather Radar Test

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

Weather Radar Mode selector .... TEST

ND Mode selector .... MAP

EFIS WXR switch .... Push

Verify radar test pattern displays on ND.

EFIS WXR switch .... Push

Removes Captain's and First Officer's weather radar displays.

Weather Radar Mode selector .... As desired

Weather Radar Test

VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX

Weather Radar Mode selector .... non-TEST mode

ND Mode selector .... MAP

EFIS WXR switch .... Push

Note: In the short time the weather radar is on and not in the TEST position, it will radiate.

Weather Radar Mode selector .... TEST

Observe the following sequence (approximately 20 seconds).

The amber WINDSHEAR annunciation shows on the NDs and the aural message "monitor radar display" sounds.

Then the amber WINDSHEAR annunciation blanks, the Master Warning lights illuminate, and the WINDSHEAR SYS and WINDSHEAR PRED EICAS messages show.

Then the red WINDSHEAR annunciation shows on the NDs, the WINDSHEAR SYS and WINDSHEAR PRED EICAS messages blank, the Master Warning lights extinguish, and the aural messages "go around, windshear ahead", and then "windshear ahead, windshear ahead" sound.

During this time, the "rainbow" test pattern (with embedded PWS symbol) is shown.

EFIS WXR switch .... Push

Removes Captain’s and First Officer’s weather radar displays.

Weather Radar Mode selector .... As desired

Weather Radar Test

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

Weather Radar Mode switch (non-TEST).. Push

ND Mode selector .... MAP

EFIS WXR switch .... Push

Note: In the short time the weather radar is on and not in the TEST position, it will radiate.

Weather Radar Mode TEST switch .... Push

EI-XLB, EI-XLD, EI-XLE, EI-XLG
Verify radar test pattern displays on ND.

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ
Observe the following sequence (approximately 20 seconds).

Amber windshear caution light illuminates and the aural message “monitor radar display” is initiated, then Master Warning light illuminates. The windshear fail message is displayed on the flight deck, then Red windshear warning light will illuminate and the aural message “go around, windshear ahead, windshear ahead, windshear ahead” is initiated. During this time period the “rainbow” (with embedded windshear icon) self-test is displayed.

EFIS WXR switch .... Push

Removes Captain’s and First Officer’s weather radar displays.

Desired Mode switch .... Push

Fuel Balancing

Consider the possibility of an engine fuel leak. If fuel imbalance has occurred without indications of a fuel leak, fuel may be balanced.

Excessive fuel imbalance adversely affects CG, aerodynamic drag, and therefore, fuel economy. To maintain CG and reduce drag, operate the airplane within limits of FUEL IMBALANCE EICAS advisories.

Fuel may be balanced:

- between main tanks 1 and 4 by opening crossfeed valves 1 and 4, closing crossfeed valves 2 and 3, turning off the fuel pumps in the low tank, and turning off the override pumps in main tanks 2 and 3
- between main tanks 2 and 3 by turning off the fuel pumps in the low tank
- longitudinally by opening all crossfeed valves and turning off the fuel pumps in the low tanks.

Avoid conditions which require fuel suction feed, unless directed by published non-normal procedure.

The fuel system should be returned to normal operating condition when the imbalance condition has been corrected.

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Introduction

Airplane operation in adverse weather conditions may require additional considerations due to effects of extreme temperatures, precipitation, turbulence, and windshear. Procedures in this section supplement normal procedures and should be observed when applicable.

Takeoff - Wet or Contaminated Runway Conditions

The following information applies to takeoffs on wet or contaminated runways:

- For wet runways, reduced thrust (fixed derate, assumed temperature method, or both) is allowed provided suitable takeoff performance accountability is made for the increased stopping distance on a wet surface
- For runways contaminated by slush, snow, standing water, or ice, reduced thrust (fixed derate) is allowed provided takeoff performance accounts for the runway surface condition. Reduced thrust using assumed temperature method, whether alone or in combination with a fixed derate is not allowed
- V1 may be reduced to minimum V1 to provide increased stopping margin provided the field length required for a continued takeoff from the minimum V1 and obstacle clearance meet the regulatory requirements. The determination of such minimum V1 may require a real-time performance calculation tool or other performance information supplied by dispatch
- Takeoffs are not recommended when slush, wet snow, or standing water depth is more than 1/2 inch (13 mm) or dry snow depth is more than 4 inches (102mm).

Cold Weather Operation

Considerations associated with cold weather operation are primarily concerned with low temperatures and with ice, snow, slush, and standing water on the airplane, ramps, taxiways and runways.

Icing conditions exist when OAT (on the ground) or TAT (in flight) is 10°C or below, and any of the following exist:

- visible moisture (clouds, fog with visibility of one statute mile (1600 m) or less, rain, snow, sleet, ice crystals, and so on) is present, or
- ice, snow, slush, or standing water is present on the ramps, taxiways, or runways.

CAUTION: Do not use nacelle anti-ice when OAT (on the ground) is above 10°C. Do not use nacelle or wing anti–ice when TAT (in flight) is above 10°C.

Exterior Inspection

Although removal of surface snow, ice, and frost is normally a maintenance function, during preflight procedures, the captain or first officer should carefully inspect areas where surface snow, ice or frost could change or affect normal system operations.

Do the normal Exterior Inspection with the following additional steps:

Surfaces .... Check

Takeoff with light coatings of frost, up to 1/8 inch (3mm) in thickness, on lower wing surfaces due to cold fuel is allowable; however, all leading edge devices, all control surfaces, and upper wing surfaces must be free of snow, ice and frost.

Thin hoarfrost is acceptable on the upper surface of the fuselage provided all vents and ports are clear. Thin hoarfrost is a uniform white deposit of fine crystalline texture, which usually occurs on exposed surfaces on a cold and cloudless night, and which is thin enough to distinguish surface features underneath, such as paint lines, markings, or lettering.

Pitot probes and static ports .... Check

Verify that all pitot probes and static ports are free of snow or ice. Water rundown after snow removal may freeze immediately forward of static ports and cause an ice buildup which disturbs airflow over the static ports resulting in erroneous static readings even when the static ports are clear.

Air conditioning inlets and exits .... Clear

Verify that the air inlets and exits, including the outflow valves, are clear of snow or ice.

Engine inlets .... Clear

Verify that the inlet cowling is free of snow and ice.

Fuel tank vents .... Clear

Verify that all traces of ice or frost are removed.

Landing gear doors .... Check

Landing gear doors should be free of snow and ice.

APU air inlets .... Check

The APU inlet door and cooling air inlet must be free of snow or ice prior to APU start.

Engine Start Procedure

Do the normal Engine Start Procedure with the following considerations:

GE engines

- If the engine has been cold soaked for more than 4 hours at ambient temperatures at or below -30°C, do not start or motor the engine. Maintenance personnel should do appropriate procedures for adverse weather heating of the engine fuel system components.
- Oil pressure may be slow to rise
- Initial oil pressure rise may be higher than normal
- Additional warm-up time may be needed to allow oil temperature to reach the normal range
- Airplanes with LCD displays: Displays may require additional warm-up time before displayed engine indications accurately show changing values. Displays may appear less bright than normal.

Nacelle Anti–Ice Operation – On the Ground

Nacelle anti–ice must be selected ON immediately after all engines are started and remain on during all ground operations when icing conditions exist or are anticipated except when temperature is less than -40°C OAT.

WARNING: Do not rely on airframe visual icing cues before activating nacelle anti–ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in damage or failure.

CAUTION: Do not use nacelle anti-ice when OAT is above 10° C.

When nacelle anti–ice is needed:

Nacelle anti-ice switches ....ON F/O

When nacelle anti-ice is no longer needed:

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Nacelle Anti-ice switches ....OFF F/O

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Nacelle Anti-ice switches ....AUTO F/O

Before Taxi Procedure

Do the normal Before Taxi Procedure with the following modifications:

If taxi route is through ice, snow, slush, or standing water in low temperatures or if precipitation is falling with temperatures below freezing, taxi out with the flaps up. Taxiing with the flaps extended subjects the flaps and flaps drives to contamination. Leading edge flaps are also susceptible to slush accumulations.

Call “FLAPS ___” as needed. C

Flap lever .... Set flaps, as needed F/O

Taxi-Out

CAUTION: Taxi at a reduced speed. Use smaller tiller and rudder inputs, and apply minimum thrust evenly and smoothly. Taxiing on slippery taxiways or runways at excessive speed or with high crosswinds may start a skid.

When nacelle anti-ice is required and the OAT is 3°C or below, do an engine run up, as needed, to minimize ice build-up. Use the following procedure: C

Check that the area behind the airplane is clear.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Run-up to a minimum of 60% N1 for approximately 30 seconds duration at intervals no greater than 30 minutes.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Run-up to a minimum of 50% N1 for approximately 1 second duration at intervals no greater than 15 minutes.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Run-up to a minimum of 60% N1 and a maximum of 65% N1 for approximately 10 seconds duration at intervals no greater than 60 minutes.

De-icing / Anti-icing

Testing of undiluted de-icing/anti-icing fluids has shown that some of the fluid remains on the wing during takeoff rotation and initial climb. The residual fluid causes a temporary decrease in lift and increase in drag, however, the effects are temporary. Use the normal takeoff rotation rate.

CAUTION: Operate the APU during de-icing only if necessary. If the APU is running, ingestion of de-icing fluid causes objectionable fumes and odors to enter the airplane. Ingestion of snow, slush, ice, or de-icing/anti-icing fluid can also damage to the APU.

If de-icing / anti-icing is needed:

APU .... As needed F/O

The APU should be shut down unless APU operation is necessary.

Call “FLAPS UP”. C

Flaps .... UP F/O

Prevents ice and slush from accumulating in flap cavities during de-icing.

Thrust levers .... Idle C

Reduces the possibility of injury to personnel at inlet or exhaust area.

PACK control selectors .... OFF F/O

Reduces the possibility of fumes entering the air conditioning system.

APU bleed air switch (APU running) .... OFF F/O

Reduces the possibility of fumes entering the air conditioning system.

After de-icing / anti-icing is completed:

APU .... As needed F/O

APU bleed air switch (APU running) .... ON F/O

Wait approximately one minute after de-icing is completed to turn pack selectors on to ensure all de-icing fluid has been cleared from the engines.

PACK control selectors .... NORM F/O

Before Takeoff Procedure

Do the normal Before Takeoff Procedure with the following modification:

Call “FLAPS ___” as needed for takeoff. PF

Flap lever .... Set takeoff flaps, as needed PM

Extend the flaps to the takeoff setting at this time if they have been held due to slush, standing water, or icing conditions, or because of exterior de-icing / anti-icing.

Takeoff Procedure

Do the normal Takeoff Procedure with the following modifications.

When nacelle anti-ice is required and the OAT is 3°C or below, the takeoff must be preceded by a static engine run-up. Use the following procedure: PF

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Run-up to a minimum of 60% N1 for approximately 30 seconds duration and confirm stable engine operation before the start of the takeoff roll.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Run-up to a minimum of 50% N1 and confirm stable engine operation before the start of the takeoff roll.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Run-up to a minimum of 60% N1 for approximately 10 seconds duration and confirm stable engine operation before the start of the takeoff roll.

Nacelle Anti-ice Operation - In flight

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Nacelle anti-ice must be AUTO or ON during all flight operations when icing conditions exist or are anticipated, except when the temperature is below –40°C SAT.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Nacelle anti-ice must be ON during all flight operations when icing conditions exist or are anticipated, except when the temperature is below –40°C SAT.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Nacelle anti-ice must be AUTO or ON during all flight operations when icing conditions exist or are anticipated, except during climb and cruise when the temperature is below –40°C SAT.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

When operating in areas of possible icing, activate nacelle anti-ice before entering icing conditions.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

WARNING: Do not rely on airframe visual icing cues before activating nacelle anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

CAUTION: Do not use nacelle anti-ice when TAT is above 10°C.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

When nacelle anti-ice is needed:

Nacelle anti-ice switches ....ON PM

When nacelle anti-ice is no longer needed:

Nacelle anti-ice switches .... OFF PM

Manual Use of Nacelle Anti-ice

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

When using the nacelle anti-ice system manually in areas of possible icing, activate nacelle anti-ice before entering icing conditions.

WARNING: If using the nacelle anti-ice system manually, do not rely on airframe visual icing cues before activating nacelle anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

When manual use of nacelle anti-ice is needed:

Nacelle anti-ice switches .... ON PM

When manual use of nacelle anti-ice is no longer needed:

Nacelle anti-ice switches .... AUTO or OFF PM

Fan Ice Removal

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

CAUTION: Avoid prolonged operation in moderate to severe icing conditions.

If moderate to severe icing conditions are encountered:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

During flight in moderate to severe icing conditions for prolonged periods with N1 settings at or below 70%, or when fan icing is suspected due to high engine vibration, the fan blades must be cleared of any ice. Do the following procedure every 10 minutes on all engines, one engine at a time: increase thrust to a minimum of 70% N1 for 10 to 30 seconds.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

During flight in moderate to severe icing conditions for prolonged periods, if fan icing is suspected due to high engine vibration (exceeding 2.5 units), the fan blades must be cleared of any ice. Do the following procedures on all engines, one engine at a time: quickly reduce thrust to idle for five seconds, then restore the required thrust. If vibration persists, advance thrust lever to 90% N1 momentarily.

Wing Anti-ice Operation - In flight

Ice accumulation on the flight deck window frames, windshield center post, or windshield wiper arm, or side windows may be used as an indication of structural icing conditions and the need to turn on wing anti-ice.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The wing anti-ice system may be used as a de-icer or anti-icer in flight only. The primary method is to use it as a de-icer by allowing ice to accumulate before turning wing anti-ice on. This procedure provides the cleanest airfoil surface, the least possible runback ice formation, and the least thrust and fuel penalty. Normally, it is not necessary to shed ice periodically unless extended flight through icing conditions is necessary (holding).

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The wing anti-ice system may be used as a de-icer or anti-icer in flight only. The primary method is to use the automatic ice detection system which acts as a de-icer by allowing ice to accumulate before turning wing anti-ice on. This procedure provides the cleanest airfoil surface, the least possible runback ice formation, and the least thrust and fuel penalty.

The secondary method is to use wing anti-ice before ice accumulation. Operate the wing anti-ice system as an anti-icer only during extended operations in moderate or severe icing conditions.

CAUTION: Do not use wing anti-ice when TAT is above 10°C.

Note: Wing anti-icing is not effective with leading edge flaps extended. If icing conditions exist, turn anti-icing on after retraction of leading edge flaps; or complete anti-icing before extension of leading edge flaps.

Note: Prolonged operation in icing conditions with the leading edge and trailing edge flaps extended is not recommended.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

When wing anti-ice is needed:

WING ANTI-ICE switch ....ON PM

When wing anti-ice is no longer needed:

WING ANTI-ICE switch .... OFF PM

Manual Use of Wing Anti-ice

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

When manual use of wing anti-ice is needed:

WING ANTI-ICE switch ....ON PM

When manual use of wing anti-ice is no longer needed:

WING ANTI-ICE switch .... AUTO or OFF PM

Cold Temperature Altitude Corrections

Extremely low temperatures create significant altimeter errors and greater potential for reduced terrain clearance. When the temperature is colder than ISA, true altitude will be lower than indicated altitude. Altimeter errors become significantly larger when the surface temperature approaches -30°C or colder, and also become larger with increasing height above the altimeter reference source.

Apply the altitude correction table when needed:

- no corrections are needed for reported temperatures above 0°C or if the airport temperature is at or above the minimum published temperature for the procedure being flown
- do not correct altimeter barometric reference settings
- corrections apply to QNH and QFE operations
- ATC assigned altitudes or flight levels should not be adjusted for temperature when under radar control
- apply corrections to all published minimum departure, enroute and approach altitudes, including missed approach altitudes according to the table below. Advise ATC of the corrections
- MDA/DA settings should be set at the corrected minimum altitudes for the approach
- subtract the elevation of the altimeter barometric reference setting source (normally the departure or destination airport elevation) from the published minimum altitude to be flown to determine "height above altimeter reference source"
- enter the table with Airport Temperature and with "height above altimeter reference source." Read the correction where these two entries intersect. Add the correction to the published minimum altitude to be flown to determine the corrected indicated altitude to be flown. To correct an altitude above the altitude in the last column, use linear extrapolation (e.g., to correct 6000 feet or 1800 meters, use twice the correction for 3000 feet or 900 meters, respectively). The corrected altitude must always be greater than the published minimum altitude
- if the corrected indicated altitude to be flown is between 100 foot increments, set the MCP altitude to the closest 100 foot increment above the corrected indicated altitude to be flown

Altitude Correction Table (Heights and Altitudes in Feet)

Airport Temp °C	Height Above Altimeter Reference Source											
	200 feet	300 feet	400 feet	500 feet	600 feet	700 feet	800 feet	900 feet	1000 feet	1500 feet	2000 feet	3000 feet
0°	20	20	30	30	40	40	50	50	60	90	120	170
-10°	20	30	40	50	60	70	80	90	100	150	200	290
-20°	30	50	60	70	90	100	120	130	140	210	280	420
-30°	40	60	80	100	120	140	150	170	190	280	380	570
-40°	50	80	100	120	150	170	190	220	240	360	480	720
-50°	60	90	120	150	180	210	240	270	300	450	590	890

Altitude Correction Table (Heights and Altitudes in Meters)

Airport Temp °C	Height Above Altimeter Reference Source											
	60 MTRS	90 MTRS	120 MTRS	150 MTRS	180 MTRS	210 MTRS	240 MTRS	270 MTRS	300 MTRS	450 MTRS	600 MTRS	900 MTRS
0°	5	5	10	10	10	15	15	15	20	25	35	50
-10°	10	10	15	15	20	20	25	30	30	45	60	90
-20°	10	15	20	25	25	30	35	40	45	65	85	130
-30°	15	20	25	30	35	40	45	55	60	85	115	170
-40°	15	25	30	40	45	50	60	65	75	110	145	220
-50°	20	30	40	45	55	65	75	80	90	135	180	270

After Landing Procedure

CAUTION: Taxi at a reduced speed. Use smaller tiller and rudder inputs, and apply minimum thrust evenly and smoothly. Taxiing on slippery taxiways or runways at excessive speed or with high crosswinds may start a skid.

Do the normal After Landing Procedure with the following modifications:

After prolonged operation in icing conditions with the flaps extended, or when an accumulation of airframe ice is observed, or when operating on a runway contaminated with ice, snow, slush, or standing water:

Do not retract the flaps to less than flaps 25 until the flap areas have been checked to be free of contaminants.

Nacelle anti-ice must be selected ON and remain on during all ground operations when icing conditions exist or are anticipated, except when the temperature is below -40°C OAT.

WARNING: Do not rely on airframe visual cues before activating nacelle anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

CAUTION: Do not use nacelle anti-ice when OAT is above 10°C.

When nacelle anti-ice is needed:

Nacelle anti-ice switches .... ON F/O

When nacelle anti-ice is no longer needed:

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Nacelle anti-ice switches ....OFF F/O

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Nacelle anti-ice switches .... AUTO F/O

When nacelle anti-ice is required and the OAT is 3°C or below, do an engine run up as needed, to minimize ice build-up. Use the following procedure: C

Check that the area behind the airplane is clear.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Run-up to a minimum of 60% N1 for approximately 30 seconds duration at intervals no greater than 30 minutes.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Run-up to a minimum of 50% N1 for approximately 1 second duration at intervals no greater than 15 minutes.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Run-up to a minimum of 60% N1 and a maximum of 65% N1 for approximately 10 seconds duration at intervals no greater than 60 minutes.

Secure Procedure

Do the normal Secure Procedure with the following modifications:

If the airplane will be attended:

PACK control selectors .... NORM F/O

If the airplane will not be attended, or if staying overnight at off-line stations or at airports where normal support is not available, the flight crew must arrange for or verify that the following steps are done:

Outflow valve manual switches ....ON F/O

Outflow valve manual control.........................CLOSE F/O

Position the outflow valves fully closed to inhibit the intake of snow and ice.

Wheel chocks ....Verify in place C or F/O

Parking brake ....Released C

Reduces the possibility of frozen brakes.

Cold weather maintenance procedures for securing the airplane may be required. These procedures are found in the approved Airplane Maintenance Manual.

Hot Weather Operation

During flight planning, consider the following:

- high temperatures inflict performance penalties which must be taken into account on the ground before takeoff
- alternate takeoff procedures (Packs Off Takeoff, APU-to-Pack Takeoff, etc.)

During ground operation, consider the following to help keep the airplane as cool as possible:

- all packs should be used (when possible) for maximum cooling

- recirculation fans should be off because the fans add warm air to the conditioned air
- if cooling air is available from an outside source, the supply should be plugged in immediately after engine shutdown and should not be removed until just prior to engine start
- keep all doors, including cargo doors, closed as much as possible
- electronic components which contribute to a high temperature level in the flight deck should be turned off while not needed
- all air outlets on flight deck should be open

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

- close all window shades on the sun–exposed side of the passenger cabin

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- open all passenger cabin gasper outlets and close all window shades on the sun–exposed side of the passenger cabin

Note: If only cooling air from ground air conditioning cart is supplied (no pressurized air from the APU or ground external air), then the TAT probes are not aspirated. Because of high TAT probe temperatures, the FMCs may not accept an assumed temperature derate. Delay selecting an assumed temperature derate until after bleed air is available.

Brake temperature levels may be reached which can cause the wheel fuse plugs to melt and deflate the tires. Consider the following actions:

- be aware of brake temperature buildup when operating a series of short flight sectors. The energy absorbed by the brakes from each landing is cumulative
- extending the landing gear early during the approach provides additional cooling for tires and brakes
- in–flight cooling time can be determined from the “Brake Cooling Schedule” in the Performance–In flight section

Moderate to Heavy Rain, Hail, or Sleet

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Flight should be conducted to avoid thunderstorms, hail activity or visible moisture over storm cells. To the maximum extent possible, moderate to heavy rain, hail, or sleet should also be avoided.

If heavy rain or hail encountered or anticipated:

Continuous Ignition switch .... ON

Provides flameout protection and maintains a minimum thrust setting of approach idle. Confirm CON IGNITION memo message is displayed.

During descent:

Autothrottles .... Disconnect

Note: In heavy precipitation, engine parameter fluctuations may occur, particularly a noticeable drop in EGT. Engine parameters will return to normal immediately upon leaving the area of heavy precipitation.

Turbulence

During flight in light to moderate turbulence, the autopilot and/or autothrottle may remain engaged unless performance is objectionable. Increased thrust lever activity can be expected when encountering wind, temperature, and large pressure changes. Short–time airspeed excursions of 10 to 15 knots can be expected.

Passenger Signs switches .... ON

Advise passengers to fasten seat belts prior to entering areas of reported or anticipated turbulence. Instruct flight attendants to check all passengers' seat belts are fastened.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

In moderate to severe turbulence:

Continuous Ignition Switch .... ON

Severe Turbulence

The turbulent air penetration speed of 290-310 KIAS or .82-.85 Mach provides ample protection from stall and high speed buffet, while also providing protection from exceeding the structural limit.

Flight test data substantiates important benefits are obtained from the use of the yaw dampers during turbulence penetration. Excursions in sideslip and roll are minimized and, even though the rudder control may be more active, the structural loads imposed on the vertical tail are considerably reduced.

The recommended procedures for flight in severe turbulence are summarized below.

Climb and Cruise

After takeoff and when established in a clean climb configuration, the autoflight system is recommended for flight through turbulence. To reduce pitch changes as the AFDS attempts to fly speed with elevators, climb and descend using vertical speed (speed on thrust) and cruise using altitude hold.

During cruise, VNAV and altitude hold modes each fly speed on autothrottles and can be used in turbulence.

In extreme turbulence, it may be necessary to disconnect the autothrottles. With autothrottles disconnected, the FMC generates a target thrust setting for cruise which is displayed on EICAS. Set thrust at or slightly above the target thrust indicator. Change thrust setting only if required to reverse an unacceptable speed trend.

Descent

If severe turbulence is encountered at altitudes below 15,000 feet and the gross weight is less than the maximum landing weight, the airplane may be slowed to 250 KIAS in the clean configuration. Adequate stall margin exists under these conditions.

Delay flap extension in an area of known turbulence as long as possible because the airplane can withstand higher gust loads in the clean configuration. Diversion to another airfield is the best policy if severe turbulence persists in the area.

Manual Flight in Severe Turbulence

If manual flight in severe turbulence becomes necessary, trim the airplane for penetration speed, then do not change stabilizer position. Control the airplane pitch attitude with the elevators using the attitude indicator as the primary instrument. In extreme drafts, large altitude changes may occur. Do not make sudden large control inputs. Corrective actions to regain the desired attitude should be smooth and deliberate. Altitude variations are likely in severe turbulence and should be allowed to occur if terrain clearance is adequate. Control airplane attitude first, then make corrections for airspeed, altitude, and heading.

Windshear

Windshear is a change of wind speed and/or direction over a short distance along the flight path. Indications of windshear are listed in the Windshear Non-normal Maneuver in this manual.

Avoidance

The flight crew should search for any clues to the presence of windshear along the intended flight path. Presence of windshear may be indicated by:

- Thunderstorm activity
- Virga (rain that evaporates before reaching the ground)
- Pilot reports
- Low level windshear alerting system (LLWAS) warnings.

Stay clear of thunderstorm cells and heavy precipitation and areas of known windshear. If the presence of windshear is confirmed, delay takeoff or do not continue approach.

Precautions

If windshear is suspected, be especially alert to any of the danger signals and be prepared for the possibility of an inadvertent encounter. The following precautionary actions are recommended if windshear is suspected:

Takeoff

- Takeoff with full-rated takeoff thrust is recommended, unless the use of a fixed derate is required to meet a dispatch performance requirement.
- For optimum takeoff performance, use flaps 20 for takeoff unless limited by obstacle clearance and/or climb gradient.
- Use the longest suitable runway provided it is clear of areas of known windshear.
- Use the flight director after takeoff.
- increasing the Vr speed to the performance limited gross weight rotation speed, not to exceed actual gross weight Vr + 20 knots. Set V speeds for the actual gross weight. Rotate at the adjusted (higher) rotation speed. This increased rotation speed results in an increased stall margin, and meets takeoff performance requirements. If windshear is encountered at or beyond the actual gross weight Vr, do not attempt to accelerate to the increased Vr, but rotate without hesitation.

- Be alert for any airspeed fluctuations during takeoff and initial climb. Such fluctuations may be the first indication of windshear.
- Know the all-engine initial climb pitch attitude. Rotate at the normal rate to this attitude for all non-engine failure takeoffs. Minimize reductions from the initial climb pitch attitude until terrain and obstruction clearance is assured, unless stick shaker activates.
- Crew coordination and awareness are very important. Develop an awareness of normal values of airspeed, attitude, vertical speed, airspeed buildup. Closely monitor vertical flight path instruments such as vertical speed and altimeters. The pilot monitoring should be especially aware of vertical path instruments and call out any deviations from normal.
- Should airspeed fall below the trim airspeed, unusual control column forces may be required to maintain the desired pitch attitude. Stick shaker must be respected at all times.

Approach and Landing

- Use Flaps 25 or 30 for landing.
- Establish a stabilized approach no lower than 1,000 feet above the airport to improve windshear recognition capability.
- Use the most suitable runway that avoids the areas of suspected windshear and is compatible with crosswind or tailwind limitations. Use ILS G/S, VNAV path or VASI/PAPI indications to detect flight path deviations and help with timely detection of windshear.
- If the autothrottle is disengaged, or is planned to be disengaged prior to landing, add an appropriate airspeed correction (correction applied in the same manner as gust), up to a maximum of 20 knots.
- Avoid large thrust reductions or trim changes in response to sudden airspeed increases, as these may by followed by airspeed decreases.
- Crosscheck flight director commands using vertical flight instruments.
- Crew coordination and awareness are very important, particularly at night or in marginal weather conditions. Closely monitor the vertical flight path instruments such as vertical speed, altimeters and glide slope displacement. The pilot monitoring should call out any deviations from normal. Use of the autopilot and autothrottle for the approach may provide more monitoring and recognition time.

Recovery

Accomplish the WINDSHEAR maneuver found in the Non-Normal Maneuvers section of this manual.

Windshield Washer and Rain Repellent

(VP-BKJ, VP-BVR ; before SB, rain repellant not removed)

Note: Do not use windshield wipers or rain repellent on dry window. If rain repellent inadvertently applied, do not use windshield wipers unless windshield washer activated first.

Windshield Washer switch (As required) ....ON

Rain Repellent switch (As required) ....Push

Use on one window at a time.

Windshield Wiper selector..As required

Windshield Washer

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
(VP-BKJ, VP-BVR ; SB removes rain repellant)

Note: Do not use windshield wipers on dry window.

Windshield Washer switch (As required) ....ON

Windshield Wiper selector..As required

Ice Crystal Icing

At temperatures below freezing near convective weather, the airplane can encounter visible moisture made up of high concentrations of small ice crystals. Ice crystals can accumulate aft of the engine fan, in the engine core. Ice shedding can cause engine vibration, engine power loss, and engine damage.

These weather conditions are difficult to detect because ice crystals do not cause significant weather radar returns. They are often found in high concentrations above and near regions of heavy precipitation. Ice crystals do not stick to cold aircraft surfaces.

Flight in clouds containing ice crystals has been associated with engine vibration, engine power loss, engine damage, and airplane Total Air Temperature (TAT) probe icing.

Recognize Ice Crystal Icing Weather

Ice crystals are most frequently found in areas of visible moisture and above altitudes normally associated with icing conditions. Their presence can be indicated by one or more of the following:

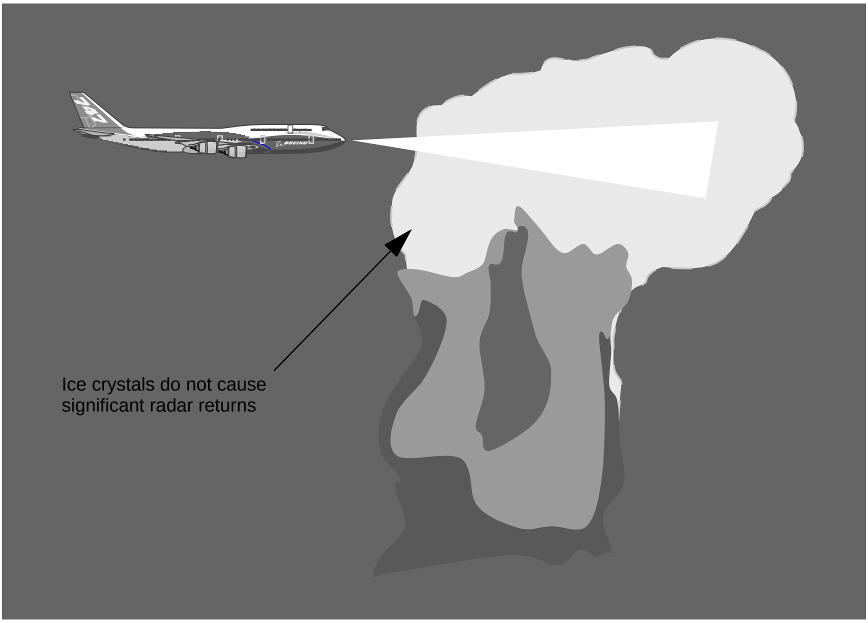
- Appearance of rain on the windshield at temperatures too cold for liquid water to exist. This is due to ice crystals melting on the heated windows (sounds different than rain)
- Airplane TAT indication remains near 0 degrees C due to TAT probe icing
- Areas of light to moderate turbulence
- In IMC with:
  - No significant radar returns at airplane altitude and
  - Heavy precipitation below the airplane, identified by amber and red radar returns on weather radar
- Cloud tops above typical cruise levels (above the tropopause)

Note: There is no significant airframe icing. The icing conditions detections system does not detect ice crystal icing. It is designed to detect supercooled water only.

Avoid Ice Crystal Icing Weather

During flight in IMC, avoid flying directly over significant amber or red radar returns, even if there are no returns at airplane altitude.

Use the weather radar controls to assess weather radar reflectivity below the airplane flight path. Refer to weather radar operating instructions for additional information.



Ice Crystal Icing Suspected

Exit the ice crystal icing conditions. Request a route change to minimize the time above red and amber radar returns.

Do the Ice Crystal Icing non-normal checklist in the Quick Reference Handbook (QRH).

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Performance Inflight — Chap PI
Pkg Model Identification — Section 10

This Section Applies to EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

General

The aircraft listed in the table below are covered in the Performance Dispatch, Performance Inflight and Performance Inflight - Quick Reference Handbook.

Configuration data reflects the airplane as delivered configuration and is updated for service bulletin incorporations in conformance with the policy stated in the introduction section of the FCOM.

Serial and tabulation number are supplied by Boeing.

Airplane Number	Registry Number	Serial Number	Tabulation Number
006	EI-XLZ	29119	RM147
004	VP-BKJ	26638	RT784
005	VP-BKL	28468	RM146
003	VP-BVR	26637	RT783

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Performance Inflight — Chapter PI
General — Section 10

Maximum Allowable Clearway

FIELD LENGTH (FT)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (FT)
6000	500
8000	600
10000	650
12000	700
14000	750
16000	750

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (FT)	NORMAL V1 (KIAS)				
	100	120	140	160	180
900	-3	-3	-3	-3	-3
600	-2	-2	-2	-2	-2
300	-1	-1	-1	-1	-1
0	0	0	0	0	0
-300	1	1	1	1	1
-600	2	2	2	2	2
-900	3	3	3	3	3

VREF (KIAS)

WEIGHT (1000 KG)	FLAPS	
	30	25
400	184	192
380	179	187
360	174	181
340	168	176
320	163	170
300	157	164
280	152	158
260	146	152
240	140	146
220	133	139
200	127	132

Increase VREF 1 knot/4000 ft above sea level.

Flap Maneuver Speeds

FLAP POSITION	MANEUVER SPEED
UP	VREF 30 + 80
1	VREF 30 + 60
5	VREF 30 + 40
10	VREF 30 + 20
20	VREF 30 + 10
25	VREF 25
30	VREF 30

ADVISORY INFORMATION

Slush/Standing Water Takeoff

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440				-34	-34	-34	-61	-61	-61
420	-25	-25	-25	-32	-32	-32	-58	-58	-58
400	-23	-23	-23	-30	-30	-30	-54	-54	-54
380	-21	-21	-21	-28	-28	-28	-51	-51	-51
360	-20	-20	-20	-27	-27	-27	-48	-48	-48
340	-18	-18	-18	-25	-25	-25	-44	-44	-44
320	-16	-16	-16	-23	-23	-23	-41	-41	-41
300	-15	-15	-15	-21	-21	-21	-37	-37	-37
280	-13	-13	-13	-19	-19	-19	-34	-34	-34

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
8600							247		
9000				238			268		
9400				259			288	225	
9800	260			280	215		308	245	
10200	280			301	236		329	266	
10600	301	237		322	257		349	296	223
11000	322	258		343	278	213	369	306	243
11400	343	278		363	299	234	390	327	263
11800	363	299	235	384	320	255	410	347	284
12200	384	320	256	405	340	276		367	304
12600	405	341	276		361	297		388	325
13000		361	297		382	317		408	345
13400		382	318		403	338			365
13800		403	339			359			386
14200			359			380			
14600			380			401			
15000			401						

1. **Enter Weight Adjustment table with slush/standing water depth and field/obstacle limit weight to obtain slush/standing water adjustment.**
2. **Find VMCG limited weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 11000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

Slush/Standing Water Takeoff
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-30	-28	-26	-25	-23	-21	-15	-13	-11
380	-31	-29	-27	-26	-24	-22	-16	-14	-12
360	-32	-30	-28	-27	-25	-23	-18	-16	-14
340	-33	-31	-29	-28	-26	-24	-19	-17	-15
320	-33	-31	-29	-29	-27	-25	-21	-19	-17
300	-33	-31	-29	-30	-28	-26	-23	-21	-19
280	-33	-31	-29	-31	-29	-27	-25	-23	-21

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by 1 kt. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440	-32	-32	-32	-41	-41	-41	-68	-68	-68
420	-30	-30	-30	-39	-39	-39	-64	-64	-64
400	-28	-28	-28	-36	-36	-36	-61	-61	-61
380	-26	-26	-26	-34	-34	-34	-57	-57	-57
360	-24	-24	-24	-32	-32	-32	-54	-54	-54
340	-22	-22	-22	-30	-30	-30	-50	-50	-50
320	-20	-20	-20	-28	-28	-28	-46	-46	-46
300	-19	-19	-19	-25	-25	-25	-43	-43	-43
280	-17	-17	-17	-23	-23	-23	-39	-39	-39

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
10600							258		
11000							279		
11400							299	246	
11800				259			320	266	
12200				281			340	287	
12600	258			302	247		361	308	254
13000	280			323	268		381	328	275
13400	301	245		345	289		402	349	295
13800	323	266		366	311	255	422	369	316
14200	345	288		388	332	277	443	390	336
14600	367	310	253	409	353	298	463	410	357
15000	389	332	275	430	375	319		431	377

1. **Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 17000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-39	-36	-33	-34	-31	-28	-22	-19	-16
380	-40	-37	-34	-35	-32	-29	-23	-21	-18
360	-40	-38	-35	-36	-33	-30	-25	-22	-19
340	-41	-38	-35	-37	-34	-31	-27	-24	-21
320	-41	-38	-36	-38	-35	-32	-28	-26	-23
300	-41	-39	-36	-38	-35	-33	-30	-28	-25
280	-41	-38	-35	-38	-36	-33	-32	-29	-27

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by an additional 2 kts. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

Slippery Runway Takeoff

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-6	-6	-6	-16	-16	-16
380	0	0	0	-5	-5	-5	-15	-15	-15
360	0	0	0	-5	-5	-5	-14	-14	-14
340	0	0	0	-5	-5	-5	-12	-12	-12
320	0	0	0	-4	-4	-4	-11	-11	-11
300	0	0	0	-4	-4	-4	-10	-10	-10
280	0	0	0	-4	-4	-4	-9	-9	-9
260	0	0	0	-3	-3	-3	-8	-8	-8
240	0	0	0	-3	-3	-3	-7	-7	-7

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5600	205								
6000	245								
6400	286	213							
6800	326	253							
7200	367	294	221						
7600	407	334	261	204					
8000		375	302	236					
8400		415	342	269	200				
8800			383	302	233				
9200			423	335	266	197			
9600				368	299	230			
10000				400	331	263	203		
10400					364	295	222		
10800					397	328	242		
11200						361	263	210	
11600						394	284	230	
12000							307	250	
12400							330	271	218
12800							354	293	238
13200							379	316	258
13600							405	340	280
14000								364	302
14400								389	325
14800									349
15200									374
15600									400

1. **Enter Weight Adjustment table with reported braking action and field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limited weight by 7000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

Slippery Runway Takeoff
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-6	-5	-4	-22	-19	-16	-41	-37	-32
380	-8	-7	-6	-23	-20	-17	-43	-39	-34
360	-9	-8	-7	-26	-23	-20	-46	-42	-37
340	-12	-11	-10	-28	-25	-22	-48	-44	-39
320	-12	-11	-10	-30	-27	-24	-50	-46	-41
300	-14	-13	-12	-31	-28	-25	-51	-47	-42
280	-15	-14	-13	-32	-29	-26	-52	-48	-43
260	-15	-14	-13	-33	-30	-27	-53	-49	-44
240	-15	-14	-13	-33	-30	-27	-53	-49	-44

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment.**
   For flaps 10 and good or medium reported braking action, increase V1 by 1 kt.
   If adjusted V1 is less than VMCG, set V1 = VMCG.

ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-9	-9	-9	-21	-21	-21
380	0	0	0	-9	-9	-9	-20	-20	-20
360	0	0	0	-9	-9	-9	-18	-18	-18
340	0	0	0	-8	-8	-8	-17	-17	-17
320	0	0	0	-7	-7	-7	-16	-16	-16
300	0	0	0	-7	-7	-7	-14	-14	-14
280	0	0	0	-6	-6	-6	-12	-12	-12
260	0	0	0	-5	-5	-5	-10	-10	-10
240	0	0	0	-4	-4	-4	-8	-8	-8

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6600	224								
7000	269								
7400	314	238							
7800	359	283	206						
8200	403	327	251						
8600		372	296						
9000		417	341						
9400			386						
9800			430	231					
10200				270					
10600				309	239				
11000				348	278	207			
11400				387	317	246			
11800				426	356	286			
12200					395	325			
12600					434	364			
13000						403			
13400									
13800									
14200									
14600							208		
15000							237		

1. **Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limited weight by 22000 kg.**
3. **ax allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-8	-6	-3	-28	-23	-19	-54	-48	-43
380	-10	-8	-5	-30	-26	-22	-56	-51	-46
360	-12	-10	-7	-33	-28	-24	-59	-53	-48
340	-14	-11	-9	-35	-30	-26	-60	-55	-50
320	-15	-13	-11	-37	-32	-28	-62	-57	-52
300	-17	-15	-12	-38	-34	-29	-63	-58	-53
280	-18	-16	-13	-40	-35	-31	-64	-59	-54
260	-19	-16	-14	-40	-36	-31	-64	-59	-54
240	-19	-16	-14	-40	-36	-31	-64	-59	-54

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment.**
   For flaps 10 and good reported braking action, increase V1 by 2 kts.
   If adjusted V1 is less than VMCG, set V1 = VMCG.

Minimum Control Speeds
Max Takeoff Thrust
VMCG, VRMIN (KIAS)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)													
		-2000		0		2000		4000		6000		8000		10000	
°C	°F	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN
60	140	113	113	109	109	106	106	102	102	98	98	94	94	91	91
55	131	117	117	113	113	109	109	105	105	101	101	97	97	94	94
50	122	120	120	116	116	112	112	108	108	104	104	100	100	96	96
45	113	123	123	119	119	115	115	110	110	106	106	102	102	99	99
44	111	124	124	119	119	115	115	111	111	107	107	103	103	99	99
40	104	126	126	122	122	117	117	113	113	109	109	105	105	101	101
37	98	128	128	123	123	119	119	115	115	111	110	106	106	102	102
36	97	128	128	124	124	119	119	115	115	111	111	107	107	103	103
35	95	129	129	124	124	120	120	115	116	111	111	107	107	103	103
34	93	129	129	125	125	120	120	116	116	112	112	107	107	103	103
33	91	129	129	125	125	121	121	116	116	112	112	108	108	104	104
32	90	129	129	125	125	121	121	117	117	112	112	108	108	104	104
31	88	129	129	126	126	121	121	117	117	113	112	108	108	104	104
30	86	129	129	126	126	121	121	117	117	113	113	109	109	105	105
28	82	129	129	126	126	122	122	117	117	113	113	109	109	105	105
25	77	129	129	126	126	122	122	118	118	113	113	109	109	105	105
24	75	129	129	126	126	122	122	118	118	114	114	109	109	105	105
21	70	129	129	126	126	122	122	118	118	114	114	110	110	105	105
-55	-67	129	130	126	126	122	122	119	119	115	115	110	110	106	106

Flaps 20 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)													
	100		105		110		115		120		125		130	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
280	112	21	119	19	125	18	132	18	138	18	145	18	151	17
260	112	20	119	19	126	18	132	18	139	18	145	17	152	18
240	113	19	120	18	126	18	133	18	140	18	146	18	152	18
220	114	18	120	18	127	18	134	18	140	18	147	18	153	18
200	115	18	121	18	128	18	134	18	141	18	147	18	153	19

Flaps 10 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)													
	100		105		110		115		120		125		130	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
260	114	22	121	21	128	20	134	20	141	20	147	20	153	20
240	115	21	122	20	128	20	135	20	141	20	148	20	154	20
220	116	20	123	20	129	20	135	20	142	20	148	20	155	21
200	117	20	123	20	130	20	136	20	142	20	149	21	155	21

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

10% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440				-34	-34	-34	-62	-62	-62
420	-25	-25	-25	-32	-32	-32	-59	-59	-59
400	-23	-23	-23	-30	-30	-30	-55	-55	-55
380	-21	-21	-21	-28	-28	-28	-52	-52	-52
360	-20	-20	-20	-27	-27	-27	-48	-48	-48
340	-18	-18	-18	-25	-25	-25	-45	-45	-45
320	-17	-17	-17	-23	-23	-23	-42	-42	-42
300	-15	-15	-15	-21	-21	-21	-38	-38	-38
280	-14	-14	-14	-20	-20	-20	-35	-35	-35

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
8200							249		
8600				241			271		
9000				264			292	225	
9400	265			286	217		314	247	
9800	288			308	239		336	269	201
10200	310	241		330	261		357	290	223
10600	332	263		352	284	215	379	312	245
11000	354	285		374	306	237	401	333	266
11400	376	307	239	396	328	259		355	288
11800	398	329	261		350	281		377	310
12200	420	351	283		372	304		398	331
12600		373	305		394	326			353
13000		395	327			348			375
13400		417	349			370			396
13800			371			392			
14200			393						
14600			415						

1. **Enter Weight Adjustment table with slush/standing water depth and TO1 field/obstacle limit weight to obtain slush/standing water adjustment.**
2. **Find VMCG limited weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 11000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff
10% Thrust Reduction
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-27	-25	-23	-22	-20	-18	-11	-9	-7
380	-29	-27	-25	-24	-22	-20	-12	-10	-8
360	-30	-28	-26	-25	-23	-21	-14	-12	-10
340	-31	-29	-27	-26	-24	-22	-16	-14	-12
320	-32	-30	-28	-27	-25	-23	-18	-16	-14
300	-32	-30	-28	-28	-26	-24	-20	-18	-16
280	-32	-30	-28	-29	-27	-25	-22	-20	-18

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by 1 kt. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

10% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440	-29	-29	-29	-37	-37	-37	-65	-65	-65
420	-27	-27	-27	-35	-35	-35	-61	-61	-61
400	-25	-25	-25	-33	-33	-33	-58	-58	-58
380	-24	-24	-24	-31	-31	-31	-54	-54	-54
360	-22	-22	-22	-29	-29	-29	-51	-51	-51
340	-20	-20	-20	-27	-27	-27	-47	-47	-47
320	-19	-19	-19	-25	-25	-25	-44	-44	-44
300	-17	-17	-17	-23	-23	-23	-40	-40	-40
280	-15	-15	-15	-21	-21	-21	-37	-37	-37

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
9800							245		
10200							267		
10600							288		
11000				249			310	254	
11400				271			331	275	
11800	249			293			353	297	241
12200	272			316	258		374	318	262
12600	295			338	280		396	340	284
13000	317	258		361	302	244	417	361	305
13400	340	281		383	325	267	439	383	327
13800	363	304	244	405	347	289	460	404	348
14200	386	327	267	428	370	311		426	370
14600	409	349	290	450	392	334		447	391
15000	432	372	313	472	414	356		469	413

1. **Enter Weight Adjustment table with slush/standing water depth and TO1 field/obstacle limit weight to obtain slush/standing water adjustment.**
2. **Find VMCG limited weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 18000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

10% Thrust Reduction

No Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-36	-33	-29	-30	-27	-23	-16	-13	-10
380	-37	-34	-30	-31	-28	-25	-18	-15	-11
360	-38	-35	-31	-33	-29	-26	-20	-16	-13
340	-38	-35	-32	-34	-30	-27	-22	-18	-15
320	-39	-36	-32	-35	-31	-28	-24	-20	-17
300	-39	-36	-32	-35	-32	-29	-26	-23	-19
280	-39	-36	-32	-36	-33	-29	-28	-25	-22

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by an additional 2 kts. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff

10% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-6	-6	-6	-16	-16	-16
380	0	0	0	-5	-5	-5	-15	-15	-15
360	0	0	0	-5	-5	-5	-14	-14	-14
340	0	0	0	-5	-5	-5	-13	-13	-13
320	0	0	0	-4	-4	-4	-12	-12	-12
300	0	0	0	-4	-4	-4	-11	-11	-11
280	0	0	0	-4	-4	-4	-9	-9	-9
260	0	0	0	-3	-3	-3	-8	-8	-8
240	0	0	0	-3	-3	-3	-7	-7	-7
220	0	0	0	-3	-3	-3	-6	-6	-6

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5200	195								
5600	235								
6000	276	203							
6400	316	243							
6800	356	284	211						
7200	397	324	251	205					
7600		365	292	238					
8000		405	332	271	202				
8400			373	304	235				
8800			413	337	268	199			
9200				371	301	232			
9600				404	334	265	207		
10000					367	298	227		
10400					400	331	249	257	
10800						364	271	280	
11200						397	294	303	
11600							318	328	203
12000							343	353	223
12400							369	379	244
12800							395	406	266
13200									289
13600									313
14000									338
14400									363
14800									390

1. **Enter Weight Adjustment table with reported braking action and TO1 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limited weight by 7000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
10% Thrust Reduction
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-5	-4	-3	-19	-17	-14	-36	-31	-25
380	-7	-6	-5	-21	-18	-15	-38	-33	-28
360	-8	-7	-6	-24	-21	-18	-42	-37	-31
340	-11	-10	-9	-26	-23	-20	-45	-40	-34
320	-11	-10	-9	-28	-25	-22	-47	-42	-36
300	-13	-12	-11	-29	-26	-23	-49	-43	-38
280	-14	-13	-12	-30	-28	-25	-50	-46	-40
260	-14	-13	-12	-31	-29	-26	-51	-47	-41
240	-14	-13	-12	-31	-29	-26	-51	-47	-41
220	-14	-13	-12	-31	-28	-25	-51	-46	-40

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment.**
   For flaps 10 and good or medium reported braking action, increase V1 by 1 kt.
   If adjusted V1 is less than VMCG, set V1 = VMCG.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
10% Thrust Reduction
No Reverse Thrust
Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-8	-8	-8	-20	-20	-20
380	0	0	0	-8	-8	-8	-19	-19	-19
360	0	0	0	-7	-7	-7	-18	-18	-18
340	0	0	0	-7	-7	-7	-16	-16	-16
320	0	0	0	-7	-7	-7	-15	-15	-15
300	0	0	0	-6	-6	-6	-14	-14	-14
280	0	0	0	-5	-5	-5	-12	-12	-12
260	0	0	0	-5	-5	-5	-10	-10	-10
240	0	0	0	-4	-4	-4	-9	-9	-9
220	0	0	0	-3	-3	-3	-7	-7	-7

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6600	193								
7000	236								
7400	279	206							
7800	322	249							
8200	365	292	219						
8600	408	335	262						
9000		378	305	200					
9400		421	348	239					
9800			391	278	207				
10200			434	317	246				
10600				356	286	215			
11000				395	325	254			
11400				434	364	293			
11800					403	333			
12200						372			
12600						411			
13000									
13400									
13800							202		
14200							232		
14600							263	196	
15000							293	226	

1. **Enter Weight Adjustment table with reported braking action and TO1 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limited weight by 23000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff

10% Thrust Reduction

No Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-7	-4	-2	-24	-19	-15	-49	-43	-36
380	-9	-6	-4	-28	-23	-18	-52	-46	-40
360	-11	-8	-6	-32	-27	-22	-55	-49	-42
340	-12	-10	-7	-34	-29	-25	-57	-51	-45
320	-14	-12	-9	-35	-30	-25	-59	-53	-47
300	-16	-13	-11	-36	-31	-26	-60	-54	-48
280	-17	-15	-12	-38	-33	-28	-62	-56	-49
260	-18	-16	-13	-39	-34	-29	-63	-56	-50
240	-18	-16	-13	-39	-34	-29	-62	-56	-50
220	-17	-14	-12	-37	-32	-27	-61	-55	-49

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment.**
   For flaps 10 and good reported braking action, increase V1 by 2 kts.

   If adjusted V1 is less than VMCG, set V1 = VMCG.

TO1 Minimum Control Speeds
10% Thrust Reduction
VMCG, VRMIN (KIAS)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)													
		-2000		0		2000		4000		6000		8000		10000	
°C	°F	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN
60	140	109	109	105	105	101	101	97	97	93	93	90	90	86	86
55	131	112	112	108	108	104	104	100	100	96	96	93	93	89	89
50	122	115	115	111	111	107	107	103	103	99	99	95	95	92	92
45	113	118	118	114	114	110	110	106	106	102	102	98	98	94	94
44	111	118	118	114	114	110	110	106	106	102	102	98	98	94	94
40	104	120	120	116	116	112	112	108	108	104	104	100	100	96	96
36	97	122	122	118	118	114	114	110	110	106	106	102	102	98	98
35	95	123	123	119	119	115	115	111	111	106	106	102	102	98	98
34	93	123	123	119	119	115	115	111	111	107	107	103	103	99	99
33	91	123	123	120	120	116	116	111	111	107	107	103	103	99	99
32	90	123	123	120	120	116	116	112	112	108	107	103	103	99	99
30	86	123	123	120	120	116	116	112	112	108	108	104	104	100	100
28	82	123	123	120	120	117	117	113	113	108	108	104	104	100	100
26	79	123	123	120	120	117	117	113	113	109	109	104	104	100	100
25	77	123	123	120	120	117	117	113	113	109	109	105	105	101	100
20	68	123	123	120	120	117	117	113	113	109	109	105	105	101	101
-55	-67	123	123	120	120	117	117	114	114	110	110	106	106	102	102

Flaps 20 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)													
	100		105		110		115		120		125		130	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
280	112	21	119	19	125	18	132	18	138	18	145	18	151	17
260	112	20	119	19	126	18	132	18	139	18	145	17	152	18
240	113	19	120	18	126	18	133	18	140	18	146	18	152	18
220	114	18	120	18	127	18	134	18	140	18	147	18	153	18
200	115	18	121	18	128	18	134	18	141	18	147	18	153	19

Flaps 10 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)													
	100		105		110		115		120		125		130	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
260	114	22	121	21	128	20	134	20	141	20	147	20	153	20
240	115	21	122	20	128	20	135	20	141	20	148	20	154	20
220	116	20	123	20	129	20	135	20	142	20	148	20	155	21
200	117	20	123	20	130	20	136	20	142	20	149	21	155	51

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

25% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440				-34	-34	-34	-64	-64	-64
420	-25	-25	-25	-32	-32	-32	-60	-60	-60
400	-24	-24	-24	-31	-31	-31	-56	-56	-56
380	-22	-22	-22	-29	-29	-29	-53	-53	-53
360	-21	-21	-21	-27	-27	-27	-50	-50	-50
340	-19	-19	-19	-25	-25	-25	-46	-46	-46
320	-18	-18	-18	-24	-24	-24	-43	-43	-43
300	-16	-16	-16	-22	-22	-22	-40	-40	-40
280	-15	-15	-15	-20	-20	-20	-36	-36	-36

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
7000							217		
7400							241		
7800				235			265		
8200	240			260			289	214	
8600	264			284	208		313	238	
9000	287			309	233		337	262	
9400	313	237		333	257		360	286	212
9800	337	261		358	282		384	310	236
10200	362	286		382	306	230	408	334	260
10600	386	310	235	407	331	255		358	284
11000	410	335	259		355	279		382	308
11400		359	283		380	304		406	332
11800		383	308		405	328			356
12200		407	332			353			380
12600			357			377			
13000			381			402			
13400			405						

1. **Enter Weight Adjustment table with slush/standing water depth and TO2 field/obstacle limit weight to obtain slush/standing water adjustment.**
2. **Find VMCG limited weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 12000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

25% Thrust Reduction

2 Engine Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-22	-20	-18	-16	-14	-12	-2	0	0
380	-23	-21	-19	-17	-15	-13	-4	-2	0
360	-24	-22	-20	-18	-16	-14	-6	-4	-2
340	-26	-24	-22	-20	-18	-16	-8	-6	-4
320	-26	-24	-22	-21	-19	-17	-10	-8	-6
300	-27	-25	-23	-22	-20	-18	-13	-11	-9
280	-27	-25	-23	-23	-21	-19	-15	-13	-11

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by 1 kt. If adjusted V1 is less than VMCG, set V1 = VMCG.**

No Reverse Thrust

Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440	-27	-27	-27	-35	-35	-35	-62	-62	-62
420	-26	-26	-26	-33	-33	-33	-59	-59	-59
400	-24	-24	-24	-31	-31	-31	-55	-55	-55
380	-22	-22	-22	-29	-29	-29	-52	-52	-52
360	-21	-21	-21	-27	-27	-27	-48	-48	-48
340	-19	-19	-19	-25	-25	-25	-45	-45	-45
320	-17	-17	-17	-23	-23	-23	-42	-42	-42
300	-16	-16	-16	-21	-21	-21	-38	-38	-38
280	-14	-14	-14	-20	-20	-20	-35	-35	-35

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff
25% Thrust Reduction
No Reverse Thrust
VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
9000							255		
9400							278		
9800							301	241	
10200				263			324	264	
10600	242			287			347	287	
11000	267			311	249		369	310	250
11400	291			335	273		392	333	273
11800	316	252		359	297		415	356	296
12200	340	277		383	321	259	438	379	319
12600	364	301		407	344	282	461	402	342
13000	389	325	262	430	368	306		424	365
13400	413	350	286	454	392	330		447	388
13800	437	374	311	478	416	354		470	412
14200	462	398	335		440	378			434
14600		423	359		464	402			457
15000		447	384			426			479

1. **Enter Weight Adjustment table with slush/standing water depth and TO2 field/obstacle limit weight to obtain slush/standing water adjustment.**
2. **Find VMCG limited weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 19000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-29	-25	-21	-22	-18	-14	-6	-2	2
380	-30	-27	-23	-24	-20	-16	-8	-4	0
360	-31	-28	-24	-25	-21	-17	-10	-6	-2
340	-32	-28	-24	-26	-23	-19	-12	-8	-4
320	-33	-29	-25	-28	-24	-20	-15	-11	-7
300	-33	-29	-25	-28	-24	-21	-17	-13	-10
280	-33	-29	-25	-30	-26	-22	-21	-17	-13

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by an additional 2 kts. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
25% Thrust Reduction
2 Engine Reverse Thrust
Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-6	-6	-6	-17	-17	-17
380	0	0	0	-5	-5	-5	-16	-16	-16
360	0	0	0	-5	-5	-5	-15	-15	-15
340	0	0	0	-5	-5	-5	-14	-14	-14
320	0	0	0	-4	-4	-4	-12	-12	-12
300	0	0	0	-4	-4	-4	-11	-11	-11
280	0	0	0	-4	-4	-4	-10	-10	-10
260	0	0	0	-3	-3	-3	-9	-9	-9
240	0	0	0	-3	-3	-3	-8	-8	-8
220	0	0	0	-3	-3	-3	-7	-7	-7

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
4800	196								
5200	238								
5600	279	205							
6000	321	246							
6400	362	288	213						
6800	404	329	255	228					
7200		371	296	261					
7600		412	338	295	225				
8000			379	328	258				
8400			420	361	291				
8800				394	325	255			
9200				428	358	288	228		
9600					391	321	251		
10000					424	355	276		
10400						388	301	237	
10800						421	327	261	
11200							355	286	
11600							383	311	247
12000							413	338	271
12400								366	296
12800								395	322
13200									349
13600									378
14000									407

1. **Enter Weight Adjustment table with reported braking action and TO2 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limited weight by 8000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff

25% Thrust Reduction

2 Engine Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-1	0	0	-13	-11	-7	-26	-20	-12
380	-3	-2	-1	-14	-12	-9	-28	-22	-15
360	-5	-3	-2	-18	-15	-11	-33	-26	-19
340	-7	-6	-5	-20	-17	-13	-36	-30	-22
320	-8	-7	-5	-22	-19	-15	-39	-32	-25
300	-10	-8	-7	-24	-22	-18	-43	-36	-29
280	-10	-9	-8	-25	-24	-20	-46	-39	-32
260	-11	-10	-8	-25	-24	-21	-47	-40	-33
240	-11	-10	-8	-26	-25	-22	-48	-41	-34
220	-11	-10	-8	-25	-24	-21	-47	-40	-33

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment.**
   For flaps 10 and good or medium reported braking action, increase V1 by 1 kt.
   If adjusted V1 is less than VMCG, set V1 = VMCG.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff

25% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-7	-7	-7	-20	-20	-20
380	0	0	0	-7	-7	-7	-19	-19	-19
360	0	0	0	-7	-7	-7	-18	-18	-18
340	0	0	0	-7	-7	-7	-16	-16	-16
320	0	0	0	-6	-6	-6	-15	-15	-15
300	0	0	0	-6	-6	-6	-14	-14	-14
280	0	0	0	-6	-6	-6	-13	-13	-13
260	0	0	0	-5	-5	-5	-11	-11	-11
240	0	0	0	-4	-4	-4	-9	-9	-9
220	0	0	0	-3	-3	-3	-8	-8	-8

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5800	221								
6200	264	191							
6600	307	234							
7000	350	277	204						
7400	392	320	247						
7800	435	363	290						
8200		405	333	201					
8600			375	240					
9000			418	279	209				
9400				317	248				
9800				356	286	217			
10200				394	325	255			
10600				433	364	294			
11000					402	333			
11400						371			
11800						410			
12200									
12600							204		
13000							236		
13400							268	197	
13800							300	229	
14200							332	262	191
14600							365	294	223
15000							397	326	255

1. **Enter Weight Adjustment table with reported braking action and TO2 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limited weight by 24000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
25% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-6	-3	-1	-18	-12	-7	-39	-31	-23
380	-7	-4	-2	-21	-15	-10	-43	-35	-27
360	-7	-5	-2	-23	-18	-12	-46	-38	-30
340	-8	-6	-3	-26	-21	-15	-49	-41	-33
320	-10	-8	-5	-28	-23	-17	-52	-44	-36
300	-12	-9	-7	-30	-25	-19	-54	-46	-38
280	-13	-11	-8	-33	-27	-22	-55	-47	-39
260	-15	-12	-10	-34	-28	-23	-56	-48	-40
240	-15	-12	-10	-34	-28	-23	-56	-48	-40
220	-15	-12	-10	-32	-27	-22	-55	-47	-39

1. Obtain V1, VR and V2 for the actual weight.

2. If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment.
For flaps 10 and good reported braking action, increase V1 by 2 knots.

If adjusted V1 is less than VMCG, set V1 = VMCG.

TO2 Minimum Control Speeds

25% Thrust Reduction

VMCG, VRMIN (KIAS)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)													
		-2000		0		2000		4000		6000		8000		10000	
°C	°F	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN
60	140	100	100	96	96	93	93	89	89	86	86	83	83	80	80
55	131	103	103	99	99	96	96	92	92	89	89	85	85	82	82
50	122	106	106	102	102	98	98	95	95	91	91	88	88	84	84
45	113	108	108	105	105	101	101	97	97	93	93	90	90	86	86
44	111	109	109	105	105	101	101	98	98	94	94	90	90	87	87
40	104	111	111	107	107	103	103	99	100	96	96	92	92	88	89
37	98	112	112	108	108	105	105	101	101	97	97	94	93	90	90
36	97	112	112	109	109	105	105	101	101	98	97	94	94	90	90
35	95	113	113	109	109	106	106	102	102	98	98	94	94	90	90
34	93	113	113	109	109	106	106	102	102	98	98	94	94	91	91
33	91	113	113	110	110	106	106	102	102	99	98	95	95	91	91
32	90	113	113	110	110	106	106	103	103	99	99	95	95	91	91
31	88	113	113	110	110	107	107	103	103	99	99	95	95	92	92
30	86	113	113	110	110	107	107	103	103	99	99	96	96	92	92
28	82	113	113	110	110	107	107	103	103	100	100	96	96	92	92
25	77	113	113	110	110	107	107	104	104	100	100	96	96	92	92
24	75	113	113	110	110	108	107	104	104	100	100	96	96	92	92
21	70	113	113	110	110	108	108	104	104	100	100	96	96	93	93
20	68	113	113	110	110	108	108	104	104	100	100	97	96	93	93
-55	-67	113	113	111	111	108	108	104	104	101	101	97	97	93	93

Flaps 20 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)													
	100		105		110		115		120		125		130	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
260	112	20	119	19	126	18	132	18	139	18	145	17	152	18
240	113	19	120	18	126	18	133	18	140	18	146	18	152	18
220	114	18	120	18	127	18	134	18	140	18	147	18	153	18
200	115	18	121	18	128	18	134	18	141	18	147	18	153	19

Flaps 10 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)													
	100		105		110		115		120		125		130	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
260	114	22	121	21	128	20	134	20	141	20	147	20	153	20
240	115	21	122	20	128	20	135	20	141	20	148	20	154	20
220	116	20	123	20	129	20	135	20	142	20	148	20	155	21
200	117	20	123	20	130	20	136	20	142	20	149	21	155	21

Assumed Temperature Reduced Thrust

Based on 25% thrust reduction or minimum allowable EPR

MINIMUM ALLOWABLE EPR FOR REDUCED THRUST	
MAX TAKEOFF EPR FOR ACTUAL OAT	MIN TAKEOFF EPR ALLOWED
1.90	1.67
1.80	1.59
1.70	1.52
1.60	1.45
1.52	1.39
1.50	1.39
1.40	1.39

Initial Climb EPR

Based on engine bleed for 3 packs on, engine and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	129	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42
50	122	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44
45	113	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46
40	104	1.49	1.49	1.48	1.48	1.48	1.48	1.48	1.49	1.49	1.49	1.49	1.49	1.48
35	95	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
30	86	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54
25	77	1.54	1.55	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.57	1.57	1.56
20	68	1.54	1.55	1.56	1.57	1.58	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
15	59	1.54	1.55	1.56	1.57	1.58	1.59	1.61	1.62	1.62	1.62	1.62	1.62	1.62
10	41	1.54	1.55	1.56	1.57	1.58	1.59	1.61	1.62	1.63	1.64	1.65	1.65	1.65
5 & BELOW	41 & BELOW	1.54	1.55	1.56	1.57	1.58	1.59	1.61	1.62	1.63	1.64	1.66	1.67	1.68

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	EPR ADJUSTMENT
NACELLE ANTI-ICE	-0.01
WING ANTI-ICE	-0.01
NACELLE & WING ANTI-ICE	-0.02
EACH 40 KTS ABOVE 200 KIAS	0.01

Max Climb EPR

Based on engine bleed for 3 packs on, engine and wing anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)									
	0	5	10	15	20	25	30	35	40	45
	340	340	340	340	340	340	.84	.84	.84	.84
60	1.43	1.43								
50	1.48	1.48	1.47	1.47						
40	1.53	1.53	1.52	1.52	1.51	1.51				
30	1.53	1.57	1.58	1.57	1.57	1.56	1.54			
20	1.53	1.57	1.60	1.63	1.62	1.62	1.60	1.57		
10	1.53	1.57	1.60	1.63	1.66	1.68	1.66	1.63	1.61	1.58
0	1.53	1.57	1.60	1.63	1.66	1.69	1.72	1.69	1.67	1.65
-10	1.53	1.57	1.60	1.63	1.66	1.69	1.73	1.75	1.74	1.71
-20 & BELOW	1.53	1.57	1.60	1.63	1.66	1.69	1.73	1.76	1.76	1.74

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)	
	0	45
ENGINE ANTI-ICE ON	-0.01	-0.01
ENGINE & WING ANTI-ICE ON	-0.02	-0.02

Go-around EPR

Based on engine bleed for 3 packs on

REPORTED OAT		TAT (°C)	AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F		-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
51	124	54	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
47	117	50	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62
45	108	42	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66
37	99	40	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69
32	90	35	1.71	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72
27	81	30	1.71	1.72	1.73	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74
22	72	25	1.71	1.72	1.73	1.74	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75
17	63	20	1.71	1.72	1.73	1.74	1.75	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76
12	54	15	1.71	1.72	1.73	1.74	1.75	1.76	1.76	1.77	1.77	1.77	1.77	1.77	1.77
7	45	12	1.71	1.72	1.73	1.74	1.75	1.76	1.76	1.77	1.77	1.77	1.77	1.77	1.77
2 & BELOW	36 & BELOW	5 & BELOW	1.71	1.72	1.73	1.74	1.75	1.76	1.76	1.77	1.77	1.77	1.77	1.77	1.77

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-2000	10000
2 PACKS OFF	0.01	0.01
3 PACKS OFF	0.01	0.01

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb (290/.84)

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
40000	**PITCH ATT**	**3.5**	**3.5**			
	V/S (FT/MIN)	+1600	+800			
35000	**PITCH ATT**	**4.5**	**4.0**	**4.0**	**3.5**	
	V/S (FT/MIN)	+2800	+1900	+1100	+400	
30000	**PITCH ATT**	**4.5**	**4.5**	**4.5**	**4.5**	**5.0**
	V/S (FT/MIN)	+2700	+2000	+1400	+900	+500
20000	**PITCH ATT**	**7.5**	**7.0**	**6.5**	**6.5**	**7.0**
	V/S (FT/MIN)	+4200	+3100	+2400	+1900	+1500
10000	**PITCH ATT**	**10.5**	**9.5**	**9.0**	**8.5**	**8.5**
	V/S (FT/MIN)	+5400	+4200	+3300	+2600	+2200
SEA LEVEL	**PITCH ATT**	**14.0**	**12.5**	**11.5**	**11.0**	**10.5**
	V/S (FT/MIN)	+6500	+5100	+4100	+3400	+2900

Cruise (.84/290)

Flaps Up, Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
40000	**PITCH ATT**	**2.0**	**3.0**			
	EPR	1.48	1.59			
	(AltMode%N1)	(85.0)	(90.1)			
35000	**PITCH ATT**	**1.0**	**2.0**	**2.5**	**3.0**	
	EPR	1.42	1.47	1.55	1.67	
	(AltMode%N1)	(82.2)	(84.9)	(88.4)	(94.6)	
30000	**PITCH ATT**	**1.0**	**2.0**	**3.0**	**3.5**	**4.0**
	EPR	1.33	1.38	1.44	1.51	1.60
	(AltMode%N1)	(78.6)	(81.0)	(83.9)	(87.5)	(91.6)
20000	**PITCH ATT**	**1.5**	**2.5**	**3.0**	**4.0**	**4.5**
	EPR	1.23	1.26	1.29	1.34	1.38
	(AltMode%N1)	(71.9)	(74.1)	(76.8)	(79.7)	(82.3)
10000	**PITCH ATT**	**1.5**	**2.5**	**3.5**	**4.5**	**5.0**
	EPR	1.16	1.18	1.20	1.23	1.26
	(AltMode%N1)	(65.6)	(67.3)	(69.6)	(72.2)	(74.7)
SEA LEVEL	**PITCH ATT**	**1.5**	**2.5**	**3.5**	**4.5**	**5.0**
	EPR	1.12	1.13	1.14	1.16	1.18
	(AltMode%N1)	(58.7)	(60.5)	(62.8)	(65.3)	(67.6)

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Descent (.84/290)

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
40000	**PITCH ATT**	**-1.0**	**0.0**			
	V/S (FT/MIN)	-2600	-2500			
35000	**PITCH ATT**	**-3.0**	**-2.0**	**-1.0**	**-0.5**	
	V/S (FT/MIN)	-3500	-3200	-3100	-3100	
30000	**PITCH ATT**	**-2.0**	**-0.5**	**0.5**	**1.0**	**1.5**
	V/S (FT/MIN)	-2300	-2100	-2000	-2000	-2000
20000	**PITCH ATT**	**-1.5**	**-0.5**	**0.5**	**1.5**	**2.0**
	V/S (FT/MIN)	-2200	-2000	-1800	-1800	-1800
10000	**PITCH ATT**	**-2.0**	**-0.5**	**0.5**	**1.5**	**2.5**
	V/S (FT/MIN)	-2000	-1800	-1600	-1600	-1600
SEA LEVEL	**PITCH ATT**	**-2.0**	**-0.5**	**0.5**	**1.5**	**2.5**
	V/S (FT/MIN)	-1800	-1600	-1500	-1400	-1400

Holding (VREF30+80)

Flaps Up, Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
10000	**PITCH ATT**	**5.5**	**6.0**	**6.0**	**5.5**	**5.5**
	EPR	1.14	1.17	1.20	1.23	1.26
	(Alt Mode %N1)	(58.1)	(63.7)	(68.0)	(71.8)	(74.8)
	KIAS	207	224	242	266	283

Terminal Area (5000 FT)

Thrust for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)					
		200	250	300	350	400	410
FLAPS UP (VREF30+80) (GEAR UP)	**PITCH ATT**	**5.0**	**5.5**	**5.5**	**6.0**	**6.5**	**6.5**
	EPR	1.12	1.15	1.18	1.21	1.25	1.26
	(Alt Mode %N1)	(55.1)	(61.3)	(66.0)	(70.0)	(73.6)	(74.2)
	KIAS	208	224	239	253	266	269
FLAPS 1 (VREF30+60) (GEAR UP)	**PITCH ATT**	**6.5**	**7.0**	**7.0**	**7.5**	**7.5**	**7.5**
	EPR	1.14	1.17	1.21	1.24	1.28	1.29
	(Alt Mode %N1)	(57.8)	(63.7)	(68.2)	(72.2)	(76.0)	(76.6)
	KIAS	188	204	219	233	246	249
FLAPS 5 (VREF30+40) (GEAR UP)	**PITCH ATT**	**7.5**	**7.5**	**8.0**	**8.0**	**8.0**	**8.0**
	EPR	1.17	1.21	1.25	1.30	1.34	1.35
	(Alt Mode %N1)	(61.7)	(67.3)	(72.3)	(76.4)	(80.0)	(80.8)
	KIAS	168	184	199	213	226	229
FLAPS 10 (VREF30+20) (GEAR UP)	**PITCH ATT**	**8.5**	**8.5**	**8.5**	**9.0**	**9.0**	**9.0**
	EPR	1.17	1.21	1.25	1.29	1.34	1.34
	(Alt Mode %N1)	(60.9)	(66.6)	(71.8)	(75.9)	(79.4)	(80.0)
	KIAS	148	164	179	193	206	209
FLAPS 20 (VREF30+10) (GEAR DOWN)	**PITCH ATT**	**7.5**	**7.5**	**7.5**	**7.5**	**8.5**	**8.5**
	EPR	1.22	1.27	1.33	1.38	1.44	1.45
	(Alt Mode %N1)	(67.2)	(73.3)	(78.2)	(82.5)	(86.2)	(87.0)
	KIAS	138	154	169	183	196	199

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Final Approach (1500 FT)

Gear Down, Thrust for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)					
		200	250	300	350	400	410
FLAPS 25 (VREF25+10)	**PITCH ATT**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**
	EPR	1.12	1.15	1.18	1.21	1.24	1.24
	(Alt Mode %N1)	(52.9)	(58.3)	(63.0)	(67.3)	(70.7)	(71.2)
	KIAS	143	159	175	189	203	205
FLAPS 30 (VREF30+10)	**PITCH ATT**	**0.5**	**1.0**	**1.0**			
	EPR	1.16	1.20	1.24			
	(Alt Mode %N1)	(59.5)	(65.2)	(70.0)			
	KIAS	138	154	168			

Performance Inflight — Chapter PI
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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 10°C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	28200	5	33100*	32900	32100	30500	28900
380	29300	2	34300*	34000	33200	31600	30100
360	30500	-1	35700*	35100	34300	32700	31300
340	31800	-4	36800*	36300	35500	34000	32500
320	33100	-7	38000*	37600	36800	35200	33800
300	34500	-10	39300*	38900	38100	36600	35100
280	35900	-13	40600*	40400	39600	38000	36600
260	37400	-13	42000*	41900	41100	39600	38100
240	39100	-13	43600*	43600	42800	41200	39800
220	40900	-13	45000	45000	44600	43000	41600
200	42900	-13	45000	45000	45000	45000	43600

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	28200	10	32300*	32300*	32100	30500	28900
380	29300	8	33600*	33600*	33200	31600	30100
360	30500	5	34900*	34900*	34300	32700	31300
340	31800	2	36400*	36300	35500	34000	32500
320	33100	-1	37600*	37600	36800	35200	33800
300	34500	-4	38800*	38800*	38100	36600	35100
280	35900	-7	40000*	40000*	39600	38000	36600
260	37400	-8	41400*	41400*	41100	39600	38100
240	39100	-8	42800*	42800*	42800	41200	39800
220	40900	-8	44400*	44400*	44400*	43000	41600
200	42900	-8	45000	45000	45000	45000	43600

ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	28200	16	31200*	31200*	31200*	30500	28900
380	29300	13	32600*	32600*	32600*	31600	30100
360	30500	11	33900*	33900*	33900*	32700	31300
340	31800	8	35500*	35500*	35500	34000	32500
320	33100	5	36800*	36800*	36800	35200	33800
300	34500	2	38000*	38000*	38000*	36600	35100
280	35900	-1	39200*	39200*	39200*	38000	36600
260	37400	-2	40600*	40600*	40600*	39600	38100
240	39100	-2	42000*	42000*	42000*	41200	39800
220	40900	-2	43500*	43500*	43500*	43000	41600
200	42900	-2	45000	45000	45000	45000	43600

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)										
		25	27	29	31	33	35	37	39	41	43	45
400	EPR	1.47	1.51	1.56	1.63							
	MACH	.832	.848	.859	.861							
	KIAS	353	345	336	322							
	FF/ENG	3494	3483	3494	3568							
380	EPR	1.45	1.48	1.53	1.59	1.66						
	MACH	.823	.839	.853	.860	.860						
	KIAS	348	341	333	322	308						
	FF/ENG	3312	3291	3292	3319	3434						
360	EPR	1.42	1.46	1.50	1.55	1.62						
	MACH	.814	.829	.845	.858	.861						
	KIAS	344	337	330	321	309						
	FF/ENG	3137	3110	3098	3107	3162						
340	EPR	1.40	1.44	1.48	1.52	1.57	1.65					
	MACH	.803	.819	.835	.851	.860	.860					
	KIAS	339	332	325	318	308	295					
	FF/ENG	2972	2936	2915	2914	2932	3015					
320	EPR	1.38	1.41	1.45	1.49	1.54	1.60	1.68				
	MACH	.791	.808	.824	.840	.855	.860	.860				
	KIAS	334	328	321	314	306	295	282				
	FF/ENG	2811	2770	2742	2730	2735	2766	2898				
300	EPR	1.36	1.39	1.42	1.46	1.50	1.56	1.62				
	MACH	.777	.796	.813	.829	.845	.858	.861				
	KIAS	327	322	316	309	302	294	282				
	FF/ENG	2653	2612	2576	2557	2552	2555	2625				
280	EPR	1.35	1.37	1.40	1.43	1.47	1.52	1.57	1.65			
	MACH	.760	.782	.800	.817	.833	.849	.859	.860			
	KIAS	320	316	311	304	298	291	281	269			
	FF/ENG	2493	2455	2418	2391	2377	2375	2400	2500			
260	EPR	1.33	1.35	1.38	1.41	1.44	1.48	1.53	1.59	1.67		
	MACH	.739	.764	.785	.803	.820	.837	.853	.860	.860		
	KIAS	310	308	304	299	292	286	279	269	257		
	FF/ENG	2325	2298	2262	2233	2211	2200	2214	2263	2368		
240	EPR	1.31	1.33	1.36	1.38	1.41	1.45	1.49	1.54	1.61	1.69	
	MACH	.713	.742	.766	.787	.806	.823	.839	.855	.860	.860	
	KIAS	298	298	296	292	287	280	274	267	257	245	
	FF/ENG	2149	2133	2106	2077	2052	2033	2035	2065	2114	2222	
220	EPR	1.28	1.31	1.33	1.36	1.39	1.42	1.46	1.50	1.55	1.62	
	MACH	.681	.713	.742	.767	.789	.807	.824	.841	.856	.861	
	KIAS	284	286	286	284	280	275	268	262	255	245	
	FF/ENG	1960	1957	1943	1921	1896	1873	1867	1881	1908	1956	
200	EPR	1.26	1.28	1.31	1.33	1.36	1.39	1.42	1.46	1.50	1.55	1.62
	MACH	.648	.678	.711	.741	.767	.788	.807	.824	.841	.856	.861
	KIAS	269	271	273	273	271	268	262	256	250	244	234
	FF/ENG	1769	1768	1767	1760	1742	1718	1706	1712	1724	1747	1788

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitudes

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
683	637	596	560	529	500	479	460	442	426	411
1369	1276	1193	1121	1058	1000	960	923	888	856	827
2059	1919	1793	1683	1587	1500	1441	1385	1334	1286	1243
2754	2565	2395	2247	2118	2000	1921	1848	1779	1716	1658
3454	3214	2998	2812	2648	2500	2402	2310	2225	2146	2073
4161	3868	3606	3379	3180	3000	2882	2772	2670	2575	2488
4876	4528	4217	3949	3713	3500	3362	3234	3114	3004	2902
5599	5194	4831	4519	4246	4000	3843	3696	3559	3432	3316
6333	5867	5451	5093	4781	4500	4322	4157	4002	3860	3729
7077	6547	6075	5670	5317	5000	4802	4617	4446	4287	4142

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		25	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
500	14.2	1:24	12.9	1:21	11.7	1:17	10.7	1:13	10.0	1:12
1000	28.8	2:45	26.4	2:39	24.1	2:30	22.3	2:21	21.0	2:17
1500	43.0	4:08	39.5	3:58	36.3	3:45	33.6	3:30	31.8	3:23
2000	57.0	5:32	52.4	5:18	48.3	5:01	44.7	4:41	42.4	4:30
2500	70.7	6:58	65.0	6:40	60.0	6:19	55.6	5:53	52.7	5:38
3000	84.0	8:26	77.3	8:04	71.4	7:38	66.2	7:07	62.8	6:48
3500	97.1	9:57	89.4	9:29	82.5	8:59	76.5	8:23	72.7	7:59
4000	109.9	11:30	101.2	10:56	93.4	10:21	86.8	9:40	82.3	9:11
4500	122.5	13:05	112.7	12:25	104.1	11:45	96.7	10:59	91.7	10:26
5000	134.7	14:45	124.0	13:56	114.5	13:10	106.5	12:20	100.9	11:42

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-0.8	-0.7	0.0	2.7	7.7
20	-2.5	-1.4	0.0	5.0	13.6
30	-4.2	-2.0	0.0	7.2	18.8
40	-5.8	-2.7	0.0	9.2	23.5
50	-7.4	-3.4	0.0	10.9	27.7
60	-8.9	-4.1	0.0	12.5	31.2
70	-10.3	-4.9	0.0	13.9	34.2
80	-11.6	-5.6	0.0	15.1	36.6
90	-13.0	-6.4	0.0	16.1	38.5
100	-14.2	-7.1	0.0	16.9	39.8
110	-15.4	-7.9	0.0	17.5	40.4
120	-16.5	-8.7	0.0	18.0	40.6
130	-17.6	-9.5	0.0	18.2	40.1
140	-18.6	-10.4	0.0	18.2	39.1

Long Range Cruise Enroute Fuel and Time - High Altitudes

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
3869	3660	3468	3297	3142	3000	2882	2772	2670	2575	2488
4523	4276	4051	3850	3667	3500	3362	3234	3114	3004	2902
5183	4897	4636	4404	4193	4000	3843	3696	3559	3432	3316
5847	5521	5223	4958	4719	4500	4322	4157	4002	3860	3729
6516	6149	5814	5515	5247	5000	4802	4617	4446	4287	4142
7190	6780	6406	6073	5774	5500	5282	5078	4889	4714	4553
7869	7414	7000	6633	6303	6000	5761	5538	5331	5140	4965
8553	8052	7597	7194	6832	6500	6241	5999	5774	5566	5376
9241	8693	8195	7755	7361	7000	6720	6459	6216	5992	5786
9934	9338	8797	8319	7891	7500	7199	6918	6657	6416	6195
10632	9987	9401	8884	8422	8000	7678	7377	7098	6840	6603

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)							
	25		29		33		37	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
3000	62.7	6:45	59.1	6:31	56.3	6:20	55.2	6:13
3500	72.5	7:54	68.4	7:37	65.2	7:24	63.7	7:15
4000	82.2	9:05	77.4	8:44	73.8	8:28	72.0	8:18
4500	91.6	10:16	86.3	9:52	82.3	9:33	80.1	9:20
5000	100.8	11:28	95.0	11:01	90.5	10:39	88.0	10:24
5500	109.8	12:41	103.5	12:11	98.5	11:46	95.7	11:28
6000	118.7	13:55	111.8	13:22	106.4	12:53	103.2	12:32
6500	127.3	15:11	120.0	14:33	114.1	14:01	110.6	13:37
7000	135.9	16:28	128.0	15:46	121.7	15:10	117.8	14:43
7500	144.2	17:47	135.9	17:00	129.1	16:21	124.8	15:49
8000	152.5	19:09	143.7	18:14	136.5	17:31	131.7	16:57

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
50	-9.4	-4.6	0.0	11.0	28.0
60	-11.4	-5.7	0.0	12.4	31.0
70	-13.3	-6.7	0.0	13.8	33.8
80	-15.2	-7.7	0.0	15.1	36.5
90	-17.1	-8.6	0.0	16.3	39.0
100	-19.0	-9.6	0.0	17.5	41.3
110	-20.8	-10.6	0.0	18.7	43.5
120	-22.6	-11.5	0.0	19.8	45.6
130	-24.4	-12.5	0.0	20.8	47.4
140	-26.2	-13.4	0.0	21.8	49.1
150	-27.9	-14.4	0.0	22.8	50.7
160	-29.7	-15.3	0.0	23.7	52.1

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)										
	400	380	360	340	320	300	280	260	240	220	200
45										36	10
43									33	10	0
41							59	27	8	0	1
39						45	21	6	0	1	9
37				60	33	14	4	0	2	9	20
35			41	22	8	1	0	3	10	20	34
33	46	27	13	4	0	0	4	11	21	34	48
31	15	6	1	0	1	6	14	23	35	47	61
29	2	0	0	3	9	16	26	36	48	61	74
27	0	2	6	12	20	28	38	49	61	73	85
25	5	9	16	23	32	41	51	62	73	85	96

The above wind factor table is for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. **Read wind factors for present and new altitudes from table.**
2. **Determine difference (new altitude wind factor minus present altitude wind factor); this difference may be negative or positive.**
3. **Break-even wind at new altitude is present altitude wind plus difference from step 2.**

Descent at .84/290/250

PRESSURE ALT (1000 FT)	19	21	23	25	27	29	31	33	35	37	39	41	43	45
DISTANCE (NM)	76	83	90	98	105	112	120	127	134	140	146	152	158	163
TIME (MINUTES)	16	17	18	20	21	22	23	24	25	25	26	27	27	28

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	45000
400	EPR	1.19	1.22	1.27	1.33	1.38	1.47	1.59			
	KIAS	286	286	286	286	307	311	316			
	FF/ENG	3340	3270	3230	3180	3230	3300	3530			
380	EPR	1.18	1.21	1.25	1.31	1.36	1.44	1.56			
	KIAS	280	280	280	280	300	303	307			
	FF/ENG	3180	3100	3050	3000	3050	3090	3250			
360	EPR	1.17	1.20	1.24	1.29	1.35	1.42	1.52			
	KIAS	271	271	271	271	291	294	298			
	FF/ENG	3010	2940	2880	2830	2860	2890	3010			
340	EPR	1.17	1.19	1.23	1.28	1.33	1.40	1.49	1.64		
	KIAS	261	261	261	261	282	285	289	292		
	FF/ENG	2850	2790	2720	2660	2690	2700	2780	3110		
320	EPR	1.16	1.18	1.21	1.26	1.31	1.38	1.47	1.59		
	KIAS	251	251	251	251	273	276	280	284		
	FF/ENG	2700	2640	2570	2520	2520	2520	2570	2780		
300	EPR	1.15	1.17	1.20	1.25	1.29	1.36	1.44	1.55		
	KIAS	242	242	242	242	264	267	270	275		
	FF/ENG	2540	2490	2430	2360	2350	2350	2380	2520		
280	EPR	1.14	1.16	1.19	1.23	1.27	1.34	1.41	1.52		
	KIAS	233	233	233	233	255	257	260	264		
	FF/ENG	2400	2340	2280	2210	2190	2180	2200	2290		
260	EPR	1.13	1.15	1.18	1.21	1.26	1.31	1.39	1.48	1.62	
	KIAS	228	228	228	228	246	248	250	254	259	
	FF/ENG	2250	2190	2140	2060	2050	2010	2020	2080	2370	
240	EPR	1.12	1.13	1.16	1.20	1.24	1.29	1.36	1.45	1.57	
	KIAS	221	221	221	221	236	237	239	243	247	
	FF/ENG	2110	2040	2000	1920	1880	1850	1850	1890	2060	
220	EPR	1.11	1.12	1.15	1.18	1.22	1.27	1.33	1.41	1.52	
	KIAS	215	215	215	215	225	226	229	231	235	
	FF/ENG	1960	1900	1860	1780	1730	1710	1680	1710	1820	
200	EPR	1.10	1.11	1.14	1.16	1.20	1.25	1.31	1.38	1.48	1.61
	KIAS	208	208	208	208	215	216	218	220	223	226
	FF/ENG	2030	1760	1720	1640	1590	1540	1520	1530	1610	1800

This table includes 5% additional fuel for holding in a racetrack pattern.

Holding
Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
400	EPR	1.24	1.28	1.34	1.41	1.51
	KIAS	245	246	248	251	251
	FF/ENG	3820	3770	3660	3640	3680
380	EPR	1.23	1.26	1.32	1.39	1.48
	KIAS	240	241	243	245	245
	FF/ENG	3620	3570	3470	3440	3460
360	EPR	1.22	1.25	1.30	1.37	1.45
	KIAS	234	236	238	240	240
	FF/ENG	3430	3380	3280	3240	3250
340	EPR	1.20	1.23	1.28	1.35	1.43
	KIAS	229	230	232	234	234
	FF/ENG	3250	3190	3140	3050	3050
320	EPR	1.19	1.22	1.27	1.33	1.40
	KIAS	223	224	226	228	228
	FF/ENG	3060	3010	2950	2860	2850
300	EPR	1.18	1.20	1.25	1.30	1.38
	KIAS	218	219	220	222	222
	FF/ENG	2880	2830	2760	2680	2660
280	EPR	1.17	1.19	1.23	1.28	1.35
	KIAS	212	213	215	216	216
	FF/ENG	2710	2650	2580	2540	2470
260	EPR	1.16	1.18	1.21	1.26	1.32
	KIAS	207	207	209	210	210
	FF/ENG	2530	2470	2410	2360	2290
240	EPR	1.14	1.16	1.20	1.24	1.30
	KIAS	200	201	202	203	203
	FF/ENG	2360	2300	2240	2180	2110
220	EPR	1.13	1.15	1.18	1.22	1.27
	KIAS	194	194	195	196	196
	FF/ENG	2190	2140	2080	2010	1970
200	EPR	1.12	1.14	1.17	1.20	1.25
	KIAS	187	188	189	190	190
	FF/ENG	2030	1970	1920	1840	1790

This table includes 5% additional fuel for holding in a racetrack pattern.
Holding at Flaps 1 in icing conditions is not recommended.

Intentionally
Blank

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 30

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF30	TWO REV	NO REV

Dry Runway

BRAKING CONFIGURATION	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	TWO REV	NO REV
MAX MANUAL	3910	110/-60	110	-190/620	60/-60	110/-110	190	110	250
AUTOBRAKE MAX	4750	90/-70	150	-220/740	0/0	130/-130	260	0	0
AUTOBRAKE 4	5860	100/-90	190	-290/970	0/-10	180/-180	340	0	0
AUTOBRAKE 3	6940	120/-110	230	-350/1180	30/-40	210/-210	370	10	10
AUTOBRAKE 2	7780	140/-130	260	-410/1360	110/-150	240/-240	340	180	180
AUTOBRAKE 1	8580	160/-160	290	-470/1590	230/-260	270/-270	340	610	920

Good Reported Braking Action

BRAKING CONFIGURATION	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	TWO REV	NO REV
MAX MANUAL	5120	90/-80	160	-270/920	150/-130	150/-150	240	310	700
AUTOBRAKE MAX	5390	90/-90	170	-280/940	130/-110	160/-160	270	310	700
AUTOBRAKE 4	5940	100/-100	190	-300/1010	40/-30	180/-180	340	40	200
AUTOBRAKE 3	6940	120/-110	230	-350/1180	30/-40	210/-210	370	10	10
AUTOBRAKE 2	7780	140/-130	260	-410/1360	110/-150	240/-240	340	180	180
AUTOBRAKE 1	8580	160/-160	290	-470/1590	230/-260	270/-270	340	610	920

Medium Reported Braking Action

BRAKING CONFIGURATION	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	TWO REV	NO REV
MAX MANUAL	6880	120/-120	220	-400/1440	350/-270	210/-210	290	750	1820
AUTOBRAKE MAX	6980	130/-120	230	-400/1450	330/-250	220/-210	320	720	1770
AUTOBRAKE 4	7000	130/-120	230	-410/1460	330/-230	220/-210	320	740	1810
AUTOBRAKE 3	7470	130/-120	240	-420/1510	260/-180	230/-230	370	450	1430
AUTOBRAKE 2	8070	140/-140	260	-450/1590	270/-240	250/-250	340	390	1030
AUTOBRAKE 1	8680	160/-160	290	-480/1690	340/-310	270/-270	340	680	1240

Poor Reported Braking Action

BRAKING CONFIGURATION	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	TWO REV	NO REV
MAX MANUAL	8860	160/-150	280	-590/2290	860/-530	280/-270	310	1490	3960
AUTOBRAKE MAX	8900	170/-150	280	-590/2290	870/-530	280/-280	330	1500	3970
AUTOBRAKE 4	8920	170/-150	280	-590/2290	860/-530	280/-280	330	1480	3950
AUTOBRAKE 3	9010	170/-150	290	-600/2300	850/-480	290/-280	370	1460	3940
AUTOBRAKE 2	9290	170/-160	300	-610/2330	830/-510	300/-290	340	1310	3660
AUTOBRAKE 1	9590	170/-170	310	-620/2380	830/-540	310/-300	340	1360	3580

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and 4 engines at maximum reverse thrust.

Max manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes an air distance from threshold to touchdown associated with a flare time of 4.22 seconds

Max manual and autobrake data valid for auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 220 ft.
For autobrake and manual speedbrakes, increase reference landing distance by 170 ft.

ADVISORY INFORMATION

Normal Configuration Landing Distance
Flaps 25

BRAKING CONFIGURATION	REF DIST 290000 KG LANDING WEIGHT	WT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	VREF ADJ PER 5 KTS ABV VREF30	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	4220	130/-70	130	-200/650	70/-60	120/-120	180	150	320
AUTOBRAKE MAX	5090	110/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 4	6290	110/-100	210	-300/1000	10/0	190/-190	360	0	0
AUTOBRAKE 3	7520	130/-120	250	-370/1220	10/-50	230/-230	400	10	20
AUTOBRAKE 2	8490	150/-150	290	-420/1420	90/-170	260/-260	370	160	160
AUTOBRAKE 1	9350	180/-170	320	-490/1650	250/-290	300/-290	370	770	1000
Good Reported Braking Action									
MAX MANUAL	5420	90/-90	170	-270/940	150/-130	160/-160	250	370	840
AUTOBRAKE MAX	5700	100/-90	180	-280/960	130/-110	170/-160	270	370	840
AUTOBRAKE 4	6380	100/-100	210	-310/1050	40/-30	190/-190	360	30	220
AUTOBRAKE 3	7520	130/-120	250	-370/1220	20/-50	230/-230	400	10	20
AUTOBRAKE 2	8490	150/-150	290	-420/1420	90/-170	260/-260	370	160	160
AUTOBRAKE 1	9350	180/-170	320	-490/1650	250/-290	300/-290	370	770	1000
Medium Reported Braking Action									
MAX MANUAL	7350	130/-130	240	-410/1480	370/-290	230/-220	300	910	2270
AUTOBRAKE MAX	7410	140/-130	240	-410/1490	360/-260	230/-220	330	870	2200
AUTOBRAKE 4	7430	140/-130	240	-420/1490	350/-230	230/-230	340	890	2230
AUTOBRAKE 3	8050	140/-130	260	-440/1550	240/-170	250/-250	400	510	1790
AUTOBRAKE 2	8770	150/-150	290	-470/1650	250/-260	270/-270	370	380	1210
AUTOBRAKE 1	9450	180/-170	320	-510/1760	360/-340	300/-290	370	850	1390
Poor Reported Braking Action									
MAX MANUAL	9510	180/-170	310	-610/2350	900/-560	300/-290	330	1830	5070
AUTOBRAKE MAX	9520	180/-170	310	-610/2350	920/-560	300/-300	340	1830	5070
AUTOBRAKE 4	9530	180/-170	310	-610/2360	910/-560	310/-300	340	1820	5060
AUTOBRAKE 3	9650	180/-170	310	-610/2370	870/-500	310/-300	390	1780	5040
AUTOBRAKE 2	10000	190/-170	320	-630/2400	830/-540	320/-310	360	1500	4680
AUTOBRAKE 1	10360	190/-190	340	-640/2460	850/-570	330/-320	360	1640	4450

Reference distance is for sea level, standard day, no wind or slope, VREF25 approach speed and 4 engines at maximum reverse thrust.

Max manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes an air distance from threshold to touchdown associated with a flare time of 4.22 seconds

Max manual and autobrake data valid for auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 240 ft.
For autobrake and manual speedbrakes, increase reference landing distance by 170 ft.

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

AIR/GND SYSTEM - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5070	150/-80	160	-230/750	110/-100	140/-150	300	0	0
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Good Reported Braking Action

MAX MANUAL	7340	120/-110	240	-360/1190	330/-260	220/-220	410	0	0
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Medium Reported Braking Action

MAX MANUAL	11360	180/-180	370	-610/2090	1070/-730	360/-360	550	0	0
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Poor Reported Braking Action

MAX MANUAL	17450	260/-250	540	-1060/3810	3930/-1860	570/-570	660	0	0
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

AIR/GND SYSTEM - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4730	110/-70	140	-220/730	110/-90	130/-130	290	0	0
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Good Reported Braking Action

MAX MANUAL	6670	100/-100	210	-340/1140	290/-230	200/-200	380	0	0
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Medium Reported Braking Action

MAX MANUAL	9970	160/-150	320	-560/1950	880/-610	310/-310	480	0	0
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Poor Reported Braking Action

MAX MANUAL	14760	220/-210	450	-960/3480	3050/-1470	480/-480	550	0	0
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID / ANTISKID OFF - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	8060	140/-130	250	-430/1540	340/-280	240/-230	320	900	2240
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Good Reported Braking Action

MAX MANUAL	8060	140/-130	250	-430/1540	340/-280	240/-230	320	900	2240
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Medium Reported Braking Action

MAX MANUAL	10210	190/-170	320	-630/2410	760/-560	310/-300	360	1810	5010
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Poor Reported Braking Action

MAX MANUAL	13810	250/-220	400	-1100/5450	3790/-1380	440/-430	380	4360	15420
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID / ANTISKID OFF - Flaps 30
VREF30

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	7530	130/-120	230	-420/1500	350/-270	220/-220	310	730	1780
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Good Reported Braking Action

MAX MANUAL	7530	130/-120	230	-420/1500	350/-270	220/-220	310	730	1780
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Medium Reported Braking Action

MAX MANUAL	9500	170/-160	290	-610/2350	860/-530	290/-280	340	1470	3900
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Poor Reported Braking Action

MAX MANUAL	12840	230/-210	370	-1050/5150	4500/-1300	410/-400	360	3640	12040
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
BLD DUCT LEAK L / BLD DUCT LEAK R - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4300	130/-70	130	-200/660	70/-70	120/-120	190	110	250
AUTOBRAKE MAX	5090	110/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8570	150/-150	290	-430/1430	60/-140	270/-270	400	70	70

Good Reported Braking Action

MAX MANUAL	5530	90/-90	170	-280/950	160/-130	160/-160	250	320	730
AUTOBRAKE MAX	5750	100/-90	180	-280/970	140/-120	170/-170	270	340	790
AUTOBRAKE 2	8570	150/-150	290	-430/1430	60/-140	270/-270	400	70	70

Medium Reported Braking Action

MAX MANUAL	7500	130/-130	240	-420/1500	370/-290	230/-220	300	850	2120
AUTOBRAKE MAX	7500	140/-130	240	-420/1500	380/-270	230/-230	320	840	2110
AUTOBRAKE 3	8080	140/-130	260	-440/1560	250/-170	250/-250	400	500	1750

Poor Reported Braking Action

MAX MANUAL	9700	180/-170	310	-610/2370	910/-570	310/-300	340	1760	4880
AUTOBRAKE MAX	9700	180/-170	310	-620/2370	930/-580	310/-300	340	1760	4880
AUTOBRAKE 3	9800	180/-170	310	-620/2380	890/-530	310/-300	370	1740	4890

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

BLD DUCT LEAK L / BLD DUCT LEAK R - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	3970	110/-60	120	-190/630	70/-60	110/-110	200	90	180
AUTOBRAKE MAX	4750	90/-70	150	-220/740	0/0	130/-130	260	0	0
AUTOBRAKE 2	7890	140/-130	260	-410/1370	70/-140	240/-240	360	70	70

Good Reported Braking Action

MAX MANUAL	5210	90/-80	160	-270/930	150/-130	150/-150	250	270	600
AUTOBRAKE MAX	5440	90/-90	170	-280/950	130/-110	160/-160	270	290	650
AUTOBRAKE 2	7890	140/-130	260	-410/1370	70/-140	240/-240	360	70	70

Medium Reported Braking Action

MAX MANUAL	7010	120/-120	220	-410/1460	360/-280	210/-210	290	700	1690
AUTOBRAKE MAX	7050	130/-120	230	-410/1460	360/-250	220/-210	320	700	1700
AUTOBRAKE 3	7490	130/-120	240	-420/1510	280/-170	230/-230	380	440	1410

Poor Reported Braking Action

MAX MANUAL	9020	160/-150	280	-600/2300	870/-540	280/-280	320	1430	3800
AUTOBRAKE MAX	9050	170/-150	290	-600/2310	880/-550	290/-280	320	1440	3820
AUTOBRAKE 3	9130	170/-150	290	-600/2310	880/-500	290/-280	350	1430	3830

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG 1, 2, 3, 4 SHUTDOWN - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4370	140/-70	130	-200/680	80/-70	120/-120	190	0	170
AUTOBRAKE MAX	5090	120/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8640	150/-140	300	-430/1440	20/-40	270/-270	480	0	0

Good Reported Braking Action

MAX MANUAL	5760	100/-90	180	-290/990	180/-160	170/-170	270	0	470
AUTOBRAKE MAX	6040	100/-100	190	-300/1010	160/-140	180/-180	300	0	470
AUTOBRAKE 2	8640	150/-140	300	-430/1440	20/-40	270/-270	480	0	0

Medium Reported Braking Action

MAX MANUAL	8190	140/-140	270	-460/1620	490/-370	260/-250	340	0	1330
AUTOBRAKE MAX	8210	150/-140	270	-460/1620	480/-340	260/-260	370	0	1290
AUTOBRAKE 3	8490	150/-140	280	-470/1640	430/-280	270/-260	400	0	1230

Poor Reported Braking Action

MAX MANUAL	11140	200/-190	360	-710/2640	1320/-790	360/-350	390	0	3080
AUTOBRAKE MAX	11150	200/-190	370	-710/2640	1340/-800	360/-350	390	0	3090
AUTOBRAKE 3	11240	200/-190	370	-710/2650	1320/-800	360/-360	390	0	3110

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG 1, 2, 3, 4 SHUTDOWN - Flaps 30
VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4120	120/-70	120	-200/660	80/-70	120/-120	190	0	140
AUTOBRAKE MAX	4750	110/-70	150	-220/740	10/0	130/-130	260	0	0
AUTOBRAKE 2	8050	140/-130	270	-410/1390	10/-30	250/-250	460	0	0

Good Reported Braking Action

MAX MANUAL	5430	90/-90	170	-280/970	180/-150	160/-160	270	0	390
AUTOBRAKE MAX	5700	90/-90	180	-290/990	160/-130	170/-170	300	0	390
AUTOBRAKE 2	8050	140/-130	270	-410/1390	10/-30	250/-250	460	0	0

Medium Reported Braking Action

MAX MANUAL	7810	140/-130	250	-450/1590	490/-370	240/-240	340	0	1150
AUTOBRAKE MAX	7840	140/-130	260	-450/1600	500/-340	250/-240	370	0	1140
AUTOBRAKE 3	8050	140/-140	270	-460/1620	460/-300	250/-250	400	0	1140

Poor Reported Braking Action

MAX MANUAL	10780	190/-180	350	-700/2620	1340/-790	350/-340	400	0	2750
AUTOBRAKE MAX	10830	200/-190	350	-700/2630	1360/-810	350/-340	400	0	2770
AUTOBRAKE 3	10920	200/-190	360	-710/2640	1330/-810	350/-350	410	0	2780

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS CONTROL - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4220	130/-70	130	-200/650	70/-60	120/-120	180	150	320
AUTOBRAKE MAX	5090	110/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8490	150/-150	290	-420/1420	90/-170	260/-260	370	160	160

Good Reported Braking Action

MAX MANUAL	5420	90/-90	170	-270/940	150/-130	160/-160	250	370	840
AUTOBRAKE MAX	5700	100/-90	180	-280/960	130/-110	170/-160	270	370	840
AUTOBRAKE 2	8490	150/-150	290	-420/1420	90/-170	260/-260	370	160	160

Medium Reported Braking Action

MAX MANUAL	7350	130/-130	240	-410/1480	370/-290	230/-220	300	910	2270
AUTOBRAKE MAX	7410	140/-130	240	-410/1490	360/-260	230/-220	330	870	2200
AUTOBRAKE 3	8050	140/-130	260	-440/1550	240/-170	250/-250	400	510	1790

Poor Reported Braking Action

MAX MANUAL	9510	180/-170	310	-610/2350	900/-560	300/-290	330	1830	5070
AUTOBRAKE MAX	9520	180/-170	310	-610/2350	920/-560	300/-300	340	1830	5070
AUTOBRAKE 3	9650	180/-170	310	-610/2370	870/-500	310/-300	390	1780	5040

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

FLAPS DRIVE - Flaps 25

VREF30+25

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5020	140/-70	150	-210/690	80/-70	140/-140	220	200	430
AUTOBRAKE MAX	6260	110/-90	190	-260/830	30/-40	180/-180	270	40	60
AUTOBRAKE 2	9940	160/-160	330	-460/1520	190/-220	310/-310	360	520	550

Good Reported Braking Action

MAX MANUAL	6470	100/-100	200	-300/1000	170/-150	190/-190	260	470	1070
AUTOBRAKE MAX	6810	100/-100	210	-300/1030	180/-150	200/-200	260	510	1150
AUTOBRAKE 2	9940	160/-160	330	-460/1520	210/-220	310/-310	370	520	550

Medium Reported Braking Action

MAX MANUAL	8580	140/-140	280	-440/1570	410/-330	270/-260	310	1110	2780
AUTOBRAKE MAX	8710	140/-140	280	-450/1580	390/-310	270/-270	330	1080	2710
AUTOBRAKE 3	9570	150/-150	310	-470/1660	300/-250	300/-300	370	600	2000

Poor Reported Braking Action

MAX MANUAL	10900	190/-180	350	-640/2460	970/-620	350/-340	340	2120	5870
AUTOBRAKE MAX	10940	190/-180	350	-640/2460	960/-620	350/-340	340	2080	5830
AUTOBRAKE 3	11200	190/-180	360	-650/2480	910/-580	360/-350	370	1900	5670

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Flaps Up Landing - Flaps Up

VREF30+70

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV
Dry Runway									
MAX MANUAL	7740	400/-140	360	-320/1310	140/-130	320/-290	360	450	1020
AUTOBRAKE MAX	9290	350/-110	320	-320/1160	30/-30	290/-290	370	80	350
AUTOBRAKE 2	15180	250/-230	510	-570/1860	350/-380	490/-480	430	1180	1310
Good Reported Braking Action									
MAX MANUAL	8860	350/-120	280	-340/1130	220/-190	270/-260	270	730	1700
AUTOBRAKE MAX	9690	330/-120	300	-360/1190	130/-110	290/-290	350	490	1430
AUTOBRAKE 2	15180	250/-230	510	-570/1860	350/-380	490/-480	430	1180	1310
Medium Reported Braking Action									
MAX MANUAL	12160	230/-180	390	-510/1790	530/-430	380/-370	340	1810	4640
AUTOBRAKE MAX	12320	230/-180	400	-520/1800	490/-400	390/-380	360	1770	4540
AUTOBRAKE 3	14420	220/-210	470	-570/1970	400/-360	460/-450	440	970	2920
Poor Reported Braking Action									
MAX MANUAL	15690	260/-250	510	-750/2790	1240/-820	510/-490	390	3590	10460
AUTOBRAKE MAX	15610	260/-250	510	-750/2790	1220/-800	510/-490	400	3490	10280
AUTOBRAKE 3	16390	260/-250	540	-770/2840	1150/-780	540/-520	440	3020	9780

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (1 Body or 1 Wing Gear Up) - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5460	180/-110	160	-250/850	130/-110	150/-150	230	230	520
AUTOBRAKE MAX	5380	200/-90	160	-250/840	120/-80	150/-150	270	210	490
AUTOBRAKE 2	8650	160/-150	300	-430/1440	30/-90	270/-270	450	30	30

Good Reported Braking Action

MAX MANUAL	5990	160/-90	180	-290/990	170/-150	170/-170	270	340	790
AUTOBRAKE MAX	5930	170/-90	180	-290/980	170/-150	170/-170	290	340	770
AUTOBRAKE 2	8680	160/-150	300	-430/1440	30/-100	270/-270	450	40	40

Medium Reported Braking Action

MAX MANUAL	7940	140/-130	250	-430/1530	400/-310	240/-230	320	890	2220
AUTOBRAKE MAX	7870	140/-130	250	-430/1530	410/-310	240/-230	330	870	2190
AUTOBRAKE 3	8250	140/-130	270	-440/1570	300/-190	250/-250	420	520	1810

Poor Reported Braking Action

MAX MANUAL	10140	190/-170	320	-630/2410	940/-600	320/-310	350	1820	5080
AUTOBRAKE MAX	10110	190/-170	320	-630/2410	960/-610	320/-310	360	1810	5060
AUTOBRAKE 3	10130	190/-170	320	-630/2410	950/-560	320/-310	390	1790	5040

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (1 Body or 1 Wing Gear Up) - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5050	150/-100	150	-240/810	110/-100	140/-140	220	180	390
AUTOBRAKE MAX	4940	160/-80	150	-240/790	110/-50	140/-140	260	150	360
AUTOBRAKE 2	8020	140/-140	270	-410/1390	20/-90	250/-250	410	40	40

Good Reported Braking Action

MAX MANUAL	5660	130/-90	170	-280/970	170/-140	160/-160	270	290	650
AUTOBRAKE MAX	5600	140/-90	170	-280/960	160/-140	160/-160	290	280	640
AUTOBRAKE 2	8040	140/-140	270	-410/1390	30/-100	250/-250	410	40	40

Medium Reported Braking Action

MAX MANUAL	7450	130/-120	230	-420/1500	380/-300	220/-220	310	730	1780
AUTOBRAKE MAX	7410	130/-120	230	-420/1500	390/-290	220/-220	320	720	1760
AUTOBRAKE 3	7710	130/-120	250	-430/1530	300/-180	240/-240	410	460	1460

Poor Reported Braking Action

MAX MANUAL	9470	170/-160	290	-610/2350	900/-560	290/-290	330	1490	3960
AUTOBRAKE MAX	9480	170/-160	290	-610/2350	910/-580	300/-290	340	1490	3960
AUTOBRAKE 3	9490	170/-160	300	-610/2350	910/-530	300/-290	380	1470	3950

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (2 Body or 2 Wing Gear Up) - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6580	360/-140	280	-320/1520	230/-180	240/-190	360	460	1070
AUTOBRAKE MAX	6620	400/-140	290	-350/1580	220/-190	250/-240	400	470	1120
AUTOBRAKE 2	8720	320/-150	310	-430/1530	70/-90	270/-270	470	20	30

Good Reported Braking Action

MAX MANUAL	6580	360/-120	280	-320/1520	230/-180	240/-190	360	460	1070
AUTOBRAKE MAX	6620	400/-130	290	-350/1580	220/-190	250/-240	400	470	1120
AUTOBRAKE 2	8720	320/-150	310	-430/1530	70/-90	270/-270	470	20	30

Medium Reported Braking Action

MAX MANUAL	7980	300/-130	250	-430/1540	400/-320	240/-230	320	900	2260
AUTOBRAKE MAX	7910	350/-130	250	-430/1530	410/-320	240/-230	330	890	2230
AUTOBRAKE 3	8270	330/-130	270	-440/1570	300/-200	250/-250	420	550	1880

Poor Reported Braking Action

MAX MANUAL	10220	210/-180	320	-630/2420	960/-600	320/-310	360	1860	5220
AUTOBRAKE MAX	10190	260/-180	320	-630/2420	970/-620	320/-310	360	1860	5210
AUTOBRAKE 3	10200	260/-170	320	-630/2420	960/-570	320/-310	390	1840	5190

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
GEAR DISAGREE (2 Body or 2 Wing Gear Up) - Flaps 30
VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV
Dry Runway									
MAX MANUAL	6000	280/-120	230	-310/1280	190/-160	170/-170	270	350	800
AUTOBRAKE MAX	5950	310/-130	250	-300/1400	190/-160	220/-170	350	340	770
AUTOBRAKE 2	8070	240/-140	280	-410/1410	30/-100	250/-250	430	30	30
Good Reported Braking Action									
MAX MANUAL	6000	280/-100	230	-310/1280	190/-160	170/-170	270	350	800
AUTOBRAKE MAX	5950	310/-100	250	-300/1400	190/-160	220/-170	350	340	770
AUTOBRAKE 2	8070	240/-140	280	-410/1410	30/-100	250/-250	430	30	30
Medium Reported Braking Action									
MAX MANUAL	7490	220/-120	230	-420/1500	380/-300	220/-220	310	740	1810
AUTOBRAKE MAX	7440	250/-120	230	-420/1500	390/-300	220/-220	330	740	1790
AUTOBRAKE 3	7720	240/-120	250	-430/1530	300/-190	240/-240	410	470	1520
Poor Reported Braking Action									
MAX MANUAL	9540	170/-160	300	-610/2360	910/-570	300/-290	340	1520	4060
AUTOBRAKE MAX	9550	170/-160	300	-610/2360	930/-580	300/-290	340	1520	4060
AUTOBRAKE 3	9550	170/-160	300	-610/2360	920/-540	300/-290	370	1510	4050

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (Nose Gear Up) - Flaps 25

VREF25

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4220	130/-70	130	-200/650	70/-60	120/-120	180	150	320
AUTOBRAKE MAX	5090	110/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8490	150/-150	290	-420/1420	90/-170	260/-260	370	160	160

Good Reported Braking Action

MAX MANUAL	5420	90/-90	170	-270/940	150/-130	160/-160	250	370	840
AUTOBRAKE MAX	5700	100/-90	180	-280/960	130/-110	170/-160	270	370	840
AUTOBRAKE 2	8490	150/-150	290	-420/1420	90/-170	260/-260	370	160	160

Medium Reported Braking Action

MAX MANUAL	7350	130/-130	240	-410/1480	370/-290	230/-220	300	910	2270
AUTOBRAKE MAX	7410	140/-130	240	-410/1490	360/-260	230/-220	330	870	2200
AUTOBRAKE 3	8050	140/-130	260	-440/1550	240/-170	250/-250	400	510	1790

Poor Reported Braking Action

MAX MANUAL	9510	180/-170	310	-610/2350	900/-560	300/-290	330	1830	5070
AUTOBRAKE MAX	9520	180/-170	310	-610/2350	920/-560	300/-300	340	1830	5070
AUTOBRAKE 3	9650	180/-170	310	-610/2370	870/-500	310/-300	390	1780	5040

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (Nose Gear Up) - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	3910	110/-60	110	-190/620	60/-60	110/-110	190	110	250
AUTOBRAKE MAX	4750	90/-70	150	-220/740	0/0	130/-130	260	0	0
AUTOBRAKE 2	7780	140/-130	260	-410/1360	110/-150	240/-240	340	180	180

Good Reported Braking Action

MAX MANUAL	5120	90/-80	160	-270/920	150/-130	150/-150	240	310	700
AUTOBRAKE MAX	5390	90/-90	170	-280/940	130/-110	160/-160	270	310	700
AUTOBRAKE 2	7780	140/-130	260	-410/1360	110/-150	240/-240	340	180	180

Medium Reported Braking Action

MAX MANUAL	6880	120/-120	220	-400/1440	350/-270	210/-210	290	750	1820
AUTOBRAKE MAX	6980	130/-120	230	-400/1450	330/-250	220/-210	320	720	1770
AUTOBRAKE 3	7470	130/-120	240	-420/1510	260/-180	230/-230	370	450	1430

Poor Reported Braking Action

MAX MANUAL	8860	160/-150	280	-590/2290	860/-530	280/-270	310	1490	3960
AUTOBRAKE MAX	8900	170/-150	280	-590/2290	870/-530	280/-280	330	1500	3970
AUTOBRAKE 3	9010	170/-150	290	-600/2300	850/-480	290/-280	370	1460	3940

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR LEVER JAMMED IN UP POSITION - Flaps 25

VREF25

BRAKING CONFIGURATION	REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	6580	360/-140	280	-320/1520	230/-180	240/-190	360	460	1070
AUTOBRAKE MAX	6620	400/-140	290	-350/1580	220/-190	250/-240	400	470	1120
AUTOBRAKE 2	8720	320/-150	310	-430/1530	70/-90	270/-270	470	20	30
Good Reported Braking Action									
MAX MANUAL	6580	360/-120	280	-320/1520	230/-180	240/-190	360	460	1070
AUTOBRAKE MAX	6620	400/-130	290	-350/1580	220/-190	250/-240	400	470	1120
AUTOBRAKE 2	8720	320/-150	310	-430/1530	70/-90	270/-270	470	20	30
Medium Reported Braking Action									
MAX MANUAL	7980	300/-130	250	-430/1540	400/-320	240/-230	320	900	2260
AUTOBRAKE MAX	7910	350/-130	250	-430/1530	410/-320	240/-230	330	890	2230
AUTOBRAKE 3	8270	330/-130	270	-440/1570	300/-200	250/-250	420	550	1880
Poor Reported Braking Action									
MAX MANUAL	10220	210/-180	320	-630/2420	960/-600	320/-310	360	1860	5220
AUTOBRAKE MAX	10190	260/-180	320	-630/2420	970/-620	320/-310	360	1860	5210
AUTOBRAKE 3	10200	260/-170	320	-630/2420	960/-570	320/-310	390	1840	5190

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
GEAR LEVER JAMMED IN UP POSITION - Flaps 30
VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6000	280/-120	230	-310/1280	190/-160	170/-170	270	350	800
AUTOBRAKE MAX	5950	310/-130	250	-300/1400	190/-160	220/-170	350	340	770
AUTOBRAKE 2	8070	240/-140	280	-410/1410	30/-100	250/-250	430	30	30

Good Reported Braking Action

MAX MANUAL	6000	280/-100	230	-310/1280	190/-160	170/-170	270	350	800
AUTOBRAKE MAX	5950	310/-100	250	-300/1400	190/-160	220/-170	350	340	770
AUTOBRAKE 2	8070	240/-140	280	-410/1410	30/-100	250/-250	430	30	30

Medium Reported Braking Action

MAX MANUAL	7490	220/-120	230	-420/1500	380/-300	220/-220	310	740	1810
AUTOBRAKE MAX	7440	250/-120	230	-420/1500	390/-300	220/-220	330	740	1790
AUTOBRAKE 3	7720	240/-120	250	-430/1530	300/-190	240/-240	410	470	1520

Poor Reported Braking Action

MAX MANUAL	9540	170/-160	300	-610/2360	910/-570	300/-290	340	1520	4060
AUTOBRAKE MAX	9550	170/-160	300	-610/2360	930/-580	300/-290	340	1520	4060
AUTOBRAKE 3	9550	170/-160	300	-610/2360	920/-540	300/-290	370	1510	4050

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 1 / HYD PRESS SYS 2 / HYD PRESS SYS 3 - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV
Dry Runway									
MAX MANUAL	4320	130/-70	130	-200/650	70/-70	120/-120	200	160	350
AUTOBRAKE MAX	5080	110/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8670	150/-150	300	-430/1440	10/-90	270/-270	460	20	20
Good Reported Braking Action									
MAX MANUAL	5710	100/-90	180	-280/970	170/-150	170/-170	280	430	1010
AUTOBRAKE MAX	5870	100/-100	190	-290/980	150/-130	170/-170	290	420	970
AUTOBRAKE 2	8670	150/-150	300	-430/1440	10/-90	270/-270	460	20	20
Medium Reported Braking Action									
MAX MANUAL	7790	150/-140	260	-430/1530	420/-320	240/-240	340	1080	2760
AUTOBRAKE MAX	7780	150/-140	260	-430/1530	420/-310	240/-240	350	1060	2730
AUTOBRAKE 3	8140	150/-130	270	-440/1570	300/-160	250/-250	430	830	2530
Poor Reported Braking Action									
MAX MANUAL	10130	200/-180	330	-640/2440	1000/-630	330/-310	380	2170	6250
AUTOBRAKE MAX	10120	200/-180	330	-640/2440	1020/-640	330/-320	380	2170	6240
AUTOBRAKE 3	10140	200/-180	330	-640/2440	1010/-580	330/-320	400	2170	6230

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 1 / HYD PRESS SYS 2 / HYD PRESS SYS 3 - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV
Dry Runway									
MAX MANUAL	4050	110/-60	120	-190/640	70/-60	110/-110	220	130	290
AUTOBRAKE MAX	4750	90/-70	150	-220/740	0/0	130/-130	260	0	10
AUTOBRAKE 2	8020	140/-140	270	-410/1390	20/-120	250/-250	400	30	30
Good Reported Braking Action									
MAX MANUAL	5400	90/-90	170	-280/950	170/-140	160/-160	270	370	840
AUTOBRAKE MAX	5560	90/-90	180	-280/970	140/-120	160/-160	290	350	810
AUTOBRAKE 2	8020	140/-140	270	-410/1390	20/-120	250/-250	400	30	30
Medium Reported Braking Action									
MAX MANUAL	7290	130/-130	240	-420/1500	400/-310	230/-220	320	890	2190
AUTOBRAKE MAX	7300	130/-130	240	-420/1500	400/-300	230/-220	340	860	2170
AUTOBRAKE 3	7630	130/-130	250	-430/1530	300/-190	240/-240	400	690	2030
Poor Reported Braking Action									
MAX MANUAL	9430	180/-170	300	-620/2370	960/-590	300/-290	350	1760	4790
AUTOBRAKE MAX	9440	180/-170	310	-620/2370	970/-600	300/-290	350	1760	4800
AUTOBRAKE 3	9500	180/-170	310	-620/2370	950/-570	300/-300	370	1770	4830

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 4 - Flaps 25
VREF25

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5220	100/-80	160	-240/810	120/-100	150/-150	270	280	620
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Good Reported Braking Action

MAX MANUAL	6790	120/-110	220	-340/1190	250/-210	200/-200	320	660	1610
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Medium Reported Braking Action

MAX MANUAL	8870	170/-160	290	-510/1850	570/-420	280/-270	360	1440	3850
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Poor Reported Braking Action

MAX MANUAL	11150	220/-200	350	-740/2930	1490/-780	360/-340	390	2640	7960
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 4 - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4870	80/-80	150	-230/790	110/-100	140/-140	260	220	500
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Good Reported Braking Action

MAX MANUAL	6240	110/-100	200	-330/1140	230/-190	180/-180	300	510	1210
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Medium Reported Braking Action

MAX MANUAL	8050	150/-140	260	-480/1770	520/-380	250/-240	330	1080	2750
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Poor Reported Braking Action

MAX MANUAL	10050	190/-170	310	-700/2790	1350/-700	320/-310	340	1980	5520
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 1 and HYD PRESS SYS 2 / HYD PRESS SYS 1 and HYD PRESS SYS 3 - Flaps 25

VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4870	150/-70	150	-210/690	90/-80	140/-140	240	200	440
AUTOBRAKE MAX	5840	130/-80	180	-250/810	10/-10	170/-170	300	0	0
AUTOBRAKE 2	9920	160/-160	330	-460/1530	80/-190	310/-310	420	160	160

Good Reported Braking Action

MAX MANUAL	6470	100/-100	210	-300/1020	190/-170	190/-190	290	520	1220
AUTOBRAKE MAX	6680	100/-100	210	-310/1040	170/-150	200/-200	310	510	1190
AUTOBRAKE 2	9920	160/-160	330	-460/1530	90/-190	310/-310	420	160	160

Medium Reported Braking Action

MAX MANUAL	8710	150/-140	280	-450/1600	450/-350	270/-270	340	1240	3170
AUTOBRAKE MAX	8730	150/-140	290	-450/1600	440/-340	270/-270	350	1190	3110
AUTOBRAKE 3	9320	150/-140	310	-470/1660	290/-190	290/-290	440	780	2720

Poor Reported Braking Action

MAX MANUAL	11160	200/-190	360	-660/2510	1050/-660	360/-350	380	2390	6850
AUTOBRAKE MAX	11150	200/-190	360	-660/2510	1060/-670	360/-350	380	2390	6840
AUTOBRAKE 3	11250	200/-190	370	-660/2520	1020/-600	360/-350	420	2350	6820

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 1+4 - Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6030	110/-90	180	-260/860	140/-120	170/-170	290	320	730
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Good Reported Braking Action

MAX MANUAL	7760	120/-120	240	-370/1250	290/-240	230/-230	340	760	1840
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Medium Reported Braking Action

MAX MANUAL	9970	170/-160	320	-530/1920	620/-460	310/-300	370	1590	4240
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Poor Reported Braking Action

MAX MANUAL	12320	220/-210	390	-760/3010	1550/-820	390/-380	390	2830	8490
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 2+3 - Flaps 25
VREF30+20

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT) REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	5150	150/-70	160	-220/720	100/-90	150/-150	270	240	540
AUTOBRAKE MAX	5840	130/-80	180	-250/810	20/-10	170/-170	300	20	190
AUTOBRAKE 2	10040	150/-160	340	-460/1540	20/-120	320/-320	490	40	40
Good Reported Braking Action									
MAX MANUAL	6870	110/-110	220	-310/1060	220/-190	210/-200	330	630	1500
AUTOBRAKE MAX	6920	110/-110	220	-320/1070	210/-160	210/-210	340	590	1400
AUTOBRAKE 2	10040	150/-160	340	-460/1540	30/-120	320/-320	490	40	40
Medium Reported Braking Action									
MAX MANUAL	9200	160/-150	300	-470/1650	500/-390	290/-280	380	1450	3800
AUTOBRAKE MAX	9160	160/-150	300	-470/1650	520/-390	290/-280	380	1440	3780
AUTOBRAKE 3	9450	160/-140	310	-480/1680	390/-200	300/-290	450	1240	3590
Poor Reported Braking Action									
MAX MANUAL	11740	220/-200	380	-680/2580	1140/-720	380/-370	410	2740	8110
AUTOBRAKE MAX	11710	220/-200	390	-680/2580	1160/-740	380/-370	410	2730	8090
AUTOBRAKE 3	11720	220/-200	390	-680/2580	1160/-680	380/-370	430	2730	8080

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 2 and HYD PRESS SYS 4 / HYD PRESS SYS 3 and HYD PRESS SYS 4 - Flaps 25

VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6370	100/-90	200	-270/900	160/-140	180/-180	340	440	1030
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Good Reported Braking Action

MAX MANUAL	8180	130/-130	260	-380/1300	330/-270	250/-240	380	960	2410
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Medium Reported Braking Action

MAX MANUAL	10520	190/-180	340	-550/1990	700/-510	330/-320	420	1950	5400
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Poor Reported Braking Action

MAX MANUAL	13000	240/-220	420	-790/3100	1690/-900	420/-400	430	3400	10650
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 1+2+4 - Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)									
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	7480	120/-110	240	-330/1120	250/-210	220/-220	370	670	1630
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Good Reported Braking Action

MAX MANUAL	8590	140/-140	280	-410/1390	370/-300	260/-250	390	1040	2620
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 2	Autobrakes Inoperative								

Medium Reported Braking Action

MAX MANUAL	10970	190/-180	360	-590/2120	780/-560	340/-330	420	2080	5840
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Poor Reported Braking Action

MAX MANUAL	13480	250/-230	430	-840/3330	2020/-980	440/-420	440	3600	11520
AUTOBRAKE MAX	Autobrakes Inoperative								
AUTOBRAKE 3	Autobrakes Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Jammed Stab Landing - Flaps 25

VREF30+20

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4730	140/-70	140	-200/680	80/-70	130/-130	190	180	380
AUTOBRAKE MAX	5840	120/-80	180	-250/810	10/-10	170/-170	290	0	0
AUTOBRAKE 2	9490	150/-160	320	-450/1490	180/-210	300/-290	360	460	480

Good Reported Braking Action

MAX MANUAL	6100	90/-90	190	-290/980	170/-140	180/-180	250	430	1000
AUTOBRAKE MAX	6440	100/-100	200	-300/1010	150/-130	190/-190	280	440	1010
AUTOBRAKE 2	9490	150/-160	320	-450/1490	190/-210	300/-290	360	460	480

Medium Reported Braking Action

MAX MANUAL	8160	140/-130	260	-430/1540	390/-310	250/-250	300	1030	2560
AUTOBRAKE MAX	8300	140/-130	270	-440/1550	370/-290	260/-250	330	1000	2500
AUTOBRAKE 3	9130	140/-140	290	-460/1630	280/-230	290/-280	370	540	1820

Poor Reported Braking Action

MAX MANUAL	10420	180/-170	330	-630/2420	940/-590	330/-320	330	1990	5490
AUTOBRAKE MAX	10460	190/-170	340	-630/2420	930/-590	340/-330	340	1960	5460
AUTOBRAKE 3	10710	180/-170	340	-640/2440	880/-560	340/-340	370	1790	5310

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

NOSE AND BODY GEAR UP - Flaps 25

VREF25

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT) REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	6580	360/-140	280	-320/1520	230/-180	240/-190	360	460	1070
AUTOBRAKE MAX	6620	400/-140	290	-350/1580	220/-190	250/-240	400	470	1120
AUTOBRAKE 2	8720	320/-150	310	-430/1530	70/-90	270/-270	470	20	30
Good Reported Braking Action									
MAX MANUAL	6580	360/-120	280	-320/1520	230/-180	240/-190	360	460	1070
AUTOBRAKE MAX	6620	400/-130	290	-350/1580	220/-190	250/-240	400	470	1120
AUTOBRAKE 2	8720	320/-150	310	-430/1530	70/-90	270/-270	470	20	30
Medium Reported Braking Action									
MAX MANUAL	7980	300/-130	250	-430/1540	400/-320	240/-230	320	900	2260
AUTOBRAKE MAX	7910	350/-130	250	-430/1530	410/-320	240/-230	330	890	2230
AUTOBRAKE 3	8270	330/-130	270	-440/1570	300/-200	250/-250	420	550	1880
Poor Reported Braking Action									
MAX MANUAL	10220	210/-180	320	-630/2420	960/-600	320/-310	360	1860	5220
AUTOBRAKE MAX	10190	260/-180	320	-630/2420	970/-620	320/-310	360	1860	5210
AUTOBRAKE 3	10200	260/-170	320	-630/2420	960/-570	320/-310	390	1840	5190

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

NOSE AND BODY GEAR UP - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6000	280/-120	230	-310/1280	190/-160	170/-170	270	350	800
AUTOBRAKE MAX	5950	310/-130	250	-300/1400	190/-160	220/-170	350	340	770
AUTOBRAKE 2	8070	240/-140	280	-410/1410	30/-100	250/-250	430	30	30

Good Reported Braking Action

MAX MANUAL	6000	280/-100	230	-310/1280	190/-160	170/-170	270	350	800
AUTOBRAKE MAX	5950	310/-100	250	-300/1400	190/-160	220/-170	350	340	770
AUTOBRAKE 2	8070	240/-140	280	-410/1410	30/-100	250/-250	430	30	30

Medium Reported Braking Action

MAX MANUAL	7490	220/-120	230	-420/1500	380/-300	220/-220	310	740	1810
AUTOBRAKE MAX	7440	250/-120	230	-420/1500	390/-300	220/-220	330	740	1790
AUTOBRAKE 3	7720	240/-120	250	-430/1530	300/-190	240/-240	410	470	1520

Poor Reported Braking Action

MAX MANUAL	9540	170/-160	300	-610/2360	910/-570	300/-290	340	1520	4060
AUTOBRAKE MAX	9550	170/-160	300	-610/2360	930/-580	300/-290	340	1520	4060
AUTOBRAKE 3	9550	170/-160	300	-610/2360	920/-540	300/-290	370	1510	4050

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
REVERSER UNLOCKED - Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4910	160/-70	150	-210/700	90/-80	140/-140	200	0	210
AUTOBRAKE MAX	5840	140/-80	180	-250/810	10/-10	170/-170	300	0	0
AUTOBRAKE 2	9950	150/-150	330	-460/1530	40/-140	310/-310	430	0	20

Good Reported Braking Action

MAX MANUAL	6540	100/-100	210	-310/1050	210/-180	200/-200	280	0	560
AUTOBRAKE MAX	6890	100/-100	210	-320/1080	190/-160	200/-200	310	0	570
AUTOBRAKE 2	9950	150/-150	330	-460/1530	60/-140	310/-310	430	0	20

Medium Reported Braking Action

MAX MANUAL	9200	150/-140	300	-490/1710	540/-410	290/-290	340	0	1540
AUTOBRAKE MAX	9310	150/-140	300	-490/1720	510/-380	290/-290	380	0	1500
AUTOBRAKE 3	9680	150/-150	320	-500/1750	460/-300	310/-300	430	0	1280

Poor Reported Braking Action

MAX MANUAL	12430	210/-200	390	-760/2840	1490/-870	400/-390	390	0	3500
AUTOBRAKE MAX	12440	210/-200	400	-760/2840	1510/-870	410/-400	390	0	3500
AUTOBRAKE 3	12520	210/-200	400	-760/2840	1510/-850	410/-400	400	0	3520

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

STAB TRIM UNSCHD- Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV
Dry Runway									
MAX MANUAL	4730	140/-70	140	-200/680	80/-70	130/-130	190	180	380
AUTOBRAKE MAX	5840	120/-80	180	-250/810	10/-10	170/-170	290	0	0
AUTOBRAKE 2	9490	150/-160	320	-450/1490	180/-210	300/-290	360	460	480
Good Reported Braking Action									
MAX MANUAL	6100	90/-90	190	-290/980	170/-140	180/-180	250	430	1000
AUTOBRAKE MAX	6440	100/-100	200	-300/1010	150/-130	190/-190	280	440	1010
AUTOBRAKE 2	9490	150/-160	320	-450/1490	190/-210	300/-290	360	460	480
Medium Reported Braking Action									
MAX MANUAL	8160	140/-130	260	-430/1540	390/-310	250/-250	300	1030	2560
AUTOBRAKE MAX	8300	140/-130	270	-440/1550	370/-290	260/-250	330	1000	2500
AUTOBRAKE 3	9130	140/-140	290	-460/1630	280/-230	290/-280	370	540	1820
Poor Reported Braking Action									
MAX MANUAL	10420	180/-170	330	-630/2420	940/-590	330/-320	330	1990	5490
AUTOBRAKE MAX	10460	190/-170	340	-630/2420	930/-590	340/-330	340	1960	5460
AUTOBRAKE 3	10710	180/-170	340	-640/2440	880/-560	340/-340	370	1790	5310

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
Two Engines Inop - Flaps 25
VREF25

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT) REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	4530	150/-70	140	-210/700	90/-80	130/-130	200	0	0
AUTOBRAKE MAX	5090	140/-80	160	-230/760	30/0	140/-140	270	0	0
AUTOBRAKE 2	8640	150/-150	300	-430/1440	20/-30	270/-270	480	0	0
Good Reported Braking Action									
MAX MANUAL	6200	100/-100	200	-310/1050	230/-190	190/-190	300	0	0
AUTOBRAKE MAX	6480	100/-100	210	-320/1080	210/-170	190/-200	330	0	0
AUTOBRAKE 2	8640	150/-150	300	-430/1440	20/-30	270/-270	480	0	0
Medium Reported Braking Action									
MAX MANUAL	9410	150/-150	310	-520/1810	720/-520	300/-300	400	0	0
AUTOBRAKE MAX	9400	160/-150	320	-520/1810	730/-490	300/-300	430	0	0
AUTOBRAKE 3	9620	160/-150	320	-530/1830	720/-520	300/-300	410	0	0
Poor Reported Braking Action									
MAX MANUAL	13910	230/-220	460	-870/3120	2300/-1240	450/-450	490	0	0
AUTOBRAKE MAX	13920	230/-220	460	-870/3120	2320/-1260	450/-450	490	0	0
AUTOBRAKE 3	14030	230/-220	460	-870/3130	2300/-1270	460/-460	480	0	0

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Reference Brake Energy per Brake (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)																	
		80			100			120			140			160			180		
WEIGHT	OAT	PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT		
(1000 KG)	(°C)	0	2	4	0	2	4	0	2	4	0	2	4	0	2	4	0	2	4
400	0	19.1	20.1	21.1	28.2	29.7	31.3	38.0	40.5	43.1	49.1	52.3	55.3	61.2	65.3	69.3	73.6	78.1	
	15	19.9	20.9	21.9	29.2	30.8	32.5	39.6	42.1	44.8	51.1	54.3	57.5	63.7	67.9	71.9	76.5	81.4	
	20	20.1	21.1	22.1	29.5	31.2	32.9	40.1	42.6	45.3	51.7	55.0	58.4	64.5	68.7	72.8	77.5	82.5	
	40	21.2	22.2	23.2	30.8	32.6	34.5	42.2	44.7	47.4	54.2	57.8	61.4	67.8	72.2	76.5	81.4	87.0	
	60	22.3	23.3	24.2	32.1	33.0	36.1	44.3	46.8	49.6	56.8	60.5	64.4	71.1	75.6	80.1	85.3	91.5	
350	0	17.2	18.0	18.9	25.2	26.7	27.4	33.8	36.0	38.2	43.6	46.4	49.3	54.1	57.6	61.1	65.0	69.4	74.0
	15	17.9	18.8	19.7	26.0	27.6	28.3	35.2	37.4	39.7	45.3	48.2	51.3	56.3	59.9	63.6	68.5	73.1	77.5
	20	18.1	19.1	20.0	26.3	27.9	28.6	35.7	37.9	40.2	45.8	48.8	51.9	57.0	60.6	64.4	69.5	74.2	78.6
	40	19.1	20.2	21.1	27.4	29.1	29.8	37.5	39.9	42.3	47.9	51.2	54.4	59.9	61.8	67.7	73.3	78.1	82.8
	60	20.0	21.3	22.2	28.4	30.3	31.0	39.3	41.8	44.4	50.1	53.6	57.0	62.8	67.1	71.0	75.3	80.6	85.3
300	0	15.4	16.2	16.9	22.0	23.4	24.7	29.7	31.4	33.1	37.8	40.3	42.9	47.1	50.1	53.1	56.3	60.0	63.6
	15	15.9	16.7	17.6	22.8	24.2	25.5	30.8	32.6	34.5	39.4	41.9	44.5	48.9	52.1	55.2	58.6	62.4	66.2
	20	16.1	16.9	17.8	23.1	24.4	25.8	31.2	33.0	34.9	39.9	42.4	45.0	49.5	52.7	55.9	59.4	63.2	67.0
	40	16.7	17.7	18.7	24.1	25.4	26.8	32.6	34.6	36.6	41.9	44.5	47.1	52.0	55.3	58.7	62.5	66.4	70.4
	60	17.4	18.5	19.6	25.1	26.4	27.9	34.0	36.2	38.4	44.0	46.6	49.3	54.4	57.9	61.5	65.6	69.7	73.7
250	0	13.7	14.3	15.0	18.8	19.8	20.8	25.6	27.2	28.7	32.2	34.2	36.2	40.0	42.6	45.3	47.9	50.9	53.9
	15	14.0	14.7	15.4	19.6	20.6	21.6	26.4	28.1	29.7	33.5	35.6	37.7	41.6	44.3	47.0	49.8	52.9	56.1
	20	14.1	14.8	15.5	19.9	20.9	21.8	26.7	28.4	30.0	33.9	36.1	38.2	42.1	44.8	47.6	50.4	53.6	56.8
	40	14.5	15.3	16.1	21.0	21.9	22.9	27.8	29.6	31.3	35.6	37.9	40.2	44.1	46.9	49.9	52.8	56.2	59.7
	60	14.9	15.7	16.7	22.0	23.0	23.9	28.9	30.8	32.7	37.4	39.7	42.1	46.2	49.0	52.2	55.3	58.9	62.6
200	0	11.8	12.3	12.9	15.9	16.6	17.4	21.2	22.5	23.7	26.8	29.3	29.9	32.8	34.9	36.9	39.2	41.9	44.5
	15	12.0	12.5	13.1	16.4	17.3	18.2	22.0	23.3	24.5	27.7	29.5	31.0	34.5	36.3	38.4	40.8	43.6	46.2
	20	12.0	12.6	13.2	16.6	17.5	18.4	22.3	23.5	24.7	28.0	29.6	31.4	34.6	36.7	38.9	41.3	44.0	46.7
	40	12.2	12.9	13.5	17.3	18.3	19.3	23.3	24.5	25.7	29.2	30.9	32.8	36.3	38.7	40.9	43.4	46.1	49.0
	60	12.4	13.1	13.8	18.1	19.1	20.3	24.4	25.6	26.7	30.4	32.1	34.3	38.1	40.5	43.0	45.5	48.2	51.2

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.
If ground speed is used for brakes on speed, ignore wind, altitude, and OAT effects and enter table with SL + 15°.

Adjusted Brake Energy per Brake (Millions of Foot Pounds)

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)								
EVENT		10	20	30	40	50	60	70	80	90
RTO MAX MAN		10	20	30	40	50	60	70	80	90
LANDING	MAX MAN	5.0	13.5	22.3	30.6	39.4	48.1	57.2	66.5	75.5
	MAX AUTO	5.0	12.5	20.4	28.5	36.8	45.5	54.1	63.0	72.4
	AUTOBRAKE 4	4.8	12.0	19.3	26.6	34.3	42.3	50.7	60.0	69.3
	AUTOBRAKE 3	4.5	11.0	18.2	25.0	32.1	40.0	47.5	56.2	65.0
	AUTOBRAKE 2	4.4	10.5	17.1	23.4	30.0	36.8	43.7	51.7	60.0
	AUTOBRAKE 1	4.3	10.0	15.4	20.5	26.5	32.5	38.5	45.5	52.0

ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Cooling Time (Minutes)

	ADJUSTED BRAKE ENERGY PER BRAKE (MILLION OF FOOT POUNDS)								
	15 & BELOW	16	20	24	28	32	34	35 TO 45	45 & ABOVE
INFLIGHT GEAR DOWN	NO SPECIAL PROCEDURE REQUIRED	1.8	3.0	4.2	5.1	6.0	6.0	CAUTION	FUSE PLUG MELT ZONE
GROUND		10	28	40	55	65	70		
BTMS	UP TO 2	2	2	3	4	4	4	5 TO 6	7 & ABOVE

Observe maximum quick turnaround limit.
Table does not consider the benefit of reverse thrust.
Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.
Add 1.0 million foot pounds for each taxi mile.
For one brake deactivated, increase brake energy by 7 percent.
For two brakes deactivated, increase brake energy by 15 percent.
When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after one hour. If overheat occurs after takeoff, extend gear soon for at least 8 minutes.
When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not attempt to taxi for one hour. Tire, wheel, and brake replacement may be required. If overheat occurs after takeoff, extend gear soon for at least 12 minutes.
Brake temperature monitor system (BTMS) indication on EICAS may be used 10 to 15 minutes after airplane has come to a complete stop, or inflight with gear retracted, to determine recommended cooling schedule.

Performance Inflight — Chapter PI

One Engine Inoperative — Section 13

1 ENGINE INOP

Max Continuous EPR

45000 FT to 25000 FT Pressure Altitudes

Based on engine bleed for 3 packs on

PRESSURE ALTITUDE (FT)		KIAS					MACH NUMBER				
		150	200	250	300	350	.70	.75	.80	.85	.90
45000	EPR		1.76	1.71			1.77	1.76	1.75	1.73	1.71
	MAX TAT		-21	-9			-24	-21	-17	-14	-10
	EPR CORR		0.06	0.07			0.06	0.06	0.06	0.06	0.07
43000	EPR		1.77	1.73	1.67		1.77	1.76	1.75	1.74	1.72
	MAX TAT		-23	-12	1		-24	-21	-17	-14	-10
	EPR CORR		0.06	0.06	0.06		0.06	0.06	0.06	0.06	0.06
41000	EPR		1.78	1.74	1.69		1.78	1.77	1.76	1.74	1.72
	MAX TAT		-25	-15	-3		-24	-21	-17	-14	-10
	EPR CORR		0.06	0.06	0.06		0.06	0.06	0.06	0.06	0.06
39000	EPR		1.79	1.76	1.71		1.79	1.78	1.77	1.75	1.73
	MAX TAT		-27	-17	-6		-24	-21	-17	-14	-10
	EPR CORR		0.05	0.06	0.06		0.05	0.06	0.06	0.06	0.06
37000	EPR		1.79	1.78	1.73		1.79	1.78	1.77	1.75	1.74
	MAX TAT		-29	-19	-9		-24	-21	-17	-14	-10
	EPR CORR		0.05	0.05	0.06		0.05	0.05	0.06	0.06	0.06
35000	EPR		1.80	1.78	1.74		1.79	1.78	1.77	1.75	1.73
	MAX TAT		-28	-19	-9		-22	-19	-15	-11	-7
	EPR CORR		0.06	0.06	0.06		0.06	0.06	0.06	0.06	0.06
33000	EPR		1.79	1.78	1.74		1.78	1.77	1.76	1.74	1.72
	MAX TAT		-25	-17	-8		-18	-14	-11	-7	-3
	EPR CORR		0.06	0.06	0.06		0.06	0.06	0.06	0.06	0.06
31000	EPR		1.79	1.78	1.75	1.70	1.78	1.76	1.75	1.73	1.71
	MAX TAT		-22	-14	-6	4	-13	-10	-6	-2	2
	EPR CORR		0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
29000	EPR		1.78	1.76	1.74	1.69	1.76	1.75	1.73	1.71	1.68
	MAX TAT		-19	-12	-4	6	-9	-5	-2	2	7
	EPR CORR		0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
27000	EPR	1.79	1.76	1.75	1.73	1.68	1.75	1.73	1.71	1.69	1.66
	MAX TAT	-21	-16	-9	-1	8	-5	-1	3	7	11
	EPR CORR	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
25000	EPR	1.78	1.75	1.75	1.73	1.68	1.74	1.72	1.69	1.67	
	MAX TAT	-18	-13	-6	1	9	0	3	7	11	
	EPR CORR	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	

Decrease EPR by the EPR CORR for every 10°C above the MAX TAT shown.

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	0	10	20	30	40	45
2 PACKS OFF	0.01	0.01	0.01	0.01	0.02	0.02
3 PACKS OFF	0.01	0.01	0.01	0.01	0.02	0.02
ENGINE ANTI-ICE ON	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
ENGINE & WING ANTI-ICE ON	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02

1 ENGINE INOP

Max Continuous EPR
24000 FT to S.L. Pressure Altitudes
Based on engine bleed for 3 packs on

PRESSURE ALTITUDE (FT)		KIAS					MACH NUMBER				
		150	200	250	300	350	.70	.75	.80	.85	.90
24000	EPR	1.77	1.75	1.74	1.73	1.67	1.73	1.70	1.68	1.65	
	MAX TAT	-16	-11	-5	2	10	2	6	10	14	
	EPR CORR	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
22000	EPR	1.76	1.74	1.74	1.71	1.66	1.70	1.68	1.65		
	MAX TAT	-12	-8	-2	5	13	6	10	14		
	EPR CORR	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06		
20000	EPR	1.74	1.73	1.73	1.70	1.65	1.68	1.65			
	MAX TAT	-9	-5	1	7	15	11	14			
	EPR CORR	0.06	0.06	0.06	0.06	0.06	0.06	0.06			
18000	EPR	1.73	1.72	1.71	1.69	1.64	1.65	1.63			
	MAX TAT	-5	-1	4	10	17	15	19			
	EPR CORR	0.06	0.06	0.06	0.06	0.06	0.06	0.06			
16000	EPR	1.71	1.71	1.71	1.67	1.63	1.63				
	MAX TAT	-2	2	7	13	19	19				
	EPR CORR	0.06	0.06	0.06	0.06	0.06	0.06				
14000	EPR	1.69	1.70	1.69	1.66	1.62	1.60				
	MAX TAT	2	6	10	16	22	24				
	EPR CORR	0.06	0.06	0.06	0.06	0.06	0.06				
12000	EPR	1.67	1.68	1.67	1.64	1.60					
	MAX TAT	6	9	13	19	25					
	EPR CORR	0.06	0.06	0.06	0.06	0.05					
10000	EPR	1.65	1.67	1.66	1.63	1.59					
	MAX TAT	9	13	17	21	27					
	EPR CORR	0.05	0.06	0.06	0.05	0.05					
5000	EPR	1.61	1.60	1.61	1.59	1.56					
	MAX TAT	19	21	25	29	34					
	EPR CORR	0.05	0.05	0.05	0.05	0.05					
1500	EPR	1.57	1.56	1.58	1.56	1.53					
	MAX TAT	25	28	31	35	39					
	EPR CORR	0.05	0.05	0.05	0.05	0.05					
0	EPR	1.56	1.55	1.56	1.54	1.52					
	MAX TAT	28	30	34	37	42					
	EPR CORR	0.05	0.05	0.05	0.05	0.05					

Decrease EPR by the EPR CORR for every 10°C above the MAX TAT shown.

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	0	10	20	30	40	45
2 PACKS OFF	0.01	0.01	0.01	0.01	0.02	0.02
3 PACKS OFF	0.01	0.01	0.01	0.01	0.02	0.02
ENGINE ANTI-ICE ON	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
ENGINE & WING ANTI-ICE ON	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02

1 ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	391	306	26600	25500	24300
390	381	302	27300	26200	25000
380	372	298	28100	26900	25700
370	362	295	28800	27700	26500
360	352	290	29600	28400	27200
350	343	288	30300	29300	28000
340	333	283	31000	30000	28800
330	324	279	31700	30800	29700
320	314	276	32400	31500	30500
310	304	271	33100	32300	31200
300	294	268	33800	33100	32100
290	284	263	34700	33900	32900
280	275	259	35400	34900	33700
270	265	254	36100	35600	34800
260	255	249	36800	36300	35600
250	245	245	37500	37000	36300
240	235	240	38300	37800	37000
230	225	234	39100	38500	37800
220	215	229	39900	39300	38600
210	206	223	40800	40200	39400
200	196	218	41700	41000	40300

Altitude reduced by 1000 ft for additional margin.

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability

Based on engine bleed for packs on or off

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	24700	22500	20100
390	25500	23600	21200
380	26400	24600	22400
370	27200	25600	23500
360	28100	26500	24500
350	28900	27500	25500
340	29800	28400	26500
330	30500	29300	27500
320	31300	30200	28500
310	32000	31000	29600
300	32800	31800	30500
290	33500	32600	31400
280	34400	33500	32300
270	35200	34500	33100
260	35900	35400	34100
250	36700	36100	35300
240	37400	36900	36000
230	38200	37600	36800
220	39000	38400	37500
210	39900	39200	38300
200	40800	40100	39200

Altitude reduced by 1000 ft for additional margin.
With engine anti-ice on, decrease altitude capability by 900 ft.
With engine and wing anti-ice on, decrease altitude capability by 1800 ft.

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	14	20	25	27	29	31	33	35	37
400	EPR	1.38	1.44	1.55	1.67						
	MACH	.647	.694	.773	.807						
	KIAS	360	360	360	341						
	FF/ENG	4758	4779	4866	4890						
380	EPR	1.37	1.42	1.53	1.64	1.69					
	MACH	.632	.681	.762	.801	.815					
	KIAS	352	353	354	338	330					
	FF/ENG	4502	4525	4614	4591	4662					
360	EPR	1.35	1.40	1.51	1.61	1.66	1.71				
	MACH	.617	.664	.746	.794	.805	.824				
	KIAS	343	344	346	335	326	321				
	FF/ENG	4246	4252	4338	4323	4336	4454				
340	EPR	1.33	1.38	1.48	1.58	1.63	1.68				
	MACH	.601	.646	.726	.783	.798	.810				
	KIAS	334	334	336	330	323	315				
	FF/ENG	4000	3989	4050	4059	4063	4095				
320	EPR	1.31	1.36	1.46	1.55	1.60	1.64	1.70			
	MACH	.586	.628	.705	.772	.788	.802	.817			
	KIAS	325	325	326	325	319	311	304			
	FF/ENG	3763	3735	3776	3814	3801	3808	3878			
300	EPR	1.30	1.34	1.43	1.52	1.56	1.61	1.66	1.72		
	MACH	.570	.610	.684	.756	.776	.793	.805	.825		
	KIAS	316	315	316	318	313	307	299	294		
	FF/ENG	3533	3492	3507	3571	3552	3549	3563	3670		
280	EPR	1.28	1.32	1.41	1.49	1.54	1.58	1.62	1.67	1.74	
	MACH	.553	.592	.662	.733	.761	.780	.796	.808	.832	
	KIAS	307	305	305	307	307	302	296	288	284	
	FF/ENG	3306	3257	3245	3298	3318	3297	3305	3330	3458	
260	EPR	1.26	1.30	1.38	1.46	1.50	1.54	1.59	1.64	1.69	1.76
	MACH	.535	.573	.639	.707	.738	.765	.783	.799	.812	.839
	KIAS	297	295	294	296	297	296	290	284	276	274
	FF/ENG	3114	3029	2994	3029	3052	3066	3051	3064	3100	3262
240	EPR	1.24	1.28	1.35	1.43	1.47	1.51	1.55	1.60	1.65	1.70
	MACH	.517	.554	.616	.681	.710	.741	.768	.785	.801	.816
	KIAS	287	285	283	284	285	286	284	279	272	265
	FF/ENG	2886	2805	2750	2765	2782	2806	2816	2808	2822	2886
220	EPR	1.23	1.26	1.33	1.40	1.43	1.47	1.51	1.56	1.60	1.65
	MACH	.499	.533	.593	.654	.681	.711	.742	.769	.787	.802
	KIAS	276	274	272	272	272	273	274	272	267	260
	FF/ENG	2673	2610	2517	2508	2519	2535	2562	2570	2565	2594
200	EPR	1.21	1.24	1.30	1.37	1.40	1.43	1.47	1.51	1.56	1.60
	MACH	.480	.512	.569	.625	.651	.679	.709	.741	.769	.787
	KIAS	265	263	260	259	260	260	261	262	260	255
	FF/ENG	2471	2385	2295	2261	2264	2275	2294	2320	2328	2339

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
694	645	601	563	530	500	479	459	441	425	410
1391	1292	1203	1127	1060	1000	959	920	885	852	823
2096	1945	1810	1693	1592	1500	1438	1381	1328	1279	1235
2806	2601	2418	2261	2124	2000	1918	1842	1771	1706	1646
3524	3264	3031	2831	2657	2500	2398	2302	2214	2132	2058
4249	3930	3646	3403	3191	3000	2877	2762	2656	2558	2468
4982	4602	4264	3976	3725	3500	3356	3222	3098	2983	2878
5724	5281	4888	4552	4261	4000	3835	3682	3539	3408	3288
6475	5966	5514	5130	4798	4500	4314	4140	3979	3831	3696
7237	6659	6146	5712	5336	5000	4792	4598	4419	4254	4104

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		22		29		33	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
500	14.0	1:27	12.7	1:23	10.9	1:16	9.6	1:11	9.4	1:10
1000	28.2	2:52	26.0	2:44	22.7	2:27	20.6	2:16	20.3	2:14
1500	42.1	4:19	39.0	4:06	34.2	3:39	31.2	3:21	30.8	3:18
2000	55.7	5:48	51.6	5:30	45.5	4:53	41.5	4:27	40.9	4:22
2500	69.0	7:20	64.0	6:56	56.4	6:09	51.6	5:34	50.7	5:27
3000	82.0	8:53	76.0	8:24	67.0	7:26	61.4	6:42	60.1	6:33
3500	94.6	10:29	87.8	9:53	77.4	8:44	70.9	7:51	69.3	7:39
4000	107.0	12:07	99.4	11:25	87.5	10:05	80.2	9:02	78.1	8:45
4500	119.1	13:48	110.6	12:59	97.4	11:27	89.2	10:14	86.8	9:52
5000	130.9	15:32	121.6	14:36	107.0	12:50	97.9	11:27	95.2	11:01

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-1.5	-0.7	0.0	1.9	4.5
20	-3.1	-1.5	0.0	3.9	8.9
30	-4.6	-2.4	0.0	5.7	13.0
40	-6.2	-3.2	0.0	7.5	16.9
50	-7.7	-4.0	0.0	9.1	20.5
60	-9.3	-4.8	0.0	10.7	23.8
70	-10.8	-5.6	0.0	12.1	26.9
80	-12.3	-6.3	0.0	13.4	29.8
90	-13.8	-7.1	0.0	14.7	32.4
100	-15.3	-7.8	0.0	15.8	34.7
110	-16.7	-8.6	0.0	16.9	36.8
120	-18.2	-9.3	0.0	17.8	38.7
130	-19.6	-10.0	0.0	18.6	40.3
140	-21.0	-10.7	0.0	19.4	41.7

1 ENGINE INOP

MAX CONTINUOUS THRUST

Holding

Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)								
		1500	5000	10000	15000	20000	25000	30000	35000	40000
400	EPR	1.27	1.31	1.37	1.45	1.54	1.66			
	KIAS	286	286	286	286	307	311			
	FF/ENG	4370	4270	4250	4280	4450	4710			
380	EPR	1.25	1.29	1.35	1.43	1.51	1.63			
	KIAS	280	280	280	280	300	303			
	FF/ENG	4150	4050	4010	4020	4170	4360			
360	EPR	1.24	1.27	1.34	1.41	1.49	1.60	1.74		
	KIAS	271	271	271	271	291	294	298		
	FF/ENG	3920	3880	3780	3780	3900	4040	4470		
340	EPR	1.23	1.26	1.32	1.39	1.46	1.57	1.70		
	KIAS	261	261	261	261	282	285	289		
	FF/ENG	3710	3650	3550	3540	3640	3740	4050		
320	EPR	1.21	1.25	1.30	1.37	1.44	1.54	1.66		
	KIAS	251	251	251	251	273	276	280		
	FF/ENG	3490	3440	3340	3310	3390	3470	3680		
300	EPR	1.20	1.23	1.28	1.35	1.41	1.50	1.62		
	KIAS	242	242	242	242	264	267	270		
	FF/ENG	3280	3230	3170	3090	3150	3210	3350		
280	EPR	1.19	1.22	1.26	1.32	1.39	1.47	1.59	1.73	
	KIAS	233	233	233	233	255	257	260	264	
	FF/ENG	3070	3020	2960	2880	2920	2960	3060	3380	
260	EPR	1.18	1.20	1.24	1.30	1.36	1.44	1.55	1.68	
	KIAS	228	228	228	228	246	248	250	254	
	FF/ENG	2870	2810	2750	2670	2690	2710	2780	3000	
240	EPR	1.16	1.18	1.22	1.27	1.33	1.41	1.51	1.63	
	KIAS	221	221	221	221	236	237	239	243	
	FF/ENG	2670	2610	2540	2490	2470	2470	2520	2660	
220	EPR	1.15	1.17	1.20	1.25	1.31	1.38	1.47	1.59	1.74
	KIAS	215	215	215	215	225	226	229	231	235
	FF/ENG	2480	2420	2350	2290	2250	2240	2280	2360	2700
200	EPR	1.14	1.15	1.19	1.23	1.28	1.35	1.43	1.54	1.67
	KIAS	208	208	208	208	215	216	218	220	223
	FF/ENG	2290	2230	2170	2090	2070	2020	2040	2100	2310

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight — Chapter PI
Two Engines Inoperative — Section 14

2 ENGINES INOP
MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	385	296	12600	10900	9100
390	376	293	13600	12000	10200
380	366	289	14600	13000	11300
370	357	286	15700	14000	12400
360	347	282	16700	15000	13400
350	339	279	17700	16000	14400
340	329	275	18600	17100	15400
330	319	271	19400	18100	16500
320	310	267	20200	19000	17500
310	300	263	21100	19900	18500
300	290	259	22000	20700	19400
290	280	255	22900	21700	20300
280	271	251	23800	22600	21200
270	261	246	24700	23500	22200
260	251	242	25700	24500	23200
250	242	237	26600	25500	24200
240	232	233	27700	26500	25300
230	223	228	28900	27500	26400
220	213	223	29900	28800	27500
210	203	219	31100	30100	28900
200	194	213	32200	31300	30200

Altitude reduced by 2000 ft for additional margin.

2 ENGINES INOP

MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
672	628	591	557	527	500	476	454	434	415	398
1334	1251	1177	1111	1053	1000	952	909	869	833	800
1996	1872	1763	1666	1578	1500	1429	1364	1305	1251	1201
2658	2494	2349	2220	2104	2000	1906	1820	1741	1669	1603
3323	3118	2936	2775	2630	2500	2382	2275	2177	2087	2004
3991	3743	3525	3331	3157	3000	2858	2729	2611	2503	2403
4663	4372	4116	3888	3684	3500	3334	3183	3044	2918	2801
5341	5005	4710	4447	4211	4000	3809	3635	3476	3331	3197
6027	5644	5307	5007	4740	4500	4283	4086	3906	3742	3591
6721	6288	5908	5570	5270	5000	4756	4536	4334	4150	3981

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG)											TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 KG)											
	200	220	240	260	280	300	320	340	360	380	400	
500	9.0	9.9	10.5	11.4	12.2	13.0	13.9	14.6	15.4	16.0	16.9	1:17
1000	17.8	19.4	20.9	22.6	24.2	25.8	27.3	28.8	30.4	31.9	33.7	2:30
1500	26.1	28.5	30.8	33.3	35.7	38.0	40.4	42.6	45.0	47.3	50.0	3:44
2000	34.0	37.2	40.3	43.5	46.6	49.8	52.9	55.9	59.1	62.2	65.7	4:57
2500	41.6	45.5	49.3	53.3	57.2	61.0	64.9	68.7	72.6	76.6	80.9	6:11
3000	48.9	53.5	58.0	62.7	67.3	71.9	76.4	81.0	85.7	90.4	95.5	7:27
3500	55.9	61.2	66.4	71.7	77.0	82.3	87.6	92.8	98.3	103.8	109.7	8:44
4000	62.6	68.5	74.4	80.4	86.4	92.4	98.3	104.3	110.5	116.7	123.5	10:03
4500	69.1	75.7	82.2	88.9	95.5	102.1	108.7	115.4	122.4	129.3	136.8	11:24
5000	75.4	82.6	89.7	97.0	104.3	111.5	118.8	126.1	133.8	141.5	149.7	12:48

Driftdown at optimum driftdown speed and cruise at Long Range Cruise speed.

2 ENGINES INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	5400	3500	1100
380	7900	5700	3600
360	10300	8200	6100
340	12800	10800	8700
320	15200	13300	11400
300	17700	15900	14100
280	20100	18500	16800
260	22800	21000	19300
240	24900	23600	22000
220	27200	25900	24500
200	29700	28500	27000

Altitude reduced by 2000 ft for additional margin.

2 ENGINES INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)								
		10	14	17	20	23	25	27	29	31
380	EPR	1.59								
	MACH	.632								
	KIAS	352								
	FF/ENG	6975								
360	EPR	1.56								
	MACH	.617								
	KIAS	343								
	FF/ENG	6519								
340	EPR	1.53	1.62							
	MACH	.601	.646							
	KIAS	334	334							
	FF/ENG	6096	6242							
320	EPR	1.51	1.59	1.66						
	MACH	.586	.628	.665						
	KIAS	325	325	325						
	FF/ENG	5696	5776	5946						
300	EPR	1.48	1.55	1.62						
	MACH	.570	.610	.645						
	KIAS	316	315	315						
	FF/ENG	5310	5343	5457						
280	EPR	1.45	1.52	1.58	1.66					
	MACH	.553	.592	.625	.662					
	KIAS	307	305	305	305					
	FF/ENG	4942	4945	5003	5151					
260	EPR	1.42	1.49	1.55	1.61	1.69				
	MACH	.535	.573	.604	.639	.679				
	KIAS	297	295	294	294	295				
	FF/ENG	4583	4563	4583	4672	4852				
240	EPR	1.39	1.46	1.51	1.57	1.64	1.70	1.76		
	MACH	.517	.554	.583	.616	.654	.681	.710		
	KIAS	287	285	284	283	283	284	285		
	FF/ENG	4229	4194	4193	4230	4343	4469	4644		
220	EPR	1.37	1.42	1.47	1.53	1.60	1.65	1.70	1.76	
	MACH	.499	.533	.562	.593	.628	.654	.681	.711	
	KIAS	276	274	273	272	272	272	272	273	
	FF/ENG	3891	3837	3820	3827	3882	3960	4078	4243	
200	EPR	1.34	1.39	1.43	1.49	1.55	1.59	1.65	1.70	1.76
	MACH	.480	.512	.539	.569	.601	.625	.651	.679	.709
	KIAS	265	263	262	260	260	259	260	260	261
	FF/ENG	3561	3490	3462	3450	3465	3504	3572	3679	3836

ALTERNATE MODE EEC

Takeoff Field Limit Weight Adjustment

FULL RATED WEIGHT (1000 KG)	WEIGHT ADJUSTMENT (1000 KG)
460	-20.5
440	-20.5
420	-20.5
410	-24.0
400	-24.5
390	-22.0
380	-19.5
360	-18.0
340	-17.0
320	-16.0
300	-14.5
280	-14.0
260	-13.0

The minimum takeoff field length required is 5800 ft with anti-skid on.

ALTERNATE MODE EEC

Takeoff Climb Limit Weight Adjustment

FULL RATED WEIGHT (1000 KG)	WEIGHT ADJUSTMENT (1000 KG)
460	-35.0
440	-34.0
420	-32.5
400	-31.0
380	-29.5
360	-28.0
340	-26.5
320	-25.5
300	-24.0
280	-22.5
260	-21.5

ALTERNATE MODE EEC

Takeoff Obstacle Limit Weight Adjustment

FULL RATED WEIGHT (1000 KG)	WEIGHT ADJUSTMENT (1000 KG)
460	-36.0
440	-35.0
420	-33.0
400	-32.5
380	-31.0
360	-29.5
340	-28.5
320	-27.0
300	-26.0
280	-24.5
260	-23.0

ALTERNATE MODE EEC

Takeoff Tire Speed Limit Weight Adjustment

FULL RATED WEIGHT (1000 KG)	WEIGHT ADJUSTMENT (1000 KG)
460	-2.5
440	-3.0
420	-3.5
400	-3.5
395	-9.5
390	-5.0
380	-3.0
360	-3.0
340	-2.5
320	-2.5
300	-2.5
280	-2.0
260	-2.0

ALTERNATE MODE EEC

Landing Climb Limit Weight Adjustment

FULL RATED WEIGHT (1000 KG)	WEIGHT ADJUSTMENT (1000 KG)
460	-35.0
440	-33.5
420	-32.0
400	-30.5
380	-29.0
360	-27.5
340	-26.0
320	-24.5
300	-22.5
280	-21.5
260	-20.0

ALTERNATE MODE EEC

Takeoff EPR

Based on engine bleed for 3 packs on

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	124	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55
50	122	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58
45	113	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61
40	104	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
35	95	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
30	86	1.68	1.69	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
25	77	1.68	1.69	1.70	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71
20	68	1.68	1.69	1.70	1.71	1.71	1.72	1.72	1.72	1.72	1.72	1.72	1.72	1.72
15	59	1.68	1.69	1.70	1.71	1.71	1.72	1.73	1.73	1.73	1.73	1.73	1.73	1.73
10	50	1.68	1.69	1.70	1.71	1.71	1.72	1.73	1.73	1.74	1.74	1.74	1.74	1.74
5 & BELOW	41 & BELOW	1.68	1.69	1.70	1.71	1.71	1.72	1.73	1.73	1.74	1.74	1.74	1.74	1.74

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-2000	10000
2 PACKS OFF	0.01	0.01
3 PACKS OFF	0.01	0.01

ALTERNATE MODE EEC

Max Continuous %N1

No EPR available

Based on engine bleed for 3 packs on and anti-ice off
45000 FT to 25000 FT Pressure Altitudes

45000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	35
150	.57	95.0	99.2	96.2	95.2	94.4	93.8	93.1	92.4	91.6	90.8	90.0	88.1
200	.75	95.1	99.2	99.8	98.6	97.5	96.5	95.6	94.9	94.2	93.5	92.9	91.4
250	.91	91.8	95.8	98.7	99.7	98.8	97.4	96.4	95.6	94.9	94.2	93.6	92.2
41000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	35
150	.53	95.1	99.3	96.2	95.3	94.4	93.8	93.0	92.3	91.5	90.7	89.9	88.0
200	.69	96.5	100.8	100.1	98.9	97.7	96.7	95.8	95.0	94.4	93.7	93.0	91.5
250	.84	94.3	98.5	101.5	100.8	99.5	98.3	97.2	96.4	95.7	95.0	94.3	93.0
270	.90	92.9	97.0	100.0	100.9	100.1	98.7	97.5	96.7	95.9	95.2	94.5	93.2
37000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	35
150	.48	95.4	99.5	96.3	95.4	94.5	93.7	92.9	92.2	91.5	90.7	89.9	88.0
200	.63	97.3	101.5	99.9	98.7	97.5	96.5	95.6	94.9	94.2	93.5	92.8	91.3
250	.77	96.6	100.8	103.0	101.8	100.5	99.2	98.1	97.2	96.4	95.7	95.0	93.8
300	.91	93.6	97.7	100.7	101.6	101.8	100.3	99.0	97.9	97.1	96.4	95.7	94.4
33000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	35
150	.44	97.7	102.0	98.4	97.3	96.2	95.3	94.4	93.6	92.9	92.2	91.4	89.7
200	.58	96.9	101.1	100.3	99.1	97.8	96.8	95.9	95.2	94.6	93.8	93.1	91.6
250	71	96.6	100.8	103.4	102.2	100.9	99.6	98.5	97.5	96.7	95.9	95.3	93.9
300	.84	94.2	98.3	101.3	102.3	102.4	101.0	99.8	98.7	97.8	97.0	96.3	95.1
330	.91	92.2	96.3	99.2	100.2	101.1	101.6	100.3	99.1	98.1	97.3	96.6	95.3
29000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	35
150	.40	98.1	102.4	101.0	99.6	98.3	97.1	96.1	95.3	94.5	93.7	93.0	91.5
200	.53	95.9	100.1	101.4	100.1	98.8	97.7	96.7	95.9	95.2	94.5	93.7	92.2
250	.65	95.2	99.3	102.4	102.6	101.3	100.0	98.8	97.8	96.9	96.2	95.6	94.2
300	.78	93.9	98.1	101.0	102.0	103.0	102.4	101.0	99.9	98.9	98.0	97.3	96.0
350	.89	90.6	94.6	97.5	98.4	99.4	100.3	101.2	100.4	99.2	98.4	97.6	96.2
25000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	35
150	.37	95.0	99.2	100.9	99.5	98.1	97.0	96.0	95.1	94.3	93.6	92.9	91.4
200	.49	93.3	97.4	100.4	100.1	98.7	97.6	96.6	95.7	94.9	94.1	93.4	92.0
250	.60	93.9	98.0	101.0	101.9	102.3	101.0	99.6	98.5	97.6	96.9	96.3	94.9
300	.72	93.4	97.5	100.5	101.4	102.4	103.3	102.5	101.1	100.0	99.0	98.2	96.9
350	.83	89.9	93.9	96.7	97.7	98.6	99.5	100.4	101.1	100.0	99.1	98.3	96.9

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)					
	25	29	33	37	41	45
PACKS OFF	0.6	0.6	0.7	0.9	1	1.1
ENGINE ANTI-ICE ON	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
ENGINE & WING ANTI-ICE ON	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2

ALTERNATE MODE EEC

Max Continuous %N1

No EPR available

Based on engine bleed for 3 packs on and anti-ice off
22000 FT to 12000 FT Pressure Altitudes

22000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
150	.35	93.4	97.5	100.4	100.3	98.8	97.6	96.6	95.7	94.9	94.1	93.4	92.7
200	.46	92.7	96.7	99.7	100.6	100.2	98.9	97.8	96.8	96.0	95.1	94.5	93.7
250	.57	92.9	97.0	99.9	100.9	101.9	101.9	100.5	99.3	98.4	97.6	97.0	96.3
300	.68	91.7	95.7	98.6	99.6	100.5	101.5	102.3	101.0	99.8	98.9	98.1	97.4
350	.78	88.9	92.8	95.7	96.6	97.5	98.4	99.3	100.2	100.1	99.2	98.4	97.7
20000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
200	.44	91.9	95.9	98.8	99.8	100.7	99.6	98.4	97.3	96.4	95.6	94.9	94.2
250	.55	92.3	96.4	99.3	100.3	101.2	102.1	101.2	99.9	98.9	98.1	97.5	96.8
300	.65	90.9	94.9	97.8	98.7	99.6	100.6	101.5	101.3	100.1	99.1	98.3	97.6
350	.75	88.2	92.1	94.9	95.8	96.7	97.6	98.5	99.4	100.2	99.2	98.5	97.7
18000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
200	.44	91.1	95.0	97.9	98.9	99.8	100.2	98.9	97.8	96.9	96.1	95.3	94.6
250	.55	91.2	95.2	98.0	99.0	99.9	100.9	101.3	100.0	98.9	98.1	97.4	96.7
300	.65	89.9	93.9	96.7	97.7	98.6	99.5	100.4	101.3	100.2	99.2	98.4	97.7
350	.75	87.6	91.4	94.2	95.1	96.0	96.9	97.8	98.6	99.5	99.3	98.5	97.8
16000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
200	.42	90.2	94.2	97.0	97.9	98.9	99.8	99.5	98.3	97.3	96.5	95.7	95.0
250	.53	90.4	94.4	97.2	98.2	99.1	100.0	100.9	100.5	99.4	98.4	97.7	96.9
300	.63	89.0	92.9	95.7	96.6	97.5	98.4	99.3	100.2	100.2	99.2	98.4	97.8
350	.73	86.9	90.7	93.4	94.3	95.2	96.1	97.0	97.8	98.7	99.3	98.5	97.8
14000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
200	.39	89.3	93.3	96.1	97.0	97.9	98.8	99.7	98.8	97.8	96.9	96.1	95.4
250	.49	89.4	93.3	96.1	97.0	98.0	98.9	99.8	100.7	99.6	98.6	97.8	97.0
300	.58	88.1	91.9	94.7	95.6	96.5	97.4	98.3	99.2	100.1	99.3	98.6	97.9
350	.68	86.1	89.9	92.6	93.5	94.4	95.3	96.1	97.0	97.9	98.7	98.6	97.9
12000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
200	.37	88.4	92.3	95.1	96.0	96.9	97.8	98.7	99.2	98.2	97.3	96.5	95.8
250	.47	88.2	92.0	94.8	95.7	96.6	97.5	98.4	99.3	99.6	98.6	97.8	97.0
300	.56	87.2	91.0	93.7	94.6	95.5	96.4	97.3	98.2	99.0	99.4	98.7	98.0
350	.65	85.4	89.1	91.8	92.7	93.6	94.5	95.3	96.2	97.0	97.9	98.6	97.9

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)					
	12	14	16	18	20	22
PACKS OFF	0.4	0.4	0.4	0.5	0.5	0.5
ENGINE ANTI-ICE ON	-0.5	-0.6	-0.6	-0.6	-0.6	-0.6
ENGINE & WING ANTI-ICE ON	-1	-1.2	-1.2	-1.2	-1.2	-1.2

ALTERNATE MODE EEC

Max Continuous %N1

No EPR available

Based on engine bleed for 3 packs on and anti-ice off
10000 FT to 0 FT Pressure Altitudes

10000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
150	.27	86.2	90.0	92.7	93.6	94.5	95.3	96.2	96.9	96.1	95.3	94.7	94.0
200	.36	87.4	91.2	94.0	94.9	95.8	96.7	97.6	98.4	98.4	97.5	96.7	96.0
250	.45	87.3	91.1	93.9	94.8	95.7	96.6	97.5	98.3	99.2	98.8	98.0	97.2
300	.54	86.2	90.0	92.7	93.6	94.5	95.4	96.2	97.1	97.9	98.8	98.6	97.9
350	.63	84.7	88.4	91.1	91.9	92.8	93.7	94.5	95.4	96.2	97.0	97.9	97.9
8000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
150	.26	85.1	88.9	91.6	92.5	93.3	94.2	95.1	95.9	96.2	95.4	94.8	94.2
200	.35	85.9	89.7	92.4	93.3	94.2	95.0	95.9	96.8	97.6	97.1	96.4	95.7
250	.44	86.3	90.1	92.8	93.7	94.6	95.5	96.3	97.2	98.1	98.9	98.0	97.3
300	.52	85.3	89.0	91.7	92.6	93.5	94.3	95.2	96.0	96.9	97.7	98.4	97.7
6000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
150	.25	84.2	87.9	90.5	91.4	92.3	93.1	94.0	94.8	95.6	95.5	94.9	94.3
200	.34	84.5	88.2	90.9	91.8	92.7	93.5	94.4	95.2	96.1	96.8	96.1	95.4
250	.42	85.3	89.1	91.8	92.6	93.5	94.4	95.3	96.1	96.9	97.8	98.1	97.3
300	.50	84.2	87.9	90.6	91.5	92.3	93.2	94.0	94.9	95.7	96.6	97.4	97.4
4000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
150	.24	83.3	86.9	89.6	90.4	91.3	92.1	93.0	93.8	94.6	95.4	95.0	94.4
200	.33	83.3	87.0	89.6	90.5	91.3	92.2	93.0	93.9	94.7	95.5	95.8	95.1
250	.41	84.4	88.1	90.7	91.6	92.5	93.3	94.2	95.0	95.9	96.7	97.5	97.3
300	.49	83.3	87.0	89.6	90.5	91.3	92.2	93.0	93.9	94.7	95.5	96.3	97.1
2000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
150	.24	82.4	86.0	88.6	89.5	90.3	91.2	92.0	92.8	93.7	94.5	95.1	94.5
200	.31	82.2	85.9	88.5	89.3	90.2	91.0	91.8	92.6	93.5	94.3	95.1	94.9
250	.39	83.2	86.9	89.5	90.4	91.2	92.1	92.9	93.8	94.6	95.4	96.2	97.0
300	.47	82.5	86.1	88.7	89.6	90.4	91.3	92.1	92.9	93.7	94.5	95.3	96.1
0 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-30	-15	-10	-5	0	5	10	15	20	25	30
150	.23	81.6	85.1	87.7	88.6	89.4	90.2	91.1	91.9	92.7	93.5	94.3	94.6
200	.30	81.2	84.8	87.4	88.2	89.0	89.9	90.7	91.5	92.3	93.1	93.9	94.7
250	.38	82.0	85.6	88.2	89.1	89.9	90.8	91.6	92.4	93.2	94.0	94.8	95.6
300	.45	81.6	85.2	87.8	88.6	89.5	90.3	91.1	92.0	92.8	93.6	94.4	95.1

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)					
	0	2	4	6	8	10
PACKS OFF	0.3	0.3	0.3	0.3	0.3	0.3
ENGINE ANTI-ICE ON	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
ENGINE & WING ANTI-ICE ON	-1	-1	-1	-1	-1	-1

ALTERNATE MODE EEC

Go-around EPR

Based on engine bleed for 3 packs on

REPORTED OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	(°C)	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
51	124	54	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55
47	117	50	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58
42	108	45	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62
37	99	40	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
32	90	35	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67
27	81	30	1.67	1.67	1.68	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69
22	72	25	1.67	1.67	1.68	1.69	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
17	63	20	1.67	1.67	1.68	1.69	1.70	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71
12	54	15	1.67	1.67	1.68	1.69	1.70	1.71	1.71	1.72	1.72	1.72	1.72	1.72	1.72
7	45	12	1.67	1.67	1.68	1.69	1.70	1.71	1.71	1.72	1.72	1.72	1.72	1.72	1.72
2 & BELOW	36 & BELOW	5 & BELOW	1.67	1.67	1.68	1.69	1.70	1.71	1.71	1.72	1.72	1.72	1.72	1.72	1.72

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-2000	10000
2 PACKS OFF	0.01	0.01
3 PACKS OFF	0.01	0.01

ALTERNATE MODE EEC

Go-around %N1

No EPR available

Based on engine bleed for packs on and anti-ice on or off

AIRPORT OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)								
°C	°F	(°C)	-2000	-1000	0	2000	4000	5700	6000	8000	10000
55	131	58.2	99.3	99.3	99.3	99.3	99.3	99.3	99.3	99.3	99.3
50	122	53.1	100.8	100.8	100.8	100.8	100.8	100.8	100.8	100.8	100.8
45	113	48.1	102.4	102.4	102.4	102.4	102.4	102.4	102.4	102.4	102.4
40	104	43.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0
35	95	38.0	105.5	105.5	105.5	105.5	105.5	105.5	105.5	105.5	105.5
30	86	32.9	105.1	105.9	106.6	106.6	106.6	106.6	106.6	106.6	106.6
25	77	27.9	104.2	104.9	105.7	107.0	107.0	107.0	107.0	107.0	107.0
20	68	22.8	103.2	104.0	104.7	106.2	106.7	106.7	106.7	106.7	106.7
15	59	17.8	102.3	103.0	103.8	105.3	106.5	106.5	106.5	106.5	106.5
10	50	12.7	101.4	102.1	102.8	104.3	105.6	106.2	106.2	106.2	106.2
5	41	7.7	100.5	101.2	101.9	103.3	104.6	105.2	105.2	105.2	105.2
0	32	2.6	99.5	100.2	101.0	102.4	103.6	104.3	104.3	104.3	104.3
-10	14	-7.5	97.6	98.3	99.0	100.3	101.5	102.2	102.2	102.2	102.2
-20	-4	-17.5	95.7	96.4	97.1	98.4	99.5	100.2	100.2	100.2	100.2
-30	-22	-27.6	93.9	94.6	95.2	96.5	97.6	98.3	98.3	98.3	98.3
-40	-40	-37.7	91.9	92.6	93.3	94.5	95.6	96.2	96.2	96.2	96.2
-50 & BELOW	-58 & BELOW	-47.8	90.1	90.7	91.3	92.6	93.6	94.2	94.2	94.2	94.2

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)								
	-2000	-1000	0	2000	4000	5700	6000	8000	10000
PACKS OFF	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Intentionally
Blank

Performance Inflight — Chapter PI
Gear Down — Section 16

GEAR DOWN

Takeoff Climb Limit
Based on engine bleed for 3 packs on and anti-ice off
Weight (1000 KG)

AIRPORT TEMP (°C)	AIRPORT PRESSURE ALTITUDE (FT)												
	-2000	-1000	SL	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
55	299	283	271	260									
50	318	301	288	275	263	241							
45	336	319	304	291	278	265	253	240	229				
40	354	335	320	307	293	280	267	254	242	229	218		
35	371	353	338	323	309	294	281	268	255	243	230	217	201
30	389	370	354	340	325	310	296	282	269	256	243	230	216
25	393	380	372	357	342	327	312	297	284	270	256	243	229
20	393	380	372	363	355	343	328	313	298	284	270	257	242
15	393	380	372	363	355	346	337	328	314	299	285	270	256
10	393	380	372	363	355	346	337	328	320	301	299	284	270
5 & BELOW	392	380	372	363	354	346	337	328	319	300	301	292	284

Applicable for flaps 10 or 20 takeoff.

Adjustments for Engine Bleed

BLEED CONFIGURATION	WEIGHT ADJUSTMENT (KG)	
	A/C PACKS OFF	A/C PACKS ON
A/I OFF	2250	0
NACELLE A/I ON	-5000	-7550
NACELLE & WING A/I ON	-12450	-14900

Boeing Converted Freighters are not certified for packs-off takeoff.

Landing Climb Limit
Based on engine bleed for 3 packs on
Weight (1000 KG)

AIRPORT OAT (°C)	AIRPORT PRESSURE ALTITUDE (FT)												
	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
55	349	337	325										
50	368	355	343	331	320	308							
45	388	375	361	349	337	324	313	301	290				
40	407	393	380	366	353	340	328	316	304	293	282		
35	427	412	398	383	370	356	343	330	319	307	295	284	273
30	432	421	410	395	381	367	354	341	328	316	304	293	282
25	432	421	410	400	388	374	360	347	334	322	310	298	287
20	432	421	410	400	389	378	364	350	338	325	313	301	289
15	432	421	410	400	389	379	367	354	341	328	316	304	292
10 & BELOW	432	421	410	400	389	379	367	355	344	331	318	306	295

Applicable for flaps 25 or 30 landing.
With engine bleed for 1 pack on, increase weight by 3750 kg.
With engine bleed for packs off, increase weight by 5650 kg.
Reduce landing climb limit weight by 37600 kg when operating in icing conditions during any part of the flight with forecast landing temperature below 8°C.

GEAR DOWN

Max Climb EPR

Based on engine bleed for 3 packs on, engine and wing anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)															
	0	5	10	12	14	16	18	20	22	24	26	28	30	31	33	35
	240	240	240	240	240	240	240	240	240	240	240	.60	.60	.60	.60	.60
55	1.45															
50	1.47	1.49														
45	1.49	1.51	1.51													
40	1.52	1.53	1.53	1.52												
35	1.54	1.56	1.56	1.55	1.55	1.54										
30	1.55	1.59	1.59	1.58	1.57	1.57	1.56	1.55								
25	1.55	1.62	1.61	1.61	1.60	1.60	1.59	1.58	1.57	1.56						
20	1.55	1.62	1.64	1.63	1.63	1.63	1.62	1.61	1.60	1.59	1.58					
15	1.55	1.62	1.67	1.67	1.66	1.66	1.65	1.64	1.63	1.62	1.61	1.59				
10	1.55	1.62	1.67	1.68	1.69	1.69	1.68	1.67	1.66	1.65	1.64	1.62	1.61	1.60	1.59	
5	1.55	1.62	1.67	1.68	1.70	1.71	1.71	1.70	1.69	1.68	1.67	1.65	1.64	1.63	1.63	1.62
0	1.55	1.62	1.67	1.68	1.70	1.71	1.72	1.73	1.72	1.71	1.70	1.68	1.67	1.67	1.66	1.65
-5	1.55	1.62	1.67	1.68	1.70	1.71	1.72	1.73	1.74	1.74	1.73	1.72	1.70	1.70	1.69	1.68
-10	1.55	1.62	1.67	1.68	1.70	1.71	1.72	1.73	1.74	1.75	1.76	1.75	1.73	1.73	1.72	1.71
-15	1.55	1.62	1.67	1.68	1.70	1.71	1.72	1.73	1.74	1.75	1.76	1.76	1.76	1.76	1.75	1.74
-20	1.55	1.62	1.67	1.68	1.70	1.71	1.72	1.73	1.74	1.75	1.76	1.76	1.77	1.78	1.78	1.77

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)	
	0	35
ENGINE ANTI-ICE ON	-0.01	-0.01
ENGINE & WING ANTI-ICE ON	-0.02	-0.02

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	19400	17600	15900
390	20200	18300	16600
380	20800	19100	17300
370	21400	20000	18000
360	22000	20600	18700
350	22600	21200	19500
340	23200	21700	20200
330	23900	22400	20900
320	24900	23300	21800
310	25700	24200	22700
300	26600	25200	23600
290	27500	26100	24600
280	28400	27000	25500
270	29300	27900	26500
260	30300	28900	27500
250	31400	29900	28500
240	32400	31200	29500
230	33400	32300	30900
220	34500	33500	32100
210	35500	34700	33400
200	36500	36100	34700

GEAR DOWN

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	14	17	20	23	25	27	29	31	33
400	EPR	1.48	1.56	1.64							
	MACH	.488	.525	.556							
	KIAS	270	270	270							
	FF/ENG	4951	5003	5113							
380	EPR	1.46	1.54	1.61	1.68						
	MACH	.488	.525	.556	.589						
	KIAS	270	270	270	270						
	FF/ENG	4776	4807	4883	5023						
360	EPR	1.45	1.52	1.59	1.66						
	MACH	.488	.525	.556	.589						
	KIAS	270	270	270	270						
	FF/ENG	4621	4635	4682	4786						
340	EPR	1.43	1.50	1.57	1.63						
	MACH	.488	.525	.556	.589						
	KIAS	270	270	270	270						
	FF/ENG	4482	4484	4514	4591						
320	EPR	1.41	1.48	1.54	1.60	1.68					
	MACH	.479	.513	.542	.575	.610					
	KIAS	265	263	263	263	264					
	FF/ENG	4250	4210	4224	4279	4384					
300	EPR	1.39	1.45	1.50	1.57	1.64	1.69				
	MACH	.467	.498	.526	.558	.592	.617				
	KIAS	258	256	255	255	255	256				
	FF/ENG	3995	3929	3925	3953	4029	4111				
280	EPR	1.37	1.42	1.47	1.53	1.60	1.65	1.70			
	MACH	.455	.484	.510	.540	.573	.597	.623			
	KIAS	252	248	247	247	247	247	248			
	FF/ENG	3758	3662	3638	3648	3694	3750	3836			
260	EPR	1.34	1.39	1.44	1.50	1.56	1.61	1.66	1.71		
	MACH	.444	.469	.493	.522	.554	.577	.601	.627		
	KIAS	245	241	239	238	238	238	238	239		
	FF/ENG	3537	3409	3365	3356	3377	3415	3467	3559		
240	EPR	1.32	1.37	1.41	1.46	1.52	1.56	1.61	1.67	1.72	
	MACH	.433	.456	.477	.503	.533	.555	.579	.604	.631	
	KIAS	239	233	231	229	229	229	229	229	230	
	FF/ENG	3329	3172	3105	3076	3078	3096	3132	3184	3278	
220	EPR	1.30	1.34	1.38	1.42	1.48	1.52	1.57	1.62	1.67	1.72
	MACH	.423	.442	.461	.484	.512	.533	.556	.580	.605	.632
	KIAS	234	226	223	221	220	220	220	220	220	220
	FF/ENG	3135	2954	2863	2812	2795	2799	2815	2849	2904	2992
200	EPR	1.29	1.32	1.35	1.39	1.44	1.48	1.52	1.56	1.61	1.67
	MACH	.413	.430	.446	.466	.491	.510	.531	.554	.578	.604
	KIAS	228	220	215	212	210	210	210	210	210	210
	FF/ENG	2956	2752	2641	2567	2527	2518	2520	2536	2569	2623

GEAR DOWN

Long Range Cruise Enroute Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
289	266	246	229	213	200	190	182	174	167	161
599	547	500	462	429	400	381	363	347	332	319
907	826	754	695	645	600	571	544	520	497	477
1216	1105	1008	928	860	800	761	725	692	663	636
1526	1386	1263	1161	1076	1000	951	906	865	828	794
1838	1667	1518	1395	1292	1200	1141	1087	1037	992	952
2152	1950	1774	1629	1508	1400	1331	1267	1209	1156	1109
2468	2235	2031	1864	1724	1600	1520	1447	1380	1319	1265
2786	2521	2289	2100	1941	1800	1710	1627	1551	1482	1421
3106	2808	2548	2336	2157	2000	1899	1806	1722	1645	1576
3428	3097	2808	2572	2374	2200	2088	1986	1892	1807	1731
3752	3387	3068	2809	2592	2400	2277	2165	2062	1969	1886
4078	3677	3329	3046	2809	2600	2466	2343	2231	2130	2040
4405	3969	3591	3283	3026	2800	2655	2522	2401	2291	2193
4734	4262	3853	3521	3244	3000	2844	2700	2569	2451	2346
5065	4557	4116	3759	3462	3200	3032	2877	2737	2611	2498
5396	4852	4380	3998	3680	3400	3220	3055	2905	2770	2650
5730	5148	4644	4236	3898	3600	3408	3232	3072	2929	2802
6065	5445	4909	4476	4116	3800	3596	3409	3239	3087	2952
6401	5743	5174	4715	4334	4000	3784	3586	3406	3245	3102

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		25	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	10.3	0:41	9.3	0:39	8.6	0:38	7.9	0:36	7.6	0:35
400	20.3	1:23	18.7	1:20	17.4	1:16	16.3	1:12	15.7	1:09
600	30.3	2:05	28.1	2:00	26.2	1:54	24.7	1:47	23.9	1:43
800	40.4	2:48	37.4	2:40	35.0	2:32	33.0	2:23	32.0	2:17
1000	50.4	3:30	46.8	3:21	43.8	3:10	41.4	2:59	40.1	2:51
1200	60.0	4:14	55.7	4:03	52.2	3:50	49.3	3:36	47.8	3:26
1400	69.7	4:57	64.6	4:44	60.5	4:29	57.3	4:13	55.5	4:01
1600	79.1	5:41	73.3	5:27	68.7	5:10	65.0	4:51	63.0	4:37
1800	88.3	6:26	81.9	6:10	76.7	5:51	72.5	5:29	70.2	5:14
2000	97.5	7:11	90.4	6:53	84.7	6:32	80.1	6:08	77.5	5:50
2200	106.4	7:57	98.5	7:38	92.2	7:14	87.2	6:48	84.4	6:28
2400	115.3	8:43	106.7	8:22	99.8	7:56	94.4	7:28	91.2	7:06
2600	124.1	9:29	114.7	9:07	107.3	8:39	101.4	8:08	97.9	7:45
2800	132.7	10:16	122.5	9:53	114.5	9:23	108.2	8:50	104.5	8:24
3000	141.3	11:03	130.3	10:39	121.8	10:07	115.0	9:31	111.0	9:03
3200	149.5	11:51	137.9	11:25	128.7	10:52	121.5	10:14	117.2	9:44
3400	157.8	12:39	145.5	12:12	135.7	11:37	127.9	10:57	123.4	10:25
3600	165.9	13:27	153.0	13:00	142.5	12:23	134.3	11:40	129.5	11:06
3800	173.8	14:16	160.3	13:47	149.1	13:10	140.5	12:25	135.4	11:49
4000	181.8	15:04	167.6	14:35	155.8	13:56	146.7	13:09	141.3	12:31

GEAR DOWN

Long Range Cruise Enroute Fuel and Time
Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
20	-2.8	-1.7	0.0	2.9	6.2
30	-4.4	-2.4	0.0	4.6	9.5
40	-5.9	-3.2	0.0	6.3	12.7
50	-7.4	-3.9	0.0	7.9	15.9
60	-8.9	-4.7	0.0	9.4	19.1
70	-10.3	-5.4	0.0	10.9	22.1
80	-11.7	-6.1	0.0	12.4	25.1
90	-13.1	-6.8	0.0	13.8	28.0
100	-14.5	-7.6	0.0	15.1	30.8
110	-15.9	-8.3	0.0	16.4	33.6
120	-17.2	-8.9	0.0	17.7	36.3
130	-18.5	-9.6	0.0	18.9	38.9
140	-19.8	-10.3	0.0	20.1	41.4
150	-21.1	-11.0	0.0	21.2	43.9
160	-22.3	-11.6	0.0	22.3	46.3

Descent at .66/240

PRESSURE ALT (1000 FT)	5	10	15	17	19	21	23	25	27	29	31	33	35
DISTANCE (NM)	18	28	37	41	45	49	53	57	61	65	70	73	76
TIME (MINUTES)	5	8	10	10	11	12	13	13	14	15	15	16	16

GEAR DOWN

Holding

Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
400	EPR	1.35	1.40	1.48	1.59			
	KIAS	270	270	270	270			
	FF/ENG	5240	5190	5200	5280			
380	EPR	1.34	1.38	1.46	1.56	1.68		
	KIAS	270	270	270	270	270		
	FF/ENG	5090	5030	5020	5070	5270		
360	EPR	1.33	1.37	1.45	1.54	1.66		
	KIAS	270	270	270	270	270		
	FF/ENG	4950	4880	4850	4880	5030		
340	EPR	1.31	1.35	1.42	1.51	1.63		
	KIAS	261	261	261	261	270		
	FF/ENG	4640	4570	4520	4530	4820		
320	EPR	1.29	1.33	1.39	1.48	1.61		
	KIAS	251	251	251	251	270		
	FF/ENG	4380	4270	4200	4190	4650		
300	EPR	1.27	1.30	1.37	1.45	1.58		
	KIAS	242	242	242	242	264		
	FF/ENG	4090	3980	3910	3880	4360		
280	EPR	1.25	1.28	1.34	1.42	1.55	1.67	
	KIAS	233	233	233	233	255	257	
	FF/ENG	3800	3740	3620	3580	4010	4170	
260	EPR	1.23	1.26	1.32	1.39	1.51	1.63	
	KIAS	228	228	228	228	246	248	
	FF/ENG	3580	3530	3410	3350	3670	3790	
240	EPR	1.22	1.25	1.30	1.36	1.47	1.58	1.71
	KIAS	221	221	221	221	236	237	239
	FF/ENG	3350	3290	3180	3110	3350	3410	3610
220	EPR	1.20	1.23	1.28	1.34	1.43	1.53	1.66
	KIAS	215	215	215	215	225	226	229
	FF/ENG	3130	3070	3000	2900	3040	3060	3200
200	EPR	1.19	1.21	1.26	1.31	1.39	1.49	1.61
	KIAS	208	208	208	208	215	216	218
	FF/ENG	2910	2850	2770	2680	2740	2750	2820

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
Based on engine bleed for 3 packs on

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	387	266	9400	7800	6100
390	378	264	10400	8800	7100
380	369	261	11300	9700	8000
370	358	259	12500	10800	9100
360	350	256	13400	11800	10100
350	341	254	14200	12800	11000
340	330	251	15200	13900	12200
330	321	248	15900	14700	13200
320	312	246	16700	15500	14100
310	301	243	17700	16400	15100
300	292	240	18600	17200	15900
290	282	237	19500	18200	16800
280	273	234	20300	19000	17700
270	262	231	21300	20000	18700
260	253	228	22100	20900	19600
250	243	225	23200	21900	20600
240	233	220	24300	23000	21700
230	223	215	25700	24300	22900
220	214	210	27000	25800	24300
210	204	204	28400	27300	26000
200	195	200	29700	28700	27700

Altitude reduced by 1000 ft for additional margin.

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
Based on engine bleed for 3 packs on

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	7900	6000	4000
390	8600	6800	4700
380	9400	7500	5500
370	10100	8200	6200
360	10800	8900	6900
350	11900	10000	8000
340	13100	11300	9300
330	14200	12600	10600
320	15200	13900	11900
310	16200	14800	13200
300	17200	15800	14500
290	18200	16800	15400
280	19300	17800	16500
270	20200	18900	17500
260	21200	19900	18600
250	22300	21000	19700
240	23300	22100	20800
230	24500	23200	21900
220	25800	24400	23100
210	27100	25900	24400
200	28400	27300	26000

Altitude reduced by 1000 ft for additional margin.
With engine bleed for 1 pack on, increase altitude capability by 300 ft.
With engine bleed for 2 packs on, increase altitude capability by 100 ft.
With engine anti-ice on, decrease altitude capability by 900 ft.
With engine and wing anti-ice on, decrease altitude capability by 1700 ft.

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT) 10	14	17	20	23	25	27	29
380	EPR	1.64							
	MACH	.488							
	KIAS	270							
	FF/ENG	6622							
360	EPR	1.61							
	MACH	.488							
	KIAS	270							
	FF/ENG	6356							
340	EPR	1.58	1.68						
	MACH	.476	.514						
	KIAS	264	264						
	FF/ENG	5941	6147						
320	EPR	1.55	1.64						
	MACH	.465	.498						
	KIAS	257	256						
	FF/ENG	5552	5650						
300	EPR	1.52	1.60	1.68					
	MACH	.453	.483	.513					
	KIAS	250	248	248					
	FF/ENG	5194	5194	5358					
280	EPR	1.49	1.56	1.63	1.72				
	MACH	.442	.469	.495	.528				
	KIAS	244	240	240	241				
	FF/ENG	4864	4796	4867	5090				
260	EPR	1.46	1.53	1.59	1.67				
	MACH	.433	.456	.479	.508				
	KIAS	239	233	231	232				
	FF/ENG	4559	4436	4433	4545				
240	EPR	1.43	1.49	1.55	1.62	1.70			
	MACH	.424	.443	.463	.488	.521			
	KIAS	234	227	224	222	223			
	FF/ENG	4280	4107	4054	4086	4235			
220	EPR	1.41	1.46	1.51	1.57	1.64	1.70		
	MACH	.416	.431	.448	.470	.498	.520		
	KIAS	229	221	216	214	213	214		
	FF/ENG	4031	3806	3714	3685	3751	3850		
200	EPR	1.39	1.43	1.47	1.52	1.59	1.64	1.70	1.76
	MACH	.409	.421	.435	.453	.476	.496	.518	.544
	KIAS	226	215	210	206	204	204	204	206
	FF/ENG	3814	3538	3407	3334	3323	3373	3462	3624

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM) HEADWIND COMPONENT (KTS)					GROUND DISTANCE (NM)	AIR DISTANCE (NM) TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
302	275	251	231	215	200	191	182	174	167	160
610	554	505	464	430	400	381	363	347	333	320
921	835	759	698	646	600	572	545	521	499	479
1233	1117	1015	932	862	800	762	727	694	665	638
1548	1400	1271	1166	1078	1000	952	907	866	829	796
1864	1684	1528	1401	1294	1200	1141	1087	1038	993	953
2182	1971	1787	1637	1511	1400	1331	1268	1210	1157	1110
2502	2258	2045	1872	1728	1600	1520	1447	1380	1320	1266
2823	2546	2305	2109	1944	1800	1710	1627	1551	1482	1421
3146	2835	2565	2345	2161	2000	1899	1806	1722	1645	1576

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		25		29	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	9.7	0:43	8.9	0:42	8.4	0:40	8.1	0:38	7.7	0:36
400	20.3	1:26	18.9	1:22	18.1	1:18	17.8	1:13	17.3	1:09
600	30.6	2:09	28.6	2:03	27.5	1:56	27.2	1:49	26.6	1:43
800	40.6	2:52	38.1	2:45	36.6	2:36	36.2	2:25	35.7	2:17
1000	50.5	3:36	47.4	3:27	45.5	3:15	45.0	3:02	44.4	2:52
1200	60.2	4:20	56.5	4:09	54.2	3:56	53.5	3:40	52.9	3:27
1400	69.7	5:05	65.5	4:53	62.6	4:37	61.7	4:18	61.2	4:04
1600	79.1	5:50	74.2	5:36	70.9	5:19	69.6	4:58	69.1	4:41
1800	88.2	6:35	82.7	6:20	78.9	6:01	77.4	5:37	76.8	5:18
2000	97.2	7:21	91.1	7:05	86.8	6:44	84.9	6:18	84.2	5:57

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-1.6	-0.9	0.0	1.1	2.7
20	-3.3	-1.8	0.0	2.6	5.5
30	-5.0	-2.7	0.0	4.1	8.3
40	-6.6	-3.6	0.0	5.6	11.2
50	-8.2	-4.5	0.0	7.2	14.2
60	-9.7	-5.3	0.0	8.8	17.3
70	-11.2	-6.1	0.0	10.5	20.4
80	-12.6	-6.9	0.0	12.1	23.6
90	-13.9	-7.6	0.0	13.8	26.9

GEAR DOWN

1 ENGINE INOP

MAX CONTINUOUS THRUST

Holding

Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
400	EPR	1.48	1.54				
	KIAS	270	270				
	FF/ENG	6990	7030				
380	EPR	1.46	1.52	1.64			
	KIAS	270	270	270			
	FF/ENG	6760	6790	6950			
360	EPR	1.44	1.51	1.61			
	KIAS	270	270	270			
	FF/ENG	6550	6560	6670			
340	EPR	1.42	1.48	1.58			
	KIAS	261	261	261			
	FF/ENG	6110	6100	6160			
320	EPR	1.39	1.44	1.54	1.66		
	KIAS	251	251	251	251		
	FF/ENG	5680	5660	5680	5860		
300	EPR	1.36	1.42	1.50	1.61		
	KIAS	242	242	242	242		
	FF/ENG	5280	5240	5250	5340		
280	EPR	1.34	1.38	1.47	1.57		
	KIAS	233	233	233	233		
	FF/ENG	4890	4840	4820	4870		
260	EPR	1.32	1.36	1.44	1.54	1.70	
	KIAS	228	228	228	228	246	
	FF/ENG	4610	4560	4520	4530	5220	
240	EPR	1.29	1.34	1.41	1.50	1.65	
	KIAS	221	221	221	221	236	
	FF/ENG	4290	4240	4180	4180	4670	
220	EPR	1.27	1.31	1.38	1.46	1.60	1.73
	KIAS	215	215	215	215	225	226
	FF/ENG	4050	3950	3890	3860	4160	4420
200	EPR	1.25	1.29	1.35	1.43	1.54	1.67
	KIAS	208	208	208	208	215	216
	FF/ENG	3750	3690	3580	3530	3700	3850

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

SPARE ENGINE CARRIAGE

VREF (KIAS)

WEIGHT (1000 KG)	FLAPS	
	30	25
400	188	195
380	182	191
360	177	185
340	172	179
320	166	173
300	161	167
280	155	162
260	149	155
240	143	149
220	136	142
200	130	135

Increase VREF 1 knot for every 2000 ft above sea level.

SPARE ENGINE CARRIAGE

Max Climb EPR

Based on engine bleed for 3 packs on, engine and wing anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)															
	0	5	10	12	14	16	18	20	22	24	26	28	30	31	33	35
	305	305	305	305	305	305	305	305	305	305	305	305	0.78	0.78	0.78	0.78
55	1.46	1.46														
50	1.48	1.48	1.48	1.47												
45	1.51	1.50	1.50	1.50	1.50	1.50										
40	1.53	1.53	1.53	1.52	1.52	1.52	1.52	1.51								
35	1.54	1.56	1.55	1.55	1.55	1.55	1.55	1.54	1.54	1.54						
30	1.54	1.58	1.58	1.58	1.58	1.58	1.57	1.57	1.57	1.57	1.56	1.55				
25	1.54	1.59	1.61	1.61	1.61	1.60	1.60	1.60	1.59	1.59	1.59	1.58	1.57	1.57		
20	1.54	1.59	1.63	1.64	1.64	1.63	1.63	1.63	1.62	1.62	1.62	1.61	1.60	1.60	1.58	
15	1.54	1.59	1.63	1.64	1.66	1.66	1.66	1.66	1.65	1.65	1.65	1.64	1.63	1.63	1.61	1.59
10	1.54	1.59	1.63	1.64	1.66	1.67	1.69	1.69	1.68	1.68	1.68	1.67	1.66	1.66	1.64	1.62
5	1.54	1.59	1.63	1.64	1.66	1.67	1.69	1.70	1.71	1.71	1.71	1.70	1.69	1.69	1.67	1.65
0	1.54	1.59	1.63	1.64	1.66	1.67	1.69	1.70	1.71	1.73	1.73	1.73	1.72	1.72	1.70	1.68
-5	1.54	1.59	1.63	1.64	1.66	1.67	1.69	1.70	1.71	1.73	1.73	1.74	1.75	1.75	1.73	1.71
-10	1.54	1.59	1.63	1.64	1.66	1.67	1.69	1.70	1.71	1.73	1.73	1.74	1.75	1.76	1.76	1.74
-15	1.54	1.59	1.63	1.64	1.66	1.67	1.69	1.70	1.71	1.73	1.73	1.74	1.75	1.76	1.77	1.77
-20	1.54	1.59	1.63	1.64	1.66	1.67	1.69	1.70	1.71	1.73	1.73	1.74	1.75	1.76	1.77	1.78

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	0	10	20	30	40
ENGINE ANTI-ICE ON	-0.01	-0.01	-0.01	-0.01	-0.01
ENGINE & WING ANTI-ICE ON	-0.02	-0.02	-0.02	-0.02	-0.02

SPARE ENGINE CARRIAGE

Long Range Cruise Maximum Operating Altitude

Max Cruise Thrust

ISA + 10°C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	27000	2	30000	29000	28000	26000	25000
380	28000	-1	31000	30000	29000	27000	26000
360	29000	-3	32000	31000	30000	29000	27000
340	30000	-6	33000	32000	31000	30000	28000
320	32000	-9	34000	34000	33000	31000	30000
300	33000	-12	36000	35000	34000	33000	31000
280	34000	-16	37000	36000	36000	34000	33000
260	36000	-19	39000	38000	37000	36000	34000
240	38000	-19	40000	40000	39000	37000	36000
220	39000	-19	42000	41000	41000	39000	38000
200	41000	-19	44000	43000	43000	41000	40000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	27000	7	29000*	29000	28000	26000	25000
380	28000	5	31000	30000	29000	27000	26000
360	29000	2	32000	31000	30000	29000	27000
340	30000	-1	33000	32000	31000	30000	28000
320	32000	-4	34000	34000	33000	31000	30000
300	33000	-7	36000	35000	34000	33000	31000
280	34000	-10	37000	36000	36000	34000	33000
260	36000	-13	39000	38000	37000	36000	34000
240	38000	-13	40000	40000	39000	37000	36000
220	39000	-13	42000	41000	41000	39000	38000
200	41000	-13	44000	43000	43000	41000	40000

ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	27000	13	28000*	28000*	28000	26000	25000
380	28000	10	30000*	30000	29000	27000	26000
360	29000	8	31000*	31000	30000	29000	27000
340	30000	5	32000*	32000	31000	30000	28000
320	32000	2	34000	34000	33000	31000	30000
300	33000	-1	36000	35000	34000	33000	31000
280	34000	-4	37000	36000	36000	34000	33000
260	36000	-8	38000*	38000	37000	36000	34000
240	38000	-8	40000	40000	39000	37000	36000
220	39000	-8	41000*	41000	41000	39000	38000
200	41000	-8	43000*	43000	43000	41000	40000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

SPARE ENGINE CARRIAGE

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)										
		25	27	29	31	33	35	37	39	41	43	45
400	EPR	1.52	1.56	1.62	1.71							
	MACH	.780	.780	.780	.780							
	KIAS	329	315	302	289							
	FF/ENG	3591	3530	3566	3766							
380	EPR	1.49	1.53	1.59	1.66							
	MACH	.777	.780	.780	.780							
	KIAS	327	315	302	289							
	FF/ENG	3428	3357	3332	3422							
360	EPR	1.47	1.51	1.55	1.61	1.69						
	MACH	.768	.780	.780	.780	.780						
	KIAS	323	315	302	289	277						
	FF/ENG	3235	3208	3142	3159	3313						
340	EPR	1.44	1.48	1.52	1.57	1.64						
	MACH	.757	.773	.780	.780	.780						
	KIAS	318	312	302	289	277						
	FF/ENG	3054	3033	2985	2947	3006						
320	EPR	1.42	1.45	1.50	1.54	1.59	1.67					
	MACH	.746	.762	.778	.780	.780	.780					
	KIAS	313	307	301	289	277	264					
	FF/ENG	2878	2850	2837	2777	2769	2866					
300	EPR	1.40	1.43	1.47	1.51	1.55	1.62	1.70				
	MACH	.733	.751	.767	.780	.780	.780	.780				
	KIAS	307	302	296	289	277	264	252				
	FF/ENG	2707	2677	2653	2636	2582	2601	2756				
280	EPR	1.38	1.40	1.44	1.48	1.52	1.57	1.64				
	MACH	.718	.737	.754	.771	.780	.780	.780				
	KIAS	301	296	291	285	277	264	252				
	FF/ENG	2538	2507	2481	2465	2436	2397	2456				
260	EPR	1.35	1.38	1.41	1.45	1.49	1.53	1.59	1.66			
	MACH	.701	.721	.740	.757	.774	.780	.780	.780			
	KIAS	293	290	285	280	274	264	252	241			
	FF/ENG	2368	2339	2311	2291	2281	2241	2234	2324			
240	EPR	1.33	1.36	1.39	1.42	1.45	1.50	1.54	1.60	1.68		
	MACH	.682	.703	.723	.742	.760	.777	.780	.780	.780		
	KIAS	284	282	278	274	269	263	252	241	230		
	FF/ENG	2202	2171	2144	2122	2106	2098	2066	2086	2182		
220	EPR	1.31	1.33	1.36	1.39	1.42	1.46	1.50	1.55	1.61	1.69	
	MACH	.660	.682	.704	.724	.743	.761	.778	.780	.780	.780	
	KIAS	275	273	270	267	262	257	252	241	230	220	
	FF/ENG	2031	2005	1977	1955	1938	1922	1925	1908	1928	2025	
200	EPR	1.28	1.31	1.33	1.36	1.39	1.42	1.46	1.51	1.55	1.61	1.69
	MACH	.635	.658	.681	.703	.724	.743	.761	.778	.780	.780	.780
	KIAS	263	262	261	258	255	251	246	240	230	220	210
	FF/ENG	1854	1835	1812	1789	1771	1755	1750	1765	1748	1764	1851

SPARE ENGINE CARRIAGE

Long Range Cruise Enroute Fuel and Time - Low Altitudes

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
690	642	599	562	529	500	479	460	442	426	411
1384	1287	1201	1126	1060	1000	960	922	887	854	824
2086	1938	1806	1691	1591	1500	1439	1383	1330	1282	1237
2794	2593	2413	2258	2122	2000	1919	1844	1774	1709	1649
3509	3252	3023	2827	2655	2500	2399	2304	2216	2135	2060
4232	3918	3638	3398	3189	3000	2878	2764	2658	2560	2471
4963	4589	4256	3972	3723	3500	3357	3223	3099	2985	2881
5703	5267	4878	4547	4259	4000	3836	3682	3540	3409	3289
6453	5951	5504	5125	4795	4500	4314	4141	3980	3833	3698
7217	6645	6137	5706	5334	5000	4793	4600	4421	4256	4105

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		25	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
500	15.2	1:26	13.8	1:22	12.5	1:18	11.5	1:16	10.8	1:14
1000	30.6	2:50	28.2	2:42	25.8	2:34	23.9	2:27	22.7	2:23
1500	45.7	4:16	42.2	4:03	38.8	3:50	36.0	3:40	34.3	3:33
2000	60.4	5:44	55.9	5:26	51.4	5:08	47.9	4:53	45.5	4:44
2500	74.7	7:15	69.2	6:51	63.8	6:28	59.4	6:08	56.5	5:56
3000	88.8	8:48	82.2	8:19	75.9	7:50	70.6	7:25	67.2	7:10
3500	102.5	10:23	94.8	9:48	87.7	9:14	81.6	8:43	77.7	8:24
4000	115.9	12:01	107.2	11:20	99.2	10:39	92.3	10:03	87.9	9:40
4500	129.0	13:41	119.3	12:54	110.4	12:07	102.8	11:24	97.8	10:57
5000	141.8	15:26	131.1	14:31	121.3	13:37	113.1	12:48	107.5	12:16

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-0.9	-0.8	0.0	2.6	7.7
20	-2.6	-1.5	0.0	5.1	13.6
30	-4.3	-2.2	0.0	7.4	19.0
40	-5.9	-2.9	0.0	9.6	23.9
50	-7.5	-3.6	0.0	11.5	28.3
60	-9.0	-4.3	0.0	13.3	32.2
70	-10.5	-5.0	0.0	15.0	35.7
80	-11.9	-5.8	0.0	16.4	38.6
90	-13.2	-6.6	0.0	17.7	41.1
100	-14.5	-7.3	0.0	18.8	43.1
110	-15.7	-8.1	0.0	19.7	44.7
120	-16.8	-8.9	0.0	20.5	45.7
130	-17.9	-9.7	0.0	21.1	46.3
140	-18.9	-10.5	0.0	21.5	46.3

SPARE ENGINE CARRIAGE

Long Range Cruise Enroute Fuel and Time - High Altitudes
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1310	1231	1160	1101	1049	1000	965	929	891	852	811
1959	1845	1742	1653	1574	1500	1443	1387	1333	1280	1229
2612	2462	2326	2206	2099	2000	1921	1846	1775	1708	1645
3269	3082	2911	2760	2625	2500	2399	2305	2217	2135	2059
3930	3704	3498	3315	3151	3000	2878	2764	2658	2560	2471
4595	4328	4085	3870	3677	3500	3357	3223	3099	2985	2881
5264	4956	4675	4427	4204	4000	3836	3682	3540	3409	3289
5937	5586	5267	4984	4732	4500	4314	4141	3980	3833	3698
6614	6220	5861	5544	5260	5000	4793	4600	4421	4256	4105
7297	6857	6457	6104	5789	5500	5271	5058	4860	4678	4512
7986	7498	7055	6666	6318	6000	5749	5515	5299	5100	4918
8680	8144	7657	7230	6848	6500	6227	5973	5738	5521	5324
9381	8794	8262	7795	7379	7000	6705	6430	6175	5941	5728
10088	9448	8869	8362	7911	7500	7182	6887	6613	6361	6132
10802	10108	9481	8932	8444	8000	7659	7343	7049	6780	6534

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)							
	25		29		33		37	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
1000	25.4	2:12	24.2	2:11	23.7	2:10	25.1	2:05
1500	35.9	3:26	34.0	3:22	33.1	3:18	34.2	3:12
2000	46.3	4:41	43.8	4:33	42.5	4:27	43.4	4:18
2500	56.8	5:55	53.7	5:44	51.9	5:35	52.5	5:24
3000	67.2	7:10	63.5	6:54	61.3	6:43	61.6	6:30
3500	77.7	8:24	73.3	8:05	70.7	7:51	70.8	7:37
4000	87.9	9:40	82.9	9:17	79.9	9:00	79.6	8:43
4500	97.8	10:57	92.3	10:30	88.8	10:10	88.2	9:51
5000	107.5	12:16	101.4	11:44	97.4	11:21	96.5	10:59
5500	117.0	13:37	110.3	12:59	105.8	12:32	104.5	12:08
6000	126.2	14:59	118.9	14:15	114.0	13:44	112.4	13:17
6500	135.3	16:24	127.4	15:33	122.0	14:58	120.0	14:27
7000	144.1	17:50	135.6	16:53	129.8	16:12	127.4	15:38
7500	152.7	19:19	143.6	18:14	137.4	17:28	134.6	16:50
8000	161.1	20:50	151.5	19:37	144.8	18:45	141.6	18:02

SPARE ENGINE CARRIAGE

Long Range Cruise Enroute Fuel and Time - High Altitudes
Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
60	-11.9	-6.0	0.0	13.4	32.2
70	-13.9	-7.0	0.0	14.9	35.4
80	-15.9	-8.0	0.0	16.3	38.3
90	-17.9	-9.0	0.0	17.7	41.1
100	-19.8	-10.0	0.0	18.9	43.6
110	-21.7	-11.0	0.0	20.1	46.0
120	-23.6	-12.0	0.0	21.3	48.2
130	-25.4	-13.0	0.0	22.4	50.2
140	-27.3	-13.9	0.0	23.4	52.1
150	-29.1	-14.9	0.0	24.3	53.7
160	-30.9	-15.8	0.0	25.2	55.1
170	-32.6	-16.8	0.0	26.0	56.4

SPARE ENGINE CARRIAGE

Descent at .78/305/250

PRESSURE ALT (1000 FT)	15	17	19	21	23	25	27	29	31	33	35	37	39	41
DISTANCE (NM)	57	63	69	75	82	88	94	100	105	110	115	120	126	131
TIME (MINUTES)	13	14	15	16	17	18	19	19	20	21	21	22	23	24

SPARE ENGINE CARRIAGE

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)								
		1500	5000	10000	15000	20000	25000	30000	35000	40000
400	EPR	1.20	1.23	1.28	1.34	1.41	1.51			
	KIAS	290	290	290	290	320	324			
	FF/ENG	3520	3450	3370	3360	3550	3710			
380	EPR	1.19	1.22	1.27	1.33	1.39	1.48	1.63		
	KIAS	284	284	284	284	312	316	322		
	FF/ENG	3350	3280	3230	3170	3330	3450	3900		
360	EPR	1.18	1.21	1.25	1.31	1.37	1.46	1.59		
	KIAS	274	274	274	274	303	307	312		
	FF/ENG	3170	3100	3040	2980	3130	3210	3510		
340	EPR	1.18	1.20	1.24	1.30	1.35	1.43	1.55		
	KIAS	264	264	264	264	294	298	302		
	FF/ENG	3000	2930	2860	2800	2930	2990	3180		
320	EPR	1.17	1.19	1.23	1.28	1.33	1.41	1.51		
	KIAS	254	254	254	254	285	288	292		
	FF/ENG	2830	2770	2700	2630	2750	2770	2900		
300	EPR	1.16	1.18	1.21	1.26	1.32	1.38	1.48	1.63	
	KIAS	245	245	245	245	275	278	282	286	
	FF/ENG	2670	2610	2540	2480	2560	2570	2650	2990	
280	EPR	1.15	1.17	1.20	1.24	1.30	1.36	1.45	1.58	
	KIAS	236	236	236	236	266	268	272	276	
	FF/ENG	2510	2450	2390	2310	2390	2380	2430	2650	
260	EPR	1.14	1.16	1.19	1.23	1.28	1.34	1.42	1.53	1.69
	KIAS	230	230	230	230	256	258	261	265	252
	FF/ENG	2350	2290	2240	2160	2210	2190	2220	2350	2630
240	EPR	1.13	1.14	1.17	1.21	1.26	1.32	1.39	1.49	1.64
	KIAS	224	224	224	224	245	247	250	253	249
	FF/ENG	2210	2140	2090	2010	2050	2010	2020	2110	2340
220	EPR	1.12	1.13	1.16	1.19	1.24	1.29	1.36	1.45	1.58
	KIAS	217	217	217	217	234	236	239	242	245
	FF/ENG	2060	2000	1950	1870	1870	1840	1840	1890	2100
200	EPR	1.11	1.12	1.15	1.18	1.22	1.27	1.33	1.41	1.52
	KIAS	210	210	210	210	224	225	227	229	233
	FF/ENG	2130	1850	1810	1720	1710	1680	1660	1680	1820

This table includes 5% additional fuel for holding in a racetrack pattern.

SPARE ENGINE CARRIAGE

Holding
Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
400	EPR	1.26	1.30	1.36	1.44	1.54
	KIAS	248	250	252	254	254
	FF/ENG	4020	3930	3870	3870	3920
380	EPR	1.24	1.28	1.34	1.41	1.51
	KIAS	243	244	247	249	249
	FF/ENG	3820	3770	3670	3650	3690
360	EPR	1.23	1.26	1.32	1.39	1.48
	KIAS	238	239	241	243	243
	FF/ENG	3620	3580	3480	3440	3460
340	EPR	1.22	1.25	1.30	1.37	1.46
	KIAS	232	233	235	237	237
	FF/ENG	3430	3380	3280	3240	3250
320	EPR	1.20	1.23	1.28	1.35	1.43
	KIAS	226	227	229	231	231
	FF/ENG	3230	3180	3130	3040	3040
300	EPR	1.19	1.22	1.27	1.33	1.40
	KIAS	221	222	223	225	225
	FF/ENG	3040	2990	2940	2850	2830
280	EPR	1.18	1.20	1.25	1.30	1.37
	KIAS	215	216	218	219	219
	FF/ENG	2860	2800	2740	2670	2630
260	EPR	1.17	1.19	1.23	1.28	1.35
	KIAS	209	210	211	213	213
	FF/ENG	2680	2620	2560	2510	2440
240	EPR	1.16	1.18	1.21	1.26	1.32
	KIAS	203	203	205	206	206
	FF/ENG	2500	2440	2380	2330	2250
220	EPR	1.14	1.16	1.19	1.24	1.29
	KIAS	196	197	198	199	199
	FF/ENG	2330	2270	2210	2140	2080
200	EPR	1.13	1.15	1.18	1.22	1.27
	KIAS	189	190	191	192	192
	FF/ENG	2150	2100	2040	1970	1920

This table includes 5% additional fuel for holding in a racetrack pattern.
Do not hold at Flaps 1 in icing conditions.

SPARE ENGINE CARRIAGE
1 ENGINE INOP
MAX CONTINUOUS THRUST
Driftdown Speed/Level Off Altitude

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	392	323	23800	22600	21200
390	383	319	24500	23400	22100
380	372	315	25300	24200	23000
370	363	311	26000	25000	23900
360	354	308	26700	25700	24600
350	345	304	27500	26500	25400
340	334	300	28400	27300	26200
330	325	295	29100	28100	27000
320	316	291	29900	28900	27800
310	305	287	30700	29900	28800
300	296	283	31400	30600	29600
280	276	273	33000	32300	31400
270	267	269	33700	33100	32200
260	256	264	34800	34100	33200
250	247	259	35500	35100	34100
240	236	254	36400	35900	35300
230	226	249	37100	36700	36000
220	218	243	37900	37400	36800
210	206	238	38800	38300	37600
200	197	232	39700	39200	38500

Altitude reduced by 1000 ft for additional margin.

SPARE ENGINE CARRIAGE
1 ENGINE INOP
MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
640	606	576	548	523	500	479	460	442	425	410
1283	1214	1152	1097	1046	1000	958	919	883	850	819
1927	1823	1730	1646	1570	1500	1436	1378	1324	1274	1228
2574	2434	2309	2196	2093	2000	1915	1836	1764	1697	1635
3222	3046	2888	2746	2617	2500	2393	2294	2204	2120	2042
3872	3659	3469	3297	3142	3000	2871	2752	2643	2542	2449
4525	4274	4050	3849	3666	3500	3348	3209	3081	2963	2854
5180	4891	4633	4401	4191	4000	3826	3666	3519	3384	3258
5837	5510	5217	4954	4716	4500	4303	4122	3956	3803	3661
6498	6130	5802	5508	5242	5000	4780	4578	4393	4222	4063

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG)											TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 KG)											
	200	220	240	260	280	300	320	340	360	380	400	
500	8.6	9.4	10.2	11.0	11.8	12.6	13.4	14.1	14.9	15.6	16.4	1:06
1000	16.7	18.3	19.8	21.3	22.9	24.4	25.9	27.4	29.0	30.5	32.1	2:12
1500	24.5	26.7	29.0	31.2	33.5	35.8	38.0	40.2	42.5	44.8	47.1	3:20
2000	31.9	34.9	37.8	40.7	43.7	46.6	49.6	52.5	55.5	58.5	61.6	4:27
2500	39.1	42.7	46.2	49.9	53.5	57.1	60.7	64.3	68.1	71.8	75.6	5:36
3000	46.0	50.2	54.4	58.7	63.0	67.2	71.5	75.8	80.2	84.6	89.2	6:45
3500	52.7	57.5	62.3	67.2	72.1	77.0	81.9	86.9	92.0	97.0	102.3	7:56
4000	59.2	64.6	69.9	75.4	80.9	86.5	92.0	97.6	103.3	109.0	115.0	9:07
4500	65.4	71.4	77.3	83.3	89.5	95.6	101.8	108.0	114.4	120.7	127.3	10:19
5000	71.5	78.0	84.4	91.1	97.8	104.5	111.3	118.1	125.1	132.1	139.3	11:31

Driftdown at optimum driftdown speed and cruise at Long Range Cruise speed.

SPARE ENGINE CARRIAGE

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability

Based on engine bleed for 3 packs on

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	23100	21200	19500
390	24100	22200	20100
380	24900	23300	21100
370	25600	24200	22300
360	26500	25100	23400
350	27300	25900	24400
340	28100	26800	25200
330	28900	27700	26100
320	29800	28500	27000
310	30600	29500	28000
300	31300	30400	28900
290	32100	31200	30000
280	32900	32000	30800
270	33700	32900	31700
260	34600	33800	32700
250	35400	35000	33600
240	36200	35800	34900
230	37000	36500	35700
220	37800	37300	36500
210	38700	38200	37300
200	39600	39000	38200

Altitude reduced by 1000 ft for additional margin.

SPARE ENGINE CARRIAGE
1 ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	14	20	25	27	29	31	33	35	37
400	EPR	1.40	1.47	1.59							
	MACH	.594	.638	.713							
	KIAS	330	330	330							
	FF/ENG	4676	4700	4847							
380	EPR	1.39	1.45	1.57	1.69						
	MACH	.594	.638	.713	.755						
	KIAS	330	330	330	317						
	FF/ENG	4522	4534	4653	4774						
360	EPR	1.37	1.43	1.54	1.65	1.71					
	MACH	.594	.638	.707	.745	.762					
	KIAS	330	330	327	313	307					
	FF/ENG	4383	4384	4433	4443	4551					
340	EPR	1.36	1.42	1.52	1.62	1.67	1.73				
	MACH	.591	.637	.696	.735	.750	.770				
	KIAS	328	329	322	308	302	298				
	FF/ENG	4229	4234	4186	4155	4198	4341				
320	EPR	1.34	1.39	1.49	1.59	1.64	1.69				
	MACH	.571	.621	.683	.725	.740	.756				
	KIAS	317	321	315	304	298	292				
	FF/ENG	3936	3980	3936	3885	3893	3959				
300	EPR	1.32	1.37	1.46	1.56	1.60	1.65	1.71			
	MACH	.551	.601	.667	.713	.729	.744	.761			
	KIAS	306	310	308	298	293	287	282			
	FF/ENG	3665	3704	3680	3630	3625	3641	3732			
280	EPR	1.30	1.35	1.44	1.53	1.57	1.62	1.67	1.73		
	MACH	.534	.579	.650	.700	.717	.733	.748	.767		
	KIAS	296	298	299	292	288	282	276	272		
	FF/ENG	3419	3420	3428	3391	3370	3370	3402	3510		
260	EPR	1.28	1.32	1.41	1.50	1.54	1.58	1.63	1.68	1.75	
	MACH	.517	.555	.631	.684	.702	.720	.736	.751	.773	
	KIAS	287	286	290	285	281	277	271	266	262	
	FF/ENG	3185	3142	3180	3152	3128	3112	3119	3163	3288	
240	EPR	1.26	1.30	1.38	1.46	1.50	1.54	1.59	1.64	1.69	1.76
	MACH	.501	.535	.609	.665	.686	.704	.722	.737	.754	.778
	KIAS	277	275	279	277	274	270	266	260	255	252
	FF/ENG	2991	2898	2921	2901	2891	2869	2860	2872	2919	3076
220	EPR	1.24	1.28	1.35	1.43	1.47	1.51	1.55	1.59	1.64	1.70
	MACH	.483	.515	.580	.643	.665	.686	.705	.723	.739	.756
	KIAS	267	265	266	267	265	263	259	254	249	244
	FF/ENG	2765	2667	2642	2653	2642	2633	2616	2610	2624	2688
200	EPR	1.22	1.26	1.32	1.40	1.43	1.47	1.51	1.55	1.59	1.65
	MACH	.465	.496	.551	.618	.641	.663	.685	.705	.722	.739
	KIAS	257	254	252	256	255	254	251	248	243	238
	FF/ENG	2556	2468	2374	2406	2396	2386	2382	2368	2363	2390

SPARE ENGINE CARRIAGE

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		(NM)	20	40	60	80
702	650	604	565	531	500	478	458	440	423	408
1410	1306	1212	1132	1063	1000	957	918	881	848	817
2126	1966	1823	1701	1595	1500	1436	1376	1321	1271	1225
2848	2630	2437	2272	2129	2000	1914	1835	1761	1693	1632
3579	3301	3055	2845	2663	2500	2392	2292	2200	2115	2038
4318	3978	3677	3421	3199	3000	2870	2750	2639	2537	2444
5066	4661	4301	3998	3735	3500	3348	3208	3077	2957	2848
5824	5350	4931	4578	4273	4000	3825	3663	3514	3377	3252
6592	6047	5565	5160	4811	4500	4303	4120	3951	3796	3655
7375	6754	6206	5746	5352	5000	4780	4576	4388	4215	4058

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		22		29		33	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
500	14.9	1:29	13.6	1:24	11.7	1:17	10.6	1:14	10.7	1:12
1000	30.1	2:58	27.9	2:47	24.4	2:30	22.4	2:23	22.7	2:19
1500	44.8	4:28	41.7	4:12	36.7	3:45	33.9	3:33	34.2	3:27
2000	59.3	6:01	55.1	5:39	48.7	5:01	45.0	4:43	45.1	4:35
2500	73.4	7:36	68.2	7:09	60.4	6:18	55.7	5:54	55.6	5:45
3000	87.1	9:13	80.9	8:40	71.7	7:36	66.1	7:06	65.7	6:55
3500	100.5	10:53	93.4	10:14	82.7	8:57	76.2	8:19	75.5	8:05
4000	113.5	12:36	105.5	11:50	93.4	10:19	86.0	9:33	84.9	9:17
4500	126.2	14:21	117.4	13:29	103.8	11:44	95.5	10:48	94.0	10:29
5000	138.7	16:10	128.9	15:10	113.9	13:12	104.7	12:05	102.8	11:42

SPARE ENGINE CARRIAGE

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-1.5	-0.7	0.0	2.0	4.4
20	-3.1	-1.5	0.0	4.2	9.1
30	-4.7	-2.3	0.0	6.3	13.6
40	-6.3	-3.1	0.0	8.2	17.8
50	-7.9	-3.9	0.0	10.1	21.8
60	-9.4	-4.7	0.0	11.8	25.5
70	-11.0	-5.5	0.0	13.4	28.9
80	-12.5	-6.3	0.0	14.9	32.1
90	-14.1	-7.1	0.0	16.2	35.1
100	-15.6	-7.9	0.0	17.5	37.8
110	-17.1	-8.6	0.0	18.6	40.2
120	-18.6	-9.4	0.0	19.6	42.4
130	-20.1	-10.2	0.0	20.5	44.4
140	-21.6	-10.9	0.0	21.2	46.1
150	-23.1	-11.7	0.0	21.9	47.5

SPARE ENGINE CARRIAGE
1 ENGINE INOP
MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)								
		1500	5000	10000	15000	20000	25000	30000	35000	40000
400	EPR	1.29	1.33	1.39	1.48	1.58				
	KIAS	290	290	290	290	320				
	FF/ENG	4560	4520	4500	4540	4930				
380	EPR	1.27	1.31	1.37	1.46	1.55	1.69			
	KIAS	284	284	284	284	312	316			
	FF/ENG	4380	4280	4250	4270	4600	4980			
360	EPR	1.26	1.29	1.36	1.43	1.53	1.65			
	KIAS	274	274	274	274	303	307			
	FF/ENG	4140	4040	3990	4000	4290	4560			
340	EPR	1.24	1.28	1.34	1.41	1.50	1.61			
	KIAS	264	264	264	264	294	298			
	FF/ENG	3910	3850	3750	3740	4000	4190			
320	EPR	1.23	1.26	1.32	1.39	1.47	1.58	1.73		
	KIAS	254	254	254	254	285	288	292		
	FF/ENG	3670	3620	3510	3490	3730	3850	4280		
300	EPR	1.21	1.24	1.30	1.36	1.44	1.54	1.68		
	KIAS	245	245	245	245	275	278	282		
	FF/ENG	3440	3390	3290	3250	3450	3540	3820		
280	EPR	1.20	1.23	1.28	1.34	1.42	1.51	1.63		
	KIAS	236	236	236	236	266	268	272		
	FF/ENG	3220	3170	3110	3020	3200	3250	3430		
260	EPR	1.19	1.21	1.26	1.31	1.39	1.48	1.59	1.75	
	KIAS	230	230	230	230	256	258	261	265	
	FF/ENG	3010	2950	2890	2810	2940	2980	3090	3500	
240	EPR	1.17	1.19	1.24	1.29	1.36	1.44	1.55	1.69	
	KIAS	224	224	224	224	245	247	250	253	
	FF/ENG	2800	2750	2680	2600	2690	2710	2790	3040	
220	EPR	1.16	1.18	1.22	1.27	1.33	1.41	1.51	1.63	
	KIAS	217	217	217	217	234	236	239	242	
	FF/ENG	2600	2540	2480	2420	2450	2460	2510	2660	
200	EPR	1.14	1.16	1.20	1.24	1.30	1.37	1.46	1.58	1.74
	KIAS	210	210	210	210	224	225	227	229	233
	FF/ENG	2410	2350	2280	2210	2230	2210	2240	2320	2690

This table includes 5% additional fuel for holding in a racetrack pattern.

SPARE ENGINE CARRIAGE

2 ENGINES INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	385	313	9200	7300	5500
390	376	309	10200	8400	6600
380	366	306	11300	9500	7700
370	357	302	12400	10600	8800
360	347	298	13500	11800	10100
350	338	294	14600	12900	11200
340	329	290	15700	14000	12400
330	319	287	16800	15100	13500
320	310	283	17900	16300	14600
310	300	279	18800	17500	15700
300	290	274	19700	18500	16900
290	281	270	20700	19400	18000
280	271	265	21700	20400	19000
270	261	261	22700	21300	20000
260	252	256	23600	22400	21000
250	242	251	24600	23400	22000
240	233	246	25600	24400	23100
230	223	242	26700	25500	24200
220	213	236	27800	26600	25400
210	203	231	29100	27800	26500
200	194	226	30300	29200	27800

Altitude reduced by 2000 ft for additional margin.

SPARE ENGINE CARRIAGE
2 ENGINES INOP
MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
671	628	590	557	527	500	476	454	434	415	398
1342	1256	1180	1113	1054	1000	952	908	867	831	797
2014	1885	1771	1671	1581	1500	1427	1361	1301	1246	1195
2690	2517	2364	2229	2108	2000	1902	1814	1733	1659	1592
3371	3151	2959	2788	2636	2500	2377	2266	2165	2072	1987
4057	3790	3556	3349	3165	3000	2851	2717	2595	2483	2380
4749	4433	4156	3912	3694	3500	3325	3167	3023	2892	2771
5449	5081	4759	4476	4225	4000	3798	3615	3450	3298	3160
6157	5735	5367	5043	4756	4500	4270	4063	3874	3703	3546
6876	6396	5979	5612	5289	5000	4741	4508	4297	4104	3928

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG)											TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 KG)											
	200	220	240	260	280	300	320	340	360	380	400	
500	9.7	10.6	11.5	12.4	13.1	13.9	14.9	15.8	16.5	17.5	18.2	1:17
1000	19.1	20.9	22.7	24.5	26.1	27.9	29.7	31.5	33.1	35.1	36.8	2:33
1500	28.1	30.7	33.4	36.1	38.6	41.2	43.9	46.6	49.2	52.1	54.7	3:50
2000	36.7	40.1	43.6	47.1	50.5	53.9	57.5	61.1	64.6	68.5	72.0	5:08
2500	44.9	49.1	53.4	57.7	61.9	66.2	70.6	75.1	79.4	84.2	88.7	6:27
3000	52.7	57.7	62.8	67.9	72.9	77.9	83.2	88.5	93.7	99.4	104.9	7:49
3500	60.2	66.0	71.8	77.7	83.4	89.2	95.2	101.4	107.5	114.1	120.5	9:12
4000	67.4	73.9	80.5	87.0	93.5	100.0	106.9	113.8	120.8	128.2	135.5	10:38
4500	74.3	81.6	88.8	96.1	103.2	110.5	118.1	125.9	133.6	142.0	150.1	12:07
5000	81.0	88.9	96.8	104.8	112.6	120.6	128.9	137.5	146.1	155.2	164.3	13:38

Driftdown at optimum driftdown speed and cruise at Long Range Cruise speed.

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Introduction

This chapter contains information to supplement performance data from the Flight Management Computer (FMC). In addition, sufficient inflight data is provided to complete a flight with the FMC inoperative. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General

Clearway and Stopway V1 Adjustments

Takeoff speed adjustments are to be applied to V1 speed when using takeoff weights based on the use of clearway and stopway.

Adjust V1 speed by the amount shown in the table. The adjusted V1 speed must not exceed VR.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF

The Reference Speed table contains flaps 30 and 25 landing speeds for a given weight. Apply adjustments shown as required.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuvering speeds. Using VREF as the basis for the schedule makes it variable as a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction, selection to the next position should be initiated when at and accelerating above the recommended flap speed for the new position. During flap extension, selection of the flaps to the next position should be made prior to decelerating below the recommended flap speed for the current flap setting.

Slush/Standing Water Takeoff

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in field/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assume an engine failure at the critical point during the takeoff. Data is shown for 2 engine reverse thrust and for no reverse thrust.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush depths greater than 0.5 inches (13mm) are not recommended because of possible airplane damage as a result of slush impingement on the airplane structure. The use of assumed temperature for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight is determined as follows:

1. Determine the field/obstacle limit weight for the takeoff flap setting.

2. Enter the Weight Adjustment table with the field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.

3. Enter the VMCG Limit Weight table with the available field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for VMCG speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 3.

Takeoff speed determination:

1. Determine takeoff speeds V1, VR and V2 for actual brake release weight using the Takeoff Speeds from the FMC or Takeoff Analysis.

2. If VMCG limited, set V1=VMCG. If not limited by VMCG considerations, reenter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than VMCG, set V1=VMCG.

Tables for no reverse thrust are also provided in the same format.

Slippery Runway Takeoff

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. The performance level of good is the same as used by the FAA and EASA to define wet runway rejected takeoff performance. Similarly, poor braking action is representative of a runway covered with ice. Performance is based on two symmetric reversers operating and a 15 ft. screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables. Data is provided for 2 engine reverse thrust and for no reverse thrust.

Tables for no reverse thrust are also provided in the same format.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum speed for control on the ground, VMCG, and VR less than minimum VR, (1.05) VMCA. Therefore, compare the adjusted V1 and VR to the VMCG and VRMIN respectively. To find VMCG and VRMIN, enter the VMCG, VRMIN table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than VMCG, set V1 equal to VMCG. If the adjusted VR is less than VRMIN, set VR equal to VRMIN. If VR is less than VMCG, set VR equal to VMCG. If VR is limited by either VMCG or VRMIN, V2 must be adjusted to account for the increase in VR. This adjusted V2 speed can be obtained from the V2 for VRMIN table by entering with weight and VRMIN. If the V2 for VRMIN is greater than V2, set V2 equal to V2 for VRMIN.

Anti-skid Inoperative

When operating with anti-skid inoperative, the field length/obstacle limited weight and the V1 speed must be reduced to allow for the effect on accelerate-stop performance as detailed in the Airplane Flight Manual. Obstacle clearance capability must also be considered since the reduced V1 speed will increase the distance required to achieve a given height above the runway following engine failure at V1.

A simplified method which conservatively accounts for the effects of anti-skid inoperative is to adjust the normal runway/obstacle limited weight by the amount shown in the table below. Then, adjust the V1 associated with the reduced weight by the V1 amount shown in the table below. If takeoff weight is below the anti-skid inoperative limited weight, it is only necessary to ensure that the V1 speed does not exceed the anti-skid limited V1 speed. If the resulting V1 speed is less than the minimum ground control speed (see Minimum Control Speeds table), takeoff is permitted with V1 set equal to VMCG provided the accelerate stop distance available exceeds approximately 13100 ft.

ANTI-SKID INOPERATIVE ADJUSTMENTS		
FIELD LENGTH (FT)	WEIGHT (1000 KG)	V1 (KTS)
13000	-27	-43
14000	-28	-41
15000	-28	-40
16000	-29	-39

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

Assumed Temperature Reduced Thrust

Regulations permit the use of up to 25% takeoff thrust reduction for operation with assumed temperature reduced thrust. Use of reduced thrust is not allowed on runways contaminated with water, ice, slush, or snow. Use of assumed temperature reduced thrust is not recommended if potential windshear conditions exist. The minimum allowable EPR for reduced thrust is based on 25% thrust reduction or the minimum allowable EPR. Note that the FMC has not been updated to reflect the absolute minimum EPR setting allowed of 1.39. In the event of disagreement, observe the limit shown in the table rather than that calculated by the FMC. It is not recommended to set takeoff EPR lower than the scheduled Climb EPR.

Field length limited allowable takeoff limit weight must be reduced by 1750 kg for operations at reduced thrust.

Initial Climb EPR

This table is used to set initial climb power once the takeoff segment is complete and enroute configuration is achieved (i.e. flaps up). The power settings shown are based on 200 KIAS at 1000 ft above the airport pressure altitude. Upon accelerating to the normal enroute climb speed of 340 KIAS, the power settings provided in the Max Climb table should be used. EPR adjustments are shown for anti-ice operation.

Max Climb EPR

This table shows Max Climb EPR for a 340/.84 climb speed schedule, normal engine bleed for 3 packs on and anti-ice off. Enter the table with airport pressure altitude and TAT and read EPR. EPR adjustments are shown for anti-ice operation.

Go-around EPR

To find Max Go-around EPR based on normal engine bleed for 3 packs on, enter the Go-around EPR table with airport pressure altitude and reported OAT or TAT and read EPR. For packs off operation, apply the EPR adjustments provided below the table. No EPR adjustment is required for engine and wing anti-ice operations.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Pitch attitude and average EPR information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome or turbulent air may also cause unreliable airspeed/Mach indications. The cruise table in this section may also be used for turbulent air penetration.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed indications may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. This table considers both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 100 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 15° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the table result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 45000 ft.

Long Range Cruise Control

The table provides target EPR, Long Range Cruise Mach number, KIAS and standard day fuel flow per engine for the airplane weight and pressure altitude. The shaded area in this table approximates optimum altitude. At optimum altitude the Long Range Cruise Mach schedule is approximated by .86M.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .84/290/250 descent. Tables are presented for low altitudes and high altitudes.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent

Distance and time for descent are shown for a .84/290/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing flaps at the outer marker.

Holding

Target EPR, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the FMC optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed for the selected flap setting. Flaps 1 data is based on VREF30 + 60 speed. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read EPR, KIAS and fuel flow per engine.

Advisory Information

Normal Configuration Landing Distance

Tables are provided as advisory information for normal configuration landing distance on dry runways and slippery runways with good, medium, and poor reported braking action. These values are actual landing distances and do not include the 1.67 regulatory factor. Therefore, they cannot be used to determine the dispatch required landing field length.

To use these tables, determine the reference landing distance for the selected braking configuration. Then adjust the reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers to obtain the actual landing distance.

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. If the surface is affected by water, snow, or ice and the braking action is reported as "good", conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate "poor" data reflects runways covered with wet ice.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" braking action, the airplane may not be able to achieve these deceleration rates. In these cases, runway slope and inoperative reversers influence the stopping distance. Since it cannot be determined quickly when this becomes a factor, it is conservative to add the effects of slope and inoperative reversers when using the autobrake system.

Non-normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances are provided for dry runway and runways with good, medium, and poor reported braking action.

Enter the table with the applicable non-normal configuration and read the normal approach speed (VREF). The reference landing distance is measured from 50 ft above the threshold to stop and is based on reference weight and speed at sea level, zero wind, zero slope and max manual braking with maximum reverse thrust. Subsequent columns provide corrections for off-reference landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers. Each correction is independently added to the reference landing distance. Landing distance includes the effect of maximum manual braking and reverse thrust.

Recommended Brake Cooling Schedule

Advisory information is provided to assist in avoiding problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Recommended Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind, at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the table with the reference brake energy per brake and the type of braking used during landing (Max Manual or Max Auto). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing. The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Brake Temperature Monitor System (BTMS) indications are also shown. If brake cooling is determined from the BTMS, the hottest brake indication 10 to 15 minutes after the airplane has come to a complete stop, or inflight with gear retracted, may be used to determine recommended cooling schedule by entering at the bottom of the chart. An EICAS advisory message, BRAKE TEMP, will appear when any brake registers 5 on the GEAR synoptic display and disappears as the hottest brake cools to an indication of 4. Note that even without an EICAS advisory message, brake cooling is recommended.

One Engine Inoperative

Max Continuous EPR

Power setting is based on one engine inoperative with 3 packs on and all anti-ice bleeds off. Enter the table with pressure altitude and KIAS or Mach to read EPR.

It is desirable to maintain engine thrust level within the limits of the Max Cruise thrust rating. However, where thrust level in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off.

The level off altitude is dependent on air temperature (ISA deviation). The level off altitude shown is 1000 ft below the maximum altitude. This reduction in altitude is consistent with the FMC logic.

Long Range Cruise Altitude Capability

The table shows the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on Long Range Cruise speed and Max Continuous thrust. Note that the maximum altitude shown has been reduced by 1000 ft. This reduction in altitude is consistent with the FMC logic.

Long Range Cruise Control

The table provides target EPR, one engine inoperative Long Range Cruise Mach number, KIAS, and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on three engine Long Range Cruise speed and .84/290/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the Fuel Required Adjustment table with the fuel required for the reference weight and the actual weight at checkpoint.

Holding

One engine inoperative holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Two Engines Inoperative

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off.

The level off altitude is dependent on air temperature (ISA deviation). The level off altitude shown is 2000 ft below the maximum altitude. This reduction in altitude is consistent with the FMC.

Driftdown/LRC Cruise Range Capability

This table shows the range capability from the start of driftdown. Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to Long Range Cruise speed. Cruise is continued at level off altitude and Long Range Cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and correct for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required.

Long Range Cruise Altitude Capability

The table shows the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on Long Range Cruise speed and Max Continuous thrust. Note that the maximum altitude shown has been reduced by 2000 ft. This reduction in altitude is consistent with the FMC logic.

Long Range Cruise Control

The table provides target EPR, two engines inoperative Long Range Cruise Mach number, KIAS, and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

Alternate Mode EEC

The ALTERNATE EEC mode has not been programmed into the FMC. Therefore, the use of the autothrottle is prohibited and takeoff thrust must be set manually. One Engine Pressure Ratio (EPR) indicating system may be inoperative at dispatch. All four EECs must be in the ALTERNATE mode. The anti-skid system must be operative. Operation on contaminated runways is prohibited. Use of improved climb performance is prohibited. Thrust reductions in addition to those required for ALTERNATE Mode EEC operation are prohibited.

Max Continuous %N1

Max Continuous %N1 which can be set during engine out cruise conditions is presented. Enter the appropriate table with pressure altitude, TAT, and KIAS to obtain Maximum Continuous %N1. Intermediate airspeeds may be interpolated. Appropriate bleed adjustments are shown.

Weight Limitations

Weight limitations for takeoff are adjusted by the values shown on the Weight Adjustment tables. Takeoff field, climb, obstacle, tire speed limits and landing climb weights are presented as adjustments to the respective full rate limit weight.

Takeoff Speed Adjustments

Takeoff Speeds Adjustments determined for the normal full rate and the reduced weight are increased by 2 knots for V1 and 1 knot for VR. The adjusted V1 must not exceed the adjusted VR. V2 for the reduced weight does not need to be adjusted. VMCG and Minimum VR are increased by 2 knots.

Takeoff EPR/Go-around EPR

Takeoff and Go-around power settings are presented in tabular form for normal air conditioning bleed. Max Takeoff and Go-around EPR may be read directly from the tables for the desired pressure altitude and airport OAT.

Takeoff thrust setting with EECs in ALTERNATE control mode is achieved by advancing or retarding all thrust levers together while setting target EPR using the EPR available engines. Then, adjust the N1 RPM of the engine which does not have EPR available to match that of the other engines. On takeoff, only minor adjustments to N1 RPM may be made. No adjustments to N1 RPM may be safe after a speed of 80 knots is achieved.

Gear Down

This section contains performance for airplane operation with the landing gear extended for all phases of flight. The data is based on engine bleeds for normal air conditioning.

Note: The Flight Management Computer System (FMCS) does not contain special provisions for operation with landing gear extended. As a result, the FMCS will generate inaccurate enroute speed schedules, display non-conservative predictions of fuel burn, estimated time of arrival (ETA), maximum altitude, and compute overly shallow descent path. To obtain accurate ETA predictions, gear down cruise speed and altitude should be entered on the CLB and CRZ pages. Gear down cruise speed should also be entered on the DES page and a STEP SIZE of zero should be entered on the PERF INIT or CRZ page. Use of the VNAV during descent under these circumstances is not recommended.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

Spare Engine Carriage

This section contains performance for airplane operation with spare engine carriage for all phases of flight. The data is based on engine bleeds for normal air conditioning.

The FMC incorporates a spare engine carriage input and accounts for the increased drag associated with spare engine carriage. The FMC also accounts for the reduced VMO of 330 KIAS and increased VREF. Therefore the FMC and the VNAV mode can be used for spare engine carriage operations to generate climb, cruise and descent speed schedules.

Tables for spare engine carriage performance in this section are identical in format and used in the same manner as tables for the basic configuration previously described.

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Performance Inflight — Chap PI

Pkg Model Identification — Section 20

This Section Applies to EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

General

The aircraft listed in the table below are covered in the Performance Dispatch, Performance Inflight and Performance Inflight - Quick Reference Handbook.

Configuration data reflects the airplane as delivered configuration and is updated for service bulletin incorporations in conformance with the policy stated in the introduction section of the FCOM.

Serial and tabulation number are supplied by Boeing.

Airplane Number	Registry Number	Serial Number	Tabulation Number
913	EI-XLB	26359	RM126
919	EI-XLC	27100	RM131
914	EI-XLD	26360	RM127
916	EI-XLE	26362	RM129
921	EI-XLF	27645	RM318
917	EI-XLG	29899	RM316
918	EI-XLH	27650	RM130
920	EI-XLI	27648	RM317
922	EI-XLJ	27646	RM132
007	VQ-BHW	28959	RM081
008	VQ-BHX	28960	RM083

Intentionally
Blank

Performance Inflight — Chapter PI
General — Section 20

Maximum Allowable Clearway

FIELD LENGTH (FT)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (FT)
6000	500
8000	600
10000	650
12000	700
14000	750
16000	750

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (FT)	NORMAL V1 (KIAS)				
	100	120	140	160	180
900	-3	-3	-3	-3	-3
600	-2	-2	-2	-2	-2
300	-1	-1	-1	-1	-1
0	0	0	0	0	0
-300	1	1	1	1	1
-600	2	2	2	2	2
-900	3	3	3	3	3

VREF (KIAS)

WEIGHT (1000 KG)	FLAPS	
	30	25
400	184	192
380	179	187
360	174	181
340	168	176
320	163	170
300	157	164
280	152	158
260	146	152
240	140	146
220	133	139
200	127	132

Increase VREF 1 knot/4000 ft above sea level.

Flap Maneuver Speeds

FLAP POSITION	MANEUVER SPEED
UP	VREF 30 + 80
1	VREF 30 + 60
5	VREF 30 + 40
10	VREF 30 + 20
20	VREF 30 + 10
25	VREF 25
30	VREF 30

ADVISORY INFORMATION

Slush/Standing Water Takeoff
2 Engine Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
460							-57	-57	-57
440				-34	-34	-34	-54	-54	-54
420	-25	-25	-25	-32	-32	-32	-52	-52	-52
400	-23	-23	-23	-30	-30	-30	-49	-49	-49
380	-22	-22	-22	-29	-29	-29	-47	-47	-47
360	-20	-20	-20	-27.	-27	-27	-44	-44	-44
340	-18	-18	-18	-25	-25	-25	-42	-42	-42
320	-17	-17	-17	-24	-24	-24	-40	-40	-40
300	-15	-15	-15	-22	-22	-22	-37	-37	-37
280	-14	-14	-14	-20	-20	-20	-35	-35	-35

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
8200							227		
8600				222			248		
9000				243			269		
9400	244			264			290	218	
9800	266			285	213		311	239	
10200	287			306	234		332	260	
10600	308	236		327	255		353	281	210
11000	329	257		348	276		374	303	231
11400	350	278		369	297	226	395	324	252
11800	372	299	227	390	318	247		345	273
12200	393	320	249	411	339	268		366	294
12600	414	342	270		360	289		387	315
13000		363	291		381	310		408	336
13400		384	312		402	331			357
13800		405	333			352			378
14200			354			373			399
14600			376			394			
15000			397			415			

1. **Enter Weight Adjustment table with slush/standing water depth and field/obstacle limit weight to obtain slush/standing water adjustment.**
2. **Find VMCG limited weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 6000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

Slush/Standing Water Takeoff
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-27	-26	-25	-22	-21	-20	-13	-12	-11
380	-29	-28	-27	-24	-23	-22	-13	-12	-11
360	-30	-29	-28	-25	-24	-23	-15	-14	-13
340	-31	-30	-29	-26	-25	-24	-16	-15	-14
320	-31	-30	-29	-27	-26	-25	-18	-17	-16
300	-32	-31	-30	-28	-27	-26	-20	-19	-18
280	-31	-30	-29	-29	-28	-26	-22	-21	-20

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
460	-35	-35	-35	-45	-45	-45	-66	-66	-66
440	-33	-33	-33	-43	-43	-43	-63	-63	-63
420	-31	-31	-31	-40	-40	-40	-61	-61	-61
400	-29	-29	-29	-38	-38	-38	-58	-58	-58
380	-27	-27	-27	-36	-36	-36	-55	-55	-55
360	-26	-26	-26	-34	-34	-34	-53	-53	-53
340	-24	-24	-24	-31	-31	-31	-50	-50	-50
320	-22	-22	-22	-29	-29	-29	-48	-48	-48
300	-20	-20	-20	-27	-27	-27	-45	-45	-45
280	-18	-18	-18	-25	-25	-25	-43	-43	-43

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
11000							245		
11400							266		
11800							287		
12200							308		
12600				258			329	259	
13000				280			350	280	
13400	250			302			371	301	
13800	273			324	252		392	322	253
14200	296			347	274		413	343	274
14600	319	244		369	296		434	364	295
15000	342	266		391	318	245	455	385	316

1. **Enter Weight Adjustment table with slush/standing water depth and field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 23000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-40	-37	-34	-34	-32	-29	-21	-18	-16
380	-41	-38	-36	-36	-33	-30	-23	-20	-17
360	-42	-39	-37	-37	-34	-32	-25	-22	-19
340	-43	-40	-38	-39	-36	-33	-27	-24	-21
320	-44	-41	-38	-40	-37	-34	-29	-26	-24
300	-44	-41	-39	-41	-38	-35	-32	-29	-26
280	-44	-42	-39	-41	-39	-36	-34	-31	-29

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

Slippery Runway Takeoff
2 Engine Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-5	-5	-5	-17	-17	-17
380	0	0	0	-6	-6	-6	-17	-17	-17
360	0	0	0	-6	-6	-6	-15	-15	-15
340	0	0	0	-6	-6	-6	-14	-14	-14
320	0	0	0	-5	-5	-5	-12	-12	-12
300	0	0	0	-5	-5	-5	-11	-11	-11
280	0	0	0	-4	-4	-4	-10	-10	-10
260	0	0	0	-3	-3	-3	-9	-9	-9
240	0	0	0	-3	-3	-3	-7	-7	-7

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6000	225								
6400	263	187							
6800	301	225							
7200	339	263	187						
7600	377	301	225						
8000	415	339	263	221					
8400		377	301	251					
8800		415	339	282	211				
9200			377	313	242				
9600			415	344	273	202			
10000				374	304	233			
10400				405	334	264			
10800					365	294	228		
11200					396	325	250		
11600						356	273		
12000						387	295	223	
12400							317	246	
12800							340	268	
13200							362	291	219
13600							384	313	241
14000							407	335	264
14400								358	286
14800								380	308
15200								402	331
15600									353
16000									376
16400									398

1. **Enter Weight Adjustment table with reported braking action and field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limit weight by 3000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

Slippery Runway Takeoff
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-4	-3	-2	-19	-17	-14	-38	-34	-30
380	-6	-5	-4	-22	-20	-17	-40	-36	-32
360	-8	-7	-6	-24	-22	-19	-43	-39	-35
340	-9	-8	-7	-26	-24	-21	-45	-41	-37
320	-11	-10	-9	-27	-25	-22	-47	-43	-39
300	-12	-11	-10	-29	-27	-24	-49	-45	-41
280	-13	-12	-11	-30	-28	-25	-50	-46	-42
260	-14	-13	-12	-31	-29	-26	-51	-47	-43
240	-13	-12	-11	-31	-29	-26	-51	-47	-43

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment Table with the actual weight to obtain V1 speed adjustment.**
   For flaps 10 and good reported braking action, increase V1 by 1 kts.
   For flaps 10 and poor reported braking action, decrease V1 by an additional 1 kt.
   If adjusted V1 is less than VMCG, set V1 = VMCG.

ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-10	-10	-10	-22	-22	-22
380	0	0	0	-10	-10	-10	-21	-21	-21
360	0	0	0	-9	-9	-9	-20	-20	-20
340	0	0	0	-9	-9	-9	-18	-18	-18
320	0	0	0	-9	-9	-9	-17	-17	-17
300	-1	-1	-1	-8	-8	-8	-15	-15	-15
280	-1	-1	-1	-7	-7	-7	-13	-13	-13
260	0	0	0	-6	-6	-6	-12	-12	-12
240	0	0	0	-5	-5	-5	-10	-10	-10

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
7000	229								
7400	279								
7800	328	239							
8200	377	289							
8600	427	338	249						
9000		387	298						
9400		436	348						
9800			397						
10200				208					
10600				253					
11000				297	213				
11400				341	257				
11800				385	301	217			
12200				429	345	261			
12600					389	306			
13000					433	350			
13400						394			
13800						438			

1. **Enter Weight Adjustment table with reported braking action and field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-8	-6	-4	-28	-25	-22	-55	-51	-47
380	-10	-8	-6	-31	-28	-24	-58	-54	-50
360	-12	-10	-8	-33	-30	-27	-60	-56	-52
340	-14	-12	-10	-36	-33	-29	-63	-59	-55
320	-16	-14	-12	-38	-35	-32	-65	-61	-57
300	-18	-16	-14	-40	-37	-34	-67	-63	-59
280	-19	-17	-15	-42	-39	-36	-68	-64	-60
260	-20	-18	-16	-43	-40	-37	-69	-65	-61
240	-20	-18	-16	-44	-41	-37	-69	-65	-61

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment.**
   For flaps 10 and good reported braking action, increase V1 by 1 kt.
   If adjusted V1 is less than VMCG, set V1 = VMCG.

Minimum Control Speeds

Max Takeoff Thrust

VMCG, VRMIN (KIAS)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)															
		-2000		0		2000		4000		5000		6000		8000		10000	
°C	°F	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN
60	140	112	113	111	111	108	108	104	104	102	103	101	101	96	96	92	93
55	131	115	115	113	113	109	109	106	106	104	104	102	102	98	98	94	94
50	122	119	119	116	116	111	111	107	108	106	106	104	104	100	100	96	96
45	113	122	122	119	120	115	115	110	110	108	108	106	106	102	102	98	98
40	104	124	124	122	122	118	118	113	113	111	111	108	108	104	104	99	100
36	97	126	126	123	123	119	120	115	115	113	113	111	111	106	106	101	101
32	90	126	126	125	125	121	121	117	117	115	115	113	113	108	108	103	103
30	86	126	126	125	125	122	122	118	118	116	116	114	114	109	109	104	104
28	82	126	126	125	125	123	123	119	119	117	117	114	115	110	110	105	105
25	77	126	126	125	125	123	123	120	120	117	117	115	115	111	111	106	107
23	73	126	126	125	125	123	123	121	121	118	118	116	116	112	112	107	107
20	68	126	126	125	125	123	123	121	121	119	119	117	117	113	113	108	108
19	66	126	126	125	125	123	123	121	121	119	119	117	117	113	113	108	108
18	64	126	126	125	125	123	123	121	121	119	119	118	118	113	113	109	109
15	59	126	126	125	126	123	123	121	121	119	119	118	118	114	114	110	110
14	57	126	126	125	126	123	123	121	121	119	119	118	118	115	115	110	110
10	50	126	126	126	126	123	123	121	121	119	119	118	118	115	115	111	111
5	41	126	126	126	126	123	124	121	121	119	119	118	118	115	115	111	111
0	32	126	126	126	126	124	124	121	121	119	119	118	118	115	115	111	111
-55	-67	127	127	126	126	124	124	121	122	120	120	119	119	115	115	112	112

Flaps 20 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)													
	100		105		110		115		120		125		127	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
280	114	24	120	22	126	21	132	20	138	19	144	18	146	18
260	114	23	120	21	126	20	132	19	138	18	144	18	146	18
240	114	22	120	20	126	19	132	18	139	18	145	18	147	18
220	114	20	121	19	127	18	133	18	139	18	145	17	148	18
200	114	19	121	18	127	18	133	18	139	18	146	18	148	18

Flaps 10 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)													
	100		105		110		115		120		125		127	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
260	116	25	122	24	128	22	134	21	140	21	146	20	149	20
240	116	24	122	23	128	22	134	21	140	20	147	20	149	20
220	116	23	122	22	128	21	135	20	141	20	147	20	150	20
200	116	22	122	21	129	20	135	20	141	20	148	20	150	21

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

5% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
460							-56	-56	-56
440				-33	-33	-33	-54	-54	-54
420	-25	-25	-25	-32	-32	-32	-51	-51	-51
400	-23	-23	-23	-30	-30	-30	-49	-49	-49
380	-21	-21	-21	-28	-28	-28	-46	-46	-46
360	-20	-20	-20	-27	-27	-27	-44	-44	-44
340	-18	-18	-18	-25	-25	-25	-41	-41	-41
320	-17	-17	-17	-23	-23	-23	-39	-39	-39
300	-15	-15	-15	-22	-22	-22	-36	-36	-36
280	-14	-14	-14	-20	-20	-20	-34	-34	-34

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
8200				210			236		
8600				232			258		
9000	234			253			279		
9400	256			275			301	228	
9800	277			296	223		323	249	
10200	299	225		318	244		344	271	
10600	320	247		339	266		366	292	219
11000	342	269		361	288	214	387	314	241
11400	364	290	216	383	309	236	409	335	262
11800	386	312	238	404	331	257		357	284
12200	408	334	260		352	279		379	305
12600		355	282		374	301		400	327
13000		377	303		395	322			348
13400		399	325			344			370
13800			347			365			392
14200			369			387			
14600			391						

1. **Enter Weight Adjustment table with slush/standing water depth and TO1 field/obstacle limit weight to obtain slush/standing water adjustment.**
2. **Find VMCG limited weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 6000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

5% Thrust Reduction

2 Engine Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-25	-24	-23	-20	-19	-18	-10	-9	-8
380	-27	-26	-25	-22	-21	-20	-11	-10	-9
360	-28	-27	-26	-23	-22	-21	-12	-11	-10
340	-30	-29	-28	-25	-24	-23	-14	-13	-12
320	-30	-29	-28	-26	-25	-24	-16	-15	-14
300	-31	-30	-29	-27	-26	-25	-19	-18	-17
280	-31	-30	-29	-28	-27	-26	-20	-19	-18

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

5% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
460	-34	-34	-34	-43	-43	-43	-64	-64	-64
440	-32	-32	-32	-41	-41	-41	-61	-61	-61
420	-30	-30	-30	-39	-39	-39	-59	-59	-59
400	-28	-28	-28	-37	-37	-37	-56	-56	-56
380	-26	-26	-26	-35	-35	-35	-54	-54	-54
360	-25	-25	-25	-33	-33	-33	-51	-51	-51
340	-23	-23	-23	-31	-31	-31	-49	-49	-49
320	-21	-21	-21	-28	-28	-28	-46	-46	-46
300	-19	-19	-19	-26	-26	-26	-44	-44	-44
280	-18	-18	-18	-24	-24	-24	-41	-41	-41

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
11000							261		
11400							283		
11800							304		
12200				255			326	255	
12600				278			347	276	
13000	248			300			369	298	
13400	271			323	248		390	319	248
13800	295			345	271		411	341	270
14200	318	241		368	293		433	362	291
14600	341	264		390	316	242	454	384	313
15000	365	288		413	339	264	476	405	334

1. **Enter Weight Adjustment table with slush/standing water depth and TO1 field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10, decrease VMCG limit weight by 24000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-39	-36	-33	-33	-30	-27	-19	-16	-13
380	-40	-37	-34	-35	-31	-28	-20	-17	-14
360	-41	-38	-35	-36	-33	-30	-23	-19	-16
340	-42	-39	-36	-37	-34	-31	-25	-22	-19
320	-42	-39	-36	-38	-35	-32	-27	-24	-21
300	-43	-40	-36	-39	-36	-33	-29	-26	-23
280	-43	-40	-37	-40	-37	-34	-32	-29	-26

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff

5% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-5	-5	-5	-17	-17	-17
380	0	0	0	-5	-5	-5	-17	-17	-17
360	0	0	0	-6	-6	-6	-16	-16	-16
340	0	0	0	-5	-5	-5	-14	-14	-14
320	0	0	0	-5	-5	-5	-12	-12	-12
300	0	0	0	-5	-5	-5	-11	-11	-11
280	0	0	0	-4	-4	-4	-10	-10	-10
260	0	0	0	-3	-3	-3	-9	-9	-9
240	0	0	0	-2	-2	-2	-7	-7	-7
220	0	0	0	-2	-2	-2	-6	-6	-6

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6400	274	199							
6800	312	237							
7200	350	274	199						
7600	388	312	237	204					
8000	426	350	274	235					
8400		388	312	265					
8800		426	350	296	225				
9200			388	317	256				
9600			426	358	287	216			
10000				389	318	247			
10400				420	349	278	218		
10800					380	309	241		
11200					411	340	264		
11600						371	287	213	
12000						401	310	236	
12400							333	259	
12800							356	282	209
13200							379	305	232
13600							402	328	255
14000								351	278
14400								374	301
14800								397	324
15200									347
15600									370

1. **Enter Weight Adjustment table with reported braking action and TO1 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limit weight by 3000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
5% Thrust Reduction
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-4	-3	-2	-18	-16	-13	-35	-31	-27
380	-5	-4	-3	-20	-18	-15	-38	-34	-30
360	-7	-6	-5	-22	-20	-17	-40	-36	-32
340	-9	-8	-7	-25	-23	-20	-43	-39	-35
320	-11	-10	-9	-26	-24	-21	-45	-41	-37
300	-12	-11	-10	-28	-26	-23	-47	-43	-39
280	-13	-12	-11	-29	-27	-24	-48	-44	-40
260	-13	-12	-11	-30	-28	-25	-49	-45	-41
240	-13	-12	-11	-30	-28	-25	-50	-46	-42
220	-13	-12	-11	-30	-28	-25	-49	-45	-41

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than VMCG, set V1 = VMCG.
For flaps 10 and good reported braking action, increase V1 by 1 kt.
For flaps 10 and poor reported braking action, decrease V1 by an additional 1 kt.
If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
5% Thrust Reduction
No Reverse Thrust
Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-8	-8	-8	-20	-20	-20
380	0	0	0	-8	-8	-8	-19	-19	-19
360	0	0	0	-8	-8	-8	-18	-18	-18
340	0	0	0	-8	-8	-8	-17	-17	-17
320	0	0	0	-7	-7	-7	-16	-16	-16
300	0	0	0	-7	-7	-7	-14	-14	-14
280	0	0	0	-6	-6	-6	-13	-13	-13
260	0	0	0	-5	-5	-5	-11	-11	-11
240	0	0	0	-4	-4	-4	-9	-9	-9
220	0	0	0	-3	-3	-3	-7	-7	-7

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6600	200								
7000	249								
7400	297	210							
7800	345	258							
8200	394	307	219						
8600		355	268						
9000		404	316						
9400			365						
9800			413	195					
10200				239					
10600				282	199				
11000				326	243				
11400				370	287	203			
11800				414	331	247			
12200					375	291			
12600					418	335			
13000						379			
13400						423			
13800									
14200									
14600									
15000							204		

1. **Enter Weight Adjustment table with reported braking action and TO1 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for adjusted field length and pressure altitude.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
5% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-7	-5	-3	-26	-22	-19	-51	-47	-43
380	-9	-7	-5	-29	-25	-22	-55	-50	-46
360	-11	-9	-7	-31	-28	-25	-58	-53	-49
340	-13	-11	-9	-34	-31	-27	-61	-56	-52
320	-15	-13	-11	-36	-33	-30	-63	-59	-54
300	-17	-15	-13	-39	-35	-32	-65	-60	-56
280	-18	-16	-14	-41	-37	-34	-66	-62	-58
260	-19	-17	-15	-42	-38	-35	-67	-63	-58
240	-20	-18	-16	-42	-39	-36	-67	-63	-59
220	-20	-18	-16	-43	-39	-36	-67	-63	-58

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment.
For flaps 10 and good reported braking action, increase V1 by 1 kt.
If adjusted V1 is less than VMCG, set V1 = VMCG.**

TO1 Minimum Control Speeds
5% Thrust Reduction
VMCG, VRMIN (KIAS)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)															
		-2000		0		2000		4000		5000		6000		8000		10000	
°C	°F	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN
60	140	110	110	108	108	105	105	102	102	100	100	98	98	94	94	90	90
55	131	113	113	110	110	107	107	103	103	102	102	100	100	96	96	92	92
50	122	116	116	113	113	109	109	105	105	103	104	102	102	98	98	94	94
45	113	119	119	117	117	112	112	107	107	105	106	104	104	99	100	95	96
40	104	121	121	119	119	115	115	110	110	108	108	106	106	101	101	97	97
36	97	123	123	121	121	117	117	113	113	111	111	108	108	103	103	98	99
32	90	123	123	122	122	118	119	114	114	112	112	110	110	106	106	100	100
30	86	123	123	122	122	119	119	115	115	113	113	111	111	107	107	101	101
28	82	123	123	122	123	120	120	116	116	114	114	112	112	108	108	103	103
25	77	123	123	122	123	120	120	117	117	115	115	113	113	109	109	104	104
23	73	123	123	123	123	120	121	118	118	116	116	114	114	109	109	105	105
20	69	123	123	123	123	120	121	118	118	116	117	114	114	110	110	106	106
19	66	123	123	123	123	120	121	118	118	117	117	115	115	110	111	106	106
18	64	123	123	123	123	121	121	118	118	117	117	115	115	111	111	107	107
15	59	123	123	123	123	121	121	118	118	117	117	115	115	112	112	107	107
14	57	123	123	123	123	121	121	118	118	117	117	115	115	112	112	107	107
10	50	123	124	123	123	121	121	118	118	117	117	115	115	112	112	108	109
5	41	123	124	123	123	121	121	118	118	117	117	115	115	112	112	109	109
0	32	124	124	123	123	121	121	118	118	117	117	115	115	112	112	109	109
-55	-67	124	124	123	123	121	121	119	119	117	117	116	116	113	113	109	109

Flaps 20 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)											
	100		105		110		115		120		124	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
260	114	25	120	23	126	22	132	21	138	20	143	20
240	114	24	120	22	126	21	132	20	139	20	143	20
220	114	22	121	21	127	20	133	20	139	20	144	20
200	114	21	121	20	127	20	133	20	139	20	144	20

Flaps 10 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)											
	100		105		110		115		120		127	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
240	116	25	122	25	128	24	134	23	140	22	145	22
220	116	25	122	24	128	23	135	22	141	22	146	22
200	116	24	122	23	129	22	135	22	141	22	147	22

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

15% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
460							-56	-56	-56
440				-34	-34	-34	-54	-54	-54
420	-25	-25	-25	-32	-32	-32	-51	-51	-51
400	-23	-23	-23	-30	-30	-30	-49	-49	-49
380	-22	-22	-22	-29	-29	-29	-46	-46	-46
360	-20	-20	-20	-27	-27	-27	-44	-44	-44
340	-19	-19	-19	-25	-25	-25	-41	-41	-41
320	-17	-17	-17	-24	-24	-24	-39	-39	-39
300	-16	-16	-16	-22	-22	-22	-36	-36	-36
280	-14	-14	-14	-20	-20	-20	-34	-34	-34

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
7800							237		
8200				233			259		
8600	236			255			282	205	
9000	259			278			304	228	
9400	282			301	224		327	250	
9800	304	227		323	246		350	273	
10200	327	250		346	269		372	295	219
10600	350	273		368	292	215	395	318	241
11000	373	295		391	314	237		341	264
11400	396	318	241	414	337	260		363	286
11800	419	341	264		359	283		386	309
12200		364	286		382	305		408	331
12600		386	309		404	328			354
13000		408	331			350			377
13400			354			373			399
13800			377			395			
14200			400						

1. **Enter Weight Adjustment table with slush/standing water depth and TO2 field/obstacle limit weight to obtain slush/standing water adjustment.**
2. **Find VMCG limited weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 6000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

15% Thrust Reduction

2 Engine Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-23	-22	-21	-17	-16	-15	-6	-5	-4
380	-25	-24	-23	-19	-18	-17	-7	-6	-5
360	-26	-25	-24	-21	-20	-19	-9	-8	-7
340	-27	-26	-25	-22	-21	-20	-11	-10	-9
320	-29	-28	-27	-24	-23	-22	-13	-12	-11
300	-29	-28	-27	-25	-24	-23	-16	-15	-14
280	-29	-28	-27	-26	-25	-24	-18	-17	-16

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

15% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
460	-36	-36	-36	-46	-46	-46	-65	-65	-65
440	-34	-34	-34	-43	-43	-43	-62	-62	-62
420	-32	-32	-32	-41	-41	-41	-59	-59	-59
400	-30	-30	-30	-39	-39	-39	-57	-57	-57
380	-28	-28	-28	-37	-37	-37	-54	-54	-54
360	-27	-27	-27	-34	-34	-34	-52	-52	-52
340	-25	-25	-25	-32	-32	-32	-49	-49	-49
320	-23	-23	-23	-30	-30	-30	-47	-47	-47
300	-21	-21	-21	-28	-28	-28	-44	-44	-44
280	-19	-19	-19	-25	-25	-25	-42	-42	-42

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
10200							250		
10600							272		
11000							294		
11400				246			317	243	
11800				269			339	265	
12200	241			293			362	288	
12600	265			316			384	310	
13000	289			340	262		406	332	259
13400	314			364	286		429	355	281
13800	338	258		387	309		451	377	303
14200	362	282		411	333	255	474	400	326
14600	386	306		434	356	279	496	422	348
15000	411	331	250	458	380	302		444	371

1. **Enter Weight Adjustment table with slush/standing water depth and TO2 field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10, decrease VMCG limit weight by 25000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff
15% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-36	-32	-29	-29	-25	-22	-12	-9	-5
380	-38	-34	-31	-31	-27	-24	-15	-11	-8
360	-39	-35	-32	-33	-29	-26	-17	-13	-10
340	-39	-36	-32	-34	-30	-27	-19	-16	-12
320	-39	-36	-32	-34	-31	-27	-21	-18	-14
300	-39	-36	-32	-35	-31	-28	-24	-20	-17
280	-39	-36	-32	-36	-32	-29	-27	-23	-20

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff

15% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-5	-5	-5	-15	-15	-15
380	0	0	0	-5	-5	-5	-15	-15	-15
360	0	0	0	-5	-5	-5	-15	-15	-15
340	0	0	0	-6	-6	-6	-15	-15	-15
320	0	0	0	-5	-5	-5	-13	-13	-13
300	0	0	0	-5	-5	-5	-11	-11	-11
280	0	0	0	-5	-5	-5	-10	-10	-10
260	0	0	0	-4	-4	-4	-9	-9	-9
240	0	0	0	-3	-3	-3	-8	-8	-8
220	0	0	0	-2	-2	-2	-7	-7	-7

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6000	260	185							
6400	297	222							
6800	335	260	185						
7200	372	297	222	201					
7600	410	335	260	233					
8000		372	297	264					
8400		410	335	296	223				
8800			372	328	255				
9200			410	359	286	214			
9600				391	318	245	197		
10000				422	350	277	221		
10400					381	309	245		
10800						340	269		
11200						372	292	216	
11600						403	316	240	
12000							340	264	
12400							364	288	211
12800							388	312	235
13200								335	259
13600								359	283
14000								383	307
14400								407	331
14800									355
15200									378

1. **Enter Weight Adjustment table with reported braking action and TO2 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limit weight by 3000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
15% Thrust Reduction
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-3	-2	-1	-15	-13	-10	-31	-27	-23
380	-5	-4	-3	-18	-16	-13	-34	-30	-26
360	-7	-6	-5	-20	-18	-15	-37	-33	-29
340	-8	-7	-6	-23	-21	-18	-40	-36	-32
320	-10	-9	-8	-25	-23	-20	-42	-38	-34
300	-12	-11	-10	-27	-25	-22	-45	-41	-37
280	-13	-12	-11	-28	-26	-23	-46	-42	-38
260	-13	-12	-11	-29	-27	-24	-47	-43	-39
240	-13	-12	-11	-29	-27	-24	-48	-44	-40
220	-13	-12	-11	-29	-27	-24	-48	-44	-40

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment.**
   For flaps 10 and good reported braking action, increase V1 by 1 kt.
   For flaps 10 and poor reported braking action, decrease V1 by an additional 1 kt.
   If adjusted V1 is less than VMCG, set V1 = VMCG.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
15% Thrust Reduction
No Reverse Thrust
Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-8	-8	-8	-21	-21	-21
380	0	0	0	-8	-8	-8	-20	-20	-20
360	0	0	0	-9	-9	-9	-20	-20	-20
340	0	0	0	-8	-8	-8	-18	-18	-18
320	0	0	0	-8	-8	-8	-17	-17	-17
300	0	0	0	-8	-8	-8	-15	-15	-15
280	0	0	0	-7	-7	-7	-14	-14	-14
260	-1	-1	-1	-6	-6	-6	-12	-12	-12
240	0	0	0	-5	-5	-5	-10	-10	-10
220	0	0	0	-4	-4	-4	-8	-8	-8

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6200	193								
6600	240								
7000	287	203							
7400	334	250							
7800	381	296	212						
8200	427	343	259						
8600		390	306						
9000		437	353						
9400			399	212					
9800				256					
10200				299	217				
10600				342	260				
11000				386	303	221			
11400				429	347	264			
11800					390	308			
12200					433	351			
12600						394			
13000						438			
13400									
13800									
14200							201		
14600							235		
15000							268		

1. **Enter Weight Adjustment table with reported braking action and TO2 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for adjusted field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limit weight by 17000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
15% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-7	-5	-3	-23	-19	-16	-47	-42	-37
380	-8	-6	-4	-26	-22	-19	-50	-45	-40
360	-10	-8	-6	-28	-25	-21	-54	-49	-43
340	-12	-10	-8	-31	-27	-24	-56	-51	-46
320	-13	-11	-9	-33	-29	-26	-59	-54	-49
300	-15	-13	-11	-35	-32	-28	-61	-56	-50
280	-16	-14	-12	-37	-34	-30	-62	-57	-52
260	-17	-15	-13	-39	-35	-31	-63	-58	-53
240	-18	-16	-14	-39	-36	-32	-63	-58	-53
220	-18	-16	-14	-40	-36	-32	-63	-58	-53

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment.**
   For flaps 10 and good reported braking action, increase V1 by 1 kt.

   If adjusted V1 is less than VMCG, set V1 = VMCG.

TO2 Minimum Control Speeds

15% Thrust Reduction

VMCG, VRMIN (KIAS)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)															
		-2000		0		2000		4000		5000		6000		8000		10000	
°C	°F	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN
60	140	105	105	103	103	100	100	97	97	95	95	94	94	90	90	86	86
55	131	107	108	105	105	102	102	98	98	97	97	95	95	91	91	88	88
50	122	111	111	108	108	104	104	100	100	99	99	97	97	93	93	89	89
45	113	113	113	111	111	107	107	102	102	100	101	99	99	95	95	91	91
40	104	115	116	113	113	110	110	105	105	103	103	101	101	96	97	93	93
36	97	117	117	115	115	111	111	107	107	105	105	103	103	98	98	94	94
32	90	117	117	117	117	113	113	109	109	107	107	105	105	101	101	95	96
30	86	117	117	117	117	114	114	109	110	108	108	106	106	102	102	96	97
28	82	117	117	117	117	115	115	110	111	109	109	107	107	103	103	98	98
25	77	117	117	117	117	115	115	111	111	109	109	107	107	103	104	99	99
23	73	117	118	117	117	115	115	112	112	110	110	108	108	104	104	100	100
20	69	117	118	117	117	115	115	112	112	111	111	109	109	105	105	101	101
19	66	117	118	117	117	115	115	112	112	111	111	109	109	105	105	101	101
18	64	118	118	117	117	115	115	112	112	111	111	110	110	106	106	101	101
15	59	118	118	117	117	115	115	112	112	111	111	110	110	106	106	102	102
14	57	118	118	117	117	115	115	112	112	111	111	110	110	107	107	102	102
10	50	118	118	117	117	115	115	112	113	111	111	110	110	107	107	103	103
5	41	118	118	117	117	115	115	113	113	111	111	110	110	107	107	103	103
0	32	118	118	117	117	115	115	113	113	111	111	110	110	107	107	103	103
-55	-67	118	118	118	118	116	116	113	113	112	112	110	110	107	107	104	104

Flaps 20 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)											
	96		100		105		110		115		118	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
240	109	25	114	24	120	22	126	21	132	20	136	20
220	109	24	114	22	121	21	127	20	133	20	136	20
200	109	22	114	21	121	20	127	20	133	20	137	20

Flaps 10 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)											
	96		100		105		110		115		118	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
220	111	25	116	25	122	24	128	23	135	22	138	22
200	111	25	116	24	122	23	129	22	135	22	139	22

Initial Climb %N1

Based on engine bleed for 3 packs on, engine and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	129	96.7	97.3											
50	122	97.2	97.7	98.0	98.3									
45	113	97.8	98.3	98.6	98.8	99.0	99.3							
40	104	98.4	98.9	99.1	99.4	99.6	99.8	100.0	100.1	100.3				
35	95	99.0	99.5	99.8	100.0	100.2	100.3	100.5	100.7	100.8	100.9	101.0		
30	86	99.6	100.1	100.3	100.6	100.8	101.0	101.1	101.3	101.4	101.5	101.5	101.6	101.5
25	77	99.1	100.2	100.9	101.2	101.4	101.6	101.7	101.9	102.0	102.1	102.1	102.2	102.1
20	68	98.5	99.5	100.3	101.0	101.7	102.2	102.4	102.5	102.6	102.7	102.7	102.8	102.6
15	59	97.7	98.7	99.6	100.3	101.0	101.7	102.4	103.1	103.2	103.3	103.3	103.3	103.3
10	50	96.9	97.9	98.7	99.5	100.3	101.0	101.7	102.3	102.9	103.5	103.9	103.9	103.8
5	41	96.0	97.1	97.9	98.6	99.4	100.1	100.8	101.5	102.2	102.8	103.3	103.9	104.4
0	32	95.2	96.2	97.0	97.8	98.5	99.3	100.0	100.6	101.3	101.9	102.5	103.1	103.6
-10	14	93.5	94.5	95.3	96.1	96.8	97.5	98.2	98.8	99.5	100.1	100.7	101.3	101.8
-20	-4	91.7	92.7	93.5	94.2	95.0	95.7	96.3	97.0	97.7	98.3	98.9	99.5	100.0
-30	-22	89.9	90.9	91.7	92.4	93.1	93.8	94.5	95.1	95.8	96.4	97.0	97.6	98.1
-40	-40	88.1	89.0	89.8	90.5	91.2	91.9	92.6	93.2	93.9	94.5	95.1	95.6	96.1
-42	-65	85.5	86.4	87.1	87.8	88.5	89.2	89.8	90.5	91.1	91.7	92.3	92.8	93.3

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)												
	-2	-1	0	1	2	3	4	5	6	7	8	9	10
ENGINE ANTI-ICE ON	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.6	-0.6	-0.6	-0.6
ENGINE & WING ANTI-ICE ON	-0.9	-0.9	-0.9	-1.0	-1.0	-1.0	-1.0	-1.1	-1.1	-1.1	-1.1	-1.2	-1.2

Max Climb %N1

Based on engine bleed for 3 packs on, engine and wing anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)									
	0	5	10	15	20	25	30	35	40	45
	340	340	340	340	340	340	0.84	0.84	0.84	0.84
50	99.4	100.8								
45	99.9	101.3	102.0	101.1						
40	100.3	101.9	102.6	101.6						
35	99.7	102.5	103.1	102.1	102.0					
30	99.0	102.3	103.7	102.8	102.6					
25	98.2	101.6	103.9	103.4	103.2	103.2	101.9			
20	97.4	100.8	103.2	104.1	103.6	104.1	102.7			
15	96.6	99.9	102.4	103.5	104.3	104.9	103.6	101.1	100.9	
10	95.8	99.1	101.6	102.7	104.1	105.9	104.4	101.9	101.5	101.1
5	95.0	98.3	100.7	101.8	103.3	105.8	105.2	102.7	102.3	101.9
0	94.1	97.4	99.9	100.9	102.6	105.0	106.3	103.7	103.2	102.8
-5	93.3	96.6	99.0	100.0	101.7	104.2	105.7	104.6	104.1	103.7
-10	92.5	95.7	98.1	99.1	100.8	103.2	104.9	105.6	105.0	104.5
-15	91.6	94.8	97.2	98.2	99.9	102.3	104.0	105.5	105.4	105.1
-20	90.7	93.9	96.3	97.3	99.0	101.3	103.0	104.7	104.6	104.3
-25	89.9	93.0	95.4	96.4	98.1	100.4	102.1	103.9	103.8	103.5
-30	89.0	92.1	94.5	95.5	97.1	99.4	101.1	102.9	102.8	102.5
-35	88.1	91.2	93.6	94.5	96.2	98.4	100.1	101.8	101.8	101.5
-40	87.2	90.3	92.6	93.6	95.2	97.4	99.0	100.8	100.8	100.4

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)									
	0	5	10	15	20	25	30	35	40	45
ENGINE ANTI-ICE ON	-0.5	-0.5	-0.6	-0.6	-0.7	-0.8	-0.9	-1.1	-1.6	-2.0
ENGINE & WING ANTI-ICE ON	-0.9	-1.0	-1.2	-1.1	-1.3	-1.5	-1.7	-2.0	-3.0	-4.0

Go-around %N1

Based on engine bleed for 3 packs on

REPORTED OAT		TAT (°C)	AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F		-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	129	57	102.9	103.0	103.2	103.4	103.6	103.6	103.6	103.9	104.0	104.0	103.9	103.9	103.8
47	116	50	104.0	104.7	105.3	105.5	105.1	104.5	104.0	104.3	104.5	104.4	104.4	104.3	104.3
42	107	45	104.6	105.3	106.0	106.2	106.2	106.1	105.6	105.4	105.0	104.7	104.7	104.6	104.6
37	98	40	105.2	105.9	106.6	106.9	107.0	106.9	106.7	106.9	106.9	106.3	105.6	104.9	104.8
32	90	35	104.6	105.9	107.3	107.7	107.8	107.7	107.5	107.8	107.8	107.8	107.6	106.9	106.1
27	81	30	103.7	105.1	106.4	107.4	108.4	108.5	108.4	108.6	108.7	108.7	108.6	108.2	107.8
22	72	25	102.9	104.2	105.5	106.6	107.5	108.3	109.0	109.3	109.4	109.5	109.6	109.2	108.8
17	63	20	102.0	103.4	104.7	105.7	106.6	107.4	108.1	109.0	109.8	110.2	110.3	110.1	109.8
12	54	15	101.2	102.5	103.8	104.8	105.7	106.5	107.2	108.0	108.8	109.6	110.3	110.8	110.9
7	45	10	100.3	101.6	102.9	103.9	104.8	105.5	106.2	107.1	107.9	108.6	109.3	109.9	110.4
2	36	5	99.4	100.7	102.0	103.0	103.9	104.6	105.3	106.2	107.0	107.7	108.4	108.9	109.4
-3	27	0	98.5	99.8	101.1	102.1	103.0	103.7	104.4	105.2	106.0	106.7	107.4	107.9	108.5
-12	9	-10	96.7	98.0	99.2	100.2	101.1	101.9	102.5	103.4	104.2	104.8	105.5	106.0	106.5
-22	-8	-20	94.9	96.1	97.3	98.3	99.2	100.0	100.6	101.5	102.2	102.9	103.6	104.4	104.6
-32	-26	-30	93.0	94.2	95.4	96.4	97.3	98.0	98.7	99.5	100.3	100.9	101.6	102.1	102.5
-42	-44	-40	91.1	92.3	93.5	94.4	95.3	96.0	96.7	97.5	98.3	98.9	99.5	100.0	100.5
-52	-62	-50	89.2	90.3	91.5	92.4	93.3	94.0	94.7	95.5	96.2	96.9	97.5	97.9	98.4

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)												
	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
2 PACKS OFF	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6
3 PACKS OFF	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.9
ENGINE ANTI-ICE ON	-0.5	-0.5	-0.5	-0.5	-0.5	-0.6	-0.7	-0.7	-0.8	-0.8	-0.8	-0.7	-0.7

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb (290/.84)

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
40000	**PITCH ATT**	**4.0**	**4.0**			
	V/S (FT/MIN)	+1700	+800			
35000	**PITCH ATT**	**4.5**	**4.0**	**4.0**	**4.0**	
	V/S (FT/MIN)	+3000	+2000	+1200	+600	
30000	**PITCH ATT**	**5.0**	**5.0**	**4.5**	**5.0**	**5.0**
	V/S (FT/MIN)	+2900	+2100	+1500	+1000	+700
20000	**PITCH ATT**	**8.0**	**7.0**	**7.0**	**7.0**	**7.0**
	V/S (FT/MIN)	+4400	+3300	+2500	+1900	+1600
10000	**PITCH ATT**	**11.5**	**10.0**	**9.5**	**9.0**	**9.0**
	V/S (FT/MIN)	+5900	+4500	+3600	+2900	+2400
SEA LEVEL	**PITCH ATT**	**14.5**	**12.5**	**11.5**	**11.0**	**10.5**
	V/S (FT/MIN)	+6700	+5200	+4100	+3400	+2900

Cruise (.84/290)

Flaps Up, %N1 for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
40000	**PITCH ATT**	**2.0**	**3.0**	**3.5**		
	%N1	88.3	92.9	101.1		
35000	**PITCH ATT**	**1.0**	**2.0**	**2.5**	**3.0**	
	%N1	85.8	88.2	91.6	96.4	
30000	**PITCH ATT**	**1.0**	**2.0**	**3.0**	**3.5**	**4.0**
	%N1	81.8	84.5	87.4	90.8	94.3
20000	**PITCH ATT**	**1.5**	**2.5**	**3.0**	**4.0**	**4.5**
	%N1	74.2	76.7	79.6	82.7	85.3
10000	**PITCH ATT**	**1.5**	**2.5**	**3.5**	**4.5**	**5.0**
	%N1	67.0	69.3	71.9	74.8	77.4
SEA LEVEL	**PITCH ATT**	**1.5**	**2.5**	**3.5**	**4.5**	**5.0**
	%N1	59.9	62.2	64.5	67.3	69.6

Descent (.84/290)

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
40000	**PITCH ATT**	**-1.5**	**-0.5**	**0.0**		
	V/S (FT/MIN)	-3000	-3000	-3100		
35000	**PITCH ATT**	**-3.5**	**-2.0**	**-1.5**	**-0.5**	
	V/S (FT/MIN)	-3900	-3500	-3300	-3300	
30000	**PITCH ATT**	**-2.0**	**-0.5**	**0.0**	**1.0**	**1.5**
	V/S (FT/MIN)	-2500	-2300	-2100	-2100	-2100
20000	**PITCH ATT**	**-1.5**	**-0.5**	**0.5**	**1.5**	**2.0**
	V/S (FT/MIN)	-2200	-2000	-1900	-1800	-1800
10000	**PITCH ATT**	**-2.0**	**-0.5**	**0.5**	**1.5**	**2.0**
	V/S (FT/MIN)	-2000	-1800	-1700	-1600	-1600
SEA LEVEL	**PITCH ATT**	**-2.0**	**-1.0**	**0.5**	**2.0**	**2.5**
	V/S (FT/MIN)	-1800	-1600	-1500	-1500	-1500

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Holding (VREF30+80)

Flaps Up, %N1 for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
10000	**PITCH ATT**	**5.5**	**6.0**	**6.0**	**5.5**	**5.5**
	%N1	59.7	65.3	70.0	74.2	77.2
	KIAS	208	224	242	266	283

Terminal Area (5000 FT)

%N1 for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)					
		200	250	300	350	400	410
FLAPS UP (VREF30+80) (GEAR UP)	**PITCH ATT**	**5**	**5.5**	**5.5**	**6**	**6.5**	**6.5**
	%N1	56.6	62.4	67.5	71.8	75.8	76.4
	KIAS	208	224	239	253	266	269
FLAPS 1 (VREF30+60) (GEAR UP)	**PITCH ATT**	**6.5**	**7**	**7**	**7.5**	**7.5**	**7.5**
	%N1	58.9	64.6	69.6	74.0	77.7	78.4
	KIAS	188	204	219	233	246	249
FLAPS 5 (VREF30+40) (GEAR UP)	**PITCH ATT**	**7.5**	**7.5**	**8**	**8**	**8**	**8**
	%N1	62.1	68.3	73.5	78.0	81.9	82.6
	KIAS	168	184	199	213	226	229
FLAPS 10 (VREF30+20) (GEAR UP)	**PITCH ATT**	**8.5**	**8.5**	**8.5**	**9**	**9**	**9**
	%N1	69.2	75.7	81.1	85.6	89.5	90.3
	KIAS	148	164	179	193	206	209
FLAPS 20 (VREF30+10) (GEAR DOWN)	**PITCH ATT**	**7.5**	**7.5**	**7.5**	**7.5**	**7.5**	**7.5**
	%N1	73.9	80.5	86.0	90.8	94.8	95.6
	KIAS	138	154	169	183	196	199

Final Approach (1500 FT)

Gear Down, %N1 for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)					
		200	250	300	350	400	410
FLAPS 25 (VREF25+10)	**PITCH ATT**	**2**	**2**	**2**	**2**	**2**	**2**
	%N1	53.3	58.8	63.7	68.0	71.7	72.4
	KIAS	143	159	175	189	203	205
FLAPS 30 (VREF30+10)	**PITCH ATT**	**0.5**	**1**	**1**	**1**		
	%N1	59.2	65.2	70.2	74.7		
	KIAS	138	154	168	182		

Intentionally
Blank

Long Range Cruise Maximum Operating Altitude

Max Climb Thrust

ISA + 10°C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	28500	4	33600*	32900	32100	30500	28900
380	29700	1	34800*	34000	33200	31600	30100
360	30900	-1	35900*	35100	34300	32700	31300
340	32100	-4	37100*	36300	35500	34000	32500
320	33400	-7	38300*	37600	36800	35200	33800
300	34800	-10	39600*	38900	38100	36600	35100
280	36200	-13	41000*	40400	39600	38000	36600
260	37700	-13	42400*	41900	41100	39600	38100
240	39400	-13	44000*	43600	42800	41200	39800
220	41200	-13	45000	45000	44600	43000	41600
200	43200	-13	45000	45000	45000	45000	43600
180	45000	-13	45000	45000	45000	45000	45000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	28500	10	32700*	32700*	32100	30500	28900
380	29700	7	34000*	34000	33200	31600	30100
360	30900	4	35300*	35100	34300	32700	31300
340	32100	2	36400*	36300	35500	34000	32500
320	33400	-1	37700*	37600	36800	35200	33800
300	34800	-4	39000*	38900	38100	36600	35100
280	36200	-7	40400*	40400	39600	38000	36600
260	37700	-7	41900*	41900	41100	39600	38100
240	39400	-7	43400*	43400*	42800	41200	39800
220	41200	-7	45000	45000	44600	43000	41600
200	43200	-7	45000	45000	45000	45000	43600
180	45000	-7	45000	45000	45000	45000	45000

ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	28500	15	31700*	31700*	31700*	30500	28900
380	29700	13	33000*	33000*	33000*	31600	30100
360	30900	10	34400*	34400*	34300	32700	31300
340	32100	7	35700*	35700*	35500	34000	32500
320	33400	4	36900*	36900*	36800	35200	33800
300	34800	1	38200*	38200*	38100	36600	35100
280	36200	-2	39700*	39700*	39600	38000	36600
260	37700	-2	41100*	41100*	41100	39600	38100
240	39400	-2	42700*	42700*	42700*	41200	39800
220	41200	-2	44300*	44300*	44300*	43000	41600
200	43200	-2	45000	45000	45000	45000	43600
180	45000	-2	45000	45000	45000	45000	45000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)										
		25	27	29	31	33	35	37	39	41	43	45
400	%N1	91.8	93.2	94.7	96.7	100.1						
	MACH	.834	.849	.858	.859	.859						
	KIAS	353	346	336	322	308						
	FF/ENG	3468	3467	3476	3499	3616						
380	%N1	90.7	91.9	93.3	95.0	97.4						
	MACH	.824	.841	.854	.859	.859						
	KIAS	349	342	334	322	308						
	FF/ENG	3290	3271	3277	3282	3335						
360	%N1	89.6	90.7	92.0	93.5	95.4	98.5					
	MACH	.814	.831	.847	.858	.859	.859					
	KIAS	344	338	330	321	308	295					
	FF/ENG	3122	3091	3084	3088	3099	3181					
340	%N1	88.5	89.5	90.6	92.0	93.6	95.9	100.3				
	MACH	.802	.820	.837	.852	.859	.859	.860				
	KIAS	339	333	326	319	308	295	281				
	FF/ENG	2961	2921	2899	2899	2900	2921	3074				
320	%N1	87.1	88.3	89.4	90.6	92.0	93.8	96.9				
	MACH	.788	.808	.825	.842	.856	.859	.859				
	KIAS	332	327	321	315	307	294	281				
	FF/ENG	2798	2762	2729	2716	2714	2713	2778				
300	%N1	85.7	87.0	88.1	89.2	90.5	92.0	94.4	98.6			
	MACH	.773	.794	.813	.830	.847	.858	.859	.859			
	KIAS	325	321	316	310	303	294	281	269			
	FF/ENG	2633	2605	2568	2544	2535	2532	2549	2669			
280	%N1	84.2	85.5	86.8	87.8	89.0	90.4	92.4	95.5	100.4		
	MACH	.756	.778	.798	.817	.835	.851	.859	.859	.860		
	KIAS	318	314	310	304	298	291	281	269	257		
	FF/ENG	2463	2444	2414	2382	2363	2356	2365	2413	2558		
260	%N1	82.5	83.9	85.3	86.5	87.5	88.7	90.5	93.1	96.5		
	MACH	.738	.760	.781	.802	.821	.838	.854	.859	.859		
	KIAS	309	306	303	298	293	286	279	269	257		
	FF/ENG	2292	2278	2256	2227	2201	2183	2190	2214	2272		
240	%N1	80.7	82.1	83.5	84.8	86.0	87.1	88.7	91.0	93.7	97.3	
	MACH	.718	.740	.762	.784	.805	.824	.841	.855	.859	.859	
	KIAS	300	298	294	291	286	281	275	267	256	245	
	FF/ENG	2124	2110	2093	2068	2044	2019	2015	2036	2061	2124	
220	%N1	78.9	80.2	81.5	82.9	84.3	85.5	86.9	89.0	91.4	94.1	97.9
	MACH	.696	.718	.740	.763	.785	.806	.825	.843	.856	.859	.859
	KIAS	291	288	285	282	279	274	269	263	255	245	234
	FF/ENG	1966	1944	1927	1905	1884	1862	1850	1859	1880	1903	1968
200	%N1	76.9	78.2	79.5	80.8	82.3	83.6	85.2	87.1	89.2	91.5	94.2
	MACH	.674	.695	.716	.739	.762	.785	.806	.825	.843	.856	.859
	KIAS	281	278	275	273	270	266	262	257	251	244	234
	FF/ENG	1812	1788	1765	1739	1719	1704	1694	1693	1703	1720	1740

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitudes

Ground to Air Miles Conversion

AIR DISTANCE (NM) HEADWIND COMPONENT (KTS)					GROUND DISTANCE (NM)	AIR DISTANCE (NM) TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
672	629	591	557	527	500	479	460	443	426	412
1345	1259	1182	1114	1054	1000	960	923	888	856	827
2022	1892	1775	1673	1583	1500	1440	1385	1334	1286	1243
2703	2529	2371	2234	2111	2000	1921	1847	1779	1716	1658
3390	3168	2969	2795	2640	2500	2402	2310	2224	2145	2073
4084	3813	3570	3358	3170	3000	2882	2772	2670	2575	2488
4784	4463	4174	3923	3701	3500	3363	3234	3115	3004	2903
5492	5118	4782	4491	4233	4000	3843	3696	3559	3433	3317
6209	5780	5394	5060	4766	4500	4323	4157	4003	3860	3730
6936	6448	6011	5633	5301	5000	4803	4618	4447	4288	4142

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		25	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
500	13.4	1:20	12.3	1:18	11.3	1:16	10.5	1:13	10.0	1:12
1000	27.0	2:37	25.0	2:32	23.4	2:26	21.9	2:21	20.9	2:17
1500	40.3	3:56	37.5	3:47	35.1	3:38	32.9	3:30	31.6	3:24
2000	53.3	5:16	49.7	5:03	46.6	4:51	43.8	4:39	42.0	4:31
2500	66.0	6:38	61.6	6:20	57.8	6:05	54.4	5:50	52.2	5:39
3000	78.5	8:01	73.3	7:39	68.8	7:20	64.7	7:02	62.2	6:48
3500	90.7	9:28	84.6	9:00	79.5	8:36	74.8	8:14	71.9	7:59
4000	102.6	10:56	95.8	10:22	89.9	9:54	84.7	9:28	81.3	9:10
4500	114.3	12:27	106.7	11:46	100.1	11:13	94.4	10:43	90.6	10:22
5000	125.7	14:01	117.3	13:13	110.2	12:34	103.9	11:59	99.7	11:35

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-1.5	-0.8	0.0	2.3	6.9
20	-3.1	-1.5	0.0	4.4	12.6
30	-4.7	-2.3	0.0	6.3	17.6
40	-6.3	-3.1	0.0	8.1	22.1
50	-7.9	-3.9	0.0	9.8	26.0
60	-9.5	-4.7	0.0	11.3	29.3
70	-11.2	-5.5	0.0	12.7	32.1
80	-12.9	-6.3	0.0	13.9	34.3
90	-14.6	-7.1	0.0	15.0	35.9
100	-16.3	-8.0	0.0	16.0	36.9
110	-18.0	-8.8	0.0	16.8	37.3
120	-19.8	-9.7	0.0	17.4	37.2
130	-21.5	-10.5	0.0	17.9	36.4

Long Range Cruise Enroute Fuel and Time - High Altitudes

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
3828	3630	3448	3285	3137	3000	2882	2772	2670	2575	2488
4471	4238	4025	3834	3660	3500	3363	3234	3114	3004	2902
5116	4849	4603	4384	4184	4000	3843	3696	3559	3432	3316
5764	5461	5183	4934	4708	4500	4323	4157	4003	3860	3729
6414	6075	5764	5485	5233	5000	4803	4618	4447	4288	4142
7068	6691	6346	6037	5758	5500	5282	5079	4890	4715	4555
7724	7309	6930	6590	6283	6000	5762	5539	5333	5141	4966
8383	7930	7515	7144	6809	6500	6241	5999	5774	5567	5376
9045	8552	8102	7699	7335	7000	6720	6459	6216	5992	5786
9710	9177	8690	8255	7862	7500	7199	6918	6657	6416	6195
10379	9804	9279	8811	8388	8000	7678	7377	7098	6840	6604

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
3000	58.8	6:33	57.2	6:27	55.9	6:22	55.0	6:18	54.7	6:15
3500	67.9	7:40	66.1	7:32	64.6	7:26	63.5	7:21	63.0	7:17
4000	77.0	8:47	74.9	8:38	73.2	8:30	71.9	8:25	71.4	8:20
4500	85.7	9:56	83.4	9:45	81.5	9:36	80.0	9:29	79.2	9:23
5000	94.4	11:05	91.9	10:53	89.7	10:42	88.0	10:34	87.1	10:26
5500	102.7	12:16	99.9	12:02	97.6	11:49	95.7	11:39	94.6	11:31
6000	111.0	13:27	108.0	13:11	105.4	12:57	103.4	12:45	102.1	12:35
6500	119.0	14:40	115.7	14:22	112.9	14:06	110.7	13:53	109.2	13:41
7000	126.9	15:54	123.3	15:33	120.4	15:15	118.0	15:00	116.4	14:46
7500	134.5	17:09	130.7	16:46	127.5	16:26	125.0	16:09	123.2	15:53
8000	142.1	18:24	138.1	17:59	134.6	17:37	132.0	17:18	130.0	17:00

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
50	-10.6	-5.4	0.0	9.6	25.2
60	-12.7	-6.5	0.0	11.2	28.6
70	-14.8	-7.6	0.0	12.6	31.7
80	-16.9	-8.6	0.0	14.0	34.6
90	-19.0	-9.7	0.0	15.3	37.2
100	-21.1	-10.8	0.0	16.5	39.5
110	-23.2	-11.8	0.0	17.6	41.6
120	-25.2	-12.8	0.0	18.6	43.4
130	-27.3	-13.8	0.0	19.6	45.0
140	-29.3	-14.8	0.0	20.5	46.3
150	-31.3	-15.8	0.0	21.3	47.3
160	-33.3	-16.8	0.0	22.2	48.1

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)										
	400	380	360	340	320	300	280	260	240	220	220
45									57	25	6
43								50	22	6	0
41						74	41	18	5	0	2
39					57	31	13	3	0	2	10
37			68	42	22	9	2	0	3	10	21
35		48	28	14	5	0	0	4	11	21	34
33	32	18	8	2	0	1	5	13	22	34	48
31	10	3	0	0	2	7	15	24	35	48	62
29	1	0	1	5	10	17	26	37	48	61	75
27	0	3	7	13	21	29	39	50	62	74	87
25	6	11	17	24	32	42	52	63	74	86	99

The above wind factor table is for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.
Method:
1. **Read wind factors for present and new altitudes from table.**
2. **Determine difference (new altitude wind factor minus present altitude wind factor); this difference may be negative or positive.**
3. **Break-even wind at new altitude is present altitude wind plus difference from step 2.**

Descent at .84/290/250

PRESSURE ALT (1000 FT)	19	21	23	25	27	29	31	33	35	37	39	41	43	45
DISTANCE (NM)	76	83	90	97	104	111	118	125	131	136	142	147	152	157
TIME (MINUTES)	16	18	19	20	21	22	22	23	24	25	25	26	27	27

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	45000
400	%N1	71.3	74.0	77.9	81.9	86.1	90.3	94.9			
	KIAS	286	286	286	286	304	308	312			
	FF/ENG	3130	3100	3080	3090	3180	3270	3460			
380	%N1	69.8	72.6	76.5	80.5	84.7	88.8	93.3	101.7		
	KIAS	280	280	280	280	297	300	305	279		
	FF/ENG	2970	2940	2920	2920	2990	3060	3210	3540		
360	%N1	68.4	71.0	75.0	79.0	83.3	87.3	91.6	97.8		
	KIAS	271	271	271	271	288	291	296	279		
	FF/ENG	2820	2780	2760	2750	2800	2860	2980	3180		
340	%N1	66.9	69.4	73.3	77.4	81.8	85.8	90.0	95.1		
	KIAS	261	261	261	261	280	283	286	279		
	FF/ENG	2660	2620	2600	2590	2630	2670	2760	2900		
320	%N1	65.1	67.8	71.7	75.8	80.1	84.2	88.4	93.1		
	KIAS	251	251	251	251	271	273	277	279		
	FF/ENG	2510	2470	2440	2430	2450	2490	2550	2700		
300	%N1	63.3	66.2	70.0	74.1	78.4	82.5	86.7	91.2		
	KIAS	242	242	242	242	262	264	268	272		
	FF/ENG	2360	2320	2290	2270	2290	2310	2360	2480		
280	%N1	61.4	64.2	68.2	72.2	76.6	80.7	84.8	89.2	96.9	
	KIAS	233	233	233	233	252	255	258	261	249	
	FF/ENG	2210	2170	2140	2120	2140	2140	2170	2260	2460	
260	%N1	59.6	62.2	66.3	70.2	74.7	78.9	83.0	87.3	93.9	
	KIAS	228	228	228	228	244	246	248	251	249	
	FF/ENG	2070	2030	2000	1970	1990	1990	2000	2060	2220	
240	%N1	57.5	60.2	64.3	68.2	72.6	76.8	80.9	85.2	91.5	
	KIAS	221	221	221	221	233	235	237	240	245	
	FF/ENG	1930	1890	1860	1820	1840	1830	1820	1860	2010	
220	%N1	55.4	58.2	62.0	66.0	70.4	74.5	78.7	82.9	89.0	97.1
	KIAS	215	215	215	215	223	224	227	229	233	222
	FF/ENG	1800	1760	1720	1680	1690	1690	1660	1680	1790	1960
200	%N1	53.2	55.8	59.7	63.8	67.9	72.1	76.3	80.5	86.5	93.4
	KIAS	208	208	208	208	212	214	215	218	221	222
	FF/ENG	1670	1630	1590	1550	1550	1540	1510	1510	1590	1730

This table includes 5% additional fuel for holding in a racetrack pattern.

Holding
Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
400	%N1	74.5	77.5	81.6	85.7	89.9
	KIAS	245	246	248	251	251
	FF/ENG	3460	3450	3470	3500	3510
380	%N1	73.0	76.0	80.1	84.2	88.4
	KIAS	240	241	243	245	245
	FF/ENG	3280	3270	3290	3310	3310
360	%N1	71.4	74.4	78.5	82.7	86.9
	KIAS	234	236	238	240	240
	FF/ENG	3100	3090	3100	3120	3110
340	%N1	69.7	72.7	76.9	81.1	85.3
	KIAS	229	230	232	234	234
	FF/ENG	2930	2910	2920	2940	2920
320	%N1	67.9	70.9	75.2	79.4	83.7
	KIAS	223	224	226	228	228
	FF/ENG	2750	2740	2740	2760	2740
300	%N1	66.1	69.1	73.5	77.6	81.9
	KIAS	218	219	220	222	222
	FF/ENG	2580	2560	2570	2580	2560
280	%N1	64.3	67.1	71.5	75.8	80.0
	KIAS	212	213	215	216	216
	FF/ENG	2410	2390	2390	2400	2380
260	%N1	62.1	65.1	69.4	73.8	78.0
	KIAS	207	207	209	210	210
	FF/ENG	2250	2230	2220	2220	2210
240	%N1	60.0	63.0	67.2	71.7	75.9
	KIAS	200	201	202	203	203
	FF/ENG	2090	2070	2060	2050	2050
220	%N1	57.8	60.6	64.9	69.3	73.6
	KIAS	194	194	195	196	196
	FF/ENG	1940	1910	1890	1880	1890
200	%N1	55.4	58.2	62.5	66.8	71.2
	KIAS	187	188	189	190	190
	FF/ENG	1790	1750	1730	1720	1740

This table includes 5% additional fuel for holding in a racetrack pattern.
Holding at Flaps 1 in icing conditions is not recommended.

Intentionally
Blank

Performance Inflight — Chapter PI
Advisory Information — Section 22

ADVISORY INFORMATION

Normal Configuration Landing Distance
Flaps 30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF30	TWO REV	NO REV

Dry Runway

MAX MANUAL	3870	100/-60	130	-180/620	60/-60	110/-100	190	130	280
AUTOBRAKE MAX	4750	90/-70	150	-220/740	0/0	130/-130	260	0	0
AUTOBRAKE 4	5860	100/-90	190	-290/970	0/-10	180/-180	330	0	0
AUTOBRAKE 3	6930	120/-120	230	-350/1180	40/-80	220/-210	340	20	20
AUTOBRAKE 2	7640	130/-130	300	-400/1350	140/-160	250/-230	320	330	330
AUTOBRAKE 1	8330	160/-150	360	-460/1560	240/-260	290/-260	320	750	1160

Good Reported Braking Action

MAX MANUAL	5030	80/-80	190	-260/910	140/-120	150/-140	240	340	780
AUTOBRAKE MAX	5300	90/-90	200	-270/930	120/-100	160/-150	260	340	790
AUTOBRAKE 4	5940	100/-100	190	-300/1020	40/-30	180/-180	340	30	200
AUTOBRAKE 3	6930	120/-120	230	-350/1180	40/-80	220/-210	340	20	20
AUTOBRAKE 2	7640	130/-130	300	-400/1350	140/-160	250/-230	320	330	330
AUTOBRAKE 1	8330	160/-150	360	-460/1560	240/-260	290/-260	320	750	1160

Medium Reported Braking Action

MAX MANUAL	6680	120/-110	290	-390/1430	330/-250	220/-190	270	800	2010
AUTOBRAKE MAX	6780	120/-110	290	-400/1440	310/-230	220/-200	300	780	1950
AUTOBRAKE 4	6830	120/-110	290	-400/1440	290/-200	220/-200	330	760	1960
AUTOBRAKE 3	7400	130/-120	280	-420/1510	240/-190	230/-220	340	430	1490
AUTOBRAKE 2	7900	140/-140	310	-440/1580	280/-240	260/-230	320	510	1190
AUTOBRAKE 1	8430	160/-150	360	-480/1680	340/-300	290/-260	320	820	1480

Poor Reported Braking Action

MAX MANUAL	8550	160/-140	400	-580/2300	850/-500	290/-230	300	1540	4250
AUTOBRAKE MAX	8600	160/-150	400	-580/2300	850/-500	290/-240	310	1530	4260
AUTOBRAKE 4	8600	160/-150	400	-580/2300	850/-500	290/-240	310	1530	4250
AUTOBRAKE 3	8780	160/-150	390	-590/2320	810/-470	290/-240	340	1420	4160
AUTOBRAKE 2	8990	160/-150	400	-600/2340	830/-490	300/-250	320	1390	3940
AUTOBRAKE 1	9280	170/-160	420	-610/2390	830/-510	310/-260	320	1430	3880

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and 4 engines at maximum reverse thrust.

Max manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes an air distance from threshold to touchdown associated with a flare time of 4.22 seconds

Max manual and autobrake data valid for auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 210 ft.
For autobrake and manual speedbrakes, increase reference landing distance by 170 ft.

ADVISORY INFORMATION

Normal Configuration Landing Distance
Flaps 25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF30	TWO REV	NO REV

Dry Runway

MAX MANUAL	4190	120/-70	140	-190/650	70/-60	120/-110	180	160	360
AUTOBRAKE MAX	5090	100/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 4	6290	110/-100	210	-300/1000	10/0	190/-190	360	0	0
AUTOBRAKE 3	7520	130/-130	260	-370/1220	10/-80	230/-230	370	10	20
AUTOBRAKE 2	8320	150/-150	330	-420/1400	130/-180	280/-260	350	320	320
AUTOBRAKE 1	9070	170/-170	410	-480/1620	250/-290	320/-280	350	940	1270

Good Reported Braking Action

MAX MANUAL	5330	90/-90	210	-270/930	140/-120	160/-150	240	390	920
AUTOBRAKE MAX	5600	90/-90	210	-280/950	130/-100	170/-160	270	400	930
AUTOBRAKE 4	6380	100/-100	210	-310/1050	40/-30	190/-190	360	30	220
AUTOBRAKE 3	7520	130/-130	260	-370/1220	20/-80	230/-230	370	10	20
AUTOBRAKE 2	8320	150/-150	330	-420/1400	130/-180	280/-260	350	320	320
AUTOBRAKE 1	9070	170/-170	410	-480/1620	250/-290	320/-280	350	940	1270

Medium Reported Braking Action

MAX MANUAL	7150	130/-120	320	-410/1460	340/-270	240/-200	290	960	2460
AUTOBRAKE MAX	7210	130/-120	320	-410/1470	340/-240	240/-210	310	920	2390
AUTOBRAKE 4	7280	130/-120	320	-410/1480	300/-190	240/-210	350	890	2370
AUTOBRAKE 3	7990	140/-130	300	-440/1550	210/-190	250/-230	370	470	1830
AUTOBRAKE 2	8590	150/-150	340	-460/1640	270/-260	280/-260	350	510	1380
AUTOBRAKE 1	9180	170/-170	410	-500/1740	360/-330	330/-280	350	1010	1660

Poor Reported Braking Action

MAX MANUAL	9190	170/-160	450	-600/2370	900/-530	310/-250	320	1860	5360
AUTOBRAKE MAX	9200	170/-160	450	-600/2370	910/-530	320/-250	330	1850	5360
AUTOBRAKE 4	9210	170/-160	450	-600/2370	900/-540	320/-250	320	1840	5350
AUTOBRAKE 3	9420	170/-160	440	-610/2390	840/-490	310/-260	360	1710	5250
AUTOBRAKE 2	9700	180/-170	450	-620/2420	850/-520	330/-270	340	1580	4950
AUTOBRAKE 1	10040	190/-180	470	-640/2480	860/-550	340/-280	340	1710	4760

Reference distance is for sea level, standard day, no wind or slope, VREF25 approach speed and 4 engines at maximum reverse thrust.

Max manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes an air distance from threshold to touchdown associated with a flare time of 4.22 seconds

Max manual and autobrake data valid for auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 220 ft.
For autobrake and manual speedbrakes, increase reference landing distance by 180 ft.

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

AIR/GND SYSTEM - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5070	150/-80	160	-230/750	110/-100	140/-140	300	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	7330	120/-110	250	-360/1190	330/-260	220/-200	410	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	11350	180/-180	400	-610/2090	1070/-730	370/-300	550	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	17410	260/-250	630	-1060/3810	3920/-1850	590/-380	660	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
AIR/GND SYSTEM - Flaps 30
VREF30

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT) REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	4730	110/-70	150	-220/730	110/-90	130/-130	290	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								
Good Reported Braking Action									
MAX MANUAL	6670	100/-100	220	-340/1140	290/-230	200/-180	380	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								
Medium Reported Braking Action									
MAX MANUAL	9960	160/-150	340	-560/1950	880/-610	320/-260	480	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								
Poor Reported Braking Action									
MAX MANUAL	14740	220/-210	520	-960/3490	3050/-1470	490/-320	550	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID / ANTISKID OFF - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	7860	140/-130	330	-430/1530	340/-270	250/-220	310	940	2420
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	7860	140/-130	330	-430/1530	340/-270	250/-220	310	940	2420
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	9890	180/-160	460	-620/2430	900/-530	320/-260	340	1840	5300
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	13950	220/-140	620	-1260/6560	10100/-1630	450/-170	360	4250	15290
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID / ANTISKID OFF - Flaps 30
VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	7340	120/-120	290	-410/1490	320/-250	230/-200	300	780	1970
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	7340	120/-120	290	-410/1490	320/-250	230/-200	300	780	1970
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	9190	160/-150	410	-600/2350	840/-500	290/-240	320	1520	4200
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	12860	200/-150	550	-1180/6070	9550/-1480	400/-190	340	3600	12050
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
BLD DUCT LEAK L / BLD DUCT LEAK R - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4270	120/-70	140	-200/660	70/-60	120/-120	180	120	280
AUTOBRAKE MAX	5090	110/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8440	150/-150	320	-420/1420	100/-160	280/-260	370	200	200

Good Reported Braking Action

MAX MANUAL	5460	90/-90	200	-270/940	150/-130	170/-150	240	340	800
AUTOBRAKE MAX	5660	90/-90	210	-280/960	130/-110	170/-160	270	370	870
AUTOBRAKE 2	8440	150/-150	320	-420/1420	100/-160	280/-260	370	200	200

Medium Reported Braking Action

MAX MANUAL	7320	130/-120	320	-410/1480	350/-280	240/-210	290	890	2290
AUTOBRAKE MAX	7310	130/-120	320	-410/1480	360/-250	240/-210	310	890	2280
AUTOBRAKE 3	8020	140/-130	300	-440/1560	230/-170	250/-230	380	460	1800

Poor Reported Braking Action

MAX MANUAL	9390	170/-160	450	-610/2390	910/-540	320/-250	320	1780	5150
AUTOBRAKE MAX	9400	170/-160	450	-610/2390	920/-550	320/-260	320	1780	5160
AUTOBRAKE 3	9580	170/-160	440	-620/2410	860/-500	310/-260	360	1690	5090

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
BLD DUCT LEAK L / BLD DUCT LEAK R - Flaps 30
VREF30

BRAKING CONFIGURATION	REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	3940	100/-60	120	-190/620	60/-60	110/-110	190	100	210
AUTOBRAKE MAX	4750	90/-70	150	-220/740	0/0	130/-130	260	0	0
AUTOBRAKE 2	7770	140/-130	290	-400/1360	110/-150	250/-240	340	190	190
Good Reported Braking Action									
MAX MANUAL	5140	80/-80	190	-270/920	140/-120	150/-140	240	290	670
AUTOBRAKE MAX	5350	90/-90	200	-270/940	120/-110	160/-150	260	320	740
AUTOBRAKE 2	7770	140/-130	290	-400/1360	110/-150	250/-240	340	190	190
Medium Reported Braking Action									
MAX MANUAL	6830	120/-110	280	-400/1440	330/-260	220/-190	280	740	1860
AUTOBRAKE MAX	6860	120/-110	290	-400/1440	330/-240	220/-200	310	750	1870
AUTOBRAKE 3	7430	130/-120	270	-420/1510	250/-170	230/-220	370	410	1460
Poor Reported Braking Action									
MAX MANUAL	8720	160/-150	400	-590/2310	860/-510	290/-240	300	1470	4080
AUTOBRAKE MAX	8750	160/-150	400	-590/2320	870/-520	290/-240	300	1480	4100
AUTOBRAKE 3	8900	160/-150	390	-590/2330	830/-470	290/-250	340	1410	4040

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

ENG 1, 2, 3, 4 SHUTDOWN - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4340	130/-70	140	-200/670	80/-70	120/-120	190	0	190
AUTOBRAKE MAX	5090	120/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8640	150/-140	300	-430/1440	20/-70	270/-270	460	0	0

Good Reported Braking Action

MAX MANUAL	5710	90/-90	210	-290/980	180/-150	180/-160	270	0	520
AUTOBRAKE MAX	5970	100/-100	220	-300/1010	160/-130	180/-170	290	0	530
AUTOBRAKE 2	8640	150/-140	300	-430/1440	20/-70	270/-270	460	0	0

Medium Reported Braking Action

MAX MANUAL	8040	140/-140	330	-450/1600	470/-360	260/-230	330	0	1470
AUTOBRAKE MAX	8070	140/-140	330	-450/1600	460/-330	270/-240	360	0	1430
AUTOBRAKE 3	8400	150/-140	330	-460/1630	390/-260	270/-250	400	0	1310

Poor Reported Braking Action

MAX MANUAL	10860	200/-190	490	-700/2630	1270/-750	370/-310	380	0	3340
AUTOBRAKE MAX	10870	200/-190	490	-700/2630	1290/-760	380/-310	380	0	3350
AUTOBRAKE 3	10950	200/-190	490	-700/2640	1270/-760	380/-310	380	0	3370

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

ENG 1, 2, 3, 4 SHUTDOWN - Flaps 30

VREF30

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4090	120/-70	130	-200/660	70/-70	120/-110	190	0	170
AUTOBRAKE MAX	4750	110/-70	150	-220/740	10/0	130/-130	260	0	0
AUTOBRAKE 2	8050	140/-130	280	-410/1390	10/-40	250/-250	460	0	0

Good Reported Braking Action

MAX MANUAL	5370	90/-90	190	-280/960	170/-140	160/-150	260	0	440
AUTOBRAKE MAX	5630	90/-90	200	-290/980	150/-130	170/-160	290	0	450
AUTOBRAKE 2	8050	140/-130	280	-410/1390	10/-40	250/-250	460	0	0

Medium Reported Braking Action

MAX MANUAL	7650	130/-130	310	-440/1580	460/-350	250/-220	330	0	1290
AUTOBRAKE MAX	7690	140/-130	310	-440/1580	470/-330	250/-230	360	0	1280
AUTOBRAKE 3	7940	140/-130	310	-450/1600	410/-270	260/-230	400	0	1240

Poor Reported Braking Action

MAX MANUAL	10480	190/-180	460	-690/2610	1280/-750	360/-290	390	0	3040
AUTOBRAKE MAX	10520	190/-180	470	-690/2610	1300/-770	360/-300	390	0	3060
AUTOBRAKE 3	10600	190/-180	470	-690/2620	1270/-770	360/-300	390	0	3080

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

FLAPS CONTROL - Flaps 25

VREF25

BRAKING CONFIGURATION	REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	4190	120/-70	140	-190/650	70/-60	120/-110	180	160	360
AUTOBRAKE MAX	5090	100/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8320	150/-150	330	-420/1400	130/-180	280/-260	350	320	320
Good Reported Braking Action									
MAX MANUAL	5330	90/-90	210	-270/930	140/-120	160/-150	240	390	920
AUTOBRAKE MAX	5600	90/-90	210	-280/950	130/-100	170/-160	270	400	930
AUTOBRAKE 2	8320	150/-150	330	-420/1400	130/-180	280/-260	350	320	320
Medium Reported Braking Action									
MAX MANUAL	7150	130/-120	320	-410/1460	340/-270	240/-200	290	960	2460
AUTOBRAKE MAX	7210	130/-120	320	-410/1470	340/-240	240/-210	310	920	2390
AUTOBRAKE 3	7990	140/-130	300	-440/1550	210/-190	250/-230	370	470	1830
Poor Reported Braking Action									
MAX MANUAL	9190	170/-160	450	-600/2370	900/-530	310/-250	320	1860	5360
AUTOBRAKE MAX	9200	170/-160	450	-600/2370	910/-530	320/-250	330	1850	5360
AUTOBRAKE 3	9420	170/-160	440	-610/2390	840/-490	310/-260	360	1710	5250

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

FLAPS DRIVE - Flaps 25

VREF30+25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4970	140/-70	170	-210/680	80/-70	150/-140	220	220	480
AUTOBRAKE MAX	6250	110/-90	190	-260/830	30/-40	180/-180	270	40	60
AUTOBRAKE 2	9710	160/-160	400	-450/1500	200/-220	330/-300	340	680	790

Good Reported Braking Action

MAX MANUAL	6360	100/-90	250	-290/990	160/-140	200/-180	250	500	1180
AUTOBRAKE MAX	6710	100/-100	250	-300/1020	150/-120	210/-190	260	510	1240
AUTOBRAKE 2	9710	160/-160	400	-450/1500	210/-220	330/-300	350	680	790

Medium Reported Braking Action

MAX MANUAL	8320	140/-130	370	-430/1550	380/-300	280/-240	290	1170	3020
AUTOBRAKE MAX	8460	140/-130	380	-440/1560	360/-290	290/-250	310	1140	2950
AUTOBRAKE 3	9410	150/-150	370	-470/1650	300/-250	310/-280	340	670	2160

Poor Reported Braking Action

MAX MANUAL	10500	180/-170	520	-630/2460	960/-580	370/-290	320	2160	6230
AUTOBRAKE MAX	10550	180/-170	520	-640/2470	950/-590	370/-300	320	2120	6190
AUTOBRAKE 3	10860	180/-170	510	-650/2500	920/-560	370/-310	340	1900	5980

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Flaps Up Landing - Flaps Up

VREF30+70

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	7590	380/-140	410	-310/1270	140/-120	320/-280	350	500	1160
AUTOBRAKE MAX	9270	320/-110	340	-320/1140	30/-30	290/-280	360	80	360
AUTOBRAKE 2	14580	240/-230	650	-550/1810	360/-380	530/-460	400	1570	1920

Good Reported Braking Action

MAX MANUAL	8640	330/-120	340	-330/1110	200/-180	280/-250	260	800	1900
AUTOBRAKE MAX	9600	300/-120	340	-350/1170	110/-100	300/-280	350	470	1520
AUTOBRAKE 2	14580	240/-230	650	-550/1810	360/-380	530/-460	400	1570	1920

Medium Reported Braking Action

MAX MANUAL	11670	220/-170	550	-500/1750	480/-390	410/-350	320	1920	5100
AUTOBRAKE MAX	11820	220/-170	550	-500/1760	440/-370	420/-350	340	1890	5010
AUTOBRAKE 3	13990	220/-210	580	-560/1940	410/-360	480/-430	400	1250	3330

Poor Reported Braking Action

MAX MANUAL	14870	240/-230	800	-730/2770	1180/-750	550/-430	360	3650	11210
AUTOBRAKE MAX	14810	240/-230	800	-730/2770	1170/-740	550/-430	360	3560	11020
AUTOBRAKE 3	15660	250/-240	790	-750/2830	1130/-730	570/-460	400	3170	10450

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (1 Body or 1 Wing Gear Up) - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5400	180/-110	180	-250/850	120/-110	150/-140	230	250	580
AUTOBRAKE MAX	5350	190/-90	180	-250/840	100/-70	150/-150	280	200	510
AUTOBRAKE 2	8550	160/-150	320	-430/1430	70/-120	280/-260	420	130	130

Good Reported Braking Action

MAX MANUAL	5910	160/-90	210	-290/980	160/-140	170/-160	260	370	860
AUTOBRAKE MAX	5850	170/-90	220	-280/970	160/-140	170/-160	280	360	850
AUTOBRAKE 2	8580	160/-150	320	-430/1430	80/-130	280/-260	420	130	130

Medium Reported Braking Action

MAX MANUAL	7750	130/-130	330	-420/1520	370/-290	250/-210	310	930	2390
AUTOBRAKE MAX	7680	140/-130	330	-420/1510	380/-290	250/-210	320	920	2360
AUTOBRAKE 3	8200	140/-130	300	-440/1570	270/-180	250/-240	410	470	1850

Poor Reported Braking Action

MAX MANUAL	9820	180/-160	460	-620/2430	940/-560	330/-260	340	1850	5360
AUTOBRAKE MAX	9800	180/-160	470	-620/2430	950/-570	330/-260	340	1840	5350
AUTOBRAKE 3	9890	180/-160	460	-630/2440	910/-520	320/-270	380	1750	5250

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
GEAR DISAGREE (1 Body or 1 Wing Gear Up) - Flaps 30
VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4990	150/-100	160	-240/800	110/-100	140/-130	210	200	440
AUTOBRAKE MAX	4910	160/-80	160	-240/790	90/-40	140/-130	260	140	370
AUTOBRAKE 2	7930	140/-140	290	-410/1380	60/-120	260/-240	380	130	130

Good Reported Braking Action

MAX MANUAL	5580	120/-90	200	-280/960	160/-140	160/-150	260	320	730
AUTOBRAKE MAX	5520	130/-90	200	-280/950	160/-140	160/-150	280	310	720
AUTOBRAKE 2	7940	140/-140	290	-410/1380	80/-120	260/-240	390	140	140

Medium Reported Braking Action

MAX MANUAL	7260	120/-120	300	-410/1480	350/-280	230/-200	300	780	1960
AUTOBRAKE MAX	7220	120/-120	300	-410/1480	360/-280	230/-200	310	770	1940
AUTOBRAKE 3	7640	130/-120	280	-430/1530	270/-170	230/-220	400	420	1520

Poor Reported Braking Action

MAX MANUAL	9160	160/-150	410	-600/2360	880/-530	300/-240	320	1530	4250
AUTOBRAKE MAX	9160	160/-150	410	-600/2360	900/-540	300/-250	320	1530	4250
AUTOBRAKE 3	9240	160/-150	400	-610/2370	860/-490	300/-250	370	1450	4170

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (2 Body or 2 Wing Gear Up) - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV
Dry Runway									
MAX MANUAL	6460	340/-130	330	-320/1490	210/-170	250/-180	350	490	1170
AUTOBRAKE MAX	6500	380/-140	350	-350/1550	210/-180	260/-230	380	510	1220
AUTOBRAKE 2	8630	300/-150	330	-430/1530	120/-130	290/-270	430	110	120
Good Reported Braking Action									
MAX MANUAL	6460	340/-120	330	-320/1490	210/-170	250/-180	350	490	1170
AUTOBRAKE MAX	6500	380/-120	350	-350/1550	210/-180	260/-230	380	510	1220
AUTOBRAKE 2	8630	300/-150	330	-430/1530	120/-130	290/-270	430	110	120
Medium Reported Braking Action									
MAX MANUAL	7790	280/-130	330	-420/1520	380/-300	250/-220	310	940	2440
AUTOBRAKE MAX	7720	330/-130	330	-420/1520	380/-300	250/-220	320	930	2410
AUTOBRAKE 3	8210	310/-130	310	-440/1580	280/-180	250/-240	420	490	1920
Poor Reported Braking Action									
MAX MANUAL	9890	200/-170	470	-630/2440	950/-570	330/-260	340	1890	5510
AUTOBRAKE MAX	9870	240/-170	470	-630/2440	960/-580	330/-270	340	1880	5500
AUTOBRAKE 3	9940	240/-160	460	-630/2440	930/-530	320/-270	390	1800	5420

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (2 Body or 2 Wing Gear Up) - Flaps 30

VREF30

BRAKING CONFIGURATION	REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	5900	260/-120	260	-300/1250	180/-150	180/-160	260	380	890
AUTOBRAKE MAX	5850	300/-120	290	-300/1370	180/-150	220/-160	340	370	860
AUTOBRAKE 2	7980	230/-140	290	-410/1410	70/-120	260/-240	390	120	120
Good Reported Braking Action									
MAX MANUAL	5900	260/-100	260	-300/1250	180/-150	180/-160	260	380	890
AUTOBRAKE MAX	5850	300/-100	290	-300/1370	180/-150	220/-160	340	370	860
AUTOBRAKE 2	7980	230/-140	290	-410/1410	70/-120	260/-240	390	120	120
Medium Reported Braking Action									
MAX MANUAL	7300	210/-120	300	-410/1490	360/-280	230/-200	300	790	1990
AUTOBRAKE MAX	7250	240/-120	300	-410/1480	370/-280	230/-200	310	780	1970
AUTOBRAKE 3	7650	220/-120	280	-430/1530	270/-180	230/-220	400	440	1570
Poor Reported Braking Action									
MAX MANUAL	9220	160/-150	420	-610/2370	890/-540	300/-250	320	1560	4360
AUTOBRAKE MAX	9220	160/-150	420	-610/2370	910/-550	300/-250	330	1560	4360
AUTOBRAKE 3	9290	160/-150	410	-610/2370	880/-500	300/-250	370	1500	4290

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (Nose Gear Up) - Flaps 25

VREF25

BRAKING CONFIGURATION	REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	4190	120/-70	140	-190/650	70/-60	120/-110	180	160	360
AUTOBRAKE MAX	5090	100/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8320	150/-150	330	-420/1400	130/-180	280/-260	350	320	320
Good Reported Braking Action									
MAX MANUAL	5330	90/-90	210	-270/930	140/-120	160/-150	240	390	920
AUTOBRAKE MAX	5600	90/-90	210	-280/950	130/-100	170/-160	270	400	930
AUTOBRAKE 2	8320	150/-150	330	-420/1400	130/-180	280/-260	350	320	320
Medium Reported Braking Action									
MAX MANUAL	7150	130/-120	320	-410/1460	340/-270	240/-200	290	960	2460
AUTOBRAKE MAX	7210	130/-120	320	-410/1470	340/-240	240/-210	310	920	2390
AUTOBRAKE 3	7990	140/-130	300	-440/1550	210/-190	250/-230	370	470	1830
Poor Reported Braking Action									
MAX MANUAL	9190	170/-160	450	-600/2370	900/-530	310/-250	320	1860	5360
AUTOBRAKE MAX	9200	170/-160	450	-600/2370	910/-530	320/-250	330	1850	5360
AUTOBRAKE 3	9420	170/-160	440	-610/2390	840/-490	310/-260	360	1710	5250

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
GEAR DISAGREE (Nose Gear Up) - Flaps 30
VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	3870	100/-60	130	-180/620	60/-60	110/-100	190	130	280
AUTOBRAKE MAX	4750	90/-70	150	-220/740	0/0	130/-130	260	0	0
AUTOBRAKE 2	7640	130/-130	300	-400/1350	140/-160	250/-230	320	330	330

Good Reported Braking Action

MAX MANUAL	5030	80/-80	190	-260/910	140/-120	150/-140	240	340	780
AUTOBRAKE MAX	5300	90/-90	200	-270/930	120/-100	160/-150	260	340	790
AUTOBRAKE 2	7640	130/-130	300	-400/1350	140/-160	250/-230	320	330	330

Medium Reported Braking Action

MAX MANUAL	6680	120/-110	290	-390/1430	330/-250	220/-190	270	800	2010
AUTOBRAKE MAX	6780	120/-110	290	-400/1440	310/-230	220/-200	300	780	1950
AUTOBRAKE 3	7400	130/-120	280	-420/1510	240/-190	230/-220	340	430	1490

Poor Reported Braking Action

MAX MANUAL	8550	160/-140	400	-580/2300	850/-500	290/-230	300	1540	4250
AUTOBRAKE MAX	8600	160/-150	400	-580/2300	850/-500	290/-240	310	1530	4260
AUTOBRAKE 3	8780	160/-150	390	-590/2320	810/-470	290/-240	340	1420	4160

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR LEVER JAMMED IN UP POSITION - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6460	340/-130	330	-320/1490	210/-170	250/-180	350	490	1170
AUTOBRAKE MAX	6500	380/-140	350	-350/1550	210/-180	260/-230	380	510	1220
AUTOBRAKE 2	8630	300/-150	330	-430/1530	120/-130	290/-270	430	110	120

Good Reported Braking Action

MAX MANUAL	6460	340/-120	330	-320/1490	210/-170	250/-180	350	490	1170
AUTOBRAKE MAX	6500	380/-120	350	-350/1550	210/-180	260/-230	380	510	1220
AUTOBRAKE 2	8630	300/-150	330	-430/1530	120/-130	290/-270	430	110	120

Medium Reported Braking Action

MAX MANUAL	7790	280/-130	330	-420/1520	380/-300	250/-220	310	940	2440
AUTOBRAKE MAX	7720	330/-130	330	-420/1520	380/-300	250/-220	320	930	2410
AUTOBRAKE 3	8210	310/-130	310	-440/1580	280/-180	250/-240	420	490	1920

Poor Reported Braking Action

MAX MANUAL	9890	200/-170	470	-630/2440	950/-570	330/-260	340	1890	5510
AUTOBRAKE MAX	9870	240/-170	470	-630/2440	960/-580	330/-270	340	1880	5500
AUTOBRAKE 3	9940	240/-160	460	-630/2440	930/-530	320/-270	390	1800	5420

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR LEVER JAMMED IN UP POSITION - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5900	260/-120	260	-300/1250	180/-150	180/-160	260	380	890
AUTOBRAKE MAX	5850	300/-120	290	-300/1370	180/-150	220/-160	340	370	860
AUTOBRAKE 2	7980	230/-140	290	-410/1410	70/-120	260/-240	390	120	120

Good Reported Braking Action

MAX MANUAL	5900	260/-100	260	-300/1250	180/-150	180/-160	260	380	890
AUTOBRAKE MAX	5850	300/-100	290	-300/1370	180/-150	220/-160	340	370	860
AUTOBRAKE 2	7980	230/-140	290	-410/1410	70/-120	260/-240	390	120	120

Medium Reported Braking Action

MAX MANUAL	7300	210/-120	300	-410/1490	360/-280	230/-200	300	790	1990
AUTOBRAKE MAX	7250	240/-120	300	-410/1480	370/-280	230/-200	310	780	1970
AUTOBRAKE 3	7650	220/-120	280	-430/1530	270/-180	230/-220	400	440	1570

Poor Reported Braking Action

MAX MANUAL	9220	160/-150	420	-610/2370	890/-540	300/-250	320	1560	4360
AUTOBRAKE MAX	9220	160/-150	420	-610/2370	910/-550	300/-250	330	1560	4360
AUTOBRAKE 3	9290	160/-150	410	-610/2370	880/-500	300/-250	370	1500	4290

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 1 / HYD PRESS SYS 2 / HYD PRESS SYS 3 - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV
Dry Runway									
MAX MANUAL	4280	130/-70	150	-200/650	70/-60	120/-120	190	170	390
AUTOBRAKE MAX	5080	110/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8570	150/-150	310	-430/1430	60/-130	280/-270	420	120	120
Good Reported Braking Action									
MAX MANUAL	5610	100/-90	220	-280/960	160/-140	180/-160	270	460	1110
AUTOBRAKE MAX	5760	100/-100	230	-280/970	140/-120	180/-160	280	450	1070
AUTOBRAKE 2	8570	150/-150	310	-430/1430	60/-130	280/-270	420	120	120
Medium Reported Braking Action									
MAX MANUAL	7560	140/-130	350	-420/1510	380/-300	260/-220	320	1130	2980
AUTOBRAKE MAX	7550	140/-130	350	-420/1510	380/-290	250/-220	330	1100	2940
AUTOBRAKE 3	8070	140/-130	320	-440/1570	250/-140	250/-240	430	710	2580
Poor Reported Braking Action									
MAX MANUAL	9750	190/-170	500	-630/2440	990/-590	340/-270	350	2190	6600
AUTOBRAKE MAX	9730	190/-170	510	-630/2440	1000/-600	340/-270	350	2190	6590
AUTOBRAKE 3	9780	190/-170	500	-630/2450	970/-510	340/-270	410	2150	6550

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 1 / HYD PRESS SYS 2 / HYD PRESS SYS 3 - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4010	100/-60	140	-190/630	70/-60	120/-110	220	150	330
AUTOBRAKE MAX	4750	90/-70	150	-220/740	0/0	130/-130	260	0	10
AUTOBRAKE 2	7910	140/-140	290	-410/1380	70/-150	260/-240	370	140	140

Good Reported Braking Action

MAX MANUAL	5290	90/-90	210	-270/940	160/-130	160/-150	260	400	940
AUTOBRAKE MAX	5450	90/-90	210	-280/950	130/-110	170/-160	280	390	910
AUTOBRAKE 2	7910	140/-140	290	-410/1380	70/-150	260/-240	370	140	140

Medium Reported Braking Action

MAX MANUAL	7060	130/-120	310	-410/1470	360/-280	230/-200	310	940	2410
AUTOBRAKE MAX	7080	130/-120	310	-410/1480	360/-280	240/-200	320	910	2380
AUTOBRAKE 3	7540	130/-120	290	-430/1530	240/-170	230/-220	390	610	2100

Poor Reported Braking Action

MAX MANUAL	9050	170/-160	440	-610/2370	930/-550	310/-250	330	1810	5150
AUTOBRAKE MAX	9060	170/-160	440	-610/2370	940/-560	310/-250	330	1810	5160
AUTOBRAKE 3	9150	170/-160	440	-610/2380	900/-510	310/-260	370	1780	5150

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 4 - Flaps 25
VREF25

BRAKING CONFIGURATION	REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	5150	100/-80	190	-240/800	110/-100	150/-140	260	300	690
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								
Good Reported Braking Action									
MAX MANUAL	6630	120/-110	280	-340/1170	230/-200	210/-190	310	700	1750
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								
Medium Reported Braking Action									
MAX MANUAL	8580	160/-150	410	-500/1830	530/-390	290/-240	340	1480	4120
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								
Poor Reported Braking Action									
MAX MANUAL	10740	200/-180	550	-740/2990	1700/-740	370/-280	370	2630	8320
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 4 - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4810	80/-70	170	-230/780	100/-90	140/-130	260	250	560
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	6100	100/-100	240	-320/1130	210/-180	190/-170	290	560	1350
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	7790	140/-130	350	-470/1750	480/-350	260/-220	310	1140	3010
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	9690	180/-160	460	-690/2850	1500/-670	320/-250	320	2010	5850
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 1 and HYD PRESS SYS 2 / HYD PRESS SYS 1 and HYD PRESS SYS 3 - Flaps 25

VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4800	150/-70	170	-210/680	80/-70	140/-130	230	220	480
AUTOBRAKE MAX	5840	120/-80	180	-250/810	10/-10	170/-170	300	0	0
AUTOBRAKE 2	9720	160/-160	380	-450/1510	130/-210	330/-300	380	360	360

Good Reported Braking Action

MAX MANUAL	6340	100/-100	250	-300/1010	180/-160	200/-180	280	560	1340
AUTOBRAKE MAX	6540	100/-100	260	-300/1020	160/-140	210/-190	300	550	1320
AUTOBRAKE 2	9720	160/-160	380	-450/1510	140/-210	330/-300	380	360	360

Medium Reported Braking Action

MAX MANUAL	8430	140/-140	390	-440/1570	410/-330	290/-250	320	1300	3430
AUTOBRAKE MAX	8460	140/-140	390	-440/1580	410/-320	290/-250	340	1240	3370
AUTOBRAKE 3	9250	140/-140	360	-470/1650	240/-210	290/-280	410	690	2790

Poor Reported Braking Action

MAX MANUAL	10720	190/-180	550	-650/2510	1020/-620	380/-300	350	2420	7250
AUTOBRAKE MAX	10710	190/-180	560	-650/2510	1040/-620	380/-300	360	2420	7240
AUTOBRAKE 3	10910	190/-180	540	-660/2530	950/-570	380/-310	390	2280	7130

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 1+4 - Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5950	110/-80	220	-260/850	130/-120	180/-160	290	350	810
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	7570	120/-120	310	-360/1230	270/-220	240/-220	320	800	2010
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	9640	160/-160	450	-520/1900	570/-420	330/-270	350	1640	4550
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	11870	210/-190	600	-760/3070	1750/-780	410/-310	360	2830	8890
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 2+3 - Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV
Dry Runway									
MAX MANUAL	5080	140/-70	180	-210/710	100/-90	150/-140	260	270	610
AUTOBRAKE MAX	5840	120/-80	180	-250/810	10/-10	170/-170	300	10	190
AUTOBRAKE 2	9890	160/-160	360	-460/1530	90/-160	330/-310	440	190	190
Good Reported Braking Action									
MAX MANUAL	6710	110/-100	280	-310/1040	210/-180	220/-190	320	670	1650
AUTOBRAKE MAX	6770	110/-100	280	-310/1050	190/-150	220/-200	320	640	1550
AUTOBRAKE 2	9890	160/-160	360	-460/1530	100/-160	330/-310	440	190	190
Medium Reported Braking Action									
MAX MANUAL	8880	150/-150	430	-460/1620	460/-360	310/-260	360	1510	4100
AUTOBRAKE MAX	8840	150/-150	430	-460/1620	470/-350	310/-260	370	1500	4070
AUTOBRAKE 3	9320	150/-140	390	-470/1670	310/-170	300/-280	450	1090	3700
Poor Reported Braking Action									
MAX MANUAL	11230	210/-190	600	-670/2570	1100/-670	400/-320	390	2760	8570
AUTOBRAKE MAX	11200	210/-190	600	-670/2570	1110/-680	410/-320	390	2750	8550
AUTOBRAKE 3	11250	200/-190	600	-670/2580	1090/-600	400/-320	430	2700	8490

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 2 and HYD PRESS SYS 4 / HYD PRESS SYS 3 and HYD PRESS SYS 4 - Flaps 25

VREF30+20

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6240	110/-90	240	-270/880	150/-130	190/-180	330	470	1120
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	7950	130/-130	350	-370/1270	300/-250	260/-230	360	1020	2630
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	10100	180/-170	510	-540/1960	640/-470	350/-290	390	2000	5780
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	12440	230/-210	680	-790/3150	1880/-850	440/-330	400	3370	11150
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 1+2+4 - Flaps 25
VREF30+20

BRAKING CONFIGURATION	REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	7310	110/-110	300	-330/1100	230/-200	230/-210	350	720	1790
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								
Good Reported Braking Action									
MAX MANUAL	8350	140/-130	370	-400/1360	340/-280	280/-240	370	1090	2850
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								
Medium Reported Braking Action									
MAX MANUAL	10540	190/-170	530	-570/2090	720/-510	370/-300	400	2120	6230
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								
Poor Reported Braking Action									
MAX MANUAL	12930	230/-210	700	-840/3410	2580/-930	460/-340	410	3550	12000
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Jammed Stab Landing - Flaps 25

VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4680	140/-70	160	-200/670	70/-70	140/-130	180	190	430
AUTOBRAKE MAX	5840	110/-80	180	-250/810	10/-20	170/-170	290	0	0
AUTOBRAKE 2	9270	150/-160	380	-440/1470	190/-210	320/-290	340	620	690

Good Reported Braking Action

MAX MANUAL	5990	90/-90	230	-280/970	160/-140	190/-170	250	470	1100
AUTOBRAKE MAX	6330	100/-90	240	-290/1000	140/-110	190/-180	280	470	1120
AUTOBRAKE 2	9270	150/-160	380	-440/1470	200/-210	320/-290	340	620	690

Medium Reported Braking Action

MAX MANUAL	7930	130/-130	350	-420/1520	370/-290	270/-230	290	1080	2780
AUTOBRAKE MAX	8070	130/-130	360	-430/1530	340/-280	270/-230	310	1060	2720
AUTOBRAKE 3	8980	140/-140	350	-460/1620	290/-240	290/-260	340	590	1960

Poor Reported Braking Action

MAX MANUAL	10060	180/-160	490	-620/2430	930/-560	350/-280	310	2030	5820
AUTOBRAKE MAX	10100	180/-170	490	-620/2430	920/-560	350/-280	320	1990	5790
AUTOBRAKE 3	10410	180/-170	480	-630/2460	890/-540	350/-290	340	1780	5580

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

NOSE AND BODY GEAR UP - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6460	340/-130	330	-320/1490	210/-170	250/-180	350	490	1170
AUTOBRAKE MAX	6500	380/-140	350	-350/1550	210/-180	260/-230	380	510	1220
AUTOBRAKE 2	8630	300/-150	330	-430/1530	120/-130	290/-270	430	110	120

Good Reported Braking Action

MAX MANUAL	6460	340/-120	330	-320/1490	210/-170	250/-180	350	490	1170
AUTOBRAKE MAX	6500	380/-120	350	-350/1550	210/-180	260/-230	380	510	1220
AUTOBRAKE 2	8630	300/-150	330	-430/1530	120/-130	290/-270	430	110	120

Medium Reported Braking Action

MAX MANUAL	7790	280/-130	330	-420/1520	380/-300	250/-220	310	940	2440
AUTOBRAKE MAX	7720	330/-130	330	-420/1520	380/-300	250/-220	320	930	2410
AUTOBRAKE 3	8210	310/-130	310	-440/1580	280/-180	250/-240	420	490	1920

Poor Reported Braking Action

MAX MANUAL	9890	200/-170	470	-630/2440	950/-570	330/-260	340	1890	5510
AUTOBRAKE MAX	9870	240/-170	470	-630/2440	960/-580	330/-270	340	1880	5500
AUTOBRAKE 3	9940	240/-160	460	-630/2440	930/-530	320/-270	390	1800	5420

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
NOSE AND BODY GEAR UP - Flaps 30
VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5900	260/-120	260	-300/1250	180/-150	180/-160	260	380	890
AUTOBRAKE MAX	5850	300/-120	290	-300/1370	180/-150	220/-160	340	370	860
AUTOBRAKE 2	7980	230/-140	290	-410/1410	70/-120	260/-240	390	120	120

Good Reported Braking Action

MAX MANUAL	5900	260/-100	260	-300/1250	180/-150	180/-160	260	380	890
AUTOBRAKE MAX	5850	300/-100	290	-300/1370	180/-150	220/-160	340	370	860
AUTOBRAKE 2	7980	230/-140	290	-410/1410	70/-120	260/-240	390	120	120

Medium Reported Braking Action

MAX MANUAL	7300	210/-120	300	-410/1490	360/-280	230/-200	300	790	1990
AUTOBRAKE MAX	7250	240/-120	300	-410/1480	370/-280	230/-200	310	780	1970
AUTOBRAKE 3	7650	220/-120	280	-430/1530	270/-180	230/-220	400	440	1570

Poor Reported Braking Action

MAX MANUAL	9220	160/-150	420	-610/2370	890/-540	300/-250	320	1560	4360
AUTOBRAKE MAX	9220	160/-150	420	-610/2370	910/-550	300/-250	330	1560	4360
AUTOBRAKE 3	9290	160/-150	410	-610/2370	880/-500	300/-250	370	1500	4290

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

REVERSER UNLOCKED - Flaps 25

VREF30+20

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT) REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	4880	150/-70	160	-210/700	90/-80	140/-130	190	0	230
AUTOBRAKE MAX	5840	140/-80	180	-250/810	10/-10	170/-170	300	0	0
AUTOBRAKE 2	9890	150/-150	350	-460/1530	70/-150	320/-310	410	0	70
Good Reported Braking Action									
MAX MANUAL	6460	100/-100	230	-310/1040	200/-170	200/-180	270	0	630
AUTOBRAKE MAX	6810	100/-100	240	-320/1070	180/-150	210/-190	300	0	650
AUTOBRAKE 2	9890	150/-150	350	-460/1530	80/-150	320/-310	410	0	70
Medium Reported Braking Action									
MAX MANUAL	9020	140/-140	370	-480/1690	520/-400	300/-260	330	0	1700
AUTOBRAKE MAX	9130	150/-140	370	-480/1700	490/-370	310/-260	370	0	1660
AUTOBRAKE 3	9580	150/-140	370	-500/1750	430/-280	310/-280	430	0	1360
Poor Reported Braking Action									
MAX MANUAL	12110	200/-190	540	-750/2830	1450/-830	420/-320	370	0	3790
AUTOBRAKE MAX	12110	200/-190	550	-750/2830	1460/-820	420/-320	380	0	3800
AUTOBRAKE 3	12200	200/-190	550	-750/2830	1460/-780	420/-330	420	0	3810

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
STAB TRIM UNSCHD- Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4680	140/-70	160	-200/670	70/-70	140/-130	180	190	430
AUTOBRAKE MAX	5840	110/-80	180	-250/810	10/-20	170/-170	290	0	0
AUTOBRAKE 2	9270	150/-160	380	-440/1470	190/-210	320/-290	340	620	690

Good Reported Braking Action

MAX MANUAL	5990	90/-90	230	-280/970	160/-140	190/-170	250	470	1100
AUTOBRAKE MAX	6330	100/-90	240	-290/1000	140/-110	190/-180	280	470	1120
AUTOBRAKE 2	9270	150/-160	380	-440/1470	200/-210	320/-290	340	620	690

Medium Reported Braking Action

MAX MANUAL	7930	130/-130	350	-420/1520	370/-290	270/-230	290	1080	2780
AUTOBRAKE MAX	8070	130/-130	360	-430/1530	340/-280	270/-230	310	1060	2720
AUTOBRAKE 3	8980	140/-140	350	-460/1620	290/-240	290/-260	340	590	1960

Poor Reported Braking Action

MAX MANUAL	10060	180/-160	490	-620/2430	930/-560	350/-280	310	2030	5820
AUTOBRAKE MAX	10100	180/-170	490	-620/2430	920/-560	350/-280	320	1990	5790
AUTOBRAKE 3	10410	180/-170	480	-630/2460	890/-540	350/-290	340	1780	5580

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Two Engines Inop - Flaps 25

VREF25

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT) REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	4530	150/-70	140	-210/700	90/-80	130/-130	200	0	0
AUTOBRAKE MAX	5090	140/-80	160	-230/760	30/0	140/-140	270	0	0
AUTOBRAKE 2	8640	150/-150	300	-430/1440	20/-30	270/-270	480	0	0
Good Reported Braking Action									
MAX MANUAL	6200	100/-100	200	-310/1050	230/-190	190/-180	300	0	0
AUTOBRAKE MAX	6470	100/-100	210	-320/1080	210/-170	190/-190	330	0	0
AUTOBRAKE 2	8640	150/-150	300	-430/1440	20/-30	270/-270	480	0	0
Medium Reported Braking Action									
MAX MANUAL	9410	150/-150	320	-520/1810	720/-520	300/-280	400	0	0
AUTOBRAKE MAX	9400	160/-150	330	-520/1810	730/-490	300/-280	430	0	0
AUTOBRAKE 3	9610	160/-150	330	-530/1830	720/-520	300/-280	410	0	0
Poor Reported Braking Action									
MAX MANUAL	13900	230/-220	490	-870/3120	2300/-1240	460/-390	480	0	0
AUTOBRAKE MAX	13910	230/-220	490	-870/3120	2320/-1260	460/-390	490	0	0
AUTOBRAKE 3	14020	230/-220	490	-870/3130	2300/-1270	460/-390	480	0	0

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Reference Brake Energy per Brake (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)																	
		80			100			120			140			160			180		
WEIGHT (1000 KG)	OAT (°C)	PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT		
		0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8
450	0	22.0	24.2	26.7	32.0	35.6	39.7	43.5	48.7	54.6	56.2	63.1	70.9	69.4	77.9	87.4	82.5		
	15	23.0	25.4	28.0	33.6	37.4	41.8	45.7	51.1	57.5	59.0	66.1	74.5	72.7	81.5	91.5	86.3		
	20	23.4	25.8	28.5	34.1	38.0	42.4	46.4	51.9	58.4	59.9	67.2	75.6	73.9	82.7	92.9	87.5		
	40	24.2	26.7	29.6	35.5	39.6	44.3	48.5	54.3	61.1	62.7	70.4	79.1	77.4	86.7	97.2	91.7		
	60	24.2	26.8	29.6	36.0	40.2	44.9	49.6	55.6	62.5	64.5	72.5	81.4	79.8	89.5	100.0	94.8		
400	0	20.0	22.0	24.2	29.1	32.3	36.0	39.4	44.0	49.3	50.9	57.0	64.2	62.9	70.5	79.4	74.9	83.9	94.1
	15	21.0	23.1	25.5	30.5	33.9	37.8	41.4	46.2	51.9	53.4	59.8	67.4	65.9	73.9	83.1	78.4	87.7	98.3
	20	21.3	23.4	25.8	31.0	34.4	38.4	42.1	47.0	52.8	54.2	60.8	68.4	67.0	75.0	84.5	79.6	89.0	99.8
	40	22.0	24.2	26.7	32.2	35.8	40.0	43.9	49.1	55.1	56.7	63.6	71.6	70.2	78.6	88.4	83.4	93.2	104.2
	60	22.0	24.2	26.7	32.6	36.3	40.5	44.8	50.2	56.3	58.2	65.4	73.5	72.2	81.1	90.9	86.1	96.4	107.4
350	0	18.1	19.8	21.7	26.1	28.9	32.1	35.3	39.3	44.0	45.4	50.8	57.1	56.1	63.0	70.8	67.0	75.1	84.5
	15	18.9	20.7	22.7	27.4	30.3	33.7	37.0	41.3	46.2	47.6	53.3	59.9	58.9	66.0	74.3	70.2	78.7	88.4
	20	19.2	21.0	23.1	27.8	30.8	34.3	37.6	41.9	47.0	48.4	54.1	60.9	59.8	67.1	75.5	71.3	79.9	89.8
	40	19.8	21.7	23.9	28.9	32.0	35.7	39.2	43.7	49.1	50.6	56.6	63.8	62.6	70.3	79.0	74.7	83.7	93.9
	60	19.6	21.6	23.6	29.1	32.3	36.0	39.9	44.6	50.0	51.7	58.1	65.2	64.4	72.4	81.2	77.0	86.4	96.7
300	0	16.1	17.5	19.1	23.1	25.5	28.2	31.1	34.6	38.5	39.9	44.5	50.0	49.3	55.2	62.1	58.9	66.1	74.3
	15	16.8	18.3	20.0	24.2	26.7	29.6	32.6	36.3	40.5	41.8	46.7	52.4	51.7	57.9	65.2	61.8	69.3	78.0
	20	17.1	18.6	20.4	24.6	27.2	30.1	33.2	36.8	41.3	42.5	47.5	53.3	52.5	58.8	66.2	62.8	70.3	79.2
	40	17.5	19.1	20.9	25.5	28.1	31.3	34.5	38.4	43.0	44.4	49.6	55.8	55.0	61.6	69.4	65.7	73.7	82.9
	60	17.3	19.0	20.7	25.6	28.3	31.4	34.9	39.0	43.5	45.2	50.7	56.8	56.3	63.3	71.0	67.6	76.0	85.2
250	0	14.2	15.3	16.7	20.2	22.1	24.4	26.9	29.8	33.1	34.2	38.1	42.6	42.1	47.0	52.8	50.3	56.3	63.4
	15	14.8	16.1	17.5	21.1	23.2	25.6	28.2	31.3	34.8	35.9	40.0	44.8	44.2	49.4	55.5	52.8	59.1	66.6
	20	15.0	16.3	17.7	21.5	23.6	26.1	28.7	31.8	35.4	36.5	40.7	45.6	44.9	50.2	56.4	53.6	60.0	67.6
	40	15.4	16.7	18.2	22.1	24.4	26.9	29.7	33.0	36.7	38.0	42.4	47.5	46.9	52.4	59.0	56.1	62.9	70.7
	60	15.1	16.5	17.9	22.1	24.4	26.9	30.0	33.4	37.1	38.6	43.2	48.3	47.9	53.7	60.3	57.5	64.6	72.6
200	0	12.4	13.4	14.4	17.3	18.9	20.7	22.7	25.0	27.7	28.5	31.6	35.2	34.6	38.5	43.1	40.9	45.7	51.3
	15	13.0	14.0	15.2	18.2	19.8	21.8	23.8	26.3	29.1	29.9	33.2	37.0	36.3	40.4	45.3	42.9	47.9	53.9
	20	13.2	14.2	15.4	18.4	20.1	22.1	24.2	26.7	29.6	30.4	33.7	37.6	36.9	41.1	46.1	43.6	48.7	54.9
	40	13.5	14.5	15.8	19.0	20.7	22.9	25.0	27.6	30.6	31.5	35.0	39.1	38.4	42.8	48.0	45.5	50.9	57.2
	60	13.1	14.2	15.3	18.8	20.7	22.6	25.1	27.8	30.8	31.9	35.5	39.6	39.0	43.6	48.8	46.4	52.1	58.4

To correct for wind, enter the table with the brakes-on speed minus 0.5 times headwind or plus 1.5 times tailwind.
If ground speed is used for brakes-on speed, ignore wind, altitude and OAT effects, and enter the table at sea level and 15°C.

ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Adjusted Brake Energy per Brake (Millions of Foot Pounds)

No Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)								
EVENT		10	20	30	40	50	60	70	80	90
RTO MAX MAN		10	20	30	40	50	60	70	80	90
LANDING	MAX MAN	4.2	12.9	21.9	30.8	39.8	48.8	58.0	67.4	77.0
	MAX AUTO	4.2	12.4	20.8	29.3	38.1	47.0	56.3	65.7	75.5
	AUTOBRAKE 4	3.6	11.7	19.5	27.4	35.4	43.6	52.4	61.7	71.8
	AUTOBRAKE 3	3.5	11.2	18.5	25.8	33.2	40.8	48.8	57.4	66.8
	AUTOBRAKE 2	3.5	10.6	17.4	24.1	30.9	37.8	45.1	52.9	61.4
	AUTOBRAKE 1	3.1	9.6	15.7	21.6	27.3	33.0	39.1	45.5	52.4

Four Engine Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)								
EVENT		10	20	30	40	50	60	70	80	90
RTO MAX MAN		10	20	30	40	50	60	70	80	90
LANDING	MAX MAN	2.7	11.2	19.5	27.6	35.7	43.7	51.9	60.1	68.6
	MAX AUTO	1.4	8.9	16.1	23.4	30.7	38.3	46.4	55.0	64.3
	AUTOBRAKE 4	0.0	6.5	12.6	18.7	24.9	31.5	38.8	47.0	56.5
	AUTOBRAKE 3		4.6	9.6	14.4	19.3	24.6	30.6	37.8	46.4
	AUTOBRAKE 2		3.0	7.0	10.6	14.1	18.0	22.5	28.2	35.3
	AUTOBRAKE 1		1.8	4.7	7.2	9.6	12.1	15.2	19.3	24.5

Cooling Time (Minutes)

	ADJUSTED BRAKE ENERGY PER BRAKE (MILLION OF FOOT POUNDS)								
	15 & BELOW	16	20	24	28	32	34	35 TO 45	45 & ABOVE
INFLIGHT GEAR DOWN	NO SPECIAL PROCEDURE REQUIRED	1	3	5	6	8	8	CAUTION	FUSE PLUG MELT ZONE
GROUND		10	28	42	55	65	70		
BTMS	UP TO 2	2	2	3	4	4	4	5 TO 6	7 & ABOVE

Observe maximum quick turnaround limit.
Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.
Add 1.0 million foot pounds for each taxi mile.
For one brake deactivated, increase brake energy by 7 percent.
For two brakes deactivated, increase brake energy by 15 percent.
When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after one hour. If overheat occurs after takeoff, extend gear soon for at least 8 minutes.
When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not attempt to taxi for one hour. Tire, wheel, and brake replacement may be required. If overheat occurs after takeoff, extend gear soon for at least 12 minutes.
Brake temperature monitor system (BTMS) indication on EICAS may be used 10 to 15 minutes after airplane has come to a complete stop, or inflight with gear retracted, to determine recommended cooling schedule.

1 ENGINE INOP

Max Continuous %N1

39000 FT to 29000 FT Pressure Altitudes

Based on engine bleed for 3 packs on

39000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
200	.66	100.4	101.5	102.6	103.6	104.7	105.8	106.8	106.0	105.0	104.2	103.4	102.9
240	.78	100.0	101.1	102.1	103.2	104.2	105.0	105.8	105.5	104.7	103.7	102.8	102.1
280	.89	96.8	97.8	98.9	99.9	100.9	102.0	102.9	103.6	104.3	103.8	102.9	101.9
37000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
200	.63	100.4	101.5	102.6	103.6	104.7	105.8	106.8	106.0	105.1	104.3	103.6	101.4
240	.74	100.4	101.5	102.6	103.6	104.7	105.8	106.4	105.6	104.7	103.7	102.9	102.1
280	.86	97.7	98.7	99.7	100.8	101.8	102.8	103.6	104.4	104.2	103.4	102.5	101.5
35000 FT PRESS ALT		TAT (°C)											
KIAS	M	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5
200	.60	100.4	101.5	102.6	103.6	104.7	105.8	106.8	106.9	106.0	105.1	104.3	102.7
240	.71	100.4	101.5	102.6	103.6	104.7	105.8	106.8	106.7	105.7	104.7	103.9	103.1
280	.82	98.8	99.9	100.9	102.0	103.0	104.0	104.9	105.6	105.2	104.3	103.3	102.4
33000 FT PRESS ALT		TAT (°C)											
KIAS	M	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10
200	.58	101.5	102.6	103.6	104.7	105.8	106.8	107.9	107.2	106.3	105.4	104.7	100.9
240	.68	101.5	102.6	103.6	104.7	105.8	106.8	107.9	106.9	106.0	105.0	104.2	103.5
280	.79	100.3	101.4	102.4	103.5	104.5	105.4	106.2	106.5	105.4	104.6	103.6	102.8
320	.89	97.5	98.5	99.5	100.5	101.5	102.5	103.5	104.3	105.1	104.6	103.7	102.8
31000 FT PRESS ALT		TAT (°C)											
KIAS	M	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10
200	.55	101.5	102.6	103.6	104.7	105.8	106.8	107.9	108.3	107.4	106.5	105.7	104.4
240	.65	101.5	102.6	103.6	104.7	105.8	106.8	107.9	107.9	107.0	106.1	105.3	104.4
280	.76	100.6	101.6	102.7	103.7	104.7	105.7	106.5	107.4	106.5	105.6	104.8	103.9
320	.85	97.5	98.6	99.6	100.6	101.6	102.6	103.5	104.4	105.2	105.4	104.3	103.5
29000 FT PRESS ALT		TAT (°C)											
KIAS	M	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15
200	.53	102.6	103.6	104.7	105.8	106.8	107.9	108.9	108.0	107.1	106.2	105.5	102.3
240	.63	102.6	103.6	104.7	105.8	106.8	107.9	108.6	107.6	106.8	105.9	105.0	104.2
280	.72	101.5	102.5	103.5	104.5	105.5	106.4	107.3	107.4	106.3	105.5	104.6	103.8
320	.82	98.7	99.8	100.8	101.7	102.7	103.7	104.6	105.4	106.3	105.2	104.4	103.5
360	.91	96.5	97.5	98.5	99.5	100.5	101.4	102.4	103.3	104.1	104.9	104.9	103.9

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	29	31	33	35	37	39
PACKS OFF	0.4	0.4	0.4	0.5	0.6	0.6
ENGINE ANTI-ICE ON	-0.8	-0.9	-1.0	-1.1	-1.3	-1.5
ENGINE & WING ANTI-ICE ON	-1.6	-1.8	-1.9	-2.1	-2.5	-2.9

1 ENGINE INOP

Max Continuous %N1
27000 FT to 18000 FT Pressure Altitudes
Based on engine bleed for 3 packs on

27000 FT PRESS ALT		TAT (°C)											
KIAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	.50	103.6	104.7	105.8	106.8	107.9	108.9	108.1	107.2	106.3	105.5	104.9	100.0
240	.60	103.6	104.7	105.8	106.8	107.9	108.8	107.8	106.9	106.0	105.1	104.3	103.7
280	.69	101.6	102.6	103.6	104.6	105.6	106.4	107.3	106.4	105.5	104.6	103.8	102.9
320	.79	99.5	100.5	101.5	102.5	103.4	104.4	105.2	106.1	105.8	104.9	104.0	103.2
360	.87	97.5	98.5	99.5	100.4	101.4	102.3	103.2	104.1	104.9	105.5	104.5	103.7
25000 FT PRESS ALT		TAT (°C)											
KIAS	M	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20
200	.48	103.6	104.7	105.8	106.8	107.9	108.9	108.1	107.2	106.3	105.4	104.7	102.6
240	.57	103.2	104.2	105.2	106.2	107.1	108.0	107.8	106.8	105.9	105.1	104.2	103.5
280	.66	100.6	101.6	102.6	103.6	104.5	105.4	106.3	106.4	105.4	104.5	103.6	102.8
320	.75	98.8	99.8	100.7	101.7	102.7	103.6	104.5	105.3	105.9	104.9	104.1	103.2
360	.84	97.3	98.3	99.2	100.2	101.1	102.1	103.0	103.9	104.7	105.5	105.0	104.1
24000 FT PRESS ALT		TAT (°C)											
KIAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
200	.47	104.7	105.8	106.8	107.9	108.9	108.1	107.3	106.4	105.6	104.8	103.9	99.2
240	.56	103.7	104.7	105.7	106.6	107.4	107.8	106.9	106.0	105.2	104.4	103.6	103.0
280	.65	101.3	102.3	103.2	104.2	105.1	105.9	106.5	105.5	104.7	103.9	103.1	102.3
320	.74	99.3	100.3	101.3	102.2	103.2	104.1	104.9	105.7	104.9	104.1	103.3	102.5
360	.82	97.9	98.8	99.8	100.7	101.6	102.5	103.4	104.3	105.1	104.9	104.1	103.3
22000 FT PRESS ALT		TAT (°C)											
KIAS	M	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25
200	.45	104.5	105.5	106.4	107.3	108.1	108.0	107.2	106.5	105.8	105.0	104.4	102.0
240	.54	102.5	103.5	104.5	105.4	106.2	107.1	106.7	106.0	105.3	104.6	103.9	103.2
280	.62	100.5	101.4	102.4	103.3	104.2	105.1	105.9	105.6	104.9	104.2	103.5	102.8
320	.71	98.4	99.4	100.3	101.3	102.2	103.1	103.9	104.7	104.8	104.0	103.3	102.7
360	.79	97.0	97.9	98.9	99.8	100.7	101.6	102.5	103.3	104.1	104.6	103.8	103.2
20000 FT PRESS ALT		TAT (°C)											
KIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.43	104.0	104.9	105.9	106.7	107.4	106.8	106.2	105.7	105.1	104.4	103.8	99.9
240	.51	102.1	103.1	104.0	104.9	105.7	106.3	105.6	105.1	104.5	103.9	103.2	102.7
280	.60	100.3	101.2	102.1	103.0	103.9	104.7	105.3	104.6	104.1	103.6	102.9	102.3
320	.68	98.4	99.3	100.3	101.2	102.1	102.9	103.7	104.4	103.7	103.2	102.7	102.1
360	.76	97.0	97.9	98.8	99.7	100.6	101.4	102.3	103.0	103.8	103.4	102.9	102.4
18000 FT PRESS ALT		TAT (°C)											
KIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.41	103.0	103.9	104.8	105.7	106.6	107.2	106.5	106.0	105.5	104.8	104.1	102.6
240	.49	101.1	102.1	103.0	103.9	104.8	105.7	105.9	105.3	104.8	104.2	103.6	102.8
280	.57	99.4	100.4	101.3	102.2	103.1	104.0	104.8	104.9	104.3	103.9	103.3	102.7
320	.65	97.9	98.8	99.7	100.6	101.5	102.4	103.2	104.1	104.3	103.7	103.2	102.7
360	.72	96.4	97.3	98.2	99.1	100.0	100.9	101.7	102.6	103.4	103.9	103.2	102.8

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	18	20	22	24	25	27
PACKS OFF	0.4	0.4	0.4	0.4	0.4	0.4
ENGINE ANTI-ICE ON	-0.6	-0.7	-0.7	-0.7	-0.8	-0.8
ENGINE & WING ANTI-ICE ON	-1.2	-1.4	-1.4	-1.4	-1.6	-1.6

1 ENGINE INOP

Max Continuous %N1
16000 FT to 5000 FT Pressure Altitudes
Based on engine bleed for 3 packs on

16000 FT PRESS ALT		TAT (°C)											
KIAS	M	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
200	.39	101.5	102.4	103.4	104.3	105.2	106.0	106.0	105.4	104.8	104.2	103.6	102.9
240	.47	100.2	101.1	102.0	103.0	103.9	104.7	105.6	105.2	104.6	104.0	103.4	102.8
280	.54	98.8	99.7	100.6	101.5	102.4	103.3	104.2	105.0	104.4	103.8	103.2	102.7
320	.62	97.3	98.2	99.1	100.0	100.9	101.8	102.7	103.5	104.3	103.8	103.2	102.6
360	.69	95.8	96.7	97.6	98.5	99.4	100.3	101.1	102.0	102.8	103.6	103.3	102.7
14000 FT PRESS ALT		TAT (°C)											
KIAS	M	-20	-15	-10	-5	0	5	10	15	20	25	30	35
200	.37	100.0	100.9	101.8	102.7	103.6	104.4	103.9	103.3	102.6	102.1	101.5	100.8
240	.45	99.4	100.3	101.2	102.1	103.0	103.9	104.4	103.8	103.1	102.5	101.9	101.4
280	.52	98.7	99.6	100.5	101.4	102.3	103.2	104.0	104.3	103.7	103.0	102.4	101.9
320	.59	97.7	98.6	99.5	100.4	101.3	102.1	103.0	103.8	104.0	103.4	102.8	102.1
360	.67	95.9	96.8	97.7	98.6	99.4	100.3	101.2	102.0	102.8	103.1	102.5	101.9
12000 FT PRESS ALT		TAT (°C)											
KIAS	M	-20	-15	-10	-5	0	5	10	15	20	25	30	35
200	.36	99.2	100.1	101.0	102.0	102.8	103.7	104.2	103.6	103.0	102.3	101.8	101.2
240	.43	98.7	99.6	100.5	101.4	102.3	103.1	103.9	104.0	103.4	102.8	102.2	101.6
280	.50	98.0	98.9	99.8	100.7	101.6	102.5	103.3	104.1	103.9	103.3	102.7	102.1
320	.57	97.3	98.2	99.1	100.0	100.9	101.7	102.6	103.4	104.2	103.8	103.2	102.6
360	.64	95.6	96.5	97.4	98.3	99.2	100.0	100.9	101.7	102.5	103.3	102.9	102.3
10000 FT PRESS ALT		TAT (°C)											
KIAS	M	-15	-10	-5	0	5	10	15	20	25	30	35	40
200	.34	99.3	100.2	101.1	102.0	102.8	103.6	103.7	103.1	102.6	102.0	101.4	100.9
240	.41	98.8	99.7	100.6	101.4	102.3	103.1	103.9	103.5	103.0	102.4	101.8	101.3
280	.48	98.2	99.1	99.9	100.8	101.7	102.5	103.3	103.9	103.4	102.8	102.3	101.7
320	.54	97.5	98.4	99.3	100.1	101.0	101.9	102.7	103.4	103.9	103.3	102.8	102.2
360	.61	96.1	97.0	97.9	98.8	99.6	100.5	101.3	102.1	102.9	103.2	102.7	102.2
5000 FT PRESS ALT		TAT (°C)											
KIAS	M	-10	-5	0	5	10	15	20	25	30	35	40	45
200	.30	97.3	98.2	99.1	99.9	100.8	101.6	102.3	102.1	101.5	100.9	100.3	99.7
240	.36	96.9	97.7	98.6	99.5	100.3	101.2	101.9	102.4	101.8	101.2	100.6	100.1
280	.42	96.4	97.2	98.1	99.0	99.8	100.7	101.4	102.2	102.2	101.6	101.0	100.4
320	.48	95.8	96.7	97.5	98.4	99.2	100.1	100.9	101.6	102.3	102.3	102.1	101.5
360	.55	95.2	96.0	96.9	97.7	98.6	99.4	100.2	101.0	101.8	102.5	102.0	101.4

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	5	10	12	14	16
PACKS OFF	0.2	0.2	0.3	0.3	0.4
ENGINE ANTI-ICE ON	-0.5	-0.6	-0.6	-0.6	-0.6
ENGINE & WING ANTI-ICE ON	-1.0	-1.2	-1.2	-1.2	-1.2

1 ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	392	305	26800	25400	23600
380	372	299	28300	27100	25600
360	353	291	29700	28700	27500
340	333	284	31100	30200	29200
320	314	276	32500	31700	30700
300	294	268	34000	33200	32300
280	274	259	35400	34800	33900
260	255	249	36800	36200	35400
240	235	240	38400	37800	37100
220	216	230	40100	39500	38800
200	196	219	41900	41300	40600

Altitude reduced by 1000 ft for additional margin.

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability

Based on engine bleed for packs on or off

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	24800	22100	19200
390	25700	23300	20400
380	26500	24400	21600
370	27300	25300	22700
360	28100	26200	23800
350	28900	27100	24900
340	29700	28000	26000
330	30400	28900	27000
320	31200	29700	28000
310	32000	30500	29000
300	32800	31400	29900
290	33600	32200	30800
280	34300	33100	31700
270	35100	34000	32600
260	35800	34800	33500
250	36500	35600	34400
240	37300	36400	35300
230	38100	37300	36100
220	39000	38200	37000
210	39800	39000	38000
200	40700	39900	38900

Altitude reduced by 1000 ft for additional margin.
With engine anti-ice on, decrease altitude capability by 1300 ft.
With engine and wing anti-ice on, decrease altitude capability by 2400 ft.

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	14	15	20	25	29	31	33	35	37
400	%N1	89.0	92.0	92.7	96.7	100.6					
	MACH	.647	.694	.707	.772	.819					
	KIAS	360	360	360	359	347					
	FF/ENG	4627	4706	4724	4818	4835					
380	%N1	88.0	90.9	91.6	95.3	99.0					
	MACH	.640	.687	.699	.759	.809					
	KIAS	356	356	356	353	342					
	FF/ENG	4430	4502	4514	4539	4552					
360	%N1	86.5	89.5	90.2	93.9	97.6	101.4				
	MACH	.625	.671	.683	.744	.798	.832				
	KIAS	347	348	348	345	337	324				
	FF/ENG	4167	4233	4245	4262	4282	4310				
340	%N1	85.0	88.0	88.7	92.4	96.1	99.4				
	MACH	.608	.654	.666	.727	.785	.822				
	KIAS	338	338	338	337	331	320				
	FF/ENG	3911	3969	3979	3986	4023	4039				
320	%N1	83.4	86.4	87.1	90.8	94.6	97.6	99.6			
	MACH	.591	.636	.648	.710	.770	.810	.828			
	KIAS	328	329	329	328	324	315	309			
	FF/ENG	3662	3707	3717	3720	3765	3772	3786			
300	%N1	81.7	84.7	85.5	89.2	93.0	96.0	97.6	99.9		
	MACH	.573	.617	.629	.690	.753	.797	.816	.832		
	KIAS	318	319	319	319	316	309	304	297		
	FF/ENG	3422	3451	3460	3463	3506	3516	3520	3544		
280	%N1	80.0	83.0	83.8	87.5	91.2	94.3	95.8	97.6	100.1	
	MACH	.555	.598	.609	.669	.733	.781	.802	.820	.837	
	KIAS	308	308	308	309	307	302	298	292	286	
	FF/ENG	3191	3204	3209	3213	3245	3267	3265	3268	3295	
260	%N1	78.0	81.1	81.9	85.6	89.4	92.5	94.0	95.5	97.4	
	MACH	.536	.577	.588	.647	.711	.762	.785	.806	.824	
	KIAS	297	297	297	298	298	294	291	287	281	
	FF/ENG	2968	2963	2965	2964	2987	3017	3020	3011	3014	
240	%N1	76.0	79.0	79.8	83.7	87.4	90.5	92.0	93.6	95.1	97.6
	MACH	.517	.556	.566	.624	.687	.740	.765	.788	.809	.827
	KIAS	287	286	286	287	287	285	283	280	275	269
	FF/ENG	2749	2730	2729	2718	2737	2761	2773	2773	2758	2791
220	%N1	73.8	76.8	77.6	81.5	85.3	88.3	89.9	91.5	93.0	95.0
	MACH	.498	.534	.544	.599	.661	.714	.741	.766	.790	.810
	KIAS	276	274	274	275	275	275	273	271	268	263
	FF/ENG	2535	2505	2500	2478	2492	2504	2520	2530	2526	2529
200	%N1	71.5	74.4	75.2	79.1	83.0	86.0	87.6	89.2	90.7	92.7
	MACH	.479	.512	.521	.573	.633	.686	.713	.740	.766	.790
	KIAS	265	263	262	262	263	263	262	261	259	256
	FF/ENG	2332	2286	2280	2247	2248	2256	2265	2279	2287	2296

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
692	643	600	562	530	500	479	460	442	426	411
1389	1290	1202	1126	1060	1000	960	923	888	856	827
2092	1942	1808	1693	1591	1500	1440	1384	1333	1285	1241
2801	2598	2416	2260	2123	2000	1920	1846	1777	1714	1656
3518	3259	3027	2829	2656	2500	2401	2308	2222	2143	2070
4242	3925	3642	3401	3190	3000	2881	2770	2666	2571	2483
4973	4596	4260	3974	3724	3500	3361	3231	3110	2998	2896
5713	5273	4882	4549	4260	4000	3840	3692	3553	3425	3308
6460	5955	5507	5126	4796	4500	4320	4152	3996	3852	3720
7217	6645	6137	5706	5334	5000	4800	4613	4439	4278	4130

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		22		29		33	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
500	13.5	1:26	12.4	1:22	10.6	1:15	9.5	1:11	9.1	1:10
1000	27.1	2:51	25.4	2:42	22.2	2:26	20.3	2:16	19.6	2:12
1500	40.5	4:18	38.0	4:04	33.5	3:38	30.8	3:21	29.8	3:16
2000	53.5	5:47	50.3	5:27	44.5	4:51	41.1	4:27	39.6	4:19
2500	66.3	7:18	62.3	6:52	55.3	6:05	51.0	5:34	49.2	5:24
3000	78.7	8:51	74.0	8:19	65.7	7:21	60.7	6:42	58.5	6:29
3500	90.8	10:26	85.5	9:49	75.9	8:38	70.1	7:51	67.6	7:34
4000	102.6	12:03	96.6	11:20	85.8	9:57	79.2	9:01	76.4	8:41
4500	114.1	13:43	107.4	12:54	95.5	11:18	88.1	10:13	85.0	9:48
5000	125.4	15:26	118.0	14:30	104.9	12:41	96.7	11:26	93.3	10:56

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-1.6	-0.8	0.0	3.9	11.6
20	-3.4	-1.7	0.0	6.9	19.1
30	-5.1	-2.6	0.0	9.6	25.7
40	-6.9	-3.4	0.0	12.0	31.5
50	-8.6	-4.3	0.0	14.1	36.4
60	-10.4	-5.2	0.0	15.9	40.5
70	-12.1	-6.0	0.0	17.5	43.7
80	-13.9	-6.9	0.0	18.7	46.1
90	-15.7	-7.8	0.0	19.7	47.6
100	-17.4	-8.7	0.0	20.4	48.3
110	-19.2	-9.6	0.0	20.8	48.1
120	-20.9	-10.4	0.0	20.9	47.1
130	-22.7	-11.3	0.0	20.7	45.2
140	-24.5	-12.2	0.0	20.3	42.5

1 ENGINE INOP

MAX CONTINUOUS THRUST

Holding

Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)								
		1500	5000	10000	15000	20000	25000	30000	35000	40000
400	%N1	79.0	81.7	85.8	89.8	94.3	99.2			
	KIAS	286	286	286	286	304	308			
	FF/ENG	4120	4090	4120	4190	4360	4580			
380	%N1	77.5	80.3	84.3	88.3	92.7	97.4			
	KIAS	280	280	280	280	297	300			
	FF/ENG	3900	3880	3890	3940	4080	4250			
360	%N1	76.0	78.7	82.7	86.7	91.2	95.7	101.9		
	KIAS	271	271	271	271	288	291	296		
	FF/ENG	3680	3660	3660	3700	3810	3950	4250		
340	%N1	74.3	77.0	81.0	85.1	89.6	93.9	99.4		
	KIAS	261	261	261	261	280	283	286		
	FF/ENG	3470	3440	3440	3460	3560	3670	3900		
320	%N1	72.5	75.4	79.3	83.4	87.9	92.1	97.1		
	KIAS	251	251	251	251	271	273	277		
	FF/ENG	3250	3230	3220	3230	3310	3400	3570		
300	%N1	70.7	73.6	77.5	81.6	86.1	90.3	95.0		
	KIAS	242	242	242	242	262	264	268		
	FF/ENG	3050	3020	3010	3020	3080	3140	3260		
280	%N1	68.6	71.6	75.6	79.7	84.2	88.5	92.9	99.0	
	KIAS	233	233	233	233	252	255	258	261	
	FF/ENG	2840	2820	2810	2810	2850	2890	2980	3200	
260	%N1	66.6	69.6	73.7	77.7	82.2	86.5	90.8	96.0	
	KIAS	228	228	228	228	244	246	248	251	
	FF/ENG	2650	2620	2610	2600	2630	2660	2730	2860	
240	%N1	64.5	67.3	71.5	75.5	80.0	84.3	88.6	93.4	
	KIAS	221	221	221	221	233	235	237	240	
	FF/ENG	2450	2430	2410	2400	2410	2420	2470	2570	
220	%N1	62.2	65.1	69.3	73.3	77.7	81.9	86.3	90.8	98.9
	KIAS	215	215	215	215	223	224	227	229	233
	FF/ENG	2270	2240	2220	2200	2210	2210	2230	2300	2530
200	%N1	59.8	62.6	66.7	70.9	75.2	79.4	83.8	88.1	95.1
	KIAS	208	208	208	208	212	214	215	218	221
	FF/ENG	2090	2060	2030	2010	2010	2000	2000	2050	2200

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight — Chapter PI
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2 ENGINES INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	386	297	12300	10700	9000
390	376	294	13300	11700	10000
380	366	290	14300	12700	11000
370	357	287	15300	13700	12000
360	347	283	16300	14800	13100
350	338	279	17300	15900	14400
340	328	275	18400	16900	15600
330	319	272	19600	17900	16700
320	309	268	20700	19200	17700
310	300	264	21800	20400	19000
300	290	260	22800	21600	20200
290	281	256	23800	22800	21500
280	271	252	24800	23900	22700
270	262	248	25700	25000	23900
260	252	243	26600	26100	25100
250	242	238	27500	27100	26300
240	233	234	28400	28100	27500
230	223	229	29300	29100	28600
220	214	224	30200	30000	29600
210	204	219	31100	31000	30700
200	194	213	32100	32000	31800

Altitude reduced by 2000 ft for additional margin.

2 ENGINES INOP

MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
670	627	590	556	527	500	476	454	434	416	399
1332	1249	1176	1111	1053	1000	952	909	870	834	800
1992	1869	1761	1664	1578	1500	1429	1365	1307	1253	1203
2650	2488	2345	2217	2103	2000	1907	1821	1744	1672	1606
3308	3107	2929	2771	2628	2500	2384	2277	2180	2091	2009
3970	3729	3515	3325	3154	3000	2860	2733	2616	2509	2411
4637	4354	4104	3881	3680	3500	3336	3187	3051	2926	2811
5310	4984	4695	4438	4208	4000	3812	3641	3484	3341	3208
5993	5620	5291	4998	4736	4500	4286	4092	3915	3752	3602
6687	6264	5892	5561	5266	5000	4760	4542	4343	4160	3993

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG)											TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 KG)											
	200	220	240	260	280	300	320	340	360	380	400	
500	8.7	9.4	10.1	10.8	11.4	12.2	12.9	13.7	14.3	15.2	15.8	1:16
1000	16.9	18.5	20.0	21.5	22.8	24.4	25.9	27.5	29.0	30.7	32.3	2:30
1500	24.8	27.2	29.5	31.7	33.9	36.2	38.5	40.9	43.3	45.8	48.2	3:42
2000	32.4	35.5	38.6	41.6	44.5	47.5	50.7	53.9	57.1	60.5	63.6	4:54
2500	39.7	43.6	47.3	51.1	54.7	58.5	62.4	66.5	70.4	74.6	78.5	6:06
3000	46.8	51.3	55.8	60.2	64.5	69.1	73.8	78.6	83.4	88.3	93.0	7:20
3500	53.6	58.8	63.9	69.0	74.0	79.3	84.7	90.3	95.9	101.6	107.0	8:35
4000	60.2	66.0	71.7	77.5	83.2	89.2	95.3	101.7	108.0	114.5	120.6	9:52
4500	66.6	73.0	79.3	85.7	92.1	98.7	105.6	112.7	119.7	126.9	133.8	11:13
5000	72.8	79.8	86.7	93.7	100.7	108.0	115.5	123.3	131.1	139.0	146.6	12:37

Driftdown at optimum driftdown speed and cruise at Long Range Cruise speed.

2 ENGINES INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	5700	2900	
380	7600	5200	2100
360	9900	8000	5600
340	12100	10200	8400
320	14600	12500	10700
300	17100	15200	13100
280	19800	17600	16200
260	22600	20600	18700
240	25500	23600	21800
220	27900	26800	25200
200	30000	29400	28400

Altitude reduced by 2000 ft for additional margin.

2 ENGINES INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)								
		10	14	17	20	23	25	27	29	31
360	%N1	98.4								
	MACH	.625								
	KIAS	347								
	FF/ENG	6432								
340	%N1	96.7	100.2							
	MACH	.608	.654							
	KIAS	338	338							
	FF/ENG	6015	6163							
320	%N1	95.0	98.3							
	MACH	.591	.636							
	KIAS	328	329							
	FF/ENG	5611	5734							
300	%N1	93.1	96.4	99.0						
	MACH	.573	.617	.653						
	KIAS	318	319	319						
	FF/ENG	5215	5314	5394						
280	%N1	91.2	94.5	97.0	99.8					
	MACH	.555	.598	.633	.669					
	KIAS	308	308	309	309					
	FF/ENG	4828	4912	4970	5055					
260	%N1	89.2	92.4	94.9	97.5	100.5				
	MACH	.536	.577	.611	.647	.685				
	KIAS	297	297	298	298	298				
	FF/ENG	4452	4521	4557	4616	4717				
240	%N1	87.0	90.1	92.6	95.1	97.9	100.0	102.7		
	MACH	.517	.556	.588	.624	.661	.687	.714		
	KIAS	287	286	286	287	287	287	286		
	FF/ENG	4088	4136	4155	4193	4268	4338	4444		
220	%N1	84.7	87.8	90.2	92.7	95.3	97.2	99.3	102.2	
	MACH	.498	.534	.565	.599	.636	.661	.688	.714	
	KIAS	276	274	274	275	275	275	275	275	
	FF/ENG	3738	3759	3768	3784	3839	3885	3953	4053	
200	%N1	82.3	85.2	87.6	90.1	92.6	94.4	96.3	98.4	101.3
	MACH	.479	.512	.540	.573	.608	.633	.659	.686	.713
	KIAS	265	263	262	262	263	263	263	263	262
	FF/ENG	3416	3397	3393	3389	3429	3462	3500	3562	3652

GEAR DOWN

Takeoff Climb Limit

Based on engine bleed for 3 packs on and anti-ice off

Weight (1000 KG)

AIRPORT OAT (°C)	AIRPORT PRESSURE ALTITUDE (FT)												
	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
55	280	268	252										
50	297	286	275	262	253	239							
45	313	303	293	282	271	260	247	233					
40	330	320	309	298	287	275	264	252	236	222	211		
35	348	338	326	314	303	291	280	268	256	244	232	218	201
30	367	357	344	332	320	308	296	283	271	259	247	233	220
25	371	368	362	351	338	326	313	299	286	274	262	249	235
20	371	368	363	358	352	343	330	316	302	288	276	263	249
15	371	368	363	358	352	347	339	332	318	304	290	276	263
10	371	368	363	358	352	346	339	332	324	315	305	290	276
5 & BELOW	371	368	363	358	352	346	339	332	323	315	307	299	290

Anti-Ice Adjustments

BLEED CONFIGURATION	WEIGHT ADJUSTMENT (KG)	
	PACKS OFF	PACKS ON
ANTI-ICE OFF	+2150	0
ENGINE ANTI-ICE ON	-6100	-9650
ENGINE AND WING ANTI-ICE ON	-14900	-17250

Boeing Converted Freighters are not certified for packs-off takeoff.

GEAR DOWN

Landing Climb Limit

Based on engine bleed for 3 packs on and anti-ice off

Weight (1000 KG)

AIRPORT OAT (°C)	AIRPORT PRESSURE ALTITUDE (FT)												
	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
55	320	300	299	285	270								
50	340	332	325	310	295	279	264						
45	355	349	343	332	320	303	286	272	259	243			
40	370	364	358	348	336	321	307	295	281	265	249	235	
35	383	380	373	362	350	336	322	311	300	286	272	256	240
30	383	383	382	377	365	350	336	325	314	301	289	284	260
25	383	383	382	377	372	364	350	338	326	314	302	287	274
20	383	383	382	377	372	364	356	349	337	325	313	299	286
15	383	383	382	377	372	364	356	349	342	333	323	309	296
10 & BELOW	383	383	382	377	372	364	356	349	342	333	325	315	306

Applicable for flaps 25 or 30 landing.

Anti-Ice Adjustments

BLEED CONFIGURATION	WEIGHT ADJUSTMENT (KG)		
	3 A/C PACKS ON	1 A/C PACKS ON	A/C PACKS OFF
ANTI-ICE OFF	0	+6150	+9250
ENGINE ANTI-ICE ON	-5700	-350	+2750

Reduce landing climb limit weight by 35450 kg when operating in icing conditions during any part of the flight with forecast landing temperature below 8°C.

Max Climb %N1

Based on engine bleed for 3 packs on, engine and wing anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)												
	0	5	10	12	14	16	18	20	22	24	26	28	30
	240	240	240	240	240	240	240	240	240	240	240	0.60	0.60
55	97.8												
50	98.4	99.7											
45	99.0	100.3	101.0										
40	99.6	100.8	101.5	101.3	101.0								
35	100.1	101.4	102.0	101.9	101.7	102.4							
30	100.1	102.0	102.6	102.5	102.3	103.2	103.2	103.0					
25	99.4	102.6	103.2	103.1	102.8	103.7	103.9	103.6	103.6	103.4			
20	98.7	102.1	103.7	103.7	103.5	104.3	104.6	104.3	104.2	104.0	104.0		
15	97.8	101.3	104.2	104.3	104.1	105.0	105.1	104.9	105.0	104.8	104.7	104.8	
10	97.0	100.5	103.4	104.2	104.8	105.6	105.6	105.4	105.7	105.6	105.5	105.6	105.5
5	96.2	99.7	102.6	103.4	104.2	105.9	106.2	105.9	106.4	106.4	106.4	106.4	106.4
0	95.3	98.8	101.7	102.6	103.3	105.0	106.0	106.7	107.1	107.2	107.3	107.3	107.3
-5	94.5	97.9	100.8	101.7	102.5	104.2	105.1	106.0	107.4	108.2	108.2	108.2	108.1
-10	93.6	97.0	99.9	100.8	101.6	103.3	104.2	105.2	106.6	107.8	108.9	108.9	108.9
-15	92.8	96.1	99.0	99.9	100.6	102.4	103.3	104.3	105.7	107.0	107.9	107.9	107.9
-20	91.9	95.2	98.1	99.0	99.7	101.4	102.3	103.4	104.8	106.0	106.8	106.8	106.8

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)												
	0	5	10	12	14	16	18	20	22	24	26	28	30
ENGINE ANTI-ICE ON	-0.5	-0.5	-0.6	-0.6	-0.6	-0.6	-0.6	-0.7	-0.7	-0.7	-0.8	-0.8	-0.8
ENGINE & WING ANTI-ICE ON	-0.9	-1.0	-1.2	-1.2	-1.1	-1.2	-1.2	-1.3	-1.4	-1.5	-1.6	-1.6	-1.7

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	21000	19500	18300
390	21800	20200	18900
380	22500	20900	19500
370	23100	21700	20100
360	23700	22300	20800
350	24400	23000	21400
340	25100	23600	22100
330	26000	24700	23200
320	26900	25700	24300
310	27800	26800	25400
300	28700	27800	26600
290	29500	28800	27800
280	30400	29900	28900
270	31100	30700	30100
260	31900	31600	31000
250	32800	32500	32000
240	33600	33400	32900
230	34500	34400	33900
220	35400	35400	34900
210	36300	36300	35900
200	37300	37200	36800

GEAR DOWN

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)										
		10	15	17	19	21	23	25	27	29	31	33
400	%N1	91.4	95.6	97.5	99.6	102.1						
	MACH	.488	.535	.556	.578	.600						
	KIAS	270	270	270	270	270						
	FF/ENG	4772	4850	4887	4952	5036						
380	%N1	90.5	94.5	96.3	98.3	100.5						
	MACH	.488	.535	.556	.578	.600						
	KIAS	270	270	270	270	270						
	FF/ENG	4607	4666	4694	4741	4816						
360	%N1	89.7	93.6	95.3	97.1	99.3	101.6					
	MACH	.488	.535	.556	.578	.600	.624					
	KIAS	270	270	270	270	270	270					
	FF/ENG	4469	4512	4527	4559	4621	4710					
340	%N1	88.7	92.6	94.2	96.0	98.0	100.2	102.8				
	MACH	.485	.532	.553	.575	.598	.623	.647				
	KIAS	268	268	269	268	269	270	269				
	FF/ENG	4314	4352	4362	4374	4422	4513	4612				
320	%N1	87.1	90.9	92.5	94.2	96.0	98.1	100.4	103.3			
	MACH	.472	.517	.538	.559	.581	.605	.631	.654			
	KIAS	261	260	261	261	261	261	262	261			
	FF/ENG	4054	4064	4067	4075	4096	4155	4251	4347			
300	%N1	85.3	89.1	90.7	92.3	94.0	95.9	98.1	100.5	103.8		
	MACH	.459	.501	.521	.542	.564	.586	.612	.637	.660		
	KIAS	254	252	252	253	253	253	254	254	252		
	FF/ENG	3799	3785	3778	3781	3797	3820	3888	3982	4078		
280	%N1	83.4	87.2	88.8	90.3	92.0	93.8	95.7	98.0	100.5	104.3	
	MACH	.444	.486	.504	.524	.546	.568	.591	.618	.643	.666	
	KIAS	246	244	244	244	245	245	245	245	245	244	
	FF/ENG	3540	3519	3501	3491	3505	3522	3547	3620	3706	3812	
260	%N1	81.4	85.3	86.8	88.3	89.9	91.6	93.4	95.4	97.7	100.4	
	MACH	.429	.470	.487	.506	.527	.549	.571	.595	.622	.647	
	KIAS	237	236	236	235	236	236	236	236	237	236	
	FF/ENG	3278	3264	3237	3214	3216	3235	3248	3272	3347	3424	
240	%N1	79.2	83.1	84.7	86.2	87.8	89.4	91.1	92.9	95.0	97.3	100.2
	MACH	.412	.454	.470	.488	.507	.528	.551	.573	.598	.625	.650
	KIAS	227	228	227	227	226	227	227	227	227	228	227
	FF/ENG	3012	3011	2985	2954	2940	2948	2965	2974	2998	3066	3141
220	%N1	76.8	80.8	82.4	83.9	85.4	87.0	88.7	90.4	92.2	94.3	96.7
	MACH	.394	.435	.452	.469	.487	.506	.528	.551	.574	.599	.627
	KIAS	218	218	218	218	217	217	217	218	217	218	218
	FF/ENG	2750	2752	2735	2706	2682	2675	2682	2696	2702	2727	2780
200	%N1	74.1	78.2	79.8	81.4	83.0	84.5	86.1	87.8	89.5	91.3	93.5
	MACH	.376	.415	.432	.450	.467	.485	.504	.526	.549	.573	.598
	KIAS	208	208	208	209	208	207	207	207	208	208	208
	FF/ENG	2493	2490	2481	2459	2439	2421	2413	2417	2430	2436	2458

GEAR DOWN

Long Range Cruise Enroute Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
762	692	630	580	538	500	476	454	433	414	397
1547	1400	1271	1166	1078	1000	951	905	864	826	792
2353	2121	1920	1757	1620	1500	1425	1356	1293	1236	1185
3183	2860	2580	2353	2165	2000	1898	1805	1719	1643	1574
4041	3616	3249	2955	2713	2500	2371	2252	2144	2047	1960
4929	4392	3931	3564	3263	3000	2843	2698	2567	2448	2343
5851	5191	4626	4180	3816	3500	3314	3143	2987	2847	2723
6812	6015	5335	4803	4373	4000	3784	3585	3405	3244	3100

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		25	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
500	24.5	1:46	22.8	1:41	21.1	1:36	19.7	1:30	18.9	1:27
1000	48.6	3:35	45.7	3:23	42.6	3:12	40.0	3:00	38.5	2:52
1500	71.6	5:30	67.5	5:10	63.0	4:52	59.3	4:33	57.1	4:21
2000	93.3	7:30	88.2	7:01	82.5	6:35	77.6	6:10	74.7	5:52
2500	113.9	9:36	107.8	8:58	101.0	8:23	95.1	7:51	91.5	7:27
3000	133.4	11:48	126.4	11:01	118.7	10:16	111.7	9:35	107.5	9:06
3500	151.8	14:08	144.0	13:10	135.6	12:14	127.6	11:23	122.7	10:48
4000	169.2	16:35	160.6	15:26	151.6	14:18	142.8	13:17	137.3	12:35

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
20	-3.8	-1.8	0.0	3.4	7.5
40	-8.0	-3.9	0.0	6.7	14.6
60	-12.3	-6.0	0.0	9.8	21.1
80	-16.5	-8.1	0.0	12.6	27.0
100	-20.8	-10.2	0.0	15.2	32.3
120	-25.0	-12.3	0.0	17.5	37.1
140	-29.2	-14.5	0.0	19.5	41.3
160	-33.5	-16.7	0.0	21.3	45.0

Descent at .66/240

PRESSURE ALT (1000 FT)	5	10	15	17	19	21	23	25	27	29	31	33	35	37
DISTANCE (NM)	19	29	38	42	46	50	54	58	63	67	71	74	78	81
TIME (MINUTES)	5	8	10	11	11	12	13	13	14	15	16	16	17	17

GEAR DOWN

Holding

Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
400	%N1	84.8	87.5	91.4	95.6	100.7		
	KIAS	270	270	270	270	270		
	FF/ENG	4990	4980	5010	5090	5240		
380	%N1	84.0	86.6	90.5	94.5	99.4		
	KIAS	270	270	270	270	270		
	FF/ENG	4840	4820	4840	4900	5020		
360	%N1	83.2	85.8	89.7	93.6	98.2		
	KIAS	270	270	270	270	270		
	FF/ENG	4710	4680	4690	4740	4820		
340	%N1	81.3	84.0	87.8	91.7	97.1	103.0	
	KIAS	261	261	261	261	270	270	
	FF/ENG	4400	4380	4380	4410	4650	4870	
320	%N1	79.4	82.1	85.9	89.8	96.3	101.5	
	KIAS	251	251	251	251	270	270	
	FF/ENG	4100	4070	4070	4080	4500	4680	
300	%N1	77.3	80.1	84.0	87.9	94.3	99.5	
	KIAS	242	242	242	242	262	264	
	FF/ENG	3810	3780	3780	3780	4180	4350	
280	%N1	75.1	78.0	81.9	85.8	92.2	97.2	
	KIAS	233	233	233	233	252	255	
	FF/ENG	3530	3510	3500	3500	3840	3970	
260	%N1	73.4	76.2	80.3	84.1	90.1	94.8	100.9
	KIAS	228	228	228	228	244	246	248
	FF/ENG	3320	3300	3280	3280	3530	3610	3830
240	%N1	71.3	74.2	78.3	82.2	87.8	92.2	97.6
	KIAS	221	221	221	221	233	235	237
	FF/ENG	3090	3060	3050	3040	3210	3260	3400
220	%N1	69.4	72.2	76.3	80.3	85.5	89.6	94.7
	KIAS	215	215	215	215	223	224	227
	FF/ENG	2880	2850	2840	2830	2920	2940	3020
200	%N1	67.1	69.9	74.0	78.1	82.8	87.1	91.6
	KIAS	208	208	208	208	212	214	215
	FF/ENG	2660	2630	2620	2610	2640	2640	2680

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight — Chapter PI

Gear Down, One Engine Inop — Section 26

GEAR DOWN

1 ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

Based on engine bleed for 3 packs on

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	384	266	10100	8300	6300
390	375	264	11100	9400	7500
380	366	261	12000	10400	8600
370	356	258	13100	11400	9700
360	346	255	14100	12400	10700
350	337	253	15200	13400	11700
340	327	251	16300	14600	12800
330	319	248	17200	15700	13800
320	309	246	18100	16900	15200
310	298	243	19200	17900	16600
300	289	240	20400	18900	17600
290	280	237	21400	20100	18600
280	271	235	22500	21300	19900
270	262	232	23400	22400	21100
260	252	228	24300	23500	22300
250	242	225	25300	24600	23400
240	233	222	26100	25600	24600
230	223	219	26900	26600	25700
220	213	215	27800	27600	26900
210	204	212	28700	28500	28000
200	194	209	29500	29500	29100

Altitude reduced by 1000 ft for additional margin.

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
Based on engine bleed for 3 packs on

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	8300	6100	3200
390	9100	7000	4400
380	9800	7800	5300
370	10500	8500	6200
360	11100	9200	6900
350	11900	10100	8200
340	13100	11300	9500
330	14300	12500	10800
320	15800	13700	12000
310	17100	15200	13200
300	18300	16700	14600
290	19600	18000	16400
280	21100	19300	17800
270	22400	20900	19100
260	23600	22400	20800
250	24600	23700	22300
240	25800	25100	23800
230	26700	26300	25300
220	27700	27400	26700
210	28700	28600	28000
200	29800	29700	29300

Altitude reduced by 1000 ft for additional margin.
With engine bleed for 1 pack on, increase altitude capability by 300 ft.
With engine anti-ice on, decrease altitude capability by 1900 ft.
With engine and wing anti-ice on, decrease altitude capability by 3600 ft.

GEAR DOWN

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)										
		6	10	13	15	17	19	21	23	25	27	29
400	%N1	96.7										
	MACH	.454										
	KIAS	270										
	FF/ENG	6418										
380	%N1	95.7	99.3									
	MACH	.454	.488									
	KIAS	270	270									
	FF/ENG	6195	6304									
360	%N1	94.8	98.2									
	MACH	.453	.488									
	KIAS	270	270									
	FF/ENG	5997	6094									
340	%N1	93.0	96.5	99.5								
	MACH	.440	.476	.505								
	KIAS	262	263	265								
	FF/ENG	5620	5719	5837								
320	%N1	91.2	94.5	97.4	99.4							
	MACH	.428	.461	.490	.510							
	KIAS	254	255	257	257							
	FF/ENG	5259	5320	5420	5488							
300	%N1	89.4	92.5	95.2	97.2	99.3	101.5					
	MACH	.415	.447	.474	.494	.514	.532					
	KIAS	247	247	248	249	249	248					
	FF/ENG	4911	4943	5008	5071	5133	5198					
280	%N1	87.5	90.5	93.0	94.9	96.9	99.0	101.3				
	MACH	.402	.432	.458	.477	.497	.517	.536				
	KIAS	239	238	239	240	241	241	240				
	FF/ENG	4573	4582	4617	4662	4710	4774	4831				
260	%N1	85.5	88.4	90.8	92.5	94.4	96.5	98.6	101.0			
	MACH	.389	.417	.441	.459	.479	.499	.519	.538			
	KIAS	231	230	230	231	232	232	232	231			
	FF/ENG	4246	4233	4250	4268	4300	4345	4406	4469			
240	%N1	83.3	86.3	88.5	90.1	91.9	93.8	95.9	98.0	100.5		
	MACH	.377	.402	.424	.441	.459	.479	.500	.520	.540		
	KIAS	224	222	221	221	222	223	223	223	222		
	FF/ENG	3930	3897	3899	3902	3906	3932	3978	4028	4105		
220	%N1	81.1	83.9	86.2	87.7	89.3	91.0	93.0	95.1	97.3	99.8	
	MACH	.364	.387	.408	.423	.440	.458	.479	.500	.520	.540	
	KIAS	216	214	212	212	212	213	213	214	214	213	
	FF/ENG	3623	3573	3559	3554	3540	3541	3568	3607	3652	3734	
200	%N1	78.7	81.4	83.6	85.1	86.7	88.3	90.0	91.9	94.1	96.2	98.7
	MACH	.351	.372	.391	.405	.420	.437	.456	.476	.498	.519	.539
	KIAS	209	205	204	203	202	202	203	204	204	204	203
	FF/ENG	3326	3261	3233	3218	3195	3177	3184	3209	3239	3282	3355

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
304	276	252	232	215	200	190	181	173	166	159
616	558	508	466	431	400	380	362	345	330	317
932	842	764	700	647	600	570	543	518	495	475
1250	1128	1022	936	864	800	760	723	690	659	632
1571	1416	1282	1172	1081	1000	949	903	860	822	788
1896	1706	1542	1408	1298	1200	1139	1083	1032	986	944
2224	1999	1804	1646	1515	1400	1328	1262	1202	1148	1100
2556	2294	2067	1884	1733	1600	1517	1441	1372	1310	1254
2892	2592	2332	2124	1951	1800	1706	1620	1542	1472	1409
3231	2892	2599	2364	2170	2000	1895	1799	1711	1633	1563

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		25		29	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	9.4	0:44	8.7	0:42	8.0	0:40	7.4	0:37	7.4	0:36
400	19.6	1:27	18.3	1:22	17.3	1:18	16.7	1:11	17.2	1:07
600	29.5	2:12	27.7	2:04	26.3	1:56	25.4	1:46	26.3	1:40
800	39.3	2:56	37.1	2:45	35.2	2:35	34.2	2:21	35.4	2:13
1000	48.9	3:41	46.1	3:28	43.8	3:15	42.5	2:57	43.9	2:46
1200	58.2	4:28	55.0	4:11	52.3	3:55	50.5	3:33	52.1	3:20
1400	67.4	5:15	63.8	4:55	60.5	4:36	58.3	4:09	60.0	3:54
1600	76.4	6:03	72.3	5:40	68.6	5:18	65.9	4:46	67.5	4:29
1800	85.2	6:51	80.7	6:26	76.5	6:00	73.2	5:24	74.8	5:05
2000	93.8	7:41	88.8	7:12	84.2	6:43	80.4	6:02	81.9	5:41

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-1.8	-0.9	0.0	2.1	4.6
20	-3.8	-1.9	0.0	4.3	9.3
30	-5.8	-2.9	0.0	6.5	13.8
40	-7.8	-3.9	0.0	8.6	18.2
50	-9.9	-4.9	0.0	10.7	22.4
60	-11.9	-5.9	0.0	12.7	26.6
70	-13.9	-6.9	0.0	14.7	30.6
80	-16.0	-7.9	0.0	16.6	34.5
90	-18.0	-8.9	0.0	18.4	38.2
100	-20.1	-9.9	0.0	20.2	41.9

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT) 1500	5000	10000	15000	20000	25000
400	%N1	93.1	95.8				
	KIAS	270	270				
	FF/ENG	6700	6720				
380	%N1	92.1	94.9	99.3			
	KIAS	270	270	270			
	FF/ENG	6490	6490	6620			
360	%N1	91.3	94.0	98.2			
	KIAS	270	270	270			
	FF/ENG	6300	6300	6400			
340	%N1	89.4	92.1	96.1			
	KIAS	261	261	261			
	FF/ENG	5870	5870	5930			
320	%N1	87.4	90.1	94.0	98.7		
	KIAS	251	251	251	251		
	FF/ENG	5450	5440	5490	5590		
300	%N1	85.3	88.1	92.0	96.3		
	KIAS	242	242	242	242		
	FF/ENG	5050	5040	5080	5150		
280	%N1	83.1	85.9	89.8	94.0		
	KIAS	233	233	233	233		
	FF/ENG	4670	4660	4680	4730		
260	%N1	81.3	84.2	88.1	92.1	99.4	
	KIAS	228	228	228	228	244	
	FF/ENG	4390	4370	4390	4410	4940	
240	%N1	79.2	82.0	86.1	90.1	96.4	103.5
	KIAS	221	221	221	221	233	235
	FF/ENG	4070	4060	4070	4080	4420	4730
220	%N1	77.2	80.0	84.1	88.1	93.6	99.2
	KIAS	215	215	215	215	223	224
	FF/ENG	3790	3770	3770	3780	3980	4150
200	%N1	74.8	77.7	81.8	85.8	90.7	95.7
	KIAS	208	208	208	208	212	214
	FF/ENG	3490	3470	3470	3480	3550	3640

This table includes 5% additional fuel for holding in a racetrack pattern.

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Performance Inflight — Chapter PI
Text — Section 27

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer (FMC). In addition, sufficient inflight data is provided to complete a flight with the FMC inoperative. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General

Clearway and Stopway V1 Adjustments

Takeoff speed adjustments are to be applied to V1 speed when using takeoff weights based on the use of clearway and stopway.

Adjust V1 speed by the amount shown in the table. The adjusted V1 speed must not exceed VR.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF

The Reference Speed table contains flaps 30 and 25 landing speeds for a given weight. Apply adjustments shown as required.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuvering speeds. Using VREF as the basis for the schedule makes it variable as a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction, selection to the next position should be initiated when at and accelerating above the recommended flap speed for the new position. During flap extension, selection of the flaps to the next position should be made prior to decelerating below the recommended flap speed for the current flap setting.

Slush/Standing Water Takeoff

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in field/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assume an engine failure at the critical point during the takeoff. Data is shown for 2 engine reverse thrust and for no reverse thrust.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush depths greater than 0.5 inches (13mm) are not recommended because of possible airplane damage as a result of slush impingement on the airplane structure. The use of assumed temperature for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight is determined as follows:

1. Determine the field/obstacle limit weight for the takeoff flap setting.

2. Enter the Weight Adjustment table with the field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.

3. Enter the VMCG Limit Weight table with the available field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for VMCG speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 3.

Takeoff speed determination:

1. Determine takeoff speeds V1, VR and V2 for actual brake release weight using the Takeoff Speeds from the FMC or Takeoff Analysis.

2. If VMCG limited, set V1=VMCG. If not limited by VMCG considerations, reenter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than VMCG, set V1=VMCG.

Tables for no reverse thrust are also provided in the same format.

Slippery Runway Takeoff

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. The performance level of good is the same as used by the FAA and EASA to define wet runway rejected takeoff performance. Similarly, poor braking action is representative of a runway covered with ice. Performance is based on two symmetric reversers operating and a 15 ft. screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables. Data is provided for 2 engine reverse thrust and for no reverse thrust.

Tables for no reverse thrust are also provided in the same format.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum speed for control on the ground, VMCG, and VR less than minimum VR, (1.05) VMCA. Therefore, compare the adjusted V1 and VR to the VMCG and VRMIN respectively. To find VMCG and VRMIN, enter the VMCG, VRMIN table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than VMCG, set V1 equal to VMCG. If the adjusted VR is less than VRMIN, set VR equal to VRMIN. If VR is less than VMCG, set VR equal to VMCG. If VR is limited by either VMCG or VRMIN, V2 must be adjusted to account for the increase in VR. This adjusted V2 speed can be obtained from the V2 for VRMIN table by entering with weight and VRMIN. If the V2 for VRMIN is greater than V2, set V2 equal to V2 for VRMIN.

Anti-skid Inoperative

When operating with anti-skid inoperative, the field length/obstacle limited weight and the V1 speed must be reduced to allow for the effect on accelerate-stop performance as detailed in the Airplane Flight Manual. Obstacle clearance capability must also be considered since the reduced V1 speed will increase the distance required to achieve a given height above the runway following engine failure at V1.

A simplified method which conservatively accounts for the effects of anti-skid inoperative is to reduce the normal runway/obstacle limited weight by the amount shown in the table below. Then, reduce the V1 associated with the reduced weight by the V1 amount shown in the table below. If takeoff weight is below the anti-skid inoperative limited weight, it is only necessary to ensure that the V1 speed does not exceed the anti-skid limited V1 speed. If the resulting V1 speed is less than the minimum ground control speed (see Minimum Control Speeds table), takeoff is permitted with V1 set equal to VMCG provided the accelerate stop distance available exceeds approximately 14700 ft.

ANTI-SKID INOPERATIVE ADJUSTMENT		
FIELD LENGTH (FT)	WEIGHT (1000 KG)	V1 (KTS)
12000	-25	-46
13000	-25	-46
14000	-25	-46
15000	-28	-45
16000	-28	-43
17000	-26	-40

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

Initial Climb %N1

This table is used to set initial climb power once the takeoff segment is complete and enroute configuration is achieved (i.e. flaps up). The power settings shown are based on 200 KIAS at 1000 ft above the airport pressure altitude. Upon accelerating to the normal enroute climb speed of 340 KIAS, the power settings provided in the Max Climb table should be used. %N1 adjustments are shown for anti-ice operation.

Max Climb %N1

This table shows Max Climb %N1 for a 340/.84 climb speed schedule, normal engine bleed for 3 packs on and anti-ice off. Enter the table with airport pressure altitude and TAT and read %N1. %N1 adjustments are shown for anti-ice operation.

Go-around %N1

To find Max Go-around %N1 based on normal engine bleed for 3 packs on, enter the Go-around %N1 table with airport pressure altitude and reported OAT or TAT and read %N1. For packs off operation, apply the %N1 adjustments provided below the table. %N1 adjustments are shown for engine anti-ice operation. No %N1 adjustment is required for wing anti-ice operation.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Pitch attitude and average %N1 information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome or turbulent air may also cause unreliable airspeed/Mach indications. The cruise table in this section may also be used for turbulent air penetration.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed indications may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. This table considers both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 100 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 15° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the table result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 45000 ft.

Long Range Cruise Control

The table provides target %N1, Long Range Cruise Mach number, KIAS and standard day fuel flow per engine for the airplane weight and pressure altitude. The shaded area in this table approximates optimum altitude. At optimum altitude the Long Range Cruise Mach schedule is approximated by .86M.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .84/290/250 descent. Tables are presented for low altitudes and high altitudes.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent

Distance and time for descent are shown for a .84/290/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing flaps at the outer marker.

Holding

Target %N1, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the FMC optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed for the selected flap setting. Flaps 1 data is based on VREF30 + 60 speed. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read %N1, KIAS and fuel flow per engine.

Advisory Information

Normal Configuration Landing Distance

Tables are provided as advisory information for normal configuration landing distance on dry runways and slippery runways with good, medium, and poor reported braking action. These values are actual landing distances and do not include the 1.67 regulatory factor. Therefore, they cannot be used to determine the dispatch required landing field length.

To use these tables, determine the reference landing distance for the selected braking configuration. Then adjust the reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers to obtain the actual landing distance.

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. If the surface is affected by water, snow, or ice and the braking action is reported as "good", conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate "poor" data reflects runways covered with wet ice.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" braking action, the airplane may not be able to achieve these deceleration rates. In these cases, runway slope and inoperative reversers influence the stopping distance. Since it cannot be determined quickly when this becomes a factor, it is conservative to add the effects of slope and inoperative reversers when using the autobrake system.

Non-normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances are provided for dry runway and runways with good, medium, and poor reported braking action.

Enter the table with the applicable non-normal configuration and read the normal approach speed (VREF). The reference landing distance is measured from 50 ft above the threshold to stop and is based on reference weight and speed at sea level, zero wind, zero slope and max manual braking with maximum reverse thrust. Subsequent columns provide corrections for off-reference landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers. Each correction is independently added to the reference landing distance. Landing distance includes the effect of maximum manual braking and reverse thrust.

Recommended Brake Cooling Schedule

Advisory information is provided to assist in avoiding problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Recommended Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind, at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the table with the reference brake energy per brake and the type of braking used during landing (Max Manual or Max Auto). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing. The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Brake Temperature Monitor System (BTMS) indications are also shown. If brake cooling is determined from the BTMS, the hottest brake indication 10 to 15 minutes after the airplane has come to a complete stop, or inflight with gear retracted, may be used to determine recommended cooling schedule by entering at the bottom of the chart. An EICAS advisory message, BRAKE TEMP, will appear when any brake registers 5 on the GEAR synoptic display and disappears as the hottest brake cools to an indication of 4. Note that even without an EICAS advisory message, brake cooling is recommended.

One Engine Inoperative

Max Continuous %N1

Power setting is based on one engine inoperative with 3 packs on and all anti-ice bleeds off. Enter the table with pressure altitude and KIAS or Mach to read %N1.

It is desirable to maintain engine thrust level within the limits of the Max Cruise thrust rating. However, where thrust level in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off.

The level off altitude is dependent on air temperature (ISA deviation). The level off altitude shown is 1000 ft below the maximum altitude. This reduction in altitude is consistent with the FMC logic.

Long Range Cruise Altitude Capability

The table shows the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on Long Range Cruise speed and Max Continuous thrust. Note that the maximum altitude shown has been reduced by 1000 ft. This reduction in altitude is consistent with the FMC logic.

Long Range Cruise Control

The table provides target %N1, one engine inoperative Long Range Cruise Mach number, KIAS, and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on three engine Long Range Cruise speed and .84/290/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the Fuel Required Adjustment table with the fuel required for the reference weight and the actual weight at checkpoint.

Holding

One engine inoperative holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Two Engines Inoperative

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off.

The level off altitude is dependent on air temperature (ISA deviation). The level off altitude shown is 2000 ft below the maximum altitude. This reduction in altitude is consistent with the FMC.

Driftdown/LRC Cruise Range Capability

This table shows the range capability from the start of driftdown. Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to Long Range Cruise speed. Cruise is continued at level off altitude and Long Range Cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and correct for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required.

Long Range Cruise Altitude Capability

The table shows the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on Long Range Cruise speed and Max Continuous thrust. Note that the maximum altitude shown has been reduced by 2000 ft. This reduction in altitude is consistent with the FMC logic.

Long Range Cruise Control

The table provides target %N1, two engines inoperative Long Range Cruise Mach number, KIAS, and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

Gear Down

This section contains performance for airplane operation with the landing gear extended for all phases of flight. The data is based on engine bleeds for normal air conditioning.

Note: The Flight Management Computer System (FMCS) does not contain special provisions for operation with landing gear extended. As a result, the FMCS will generate inaccurate enroute speed schedules, display non-conservative predictions of fuel burn, estimated time of arrival (ETA), maximum altitude, and compute overly shallow descent path. To obtain accurate ETA predictions, gear down cruise speed and altitude should be entered on the CLB and CRZ pages. Gear down cruise speed should also be entered on the DES page and a STEP SIZE of zero should be entered on the PERF INIT or CRZ page. Use of the VNAV during descent under these circumstances is not recommended.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

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This Section Applies to EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

General

The aircraft listed in the table below are covered in the Performance Dispatch, Performance Inflight and Performance Inflight - Quick Reference Handbook.

Configuration data reflects the airplane as delivered configuration and is updated for service bulletin incorporations in conformance with the policy stated in the introduction section of the FCOM.

Serial and tabulation number are supplied by Boeing.

Airplane Number	Registry Number	Serial Number	Tabulation Number
038	EI-XLK	29950	RM041
039	EI-XLL	28031	RM042
040	EI-XLM	28028	RM043
041	EI-XLN	28029	RM044
042	EI-XLO	28025	RM045

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Maximum Allowable Clearway

FIELD LENGTH (FT)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (FT)
6000	500
8000	600
10000	650
12000	700
14000	750
16000	750

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (FT)	NORMAL V1 (KIAS)				
	100	120	140	160	180
900	-3	-3	-3	-3	-3
600	-2	-2	-2	-2	-2
300	-1	-1	-1	-1	-1
0	0	0	0	0	0
-300	1	1	1	1	1
-600	2	2	2	2	2
-900	3	3	3	3	3

VREF (KIAS)

WEIGHT (1000 KG)	FLAPS	
	30	25
400	184	192
380	179	187
360	174	181
340	168	176
320	163	170
300	157	164
280	152	158
260	146	152
240	140	146
220	133	139
200	127	132

Increase VREF 1 knot/4000 ft above sea level.

Flap Maneuver Speeds

FLAP POSITION	MANEUVER SPEED
UP	VREF 30 + 80
1	VREF 30 + 60
5	VREF 30 + 40
10	VREF 30 + 20
20	VREF 30 + 10
25	VREF 25
30	VREF 30

ADVISORY INFORMATION

Slush/Standing Water Takeoff
2 Engine Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440				-35	-35	-35	-52	-52	-52
420	-27	-27	-27	-34	-34	-34	-51	-51	-51
400	-25	-25	-25	-32	-32	-32	-50	-50	-50
380	-24	-24	-24	-31	-31	-31	-48	-48	-48
360	-22	-22	-22	-29	-29	-29	-47	-47	-47
340	-21	-21	-21	-28	-28	-28	-46	-46	-46
320	-19	-19	-19	-26	-26	-26	-45	-45	-45
300	-18	-18	-18	-25	-25	-25	-44	-44	-44
280	-16	-16	-16	-23	-23	-23	-42	-42	-42

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
8200							222		
8600							244		
9000				230			267		
9400	228			253			290	220	
9800	252			276			312	242	
10200	275			299	228		335	265	
10600	298	226		322	251		357	287	217
11000	322	250		346	274		380	310	240
11400	346	273		369	297		403	333	262
11800	370	296	223	392	320	249		355	285
12200	394	320	247	415	343	272		378	308
12600	417	344	271	438	366	295		400	330
13000		367	294		389	318			353
13400		391	318		412	341			375
13800		415	341		436	364			398
14200			365			387			
14600			389			410			

1. **Enter Weight Adjustment table with slush/standing water depth and field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10, decrease VMCG limit weight by 12000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

Slush/Standing Water Takeoff
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-31	-29	-27	-27	-25	-23	-16	-14	-12
380	-32	-30	-28	-28	-26	-24	-17	-15	-13
360	-33	-31	-29	-29	-27	-25	-19	-17	-15
340	-34	-32	-30	-30	-28	-26	-21	-19	-17
320	-35	-33	-31	-31	-29	-27	-23	-21	-19
300	-35	-33	-31	-32	-30	-28	-25	-23	-21
280	-35	-33	-31	-32	-30	-28	-26	-24	-22

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by an additional 1 kt. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440	-32	-32	-32	-41	-41	-41	-64	-64	-64
420	-31	-31	-31	-39	-39	-39	-61	-61	-61
400	-29	-29	-29	-37	-37	-37	-58	-58	-58
380	-27	-27	-27	-35	-35	-35	-55	-55	-55
360	-25	-25	-25	-33	-33	-33	-52	-52	-52
340	-23	-23	-23	-30	-30	-30	-50	-50	-50
320	-21	-21	-21	-28	-28	-28	-47	-47	-47
300	-19	-19	-19	-26	-26	-26	-44	-44	-44
280	-18	-18	-18	-24	-24	-24	-41	-41	-41

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
10200							257		
10600							280		
11000							304		
11400				262			327	262	
11800				288			351	285	
12200	266			314	241		374	308	243
12600	294			340	267		397	332	266
13000	321	245		366	293		421	355	290
13400	348	272		392	320	247	444	379	313
13800	375	300		418	346	273	468	402	337
14200	402	326	250	444	372	299		425	360
14600	430	354	277	470	398	325		449	383
15000	457	381	305		424	351		472	407

1. **Enter Weight Adjustment table with slush/standing water depth and field/obstacle limit weight to obtain adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 decrease VMCG limit weight by 14000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-39	-37	-34	-34	-31	-28	-21	-18	-15
380	-41	-38	-35	-35	-33	-30	-23	-20	-17
360	-42	-39	-36	-37	-34	-31	-24	-22	-19
340	-42	-39	-37	-38	-35	-32	-26	-24	-21
320	-43	-40	-37	-39	-36	-33	-29	-26	-23
300	-43	-40	-37	-39	-37	-34	-31	-28	-25
280	-43	-40	-38	-40	-38	-35	-33	-30	-27

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by an additional 3 kts. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

Slippery Runway Takeoff
2 Engine Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-6	-6	-6	-18	-18	-18
380	0	0	0	-7	-7	-7	-17	-17	-17
360	0	0	0	-7	-7	-7	-16	-16	-16
340	0	0	0	-6	-6	-6	-15	-15	-15
320	0	0	0	-6	-6	-6	-14	-14	-14
300	0	0	0	-6	-6	-6	-12	-12	-12
280	0	0	0	-5	-5	-5	-11	-11	-11
260	0	0	0	-4	-4	-4	-9	-9	-9
240	0	0	0	-3	-3	-3	-7	-7	-7

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6000	236								
6400	279	193							
6800	322	236							
7200	365	279	193						
7600	408	322	236						
8000		365	279	211					
8400		408	322	246					
8800			365	281					
9200			408	317	238				
9600				352	273				
10000				387	308	230			
10400				422	343	265			
10800					379	300			
11200					414	335	227		
11600						370	250		
12000						406	275		
12400							299	230	
12800							323	254	
13200							347	279	
13600							372	303	234
14000							396	327	258
14400							420	351	282
14800								376	307
15200								400	331
15600								424	355
16000									388
16400									412

1. **Enter Weight Adjustment table with reported braking action and field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limit weight by 10000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

Slippery Runway Takeoff
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-6	-5	-4	-23	-19	-16	-43	-38	-33
380	-8	-7	-6	-25	-21	-18	-46	-41	-36
360	-9	-8	-7	-27	-23	-20	-48	-43	-38
340	-11	-10	-9	-29	-25	-22	-50	-45	-40
320	-13	-12	-11	-31	-27	-24	-52	-47	-42
300	-14	-13	-12	-32	-28	-25	-53	-48	-43
280	-15	-14	-13	-33	-29	-26	-54	-49	-44
260	-15	-14	-13	-34	-30	-27	-54	-49	-44
240	-15	-14	-13	-34	-30	-27	-54	-49	-44

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10 and good reported braking, increase V1 by 1 kt.**
   If adjusted V1 is less than VMCG, set V1 = VMCG.

ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
Weight Adjustment (1000 KG)

FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-10	-10	-10	-21	-21	-21
380	0	0	0	-9	-9	-9	-20	-20	-20
360	0	0	0	-9	-9	-9	-19	-19	-19
340	0	0	0	-9	-9	-9	-18	-18	-18
320	-1	-1	-1	-8	-8	-8	-16	-16	-16
300	-1	-1	-1	-7	-7	-7	-14	-14	-14
280	-1	-1	-1	-7	-7	-7	-13	-13	-13
260	0	0	0	-6	-6	-6	-11	-11	-11
240	0	0	0	-4	-4	-4	-9	-9	-9

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
6200	210								
6600	258								
7000	306	229							
7400	353	277	201						
7800	401	325	249						
8200		372	296						
8600		420	344						
9000			391						
9400			439	224					
9800				269					
10200				314	233				
10600				359	278				
11000				404	323	242			
11400					368	287			
11800					413	332			
12200						377			
12600						422			
13000									
13400									
13800									
14200							205		
14600							239		
15000							274		

1. **Enter Weight Adjustment table with reported braking action and field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find V1(MCG) limit weight for available field length and pressure altitude.For flaps 10 and poor reported braking action, decrease VMCG limit weight by 18000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-8	-6	-5	-28	-24	-21	-54	-50	-46
380	-10	-8	-7	-30	-27	-23	-56	-52	-48
360	-12	-10	-9	-33	-29	-26	-59	-55	-51
340	-14	-12	-11	-35	-31	-28	-61	-57	-53
320	-16	-14	-12	-37	-34	-30	-63	-59	-55
300	-17	-16	-14	-39	-36	-32	-65	-61	-57
280	-19	-17	-16	-41	-37	-34	-66	-62	-58
260	-20	-18	-16	-42	-38	-34	-67	-63	-59
240	-20	-18	-16	-42	-38	-35	-67	-63	-59

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10 and good reported braking action, increase V1 by 2 kts. If adjusted V1 is less than VMCG, set V1 = VMCG.**

Minimum Control Speeds

Max Takeoff Thrust

VMCG, VRMIN (KIAS)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)															
		-2000		0		2000		4000		5000		6000		8000		10000	
°C	°F	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN
60	140	108	111	104	107	101	103	97	100	95	98	93	96	90	93	87	89
55	131	112	115	108	111	104	107	100	103	98	100	97	99	93	96	90	92
50	122	115	118	111	114	107	110	103	106	100	103	100	102	96	99	92	95
45	113	119	122	114	118	110	113	106	109	103	105	102	105	99	101	95	97
40	104	122	125	117	120	113	116	109	112	105	108	105	108	101	104	97	100
39	103	122	125	118	121	113	117	109	112	106	109	105	108	102	104	98	100
37	99	122	125	119	122	114	117	110	113	107	110	106	109	102	105	98	101
35	95	122	125	120	123	115	119	111	114	108	111	107	110	103	106	99	102
33	92	122	125	121	124	116	119	112	115	109	112	108	111	104	107	100	103
30	86	122	125	121	124	118	121	113	116	110	113	109	112	105	108	101	104
29	85	122	125	121	124	118	121	114	117	111	114	109	112	105	108	101	104
25	77	122	125	121	124	118	121	115	118	113	116	111	114	107	110	103	106
23	73	122	125	121	124	118	121	115	118	114	117	112	115	107	110	103	106
20	68	122	125	121	124	118	121	115	118	114	117	113	116	108	111	104	107
15	59	122	125	121	124	118	121	115	118	114	117	113	116	110	113	106	108
10	50	122	125	121	124	118	121	115	118	114	117	113	116	110	113	107	110
5	41	122	125	121	124	118	121	115	118	114	117	113	116	110	113	107	110
0	32	122	125	121	124	118	121	115	118	114	117	113	116	110	113	107	110
-55	-67	122	125	121	124	118	121	115	118	114	117	113	116	110	113	107	109

Flaps 20 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)																	
	89		90		95		100		105		110		115		120		125	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
260	104	22	105	21	109	20	115	19	121	18	127	17	133	17	139	17	145	17
240	104	20	104	20	109	19	115	18	121	18	127	17	133	17	139	17	145	17
220	103	19	104	19	109	18	115	18	121	17	127	17	133	17	140	17	146	18
200	103	18	104	18	109	18	115	18	121	17	128	17	134	17	140	18	147	18

Flaps 10 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)																	
	89		90		95		100		105		110		115		120		125	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
240	105	23	106	23	111	21	116	21	123	20	129	19	135	19	141	19	147	19
220	105	22	106	21	111	21	116	20	123	19	129	19	135	19	142	20	148	20
200	105	21	106	20	111	20	117	19	123	19	129	19	136	19	142	20	149	20

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

8% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440				-34	-34	-34	-49	-49	-49
420	-27	-27	-27	-33	-33	-33	-48	-48	-48
400	-25	-25	-25	-31	-31	-31	-46	-46	-46
380	-24	-24	-24	-30	-30	-30	-45	-45	-45
360	-22	-22	-22	-28	-28	-28	-44	-44	-44
340	-20	-20	-20	-27	-27	-27	-43	-43	-43
320	-19	-19	-19	-25	-25	-25	-42	-42	-42
300	-17	-17	-17	-24	-24	-24	-40	-40	-40
280	-16	-16	-16	-22	-22	-22	-39	-39	-39

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
7800							222		
8200							246		
8600				233			270		
9000	232			257			293	220	
9400	257			281			317	244	
9800	282			306	230		341	267	
10200	306	230		330	255		365	291	218
10600	331	255		354	279		388	315	241
11000	356	279		378	303	228	412	338	265
11400	381	304	227	402	327	252		362	289
11800	405	329	252		352	276		386	312
12200		353	277		376	301		410	336
12600		378	301		400	325			360
13000		403	326			349			384
13400			351			373			407
13800			376			398			

1. **Enter Weight Adjustment table with slush/standing water depth and TO1 field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10, decrease VMCG limit weight by 12000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

8% Thrust Reduction

2 Engine Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-29	-27	-25	-24	-22	-20	-11	-9	-7
380	-30	-28	-26	-25	-23	-21	-12	-10	-8
360	-31	-29	-27	-26	-24	-22	-14	-12	-10
340	-32	-30	-28	-27	-25	-23	-17	-15	-13
320	-32	-30	-28	-28	-26	-24	-19	-17	-15
300	-33	-31	-29	-29	-27	-25	-21	-19	-17
280	-33	-31	-29	-29	-27	-25	-22	-20	-18

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by an additional 1 kt. If adjusted V1 is less than VMCG, set V1 = VMCG.**

No Reverse Thrust

Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440	-31	-31	-31	-39	-39	-39	-62	-62	-62
420	-29	-29	-29	-37	-37	-37	-59	-59	-59
400	-27	-27	-27	-35	-35	-35	-56	-56	-56
380	-26	-26	-26	-33	-33	-33	-53	-53	-53
360	-24	-24	-24	-31	-31	-31	-51	-51	-51
340	-22	-22	-22	-29	-29	-29	-48	-48	-48
320	-20	-20	-20	-27	-27	-27	-45	-45	-45
300	-19	-19	-19	-25	-25	-25	-42	-42	-42
280	-17	-17	-17	-23	-23	-23	-40	-40	-40

ADVISORY INFORMATION

TO1 Slush/Standing Water Takeoff

8% Thrust Reduction

No Reverse Thrust

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
9400							241		
9800							266		
10200							290		
10600				248			314	246	
11000				274			338	270	
11400	253			301			362	295	
11800	281			328	253		387	319	251
12200	309			355	280		411	343	275
12600	337	259		382	307		435	367	299
13000	366	287		409	334	258	459	391	324
13400	394	315		436	361	285		416	348
13800	422	343	264	463	388	312		440	372
14200	450	371	292		415	339		464	396
14600	478	399	321		441	366			420
15000		427	349		468	393			445

1. **Enter Weight Adjustment table with slush/standing water depth and TO1 field/obstacle limit weight to obtain slush/standing water adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 14000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-34	-31	-28	-28	-25	-22	-13	-10	-7
380	-36	-33	-30	-30	-27	-23	-15	-12	-9
360	-37	-34	-31	-31	-28	-25	-17	-14	-11
340	-38	-34	-31	-33	-29	-26	-20	-16	-13
320	-38	-35	-32	-34	-30	-27	-22	-19	-16
300	-38	-35	-32	-34	-31	-28	-24	-21	-18
280	-39	-36	-32	-36	-32	-29	-27	-24	-21
260	-38	-35	-32	-35	-32	-29	-29	-25	-22
240	-36	-33	-29	-34	-30	-27	-28	-25	-22
220	-35	-32	-29	-33	-30	-27	-29	-26	-23
200	-35	-32	-28	-33	-30	-27	-30	-27	-23

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by an additional 3 kts. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff

8% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-4	-4	-4	-16	-16	-16
380	0	0	0	-5	-5	-5	-16	-16	-16
360	0	0	0	-6	-6	-6	-16	-16	-16
340	0	0	0	-6	-6	-6	-15	-15	-15
320	0	0	0	-6	-6	-6	-14	-14	-14
300	0	0	0	-6	-6	-6	-12	-12	-12
280	0	0	0	-5	-5	-5	-11	-11	-11
260	0	0	0	-5	-5	-5	-9	-9	-9
240	0	0	0	-4	-4	-4	-8	-8	-8
220	0	0	0	-3	-3	-3	-6	-6	-6

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff

8% Thrust Reduction

2 Engine Reverse Thrust

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5600	216								
6000	258								
6400	301	216							
6800	344	258							
7200	387	301	216						
7600	429	344	258	208					
8000		387	301	245					
8400		429	344	281	201				
8800			387	317	237				
9200			429	354	274	194			
9600				390	310	230			
10000				426	346	266			
10400					383	303	207		
10800					419	339	232		
11200						375	258		
11600						412	283	212	
12000							308	237	
12400							333	263	
12800							357	288	217
13200							382	313	242
13600							408	338	268
14000								363	293
14400								388	318
14800								413	343
15200									367
15600									393
16000									418

1. **Enter Weight Adjustment table with reported braking action and TO1 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limit weight by 10000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
8% Thrust Reduction
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-4	-3	-2	-19	-15	-12	-39	-34	-29
380	-6	-5	-4	-22	-18	-15	-41	-36	-31
360	-8	-7	-6	-25	-21	-18	-44	-39	-34
340	-10	-9	-8	-27	-23	-20	-47	-42	-37
320	-11	-10	-9	-29	-25	-22	-49	-44	-39
300	-12	-11	-10	-31	-27	-24	-50	-45	-40
280	-13	-12	-11	-32	-28	-25	-50	-45	-40
260	-14	-13	-12	-32	-28	-25	-50	-45	-40
240	-14	-13	-12	-32	-28	-25	-50	-45	-40
220	-14	-13	-12	-32	-28	-25	-50	-45	-40

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10 and good reported braking, increase V1 by 1 kt.**
   If adjusted V1 is less than VMCG, set V1 = VMCG.

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff

8% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 KG)

TO1 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-7	-7	-7	-19	-19	-19
380	0	0	0	-7	-7	-7	-18	-18	-18
360	0	0	0	-7	-7	-7	-17	-17	-17
340	0	0	0	-7	-7	-7	-16	-16	-16
320	0	0	0	-7	-7	-7	-15	-15	-15
300	0	0	0	-6	-6	-6	-14	-14	-14
280	0	0	0	-6	-6	-6	-12	-12	-12
260	0	0	0	-5	-5	-5	-10	-10	-10
240	0	0	0	-4	-4	-4	-9	-9	-9
220	0	0	0	-3	-3	-3	-7	-7	-7

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5800	197								
6200	243								
6600	289	215							
7000	335	261	188						
7400	382	307	233						
7800	429	354	280						
8200		401	326						
8600			373	189					
9000			419	233					
9400				277	197				
9800				322	242				
10200				367	286	206			
10600				411	331	251			
11000					375	295			
11400					420	340			
11800						384			
12200						429			
12600									
13000									
13400							197		
13800							233		
14200							269	182	
14600							305	218	
15000							341	255	

1. **Enter Weight Adjustment table with reported braking action and TO1 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limited weight by 18000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO1 Slippery Runway Takeoff
8% Thrust Reduction
No Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-5	-3	-1	-22	-18	-15	-46	-42	-37
380	-7	-5	-3	-25	-21	-17	-50	-45	-40
360	-9	-7	-5	-28	-24	-20	-53	-48	-44
340	-11	-9	-7	-30	-26	-22	-56	-51	-46
320	-12	-11	-9	-33	-29	-25	-58	-53	-49
300	-14	-12	-11	-35	-31	-27	-60	-55	-51
280	-16	-14	-12	-37	-33	-28	-62	-57	-52
260	-17	-15	-13	-38	-34	-30	-62	-58	-53
240	-17	-15	-13	-38	-34	-30	-62	-58	-53
220	-16	-15	-13	-38	-34	-29	-62	-57	-52

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10 and good reported braking action, increase V1 by 2 kts. If adjusted V1 is less than VMCG, set V1 = VMCG.**

TO1 Minimum Control Speeds

8% Thrust Reduction

VMCG, VRMIN (KIAS)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)															
		-2000		0		2000		4000		5000		6000		8000		10000	
°C	°F	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN
60	140	104	107	100	103	97	99	93	96	91	94	90	92	87	89	84	86
55	131	107	110	104	106	100	103	96	99	94	96	93	95	89	92	86	89
50	122	111	114	107	110	103	106	99	102	96	99	96	98	92	95	89	91
45	113	114	117	110	113	106	109	102	105	99	101	98	101	95	97	91	94
40	104	117	120	112	115	109	111	105	107	101	104	101	103	97	100	93	96
39	103	117	120	113	116	109	112	105	108	101	104	101	104	98	100	94	96
37	99	117	120	114	117	110	113	106	109	102	105	102	105	98	101	95	97
35	95	117	120	115	118	111	114	107	110	103	106	103	106	99	102	96	98
33	92	117	120	116	119	111	115	107	110	104	107	104	106	100	102	96	99
30	86	117	120	116	119	113	116	109	112	106	109	105	108	101	104	97	100
29	85	117	120	116	119	113	116	109	112	106	109	105	108	101	104	97	100
25	77	117	120	116	119	113	116	111	114	108	111	106	109	102	105	99	101
23	73	117	120	116	119	113	116	111	114	109	112	107	110	103	106	99	102
20	68	117	120	116	119	113	116	111	114	109	112	108	111	104	107	100	103
15	59	117	120	116	119	113	116	111	114	109	112	108	111	105	108	101	104
10	50	117	120	116	119	113	116	111	113	109	112	108	111	105	108	102	105
5	41	117	120	116	119	113	116	111	113	109	112	108	111	105	108	102	105
0	32	117	120	116	119	113	116	111	113	109	112	108	111	105	108	102	105
-55	-67	117	120	116	119	113	116	110	113	109	112	108	111	105	108	102	105

Flaps 20 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)															
	86		90		95		100		105		110		115		120	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
240	101	21	104	20	109	19	115	18	121	18	127	17	133	17	139	17
220	101	20	104	19	109	18	115	18	121	17	127	17	133	17	140	17
200	100	19	104	18	109	18	115	18	121	17	128	17	134	17	140	18

Flaps 10 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)															
	86		90		95		100		105		110		115		120	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
220	102	22	106	21	111	21	116	20	123	19	129	19	135	19	142	20
200	102	21	106	20	111	20	117	19	123	19	129	19	136	19	142	20

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

20% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440				-33	-33	-33	-46	-46	-46
420	-28	-28	-28	-32	-32	-32	-44	-44	-44
400	-26	-26	-26	-31	-31	-31	-43	-43	-43
380	-24	-24	-24	-29	-29	-29	-42	-42	-42
360	-23	-23	-23	-28	-28	-28	-41	-41	-41
340	-21	-21	-21	-26	-26	-26	-40	-40	-40
320	-20	-20	-20	-25	-25	-25	-38	-38	-38
300	-18	-18	-18	-23	-23	-23	-37	-37	-37
280	-16	-16	-16	-22	-22	-22	-36	-36	-36

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
7000							209		
7400							234		
7800				223			260		
8200	223			248			285	207	
8600	250			274			310	232	
9000	276			300	220		335	257	
9400	302	221		326	246		361	282	204
9800	329	247		352	272		386	308	229
10200	355	273		377	297	217	411	333	255
10600	382	299	218	403	323	243		358	280
11000	407	326	245		349	269		383	305
11400		352	271		375	295		409	330
11800		379	297		401	321			356
12200		406	323			346			381
12600			350			372			406
13000			376			398			

1. **Enter Weight Adjustment table with slush/standing water depth and TO2 field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10, decrease VMCG limit weight by 12000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

20% Thrust Reduction

2 Engine Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-24	-22	-20	-18	-16	-14	-3	-1	0
380	-25	-23	-21	-20	-18	-16	-5	-3	-1
360	-27	-25	-23	-21	-19	-17	-7	-5	-3
340	-28	-26	-24	-22	-20	-18	-10	-8	-6
320	-28	-26	-24	-24	-22	-20	-12	-10	-8
300	-29	-27	-25	-25	-23	-21	-14	-12	-10
280	-29	-27	-25	-25	-23	-21	-17	-15	-13

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by an additional 1 kt. If adjusted V1 is less than VMCG, set V1 = VMCG.**

No Reverse Thrust

Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
440	-34	-34	-34	-42	-42	-42	-64	-64	-64
420	-32	-32	-32	-40	-40	-40	-61	-61	-61
400	-30	-30	-30	-38	-38	-38	-58	-58	-58
380	-28	-28	-28	-36	-36	-36	-55	-55	-55
360	-26	-26	-26	-34	-34	-34	-53	-53	-53
340	-24	-24	-24	-31	-31	-31	-50	-50	-50
320	-23	-23	-23	-29	-29	-29	-47	-47	-47
300	-21	-21	-21	-27	-27	-27	-44	-44	-44
280	-19	-19	-19	-25	-25	-25	-41	-41	-41

ADVISORY INFORMATION

TO2 Slush/Standing Water Takeoff

20% Thrust Reduction

No Reverse Thrust

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
9000							265		
9400							291		
9800				251			317	245	
10200				280			343	271	
10600	261			309			369	297	
11000	291			338	257		395	322	250
11400	321			367	286		421	348	276
11800	351	267		396	315		447	374	302
12200	382	297		424	344	263	473	400	328
12600	412	327	243	453	372	292		426	354
13000	442	357	273		401	321		452	380
13400	472	388	303		430	349		478	405
13800		418	333		459	378			431
14200		448	363			407			457
14600		478	394			436			
15000			424			465			

1. **Enter Weight Adjustment table with slush/standing water depth and TO2 field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10, decrease VMCG limited weight by 15000 kg.**
3. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 2.**

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3mm)			0.25 INCHES (6mm)			0.50 INCHES (13mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-27	-23	-20	-20	-16	-12	-3	1	5
380	-29	-25	-21	-22	-18	-14	-5	-1	2
360	-30	-26	-23	-23	-20	-16	-7	-4	0
340	-31	-27	-23	-25	-21	-18	-10	-6	-3
320	-31	-27	-24	-26	-22	-19	-13	-9	-5
300	-31	-28	-24	-27	-23	-20	-16	-12	-8
280	-32	-29	-25	-29	-25	-21	-19	-15	-12
260	-32	-28	-25	-29	-25	-22	-21	-18	-14
240	-30	-26	-23	-27	-24	-20	-21	-18	-14
220	-29	-26	-22	-27	-24	-20	-22	-19	-15
200	-29	-26	-22	-28	-24	-20	-24	-20	-16

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10, decrease V1 by an additional 3 kts. If adjusted V1 is less than VMCG, set V1 = VMCG.**

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff

20% Thrust Reduction

2 Engine Reverse Thrust

Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-7	-7	-7	-18	-18	-18
380	0	0	0	-7	-7	-7	-16	-16	-1
360	0	0	0	-6	-6	-6	-15	-15	-15
340	0	0	0	-5	-5	-5	-14	-14	-14
320	0	0	0	-5	-5	-5	-13	-13	-13
300	0	0	0	-4	-4	-4	-11	-11	-11
280	0	0	0	-4	-4	-4	-10	-10	-10
260	0	0	0	-3	-3	-3	-9	-9	-9
240	0	0	0	-2	-2	-2	-8	-8	-8
220	0	0	0	-2	-2	-2	-7	-7	-7

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5200	211								
5600	253								
6000	294	211							
6400	335	253							
6800	377	294	211						
7200	418	335	253	218					
7600		377	294	254					
8000		418	335	290	210				
8400			377	326	247				
8800			418	363	283	203			
9200				399	319	239			
9600					355	275	199		
10000					392	312	226		
10400					428	348	253		
10800						384	281	205	
11200						421	307	232	
11600							334	259	
12000							361	286	210
12400							388	313	237
12800							414	340	264
13200								366	291
13600								393	318
14000								420	345
14400									372
14800									399
15200									426

1. **Enter Weight Adjustment table with reported braking action and TO2 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limit weight by 10000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff
20% Thrust Reduction
2 Engine Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	-4	-3	-2	-19	-15	-12	-39	-34	-29
380	-6	-5	-4	-22	-18	-15	-41	-36	-31
360	-8	-7	-6	-25	-21	-18	-44	-39	-34
340	-10	-9	-8	-27	-23	-20	-47	-42	-37
320	-11	-10	-9	-29	-25	-22	-49	-44	-39
300	-12	-11	-10	-31	-27	-24	-50	-45	-40
280	-13	-12	-11	-32	-28	-25	-50	-45	-40
260	-14	-13	-12	-32	-28	-25	-50	-45	-40
240	-14	-13	-12	-32	-28	-25	-50	-45	-40
220	-14	-13	-12	-32	-28	-25	-50	-45	-40

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10 and good reported braking, increase V1 by 1 kt.**
   If adjusted V1 is less than VMCG, set V1 = VMCG.

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff

20% Thrust Reduction

No Reverse Thrust

Weight Adjustment (1000 KG)

TO2 FIELD/OBSTACLE LIMIT WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-7	-7	-7	-19	-19	-19
380	0	0	0	-7	-7	-7	-18	-18	-18
360	0	0	0	-7	-7	-7	-17	-17	-17
340	0	0	0	-7	-7	-7	-16	-16	-16
320	0	0	0	-7	-7	-7	-15	-15	-15
300	0	0	0	-6	-6	-6	-14	-14	-14
280	0	0	0	-6	-6	-6	-13	-13	-13
260	0	0	0	-5	-5	-5	-11	-11	-11
240	0	0	0	-4	-4	-4	-9	-9	-9
220	0	0	0	-4	-4	-4	-8	-8	-8

VMCG Limit Weight (1000 KG)

FIELD LENGTH AVAILABLE (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
5400	200								
5800	243								
6200	287	217							
6600	331	261	191						
7000	376	305	235						
7400	422	349	278						
7800		394	322						
8200			367	222					
8600			413	266	188				
9000				310	231				
9400				354	275	196			
9800				398	319	240			
10200					363	283			
10600					407	327			
11000						372			
11400						416			
11800									
12200									
12600							218		
13000							256		
13400							294	203	
13800							332	240	
14200							370	278	187
14600							408	316	225
15000								354	263

1. **Enter Weight Adjustment table with reported braking action and TO2 field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Find VMCG limit weight for available field length and pressure altitude. For flaps 10 and poor reported braking action, decrease VMCG limited weight by 19000 kg.**
3. **Max allowable slippery runway limited weight is lesser of weights from 1 and 2.**

ADVISORY INFORMATION

TO2 Slippery Runway Takeoff

20% Thrust Reduction

No Reverse Thrust

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	0	0	0	-14	-10	-6	-35	-29	-24
380	-2	-1	0	-17	-13	-9	-40	-34	-28
360	-4	-3	-1	-20	-16	-12	-44	-38	-32
340	-6	-5	-3	-23	-19	-14	-50	-44	-37
320	-8	-7	-5	-26	-21	-17	-57	-51	-45
300	-10	-8	-7	-29	-24	-19	-65	-59	-53
280	-12	-10	-9	-31	-26	-22	-62	-56	-50
260	-14	-12	-10	-33	-28	-23	-59	-53	-47
240	-14	-12	-10	-34	-29	-24	-56	-51	-45
220	-14	-12	-10	-33	-28	-23	-56	-50	-44

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. For flaps 10 and good reported braking action, increase V1 by 2 kts. If adjusted V1 is less than VMCG, set V1 = VMCG.**

TO2 Minimum Control Speeds

20% Thrust Reduction

VMCG, VRMIN (KIAS)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)															
		-2000		0		2000		4000		5000		6000		8000		10000	
°C	°F	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN	V MCG	VR MIN
60	140	97	100	94	96	90	93	87	90	86	88	84	87	81	84	78	81
55	131	100	103	97	99	93	96	90	93	88	90	87	89	84	86	81	83
50	122	103	106	100	102	96	99	93	95	90	92	89	92	86	89	83	86
45	113	106	109	102	105	99	101	95	98	92	95	92	94	89	91	85	88
40	104	109	112	105	108	101	104	98	100	94	97	94	97	91	93	87	90
39	103	109	112	105	108	102	104	98	101	95	97	94	97	91	94	88	90
37	99	109	112	106	109	102	105	99	102	96	98	95	98	92	94	88	91
35	95	109	112	107	110	103	106	100	102	97	99	96	99	93	95	89	92
33	92	109	112	108	111	104	107	100	103	97	100	97	99	93	96	90	92
30	86	109	112	108	111	105	108	101	104	99	102	98	100	94	97	91	93
29	85	109	112	108	111	106	108	102	104	99	102	98	101	95	97	91	94
25	77	109	112	108	111	106	108	103	106	101	104	99	102	96	98	92	95
23	73	109	112	108	111	106	108	103	106	102	105	100	103	96	99	93	95
20	68	109	112	108	111	106	108	103	106	102	105	101	104	97	100	93	96
15	59	109	112	108	111	106	108	103	106	102	105	101	104	98	101	95	97
10	50	109	112	108	111	106	108	103	106	102	105	101	104	98	101	96	98
-55	-67	109	112	108	111	106	108	103	106	102	104	101	104	98	101	96	98

Flaps 20 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)															
	81		85		90		95		100		105		110		112	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
220	96	21	100	20	104	19	109	18	115	18	121	17	127	17	130	17
200	96	20	100	19	104	18	109	18	115	18	121	17	128	17	130	17

Flaps 10 V2 For VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)															
	81		85		90		95		100		105		110		112	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
220	97	24	101	23	106	21	111	21	116	20	123	19	129	19	131	19
200	97	22	101	21	106	20	111	20	117	19	123	19	129	19	132	19

Initial Climb EPR

Based on engine bleed for 3 packs on, engine and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	129	1.25	1.25	1.25	1.25									
50	122	1.27	1.27	1.27	1.27	1.27	1.27	1.27						
45	113	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.28			
40	104	1.32	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.30	1.30	1.30
35	95	1.34	1.34	1.34	1.34	1.34	1.34	1.33	1.33	1.33	1.33	1.33	1.33	1.32
30	86	1.34	1.35	1.37	1.37	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.35	1.35
25	77	1.34	1.35	1.37	1.38	1.39	1.40	1.40	1.39	1.39	1.39	1.39	1.39	1.38
20	68	1.34	1.35	1.37	1.38	1.39	1.40	1.42	1.43	1.43	1.43	1.43	1.43	1.42
15	59	1.34	1.35	1.37	1.38	1.39	1.40	1.42	1.43	1.45	1.46	1.47	1.47	1.46
10 & BELOW	50 & BELOW	1.34	1.35	1.37	1.38	1.39	1.40	1.42	1.43	1.45	1.46	1.48	1.49	1.50

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)	
	-2000	10000
NACELLE ANTI-ICE	-0.01	-0.02
WING ANTI-ICE	-0.01	-0.02
NACELLE AND WING ANTI-ICE	-0.02	-0.02
EACH 20 KTS ABOVE 200 KIAS	-0.01	-0.02

Max Climb EPR

Based on engine bleed for 3 packs on, engine and wing anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)									
	0	5	10	15	20	25	30	35	40	45
	340	340	340	340	340	340	0.84	0.84	0.84	0.84
60	1.19	1.19	1.18							
50	1.23	1.23	1.22	1.21						
40	1.25	1.29	1.28	1.27	1.25					
30	1.25	1.30	1.35	1.35	1.33	1.32				
20	1.25	1.30	1.35	1.39	1.42	1.42	1.42	1.39		
10	1.25	1.30	1.35	1.39	1.43	1.48	1.52	1.48	1.44	1.41
0	1.25	1.30	1.35	1.39	1.43	1.48	1.57	1.58	1.54	1.51
-10	1.25	1.30	1.35	1.39	1.43	1.48	1.57	1.64	1.61	1.58
-20 & BELOW	1.25	1.30	1.35	1.39	1.43	1.48	1.57	1.64	1.61	1.58

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	0	10	20	30	40
ENGINE ANTI-ICE ON	-0.01	-0.02	-0.03	-0.04	-0.05
ENGINE & WING ANTI-ICE ON	-0.03	-0.04	-0.06	-0.07	-0.08

Go-around EPR

Based on engine bleed for 3 packs on

REPORTED OAT		TAT (°C)	AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F		-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
51	124	54	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	
47	117	50	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	
42	108	45	1.46	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.44	1.44	1.44	1.44
37	99	40	1.46	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48
32	90	35	1.46	1.48	1.51	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
27	81	30	1.46	1.48	1.51	1.53	1.54	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56
22	72	25	1.46	1.48	1.51	1.53	1.54	1.56	1.57	1.59	1.59	1.59	1.59	1.59	1.59
17	63	20	1.46	1.48	1.51	1.53	1.54	1.56	1.57	1.59	1.61	1.63	1.63	1.63	1.63
12	54	15	1.46	1.48	1.51	1.53	1.54	1.56	1.57	1.59	1.61	1.63	1.64	1.65	1.66
7 & BELOW	45 & BELOW	10 & BELOW	1.46	1.48	1.51	1.53	1.54	1.56	1.57	1.59	1.61	1.63	1.64	1.65	1.67

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-2000	10000
2 PACKS OFF	0.01	0.01
3 PACKS OFF	0.02	0.02

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb (290/.84)

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
40000	**PITCH ATT**	**3.5**	**3.5**			
	V/S (FT/MIN)	1500	700			
35000	**PITCH ATT**	**4.5**	**4.0**	**4.0**	**3.5**	
	V/S (FT/MIN)	2900	1900	1200	500	
30000	**PITCH ATT**	**4.5**	**4.5**	**4.5**	**4.5**	**5.0**
	V/S (FT/MIN)	2700	1900	1400	900	500
20000	**PITCH ATT**	**7.5**	**7.0**	**6.5**	**6.5**	**6.5**
	V/S (FT/MIN)	4100	3100	2400	1800	1400
10000	**PITCH ATT**	**10.5**	**9.5**	**9.0**	**8.5**	**8.5**
	V/S (FT/MIN)	5300	4100	3200	2600	2100
SEA LEVEL	**PITCH ATT**	**13.0**	**11.5**	**10.5**	**10.5**	**10.0**
	V/S (FT/MIN)	6100	4700	3800	3000	2600

Cruise (.84/290)

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
40000	**PITCH ATT**	**2.0**	**2.5**			
	EPR	1.16	1.31			
	(Alt Mode %N1)	(83.2)	(88.0)			
35000	**PITCH ATT**	**1.0**	**2.0**	**2.5**	**3.0**	
	EPR	1.08	1.14	1.24	1.43	
	(Alt Mode %N1)	(80.6)	(83.0)	(86.3)	(92.2)	
30000	**PITCH ATT**	**1.0**	**2.0**	**3.0**	**3.5**	**4.0**
	EPR	1.02	1.07	1.13	1.21	1.32
	(Alt Mode %N1)	(77.3)	(79.8)	(82.6)	(85.7)	(89.3)
20000	**PITCH ATT**	**1.5**	**2.5**	**3.0**	**4.0**	**4.5**
	EPR	0.97	0.99	1.03	1.07	1.11
	(Alt Mode %N1)	(70.5)	(72.7)	(75.3)	(78.1)	(80.8)
10000	**PITCH ATT**	**1.5**	**2.5**	**3.5**	**4.5**	**5.0**
	EPR	0.96	0.98	1.00	1.02	1.04
	(Alt Mode %N1)	(64.3)	(66.3)	(68.7)	(71.1)	(73.3)
0	**PITCH ATT**	**1.5**	**2.5**	**3.5**	**4.5**	**5.0**
	EPR	0.97	0.98	0.99	1.00	1.01
	(Alt Mode %N1)	(55.6)	(57.8)	(60.4)	(63.2)	(65.7)

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Descent (.84/290)

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
40000	**PITCH ATT**	**-1.5**	**-0.5**			
	V/S (FT/MIN)	-2800	-2700			
35000	**PITCH ATT**	**-3.5**	**-2.0**	**-1.5**	**-0.5**	
	V/S (FT/MIN)	-3800	-3400	-3200	-3300	
30000	**PITCH ATT**	**-2.0**	**-0.5**	**0.0**	**1.0**	**1.5**
	V/S (FT/MIN)	-2600	-2300	-2200	-2100	-2200
20000	**PITCH ATT**	**-2.0**	**-1.0**	**0.0**	**1.0**	**1.5**
	V/S (FT/MIN)	-2500	-2200	-2100	-2000	-2000
10000	**PITCH ATT**	**-2.5**	**-1.0**	**0.5**	**1.5**	**2.0**
	V/S (FT/MIN)	-2200	-1900	-1800	-1700	-1700
SEA LEVEL	**PITCH ATT**	**-2.5**	**-1.0**	**0.5**	**1.5**	**2.0**
	V/S (FT/MIN)	-1900	-1700	-1500	-1500	-1500

Holding

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		200	250	300	350	390
10000	**PITCH ATT**	**5.5**	**6.0**	**6.0**	**5.5**	**5.5**
	EPR	1.01	1.02	1.03	1.04	1.04
	(Alt Mode %N1)	(55.9)	(61.4)	(66.5)	(70.5)	(73.3)
	KIAS	208	224	242	266	283

Terminal Area (5000 FT)

Set Thrust for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)					
		200	250	300	350	400	410
FLAPS UP (VREF30+80) (GEAR UP)	**PITCH ATT**	**5.0**	**5.5**	**5.5**	**6.0**	**6.5**	**6.5**
	EPR	1.01	1.03	1.04	1.06	1.07	1.08
	(Alt Mode %N1)	(51.4)	(57.5)	(62.5)	(67.1)	(70.8)	(71.5)
	KIAS	208	224	239	253	266	269
FLAPS 1 (VREF30+60) (GEAR UP)	**PITCH ATT**	**6.5**	**7.0**	**7.0**	**7.5**	**7.5**	**7.5**
	EPR	1.03	1.05	1.06	1.08	1.10	1.10
	(Alt Mode %N1)	(53.9)	(60.2)	(64.8)	(68.9)	(72.7)	(73.4)
	KIAS	188	204	219	233	246	249
FLAPS 5 (VREF30+40) (GEAR UP)	**PITCH ATT**	**7.5**	**7.5**	**8.0**	**8.0**	**8.0**	**8.0**
	EPR	1.06	1.08	1.10	1.12	1.15	1.15
	(Alt Mode %N1)	(57.9)	(63.6)	(68.4)	(72.7)	(76.5)	(77.2)
	KIAS	168	184	199	213	226	229
FLAPS 10 (VREF30+20) (GEAR UP)	**PITCH ATT**	**8.5**	**8.5**	**8.5**	**9.0**	**9.0**	**9.0**
	EPR	1.07	1.09	1.11	1.14	1.16	1.17
	(Alt Mode %N1)	(57.8)	(63.8)	(68.8)	(73.1)	(77.0)	(77.7)
	KIAS	148	164	179	193	206	209
FLAPS 20 (VREF30+10) (GEAR DOWN)	**PITCH ATT**	**7.5**	**7.5**	**7.5**	**7.5**	**7.5**	**7.5**
	EPR	1.10	1.13	1.17	1.21	1.25	1.26
	(Alt Mode %N1)	(64.0)	(69.9)	(75.2)	(79.9)	(83.7)	(84.4)
	KIAS	138	154	169	183	196	199

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Final Approach (1500 FT)

Gear Down, EPR for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)					
		200	250	300	350	400	410
FLAPS 25 (VREF25+10)	**PITCH ATT**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**
	EPR	1.05	1.06	1.07	1.08	1.10	1.10
	(Alt Mode %N1)	(48.8)	(54.8)	(59.7)	(63.7)	(67.2)	(67.9)
	KIAS	143	159	175	189	203	205
FLAPS 30 (VREF30+10)	**PITCH ATT**	**0.5**	**1.0**	**1.0**			
	EPR	1.07	1.09	1.11			
	(Alt Mode %N1)	(55.8)	(61.8)	(66.8)			
	KIAS	138	154	168			

Intentionally
Blank

Performance Inflight — Chapter PI
All Engines — Section 31

Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 10°C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	27600	6	33300*	32900	32100	30500	28900
380	28800	3	34500*	34000	33200	31600	30100
360	30000	1	35700*	35100	34300	32700	31300
340	31200	-2	36800*	36300	35500	34000	32500
320	32500	-5	38000*	37600	36800	35200	33800
300	33900	-8	39200*	38900	38100	36600	35100
280	35400	-12	40400*	40400	39600	38000	36600
260	36900	-13	41800*	41800*	41100	39600	38100
240	38600	-13	43300*	43300*	42800	41200	39800
220	40400	-13	45000	45000	44600	43000	41600
200	42400	-13	45000	45000	45000	45000	43600
180	44600	-13	45000	45000	45000	45000	45000

ISA + 15°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	27600	12	33300*	32900	32100	30500	28900
380	28800	9	34500*	34000	33200	31600	30100
360	30000	6	35700*	35100	34300	32700	31300
340	31200	4	36800*	36300	35500	34000	32500
320	32500	1	37900*	37600	36800	35200	33800
300	33900	-3	39100*	38900	38100	36600	35100
280	35400	-6	40400*	40400	39600	38000	36600
260	36900	-7	41800*	41800*	41100	39600	38100
240	38600	-7	43300*	43300*	42800	41200	39800
220	40400	-7	45000	45000	44600	43000	41600
200	42400	-7	45000	45000	45000	45000	43600
180	44600	-7	45000	45000	45000	45000	45000

ISA + 20°C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
400	27600	17	32400*	32400*	32100	30500	28900
380	28800	15	33700*	33700*	33200	31600	30100
360	30000	12	35000*	35000*	34300	32700	31300
340	31200	9	36200*	36200*	35500	34000	32500
320	32500	6	37300*	37300*	36800	35200	33800
300	33900	3	38500*	38500*	38100	36600	35100
280	35400	0	39800*	39800*	39600	38000	36600
260	36900	-2	41100*	41100*	41100	39600	38100
240	38600	-2	42600*	42600*	42600*	41200	39800
220	40400	-2	44300*	44300*	44300*	43000	41600
200	42400	-2	45000	45000	45000	45000	43600
180	44600	-2	45000	45000	45000	45000	45000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT) 27	29	31	33	35	37	39	41	43	45
400	EPR	1.19	1.25	1.36							
	MACH	.852	.862	.861							
	KIAS	347	337	322							
	FF/ENG	3467	3466	3513							
380	EPR	1.16	1.21	1.29	1.42						
	MACH	.844	.858	.861	.860						
	KIAS	343	335	323	308						
	FF/ENG	3286	3274	3284	3375						
360	EPR	1.13	1.18	1.24	1.34	1.48					
	MACH	.834	.850	.861	.861	.860					
	KIAS	339	332	323	309	295					
	FF/ENG	3116	3092	3092	3124	3256					
340	EPR	1.11	1.15	1.20	1.27	1.39					
	MACH	.824	.840	.855	.862	.860					
	KIAS	334	328	320	309	295					
	FF/ENG	2950	2920	2907	2912	2973					
320	EPR	1.09	1.13	1.17	1.22	1.31	1.45				
	MACH	.811	.829	.846	.859	.861	.860				
	KIAS	329	323	316	308	295	282				
	FF/ENG	2787	2758	2735	2731	2743	2850				
300	EPR	1.08	1.10	1.14	1.18	1.25	1.35				
	MACH	.797	.816	.834	.850	.861	.861				
	KIAS	323	318	311	304	295	282				
	FF/ENG	2622	2597	2572	2555	2554	2598				
280	EPR	1.06	1.08	1.11	1.15	1.20	1.28	1.39			
	MACH	.782	.802	.821	.838	.854	.862	.860			
	KIAS	316	311	306	300	293	282	269			
	FF/ENG	2463	2437	2413	2391	2378	2391	2472			
260	EPR	1.04	1.06	1.09	1.12	1.16	1.22	1.30	1.43		
	MACH	.765	.786	.805	.825	.842	.857	.861	.860		
	KIAS	309	304	300	294	288	281	269	257		
	FF/ENG	2303	2278	2255	2233	2211	2218	2252	2341		
240	EPR	1.03	1.05	1.07	1.10	1.13	1.17	1.23	1.32	1.46	
	MACH	.745	.767	.788	.808	.827	.845	.859	.861	.860	
	KIAS	300	297	292	288	282	276	269	257	245	
	FF/ENG	2144	2119	2096	2075	2054	2049	2074	2102	2196	
220	EPR	1.01	1.03	1.05	1.07	1.10	1.13	1.18	1.24	1.34	
	MACH	.726	.746	.768	.789	.810	.829	.846	.860	.861	
	KIAS	291	288	284	280	276	270	264	257	245	
	FF/ENG	1991	1960	1937	1917	1896	1890	1901	1921	1943	
200	EPR	1.00	1.01	1.03	1.05	1.07	1.10	1.14	1.18	1.25	1.34
	MACH	.706	.724	.745	.767	.789	.810	.829	.846	.860	.861
	KIAS	283	279	275	272	268	263	258	252	245	234
	FF/ENG	1850	1810	1785	1759	1738	1733	1740	1755	1760	1775

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitudes

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
671	629	591	557	527	500	480	461	443	427	412
1346	1260	1183	1115	1055	1000	960	924	889	857	828
2029	1897	1779	1675	1583	1500	1441	1386	1335	1288	1244
2720	2541	2379	2238	2113	2000	1922	1849	1781	1717	1659
3420	3190	2983	2803	2644	2500	2403	2311	2226	2148	2075
4128	3845	3590	3370	3176	3000	2883	2773	2671	2577	2490
4844	4505	4202	3939	3709	3500	3363	3235	3116	3006	2905
5570	5173	4818	4512	4243	4000	3843	3696	3560	3434	3319
6303	5846	5437	5086	4778	4500	4323	4158	4005	3863	3732
7046	6525	6061	5662	5314	5000	4803	4619	4448	4290	4145

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		25	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
500	14.1	1:20	12.7	1:16	11.6	1:14	10.7	1:13	10.0	1:11
1000	28.4	2:38	26.0	2:29	24.0	2:24	22.2	2:20	21.0	2:16
1500	42.4	3:58	39.1	3:43	36.1	3:34	33.5	3:28	31.8	3:22
2000	56.0	5:21	51.8	4:59	47.9	4:46	44.6	4:36	42.3	4:29
2500	69.3	6:47	64.3	6:17	59.5	5:58	55.4	5:46	52.6	5:37
3000	82.2	8:16	76.4	7:38	70.8	7:12	66.0	6:57	62.7	6:45
3500	94.8	9:47	88.3	9:01	81.9	8:28	76.4	8:08	72.5	7:54
4000	107.1	11:20	100.0	10:28	92.8	9:46	86.5	9:21	82.2	9:05
4500	119.1	12:57	111.3	11:57	103.4	11:06	96.4	10:34	91.6	10:16
5000	130.9	14:35	122.4	13:29	113.8	12:29	106.1	11:49	100.8	11:28

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-1.5	-0.7	0.0	2.6	8.3
20	-3.3	-1.6	0.0	4.9	14.1
30	-5.0	-2.5	0.0	6.9	19.3
40	-6.7	-3.4	0.0	8.8	23.9
50	-8.3	-4.2	0.0	10.5	27.8
60	-9.9	-5.1	0.0	12.0	31.2
70	-11.5	-5.9	0.0	13.3	34.0
80	-13.0	-6.7	0.0	14.5	36.2
90	-14.5	-7.5	0.0	15.4	37.8
100	-16.0	-8.3	0.0	16.2	38.8
110	-17.4	-9.1	0.0	16.8	39.2
120	-18.7	-9.8	0.0	17.2	39.0
130	-20.0	-10.6	0.0	17.4	38.3
140	-21.3	-11.3	0.0	17.4	36.9

Long Range Cruise Enroute Fuel and Time - High Altitudes

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
3862	3654	3464	3295	3141	3000	2883	2773	2671	2577	2490
4512	4268	4045	3846	3666	3500	3363	3235	3116	3006	2905
5164	4884	4627	4398	4191	4000	3843	3696	3560	3434	3319
5819	5501	5210	4951	4716	4500	4323	4158	4005	3863	3732
6476	6120	5794	5504	5241	5000	4803	4619	4448	4290	4145
7137	6741	6380	6058	5767	5500	5283	5080	4891	4717	4557
7800	7364	6967	6613	6293	6000	5763	5541	5335	5144	4969
8468	7991	7556	7169	6820	6500	6242	6001	5777	5570	5380
9141	8622	8148	7727	7348	7000	6722	6461	6219	5996	5790
9819	9256	8742	8286	7876	7500	7200	6921	6660	6420	6199
10506	9896	9340	8848	8405	8000	7679	7379	7100	6844	6608

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)							
	25		29		33		37	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
3000	62.7	6:45	59.1	6:31	56.3	6:20	55.2	6:13
3500	72.5	7:54	68.4	7:37	65.2	7:24	63.7	7:15
4000	82.2	9:05	77.4	8:44	73.8	8:28	72.0	8:18
4500	91.6	10:16	86.3	9:52	82.3	9:33	80.1	9:20
5000	100.8	11:28	95.0	11:01	90.5	10:39	88.0	10:24
5500	109.8	12:41	103.5	12:11	98.5	11:46	95.7	11:28
6000	118.7	13:55	111.8	13:22	106.4	12:53	103.2	12:32
6500	127.3	15:11	120.0	14:33	114.1	14:01	110.6	13:37
7000	135.9	16:28	128.0	15:46	121.7	15:10	117.8	14:43
7500	144.2	17:47	135.9	17:00	129.1	16:21	124.8	15:49
8000	152.5	19:09	143.7	18:14	136.5	17:31	131.7	16:57

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
50	-9.4	-5.0	0.0	10.6	28.1
60	-11.1	-5.9	0.0	11.9	30.9
70	-12.9	-6.7	0.0	13.2	33.6
80	-14.7	-7.6	0.0	14.4	36.1
90	-16.5	-8.5	0.0	15.6	38.4
100	-18.4	-9.3	0.0	16.7	40.6
110	-20.3	-10.2	0.0	17.8	42.6
120	-22.3	-11.1	0.0	18.8	44.5
130	-24.3	-12.1	0.0	19.8	46.2
140	-26.3	-13.0	0.0	20.7	47.8
150	-28.4	-13.9	0.0	21.5	49.1
160	-30.5	-14.9	0.0	22.3	50.4

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)										
	400	380	360	340	320	300	280	260	240	220	200
45									75	34	10
43								66	30	9	1
41							54	25	8	1	2
39					74	42	19	6	0	2	10
37			88	55	30	13	3	0	3	10	22
35		63	38	20	8	2	0	4	11	22	36
33	43	25	12	4	0	1	5	13	23	36	51
31	14	6	1	0	2	7	15	25	37	51	66
29	2	0	1	4	10	18	27	39	51	65	80
27	0	3	7	13	21	30	41	53	66	79	94
25	5	11	17	25	34	44	55	67	79	93	106

The above wind factor table is for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. **Read wind factors for present and new altitudes from table.**
2. **Determine difference (new altitude wind factor minus present altitude wind factor); this difference may be negative or positive.**
3. **Break-even wind at new altitude is present altitude wind plus difference from step 2.**

Descent at .84/290/250

PRESSURE ALT (1000 FT)	27	29	31	33	35	37	39	41	43	45
DISTANCE (NM)	96	103	110	117	124	129	134	140	145	150
TIME (MINUTES)	19	20	21	22	23	23	24	25	25	26

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	45000
400	EPR	1.02	1.03	1.05	1.08	1.09	1.16	1.30			
	KIAS	286	286	286	286	313	317	322			
	FF/ENG	3360	3290	3200	3170	3270	3340	3550			
380	EPR	1.02	1.03	1.04	1.07	1.08	1.14	1.25			
	KIAS	280	280	280	280	306	310	314			
	FF/ENG	3190	3130	3030	3000	3090	3130	3270			
360	EPR	1.02	1.02	1.04	1.06	1.07	1.12	1.21			
	KIAS	271	271	271	271	297	300	305			
	FF/ENG	3020	2970	2880	2820	2910	2920	3040			
340	EPR	1.02	1.02	1.03	1.05	1.06	1.10	1.19	1.48		
	KIAS	261	261	261	261	288	291	295	302		
	FF/ENG	2840	2810	2730	2650	2740	2730	2820	3480		
320	EPR	1.02	1.02	1.03	1.05	1.05	1.09	1.16	1.31		
	KIAS	251	251	251	251	279	282	286	291		
	FF/ENG	2670	2640	2590	2490	2560	2550	2620	2830		
300	EPR	1.01	1.02	1.03	1.05	1.04	1.08	1.14	1.25		
	KIAS	242	242	242	242	270	272	276	281		
	FF/ENG	2500	2480	2440	2350	2390	2380	2420	2550		
280	EPR	1.01	1.02	1.03	1.04	1.03	1.07	1.12	1.21		
	KIAS	233	233	233	233	260	262	266	270		
	FF/ENG	2340	2310	2280	2210	2230	2220	2230	2330		
260	EPR	1.01	1.01	1.02	1.03	1.03	1.05	1.10	1.17	1.37	
	KIAS	228	228	228	228	251	253	255	259	264	
	FF/ENG	2170	2150	2130	2060	2060	2050	2050	2130	2430	
240	EPR	1.01	1.01	1.02	1.03	1.02	1.04	1.08	1.14	1.27	
	KIAS	221	221	221	221	240	242	244	248	252	
	FF/ENG	2010	2000	1980	1920	1900	1890	1880	1920	2100	
220	EPR	1.00	1.01	1.01	1.02	1.02	1.03	1.07	1.12	1.22	
	KIAS	215	215	215	215	229	231	234	236	240	
	FF/ENG	1860	1850	1840	1780	1760	1750	1740	1740	1870	
200	EPR	1.00	1.00	1.01	1.01	1.01	1.02	1.05	1.09	1.17	1.34
	KIAS	208	208	208	208	219	220	222	224	228	233
	FF/ENG	1710	1700	1690	1650	1620	1600	1600	1600	1660	1850

This table includes 5% additional fuel for holding in a racetrack pattern.

Holding
Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
400	EPR	1.07	1.08	1.11	1.16	1.23
	KIAS	245	246	248	251	251
	FF/ENG	3570	3520	3480	3470	3560
380	EPR	1.06	1.07	1.10	1.14	1.21
	KIAS	240	241	243	245	245
	FF/ENG	3390	3350	3300	3280	3350
360	EPR	1.06	1.07	1.09	1.13	1.19
	KIAS	234	236	238	240	240
	FF/ENG	3210	3180	3120	3090	3150
340	EPR	1.05	1.06	1.08	1.11	1.17
	KIAS	229	230	232	234	234
	FF/ENG	3030	3000	2950	2900	2940
320	EPR	1.05	1.06	1.07	1.10	1.15
	KIAS	223	224	226	228	228
	FF/ENG	2850	2830	2790	2730	2740
300	EPR	1.04	1.05	1.07	1.09	1.13
	KIAS	218	219	220	222	222
	FF/ENG	2660	2650	2620	2560	2550
280	EPR	1.04	1.04	1.06	1.08	1.11
	KIAS	212	213	215	216	216
	FF/ENG	2480	2470	2460	2400	2370
260	EPR	1.03	1.04	1.05	1.07	1.10
	KIAS	207	207	209	210	210
	FF/ENG	2300	2300	2290	2240	2200
240	EPR	1.03	1.03	1.04	1.06	1.08
	KIAS	200	201	202	203	203
	FF/ENG	2130	2120	2120	2080	2050
220	EPR	1.02	1.03	1.04	1.05	1.07
	KIAS	194	194	195	196	196
	FF/ENG	1950	1960	1960	1920	1900
200	EPR	1.02	1.02	1.03	1.04	1.06
	KIAS	187	188	189	190	190
	FF/ENG	1790	1800	1800	1770	1760

This table includes 5% additional fuel for holding in a racetrack pattern.
Holding at Flaps 1 in icing conditions is not recommended.

Intentionally
Blank

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 30

BRAKING CONFIGURATION	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF30	TWO REV	NO REV

Dry Runway

MAX MANUAL	3940	110/-60	120	-190/630	70/-60	110/-110	200	100	210
AUTOBRAKE MAX	4750	90/-70	150	-220/740	0/0	130/-130	260	0	0
AUTOBRAKE 4	5860	100/-90	190	-290/970	0/0	180/-180	340	0	0
AUTOBRAKE 3	6950	120/-110	230	-350/1180	30/-30	210/-210	380	0	10
AUTOBRAKE 2	7880	130/-130	270	-410/1370	70/-140	260/-240	350	80	80
AUTOBRAKE 1	8780	160/-150	320	-480/1610	210/-240	310/-280	350	480	720

Good Reported Braking Action

MAX MANUAL	5210	90/-80	170	-270/930	150/-130	160/-150	250	280	610
AUTOBRAKE MAX	5480	90/-90	180	-280/950	140/-120	170/-160	280	280	620
AUTOBRAKE 4	5940	100/-100	190	-300/1010	50/-30	180/-180	340	40	200
AUTOBRAKE 3	6950	120/-110	230	-350/1180	30/-30	210/-210	380	0	10
AUTOBRAKE 2	7880	130/-130	270	-410/1370	70/-140	260/-240	350	80	80
AUTOBRAKE 1	8780	160/-150	320	-480/1610	210/-240	310/-280	350	480	720

Medium Reported Braking Action

MAX MANUAL	7060	120/-120	250	-410/1470	370/-290	240/-220	290	690	1650
AUTOBRAKE MAX	7150	130/-120	260	-410/1480	360/-260	250/-220	330	670	1600
AUTOBRAKE 4	7170	130/-120	260	-410/1480	350/-270	250/-220	320	690	1640
AUTOBRAKE 3	7550	130/-120	260	-430/1520	290/-190	250/-230	380	460	1360
AUTOBRAKE 2	8170	140/-140	280	-450/1600	260/-230	270/-250	350	330	930
AUTOBRAKE 1	8880	160/-150	320	-490/1720	330/-290	310/-280	350	560	1040

Poor Reported Braking Action

MAX MANUAL	9160	170/-160	340	-600/2330	910/-570	340/-280	320	1430	3670
AUTOBRAKE MAX	9200	170/-160	340	-600/2330	920/-560	340/-290	340	1430	3680
AUTOBRAKE 4	9220	170/-160	340	-610/2330	910/-560	340/-290	340	1420	3670
AUTOBRAKE 3	9270	170/-160	340	-610/2340	920/-520	340/-290	380	1440	3700
AUTOBRAKE 2	9550	170/-160	350	-620/2370	860/-540	350/-300	350	1230	3410
AUTOBRAKE 1	9840	180/-170	360	-630/2410	880/-550	360/-310	350	1310	3340

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and 4 engines at maximum reverse thrust.

Max manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes an air distance from threshold to touchdown associated with a flare time of 4.22 seconds

Max manual and autobrake data valid for auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 210 ft.
For autobrake and manual speedbrakes, increase reference landing distance by 170 ft.

ADVISORY INFORMATION

Normal Configuration Landing Distance

Flaps 25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF25	TWO REV	NO REV

Dry Runway

MAX MANUAL	4280	130/-70	130	-200/660	70/-70	120/-120	190	130	270
AUTOBRAKE MAX	5090	110/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 4	6290	110/-100	210	-300/1000	10/0	190/-190	360	0	0
AUTOBRAKE 3	7540	130/-120	250	-370/1230	10/-30	230/-230	400	0	10
AUTOBRAKE 2	8600	150/-150	300	-430/1430	40/-140	280/-270	390	50	50
AUTOBRAKE 1	9620	180/-170	360	-500/1680	220/-270	340/-300	380	590	720

Good Reported Braking Action

MAX MANUAL	5540	90/-90	190	-280/950	160/-140	180/-160	250	320	730
AUTOBRAKE MAX	5800	100/-90	200	-290/970	140/-120	180/-170	280	330	740
AUTOBRAKE 4	6380	110/-100	210	-310/1050	40/-30	190/-190	360	40	220
AUTOBRAKE 3	7540	130/-120	250	-370/1230	20/-30	230/-230	400	0	10
AUTOBRAKE 2	8600	150/-150	300	-430/1430	40/-140	280/-270	390	50	50
AUTOBRAKE 1	9620	180/-170	360	-500/1680	220/-270	340/-300	380	590	720

Medium Reported Braking Action

MAX MANUAL	7590	140/-130	280	-420/1510	400/-310	270/-230	310	840	2040
AUTOBRAKE MAX	7640	140/-130	280	-430/1520	390/-280	270/-240	330	810	1990
AUTOBRAKE 4	7660	140/-130	280	-430/1520	380/-280	270/-240	330	830	2010
AUTOBRAKE 3	8140	140/-140	290	-440/1570	280/-200	270/-250	400	540	1710
AUTOBRAKE 2	8890	150/-150	310	-470/1660	230/-240	290/-280	390	320	1090
AUTOBRAKE 1	9730	180/-170	360	-520/1790	340/-320	350/-310	380	670	1120

Poor Reported Braking Action

MAX MANUAL	9920	190/-170	380	-630/2410	970/-610	380/-310	350	1750	4670
AUTOBRAKE MAX	9930	190/-180	380	-630/2410	980/-610	380/-310	350	1750	4680
AUTOBRAKE 4	9940	190/-180	380	-630/2410	980/-610	380/-310	350	1750	4670
AUTOBRAKE 3	10010	190/-180	380	-630/2410	960/-560	380/-310	380	1760	4710
AUTOBRAKE 2	10340	190/-180	390	-640/2450	870/-570	380/-320	380	1450	4360
AUTOBRAKE 1	10710	200/-190	400	-660/2490	910/-580	400/-330	380	1580	4120

Reference distance is for sea level, standard day, no wind or slope, VREF25 approach speed and 4 engines at maximum reverse thrust.

Max manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes an air distance from threshold to touchdown associated with a flare time of 4.22 seconds

Max manual and autobrake data valid for auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 220 ft.
For autobrake and manual speedbrakes, increase reference landing distance by 170 ft.

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
AIR/GND SYSTEM - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5080	150/-80	160	-230/750	110/-100	140/-140	300	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	7340	120/-110	240	-360/1190	330/-270	220/-220	410	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	11380	180/-180	370	-610/2090	1070/-740	360/-340	550	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	17480	260/-250	540	-1060/3800	3930/-1860	560/-510	670	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

AIR/GND SYSTEM - Flaps 30

VREF30

BRAKING CONFIGURATION	REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	4740	110/-70	140	-220/730	110/-90	130/-130	290	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								
Good Reported Braking Action									
MAX MANUAL	6680	100/-100	210	-340/1140	290/-230	200/-200	380	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								
Medium Reported Braking Action									
MAX MANUAL	9990	160/-150	320	-560/1950	880/-610	310/-300	480	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								
Poor Reported Braking Action									
MAX MANUAL	14770	220/-210	450	-960/3480	3040/-1480	470/-430	550	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID / ANTISKID OFF - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	8330	140/-140	290	-450/1580	390/-310	280/-240	330	820	1980
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	8330	140/-140	290	-450/1580	390/-310	280/-240	330	820	1980
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	10650	190/-180	390	-650/2470	970/-610	390/-320	370	1720	4590
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	14440	260/-240	520	-1120/5470	3630/-1450	570/-350	400	4290	14630
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

ANTISKID / ANTISKID OFF - Flaps 30

VREF30

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	7740	130/-120	260	-430/1530	370/-290	250/-230	320	670	1590
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	7740	130/-120	260	-430/1530	370/-290	250/-230	320	670	1590
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	9830	170/-160	350	-620/2390	900/-560	350/-290	350	1400	3590
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	13290	230/-220	460	-1070/5190	4380/-1350	500/-330	370	3550	11440
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
BLD DUCT LEAK L / BLD DUCT LEAK R - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4360	130/-70	130	-200/670	80/-70	120/-120	190	90	200
AUTOBRAKE MAX	5090	120/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8640	150/-150	300	-430/1440	20/-100	270/-270	440	0	0

Good Reported Braking Action

MAX MANUAL	5660	90/-90	190	-280/960	160/-140	180/-170	260	270	610
AUTOBRAKE MAX	5880	100/-90	200	-290/980	140/-120	180/-170	280	300	670
AUTOBRAKE 2	8640	150/-150	300	-430/1440	20/-100	270/-270	440	0	0

Medium Reported Braking Action

MAX MANUAL	7760	140/-130	280	-430/1530	410/-320	270/-230	310	770	1870
AUTOBRAKE MAX	7750	140/-130	280	-430/1530	410/-290	270/-240	330	770	1870
AUTOBRAKE 3	8170	140/-140	280	-440/1570	310/-210	270/-250	390	540	1670

Poor Reported Braking Action

MAX MANUAL	10130	190/-180	380	-630/2430	980/-620	380/-310	350	1670	4460
AUTOBRAKE MAX	10140	190/-180	380	-630/2430	990/-630	380/-310	350	1670	4470
AUTOBRAKE 3	10210	190/-180	380	-640/2430	970/-610	380/-310	360	1690	4500

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

BLD DUCT LEAK L / BLD DUCT LEAK R - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4010	110/-60	120	-190/630	70/-60	110/-110	200	70	150
AUTOBRAKE MAX	4750	100/-70	150	-220/740	0/0	130/-130	260	0	0
AUTOBRAKE 2	7970	140/-130	270	-410/1380	30/-110	250/-250	390	0	0

Good Reported Braking Action

MAX MANUAL	5310	90/-80	170	-270/940	160/-140	160/-150	250	230	510
AUTOBRAKE MAX	5540	90/-90	180	-280/960	140/-120	170/-160	280	250	560
AUTOBRAKE 2	7970	140/-130	270	-410/1380	30/-110	250/-250	390	0	0

Medium Reported Braking Action

MAX MANUAL	7210	120/-120	250	-410/1480	380/-300	240/-220	300	630	1500
AUTOBRAKE MAX	7240	130/-120	260	-420/1490	380/-270	250/-220	330	640	1510
AUTOBRAKE 3	7570	130/-120	260	-430/1520	320/-200	250/-230	380	460	1350

Poor Reported Braking Action

MAX MANUAL	9340	170/-160	340	-610/2340	920/-570	340/-290	330	1360	3500
AUTOBRAKE MAX	9380	170/-160	340	-610/2350	930/-590	340/-290	330	1360	3510
AUTOBRAKE 3	9440	170/-160	340	-610/2350	930/-570	340/-290	330	1370	3540

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG 1, 2, 3, 4 SHUTDOWN - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4400	140/-70	140	-210/680	80/-70	130/-120	190	0	140
AUTOBRAKE MAX	5090	130/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8640	150/-140	300	-430/1440	20/-30	270/-270	480	0	0

Good Reported Braking Action

MAX MANUAL	5850	100/-90	190	-290/1000	190/-160	180/-170	270	0	390
AUTOBRAKE MAX	6110	100/-100	200	-300/1020	170/-140	190/-180	300	0	400
AUTOBRAKE 2	8640	150/-140	300	-430/1440	20/-30	270/-270	480	0	0

Medium Reported Braking Action

MAX MANUAL	8370	150/-140	290	-470/1640	520/-390	280/-260	350	0	1150
AUTOBRAKE MAX	8380	150/-140	300	-470/1640	520/-360	280/-260	380	0	1130
AUTOBRAKE 3	8620	150/-140	300	-470/1660	480/-310	290/-270	400	0	1110

Poor Reported Braking Action

MAX MANUAL	11490	210/-200	420	-720/2680	1390/-830	410/-360	400	0	2750
AUTOBRAKE MAX	11500	210/-200	420	-720/2690	1410/-850	420/-360	400	0	2750
AUTOBRAKE 3	11590	210/-200	420	-720/2690	1390/-850	420/-360	400	0	2780

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

ENG 1, 2, 3, 4 SHUTDOWN - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV
Dry Runway									
MAX MANUAL	4150	120/-70	130	-200/670	80/-70	120/-120	190	0	120
AUTOBRAKE MAX	4750	110/-70	150	-220/740	10/0	130/-130	260	0	0
AUTOBRAKE 2	8050	140/-130	270	-410/1390	10/-30	250/-250	460	0	0
Good Reported Braking Action									
MAX MANUAL	5500	90/-90	180	-290/970	180/-150	170/-160	270	0	330
AUTOBRAKE MAX	5750	90/-90	190	-290/1000	160/-140	180/-170	300	0	340
AUTOBRAKE 2	8050	140/-130	270	-410/1390	10/-30	250/-250	460	0	0
Medium Reported Braking Action									
MAX MANUAL	7960	140/-130	280	-460/1610	510/-380	270/-250	350	0	1000
AUTOBRAKE MAX	7980	140/-130	280	-460/1610	520/-360	270/-250	370	0	1010
AUTOBRAKE 3	8170	140/-140	280	-460/1630	500/-320	270/-250	400	0	1040
Poor Reported Braking Action									
MAX MANUAL	11070	200/-190	400	-710/2660	1410/-830	400/-350	410	0	2480
AUTOBRAKE MAX	11120	200/-190	400	-720/2660	1430/-850	400/-350	410	0	2490
AUTOBRAKE 3	11200	200/-190	400	-720/2670	1390/-840	400/-350	420	0	2510

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS CONTROL - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4290	130/-70	130	-200/660	70/-70	120/-120	190	120	260
AUTOBRAKE MAX	5090	110/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8610	150/-150	300	-430/1430	40/-140	280/-270	400	30	30

Good Reported Braking Action

MAX MANUAL	5560	90/-90	190	-280/950	160/-140	180/-160	250	320	710
AUTOBRAKE MAX	5810	100/-90	200	-290/980	140/-120	180/-170	280	320	730
AUTOBRAKE 2	8610	150/-150	300	-430/1430	40/-140	280/-270	400	30	30

Medium Reported Braking Action

MAX MANUAL	7620	140/-130	280	-420/1520	400/-310	270/-230	310	830	2010
AUTOBRAKE MAX	7650	140/-130	280	-430/1520	390/-280	270/-240	330	800	1970
AUTOBRAKE 3	8150	140/-140	280	-440/1570	280/-200	270/-250	400	540	1700

Poor Reported Braking Action

MAX MANUAL	9960	190/-170	380	-630/2410	970/-610	380/-310	350	1740	4640
AUTOBRAKE MAX	9970	190/-180	380	-630/2410	980/-620	380/-310	350	1740	4640
AUTOBRAKE 3	10040	190/-180	380	-630/2420	960/-570	380/-310	380	1750	4680

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

FLAPS DRIVE - Flaps 25

VREF30+25

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT): REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	5100	150/-70	160	-210/700	90/-80	150/-150	230	160	350
AUTOBRAKE MAX	6140	130/-80	190	-250/830	10/-10	180/-180	300	0	0
AUTOBRAKE 2	10160	160/-160	350	-470/1540	170/-200	350/-320	380	340	340
Good Reported Braking Action									
MAX MANUAL	6640	100/-100	220	-300/1020	190/-160	220/-200	260	410	920
AUTOBRAKE MAX	6930	100/-100	230	-310/1050	170/-150	220/-200	300	430	980
AUTOBRAKE 2	10160	160/-160	350	-470/1540	180/-200	350/-320	380	340	340
Medium Reported Braking Action									
MAX MANUAL	8900	140/-140	320	-460/1610	450/-350	320/-270	320	1020	2480
AUTOBRAKE MAX	9000	150/-140	330	-460/1620	420/-330	320/-280	350	1000	2440
AUTOBRAKE 3	9740	150/-150	340	-480/1690	320/-240	320/-310	410	580	1860
Poor Reported Braking Action									
MAX MANUAL	11410	200/-190	430	-660/2520	1040/-670	440/-360	350	2020	5390
AUTOBRAKE MAX	11430	200/-190	430	-660/2520	1050/-660	440/-360	360	2010	5380
AUTOBRAKE 3	11620	200/-190	430	-670/2540	990/-610	430/-370	410	1890	5280

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Flaps Up Landing - Flaps Up

VREF30+70

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	7930	420/-150	350	-330/1350	150/-140	350/-310	380	380	850
AUTOBRAKE MAX	9080	340/-100	330	-320/1160	50/-30	290/-280	370	80	290
AUTOBRAKE 2	15280	230/-220	540	-570/1870	290/-340	550/-490	450	720	720

Good Reported Braking Action

MAX MANUAL	9140	370/-120	290	-350/1160	240/-210	310/-280	280	630	1440
AUTOBRAKE MAX	9620	320/-120	310	-360/1190	160/-120	310/-290	340	480	1310
AUTOBRAKE 2	15280	230/-220	540	-570/1870	290/-340	550/-490	450	720	720

Medium Reported Braking Action

MAX MANUAL	12750	230/-190	440	-540/1850	590/-480	480/-400	350	1660	4110
AUTOBRAKE MAX	12630	200/-180	460	-530/1850	550/-440	470/-400	370	1600	3970
AUTOBRAKE 3	14430	200/-200	500	-580/1990	380/-350	500/-460	470	780	2530

Poor Reported Braking Action

MAX MANUAL	16710	270/-260	610	-790/2900	1390/-930	690/-530	410	3450	9560
AUTOBRAKE MAX	16330	260/-260	640	-790/2880	1380/-910	670/-520	410	3330	9300
AUTOBRAKE 3	16920	250/-260	640	-800/2920	1240/-840	660/-540	470	2880	8900

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (1 Body or 1 Wing Gear Up) - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV
Dry Runway									
MAX MANUAL	5560	190/-120	170	-260/870	130/-120	160/-150	240	200	430
AUTOBRAKE MAX	5470	200/-100	170	-260/850	130/-110	160/-150	260	190	410
AUTOBRAKE 2	8680	160/-150	300	-430/1440	10/-30	270/-270	500	0	0
Good Reported Braking Action									
MAX MANUAL	6120	170/-100	200	-300/1000	180/-160	190/-170	280	290	660
AUTOBRAKE MAX	6060	180/-100	200	-290/1000	180/-160	190/-170	300	290	650
AUTOBRAKE 2	8710	160/-150	300	-430/1440	20/-50	270/-270	500	0	0
Medium Reported Braking Action									
MAX MANUAL	8210	140/-140	290	-440/1570	430/-340	280/-240	330	810	1960
AUTOBRAKE MAX	8140	140/-140	290	-440/1560	440/-340	280/-240	340	800	1940
AUTOBRAKE 3	8360	140/-140	290	-450/1590	360/-230	270/-260	420	580	1720
Poor Reported Braking Action									
MAX MANUAL	10590	190/-180	390	-650/2470	1020/-640	390/-320	370	1730	4650
AUTOBRAKE MAX	10560	190/-180	390	-650/2470	1030/-660	390/-320	370	1730	4630
AUTOBRAKE 3	10560	190/-180	390	-650/2470	1030/-640	390/-320	370	1730	4630

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (1 Body or 1 Wing Gear Up) - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5120	150/-100	150	-250/820	120/-100	150/-140	220	150	330
AUTOBRAKE MAX	5000	170/-80	150	-240/800	120/-80	140/-140	250	140	310
AUTOBRAKE 2	8060	140/-140	280	-410/1390	0/-50	250/-250	450	0	0

Good Reported Braking Action

MAX MANUAL	5760	130/-90	180	-290/980	170/-150	170/-160	270	250	560
AUTOBRAKE MAX	5710	140/-90	180	-290/980	170/-150	170/-160	290	240	540
AUTOBRAKE 2	8080	140/-140	280	-420/1390	10/-60	250/-250	460	0	0

Medium Reported Braking Action

MAX MANUAL	7660	130/-120	260	-430/1530	400/-310	250/-230	320	670	1580
AUTOBRAKE MAX	7610	130/-120	260	-430/1520	410/-310	250/-230	330	660	1570
AUTOBRAKE 3	7790	130/-130	270	-430/1540	340/-210	250/-240	410	490	1390

Poor Reported Braking Action

MAX MANUAL	9810	170/-160	350	-620/2390	950/-600	350/-300	340	1410	3640
AUTOBRAKE MAX	9810	170/-170	350	-630/2390	960/-610	350/-300	350	1410	3640
AUTOBRAKE 3	9810	170/-170	350	-630/2390	960/-600	350/-300	360	1410	3640

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
GEAR DISAGREE (2 Body or 2 Wing Gear Up) - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6750	380/-140	310	-330/1570	240/-190	270/-190	380	400	920
AUTOBRAKE MAX	6790	420/-150	330	-360/1630	240/-200	280/-250	410	420	960
AUTOBRAKE 2	8740	340/-150	310	-430/1540	60/-40	280/-280	510	0	0

Good Reported Braking Action

MAX MANUAL	6750	380/-130	310	-330/1570	240/-190	270/-190	380	400	920
AUTOBRAKE MAX	6790	420/-130	330	-360/1630	240/-200	280/-250	410	420	960
AUTOBRAKE 2	8740	340/-150	310	-430/1540	60/-40	280/-280	510	0	0

Medium Reported Braking Action

MAX MANUAL	8260	310/-140	290	-440/1580	430/-340	280/-250	330	820	2000
AUTOBRAKE MAX	8180	360/-140	290	-440/1570	440/-340	280/-250	340	810	1970
AUTOBRAKE 3	8380	360/-140	290	-450/1590	370/-240	270/-260	420	620	1780

Poor Reported Braking Action

MAX MANUAL	10680	220/-180	390	-650/2480	1030/-660	390/-320	370	1780	4780
AUTOBRAKE MAX	10650	270/-180	390	-650/2480	1050/-670	400/-320	380	1770	4770
AUTOBRAKE 3	10650	270/-180	390	-650/2480	1050/-660	400/-320	380	1770	4770

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (2 Body or 2 Wing Gear Up) - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6130	290/-130	250	-310/1300	200/-170	190/-170	280	310	690
AUTOBRAKE MAX	6070	320/-130	270	-310/1440	200/-170	240/-180	360	290	660
AUTOBRAKE 2	8100	250/-140	280	-420/1410	20/-50	260/-250	470	0	0

Good Reported Braking Action

MAX MANUAL	6130	290/-110	250	-310/1300	200/-170	190/-170	280	310	690
AUTOBRAKE MAX	6070	320/-100	270	-310/1440	200/-170	240/-180	360	290	660
AUTOBRAKE 2	8100	250/-140	280	-420/1410	20/-50	260/-250	470	0	0

Medium Reported Braking Action

MAX MANUAL	7700	230/-130	260	-430/1530	410/-320	250/-230	320	680	1620
AUTOBRAKE MAX	7650	260/-130	260	-430/1530	420/-320	260/-230	340	670	1600
AUTOBRAKE 3	7810	250/-130	270	-440/1550	350/-220	250/-240	410	510	1440

Poor Reported Braking Action

MAX MANUAL	9880	170/-170	350	-630/2400	960/-610	350/-300	350	1440	3740
AUTOBRAKE MAX	9890	180/-170	350	-630/2400	980/-620	360/-300	350	1440	3740
AUTOBRAKE 3	9890	180/-170	350	-630/2400	980/-610	360/-300	360	1440	3740

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR DISAGREE (Nose Gear Up) - Flaps 25

VREF25

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT) REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	4290	130/-70	130	-200/660	70/-70	120/-120	190	120	260
AUTOBRAKE MAX	5090	110/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8610	150/-150	300	-430/1430	40/-140	280/-270	400	30	30
Good Reported Braking Action									
MAX MANUAL	5560	90/-90	190	-280/950	160/-140	180/-160	250	320	710
AUTOBRAKE MAX	5810	100/-90	200	-290/980	140/-120	180/-170	280	320	730
AUTOBRAKE 2	8610	150/-150	300	-430/1430	40/-140	280/-270	400	30	30
Medium Reported Braking Action									
MAX MANUAL	7620	140/-130	280	-420/1520	400/-310	270/-230	310	830	2010
AUTOBRAKE MAX	7650	140/-130	280	-430/1520	390/-280	270/-240	330	800	1970
AUTOBRAKE 3	8150	140/-140	280	-440/1570	280/-200	270/-250	400	540	1700
Poor Reported Braking Action									
MAX MANUAL	9960	190/-170	380	-630/2410	970/-610	380/-310	350	1740	4640
AUTOBRAKE MAX	9970	190/-180	380	-630/2410	980/-620	380/-310	350	1740	4640
AUTOBRAKE 3	10040	190/-180	380	-630/2420	960/-570	380/-310	380	1750	4680

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
GEAR DISAGREE (Nose Gear Up) - Flaps 30
VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	3960	110/-60	120	-190/630	70/-60	110/-110	200	90	200
AUTOBRAKE MAX	4750	90/-70	150	-220/740	0/0	130/-130	260	0	0
AUTOBRAKE 2	7900	130/-130	270	-410/1380	60/-140	260/-240	360	60	60

Good Reported Braking Action

MAX MANUAL	5230	90/-80	170	-270/930	150/-130	160/-150	250	270	600
AUTOBRAKE MAX	5490	90/-90	180	-280/960	140/-120	170/-160	280	270	610
AUTOBRAKE 2	7900	130/-130	270	-410/1380	60/-140	260/-240	360	60	60

Medium Reported Braking Action

MAX MANUAL	7090	120/-120	250	-410/1470	370/-290	240/-220	290	680	1620
AUTOBRAKE MAX	7170	130/-120	260	-410/1480	360/-260	250/-220	330	670	1590
AUTOBRAKE 3	7560	130/-120	260	-430/1520	290/-190	250/-230	380	460	1360

Poor Reported Braking Action

MAX MANUAL	9190	170/-160	340	-600/2330	910/-570	340/-280	320	1420	3640
AUTOBRAKE MAX	9230	170/-160	340	-610/2330	920/-570	340/-290	330	1420	3650
AUTOBRAKE 3	9290	170/-160	340	-610/2340	920/-520	340/-290	370	1430	3680

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

GEAR LEVER JAMMED IN UP POSITION - Flaps 25

VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	7170	460/-160	340	-360/1730	300/-230	290/-210	430	0	520
AUTOBRAKE MAX	7230	530/-160	360	-390/1810	290/-240	310/-270	470	0	540
AUTOBRAKE 2	8740	460/-150	320	-430/1580	80/-20	280/-280	520	0	0

Good Reported Braking Action

MAX MANUAL	7170	460/-140	340	-360/1730	300/-230	290/-210	430	0	520
AUTOBRAKE MAX	7230	530/-140	360	-390/1810	290/-240	310/-270	470	0	540
AUTOBRAKE 2	8740	460/-150	320	-430/1580	80/-20	280/-280	520	0	0

Medium Reported Braking Action

MAX MANUAL	9090	380/-150	310	-490/1730	580/-440	300/-270	370	0	1180
AUTOBRAKE MAX	9000	450/-150	310	-490/1720	590/-440	300/-270	390	0	1160
AUTOBRAKE 3	9000	450/-150	310	-490/1720	590/-400	300/-270	400	0	1160

Poor Reported Braking Action

MAX MANUAL	12470	250/-200	440	-770/2880	1610/-940	440/-380	430	0	3010
AUTOBRAKE MAX	12440	320/-200	440	-770/2880	1630/-950	440/-380	440	0	3000
AUTOBRAKE 3	12440	320/-200	440	-770/2880	1630/-950	440/-380	440	0	3000

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
GEAR LEVER JAMMED IN UP POSITION - Flaps 30
VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6440	340/-140	260	-330/1400	240/-200	200/-180	300	0	380
AUTOBRAKE MAX	6380	380/-140	290	-330/1560	240/-200	260/-190	400	0	370
AUTOBRAKE 2	8100	310/-140	280	-420/1420	20/-10	260/-250	500	0	0

Good Reported Braking Action

MAX MANUAL	6440	340/-110	260	-330/1400	240/-200	200/-180	300	0	380
AUTOBRAKE MAX	6380	380/-110	290	-330/1560	240/-200	260/-190	400	0	370
AUTOBRAKE 2	8100	310/-140	280	-420/1420	20/-10	260/-250	500	0	0

Medium Reported Braking Action

MAX MANUAL	8390	260/-130	280	-470/1670	530/-400	270/-250	350	0	940
AUTOBRAKE MAX	8330	300/-130	280	-470/1660	540/-400	270/-250	370	0	930
AUTOBRAKE 3	8330	300/-130	280	-470/1660	540/-350	270/-250	400	0	930

Poor Reported Braking Action

MAX MANUAL	11340	190/-180	380	-730/2760	1450/-840	390/-340	400	0	2290
AUTOBRAKE MAX	11340	190/-180	390	-730/2760	1470/-850	390/-340	400	0	2290
AUTOBRAKE 3	11340	190/-180	390	-730/2760	1470/-850	390/-340	400	0	2290

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 1 / HYD PRESS SYS 2 / HYD PRESS SYS 3 - Flaps 25
VREF25

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4530	140/-70	140	-210/690	90/-80	130/-130	210	0	150
AUTOBRAKE MAX	5080	130/-80	160	-230/760	10/0	140/-140	270	0	0
AUTOBRAKE 2	8680	150/-150	300	-430/1440	0/-10	270/-270	510	0	0

Good Reported Braking Action

MAX MANUAL	6250	100/-100	210	-310/1050	220/-190	200/-190	320	0	480
AUTOBRAKE MAX	6380	110/-100	220	-310/1060	200/-160	200/-190	330	0	470
AUTOBRAKE 2	8680	150/-150	300	-430/1440	0/-10	270/-270	510	0	0

Medium Reported Braking Action

MAX MANUAL	9120	160/-150	320	-500/1750	630/-470	310/-280	400	0	1470
AUTOBRAKE MAX	9080	160/-150	320	-500/1750	640/-480	320/-280	410	0	1460
AUTOBRAKE 3	9210	160/-160	330	-500/1760	610/-440	320/-280	420	0	1490

Poor Reported Braking Action

MAX MANUAL	12770	230/-220	470	-790/2940	1770/-1010	470/-390	470	0	3660
AUTOBRAKE MAX	12760	230/-220	470	-790/2940	1790/-1030	470/-400	470	0	3660
AUTOBRAKE 3	12760	230/-220	470	-790/2940	1790/-990	470/-400	490	0	3660

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 1 / HYD PRESS SYS 2 / HYD PRESS SYS 3 - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4220	120/-60	130	-200/660	80/-70	120/-120	240	0	130
AUTOBRAKE MAX	4750	110/-70	150	-220/740	10/0	130/-130	260	0	20
AUTOBRAKE 2	8050	140/-130	270	-410/1390	0/-30	250/-250	460	0	0

Good Reported Braking Action

MAX MANUAL	5850	100/-90	190	-300/1020	210/-180	180/-170	310	0	400
AUTOBRAKE MAX	5980	100/-100	200	-310/1030	180/-150	190/-180	330	0	390
AUTOBRAKE 2	8050	140/-130	270	-410/1390	0/-30	250/-250	460	0	0

Medium Reported Braking Action

MAX MANUAL	8360	140/-140	290	-480/1680	570/-420	280/-260	380	0	1150
AUTOBRAKE MAX	8350	140/-140	290	-480/1680	580/-430	280/-260	380	0	1150
AUTOBRAKE 3	8500	150/-140	300	-480/1700	560/-410	290/-260	380	0	1180

Poor Reported Braking Action

MAX MANUAL	11510	200/-190	410	-750/2810	1580/-900	410/-350	430	0	2750
AUTOBRAKE MAX	11530	200/-190	410	-750/2810	1600/-920	420/-360	430	0	2750
AUTOBRAKE 3	11590	200/-190	410	-750/2810	1570/-910	420/-360	430	0	2770

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 4 - Flaps 25

VREF25

BRAKING CONFIGURATION	REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	5570	110/-90	180	-260/860	150/-130	170/-160	300	0	280
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								
Good Reported Braking Action									
MAX MANUAL	7610	130/-120	260	-390/1310	350/-280	250/-230	380	0	800
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								
Medium Reported Braking Action									
MAX MANUAL	10630	190/-180	380	-600/2150	920/-640	370/-320	440	0	2130
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								
Poor Reported Braking Action									
MAX MANUAL	14330	250/-240	520	-940/3610	2840/-1300	530/-430	490	0	4830
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 4 - Flaps 30
VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5150	80/-80	160	-250/830	130/-110	150/-150	290	0	230
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	6870	110/-110	230	-360/1250	310/-250	220/-200	340	0	600
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	9350	160/-150	320	-560/2010	770/-530	320/-280	380	0	1480
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	12360	210/-200	420	-860/3360	2380/-1080	440/-370	410	0	3230
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 1 and HYD PRESS SYS 2 / HYD PRESS SYS 1 and HYD PRESS SYS 3 - Flaps 25

VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5290	180/-70	160	-230/750	120/-100	150/-150	270	0	0
AUTOBRAKE MAX	5840	180/-80	180	-250/810	60/-10	170/-170	300	0	0
AUTOBRAKE 2	10080	150/-150	340	-470/1550	0/-40	320/-320	520	0	0

Good Reported Braking Action

MAX MANUAL	7710	110/-110	250	-360/1200	330/-270	240/-230	370	0	0
AUTOBRAKE MAX	7890	110/-110	250	-360/1210	290/-240	240/-240	400	0	0
AUTOBRAKE 2	10080	150/-150	340	-470/1550	20/-40	320/-320	520	0	0

Medium Reported Braking Action

MAX MANUAL	11920	170/-170	380	-610/2100	1040/-730	380/-370	490	0	0
AUTOBRAKE MAX	11890	170/-170	380	-610/2100	1050/-740	380/-370	490	0	0
AUTOBRAKE 3	12100	170/-170	390	-620/2120	1020/-740	380/-370	500	0	0

Poor Reported Braking Action

MAX MANUAL	18090	250/-240	560	-1060/3800	3680/-1810	580/-540	590	0	0
AUTOBRAKE MAX	18070	250/-240	560	-1060/3790	3710/-1830	590/-540	590	0	0
AUTOBRAKE 3	18160	250/-240	560	-1060/3800	3670/-1820	590/-540	600	0	0

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 1+4 - Flaps 25
VREF30+20

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT) REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV

Dry Runway

MAX MANUAL	6410	120/-90	200	-280/920	170/-150	190/-190	330	0	370
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	8640	130/-130	290	-410/1390	400/-320	280/-260	390	0	980
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	11850	190/-180	420	-630/2240	990/-690	420/-360	440	0	2410
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	15660	260/-250	560	-970/3710	2930/-1360	590/-480	480	0	5210
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS 2+3 - Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	5460	160/-80	170	-230/760	120/-110	160/-160	300	0	240
AUTOBRAKE MAX	5880	150/-80	180	-250/810	50/-30	170/-170	310	0	160
AUTOBRAKE 2	10080	150/-150	340	-470/1550	0/-10	320/-320	540	0	0

Good Reported Braking Action

MAX MANUAL	7640	110/-110	260	-350/1170	310/-250	250/-230	390	0	740
AUTOBRAKE MAX	7640	120/-110	260	-350/1170	290/-220	250/-230	390	0	700
AUTOBRAKE 2	10080	150/-150	340	-470/1550	10/-10	320/-320	550	0	0

Medium Reported Braking Action

MAX MANUAL	10980	180/-170	390	-560/1920	800/-590	390/-340	470	0	2080
AUTOBRAKE MAX	10930	180/-170	390	-550/1910	810/-600	390/-340	470	0	2060
AUTOBRAKE 3	11010	180/-170	400	-560/1920	770/-570	390/-340	480	0	2090

Poor Reported Braking Action

MAX MANUAL	15070	250/-240	550	-870/3160	2100/-1210	570/-470	530	0	4860
AUTOBRAKE MAX	15040	250/-240	560	-870/3160	2120/-1230	570/-470	530	0	4850
AUTOBRAKE 3	15040	250/-240	560	-870/3160	2120/-1200	570/-470	530	0	4850

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 2 and HYD PRESS SYS 4 / HYD PRESS SYS 3 and HYD PRESS SYS 4 - Flaps 25

VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	7390	120/-100	230	-320/1030	270/-220	220/-220	460	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	10630	150/-150	340	-490/1640	700/-530	330/-320	570	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	15990	230/-220	500	-830/2840	2110/-1300	510/-480	680	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	23770	310/-290	700	-1430/5200	9070/-3010	770/-680	750	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

HYD PRESS SYS 1+2+4 - Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	9140	130/-130	290	-410/1350	470/-370	280/-280	520	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Good Reported Braking Action

MAX MANUAL	11260	160/-160	360	-530/1760	820/-600	350/-340	590	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 2	Autobrake Inoperative								

Medium Reported Braking Action

MAX MANUAL	16900	240/-230	530	-890/3070	2470/-1460	540/-510	690	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Poor Reported Braking Action

MAX MANUAL	25130	330/-300	730	-1560/5710	13830/-3380	810/-710	760	0	0
AUTOBRAKE MAX	Autobrake Inoperative								
AUTOBRAKE 3	Autobrake Inoperative								

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Jammed Stab Landing - Flaps 25

VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4800	150/-70	150	-210/690	80/-70	140/-140	190	140	310
AUTOBRAKE MAX	5850	120/-80	180	-250/810	10/-10	170/-170	300	0	0
AUTOBRAKE 2	9690	150/-150	340	-450/1510	150/-190	330/-300	380	280	280

Good Reported Braking Action

MAX MANUAL	6250	90/-90	210	-290/1000	180/-150	200/-190	260	380	850
AUTOBRAKE MAX	6580	100/-100	220	-300/1030	160/-140	210/-190	290	390	880
AUTOBRAKE 2	9690	150/-150	340	-450/1510	160/-190	330/-300	380	280	280

Medium Reported Braking Action

MAX MANUAL	8460	140/-140	300	-440/1570	430/-330	300/-260	310	940	2280
AUTOBRAKE MAX	8570	140/-140	310	-450/1580	400/-310	300/-260	340	920	2240
AUTOBRAKE 3	9270	140/-140	320	-470/1650	310/-220	310/-290	410	540	1710

Poor Reported Braking Action

MAX MANUAL	10900	190/-180	410	-650/2470	1010/-640	420/-340	340	1890	5030
AUTOBRAKE MAX	10930	190/-180	410	-650/2480	1010/-640	420/-340	350	1880	5020
AUTOBRAKE 3	11100	190/-180	410	-660/2490	960/-580	410/-350	410	1790	4950

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
NOSE AND BODY GEAR UP - Flaps 25
VREF25

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6750	380/-140	310	-330/1570	240/-190	270/-190	380	400	920
AUTOBRAKE MAX	6790	420/-150	330	-360/1630	240/-200	280/-250	410	420	960
AUTOBRAKE 2	8740	340/-150	310	-430/1540	60/-40	280/-280	510	0	0

Good Reported Braking Action

MAX MANUAL	6750	380/-130	310	-330/1570	240/-190	270/-190	380	400	920
AUTOBRAKE MAX	6790	420/-130	330	-360/1630	240/-200	280/-250	410	420	960
AUTOBRAKE 2	8740	340/-150	310	-430/1540	60/-40	280/-280	510	0	0

Medium Reported Braking Action

MAX MANUAL	8260	310/-140	290	-440/1580	430/-340	280/-250	330	820	2000
AUTOBRAKE MAX	8180	360/-140	290	-440/1570	440/-340	280/-250	340	810	1970
AUTOBRAKE 3	8380	360/-140	290	-450/1590	370/-240	270/-260	420	620	1780

Poor Reported Braking Action

MAX MANUAL	10680	220/-180	390	-650/2480	1030/-660	390/-320	370	1780	4780
AUTOBRAKE MAX	10650	270/-180	390	-650/2480	1050/-670	400/-320	380	1770	4770
AUTOBRAKE 3	10650	270/-180	390	-650/2480	1050/-660	400/-320	380	1770	4770

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

NOSE AND BODY GEAR UP - Flaps 30

VREF30

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	6130	290/-130	250	-310/1300	200/-170	190/-170	280	310	690
AUTOBRAKE MAX	6070	320/-130	270	-310/1440	200/-170	240/-180	360	290	660
AUTOBRAKE 2	8100	250/-140	280	-420/1410	20/-50	260/-250	470	0	0

Good Reported Braking Action

MAX MANUAL	6130	290/-110	250	-310/1300	200/-170	190/-170	280	310	690
AUTOBRAKE MAX	6070	320/-100	270	-310/1440	200/-170	240/-180	360	290	660
AUTOBRAKE 2	8100	250/-140	280	-420/1410	20/-50	260/-250	470	0	0

Medium Reported Braking Action

MAX MANUAL	7700	230/-130	260	-430/1530	410/-320	250/-230	320	680	1620
AUTOBRAKE MAX	7650	260/-130	260	-430/1530	420/-320	260/-230	340	670	1600
AUTOBRAKE 3	7810	250/-130	270	-440/1550	350/-220	250/-240	410	510	1440

Poor Reported Braking Action

MAX MANUAL	9880	170/-170	350	-630/2400	960/-610	350/-300	350	1440	3740
AUTOBRAKE MAX	9890	180/-170	350	-630/2400	980/-620	360/-300	350	1440	3740
AUTOBRAKE 3	9890	180/-170	350	-630/2400	980/-610	360/-300	360	1440	3740

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
REVERSER UNLOCKED - Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4950	160/-70	150	-220/710	90/-80	140/-140	200	0	170
AUTOBRAKE MAX	5850	140/-80	180	-250/810	10/-10	170/-170	300	0	0
AUTOBRAKE 2	9970	150/-150	340	-460/1540	40/-100	320/-320	470	0	0

Good Reported Braking Action

MAX MANUAL	6630	100/-100	220	-310/1060	210/-180	210/-200	280	0	470
AUTOBRAKE MAX	6970	100/-100	230	-320/1090	200/-170	220/-210	310	0	490
AUTOBRAKE 2	9970	150/-150	340	-460/1540	50/-100	320/-320	470	0	0

Medium Reported Braking Action

MAX MANUAL	9410	150/-150	320	-500/1740	570/-430	320/-290	350	0	1340
AUTOBRAKE MAX	9500	150/-150	330	-500/1750	540/-400	320/-290	380	0	1320
AUTOBRAKE 3	9810	150/-150	340	-510/1770	500/-330	330/-310	430	0	1160

Poor Reported Braking Action

MAX MANUAL	12810	210/-200	450	-770/2880	1570/-920	470/-400	390	0	3140
AUTOBRAKE MAX	12830	210/-200	450	-770/2880	1590/-920	470/-400	400	0	3140
AUTOBRAKE 3	12910	210/-200	460	-770/2890	1590/-920	470/-400	390	0	3160

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
STAB TRIM UNSCHD- Flaps 25
VREF30+20

	LANDING DISTANCE AND ADJUSTMENTS (FT)								
	REF DIST	WEIGHT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	290000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 290000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABV VREF	TWO REV	NO REV

Dry Runway

MAX MANUAL	4800	150/-70	150	-210/690	80/-70	140/-140	190	140	310
AUTOBRAKE MAX	5850	120/-80	180	-250/810	10/-10	170/-170	300	0	0
AUTOBRAKE 2	9690	150/-150	340	-450/1510	150/-190	330/-300	380	280	280

Good Reported Braking Action

MAX MANUAL	6250	90/-90	210	-290/1000	180/-150	200/-190	260	380	850
AUTOBRAKE MAX	6580	100/-100	220	-300/1030	160/-140	210/-190	290	390	880
AUTOBRAKE 2	9690	150/-150	340	-450/1510	160/-190	330/-300	380	280	280

Medium Reported Braking Action

MAX MANUAL	8460	140/-140	300	-440/1570	430/-330	300/-260	310	940	2280
AUTOBRAKE MAX	8570	140/-140	310	-450/1580	400/-310	300/-260	340	920	2240
AUTOBRAKE 3	9270	140/-140	320	-470/1650	310/-220	310/-290	410	540	1710

Poor Reported Braking Action

MAX MANUAL	10900	190/-180	410	-650/2470	1010/-640	420/-340	340	1890	5030
AUTOBRAKE MAX	10930	190/-180	410	-650/2480	1010/-640	420/-340	350	1880	5020
AUTOBRAKE 3	11100	190/-180	410	-660/2490	960/-580	410/-350	410	1790	4950

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Two Engines Inop - Flaps 25

VREF25

BRAKING CONFIGURATION	LANDING DISTANCE AND ADJUSTMENTS (FT) REF DIST 290000 KG LANDING WEIGHT	WEIGHT ADJ PER 5000 KG ABV/BLW 290000 KG	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD/ TAIL WIND	SLOPE ADJ PER 1% DOWN/ UP HILL	TEMP ADJ PER 10°C ABV/ BLW ISA	APP SPD ADJ PER 5 KTS ABV VREF	REVERSE THRUST ADJ TWO REV	REVERSE THRUST ADJ NO REV
Dry Runway									
MAX MANUAL	4530	150/-70	140	-210/700	90/-80	130/-130	200	0	0
AUTOBRAKE MAX	5090	140/-80	160	-230/760	30/0	140/-140	270	0	0
AUTOBRAKE 2	8640	150/-150	300	-430/1440	20/-30	270/-270	480	0	0
Good Reported Braking Action									
MAX MANUAL	6200	100/-100	200	-310/1050	230/-190	190/-190	300	0	0
AUTOBRAKE MAX	6480	100/-100	210	-320/1080	210/-170	190/-190	330	0	0
AUTOBRAKE 2	8640	150/-150	300	-430/1440	20/-30	270/-270	480	0	0
Medium Reported Braking Action									
MAX MANUAL	9420	150/-150	310	-520/1810	720/-520	300/-290	400	0	0
AUTOBRAKE MAX	9410	160/-150	320	-520/1810	730/-490	300/-290	430	0	0
AUTOBRAKE 3	9620	160/-150	320	-530/1830	720/-520	300/-300	410	0	0
Poor Reported Braking Action									
MAX MANUAL	13920	230/-220	460	-870/3110	2300/-1250	450/-430	490	0	0
AUTOBRAKE MAX	13930	230/-220	460	-870/3110	2320/-1260	450/-440	490	0	0
AUTOBRAKE 3	14040	230/-220	460	-870/3120	2300/-1270	450/-440	480	0	0

Reference distance is for sea level, standard day, no wind or slope, and maximum available symmetrical reverse thrust.
Max Manual assumes maximum achievable manual braking.
Actual (unfactored) distances are shown.
Includes distance from 50 feet above threshold (4.22 seconds flare time).

ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Reference Brake Energy per Brake (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)																	
		80			100			120			140			160			180		
WEIGHT (1000 KG)	OAT (°C)	PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT		
		0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8
400	0	19.9	21.8	24.1	28.8	32.1	35.8	39.1	43.7	49.0	50.5	56.5	63.4	62.4	69.9	78.4	74.3	83.2	
	15	20.8	22.9	25.2	30.3	33.7	37.5	41.1	45.9	51.4	53.0	59.3	66.6	65.5	73.3	82.2	77.9	87.1	
	20	21.1	23.2	25.6	30.7	34.2	38.1	41.7	46.6	52.2	53.8	60.3	67.6	66.5	74.4	83.4	79.1	88.4	
	40	21.8	24.0	26.6	32.0	35.6	39.8	43.5	48.7	54.6	56.3	63.1	70.8	69.6	78.0	87.5	82.9	92.7	
	60	21.7	24.0	26.6	32.1	36.0	40.4	44.3	49.7	55.9	57.6	64.7	72.8	71.6	80.3	90.3	85.5	95.9	
350	0	18.0	19.7	21.6	25.9	28.8	32.0	35.0	39.1	43.7	45.0	50.4	56.6	55.7	62.4	70.1	66.4	74.4	83.5
	15	18.8	20.6	22.6	27.2	30.2	33.6	36.8	41.0	45.9	47.3	52.9	59.4	58.5	65.5	73.5	69.7	78.0	87.4
	20	19.1	20.9	23.0	27.6	30.7	34.1	37.4	41.7	46.7	48.1	53.8	60.3	59.4	66.5	74.6	70.8	79.2	88.7
	40	19.6	21.6	23.8	28.7	31.9	35.5	38.9	43.5	48.8	50.2	56.2	63.1	62.2	69.7	78.2	74.2	83.0	93.1
	60	19.5	21.5	23.7	28.8	32.0	35.9	39.5	44.3	49.7	51.3	57.5	64.8	63.8	71.6	80.5	76.3	85.7	96.2
300	0	16.1	17.5	19.1	23.1	25.5	28.2	31.0	34.5	38.5	39.7	44.3	49.7	49.0	54.9	61.6	58.5	65.5	73.6
	15	16.8	18.3	20.0	24.2	26.7	29.6	32.5	36.2	40.4	41.6	46.5	52.2	51.4	57.6	64.6	61.4	68.8	77.1
	20	17.1	18.6	20.3	24.5	27.1	30.1	33.0	36.8	41.1	42.3	47.3	53.0	52.3	58.5	65.6	62.4	69.8	78.3
	40	17.5	19.1	21.0	25.4	28.2	31.3	34.4	38.3	42.9	44.2	49.4	55.4	54.7	61.2	68.7	65.3	73.2	82.1
	60	17.2	18.9	20.8	25.5	28.3	31.4	34.7	38.9	43.6	44.9	50.4	56.7	55.9	62.8	70.6	67.0	75.3	84.6
250	0	14.2	15.4	16.7	20.1	22.1	24.4	26.8	29.7	33.1	34.0	38.0	42.5	41.8	46.7	52.4	50.2	56.2	63.1
	15	14.8	16.1	17.4	21.1	23.2	25.6	28.1	31.2	34.7	35.7	39.9	44.6	43.9	49.1	55.0	52.7	59.0	66.2
	20	15.0	16.3	17.7	21.4	23.6	26.0	28.5	31.7	35.3	36.3	40.5	45.3	44.6	49.8	55.9	53.5	59.9	67.2
	40	15.4	16.7	18.2	22.1	24.4	27.0	29.6	33.0	36.8	37.8	42.3	47.3	46.6	52.1	58.5	56.0	62.7	70.4
	60	15.0	16.4	17.9	22.0	24.4	27.0	29.8	33.2	37.2	38.3	42.9	48.2	47.4	53.2	59.9	57.3	64.3	72.4
200	0	12.4	13.3	14.3	17.3	18.9	20.7	22.6	25.0	27.6	28.3	31.5	35.1	34.4	38.3	42.9	40.7	45.5	51.1
	15	13.0	13.9	15.0	18.1	19.8	21.7	23.7	26.2	29.0	29.7	33.0	36.8	36.1	40.2	45.0	42.8	47.8	53.6
	20	13.1	14.1	15.2	18.3	20.1	22.0	24.1	26.6	29.5	30.2	33.6	37.4	36.7	40.9	45.8	43.5	48.6	54.5
	40	13.4	14.4	15.5	18.9	20.7	22.7	24.9	27.6	30.6	31.4	34.9	39.0	38.2	42.7	47.8	45.4	50.8	57.0
	60	13.0	14.0	15.2	18.7	20.5	22.7	24.9	27.7	30.8	31.5	35.3	39.6	38.7	43.4	48.7	46.2	51.8	58.3

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.
If ground speed is used for brakes on speed, ignore wind, altitude, and OAT effects, and enter table at sea level and 15°C.

No Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)								
EVENT		10	20	30	40	50	60	70	80	90
RTO MAX MAN		10	20	30	40	50	60	70	80	90
LANDING	MAX MAN	3.5	12.6	21.7	30.8	39.9	49.1	58.3	67.7	77.2
	MAX AUTO	3.5	11.9	20.5	29.2	38.2	47.3	56.5	66.0	75.7
	AUTOBRAKE 4	3.2	11.3	19.2	27.2	35.3	43.7	52.5	61.9	71.9
	AUTOBRAKE 3	3.2	10.7	18.2	25.6	33.1	40.8	48.9	57.5	66.7
	AUTOBRAKE 2	3.2	10.2	17.0	23.8	30.7	37.7	45.1	52.8	61.1
	AUTOBRAKE 1	2.7	9.1	15.2	21.1	26.9	32.8	38.8	45.1	51.8

ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Four Engine Reverse

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)								
EVENT		10	20	30	40	50	60	70	80	90
RTO MAX MAN		10	20	30	40	50	60	70	80	90
LANDING	MAX MAN	3.6	11.8	20.1	28.3	36.5	44.8	53.0	61.3	69.5
	MAX AUTO		7.7	16.1	24.5	32.9	41.3	49.7	58.1	66.6
	AUTOBRAKE 4		5.0	12.4	19.8	27.1	34.5	41.9	49.3	56.7
	AUTOBRAKE 3		3.6	9.9	16.2	22.5	28.7	35.0	41.3	47.6
	AUTOBRAKE 2		2.2	7.2	12.2	17.2	22.1	27.1	32.1	37.1
	AUTOBRAKE 1		0.7	4.3	7.8	11.3	14.8	18.4	21.9	25.4

Cooling Time (Minutes)

	ADJUSTED BRAKE ENERGY PER BRAKE (MILLION OF FOOT POUNDS)								
	15 & BELOW	16	20	22	24	27	31	34 TO 45	45 & ABOVE
INFLIGHT GEAR DOWN	NO SPECIAL PROCEDURE REQUIRED	1	3	4	5	6	7	CAUTION	FUSE PLUG MELT ZONE
GROUND		10	28	35	42	52	62		
BTMS	UP TO 2	2	2	3	3	3	4	5 TO 6	7 & ABOVE

Observe maximum quick turnaround limit.
Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.
Add 1.0 million foot pounds for each taxi mile.
For one brake deactivated, increase brake energy by 7 percent.
For two brakes deactivated, increase brake energy by 15 percent.
When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after one hour. If overheat occurs after takeoff, extend gear soon for at least 8 minutes.
When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not attempt to taxi for one hour. Tire, wheel, and brake replacement may be required. If overheat occurs after takeoff, extend gear soon for at least 12 minutes.
Brake temperature monitor system (BTMS) indication on EICAS may be used 10 to 15 minutes after airplane has come to a complete stop, or inflight with gear retracted, to determine recommended cooling schedule.

1 ENGINE INOP

Max Continuous EPR

45000 FT to 25000 FT Pressure Altitudes

Based on engine bleed for 3 packs on

PRESSURE ALTITUDE (FT)		KIAS					MACH NUMBER				
		150	200	250	300	350	.70	.75	.80	.85	.90
45000	EPR		1.61	1.52			1.61	1.61	1.59	1.56	1.52
	MAX TAT		-16	-4			-19	-15	-12	-8	-4
	EPR CORR		0.08	0.10			0.07	0.08	0.09	0.10	0.10
43000	EPR		1.62	1.55	1.43		1.62	1.62	1.60	1.57	1.53
	MAX TAT		-18	-7	7		-19	-15	-12	-8	-4
	EPR CORR		0.07	0.09	0.10		0.07	0.08	0.09	0.10	0.10
41000	EPR		1.64	1.59	1.48		1.64	1.63	1.62	1.59	1.55
	MAX TAT		-20	-9	3		-19	-15	-12	-8	-4
	EPR CORR		0.06	0.09	0.10		0.07	0.08	0.09	0.10	0.10
39000	EPR		1.67	1.63	1.53		1.66	1.65	1.64	1.61	1.57
	MAX TAT		-22	-12	0		-19	-15	-12	-8	-4
	EPR CORR		0.05	0.09	0.10		0.07	0.08	0.09	0.10	0.10
37000	EPR		1.69	1.66	1.58		1.68	1.67	1.65	1.62	1.59
	MAX TAT		-24	-14	-4		-19	-15	-12	-8	-4
	EPR CORR		0.04	0.09	0.10		0.07	0.08	0.09	0.10	0.10
35000	EPR		1.70	1.67	1.61		1.68	1.67	1.66	1.63	1.59
	MAX TAT		-18	-12	-4		-16	-13	-9	-6	-2
	EPR CORR		0.05	0.08	0.10		0.07	0.08	0.09	0.10	0.10
33000	EPR		1.71	1.67	1.62		1.67	1.66	1.64	1.61	1.57
	MAX TAT		-18	-11	-2		-12	-8	-4	-1	3
	EPR CORR		0.05	0.08	0.10		0.08	0.09	0.09	0.10	0.10
31000	EPR		1.72	1.66	1.61	1.52	1.65	1.64	1.61	1.57	1.53
	MAX TAT		-16	-8	1	8	-7	-4	0	4	8
	EPR CORR		0.06	0.08	0.10	0.10	0.08	0.09	0.09	0.10	0.10
29000	EPR		1.71	1.65	1.58	1.49	1.62	1.60	1.57	1.53	1.48
	MAX TAT		-14	-6	3	12	-3	0	4	8	12
	EPR CORR		0.06	0.08	0.09	0.10	0.08	0.09	0.10	0.10	0.10
27000	EPR	1.69	1.69	1.64	1.56	1.47	1.58	1.56	1.52	1.48	1.43
	MAX TAT	-12	-9	-4	4	13	1	5	9	13	17
	EPR CORR	0.06	0.07	0.08	0.09	0.10	0.09	0.09	0.10	0.10	0.10
25000	EPR	1.68	1.67	1.62	1.53	1.45	1.54	1.52	1.48	1.43	
	MAX TAT	-10	-6	-1	7	15	6	9	13	17	
	EPR CORR	0.07	0.08	0.09	0.09	0.10	0.09	0.09	0.10	0.10	

Decrease EPR by the EPR CORR for every 10°C above the MAX TAT shown.

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	0	10	20	30	40	45
1 PACK OFF	0.01	0.01	0.01	0.01	0.01	0.01
2 PACKS OFF	0.02	0.02	0.02	0.02	0.02	0.02
ENGINE ANTI-ICE ON	-0.01	-0.02	-0.03	-0.04	-0.05	-0.05
ENGINE & WING ANTI-ICE ON	-0.03	-0.04	-0.06	-0.07	-0.08	-0.08

1 ENGINE INOP

Max Continuous EPR

24000 FT to Sea Level Pressure Altitudes

Based on engine bleed for 3 packs on

PRESSURE ALTITUDE (FT)		KIAS					MACH NUMBER				
		150	200	250	300	350	.70	.75	.80	.85	.90
24000	EPR	1.68	1.66	1.61	1.52	1.45	1.52	1.49	1.46	1.41	
	MAX TAT	-10	-5	0	8	16	8	11	15	19	
	EPR CORR	0.07	0.08	0.09	0.09	0.10	0.09	0.09	0.10	0.10	
22000	EPR	1.67	1.64	1.58	1.50	1.43	1.48	1.45	1.41		
	MAX TAT	-7	-3	4	11	18	12	16	20		
	EPR CORR	0.07	0.09	0.09	0.09	0.09	0.09	0.09	0.09		
20000	EPR	1.65	1.61	1.56	1.48	1.40	1.44	1.41			
	MAX TAT	-3	1	6	13	20	17	20			
	EPR CORR	0.08	0.09	0.09	0.09	0.09	0.09	0.09			
18000	EPR	1.63	1.59	1.54	1.47	1.39	1.41	1.38			
	MAX TAT	0	4	9	15	23	21	24			
	EPR CORR	0.08	0.09	0.09	0.09	0.08	0.08	0.09			
16000	EPR	1.60	1.56	1.51	1.45	1.38	1.38				
	MAX TAT	4	8	12	18	25	25				
	EPR CORR	0.09	0.09	0.09	0.09	0.08	0.08				
14000	EPR	1.57	1.54	1.49	1.43	1.36	1.34				
	MAX TAT	8	11	15	21	27	30				
	EPR CORR	0.09	0.09	0.09	0.08	0.08	0.08				
12000	EPR	1.54	1.51	1.46	1.40	1.35					
	MAX TAT	11	15	19	24	30					
	EPR CORR	0.08	0.08	0.08	0.08	0.07					
10000	EPR	1.51	1.48	1.44	1.38	1.33					
	MAX TAT	16	18	22	27	33					
	EPR CORR	0.08	0.08	0.08	0.07	0.07					
5000	EPR	1.43	1.41	1.38	1.33	1.28					
	MAX TAT	25	27	30	34	40					
	EPR CORR	0.06	0.06	0.06	0.06	0.06					
1500	EPR	1.38	1.37	1.33	1.29	1.25					
	MAX TAT	31	33	37	41	45					
	EPR CORR	0.05	0.05	0.05	0.05	0.05					
0	EPR	1.37	1.35	1.32	1.28	1.24					
	MAX TAT	33	36	39	43	47					
	EPR CORR	0.05	0.05	0.05	0.05	0.05					

Decrease EPR by the EPR CORR for every 10°C above the MAX TAT shown.

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	0	10	20	30	40	45
1 PACK OFF	0.01	0.01	0.01	0.01	0.01	0.01
2 PACKS OFF	0.02	0.02	0.02	0.02	0.02	0.02
ENGINE ANTI-ICE ON	-0.01	-0.02	-0.03	-0.04	-0.05	-0.05
ENGINE & WING ANTI-ICE ON	-0.03	-0.04	-0.06	-0.07	-0.08	-0.08

1 ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	390	304	25000	24900	23800
380	371	297	26600	26600	25500
360	351	290	28300	28300	27300
340	332	282	29900	29900	29000
320	313	275	31600	31500	30700
300	294	267	33100	33100	32300
280	274	259	34600	34600	33900
260	255	249	36000	36000	35400
240	235	239	37500	37400	36900
220	215	229	39000	39000	38400
200	196	217	40700	40700	40100

Altitude reduced by 1000 ft for additional margin.

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability

Based on engine bleed for packs on or off

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	22200	22100	20100
390	23200	23100	21200
380	24200	24100	22300
370	25200	25100	23400
360	26200	26100	24500
350	27200	27100	25500
340	28200	28100	26600
330	29200	29100	27600
320	30100	30000	28700
310	31000	31000	29700
300	32000	31900	30700
290	32800	32700	31700
280	33600	33500	32600
270	34400	34300	33400
260	35100	35100	34300
250	35800	35800	35200
240	36600	36500	35900
230	37300	37300	36600
220	38100	38000	37400
210	38900	38900	38200
200	39800	39700	39000

Altitude reduced by 1000 ft for additional margin.
With engine anti-ice on, decrease altitude capability by 1800 ft.
With engine and wing anti-ice on, decrease altitude capability by 3500 ft.

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	14	20	25	27	29	31	33	35	37
400	EPR	1.11	1.17	1.29							
	MACH	.627	.680	.765							
	KIAS	349	352	356							
	FF/ENG	4632	4772	4958							
380	EPR	1.10	1.15	1.26	1.42						
	MACH	.612	.662	.750	.806						
	KIAS	340	343	348	340						
	FF/ENG	4361	4455	4670	4752						
360	EPR	1.09	1.13	1.23	1.37	1.46					
	MACH	.596	.644	.732	.792	.815					
	KIAS	331	333	340	334	331					
	FF/ENG	4100	4164	4375	4424	4511					
340	EPR	1.08	1.11	1.20	1.32	1.40	1.50				
	MACH	.580	.626	.711	.778	.800	.824				
	KIAS	322	323	329	327	324	321				
	FF/ENG	3850	3893	4066	4135	4180	4283				
320	EPR	1.06	1.10	1.18	1.28	1.35	1.43	1.53			
	MACH	.565	.607	.688	.762	.784	.807	.833			
	KIAS	313	313	318	320	317	314	311			
	FF/ENG	3609	3632	3752	3865	3877	3937	4078			
300	EPR	1.05	1.08	1.15	1.25	1.30	1.37	1.46	1.57		
	MACH	.549	.589	.665	.743	.768	.791	.815	.841		
	KIAS	304	304	307	312	310	306	303	301		
	FF/ENG	3381	3385	3447	3593	3610	3628	3706	3868		
280	EPR	1.05	1.07	1.13	1.22	1.26	1.32	1.39	1.49		
	MACH	.533	.571	.642	.719	.749	.773	.796	.821		
	KIAS	296	294	296	301	302	299	296	293		
	FF/ENG	3168	3148	3170	3305	3344	3359	3389	3481		
260	EPR	1.04	1.06	1.11	1.19	1.23	1.27	1.33	1.42	1.52	
	MACH	.517	.552	.619	.691	.724	.754	.778	.801	.827	
	KIAS	287	284	284	288	291	291	288	285	282	
	FF/ENG	2967	2919	2913	3001	3063	3097	3114	3155	3248	
240	EPR	1.03	1.05	1.09	1.15	1.19	1.23	1.28	1.35	1.43	1.54
	MACH	.502	.534	.595	.662	.693	.727	.757	.781	.805	.831
	KIAS	278	274	273	276	278	280	280	277	274	271
	FF/ENG	2775	2699	2667	2709	2763	2820	2853	2871	2911	3031
220	EPR	1.03	1.04	1.07	1.13	1.16	1.19	1.24	1.29	1.35	1.45
	MACH	.485	.516	.572	.633	.662	.694	.729	.759	.783	.807
	KIAS	269	265	262	263	264	266	269	268	265	262
	FF/ENG	2584	2496	2432	2441	2471	2524	2579	2611	2627	2685
200	EPR	1.02	1.03	1.06	1.10	1.13	1.15	1.19	1.24	1.29	1.36
	MACH	.468	.497	.548	.604	.631	.660	.693	.728	.758	.783
	KIAS	259	255	251	250	251	252	254	256	256	253
	FF/ENG	2383	2306	2205	2193	2201	2233	2285	2339	2366	2394

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
281	260	242	226	212	200	191	183	175	168	162
843	781	726	679	637	600	575	553	531	512	494
1410	1306	1212	1132	1063	1000	960	922	887	855	825
1982	1833	1700	1587	1489	1400	1343	1291	1242	1197	1155
2556	2362	2190	2043	1915	1800	1727	1659	1596	1538	1485
3135	2895	2682	2500	2342	2200	2111	2028	1951	1879	1814
3718	3431	3176	2958	2769	2600	2494	2396	2305	2220	2143
4306	3970	3671	3417	3197	3000	2878	2764	2658	2561	2472
4899	4512	4169	3878	3626	3400	3261	3131	3011	2900	2799
5496	5058	4668	4339	4055	3800	3644	3499	3364	3240	3126
6099	5607	5171	4802	4484	4200	4027	3866	3716	3578	3452
6708	6160	5676	5267	4915	4600	4410	4233	4068	3916	3777
7323	6718	6183	5733	5346	5000	4792	4599	4419	4253	4102

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		22		25		29		33	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	5.4	0:37	3.9	0:33	3.5	0:32	3.2	0:32	3.0	0:32
600	16.5	1:47	13.4	1:31	12.8	1:27	12.1	1:24	12.0	1:22
1000	27.7	2:58	22.9	2:30	22.1	2:23	21.1	2:16	20.9	2:12
1400	38.6	4:10	32.2	3:30	31.1	3:19	29.7	3:09	29.5	3:02
1800	49.3	5:23	41.2	4:30	39.9	4:16	38.2	4:03	37.8	3:53
2200	59.8	6:38	50.1	5:32	48.5	5:14	46.5	4:57	46.0	4:45
2600	70.1	7:53	58.7	6:35	56.9	6:14	54.7	5:51	53.9	5:37
3000	80.3	9:10	67.2	7:38	65.1	7:14	62.6	6:47	61.6	6:30
3400	90.2	10:28	75.4	8:43	73.0	8:15	70.3	7:43	69.0	7:23
3800	99.8	11:48	83.5	9:50	80.8	9:18	77.9	8:41	76.3	8:17
4200	109.3	13:09	91.4	10:57	88.4	10:21	85.2	9:40	83.5	9:11
4600	118.6	14:31	99.2	12:05	95.9	11:26	92.4	10:39	90.4	10:06
5000	127.7	15:56	106.7	13:15	103.1	12:32	99.4	11:40	97.3	11:02

1 ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-1.7	-0.8	0.0	2.1	4.9
20	-3.4	-1.6	0.0	4.1	9.4
30	-5.1	-2.5	0.0	6.1	13.7
40	-6.9	-3.3	0.0	7.9	17.7
50	-8.7	-4.2	0.0	9.6	21.5
60	-10.5	-5.1	0.0	11.2	24.9
70	-12.3	-6.0	0.0	12.6	28.1
80	-14.2	-6.9	0.0	14.0	31.0
90	-16.1	-7.8	0.0	15.2	33.6
100	-18.0	-8.7	0.0	16.3	35.9
110	-20.0	-9.7	0.0	17.2	38.0
120	-21.9	-10.6	0.0	18.1	39.8
130	-23.9	-11.6	0.0	18.8	41.3
140	-26.0	-12.6	0.0	19.4	42.5

1 ENGINE INOP

MAX CONTINUOUS THRUST

Holding

Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)								
		1500	5000	10000	15000	20000	25000	30000	35000	40000
400	EPR	1.07	1.10	1.14	1.22	1.29	1.47			
	KIAS	286	286	286	286	313	317			
	FF/ENG	4320	4280	4330	4430	4690	4950			
380	EPR	1.07	1.09	1.13	1.19	1.26	1.41			
	KIAS	280	280	280	280	306	310			
	FF/ENG	4100	4050	4060	4150	4390	4580			
360	EPR	1.06	1.08	1.11	1.18	1.23	1.37			
	KIAS	271	271	271	271	297	300			
	FF/ENG	3890	3830	3810	3880	4090	4250			
340	EPR	1.06	1.07	1.11	1.16	1.21	1.33	1.54		
	KIAS	261	261	261	261	288	291	295		
	FF/ENG	3680	3620	3580	3620	3790	3940	4280		
320	EPR	1.06	1.07	1.10	1.14	1.18	1.29	1.47		
	KIAS	251	251	251	251	279	282	286		
	FF/ENG	3460	3410	3360	3370	3510	3650	3870		
300	EPR	1.05	1.06	1.09	1.13	1.16	1.25	1.40		
	KIAS	242	242	242	242	270	272	276		
	FF/ENG	3250	3210	3150	3130	3250	3360	3520		
280	EPR	1.05	1.06	1.08	1.11	1.14	1.22	1.35	1.61	
	KIAS	233	233	233	233	260	262	266	270	
	FF/ENG	3030	3000	2950	2910	3000	3070	3220	3590	
260	EPR	1.04	1.05	1.07	1.10	1.12	1.19	1.30	1.50	
	KIAS	228	228	228	228	251	253	255	259	
	FF/ENG	2800	2780	2740	2680	2750	2800	2930	3160	
240	EPR	1.03	1.04	1.06	1.08	1.10	1.16	1.26	1.42	
	KIAS	221	221	221	221	240	242	244	248	
	FF/ENG	2580	2560	2540	2470	2510	2550	2650	2800	
220	EPR	1.03	1.03	1.05	1.07	1.08	1.13	1.22	1.35	
	KIAS	215	215	215	215	229	231	234	236	
	FF/ENG	2360	2350	2330	2270	2280	2300	2380	2500	
200	EPR	1.02	1.03	1.04	1.05	1.07	1.11	1.18	1.29	1.49
	KIAS	208	208	208	208	219	220	222	224	228
	FF/ENG	2160	2150	2140	2090	2080	2060	2110	2220	2430

This table includes 5% additional fuel for holding in a racetrack pattern.

2 ENGINES INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	386	296	10100	10100	8300
390	376	292	11200	11100	9500
380	367	289	12200	12200	10600
370	357	286	13200	13200	11700
360	348	282	14300	1 4200	12900
350	338	279	15300	15200	13900
340	329	275	16300	16300	15000
330	319	271	17300	17300	16100
320	310	267	18400	18300	17200
310	300	263	19400	19400	18300
300	290	259	20500	20400	19400
290	281	255	21500	21500	20500
280	271	251	22600	22600	21700
270	261	247	23700	23700	22800
260	252	243	24800	24700	24000
250	242	238	25900	25800	25100
240	233	233	27000	27000	26300
230	223	229	28100	28100	27500
220	214	224	29200	29200	28700
210	204	219	30200	30200	29800
200	195	213	31200	31200	30900

Altitude reduced by 2000 ft for additional margin.

2 ENGINES INOP

MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
271	253	237	223	211	200	190	181	173	165	158
808	756	710	669	633	600	571	544	520	497	477
1345	1258	1182	1114	1054	1000	951	907	867	830	796
1882	1761	1654	1560	1476	1400	1332	1270	1213	1162	1114
2420	2264	2127	2006	1897	1800	1712	1633	1560	1494	1433
2960	2769	2601	2452	2319	2200	2093	1995	1906	1825	1750
3503	3275	3076	2899	2741	2600	2473	2357	2252	2156	2067
4048	3784	3552	3347	3164	3000	2852	2718	2597	2485	2383
4598	4295	4030	3796	3587	3400	3232	3079	2940	2814	2697
5152	4810	4510	4246	4010	3800	3611	3439	3283	3141	3010
5711	5328	4993	4697	4435	4200	3989	3798	3625	3466	3321
6277	5850	5478	5150	4860	4600	4367	4156	3965	3790	3630
6849	6378	5967	5605	5285	5000	4744	4513	4303	4112	3937

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG)											TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 KG)											
	200	220	240	260	280	300	320	340	360	380	400	
200	3.2	3.5	3.8	4.1	4.4	4.6	4.8	5.0	5.2	5.4	5.7	0:31
600	10.8	11.8	12.8	13.8	14.8	15.8	16.7	17.8	18.7	19.8	21.0	1:33
1000	17.9	19.5	21.2	22.9	24.5	26.2	27.8	29.6	31.3	33.2	35.1	2:34
1400	24.6	27.0	29.3	31.6	33.9	36.3	38.6	41.1	43.5	46.2	48.8	3:35
1800	31.2	34.1	37.1	40.1	43.1	46.1	49.1	52.2	55.3	58.8	62.1	4:37
2200	37.5	41.1	44.6	48.2	51.9	55.6	59.2	63.0	66.8	71.1	75.1	5:39
2600	43.7	47.8	52.0	56.2	60.4	64.8	69.0	73.4	77.9	83.0	87.6	6:42
3000	49.6	54.3	59.1	63.9	68.7	73.7	78.6	83.6	88.7	94.5	99.8	7:46
3400	55.4	60.6	65.9	71.3	76.8	82.3	87.8	93.4	99.2	105.8	111.6	8:51
3800	60.9	66.7	72.6	78.5	84.6	90.7	96.8	103.0	109.4	116.7	123.1	9:58
4200	66.4	72.6	79.0	85.5	92.2	98.9	105.6	112.3	119.3	127.3	134.3	11:07
4600	71.6	78.4	85.3	92.3	99.5	106.8	114.1	121.3	129.0	137.6	145.2	12:17
5000	76.7	83.9	91.4	98.9	106.7	114.5	122.3	130.1	138.3	147.7	155.8	13:30

Driftdown at optimum driftdown speed and cruise at Long Range Cruise speed.

2 ENGINES INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	3900	3800	700
380	6700	6600	3900
360	9300	9300	6900
340	11800	11700	9800
320	14200	14100	12500
300	16500	16400	15000
280	18900	18800	17500
260	21300	21300	20100
240	23900	23800	22800
220	26400	26400	25500
200	29100	29100	28300

Altitude reduced by 2000 ft for additional margin.

2 ENGINES INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT) 10	14	17	20	23	25	27	29	31
360	EPR	1.32								
	MACH	.596								
	KIAS	331								
	FF/ENG	6512								
340	EPR	1.28								
	MACH	.580								
	KIAS	322								
	FF/ENG	6070								
320	EPR	1.25	1.35							
	MACH	.565	.607							
	KIAS	313	313							
	FF/ENG	5640	5785							
300	EPR	1.22	1.31	1.39						
	MACH	.549	.589	.624						
	KIAS	304	304	305						
	FF/ENG	5227	5334	5446						
280	EPR	1.20	1.27	1.34	1.45					
	MACH	.533	.571	.604	.642					
	KIAS	296	294	294	296					
	FF/ENG	4841	4907	4972	5134					
260	EPR	1.18	1.23	1.30	1.38	1.50				
	MACH	.517	.552	.583	.619	.660				
	KIAS	287	284	284	284	286				
	FF/ENG	4466	4500	4534	4655	4814				
240	EPR	1.15	1.20	1.26	1.33	1.43	1.51			
	MACH	.502	.534	.562	.595	.633	.662			
	KIAS	278	274	273	273	274	276			
	FF/ENG	4095	4119	4117	4202	4324	4438			
220	EPR	1.13	1.17	1.22	1.28	1.36	1.43	1.52		
	MACH	.485	.516	.542	.572	.607	.633	.662		
	KIAS	269	265	263	262	262	263	264		
	FF/ENG	3748	3752	3724	3776	3857	3938	4050		
200	EPR	1.11	1.15	1.18	1.23	1.30	1.36	1.43	1.51	1.62
	MACH	.468	.497	.521	.548	.580	.604	.631	.660	.693
	KIAS	259	255	252	251	250	250	251	252	254
	FF/ENG	3411	3388	3363	3379	3420	3475	3553	3654	3802

ALTERNATE MODE EEC

Takeoff Field Limit Weight Adjustment

AIRPORT OAT (°C)	WEIGHT ADJUSTMENT (1000 KG)
54	-43.0
50	-42.0
45	-40.5
40	-39.0
35	-37.5
30	-36.5
25	-34.5
20	-32.0
15	-30.5
10	-29.0
5	-27.5
0 & BELOW	-27.0

The minimum takeoff field length required is 5400 ft.

ALTERNATE MODE EEC

Takeoff Climb Limit Weight Adjustment

AIRPORT OAT (°C)	WEIGHT ADJUSTMENT (1000 KG)											
	AIRPORT PRESSURE ALTITUDE (FT)											
	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	-56.0	-56.0	-56.0	-56.0								
50	-54.0	-54.0	-54.0	-54.0	-54.0	-54.0						
45	-52.0	-52.0	-52.0	-52.0	-52.0	-52.0	-52.0	-52.0	-52.0			
40	-49.5	-49.5	-49.5	-49.5	-49.5	-49.5	-49.5	-49.5	-49.5	-49.5	-49.5	
35	-37.0	-47.0	-47.0	-47.0	-47.0	-47.0	-47.0	-47.0	-47.0	-47.0	-47.0	-47.0
30	-25.5	-36.5	-41.5	-44.5	-44.5	-44.5	-44.5	-44.5	-44.5	-44.5	-44.5	-44.5
25	-25.5	-25.0	-28.0	-34.0	-37.0	-40.0	-42.5	-42.5	-42.5	-42.5	-42.5	-42.5
20	-26.0	-25.0	-23.5	-23.0	-26.0	-29.5	-33.0	-40.5	-40.5	-40.5	-40.5	-40.5
15	-26.0	-25.0.	-23.5	-23.0	-22.0	-20.5	-22.0	-30.0	-34.5	-38.5	-38.5	-38.5
10	-26.0	-25.0	-23.0	-23.0	-22.0	-20.5	-19.0	-19.0	-24.5	-29.0	-32.0	-35.0
5	-25.5	-25.0	-23.0	-23.0	-22.0	-20.5	-19.0	-18.0	-18.5	-19.0	-22.5	-26.0
0 & BELOW	-25.5	-25.0	-23.0	-23.0	-22.0	-20.5	-19.0	-18.0	-18.5	-18.0	-17.0	-16.0

ALTERNATE MODE EEC

Takeoff Obstacle Limit Weight Adjustment

AIRPORT OAT(°C)	WEIGHT ADJUSTMENT (1000 KG)											
	AIRPORT PRESSURE ALTITUDE (FT)											
	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
45	-55.0	-55.0	-55.0	-55.0	-55.0	-55.0	-55.0	-55.0	-55.0	-55.0	-55.0	-55.0
40	-50.0	-53.0	-53.0	-53.0	-53.0	-53.0	-53.0	-53.0	-53.0	-53.0	-53.0	-53.0
35	-45.0	-51.5	-51.5	-51.5	-51.5	-51.5	-51.5	-51.5	-51.5	-51.5	-51.5	-51.5
30	-39.5	-44.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0	-50.0
25	-34.5	-37.5	-41.0	-42.5	-48.5	-48.5	-48.5	-48.5	-48.5	-48.5	-48.5	-48.5
20	-29.5	-31.5	-34.0	-36.0	-38.5	-41.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0
15	-26.5	-25.5	-27.5	-29.0	-31.5	-34.0	-35.5	-36.5	-37.0	-42.0	-42.0	-42.0
10	-26.5	-25.5	-25.0	-23.5	-24.5	-26.5	-28.5	-29.5	-31.5	-39.0	-36.5	-36.5
5	-26.5	-25.5	-25.0	-23.5	-23.5	-23.0	-22.0	-23.0	-25.0	-32.5	-28.0	-30.0
0	-26.0	-25.5	-25.0	-23.5	-23.5	-23.0	-22.0	-20.5	-20.0	-25.5	-21.5	-23.5
-5 & BELOW	-26.0	-25.5	-25.0	-23.5	-23.5	-23.0	-22.0	-20.5	-20.0	-18.0	-17.5	-17.0

ALTERNATE MODE EEC

Takeoff Tire Speed Limit Weight Adjustment

AIRPORT OAT (°C)	WEIGHT ADJUSTMENT (1000 KG)
54	-6.5
50	-6.0
45	-6.0
40	-6.0
35	-5.5
30	-5.0
25	-4.5
20	-4.0
15	-3.0
10	-2.5
5	-2.5
0	-2.0
-5	-1.5
-10 & BELOW	-1.5

ALTERNATE MODE EEC

Landing Climb Limit Weight Adjustment

AIRPORT OAT (°C)	WEIGHT ADJUSTMENT (1000 KG)							
	AIRPORT PRESSURE ALTITUDE (FT)							
	3000	4000	5000	6000	7000	8000	9000	10000
54	-54.0							
50	-51.0	-51.0						
45	-48.0	-48.0	-48.0	-48.0	-48.0			
40	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	-45.0	
35	-42.0	-42.0	-42.0	-42.0	-42.0	-42.0	-42.0	-42.0
30	-39.0	-39.0	-39.0	-39.0	-39.0	-39.0	-39.0	-39.0
25	-30.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0
20	-18.0	-24.0	-28.0	-33.5	-33.5	-33.5	-33.5	-33.5
15	-13.5	-14.0	-16.5	-23.0	-27.0	-30.0	-30.0	-30.0
10	-13.5	-13.5	-13.5	-13.0	-16.5	-20.0	-23.5	-26.5
5	-13.5	-13.5	-13.5	-11.5	-10.0	-10.0	-14.0	-17.0
0 & BELOW	-13.5	-13.5	-13.5	-11.5	-10.0	-9.5	-8.5	-8.0

ALTERNATE MODE EEC

Takeoff Speed Adjustment

V1 Adjustment

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)											
°C	°F	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	130	9	9	9	9								
50	122	9	9	9	9	9	9						
45	113	9	9	9	9	9	9	9	9	9			
40	104	7	8	8	8	8	8	8	8	8	8	8	8
35	95	5	7	8	8	8	8	8	8	8	8	8	8
30	86	3	5	6	7	8	8	8	8	8	8	8	8
25	77	3	3	4	5	6	6	7	7	7	7	7	7
20	68	3	3	3	3	4	5	5	7	7	7	7	7
15	59	3	3	3	3	3	3	3	5	6	6	6	6
10	50	3	3	3	3	3	3	3	3	4	5	5	6
5	41	3	3	3	3	3	3	3	3	3	3	4	4
0	32	3	3	3	3	3	3	3	3	3	3	2	2
-55	-67	3	3	3	3	3	3	3	3	3	3	2	2

VR Adjustment

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)											
°C	°F	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	130	4	4	4	4								
50	122	4	4	4	4	4	4						
45	113	4	4	4	4	4	4	4	4	4			
40	104	4	4	4	4	4	4	4	4	4	4	4	4
35	95	2	3	3	3	3	3	3	3	3	3	3	3
30	86	2	2	3	3	3	3	3	3	3	3	3	3
25	77	2	2	2	2	3	3	3	3	3	3	3	3
20	68	2	2	2	2	2	2	2	3	3	3	3	3
15	59	2	2	2	2	1	1	2	2	2	3	3	3
10	50	2	2	2	2	1	1	1	1	2	2	2	3
5	41	2	2	2	2	1	1	1	1	1	1	2	2
0 & BELOW	32 & BELOW	2	2	2	2	1	1	1	1	1	1	1	1

ALTERNATE MODE EEC

Minimum Control Speeds
VMCG, VRMIN (KIAS)
-2000 FT to 4000 FT Pressure Altitudes

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)							
		-2000		0		2000		4000	
°C	°F	VMCG	VRMIN	VMCG	VRMIN	VMCG	VRMIN	VMCG	VRMIN
60	140	108	111	104	107	101	103	97	100
55	131	112	115	108	111	104	107	100	103
50	122	115	118	111	114	107	110	103	106
45	113	119	122	114	118	110	113	106	109
40	104	123	126	117	120	113	116	109	112
39	103	124	127	118	121	113	117	109	112
37	99	125	128	119	122	114	117	110	113
35	95	125	128	120	123	115	119	111	114
33	92	125	129	122	125	116	119	112	115
30	86	126	129	123	126	118	122	113	116
29	85	126	129	123	126	118	122	114	117
25	77	126	129	124	127	120	123	115	118
23	73	126	129	124	127	120	123	115	118
20	68	126	129	124	127	121	124	116	119
15	59	126	129	124	127	121	124	117	120
10	50	126	129	124	127	121	124	117	120
5	41	126	129	124	127	121	124	117	120
0	32	126	129	124	127	121	124	117	120
-55	-67	126	129	124	127	121	124	117	120

5000 FT to 10000 FT Pressure Altitudes

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)							
		5000		6000		8000		10000	
°C	°F	VMCG	VRMIN	VMCG	VRMIN	VMCG	VRMIN	VMCG	VRMIN
60	140	95	98	93	96	90	93	87	89
55	131	98	100	97	99	93	96	90	92
50	122	100	103	100	102	96	99	92	95
45	113	103	105	102	105	99	101	95	97
40	104	105	108	105	108	101	104	97	100
39	103	106	109	105	108	102	104	98	100
37	99	107	110	106	109	102	105	98	101
35	95	108	111	107	110	103	106	99	102
33	92	109	112	108	111	104	107	100	103
30	86	110	113	109	112	105	108	101	104
29	85	111	114	109	112	105	108	101	104
25	77	113	116	111	114	107	110	103	106
23	73	114	117	112	115	107	110	103	106
20	68	114	117	113	116	108	111	104	107
15	59	116	119	113	116	110	113	106	108
10	50	116	119	115	118	110	114	107	110
5	41	116	119	115	118	111	114	107	110
0	32	116	119	115	118	111	114	108	111
-55	-67	116	119	115	118	111	114	109	111

ALTERNATE MODE EEC

Minimum Control Speeds
Flaps 20 V2 for VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)																	
	89		90		95		100		105		110		115		120		125	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
260	104	22	105	21	109	20	115	19	121	18	127	17	133	17	139	17	145	17
240	104	20	104	20	109	19	115	18	121	18	127	17	133	17	139	17	145	17
220	103	19	104	19	109	18	115	18	121	17	127	17	133	17	140	17	146	18
200	103	18	104	18	109	18	115	18	121	17	128	17	134	17	140	18	147	18

Flaps 10 V2 for VRMIN (KIAS)

WEIGHT (1000 KG)	VRMIN (KIAS)																	
	89		90		95		100		105		110		115		120		125	
	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT	V2	ATT
240	105	23	106	23	111	21	116	21	123	20	129	19	135	19	141	19	147	19
220	105	22	106	21	111	21	116	20	123	19	129	19	135	19	142	20	148	20
200	105	21	106	20	111	20	117	19	123	19	129	19	136	19	142	20	149	20

ALTERNATE MODE EEC

Takeoff EPR

Based on engine bleed for 3 packs on

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	130		1.31	1.31	1.31	1.31	1.31							
50	122		1.35	1.35	1.35	1.35	1.35	1.35	1.35					
45	113		1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39		
40	104		1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43
35	95	1.45	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46
30	86	1.47	1.48	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49
25	77	1.47	1.48	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
20	68	1.47	1.48	1.51	1.52	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54
15	59	1.47	1.48	1.51	1.52	1.54	1.55	1.56	1.56	1.56	1.56	1.56	1.56	1.56
10	50	1.47	1.48	1.51	1.52	1.54	1.55	1.56	1.57	1.59	1.59	1.59	1.59	1.59
5	41	1.47	1.48	1.51	1.52	1.54	1.55	1.56	1.57	1.59	1.61	1.62	1.62	1.62
0 & BELOW	32 & BELOW	1.47	1.48	1.51	1.52	1.54	1.55	1.56	1.57	1.59	1.61	1.62	1.63	1.64

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-2000	10000
2 PACKS OFF	0.01	0.01
3 PACKS OFF	0.02	0.02

ALTERNATE MODE EEC

Go-around EPR

Based on engine bleed for 3 packs on

REPORTED OAT		TAT (°C)	AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F		-2000	-1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
54	130	57		1.31	1.31	1.31	1.31	1.31							
52	126	55		1.33	1.33	1.33	1.33	1.33	1.33	1.33					
47	117	50		1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37		
42	108	45		1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41
37	99	40	1.43	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45
32	90	35	1.46	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.47
27	81	30	1.47	1.48	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.48	1.48	1.48
22	72	25	1.47	1.48	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
17	63	20	1.47	1.48	1.51	1.52	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54
12	54	15	1.47	1.48	1.51	1.52	1.54	1.55	1.56	1.56	1.56	1.56	1.56	1.56	1.56
7	45	10	1.47	1.48	1.51	1.52	1.54	1.55	1.56	1.57	1.59	1.59	1.59	1.59	1.59
2	36	5	1.47	1.48	1.51	1.52	1.54	1.55	1.56	1.57	1.59	1.61	1.62	1.62	1.62
-3 & BELOW	27 & BELOW	0 & BELOW	1.47	1.48	1.51	1.52	1.54	1.55	1.56	1.57	1.59	1.61	1.62	1.63	1.64

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-2000	10000
2 PACKS OFF	0.01	0.01
3 PACKS OFF	0.02	0.02

GEAR DOWN

Takeoff Climb Limit

Based on engine bleed for 3 packs on and anti-ice off

Weight (1000 KG)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)												
°C	°F	-2000	-1000	SL	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
55	131	284	272											
50	122	300	288	276	265	253								
45	113	317	304	292	280	268	256	245						
40	104	335	322	309	296	283	271	259	247	236	225			
35	95	355	342	328	314	301	287	275	263	251	239	228	217	
30	86	359	353	348	334	320	306	293	280	267	255	243	230	218
25	77	359	353	348	342	336	326	312	298	285	272	259	246	233
20	68	359	353	348	342	336	330	323	316	303	289	275	262	248
15	59	359	353	348	342	336	330	323	316	309	302	292	278	264
10 & BELOW	50 & BELOW	359	353	348	341	335	329	323	316	309	302	294	286	278

Applicable for flaps 10 or 20 takeoff.

Weight Adjustment for Bleed Configuration

BLEED CONFIGURATION	WEIGHT ADJUSTMENT (KG)	
	A/C PACKS OFF	A/C PACKS ON
A/I OFF	+6650	0
NACELLE A/I ON	-950	-10500
NACELLE AND WING A/I ON	-10350	-21200

Boeing Converted Freighters are not certified for packs-off takeoff.

Landing Climb Limit

Based on engine bleed for 3 packs on and anti-ice off

Weight (1000 KG)

AIRPORT OAT	AIRPORT PRESSURE ALTITUDE (FT)												
°C	-2000	-1000	SL	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
55	328	316	305	294	284	276							
50	300	348	337	326	318	303	292	281	272	263			
45	371	358	346	334	322	310	299	287	278	268	258		
40	392	378	365	352	339	327	315	303	292	280	270	260	250
35	395	389	385	369	354	342	330	318	307	294	283	271	261
30	395	389	385	380	370	356	343	331	318	306	295	283	272
25	396	389	385	380	372	363	354	342	329	316	304	292	281
20	396	389	385	380	372	363	355	346	339	326	314	301	290
15	396	389	385	380	372	363	355	346	340	331	322	308	297
10 & BELOW	396	389	385	380	372	364	355	346	340	331	322	313	304

Applicable for flaps 25 or 30 landing.
For 1 A/C Pack ON, add 3300 kg.
For A/C Packs OFF and 4900 kg.
Reduce Landing Climb Limit Weight by 36700 kg. when operating in icing conditions during any part of the flight with forecast landing temperature below 8°C.

GEAR DOWN

Max Climb EPR

Based on engine bleed for 3 packs on, engine and wing anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT) / SPEED (KIAS OR MACH)												
	0	5	10	12	14	16	18	20	22	24	26	28	30
	240	240	240	240	240	240	240	240	240	240	240	0.60	0.60
55	1.25												
50	1.27	1.27											
45	1.29	1.29	1.29										
40	1.32	1.32	1.32	1.31	1.30								
35	1.33	1.35	1.35	1.34	1.34	1.33							
30	1.33	1.38	1.38	1.38	1.37	1.37	1.36	1.36					
25	1.33	1.39	1.42	1.42	1.41	1.41	1.40	1.40	1.40	1.40			
20	1.33	1.39	1.46	1.46	1.45	1.45	1.45	1.45	1.45	1.45	1.45		
15	1.33	1.39	1.46	1.48	1.50	1.49	1.49	1.49	1.49	1.49	1.49	1.49	
10	1.33	1.39	1.46	1.48	1.50	1.53	1.54	1.54	1.54	1.54	1.54	1.54	1.54
5	1.33	1.39	1.46	1.48	1.50	1.53	1.56	1.58	1.58	1.58	1.58	1.58	1.58
0	1.33	1.39	1.46	1.48	1.50	1.53	1.56	1.58	1.61	1.62	1.62	1.62	1.63
-5	1.33	1.39	1.46	1.48	1.50	1.53	1.56	1.58	1.61	1.63	1.65	1.66	1.66
-10	1.33	1.39	1.46	1.48	1.50	1.53	1.56	1.58	1.61	1.63	1.65	1.68	1.70
-15	1.33	1.39	1.46	1.48	1.50	1.53	1.56	1.58	1.61	1.63	1.65	1.68	1.71
-20	1.33	1.39	1.46	1.48	1.50	1.53	1.56	1.58	1.61	1.63	1.65	1.68	1.71

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)			
	0	10	20	30
ENGINE ANTI-ICE ON	-0.01	-0.02	-0.03	-0.04
ENGINE & WING ANTI-ICE ON	-0.03	-0.04	-0.06	-0.07

Long Range Cruise Altitude Capability

Max Climb Thrust, 100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	19100	19000	17300
380	20600	20600	18900
360	22000	21900	20400
340	23200	23200	21700
320	24900	24800	23600
300	26800	26800	25700
280	28900	28800	27900
260	31000	31000	30000
240	32900	32800	32100
220	34800	34800	34100
200	36700	36700	36200

GEAR DOWN

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	14	17	20	23	25	27	29	31	33
400	EPR	1.25	1.33								
	MACH	.488	.525								
	KIAS	270	270								
	FF/ENG	5036	5128								
380	EPR	1.23	1.30	1.37							
	MACH	.488	.525	.556							
	KIAS	270	270	270							
	FF/ENG	4841	4920	4929							
360	EPR	1.21	1.28	1.35							
	MACH	.488	.525	.556							
	KIAS	270	270	270							
	FF/ENG	4671	4737	4736							
340	EPR	1.20	1.26	1.32							
	MACH	.488	.524	.552							
	KIAS	270	269	268							
	FF/ENG	4524	4561	4533							
320	EPR	1.18	1.23	1.29	1.36						
	MACH	.481	.511	.538	.570						
	KIAS	266	263	261	261						
	FF/ENG	4297	4271	4231	4281						
300	EPR	1.16	1.21	1.26	1.32	1.41					
	MACH	.468	.499	.523	.552	.589					
	KIAS	259	256	254	252	254					
	FF/ENG	4021	3999	3936	3958	4030					
280	EPR	1.15	1.19	1.23	1.28	1.36	1.42	1.50			
	MACH	.456	.485	.509	.536	.568	.595	.624			
	KIAS	252	249	246	245	245	246	248			
	FF/ENG	3760	3724	3657	3664	3695	3755	3840			
260	EPR	1.13	1.17	1.21	1.25	1.31	1.37	1.44	1.52		
	MACH	.441	.471	.494	.520	.548	.572	.599	.630		
	KIAS	244	242	239	237	236	236	238	240		
	FF/ENG	3500	3454	3395	3380	3376	3415	3477	3564		
240	EPR	1.12	1.15	1.18	1.22	1.27	1.32	1.37	1.45	1.53	
	MACH	.426	.456	.479	.503	.529	.550	.574	.602	.634	
	KIAS	235	234	232	229	227	227	227	229	231	
	FF/ENG	3239	3191	3129	3110	3086	3092	3134	3197	3279	
220	EPR	1.10	1.13	1.16	1.19	1.24	1.27	1.32	1.38	1.45	1.54
	MACH	.409	.439	.462	.486	.511	.529	.550	.575	.604	.636
	KIAS	226	225	223	221	219	218	217	218	219	222
	FF/ENG	2979	2935	2869	2848	2812	2801	2812	2853	2917	2992
200	EPR	1.09	1.11	1.14	1.17	1.20	1.23	1.27	1.32	1.37	1.45
	MACH	.390	.421	.444	.468	.492	.509	.528	.548	.574	.603
	KIAS	215	215	214	213	211	209	208	207	208	209
	FF/ENG	2713	2680	2622	2588	2553	2532	2523	2535	2577	2636

GEAR DOWN

Long Range Cruise Enroute Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
285	264	245	228	213	200	191	183	175	168	161
597	545	500	462	429	400	381	364	348	333	320
906	825	754	695	644	600	571	545	521	499	479
1215	1105	1008	928	860	800	762	726	694	664	638
1527	1386	1263	1161	1076	1000	952	907	866	829	796
1841	1669	1519	1396	1292	1200	1141	1088	1038	993	953
2159	1955	1777	1631	1508	1400	1331	1268	1210	1157	1110
2480	2243	2036	1867	1725	1600	1521	1448	1381	1321	1266
2804	2533	2297	2104	1942	1800	1710	1628	1552	1484	1423
3133	2826	2559	2342	2160	2000	1900	1807	1723	1646	1578
3466	3122	2823	2581	2378	2200	2089	1986	1892	1808	1732
3804	3421	3089	2821	2597	2400	2277	2165	2062	1969	1886
4147	3724	3357	3061	2816	2600	2466	2343	2231	2130	2040
4495	4030	3627	3303	3035	2800	2655	2522	2401	2291	2193
4850	4340	3900	3547	3255	3000	2844	2700	2569	2451	2346
5210	4654	4175	3791	3476	3200	3032	2878	2737	2611	2498
5578	4973	4453	4038	3697	3400	3220	3055	2905	2770	2650
5954	5297	4733	4286	3919	3600	3408	3232	3072	2928	2800
6338	5627	5017	4535	4142	3800	3596	3409	3239	3086	2950
6731	5962	5304	4786	4366	4000	3784	3585	3405	3244	3100

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		25	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	10.3	0:40	9.6	0:39	8.7	0:38	8.0	0:36	7.5	0:35
400	20.3	1:23	19.0	1:19	17.5	1:16	16.4	1:12	15.7	1:09
600	30.3	2:05	28.4	2:00	26.4	1:54	24.9	1:48	23.9	1:43
800	40.3	2:48	37.9	2:40	35.3	2:33	33.4	2:24	32.1	2:17
1000	50.3	3:30	47.3	3:20	44.2	3:11	41.8	3:01	40.3	2:52
1200	59.9	4:15	56.3	4:02	52.6	3:50	49.8	3:38	48.1	3:27
1400	69.4	4:59	65.2	4:44	61.1	4:30	57.8	4:15	55.8	4:03
1600	78.6	5:45	74.0	5:26	69.3	5:10	65.6	4:53	63.3	4:39
1800	87.7	6:31	82.5	6:10	77.3	5:51	73.2	5:32	70.6	5:16
2000	96.7	7:18	91.0	6:54	85.3	6:32	80.8	6:11	77.9	5:53
2200	105.3	8:07	99.1	7:39	92.8	7:14	88.0	6:50	84.9	6:31
2400	113.8	8:56	107.2	8:24	100.4	7:57	95.2	7:30	91.8	7:09
2600	122.2	9:46	115.1	9:11	107.8	8:40	102.2	8:11	98.5	7:48
2800	130.3	10:38	122.8	9:59	115.1	9:24	109.1	8:52	105.1	8:27
3000	138.5	11:30	130.5	10:47	122.3	10:08	115.9	9:34	111.7	9:07
3200	146.2	12:26	137.8	11:37	129.2	10:54	122.4	10:16	117.9	9:47
3400	153.8	13:21	145.1	12:28	136.0	11:41	128.8	10:59	124.2	10:28
3600	161.3	14:19	152.2	13:19	142.8	12:28	135.2	11:43	130.2	11:10
3800	168.5	15:18	159.1	14:13	149.3	13:16	141.4	12:28	136.1	11:52
4000	175.7	16:18	166.0	15:07	155.9	14:05	147.5	13:12	142.1	12:34

GEAR DOWN

Long Range Cruise Enroute Fuel and Time
Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
20	-3.7	-1.9	0.0	2.5	5.8
30	-5.5	-2.8	0.0	3.9	8.5
40	-7.4	-3.7	0.0	5.2	11.2
50	-9.3	-4.6	0.0	6.6	13.9
60	-11.2	-5.5	0.0	8.0	16.6
70	-13.2	-6.4	0.0	9.3	19.3
80	-15.3	-7.4	0.0	10.7	21.9
90	-17.4	-8.4	0.0	12.0	24.6
100	-19.6	-9.5	0.0	13.4	27.3
110	-21.8	-10.5	0.0	14.7	30.0
120	-24.1	-11.6	0.0	16.0	32.6
130	-26.5	-12.7	0.0	17.4	35.3
140	-28.9	-13.9	0.0	18.7	38.0
150	-31.4	-15.0	0.0	20.0	40.6
160	-33.9	-16.2	0.0	21.3	43.3

Descent at .66/240

PRESSURE ALT (1000 FT)	5	10	15	17	19	21	23	25	27	29	31	33	35	37
DISTANCE (NM)	18	27	37	40	44	48	52	55	59	63	67	71	74	77
TIME (MINUTES)	5	7	9	10	11	12	12	13	14	14	15	15	16	16

GEAR DOWN

Holding

Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
400	EPR	1.14	1.18	1.25	1.35			
	KIAS	270	270	270	270			
	FF/ENG	5230	5210	5290	5350			
380	EPR	1.13	1.16	1.23	1.32			
	KIAS	270	270	270	270			
	FF/ENG	5060	5030	5080	5130			
360	EPR	1.13	1.15	1.21	1.30			
	KIAS	270	270	270	270			
	FF/ENG	4910	4870	4910	4940			
340	EPR	1.11	1.14	1.19	1.27			
	KIAS	261	261	261	261			
	FF/ENG	4600	4560	4550	4580			
320	EPR	1.10	1.13	1.17	1.24	1.38		
	KIAS	251	251	251	251	270		
	FF/ENG	4280	4240	4210	4220	4700		
300	EPR	1.09	1.12	1.15	1.21	1.35		
	KIAS	242	242	242	242	270		
	FF/ENG	4000	3950	3910	3900	4540		
280	EPR	1.09	1.10	1.14	1.19	1.31		
	KIAS	233	233	233	233	260		
	FF/ENG	3720	3660	3620	3580	4180		
260	EPR	1.08	1.09	1.12	1.17	1.27	1.41	
	KIAS	228	228	228	228	251	253	
	FF/ENG	3510	3450	3400	3350	3830	3930	
240	EPR	1.07	1.08	1.11	1.15	1.24	1.35	1.53
	KIAS	221	221	221	221	240	242	244
	FF/ENG	3270	3220	3160	3100	3470	3550	3690
220	EPR	1.06	1.07	1.10	1.13	1.20	1.30	1.46
	KIAS	215	215	215	215	229	231	234
	FF/ENG	3050	3010	2940	2890	3140	3190	3320
200	EPR	1.06	1.07	1.09	1.12	1.17	1.25	1.38
	KIAS	208	208	208	208	219	220	222
	FF/ENG	2810	2780	2730	2660	2820	2850	2940

This table includes 5% additional fuel for holding in a racetrack pattern.

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
Based on engine bleed for 3 packs on

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	383	266	8400	8400	6200
390	374	264	9500	9500	7400
380	365	261	10500	10500	8600
370	356	259	11600	11500	9700
360	347	256	12600	12600	10800
350	337	254	13700	13600	11900
340	328	251	14700	14700	13000
330	319	248	15700	15700	14100
320	309	246	16700	16700	15200
310	300	243	17700	17700	16300
300	291	240	18800	18800	17500
290	281	237	19800	19800	18600
280	271	234	20900	20900	19800
270	262	231	22000	21900	20900
260	252	228	23100	23100	22100
250	242	225	24200	24200	23300
240	233	222	25200	25200	24400
230	223	219	26400	26300	25600
220	213	215	27500	27400	26700
210	204	212	28500	28500	27900
200	195	209	29500	29500	29000

Altitude reduced by 1000 ft for additional margin.

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
Based on engine bleed for 3 packs on

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
400	6200	6100	3100
390	7200	7100	4200
380	8100	8100	5400
370	9000	8900	6400
360	9800	9700	7300
350	10500	10500	8200
340	11400	11300	9100
330	12700	12600	10500
320	14000	13900	11900
310	15200	15100	13300
300	16400	16300	14700
290	17600	17500	16100
280	18800	18800	17400
270	20000	20000	18800
260	21200	21200	20100
250	22500	22400	21400
240	23700	23700	22800
230	25000	24900	24100
220	26200	26200	25500
210	27500	27500	26800
200	28800	28700	28200

Altitude reduced by 1000 ft for additional margin.

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)							
		10	14	17	20	23	25	27	29
360	EPR	1.39							
	MACH	.488							
	KIAS	270							
	FF/ENG	6506							
340	EPR	1.37							
	MACH	.487							
	KIAS	270							
	FF/ENG	6240							
320	EPR	1.33	1.44						
	MACH	.474	.510						
	KIAS	262	262						
	FF/ENG	5806	5930						
300	EPR	1.29	1.39	1.50					
	MACH	.461	.494	.525					
	KIAS	255	254	254					
	FF/ENG	5392	5459	5579					
280	EPR	1.26	1.34	1.43					
	MACH	.447	.479	.507					
	KIAS	247	246	246					
	FF/ENG	4974	5030	5082					
260	EPR	1.24	1.30	1.38	1.48				
	MACH	.433	.464	.489	.519				
	KIAS	239	238	237	237				
	FF/ENG	4578	4623	4612	4746				
240	EPR	1.21	1.27	1.33	1.41	1.53			
	MACH	.419	.448	.472	.499	.533			
	KIAS	231	229	228	228	229			
	FF/ENG	4199	4217	4191	4266	4422			
220	EPR	1.18	1.23	1.28	1.35	1.44	1.53	1.64	
	MACH	.402	.432	.455	.480	.510	.532	.560	
	KIAS	222	221	220	219	219	219	222	
	FF/ENG	3829	3829	3796	3832	3922	4023	4197	
200	EPR	1.16	1.20	1.24	1.30	1.37	1.44	1.52	1.64
	MACH	.385	.414	.436	.461	.487	.507	.530	.558
	KIAS	212	212	211	210	208	209	209	211
	FF/ENG	3469	3459	3412	3434	3466	3530	3622	3774

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Long Range Cruise Diversion Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
311	281	255	233	216	200	190	181	173	166	159
632	568	513	469	432	400	380	362	346	331	318
956	859	774	706	650	600	570	543	518	495	475
1284	1151	1036	943	867	800	759	722	689	658	631
1616	1446	1300	1182	1085	1000	949	902	859	820	786
1952	1744	1565	1421	1303	1200	1138	1082	1030	983	941
2293	2045	1832	1662	1522	1400	1327	1259	1198	1144	1095
2639	2350	2101	1903	1741	1600	1516	1438	1368	1304	1248
2990	2657	2372	2146	1961	1800	1704	1616	1536	1464	1400
3348	2969	2645	2389	2181	2000	1892	1793	1703	1623	1551

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		25	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
200	8.8	0:46	8.1	0:44	7.5	0:42	7.0	0:40	6.8	0:38
400	18.2	1:31	17.1	1:27	16.0	1:23	15.3	1:18	15.0	1:14
600	27.3	2:17	25.8	2:10	24.2	2:04	23.3	1:57	23.0	1:51
800	36.2	3:04	34.3	2:55	32.2	2:45	31.1	2:36	30.6	2:28
1000	44.9	3:52	42.6	3:40	40.1	3:28	38.6	3:16	38.1	3:06
1200	53.5	4:41	50.6	4:26	47.7	4:11	46.0	3:56	45.3	3:44
1400	61.8	5:31	58.5	5:12	55.2	4:55	53.1	4:38	52.3	4:23
1600	69.9	6:22	66.2	6:00	62.4	5:39	60.1	5:19	59.1	5:03
1800	77.8	7:14	73.7	6:48	69.5	6:24	66.9	6:02	65.7	5:44
2000	85.5	8:07	81.1	7:37	76.5	7:10	73.5	6:45	72.1	6:25

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	200	250	300	350	400
10	-1.1	0.0	1.3	2.8	5.1
20	-2.3	0.0	3.1	5.8	10.1
30	-3.6	0.0	5.0	9.0	15.1
40	-4.8	0.0	7.0	12.5	20.3
50	-6.1	0.0	9.0	16.2	25.5
60	-7.4	0.0	11.1	20.2	30.8
70	-8.7	0.0	13.3	24.4	36.1
80	-10.0	0.0	15.5	28.8	41.6
90	-11.3	0.0	17.8	33.5	47.1

GEAR DOWN
1 ENGINE INOP
MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT) 1500	5000	10000	15000	20000	25000
400	EPR	1.26	1.32				
	KIAS	270	270				
	FF/ENG	7080	7220				
380	EPR	1.24	1.30				
	KIAS	270	270				
	FF/ENG	6790	6910				
360	EPR	1.23	1.28	1.39			
	KIAS	270	270	270			
	FF/ENG	6540	6630	6830			
340	EPR	1.20	1.25	1.35			
	KIAS	261	261	261			
	FF/ENG	6080	6130	6310			
320	EPR	1.19	1.23	1.31	1.45		
	KIAS	251	251	251	251		
	FF/ENG	5640	5650	5790	5960		
300	EPR	1.17	1.20	1.28	1.40		
	KIAS	242	242	242	242		
	FF/ENG	5230	5220	5320	5430		
280	EPR	1.15	1.18	1.25	1.35		
	KIAS	233	233	233	233		
	FF/ENG	4840	4820	4870	4940		
260	EPR	1.14	1.17	1.22	1.31	1.53	
	KIAS	228	228	228	228	251	
	FF/ENG	4530	4510	4520	4570	5400	
240	EPR	1.12	1.15	1.20	1.27	1.45	
	KIAS	221	221	221	221	240	
	FF/ENG	4190	4170	4160	4170	4840	
220	EPR	1.11	1.13	1.18	1.24	1.38	1.58
	KIAS	215	215	215	215	229	231
	FF/ENG	3890	3870	3850	3830	4320	4570
200	EPR	1.10	1.12	1.15	1.21	1.32	1.48
	KIAS	208	208	208	208	219	220
	FF/ENG	3590	3560	3540	3500	3840	4020

This table includes 5% additional fuel for holding in a racetrack pattern.

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Performance Inflight — Chapter PI
Text — Section 38

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer (FMC). In addition, sufficient inflight data is provided to complete a flight with the FMC inoperative. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General

Clearway and Stopway V1 Adjustments

Takeoff speed adjustments are to be applied to V1 speed when using takeoff weights based on the use of clearway and stopway.

Adjust V1 speed by the amount shown in the table. The adjusted V1 speed must not exceed VR.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF

The Reference Speed table contains flaps 30 and 25 landing speeds for a given weight. Apply adjustments shown as required.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuvering speeds. Using VREF as the basis for the schedule makes it variable as a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction, selection to the next position should be initiated when at and accelerating above the recommended flap speed for the new position. During flap extension, selection of the flaps to the next position should be made prior to decelerating below the recommended flap speed for the current flap setting.

Slush/Standing Water Takeoff

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in field/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assume an engine failure at the critical point during the takeoff. Data is shown for 2 engine reverse thrust and for no reverse thrust.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush depths greater than 0.5 inches (13mm) are not recommended because of possible airplane damage as a result of slush impingement on the airplane structure. The use of assumed temperature for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight is determined as follows:

1. Determine the field/obstacle limit weight for the takeoff flap setting.

2. Enter the Weight Adjustment table with the field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.

3. Enter the VMCG Limit Weight table with the available field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for VMCG speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 3.

Takeoff speed determination:

1. Determine takeoff speeds V1, VR and V2 for actual brake release weight using the Takeoff Speeds from the FMC or Takeoff Analysis.

2. If VMCG limited, set V1=VMCG. If not limited by VMCG considerations, reenter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than VMCG, set V1=VMCG.

Tables for no reverse thrust are also provided in the same format.

Slippery Runway Takeoff

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean, dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. The performance level of good is the same as used by the FAA and EASA to define wet runway rejected takeoff performance. Similarly, poor braking action is representative of a runway covered with ice. Performance is based on two symmetric reversers operating and a 15 ft. screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables. Data is provided for 2 engine reverse thrust and for no reverse thrust.

Tables for no reverse thrust are also provided in the same format.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum speed for control on the ground, VMCG, and VR less than minimum VR, (1.05) VMCA. Therefore, compare the adjusted V1 and VR to the VMCG and VRMIN respectively. To find VMCG and VRMIN, enter the VMCG, VRMIN table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than VMCG, set V1 equal to VMCG. If the adjusted VR is less than VRMIN, set VR equal to VRMIN. If VR is less than VMCG, set VR equal to VMCG. If VR is limited by either VMCG or VRMIN, V2 must be adjusted to account for the increase in VR. This adjusted V2 speed can be obtained from the V2 for VRMIN table by entering with weight and VRMIN. If the V2 for VRMIN is greater than V2, set V2 equal to V2 for VRMIN.

Anti-skid Inoperative

When operating with anti-skid inoperative, the field length/obstacle limited weight and the V1 speed must be reduced to allow for the effect on accelerate-stop performance as detailed in the Airplane Flight Manual. Obstacle clearance capability must also be considered since the reduced V1 speed will increase the distance required to achieve a given height above the runway following engine failure at V1.

A simplified method which conservatively accounts for the effects of anti-skid inoperative is to reduce the normal runway/obstacle limited weight by the amount shown in the table below. Then, reduce the V1 associated with the reduced weight by the V1 amount shown in the table below. If takeoff weight is below the anti-skid inoperative limited weight, it is only necessary to ensure that the V1 speed does not exceed the anti-skid limited V1 speed. If the resulting V1 speed is less than the minimum ground control speed (see Minimum Control Speeds table), takeoff is permitted with V1 set equal to VMCG provided the accelerate stop distance available exceeds approximately 13250 ft.

ANTI-SKID INOPERATIVE ADJUSTMENTS		
FIELD LENGTH (FT)	WEIGHT (1000 KG)	V1 (KTS)
10000	-42	-44
12000	-26	-50
14000	-24	-45
16000	-27	-42

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

Initial Climb EPR

This table is used to set initial climb power once the takeoff segment is complete and enroute configuration is achieved (i.e. flaps up). The power settings shown are based on 200 KIAS at 1000 ft above the airport pressure altitude. Upon accelerating to the normal enroute climb speed of 340 KIAS, the power settings provided in the Max Climb table should be used. EPR adjustments are shown for anti-ice operation.

Max Climb EPR

This table shows Max Climb EPR for a 340/.84 climb speed schedule, normal engine bleed for 3 packs on and anti-ice off. Enter the table with airport pressure altitude and TAT and read EPR. EPR adjustments are shown for anti-ice operation.

Go-around EPR

To find Max Go-around EPR based on normal engine bleed for 3 packs on, enter the Go-around EPR table with airport pressure altitude and reported OAT or TAT and read EPR. For packs off operation, apply the EPR adjustments provided below the table. No EPR adjustment is required for engine and wing anti-ice operations.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Pitch attitude and average EPR information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome or turbulent air may also cause unreliable airspeed/Mach indications. The cruise table in this section may also be used for turbulent air penetration.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed indications may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

These tables provide the maximum operating altitude in the same manner as the FMC. Maximum altitudes are shown for a given cruise weight and maneuver capability. This table considers both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 100 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 15° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the table result in buffet related maneuver margins of 1.5g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 45000 ft.

Long Range Cruise Control

The table provides target EPR, Long Range Cruise Mach number, KIAS and standard day fuel flow per engine for the airplane weight and pressure altitude. The shaded area in this table approximates optimum altitude. At optimum altitude the Long Range Cruise Mach schedule is approximated by .86M.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .84/290/250 descent. Tables are presented for low altitudes and high altitudes.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent

Distance and time for descent are shown for a .84/290/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing flaps at the outer marker.

Holding

Target EPR, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the FMC optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed for the selected flap setting. Flaps 1 data is based on VREF30 + 60 speed. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read EPR, KIAS and fuel flow per engine.

Advisory Information

Normal Configuration Landing Distance

Tables are provided as advisory information for normal configuration landing distance on dry runways and slippery runways with good, medium, and poor reported braking action. These values are actual landing distances and do not include the 1.67 regulatory factor. Therefore, they cannot be used to determine the dispatch required landing field length.

To use these tables, determine the reference landing distance for the selected braking configuration. Then adjust the reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers to obtain the actual landing distance.

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. If the surface is affected by water, snow, or ice and the braking action is reported as "good", conditions should not be expected to be as good as on clean, dry runways. The value "good" is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the "good" data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate "poor" data reflects runways covered with wet ice.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" braking action, the airplane may not be able to achieve these deceleration rates. In these cases, runway slope and inoperative reversers influence the stopping distance. Since it cannot be determined quickly when this becomes a factor, it is conservative to add the effects of slope and inoperative reversers when using the autobrake system.

Non-normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances are provided for dry runway and runways with good, medium, and poor reported braking action.

Enter the table with the applicable non-normal configuration and read the normal approach speed (VREF). The reference landing distance is measured from 50 ft above the threshold to stop and is based on reference weight and speed at sea level, zero wind, zero slope and max manual braking with maximum reverse thrust. Subsequent columns provide corrections for off-reference landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers. Each correction is independently added to the reference landing distance. Landing distance includes the effect of maximum manual braking and reverse thrust.

Recommended Brake Cooling Schedule

Advisory information is provided to assist in avoiding problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Recommended Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind, at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the table with the reference brake energy per brake and the type of braking used during landing (Max Manual or Max Auto). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing. The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Brake Temperature Monitor System (BTMS) indications are also shown. If brake cooling is determined from the BTMS, the hottest brake indication 10 to 15 minutes after the airplane has come to a complete stop, or inflight with gear retracted, may be used to determine recommended cooling schedule by entering at the bottom of the chart. An EICAS advisory message, BRAKE TEMP, will appear when any brake registers 5 on the GEAR synoptic display and disappears as the hottest brake cools to an indication of 4. Note that even without an EICAS advisory message, brake cooling is recommended.

One Engine Inoperative

Max Continuous EPR

Power setting is based on one engine inoperative with 3 packs on and all anti-ice bleeds off. Enter the table with pressure altitude and KIAS or Mach to read EPR.

It is desirable to maintain engine thrust level within the limits of the Max Cruise thrust rating. However, where thrust level in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off.

The level off altitude is dependent on air temperature (ISA deviation). The level off altitude shown is 1000 ft below the maximum altitude. This reduction in altitude is consistent with the FMC logic.

Long Range Cruise Altitude Capability

The table shows the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on Long Range Cruise speed and Max Continuous thrust. Note that the maximum altitude shown has been reduced by 1000 ft. This reduction in altitude is consistent with the FMC logic.

Long Range Cruise Control

The table provides target EPR, one engine inoperative Long Range Cruise Mach number, KIAS, and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on three engine Long Range Cruise speed and .84/290/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the Fuel Required Adjustment table with the fuel required for the reference weight and the actual weight at checkpoint.

Holding

One engine inoperative holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Two Engines Inoperative

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off.

The level off altitude is dependent on air temperature (ISA deviation). The level off altitude shown is 2000 ft below the maximum altitude. This reduction in altitude is consistent with the FMC.

Driftdown/LRC Cruise Range Capability

This table shows the range capability from the start of driftdown. Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to Long Range Cruise speed. Cruise is continued at level off altitude and Long Range Cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and correct for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required.

Long Range Cruise Altitude Capability

The table shows the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on Long Range Cruise speed and Max Continuous thrust. Note that the maximum altitude shown has been reduced by 2000 ft. This reduction in altitude is consistent with the FMC logic.

Long Range Cruise Control

The table provides target EPR, two engines inoperative Long Range Cruise Mach number, KIAS, and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

Alternate Mode EEC

The ALTERNATE EEC mode has not been programmed into the FMC. Therefore, the use of the autothrottle is prohibited and takeoff thrust must be set manually. One Engine Pressure Ratio (EPR) indicating system may be inoperative at dispatch. All four EECs must be in the ALTERNATE mode. The anti-skid system must be operative. Use of improved climb performance is prohibited. Thrust reduction in addition to those required for ALTERNATE Mode EEC operation are prohibited.

Limit Weight

A simplified method which conservatively accounts for the effects of EEC in the ALTERNATE mode is to reduce the PRIMARY mode (normal) performance limited weights. The Limit Weight table provides takeoff field, climb, obstacle, and tire speed limit weights. To determine limit weights for operations with the EEC in the ALTERNATE mode, enter the table with airport OAT and pressure altitude where appropriate, and apply the weight reduction to the normal full rate limit weights. The most limiting of the takeoff weights must be used. The ALTERNATE MODE EEC Landing Climb limit must be compared to the Landing Field Length Limit and the more limiting of the two must be used as the landing limit weight. Analysis from the Airplane Flight Manual may yield less restrictive limit weights.

Takeoff Speed Adjustments

Takeoff speeds can be determined by applying increments to the normal full rate V1 and VR from the tables provided. For brake energy limit reduce the normal VMBE for the actual weight by 1 knot.

Note: The FMC does not incorporate ALTERNATE MODE EEC performance in its takeoff speeds calculations.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum speed for control on the ground, VMCG and VR less than minimum VR, (1.05) VMCA. Therefore, compare the adjusted V1 and VR to the VMCG and VRMIN respectively. To find VMCG and VRMIN, enter the VMCG, VRMIN table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than VMCG, set V1 equal to VMCG. If the adjusted VR is less than VMCG, set VR equal to VRMIN. If VR is less than VMCG, set VR equal to VMCG. If VR is limited by either VMCG or VRMIN, V2 must be adjusted to account for the increase in VR. This adjusted V2 speed can be obtained from the V2 for VRMIN table by entering with weight and VRMIN. If the V2 for VRMIN is greater than V2, set V2 equal to V2 for VRMIN.

Takeoff EPR/Go-around EPR

Takeoff and Go-around power setting are presented for normal air conditioning bleed. Takeoff or Go-around EPR may be read directly from the tables for the desired pressure altitude and airport OAT.

Thrust protection is not provided in the ALTERNATE MODE EEC and maximum rated thrust is reached at a thrust lever position less than full forward. As a result, thrust overboost can occur at full forward thrust lever positions.

Gear Down

This section contains performance for airplane operation with the landing gear extended for all phases of flight. The data is based on engine bleeds for normal air conditioning.

Note: The Flight Management Computer System (FMCS) does not contain special provisions for operation with landing gear extended. As a result, the FMCS will generate inaccurate enroute speed schedules, display non-conservative predictions of fuel burn, estimated time of arrival (ETA), maximum altitude, and compute overly shallow descent path. To obtain accurate ETA predictions, gear down cruise speed and altitude should be entered on the CLB and CRZ pages. Gear down cruise speed should also be entered on the DES page and a STEP SIZE of zero should be entered on the PERF INIT or CRZ page. Use of the VNAV during descent under these circumstances is not recommended.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

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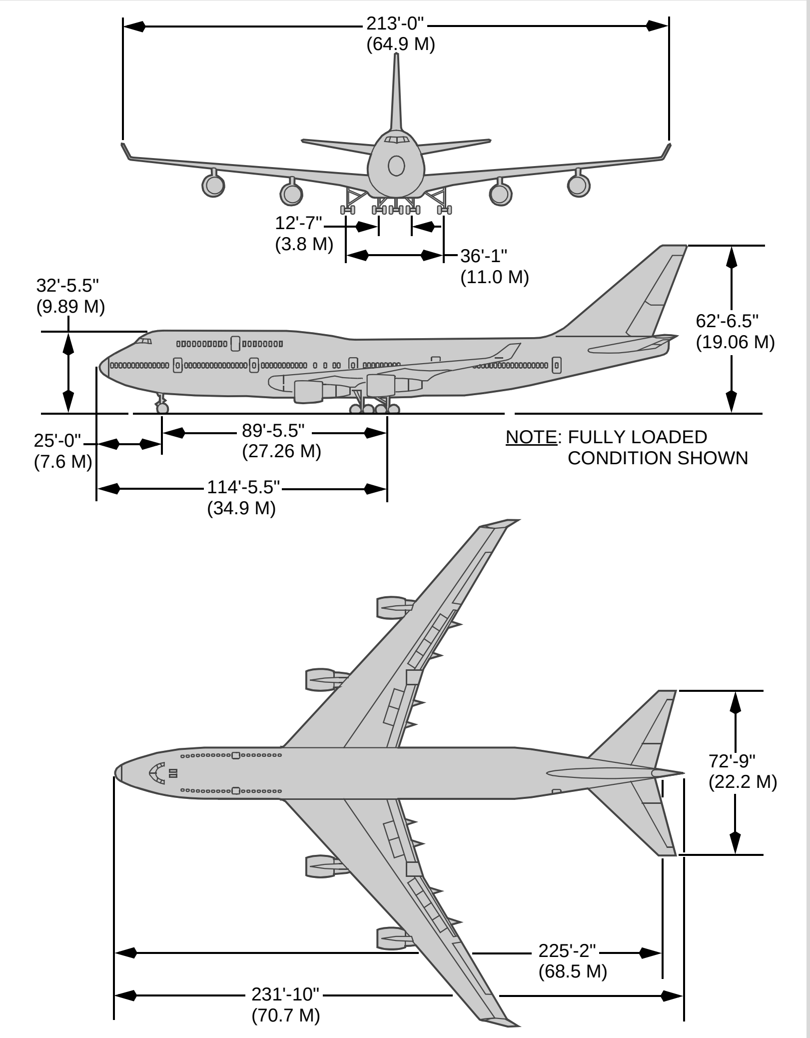
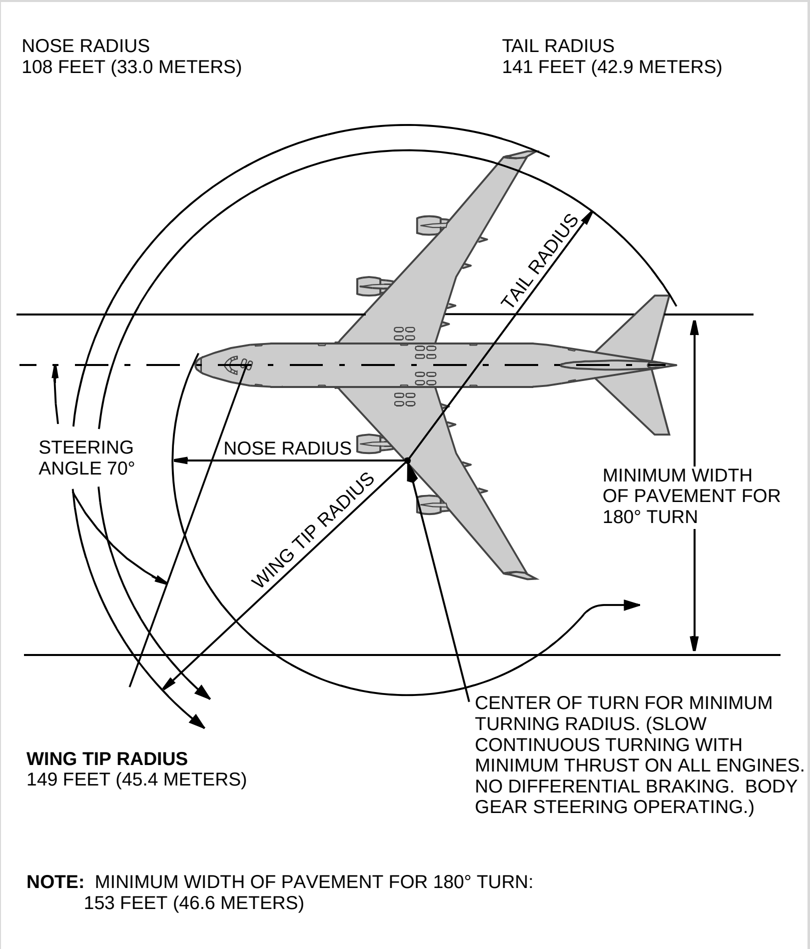
Principal Dimensions



Turning Radius

The wing tip swings the largest arc while turning and determines the minimum obstruction clearance path. All other portions of the airplane structure remain within this arc.

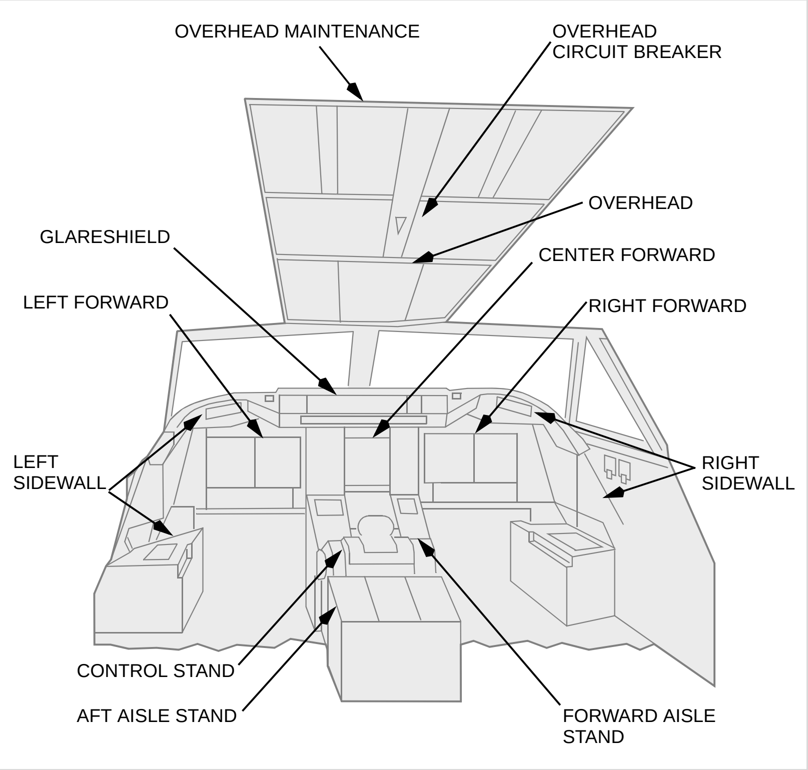


CAUTION: Do not attempt to make a turn away from an obstacle within (15 feet/4.6m) of the wing tip or within (56 feet/16.9m) of the nose.

Airplane General, Emergency Equipment, Doors, Windows — Chapter 1

Instrument Panels — Section 20

Flight Deck Panels



On the following pages, circled numbers refer to chapters where information on the item may be found.

The panels, controls, and indicators shown in this chapter are representative of installed units and may not exactly match the latest configuration. Refer to the appropriate chapter system descriptions for current information.

Intentionally
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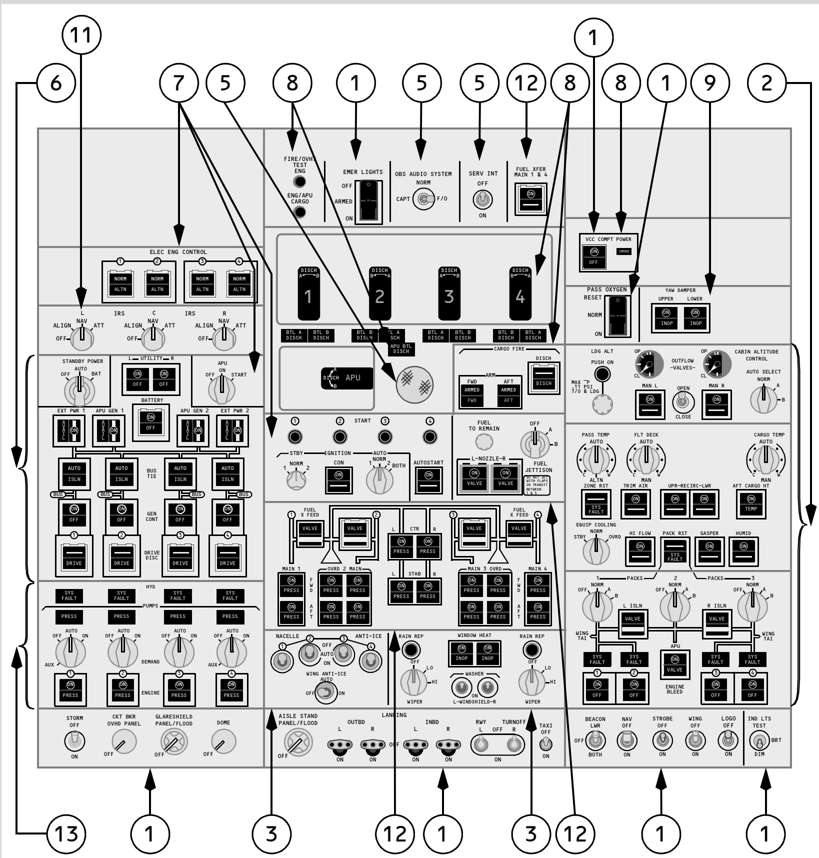
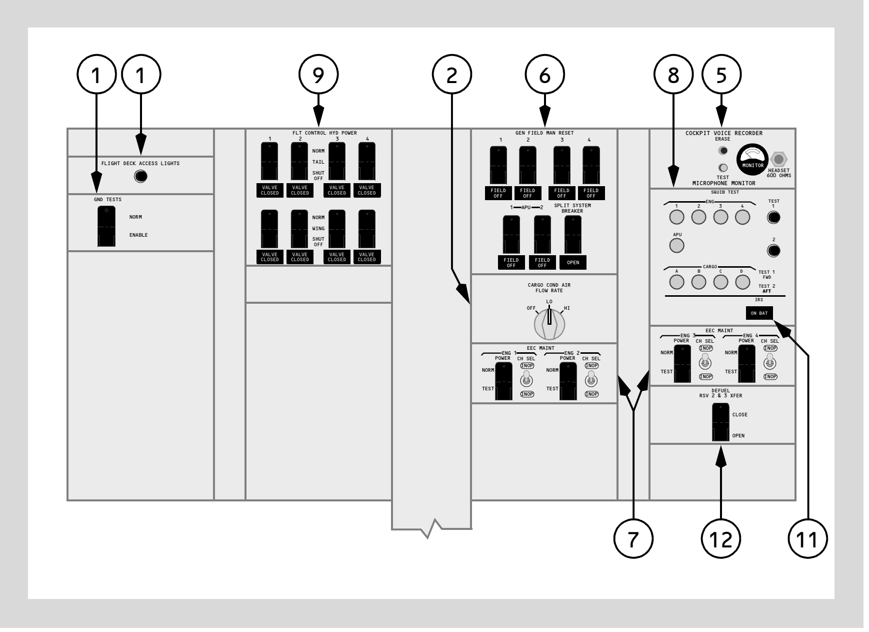
Overhead Panels

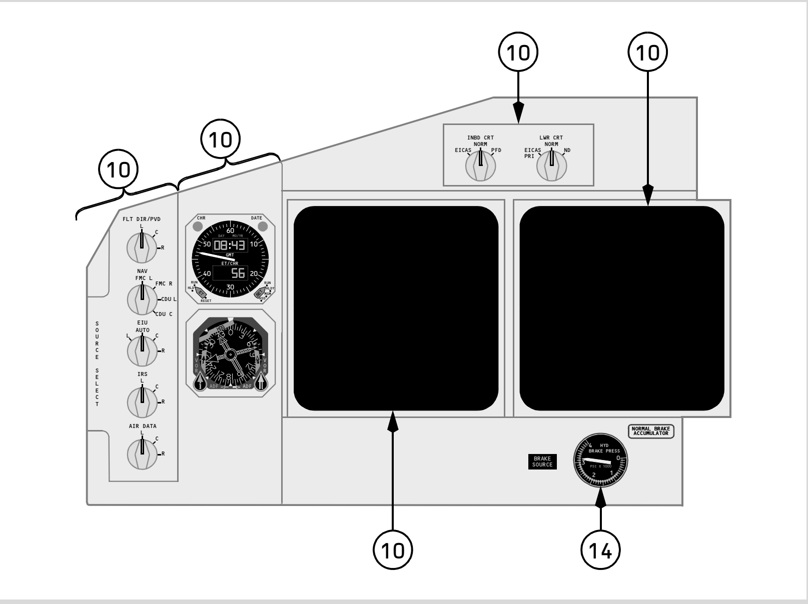
Overhead Panel



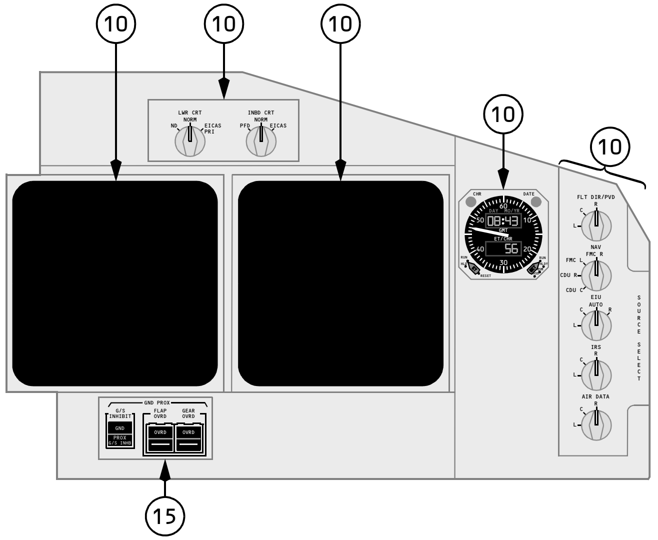
Overhead Maintenance Panel



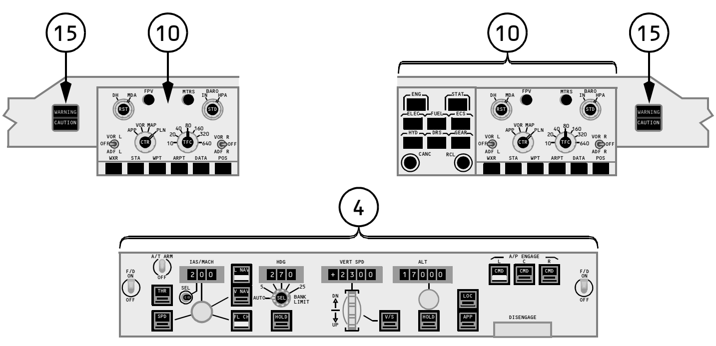
Left Forward Panel



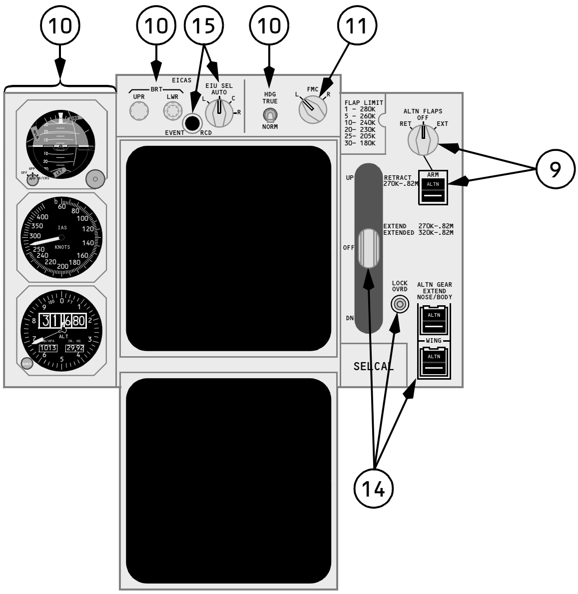
Right Forward Panel



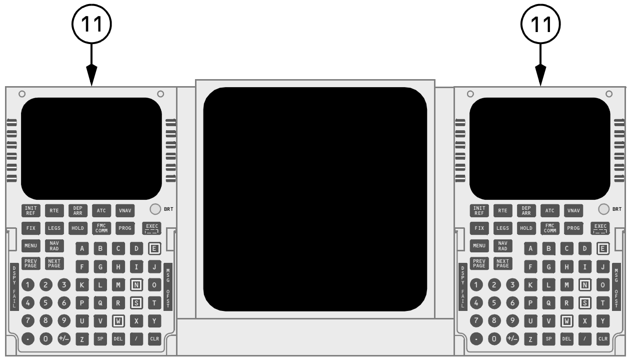
Glareshield Panel



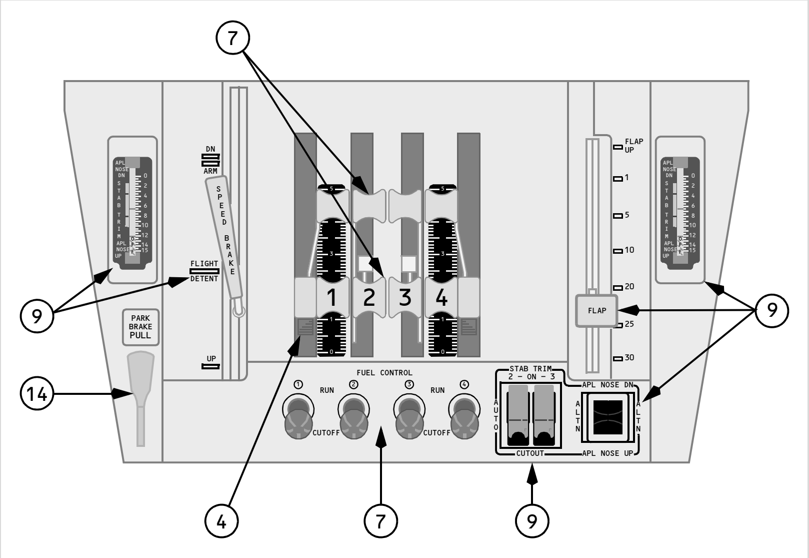
Center Instrument Panel



Forward Aisle Stand

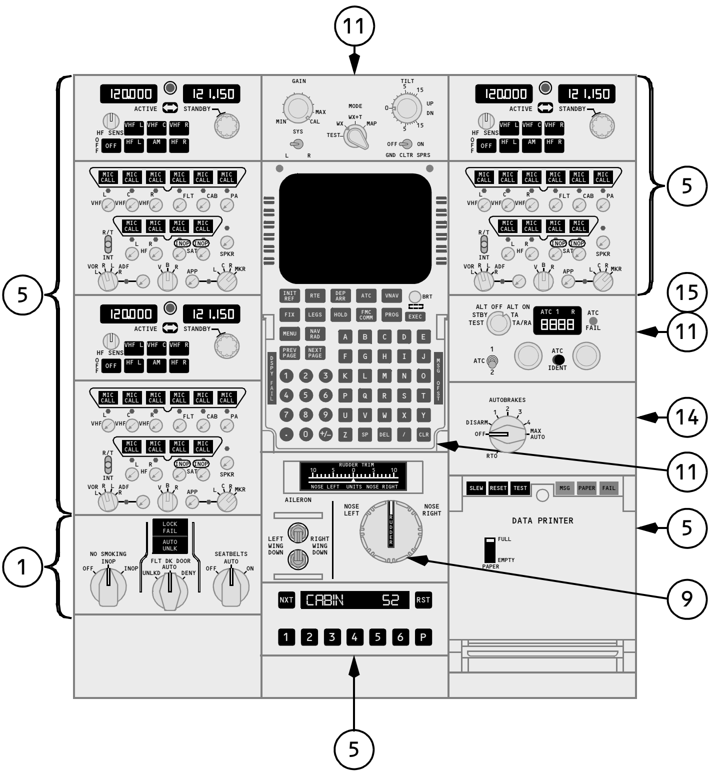


Control Stand

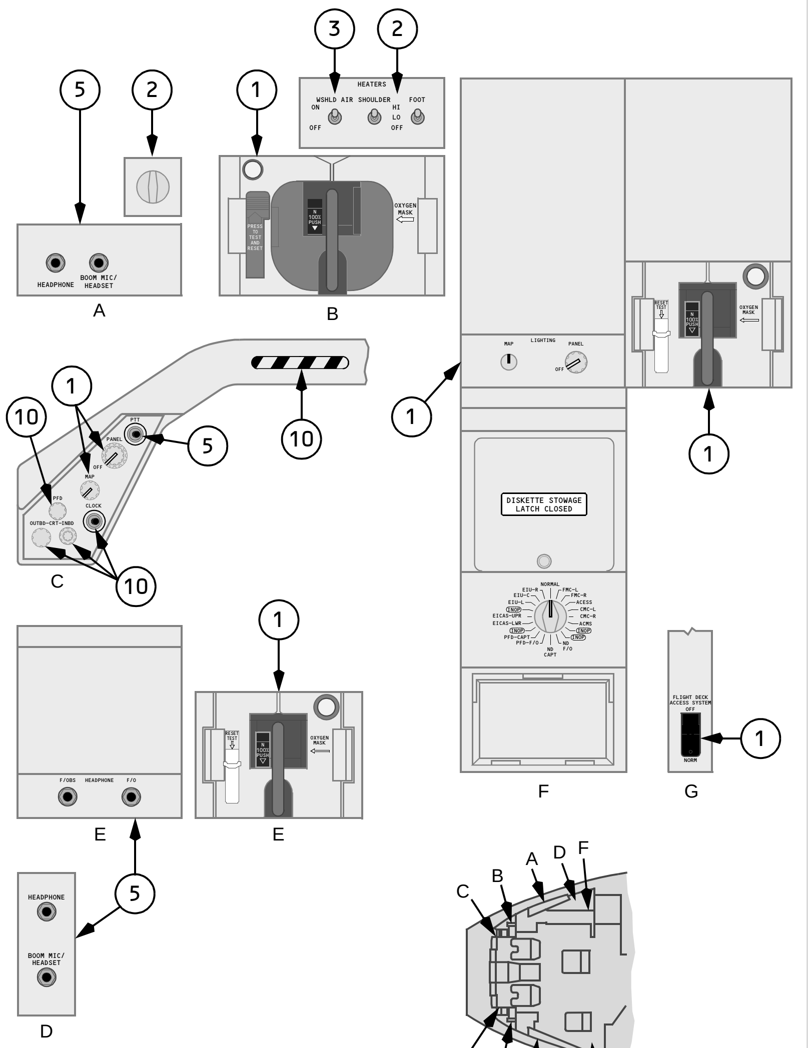


Aft Aisle Stand, Sidewall Panels

Aft Aisle Stand Panels



Left and Right Sidewall, First Observer, and Maintenance Access Terminal/Second Observer Panels



NOTE: PANELS A, B, AND D ARE SHOWN FOR CAPTAIN'S SIDE ONLY. FIRST OFFICER'S ARE OPPOSITE.

Intentionally
Blank

Push-Button Switches

The airplane has two types of push-button switches: alternate action and momentary action. Both types direct crew attention to system status and faults.

CAUTION: Flight crews should not change switch bulbs. Contact maintenance personnel whenever a bulb requires changing. Damage may result if bulbs are changed with the system powered. Switch bulb changes on the mode control panel may affect system operation in flight.

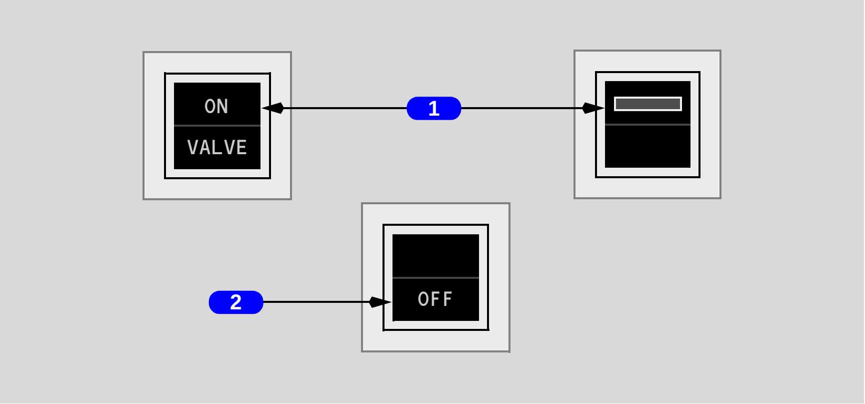
Alternate Action Switches

Alternate action switches have two positions: on and off.

When pushed in and flush with the panel, the switch is on. When the switch is on, a mechanical shutter on one half of the switch opens to show an illuminated legend, such as "ON", "AUTO", or a flow bar.

When pushed out and extended, the switch is off. When the switch is off, the mechanical shutter closes so the legend is not shown.

Additionally, the other half of many switches has a light to indicate system state, such as "PRESS", "FAIL", "INOP" or "OFF".



1 Switch is ON

ON, AUTO, or flow bar visible.

For some switches, system status (for example, MAN, OFF, VALVE) may be shown in the lower half of the switch.

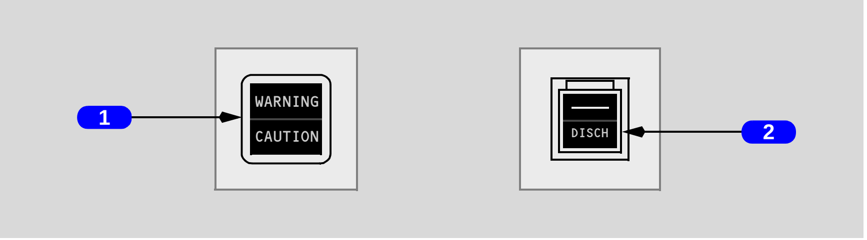
2 **Switch is OFF**

OFF or a line is visible -

- the top of the switch is blank
- a line indicates no label in this portion of the switch

Momentary Action Switches

Momentary action switches are spring loaded to the extended position. They activate or deactivate systems or reset system logic. The switch display indicates system status.



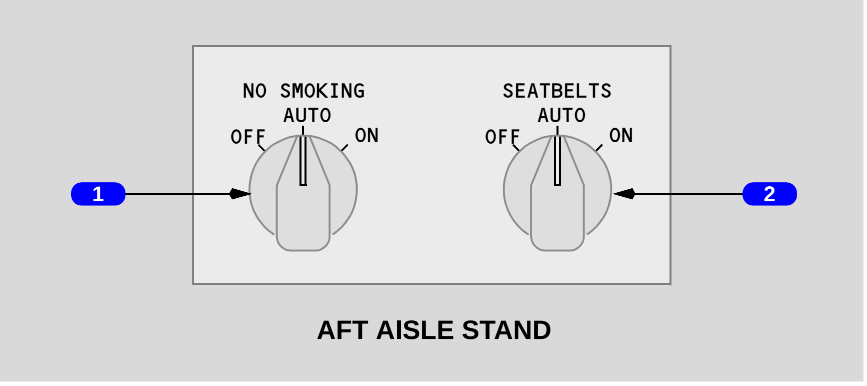
1 **Push to Reset**

Push - resets master lights and aural alerts.

2 **System Operation**

Push - activates or deactivates the system.

Passenger Signs



1 **NO SMOKING Selector**

OFF - NO SMOKING signs are not illuminated.

AUTO - NO SMOKING signs illuminate or extinguish with reference to airplane altitude and system configuration (refer to Lighting System Description section).

ON - NO SMOKING signs illuminate.

Note: Anytime passenger oxygen deploys, NO SMOKING and FASTEN SEAT S signs illuminate and RETURN TO SEAT signs extinguish, regardless of selector position.

2 **SEAT BELTS Selector**

OFF - FASTEN SEAT BELTS and RETURN TO SEAT signs are not illuminated.

AUTO - FASTEN SEAT BELTS and RETURN TO SEAT signs illuminate or extinguish with reference to airplane altitude and system configuration (refer to Lighting System Description section).

ON - FASTEN SEAT BELTS and RETURN TO SEAT signs illuminate.

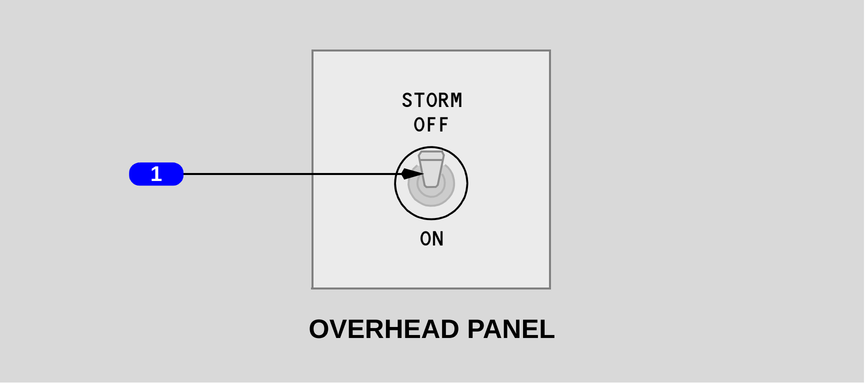
Note: Anytime passenger oxygen deploys, NO SMOKING and FASTEN SEAT BELTS signs illuminate and RETURN TO SEAT signs extinguish, regardless of selector position.

Lighting

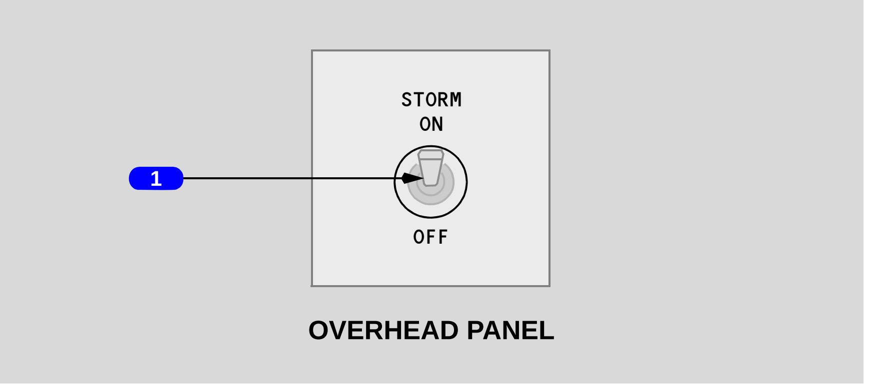
Flight Deck Lighting

Storm Lights Switch

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX

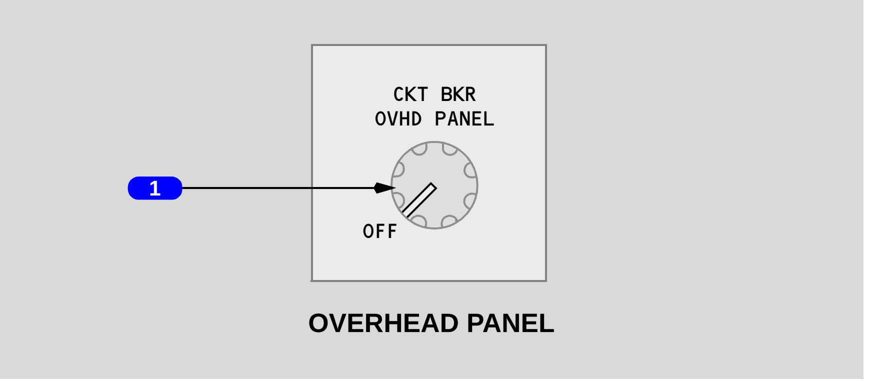


1 STORM Lights Switch

ON - overrides normal controls and illuminates the following lights at maximum brightness:

- Captain’s and First Officer’s lights
- glareshield lights
- aisle stand flood lights
- dome lights

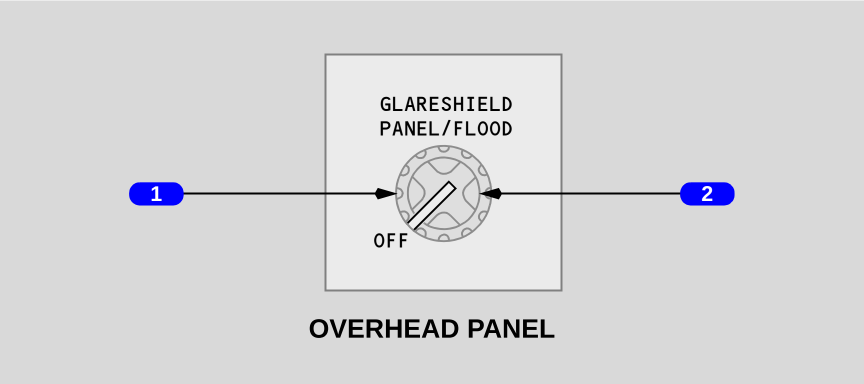
Circuit Breaker/Overhead Panel Lights Control



1 Circuit Breaker/Overhead (CKT BKR OVHD) Panel Lights Control

Rotate - controls circuit breaker panel and overhead panel brightness.

Glareshield Panel/Flood Lights Control



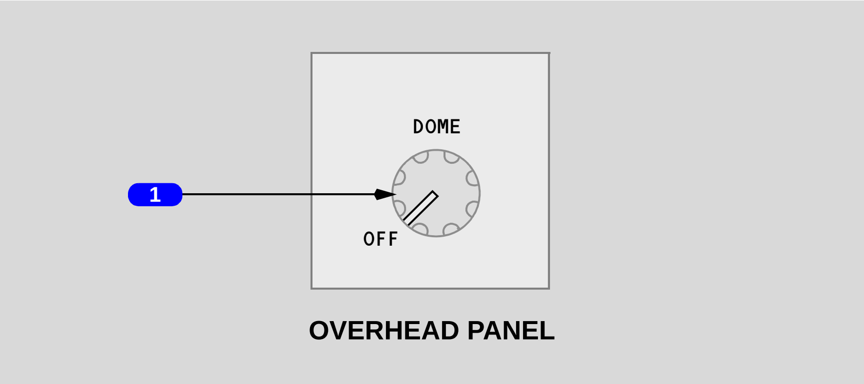
1 GLARESHIELD PANEL/FLOOD Lights Control (inner)

Rotate - controls left and right glareshield flood lights.

2 GLARESHIELD PANEL/FLOOD Lights Control (outer)

Rotate - controls glareshield panel and standby magnetic compass lights.

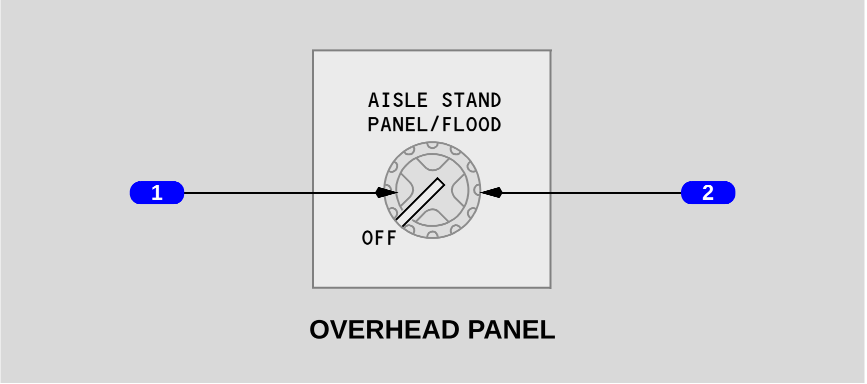
Dome Lights Control



1 DOME Lights Control

- controls dome light brightness
- overridden by storm lights switch

Aisle Stand Panel/Flood Lights Control



1 AISLE STAND PANEL/FLOOD Lights Control (inner)

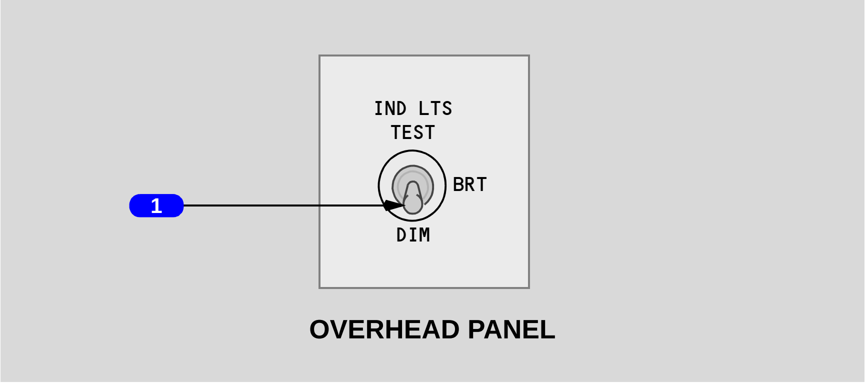
Rotate - controls aisle stand flood lights brightness.

2 AISLE STAND PANEL/FLOOD Lights Control (outer)

Rotate -

- controls aisle stand panel lights brightness
- overridden by storm lights switch

Indicator Lights Switch



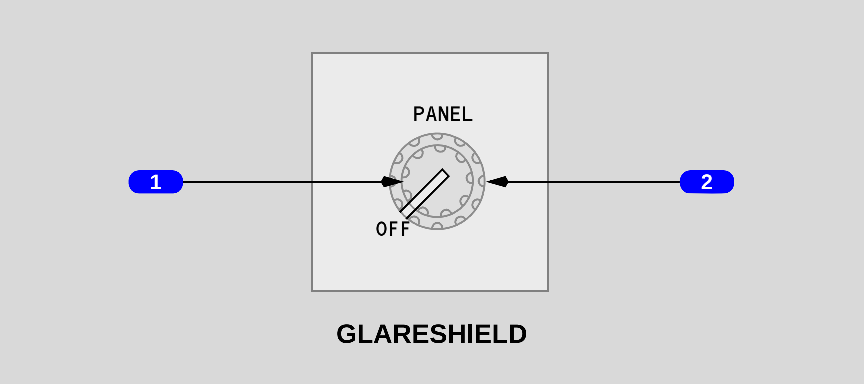
1 Indicator Lights (IND LTS) Switch

TEST (spring-loaded) - illuminates all annunciator lights to full brightness for 10 seconds to check the bulbs, then dims the lights as long as switch is held.

BRT - sets all illuminated annunciator lights to full brightness.

DIM - sets all illuminated annunciator lights to low brightness.

Captain’s Panels Light Controls



1 Captain’s Panels Light Controls (inner)

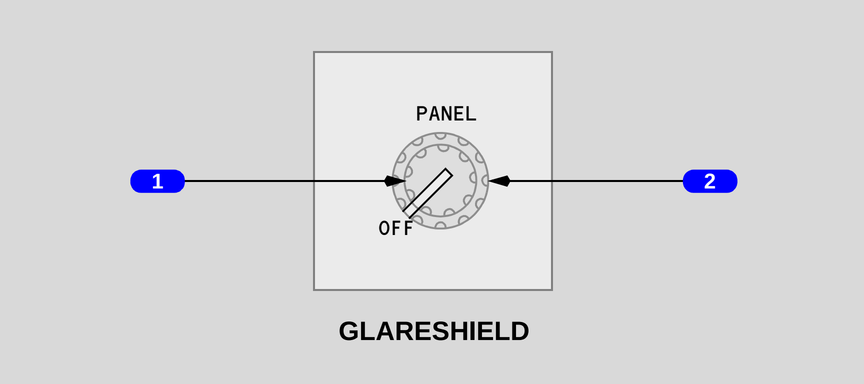
Rotate -

- controls Captain’s and center panel floodlights brightness
- overridden by storm switch

2 Captain’s Panels Light Controls (outer)

Rotate - controls Captain’s main panel, left side of center panel, and Captain’s lower auxiliary panel lighting.

First Officer’s Panels Light Controls



1 First Officer’s Panels Light Controls (inner)

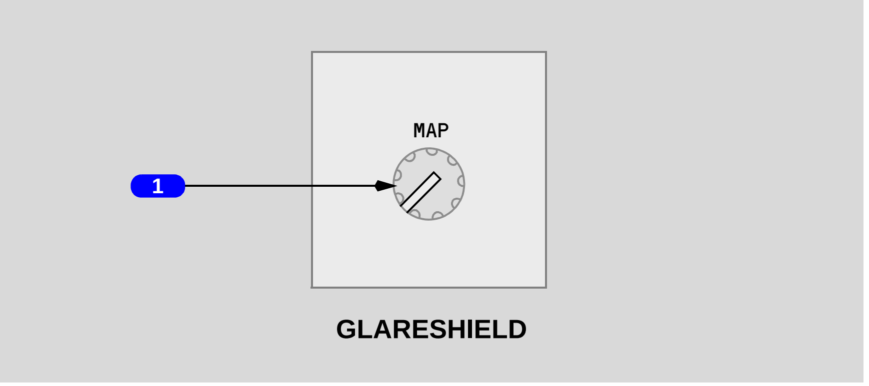
Rotate -

- controls First Officer’s panel floodlights brightness
- overridden by storm switch

2 **First Officer’s Panels Light Controls (outer)**

Rotate - controls First Officer’s main panel, right side of center panel, and First Officer’s lower auxiliary panel lighting.

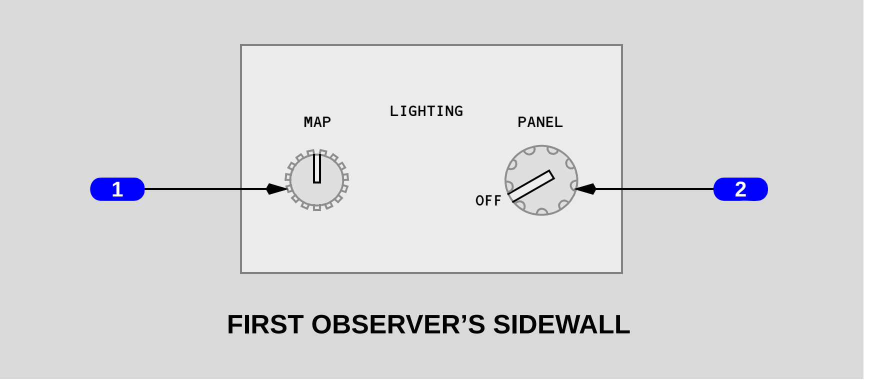
Captain’s and First Officer’s Map Light Controls



1 **Captain’s and First Officer’s MAP Light Controls**

Pull/Rotate - controls respective Captain’s and First Officer’s map light brightness.

First Observer’s Map Light Controls



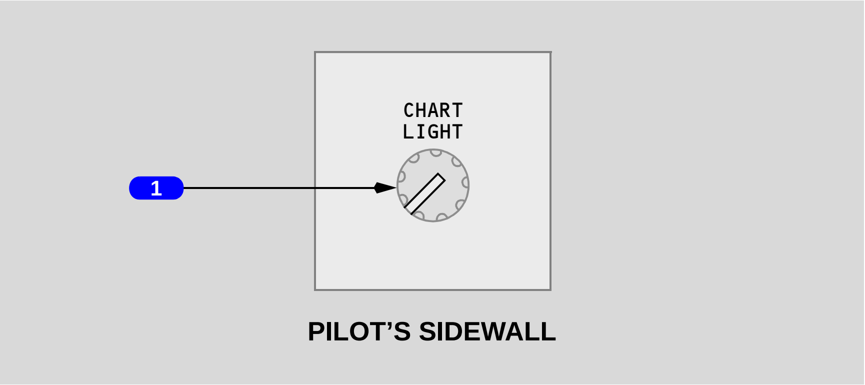
1 **First Observer’s MAP Light Switch**

Pull/Rotate - controls First Observer’s map light brightness.

2 **First Observer’s PANEL Light Switch**

Rotate - controls First Observer’s panel light brightness.

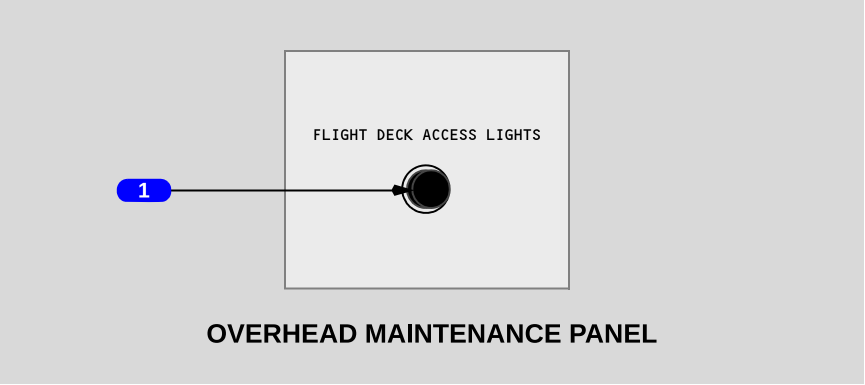
Captain’s and First Officer’s Chart Light Controls



1 Captain’s and First Officer’s CHART LIGHT Controls

Pull/Rotate - controls respective Captain’s and First Officer’s chart light brightness.

Flight Deck Access Lights Switches



1 FLIGHT DECK ACCESS LIGHTS Switch

Additional Access Lights switches are located at Door 2 left attendant’s panel, and Main Equipment Center lower hatch.

Push (any switch) - when the airplane is powered by the ground handling bus, illuminates exit or entry path to or from flight deck; activates the following:

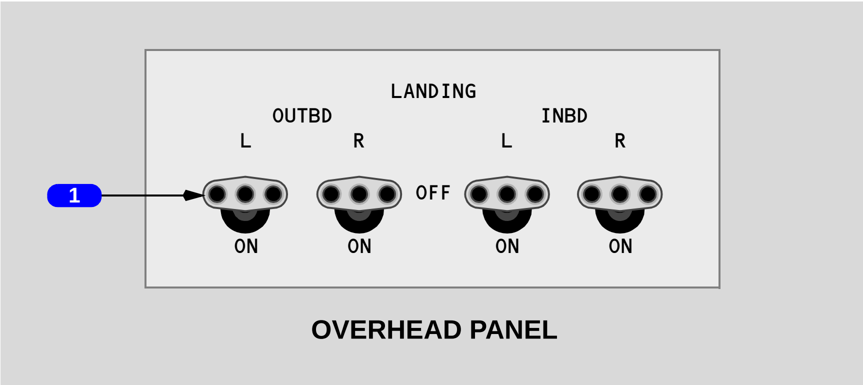
- Main Equipment Center lights
- direct ceiling light door 2
- direct ceiling lights upper deck

Second push (any switch) - extinguishes exit or entry path lighting.

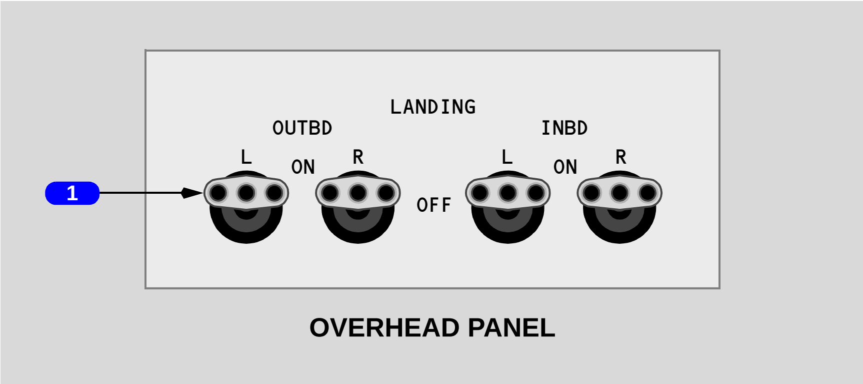
Exterior Lighting

Landing Light Switches

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX



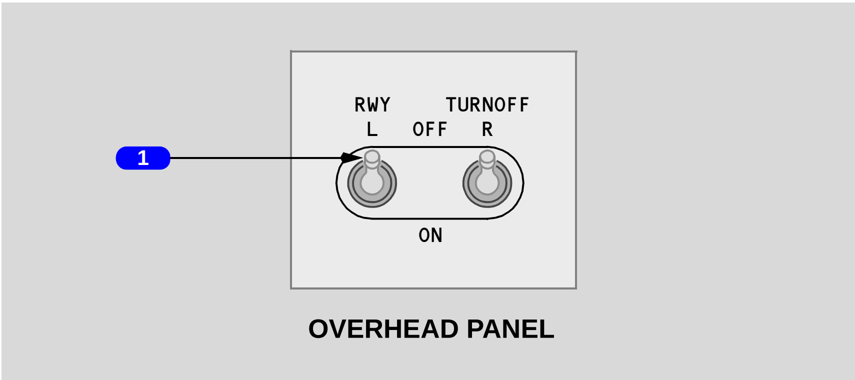
1 Outboard (OUTBD) and Inboard (INBD) LANDING Light Switches

ON (L or R)-

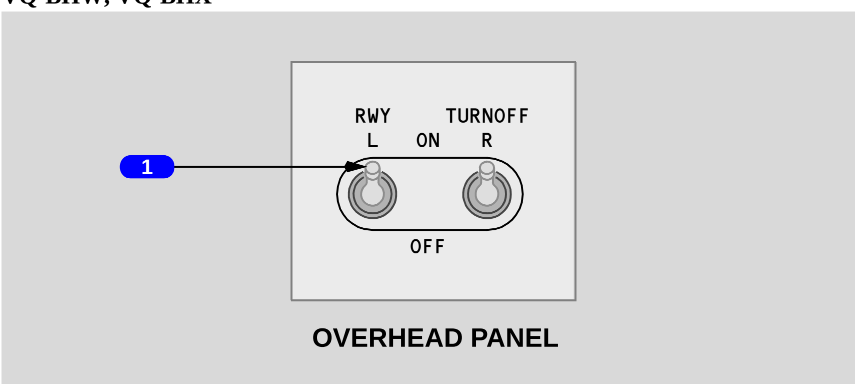
- illuminates respective wing landing light
- light intensity at maximum when Landing Gear lever in DOWN position

Runway Turnoff Light Switches

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX



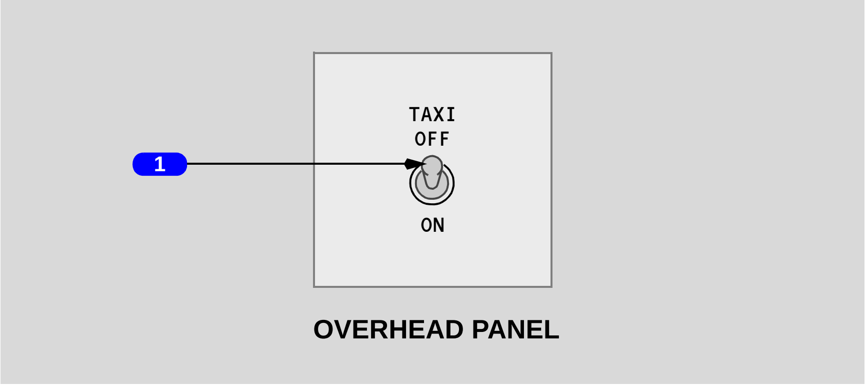
1 Runway (RWY) TURNOFF Light Switches

ON (L or R) -

- illuminates respective runway turnoff light
- lights extinguish when air/ground sensing system in air mode

Taxi Lights Switch

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



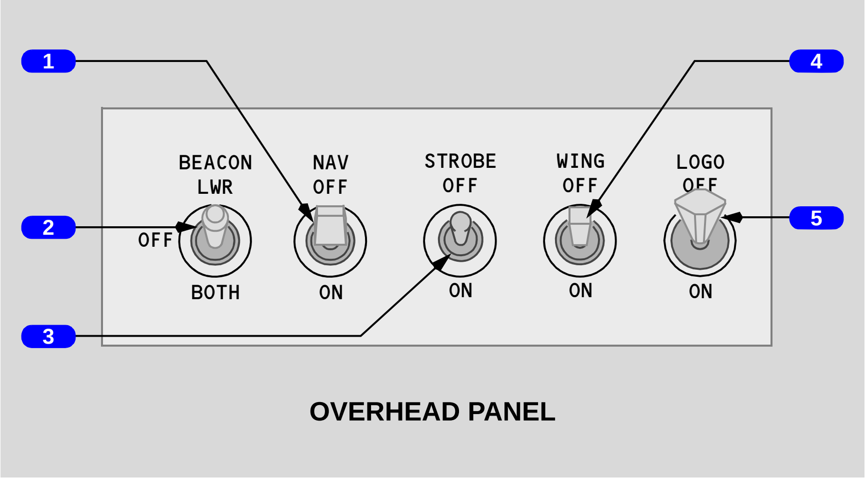
1 TAXI Lights Switch

ON -

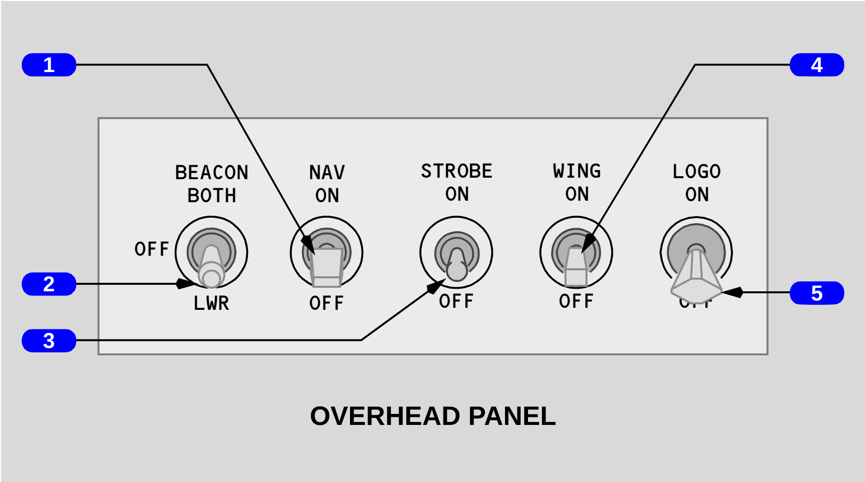
- illuminates two taxi lights on nose landing gear
- lights extinguish when air/ground sensing system in air mode

Beacon, Navigation, Strobe, Wing, and Logo Light Switches

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX



1 Navigation (NAV) Lights Switch

ON - illuminates red, green and white navigation lights.

2 BEACON Lights Switch

Lower (LWR) - activates lower red anti-collision beacon light.

BOTH - activates upper and lower red anti-collision beacon lights.

3 STROBE Lights Switch

ON - activates strobe lights.

4 WING Lights Switch

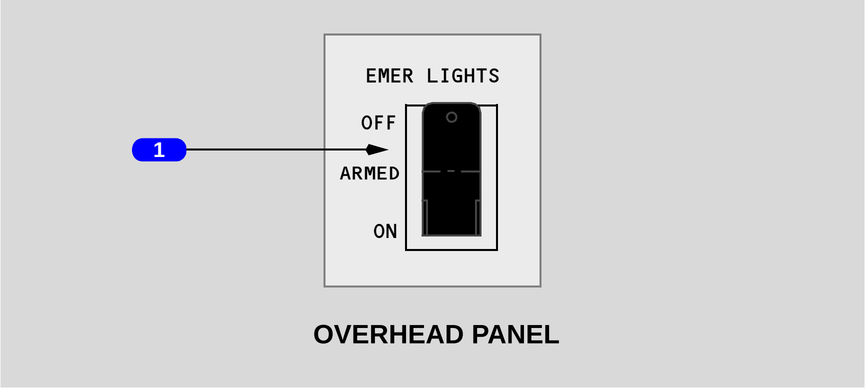
ON - illuminates wing leading edge illumination lights.

5 LOGO Lights Switch

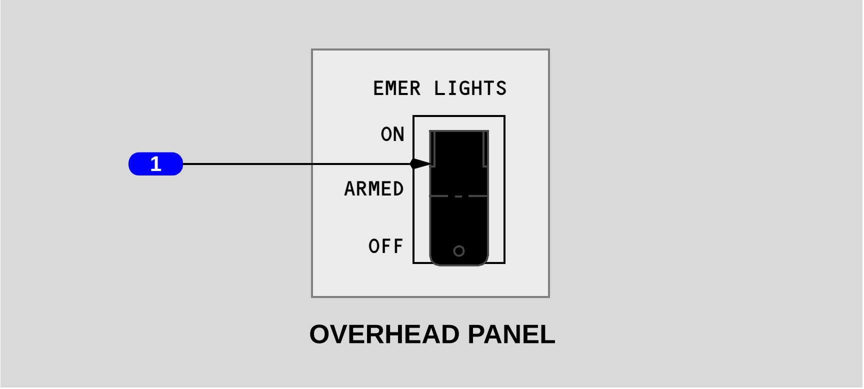
ON - illuminates logo lights.

Emergency Lighting Controls
Flight Deck Emergency Lights Switch

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX



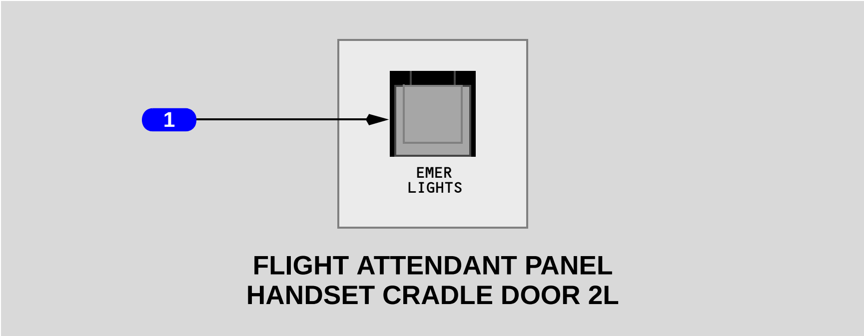
1 Flight Deck Emergency (EMER) LIGHTS Switch

OFF - prevents emergency lights system operation if airplane electrical power fails or is turned off.

ARMED (guard closed) - all emergency lights illuminate if airplane electrical power fails or is turned off.

ON - all emergency lights illuminate.

Cabin Emergency Lights Switch

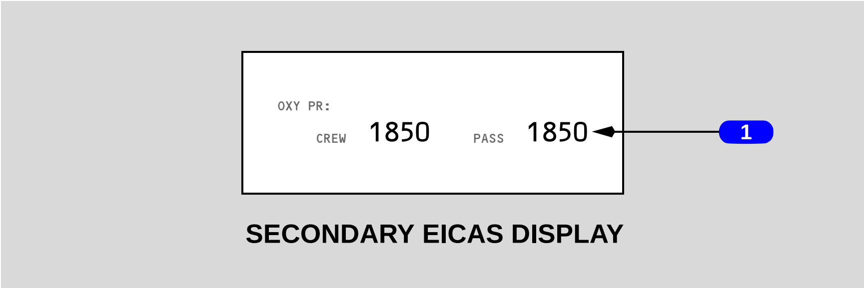


1 Cabin Emergency (EMER) LIGHTS Switch

Push -

- Illuminated (red) -
  - all passenger cabin and exterior emergency lights illuminate
  - bypasses flight deck emergency lights switch
- Extinguished - all passenger cabin and exterior emergency lights extinguish

Oxygen Systems
Oxygen Indications



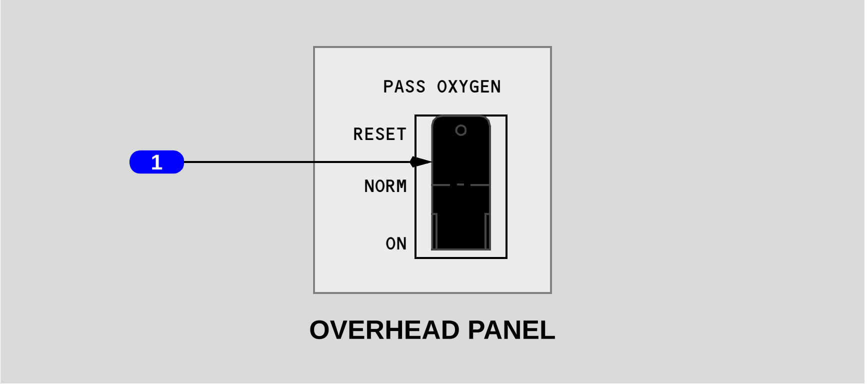
1 Oxygen Pressure (OXY PR) Display

Displays crew and passenger oxygen cylinder pressure (PSI).

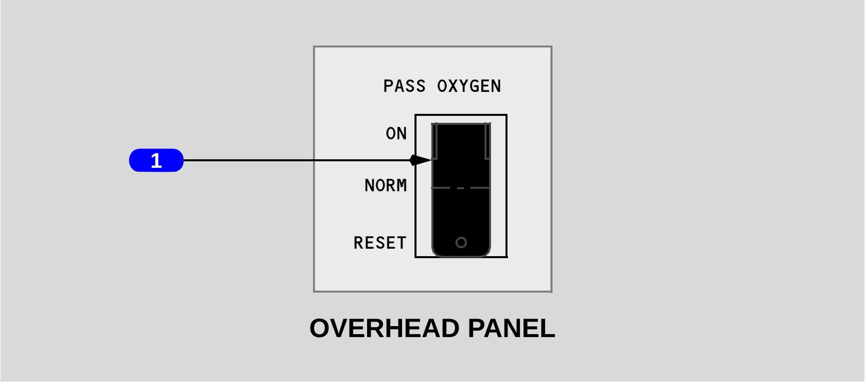
Note: Access is through display select panel STAT switch.

Passenger Oxygen Switch

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX



1 PASSENGER (PASS) OXYGEN Switch

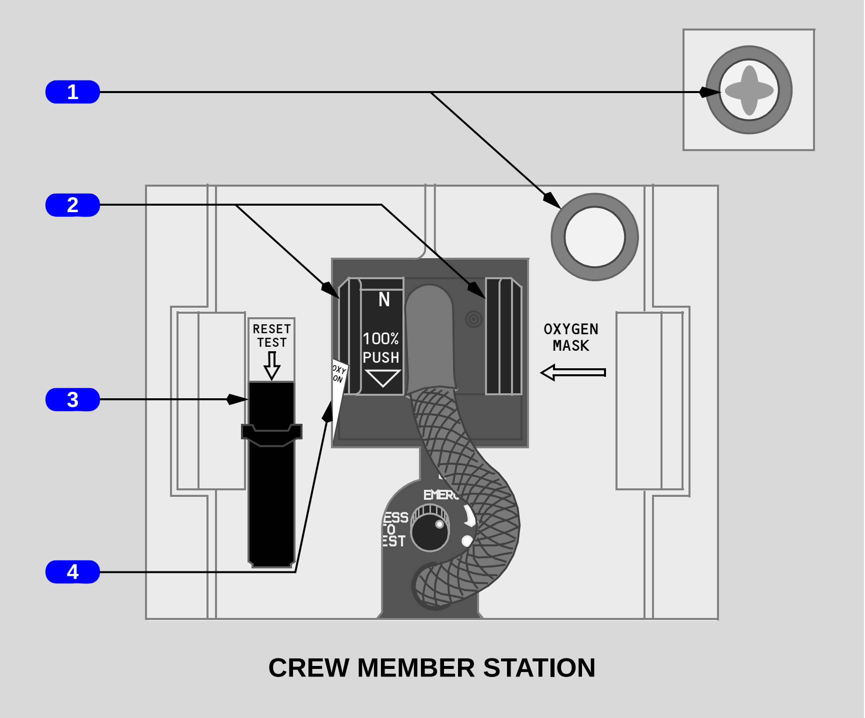
RESET (spring-loaded) - flow control units closed electrically when cabin altitude below 12,000 feet.

NORM (guard closed) - system activates if cabin altitude reaches approximately 14,000 feet.

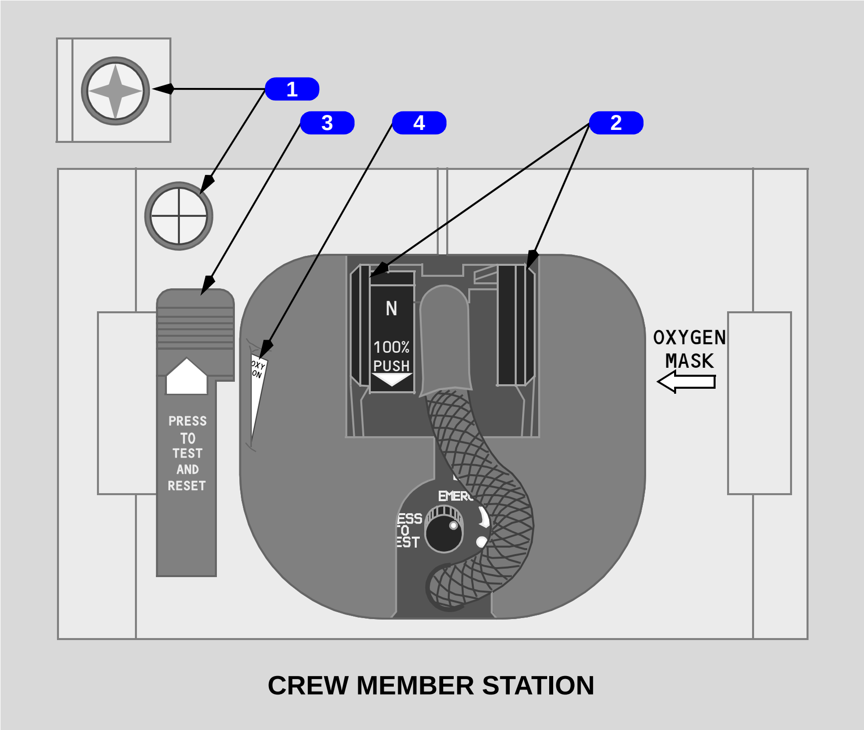
ON (spring-loaded) - passenger cabin oxygen masks drop.

Oxygen Mask Panel

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 **Oxygen Flow Indicator**

Shows a yellow cross when oxygen flowing.

2 **Oxygen Mask Release Levers**

Squeeze and pull -

- unlocks oxygen panel doors
- releases mask
- oxygen turns on when oxygen panel doors open
- flow indicator shows a yellow cross momentarily as harness inflates
- when left-hand door opens, activates mask microphone

Squeeze (right lever) - inflates mask harness.

Release - deflates mask harness into position on head and face.

3 RESET/TEST Switch

Push -

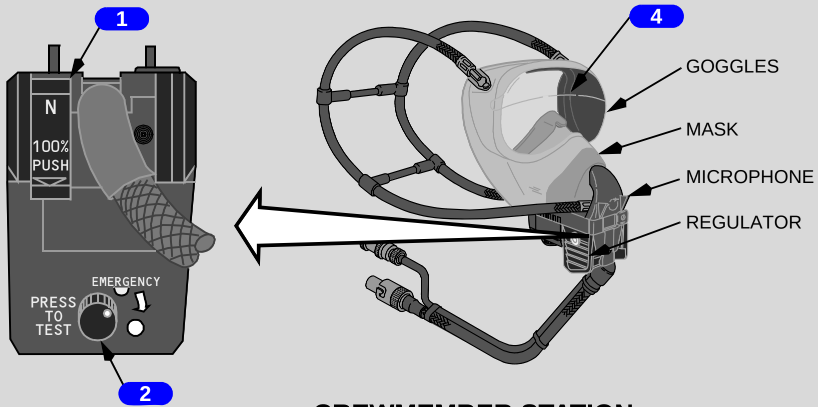
- with left oxygen panel door closed and OXY ON not displayed, turns oxygen on momentarily to test regulator
- with the left oxygen panel door closed and the OXY ON flag displayed, turns oxygen off, deactivates the mask microphone, and activates the boom microphone

4 Oxygen (OXY) ON Flag

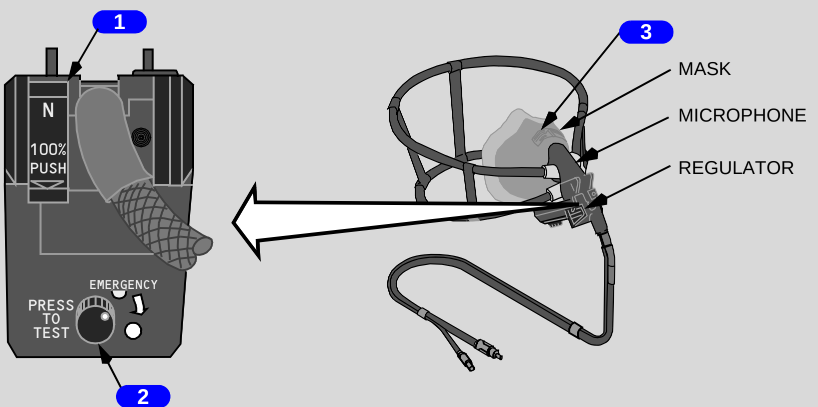
In view - oxygen is on.

Oxygen Mask and Regulator

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

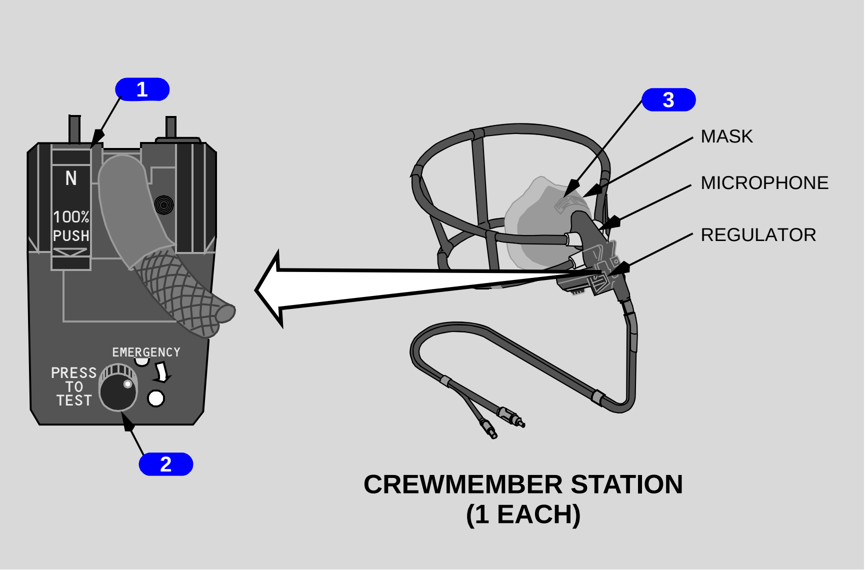


CREWMEMBER STATION
CAPTAIN AND FIRST OFFICER



CREWMEMBER STATION
OBSERVER

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



1 NORMAL/100% Switch

N - supplies an air/oxygen mixture on demand (the ratio depends on cabin altitude).

100% - supplies 100% oxygen on demand (not an air/oxygen mixture).

2 Oxygen Mask Emergency/Test Selector

Rotate (in the direction of the arrow) - supplies 100% oxygen under positive pressure at all cabin altitudes (protects against smoke and harmful vapors).

PRESS TO TEST- tests the positive pressure supply to the regulator.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

3 Observer's Smoke Vent Valve Selector

Up - vent valve closed.

Down - vent valve open, allowing oxygen flow to smoke goggles.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

3 Smoke Vent Valve Selector

Up - vent valve closed.

Down - vent valve open, allowing oxygen flow to smoke goggles.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

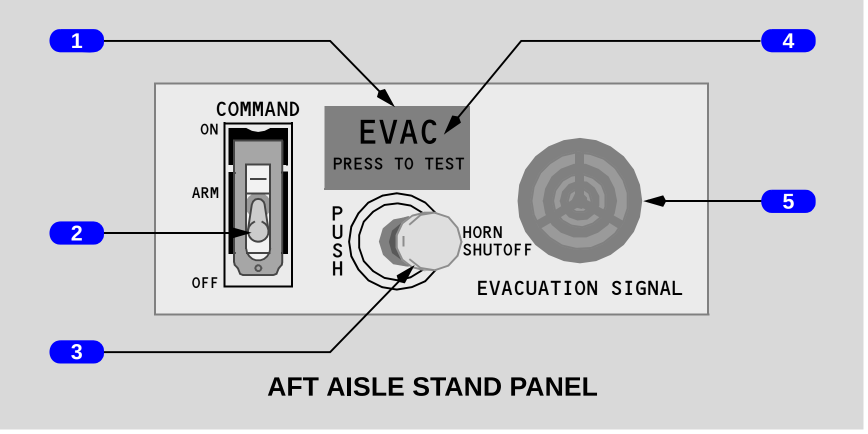
4 Protective Strip

There is a protective strip of clear plastic on the top portion of the Captain's and First Officer's lens. In case of condensation build-up caused by rapid depressurization, vision can be restored by peeling off this strip using the tab on the right side.

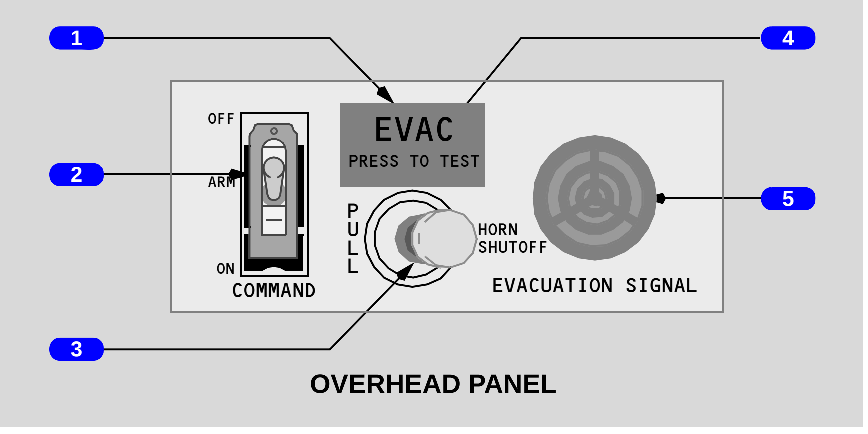
Emergency Evacuation Panel

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ (EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs emergency evacuation signal system)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs emergency evacuation signal system)



1 Evacuation (EVAC) PRESS TO TEST Switch

Push - tests the EVAC light.

2 Evacuation COMMAND Switch

ON -

- activates evacuation signal system

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
- amber EVAC light (flight deck) and amber EVAC lights (attendant panels) flash

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs emergency evacuation signal system)
- amber EVAC light (flight deck) and amber EVACUATE lights (attendant panels) flash
- audio horn sounds at each panel

ARM - evacuation signal can be activated at flight attendant panel.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
OFF - prevents activation of emergency evacuation signal at flight attendant panels. Actuating EVAC COMMAND switch at flight attendant panel sounds pulsating audio signal and illuminates flashing amber light at the flight deck panel only.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; switch guarded to OFF position only)
OFF (guard closed) - prevents activation of emergency evacuation signal at flight attendant panel.

3 Evacuation HORN SHUTOFF Switch

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
PUSH - silences flight deck evacuation signal horn.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs emergency evacuation signal system)
PULL - silences flight deck evacuation signal horn.

4 Evacuation (EVAC) Light

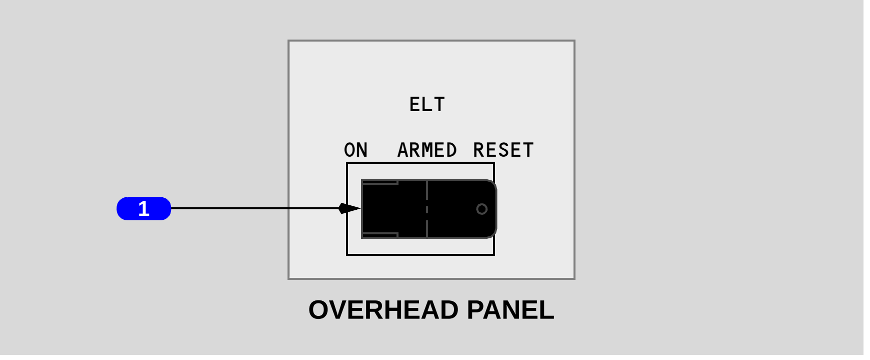
Illuminated (amber) - a command switch is in the ON position.

5 EVACUATION SIGNAL Horn

Sounds an audio signal.

Emergency Locator Transmitter

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



1 Emergency Locator Transmitter (ELT) Switch

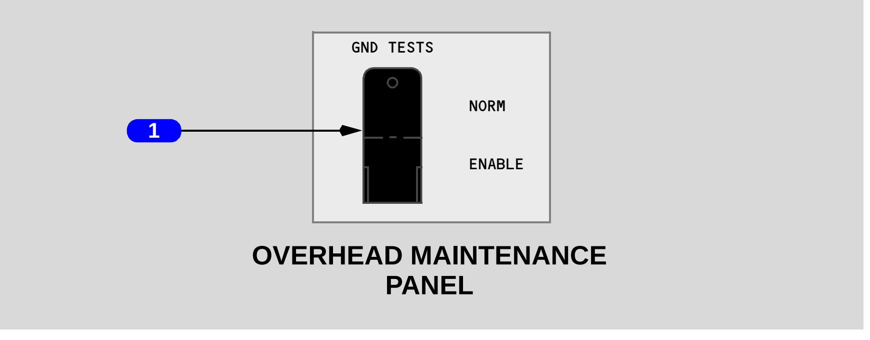
ON - transmits emergency locator signal.

ARMED (guard closed) - transmits emergency locator signal if activated by high deceleration forces.

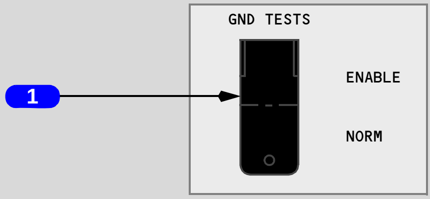
RESET (spring-loaded) - ends transmission of emergency locator signal.

Ground Tests Switch

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX



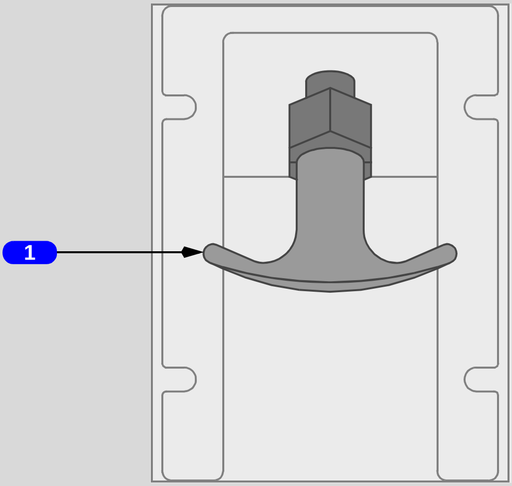
OVERHEAD MAINTENANCE PANEL

1 Ground (GND) TESTS Switch

ENABLE - allows Central Maintenance Computer to initiate ground tests of airplane systems.

NORM (Normal - guard closed) - systems configured for flight.

Smoke Evacuation Handle



OVERHEAD CIRCUIT BREAKER PANEL

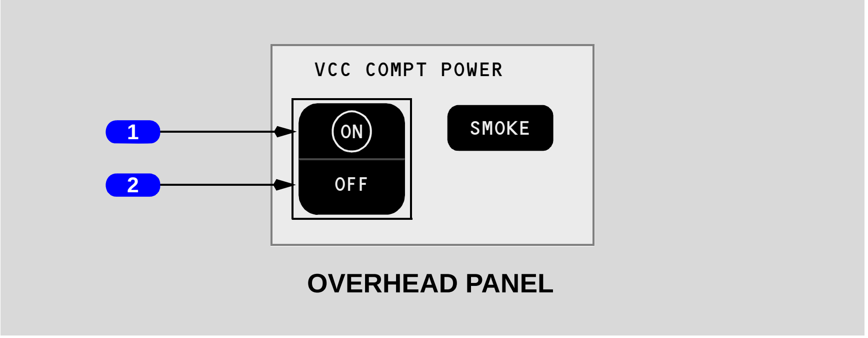
1 Smoke Evacuation Handle

Pull -

- opens flight deck smoke evacuation port
- effective only if airplane pressurized

Video Control Center Compartment Control Switch

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; system installed by STC)



1 Video Control Center Compartment Power (VCC COMPT POWER) Switch

ON - enables power to the VCC, audio-video on-demand server (ASR), and IFE.

OFF - removes power from the VCC, ASR, and IFE.

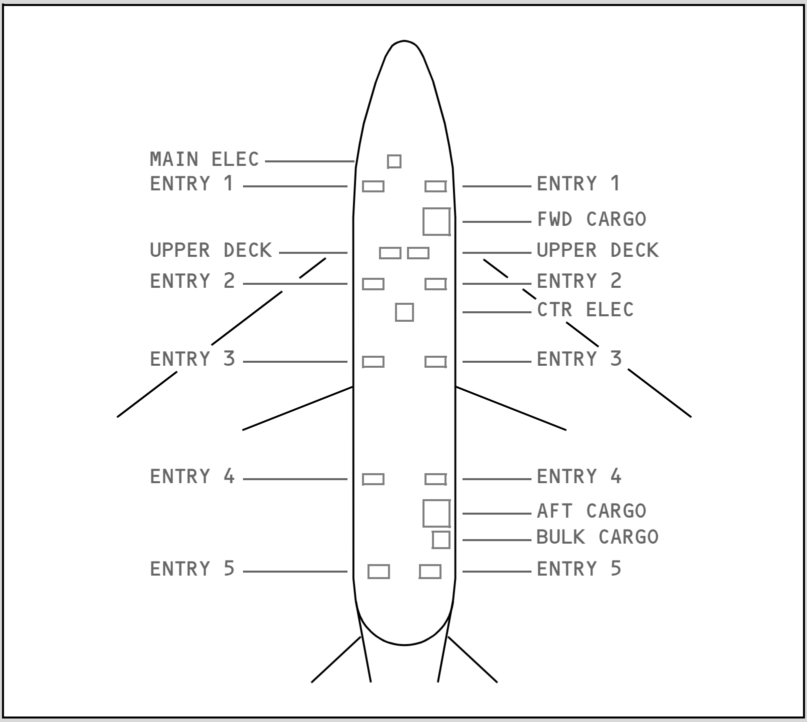
2 VCC COMPT POWER OFF Light

Illuminated (white) - power removed from the VCC, ASR, and IFE.

Doors

Doors Synoptic Display

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

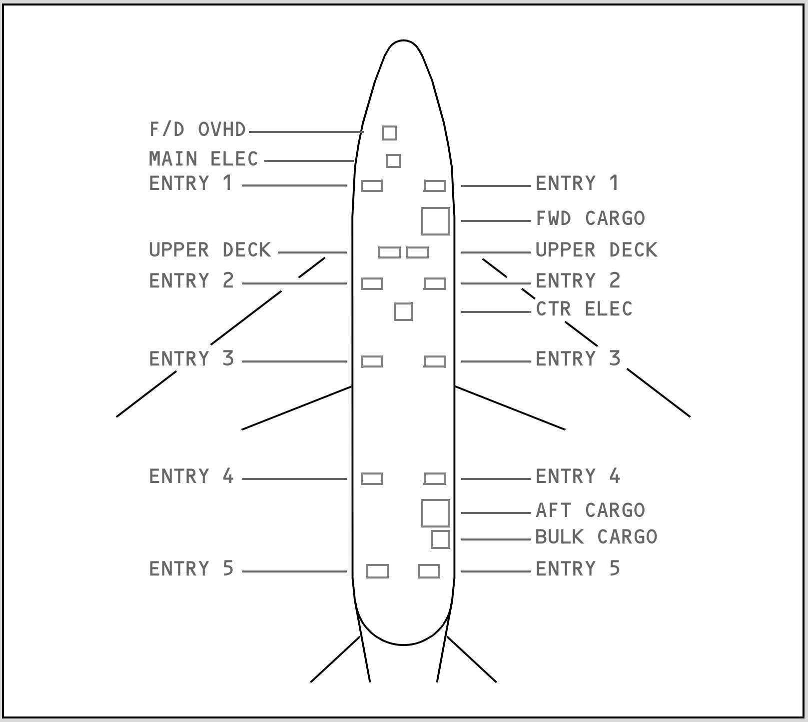


SECONDARY EICAS DISPLAY

(AMBER) - DOOR OPEN
(BLANK) - DOOR CLOSED

CYAN NOMENCLATURE DISPLAYED CONTINUOUSLY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

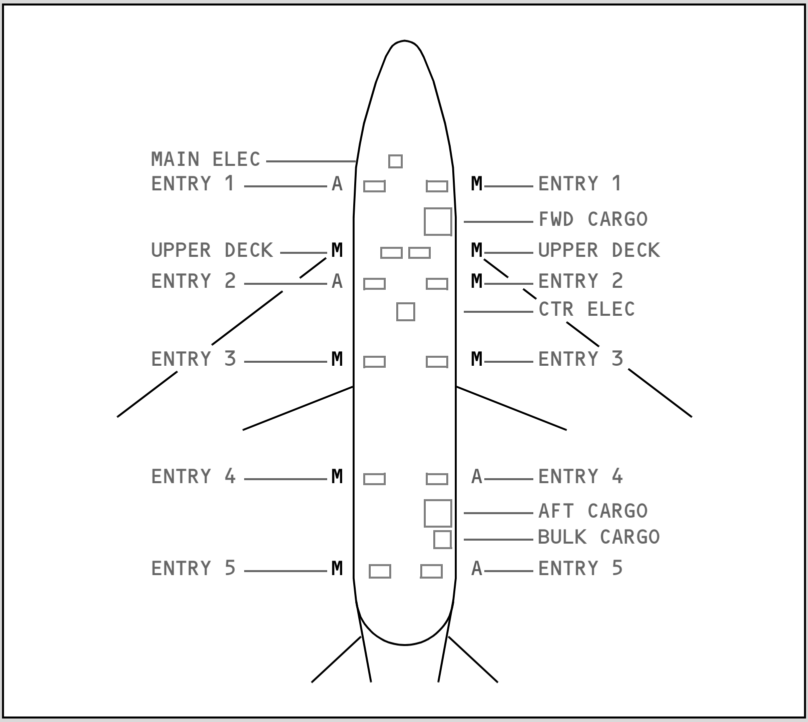


SECONDARY EICAS DISPLAY

(AMBER) - DOOR OPEN
(BLANK) - DOOR CLOSED

CYAN NOMENCLATURE
DISPLAYED CONTINUOUSLY

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



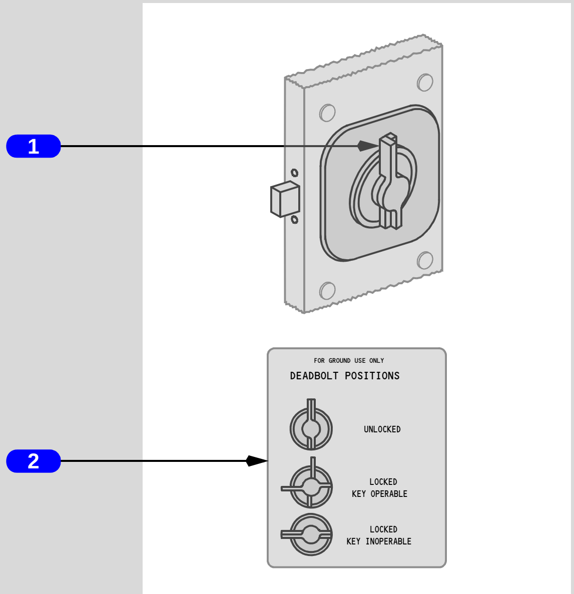
SECONDARY EICAS DISPLAY

☐	(AMBER) - DOOR OPEN (BLANK) - DOOR CLOSED
	CYAN NOMENCLATURE DISPLAYED CONTINUOUSLY
M	(WHITE) - DOOR MODE SELECT LEVER IN MANUAL POSITION
A	(GREEN) - DOOR MODE SELECT LEVER IN AUTOMATIC POSITION

Flight Deck Door

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Deadbolt

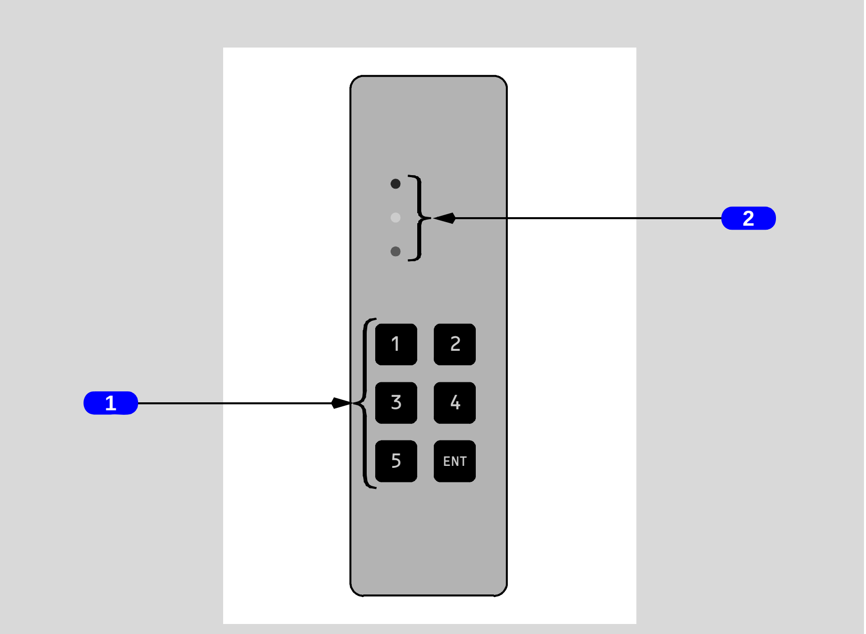


FLIGHT DECK DOOR
(TYPICAL)

1 **Deadbolt Levers**

2 **Deadbolt Positions Placard**

Flight Deck Emergency Access Panel



PASSENGER SIDE DOOR POST

1 Keypad

Push - enters 3 to 8 digit emergency access code by pressing numeric then "ENT" keys. Entry of correct emergency access code sounds flight deck chime.

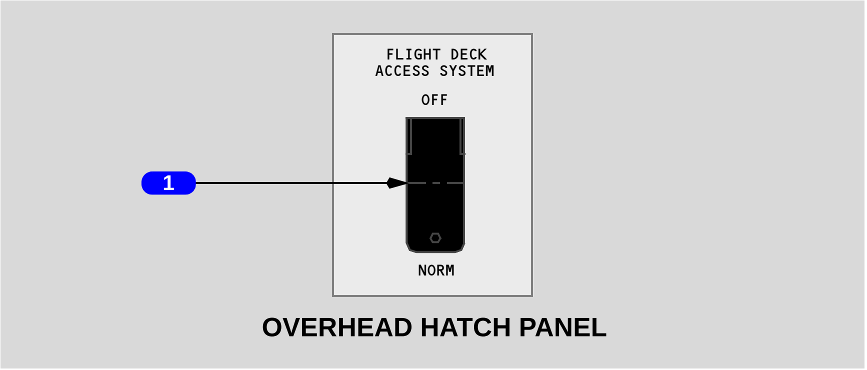
2 Access Lights

Illuminated (red) - door locked or Flight Deck Access System switch OFF.

Illuminated (amber) - correct emergency access code entered.

Illuminated (green) - door unlocked.

Flight Deck Access System Switch



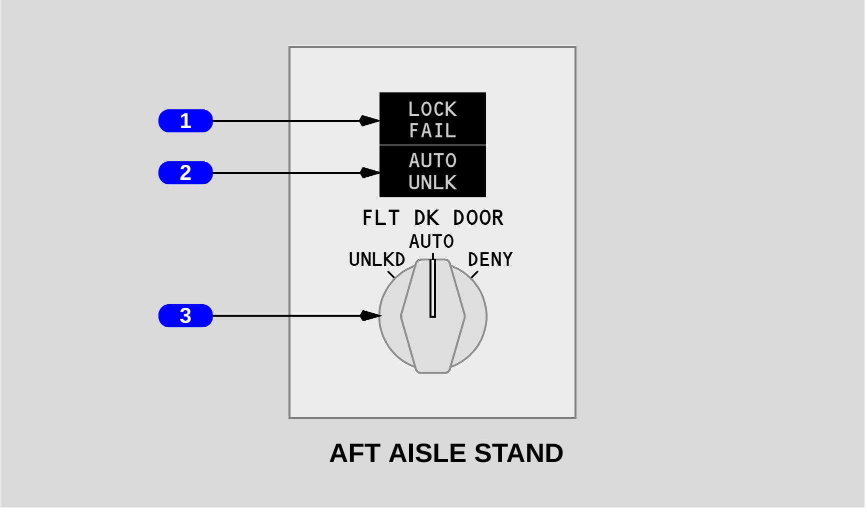
1 Flight Deck Access System Switch

OFF - removes electrical power from door lock.

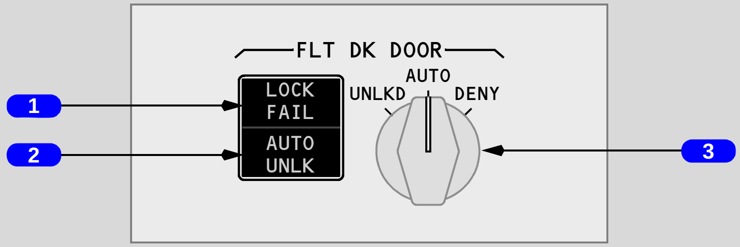
NORM (Normal - guard closed) - flight deck access system configured for flight.

Flight Deck Door Lock Panel

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



AFT AISLE STAND

1 LOCK FAIL Light

Illuminated (amber) - Flight Deck Door Lock selector in AUTO and door lock has failed or Flight Deck Access System switch in OFF.

2 AUTO Unlock (UNLK) Light

Illuminated (amber) - correct emergency access code entered in keypad. AUTO UNLK light flashes and continuous chime sounds before timer expires and door unlocks.

3 Flight Deck (FLT DK) Door Lock Selector

Spring loaded to AUTO. Selector must be pushed in to rotate from AUTO to UNLKD. Selector must not be pushed in to rotate from AUTO to DENY.

UNLKD - door unlocked while selector in UNLKD.

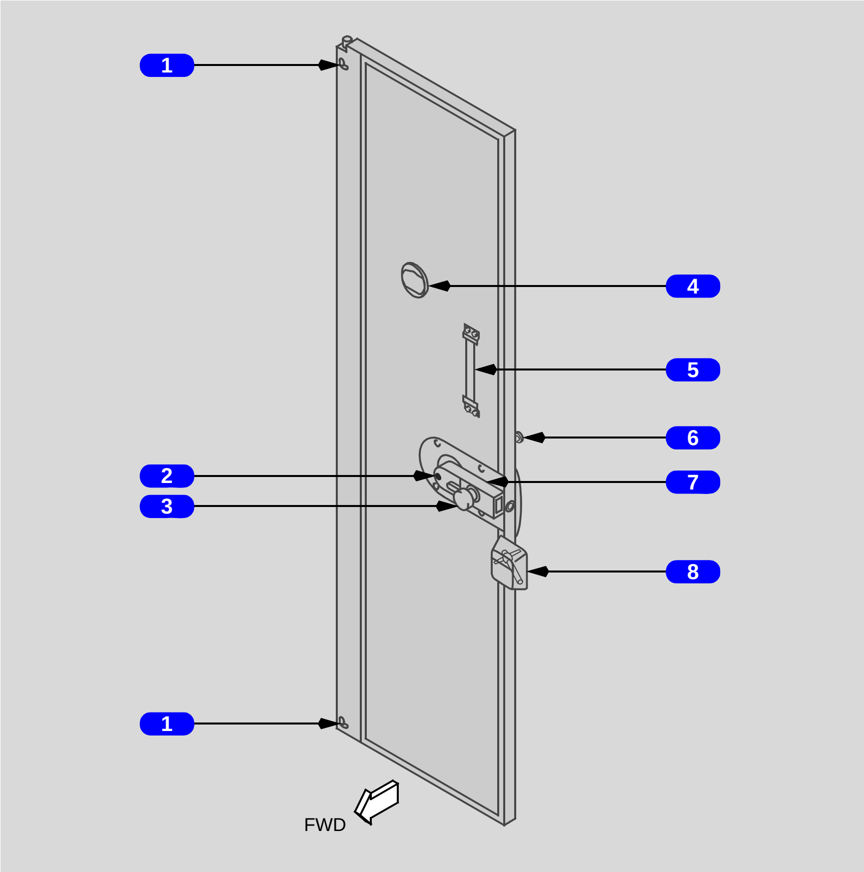
AUTO - door locked. Allows door to unlock after entry of emergency access code and expiration of timer, unless crew takes action.

DENY - rejects keypad entry request and prevents further emergency access code entry for a time period.

Flight Deck Door

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Flight Deck Door



1 Hinge Pin Release Levers

Both retracted - detaches the door assembly from the door support structure.

2 Manual Release Button (guarded by a red cover)

Push - enables the door to open under a jammed condition.

3 Door Knob

4 View Port

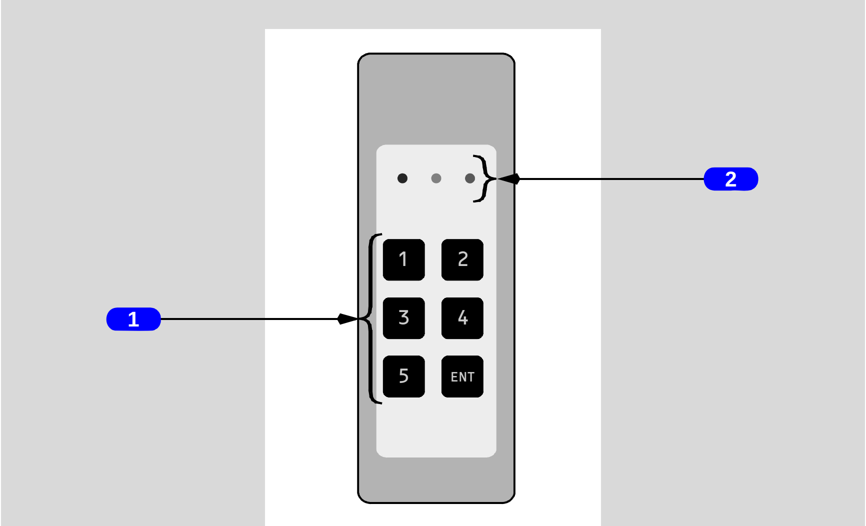
5 **Canvas Handle**

6 **Dead Bolt Knob**

7 **Door Latch**

8 **Mechanical Catch Pin Lock**

Flight Deck Door Access Panel (Keypad)



DOOR POST (CABIN SIDE)

1 **Keys**

Push - enters 3 to 8 digit numeric access code by pressing numeric then "ENT" keys. Entry of correct emergency access code sounds a continuous door horn. Incorrect entry has no effect.

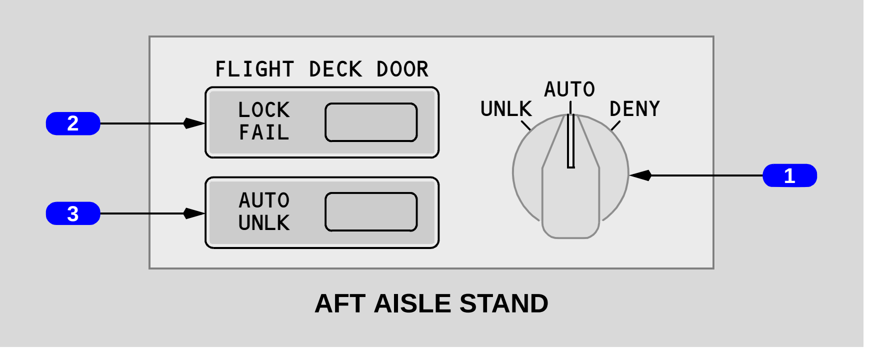
2 **Indicator Lights**

Illuminated (red) - door locked, or if door open it will lock when closed.

Illuminated (amber) - correct emergency access code entered.

Illuminated (green) - door unlocked.

Flight Deck Door Lock Panel



1 Door Lock Selector

Spring loaded to AUTO. Selector must be pushed in to rotate from AUTO to UNLK position. Selector must not be pushed in to rotate from AUTO to DENY position.

UNLK - door unlocked while selector in UNLK.

AUTO - door locked. Allows door to unlock after entry of emergency access code and expiration of access time delay (30 seconds), unless crew takes action.

DENY - rejects keypad entry request and prevents further emergency access code entry for 5 minutes (deny time delay).

2 LOCK FAIL Light

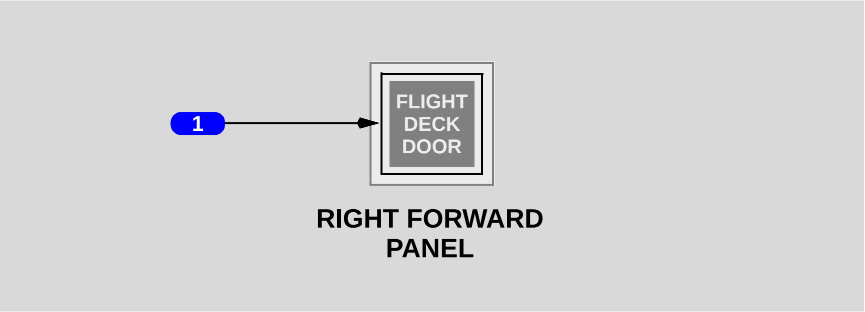
Illuminated (amber steady) - Door Lock selector in AUTO position and door is unlocked due to incomplete solenoid catch engagement.

Illuminated (amber flashing) - Door Lock selector in AUTO position and door is unlocked due to failure of both door lock solenoids.

3 AUTO UNLK Light

Illuminated (amber flashing) - correct emergency access code entered in keypad. AUTO UNLK light flashes and continuous door horn sounds before expiration of access time delay (30 seconds) and door unlocks.

Flight Deck Door Master Caution Light



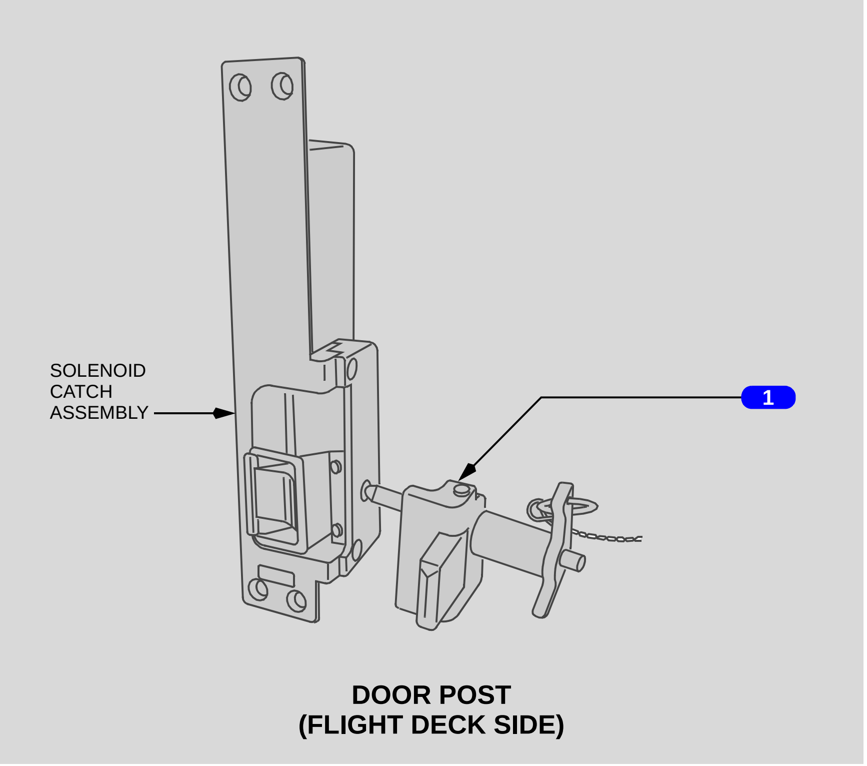
1 FLIGHT DECK DOOR Light

Illuminated (amber steady) - LOCK FAIL light illuminated steady.

Illuminated (amber flashing) - LOCK FAIL or AUTO UNLOCK light illuminated flashing.

Note: The FLIGHT DECK DOOR light serves as a master caution light for the flight deck door access system.

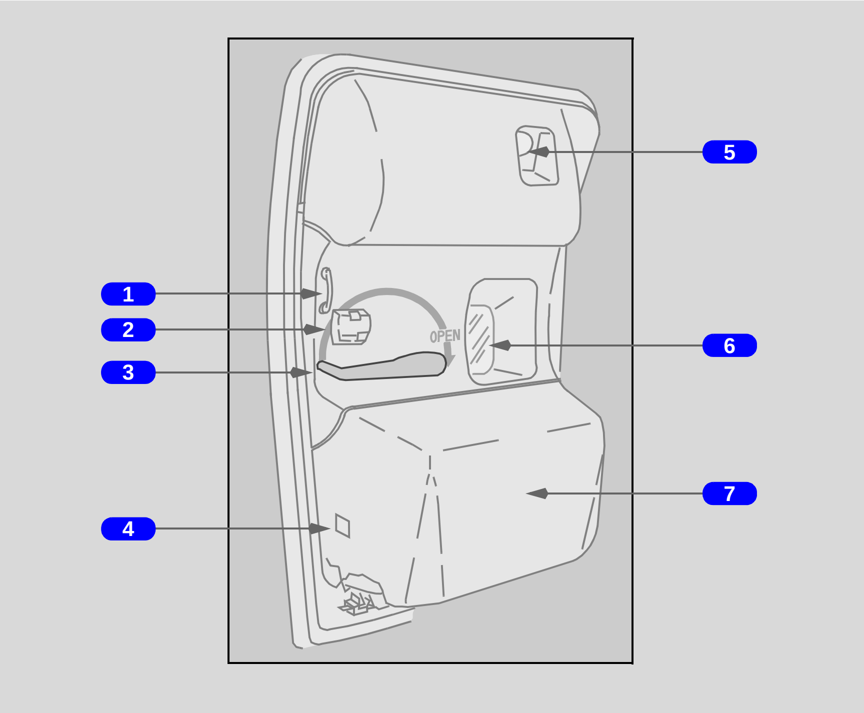
Mechanical Catch Pin Lock



1 Catch Pin Lock

When inserted into a hole on the solenoid catch assembly, the Catch Pin Lock provides a mechanical means to lock the flight deck door when both door lock solenoids fail.

Passenger Entry Doors



1 Door Assist Handle

Allows manual assistance of door-opening motion.

2 Door Mode Select Panel

See following graphic.

3 Door Operating Handle

To open the door - rotate in the direction of arrow.

To close the door - rotate in the opposite direction of arrow.

4 Slide/Raft Gas Bottle Pressure Gage

Maintenance use only.

5 Escape Slide Lamp

Illuminates escape slide if door opened in automatic mode.

6 **Viewing Window**

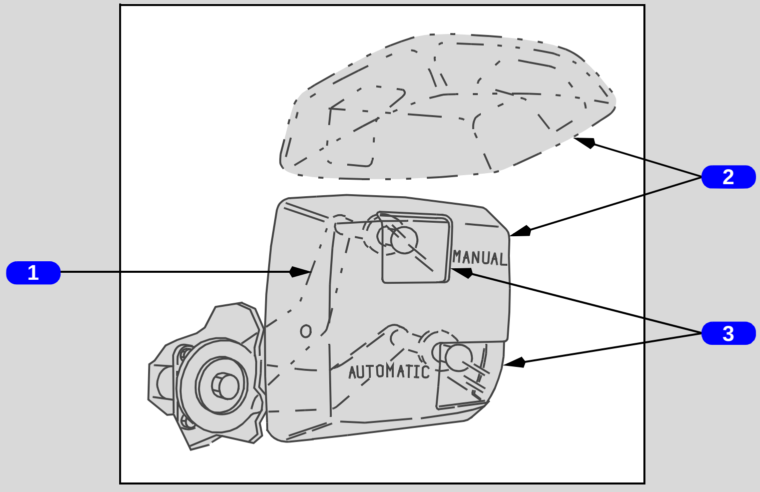
Allows observation outside the airplane.

7 **Slide/Raft Bustle**

Bustle contains the slide/raft.

Door Mode Select Panel

When door is opened from outside, door mode select lever moves to MANUAL. Lockout pin with warning flag may be installed. Lockout pin prevents handle movement from MANUAL.



DOOR

1 **Door Mode Select Lever**

AUTOMATIC - if door operating handle moved to open position, door is powered open, and slide/raft deploys.

MANUAL - disables power assist door opening and automatic slide/raft deployment.

2 **Access Cover**

Open - allows access to door mode select lever.

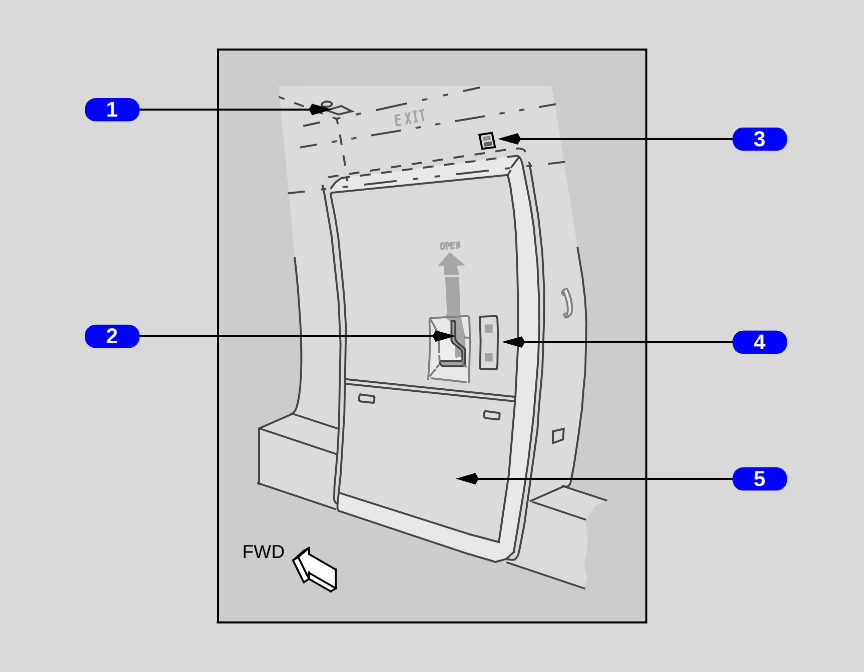
Closed - allows verification of door mode select lever position.

3 Clear Plastic Viewports

AUTOMATIC - knob visible in viewport verifies automatic mode armed.

MANUAL - knob visible in viewport verifies manual mode selected.

Upper Deck Emergency Doors



1 Door Operating Gas Bottle Pressure Gage

If gage needle is below green zone, system is unusable.

2 Door Operating Handle

OPEN -

- unlatches door and permits opening
- deploys slide with door mode select lever in AUTOMATIC

Down - closes door and engages latches.

3 Door Ground Mode Light/Battery Test Panel

See following graphic.

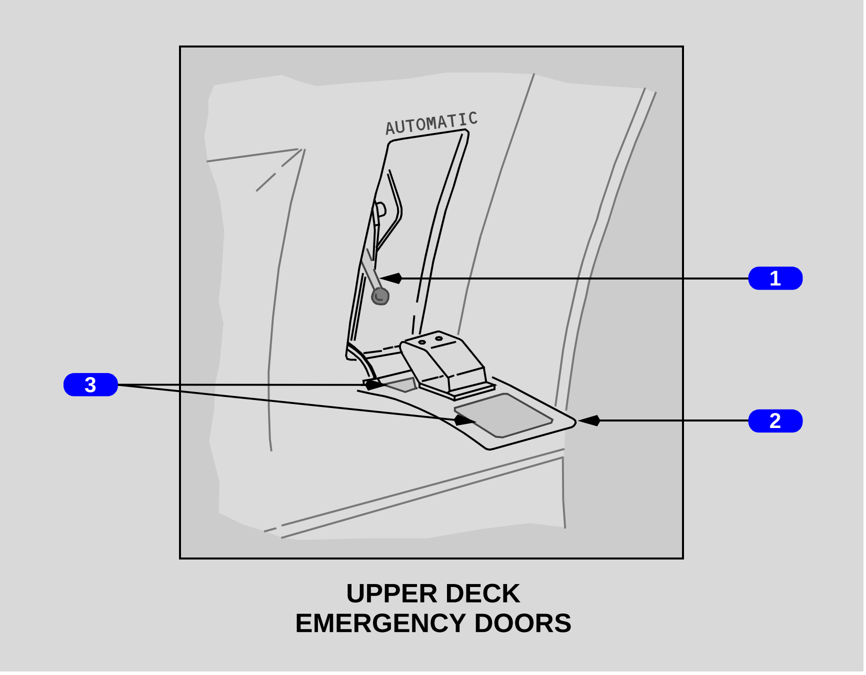
4 Door Mode Select Lever

See following graphic.

5 **Escape Slide Pack**

- pressure in slide inflation bottles checked by maintenance
- rotates through the door opening when door is opened with door mode select lever in AUTOMATIC

Upper Deck Emergency Door Mode Select Panel



1 **Door Mode Select Lever**

AUTOMATIC - if door operating handle moved to open position, door is powered open, and slide/raft deploys.

MANUAL - disables power assist door opening and automatic slide/raft deployment.

2 **Access Cover**

Open - allows access to door mode select lever.

Closed - allows verification of door mode select lever position.

Cover will not close unless door mode select lever fully in MANUAL or AUTOMATIC position.

3 Clear Plastic Viewports

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
AUTOMATIC - knob visible in viewport verifies automatic mode armed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
AUTOMATIC -

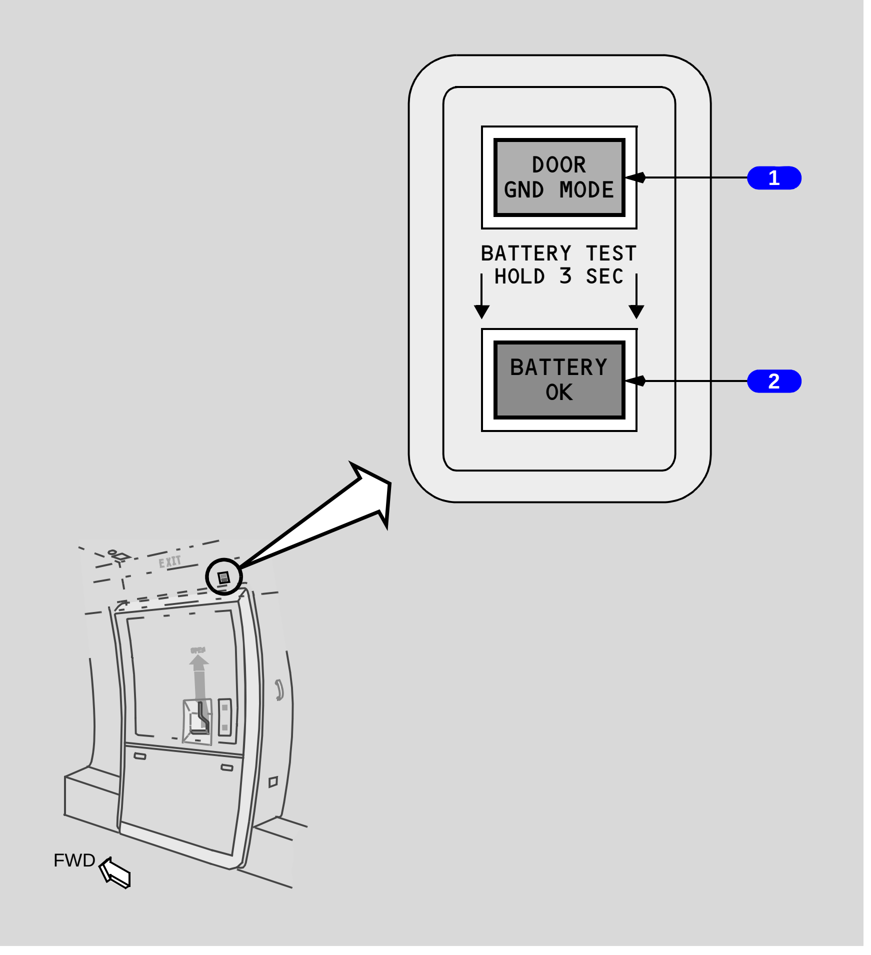
- knob visible in viewport verifies automatic mode armed
- red striping around automatic viewport

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
MANUAL - knob visible in viewport verifies manual mode selected.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
MANUAL -

- knob visible in viewport verifies manual mode selected
- green striping around manual viewport

Door Ground Mode/Battery OK Panel



1 DOOR Ground (GND) MODE Light

Illuminated (blue) - on ground or in flight when the flight lock mechanism is not in the locked position.

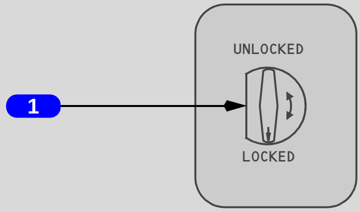
2 BATTERY OK Test Switch/Light

Push -

Illuminated (green) - battery charge is sufficient for door operation.

Note: Light must be pushed and held for 3 - 5 seconds before it will illuminate.

Overhead Escape Hatch Handle



INTERIOR VIEW

1 Overhead Escape Hatch Handle

Rotate handle to unlock hatch.

Pull hatch inward.

Intentionally
Blank

Introduction

This chapter describes miscellaneous airplane systems, including:

- lighting systems
- oxygen systems
- emergency equipment
- doors
- flight deck seats

Lighting Systems

Lighting systems described in this chapter include:

- exterior lighting
- flight deck lighting
- passenger signs
- emergency lighting

Exterior Lighting

Exterior lighting consists of these lights:

- landing
- runway turnoff

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- taxi
- strobe
- beacon
- navigation (position)
- logo
- wing leading edge illumination
- escape slide emergency lights

Landing Lights

Two landing lights are installed in the leading edge of each wing.

The landing lights are maximum brightness with the Landing Gear lever DOWN and the Landing Light switches ON. With the Landing Light switches ON and the Landing Gear lever not in the DOWN position, the landing lights are dimmed.

Runway Turnoff Lights

Two runway turnoff lights are mounted on the nose gear structure and are aimed approximately 65 degrees to left and right of the airplane center line. The runway turnoff lights illuminate only when the air/ground sensing system is in ground mode.

Taxi Lights

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Taxi lights are installed on the nose landing gear. The taxi lights illuminate only when the air/ground sensing system is in the ground mode.

Strobe Lights

The strobe lights are white anticollision strobe lights located on each forward wing tip and on the tail cone.

Beacon Lights

The beacon lights are red anticollision strobe lights located on the top and bottom of the fuselage.

Navigation Lights

The navigation lights are standard red (left forward wingtip), green (right forward wingtip), and white (tail cone) position lights.

Logo Lights

Logo lights are located on the stabilizer to illuminate the airline logo on the vertical tail surface.

Wing Lights

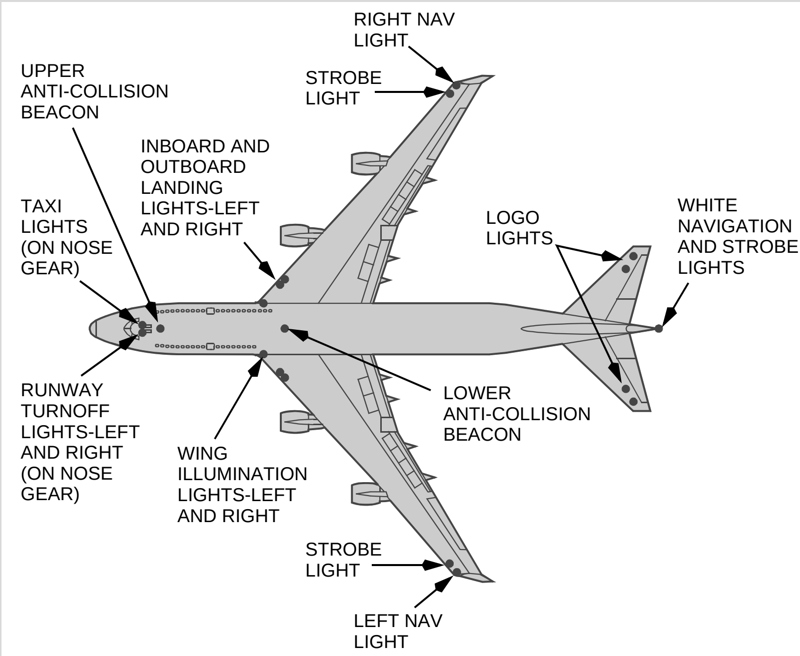
Wing lights are installed on the fuselage and illuminate the wings and engine nacelles.

Service Lights

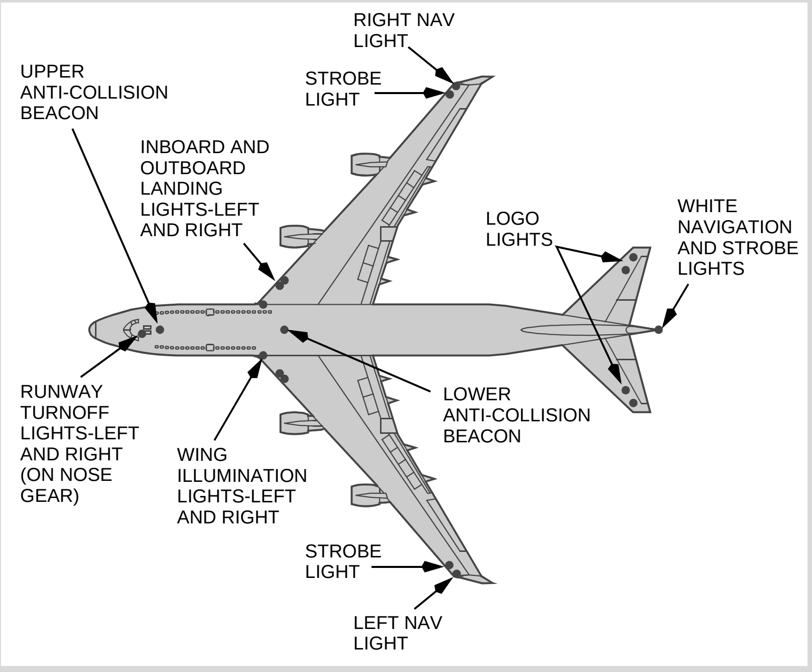
Service lights are located at various work areas, such as the wheel wells. Switches for these lights are located at the individual service areas.

Exterior Lighting Locations

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



Flight Deck Lighting

Flight deck lighting provides panel illumination, area lighting, and localized illumination. Flood lights and light plates provide panel illumination. Dome lights provide flight deck area lighting. A chart light and a utility light for each pilot, and map lights provide localized illumination.

Panel and flood lights illuminate the forward panels, glareshield, and aisle stand panels. When the Storm Light switch is on, the left and right forward panel flood lights, glare shield flood lights, dome lights and aisle stand flood light illuminate at full brightness.

If normal electrical power is lost, the flood lights operate from standby electrical power. If normal power is lost to aisle stand integral panel lights, the aisle stand flood light illuminates at a reduced intensity.

Passenger Signs

The passenger signs are controlled by selectors on the aisle stand and illuminate when the following conditions are satisfied:

FASTEN SEAT BELTS signs (AUTO selected):

- landing gear not up and locked or
- flap lever not up, or
- airplane altitude below 10,300 feet, or
- cabin altitude above 10,000 feet, or
- passenger oxygen on

NO SMOKING signs (AUTO selected):

- landing gear not up and locked, or
- cabin altitude above 10,000 feet, or
- passenger oxygen on.

All signs can be controlled manually by positioning the respective selector to ON or OFF. When the SEATBELTS and NO SMOKING selectors are in OFF position, and oxygen is ON, the FASTEN SEAT BELTS and NO SMOKING signs illuminate.

RETURN TO SEAT signs illuminate with the FASTEN SEAT BELTS signs, except when oxygen is deployed.

The memo message SEATBELTS ON displays when FASTEN SEAT BELTS signs are manually selected ON.

EI-XLF, EI-XLG, EI-XLI, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
The memo message NO SMOKING ON displays when NO SMOKING signs are manually selected ON.

EI-XLF, EI-XLG, EI-XLI, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
When FASTEN SEAT BELTS signs and NO SMOKING signs are both selected ON, the memo message PASS SIGNS ON displays, and memo messages SEATBELTS ON and NO SMOKING ON are inhibited.

When the passenger signs illuminate or extinguish, a low tone sounds over the PA system.

Emergency Lighting

Interior emergency lighting consists of door, aisle, cross-aisle, escape path, and exit lights, and luminescent exit signs.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Escape path lighting consists of floor mounted locator lights spaced at intervals in the aisles, cross-aisles, and stairway.

VQ-BHW, VQ-BHX

Escape path lighting consists of locator lights installed in selected passenger seat armrests, and on galleys, lavatories, closets and panels. Locator lights are spaced at intervals along the aisles, cross-aisles, and stairway.

Additional battery powered exit identifier lights are located at each cabin exit.

When illuminated, the escape path lighting provides visual guidance for emergency evacuation if all sources of cabin lighting more than four feet above the aisle floor are obscured by smoke.

Exterior emergency lighting consists of escape slide and overwing lights.

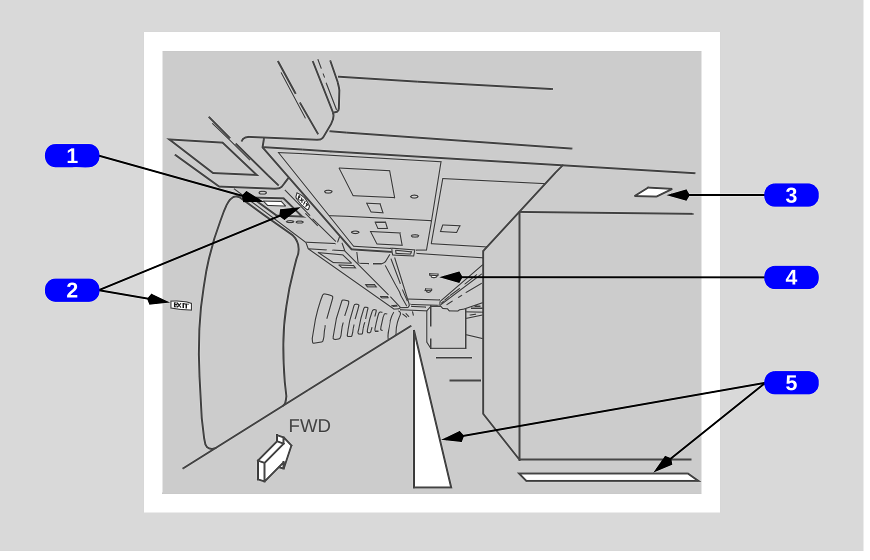
Emergency lighting is controlled by the Emergency Lights switch on the overhead panel. The switch can be used to manually activate or arm the system for automatic operation. Automatic operation occurs if DC power fails or is turned off when the system is armed. The emergency lighting system can also be controlled by the Emergency Lights switch on the main flight attendant switch panel.

The emergency lighting system is powered by remote batteries. Battery charge is maintained by DC bus 4. A fully charged battery provides at least 15 minutes of operation.

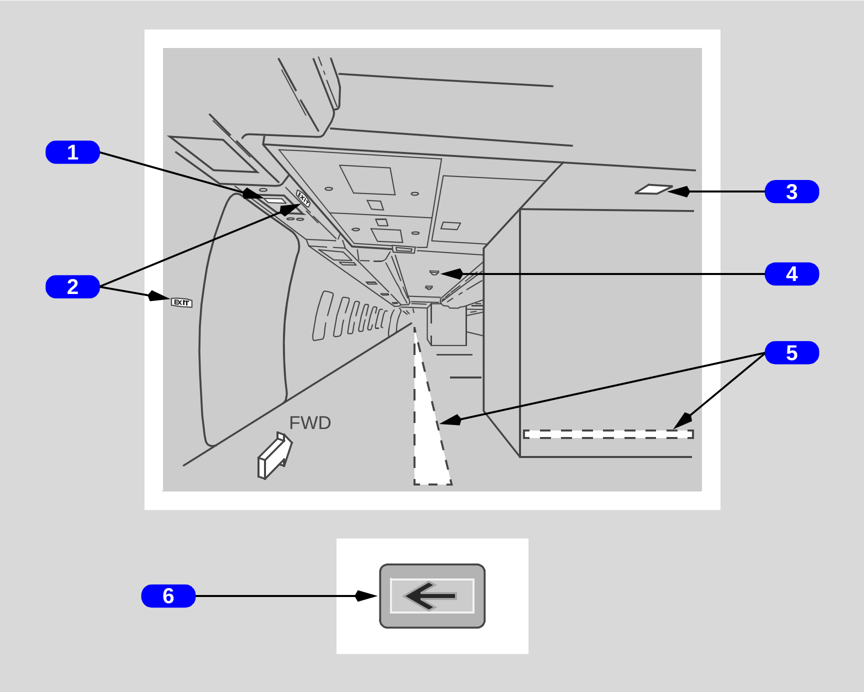
Interior Emergency Lighting Locations

All Emergency lights and EXIT signs are powered by remote NiCad batteries and are controlled by the Emergency Lights switch.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX



1 **Emergency Door Light**

2 **EXIT Signs**

3 **Emergency Cross Aisle Light**

4 **Emergency Aisle Lights**

5 **Emergency Escape Path Lighting**

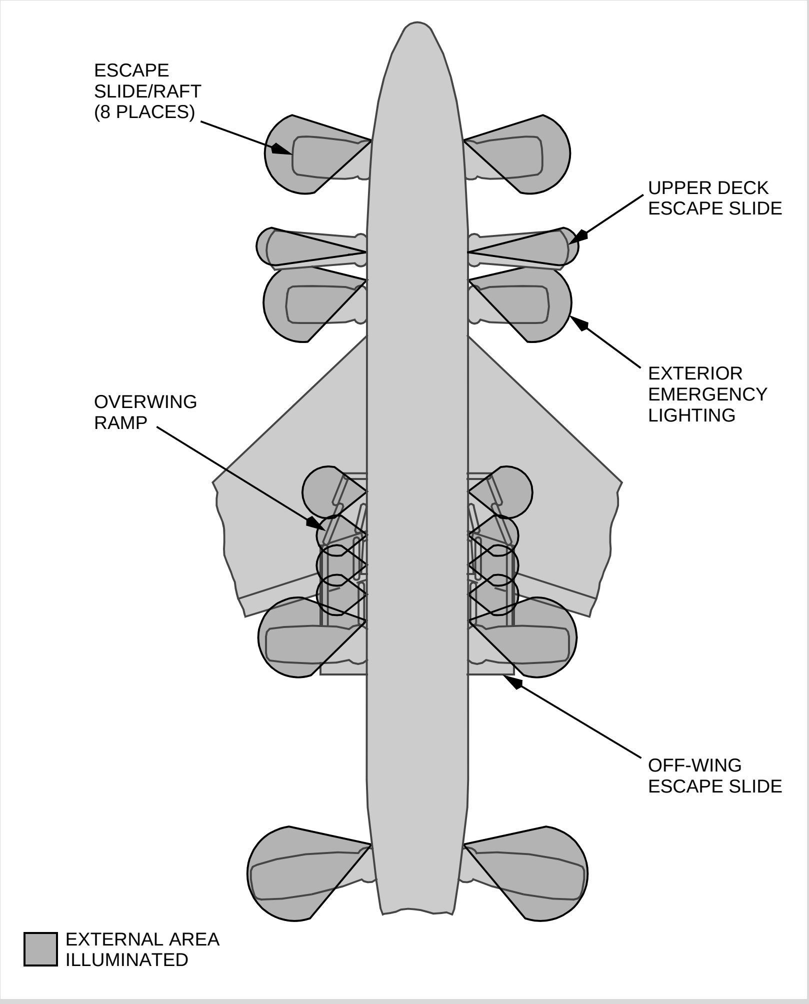
VQ-BHW, VQ-BHX

6 **Arrows**

Installed on lower side of selected seats, galleys, and lavatories.

Installed on lower side of selected seats.

Exterior Emergency Lighting Locations



Oxygen Systems

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Two independent oxygen systems are provided, one for the flight crew and one for the passengers. Portable oxygen cylinders are located in the passenger cabin for emergency use.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Two independent oxygen systems are provided, one for the flight crew and one for the passengers. Portable oxygen cylinders are located in the flight deck and passenger cabin for emergency use.

Oxygen pressure displays on the EICAS STATUS page.

Flight Crew Oxygen System

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
The flight crew oxygen system uses quick-donning diluter-demand masks located at each crew station. Oxygen flow is controlled by a regulator mounted on each mask.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
The flight crew oxygen system uses quick-donning diluter-demand masks located at each crew station. Oxygen flow is controlled by a regulator mounted on each mask. The Captain and First Officer have full face masks with automatic pressure breathing regulators.

During the preflight check of the crew oxygen mask, a pressure decrease may indicate the crew oxygen cylinder shutoff valve is closed, and oxygen is unavailable.

Squeezing the red release levers with the thumb and forefinger allows the mask to be removed from stowage, inflates the mask harness and momentarily displays the yellow cross in the flow indicator. Releasing the levers after placing the mask over the head deflates the mask harness, fitting it securely to the head and face.

When the left-hand door to the mask stowage box is opened, the mask microphone activates in the removed mask.

An OXYGEN ON flag appears in the mask compartment near the left-hand door of the stowage box, indicating the oxygen supply valve is open. The oxygen system is shut off by closing the left-hand door of the stowage box and pushing and releasing the RESET/TEST switch. This action shuts off oxygen to the mask, stows the flag, deactivates the mask microphone, and activates the boom microphone. The oxygen system can be reactivated by opening the left-hand door of the stowage box.

Passenger Oxygen System

The passenger oxygen system is supplied by bottled gaseous oxygen. The oxygen bottles provide oxygen to the passenger, attendant station, and lavatory service units. The passenger oxygen masks are located above the passenger seats in passenger service units (PSUs). The masks automatically drop from the PSUs if cabin altitude exceeds approximately 14,000 feet. Passenger oxygen masks can be manually deployed from the flight deck by positioning the overhead panel Passenger Oxygen switch to ON position.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Oxygen flow to a mask begins immediately when the mask drops.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Oxygen flow to a mask begins when the mask is pulled down.

Oxygen flow can be reset by selecting the Passenger Oxygen switch to RESET position.

Passenger oxygen pressure displays on the EICAS STATUS page.

Portable Oxygen Bottles

Portable oxygen bottles are stowed in various locations in the passenger cabin. The bottles are fitted with disposable masks and are used for first aid purposes or as walk-around units. All bottles are identical in size and capacity.

Video Control Center

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; system installed by STC)

The Video Control Center installed in the passenger cabin includes equipment for playback of audio and video entertainment media, system management and interface units, and air distribution and temperature control systems. An audio-video on-demand server rack (ASR) is also installed. Power to the VCC, ASR, and IFE system is manually controlled by the VCC COMPT POWER switch on the flight deck overhead panel or Master IFE switch on the VCC control panel. Power is automatically shut off by smoke detection or no-airflow sensing systems.

Emergency Equipment Overview

This section describes the emergency equipment located throughout the airplane, including:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ (EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs emergency evacuation panel)

- emergency evacuation signal system
- emergency locator transmitters (ELTs)
- fire extinguishers
- emergency equipment locations

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

- Lavatory Door Hooks

Emergency Evacuation Signal System

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ (EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs emergency evacuation panel)

An Emergency Evacuation Signal switch is located in the flight deck and at all attendant stations. The flight deck Command switch positions are OFF, ARM, and ON.

In the OFF position, activation of the evacuation signal is inhibited at all attendant panels.

In the ARM position, the system may be activated by the Evacuation Signal Command Switch at any attendant panel or the flight deck panel.

In the ON position, a flashing amber light illuminates and a pulsating audio horn sounds at all stations.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs emergency evacuation panel)

The emergency evacuation signal system alerts the flight attendants to evacuate the passenger cabin.

An Emergency Evacuation Signal command switch is located in the flight deck and at the door 2L attendant station. Evacuation system panels, with evacuation horn and light, are located at the door 4L attendant station and the upper deck right door attendant station. The flight deck evacuation signal COMMAND switch positions are OFF, ARM, and ON.

Placing the flight deck evacuation signal COMMAND switch to ON activates the evacuation signals on the flight deck panel and on the flight attendant panels. With the flight deck evacuation signal COMMAND switch in ARM, pressing the EVAC COMMAND switch on the door 2L flight attendant panel activates the evacuation signals on the flight deck and on the flight attendant panels.

Fire Extinguishers

Water Fire Extinguishers

Water fire extinguishers contain a solution of water mixed with antifreeze. Water fire extinguishers are to be used on fabric or paper fires only. They are not to be used on electrical or grease fires.

To use the water fire extinguisher, remove it from stowage and rotate the handle fully clockwise. Aim the nozzle at the base of the fire and press the trigger.

WARNING: Antifreeze compound has been added to the water which makes it unfit for drinking.

CAUTION: Do not use on electrical or grease-type fires.

Halon Fire Extinguishers

Halon fire extinguishers contain a liquefied gas agent under pressure. The extinguisher pressure indicator shows three pressure ranges:

- acceptable
- recharge
- overcharged

A safety pin with a pull ring prevents accidental trigger movement. When released, the liquefied gas agent vaporizes and extinguishes the fire. The extinguisher is effective on all types of fires, but is used primarily on electrical, fuel, and grease fires.

Direction for use of the fire extinguisher is printed on the extinguisher.

WARNING: If a halon fire extinguisher is to be discharged in the flight deck area, all flight crew members must wear oxygen masks and use 100% oxygen with emergency selected.

CAUTION: For electrical fires, remove the power source as soon as possible. Avoid discharging directly on persons due to possibility of suffocating effects. Do not discharge too close to fire as the discharge stream may scatter the fire. As with any fire, keep away from the fuel source. Avoid breathing vapors, fumes, and heated smoke as much as possible.

Miscellaneous Emergency Equipment

Additional emergency equipment is stowed at strategic locations throughout the airplane as shown in the Emergency Equipment diagram.

Lavatory Door Hooks

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

The forward upper deck lavatory has rotating door hooks installed at the bottom of the bifold door. With the lavatory door hooks in the down position, the lavatory door remains intact during depressurization. The door hooks must be in down position for the lavatory located forward of the flight deck door.

Emergency Locator Transmitter (ELT)

Passenger Cabin

On the passenger airplane, emergency locator transmitters (ELTs) are installed:

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
- 1 ELT - door 1L
- 1 ELT - door 2L
- 1 ELT - door 4R

Note: ELTs installed in slide/rafts transmit when the slide/raft is deployed into water.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
- 1 ELT - door 1L
- 1 ELT - door 1R
- 1 ELT - door 4L
- 1 ELT - door 4R

Note: ELTs installed in slide/rafts transmit when the slide/raft is deployed into water.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- 1 ELT - door 2L
- 1 ELT - door 2R
- 1 ELT - door 4L
- 1 ELT - door 4R

Note: ELTs installed in slide/rafts transmit when the slide/raft is deployed into water.

Fuselage Mounted Emergency Locator Transmitter

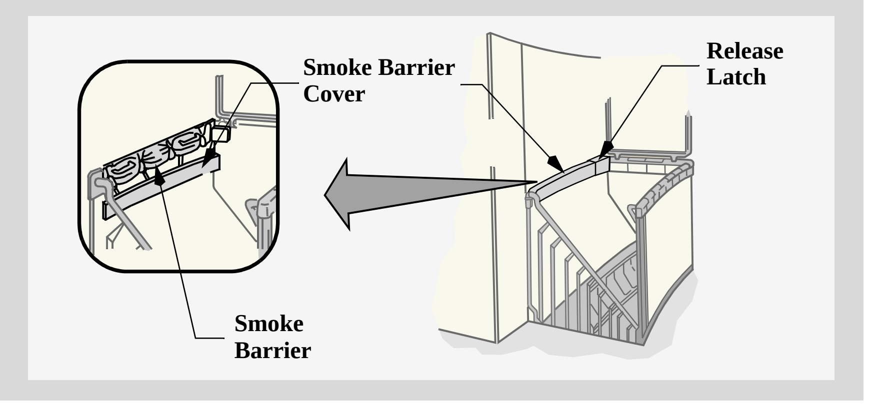
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
A fixed emergency locator transmitter is installed forward of Door 5. The ELT activates by high deceleration forces or when the ELT switch is ON. The ELT can be deactivated by moving the ELT switch to RESET momentarily, then ARMED.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
A fixed emergency locator transmitter is installed forward of Door 5. The ELT activates by high deceleration forces or when the ELT switch is ON. The ELT can be deactivated by moving the ELT switch to RESET momentarily (between 1 and 3 seconds), then ARMED.

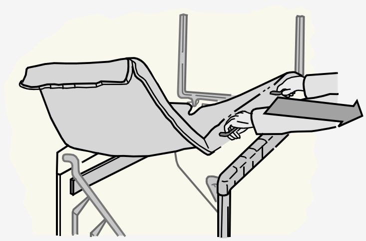
Smoke Barrier

A smoke barrier is installed at the top of the stairs on the upper deck. The smoke barrier may be used on the ground to prevent smoke migration by covering the stairwell between the main deck and the upper deck.

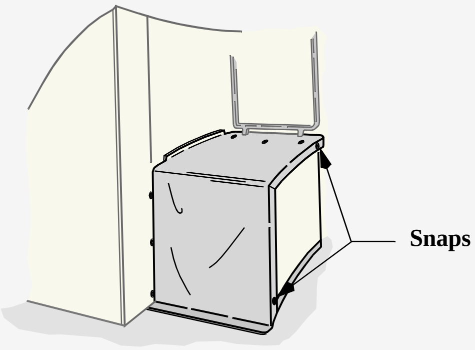


To deploy the smoke barrier:

- pull latch release
    - allows cover to fall free and expose the smoke barrier



- insert fingers in barrier loops
- pull barrier toward railing



- drape barrier over railing
- engage snaps along top of stairwell and railing sides
- press flap at bottom of barrier against carpet
    - ensures good contact between velcro flap and carpet.

WARNING: The smoke barrier is for ground use only.

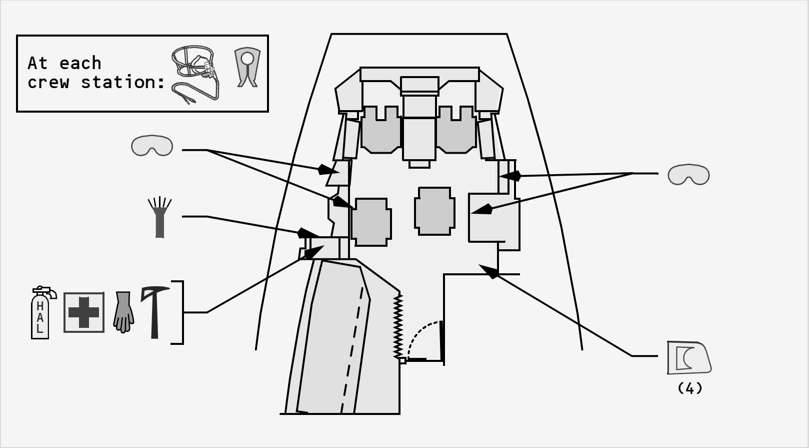
Note: The smoke barrier is used on the ground to prevent smoke from rising up the stairway into the upper deck area. In flight, normal airplane ventilation minimizes smoke migration into the upper deck area.

Emergency Equipment Symbols

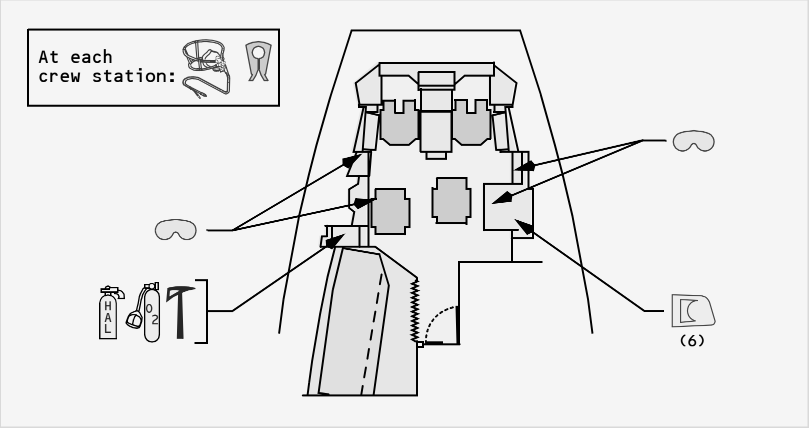
NOTE: Some symbols do not apply to all configurations.

Emergency Equipment
Flight Deck

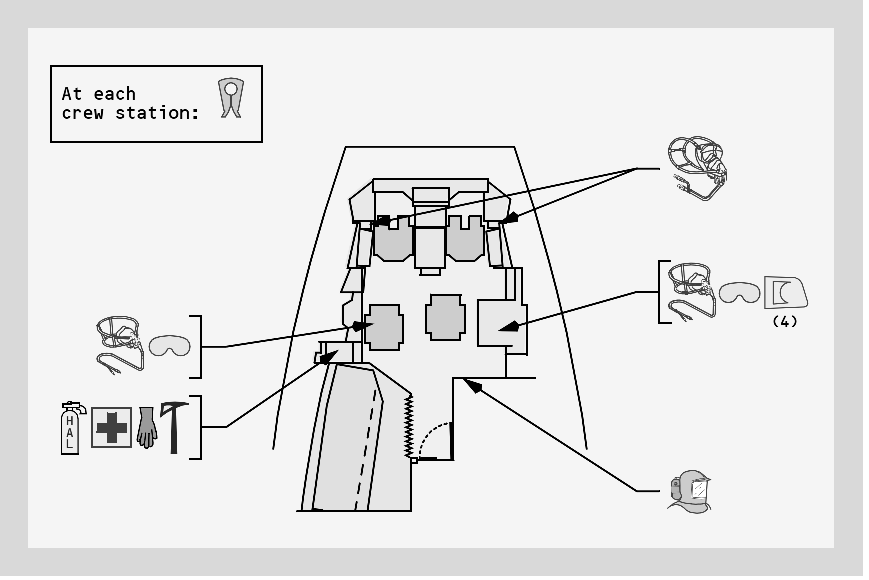
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

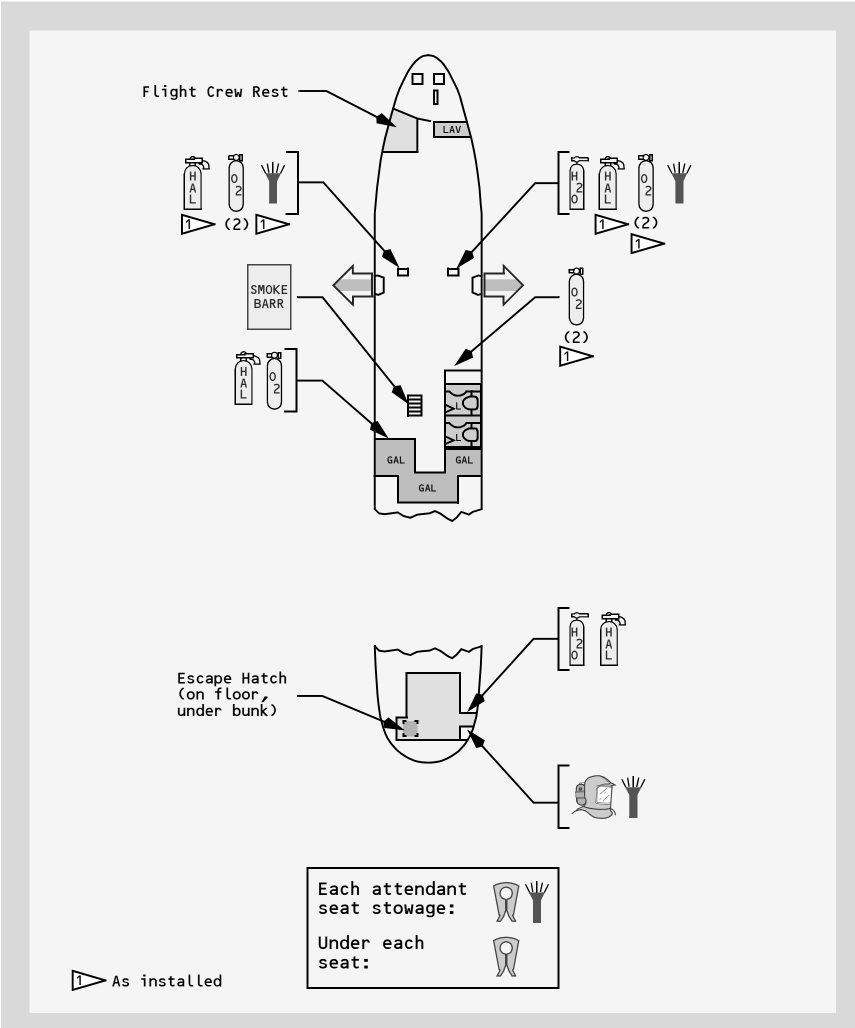


EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

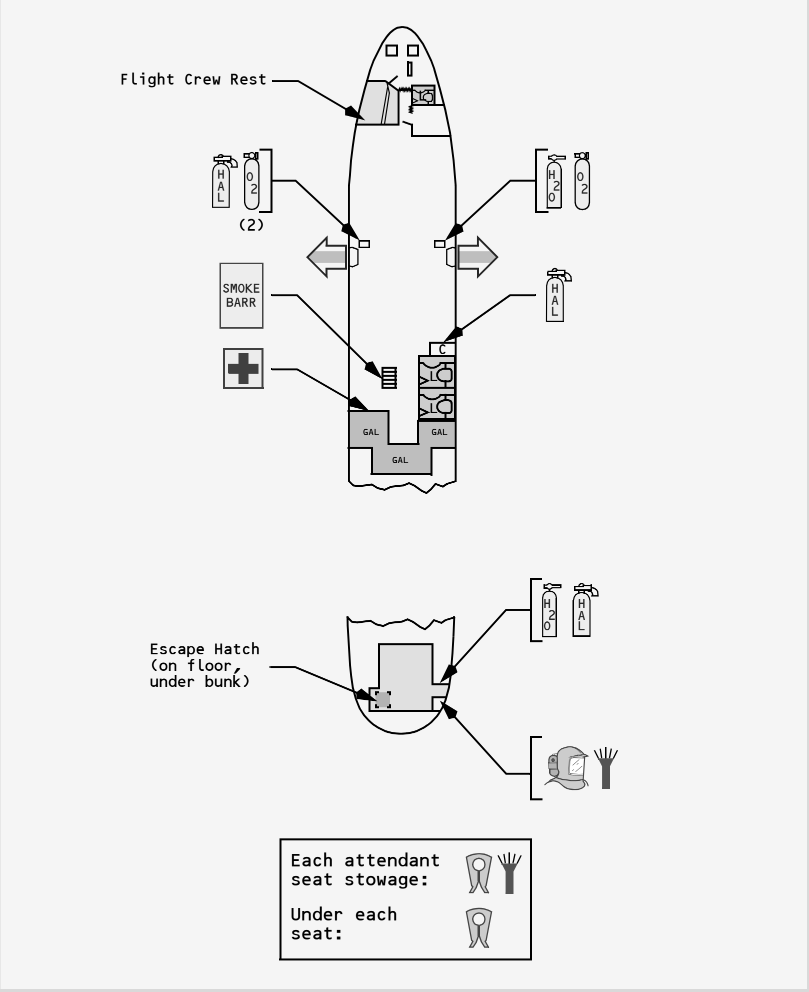


Upper Deck/Door 5 Overhead Crew Rest

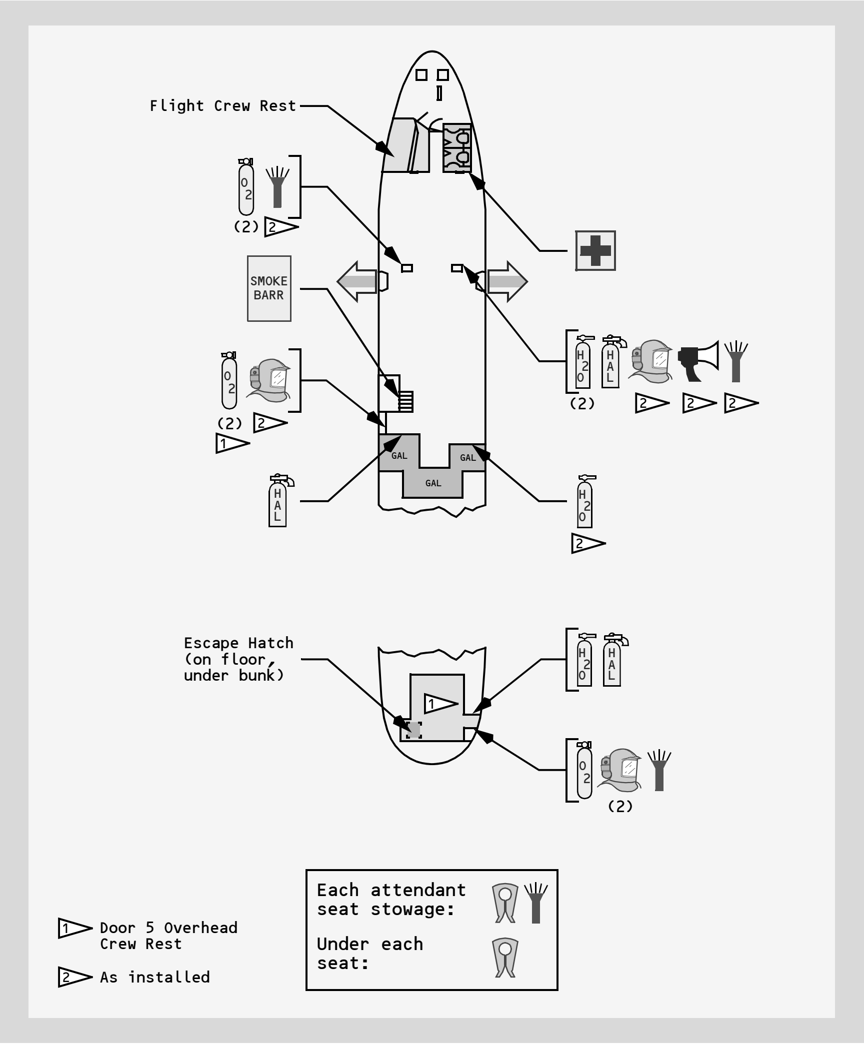
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



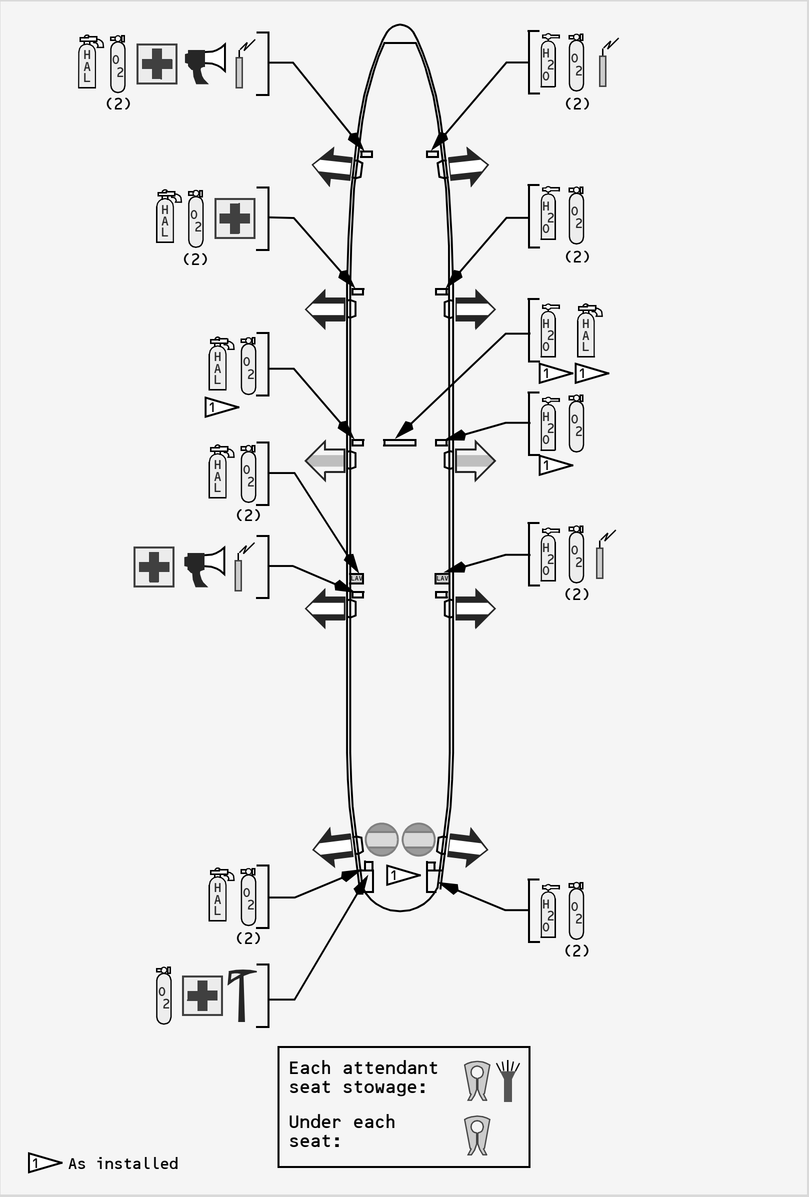
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



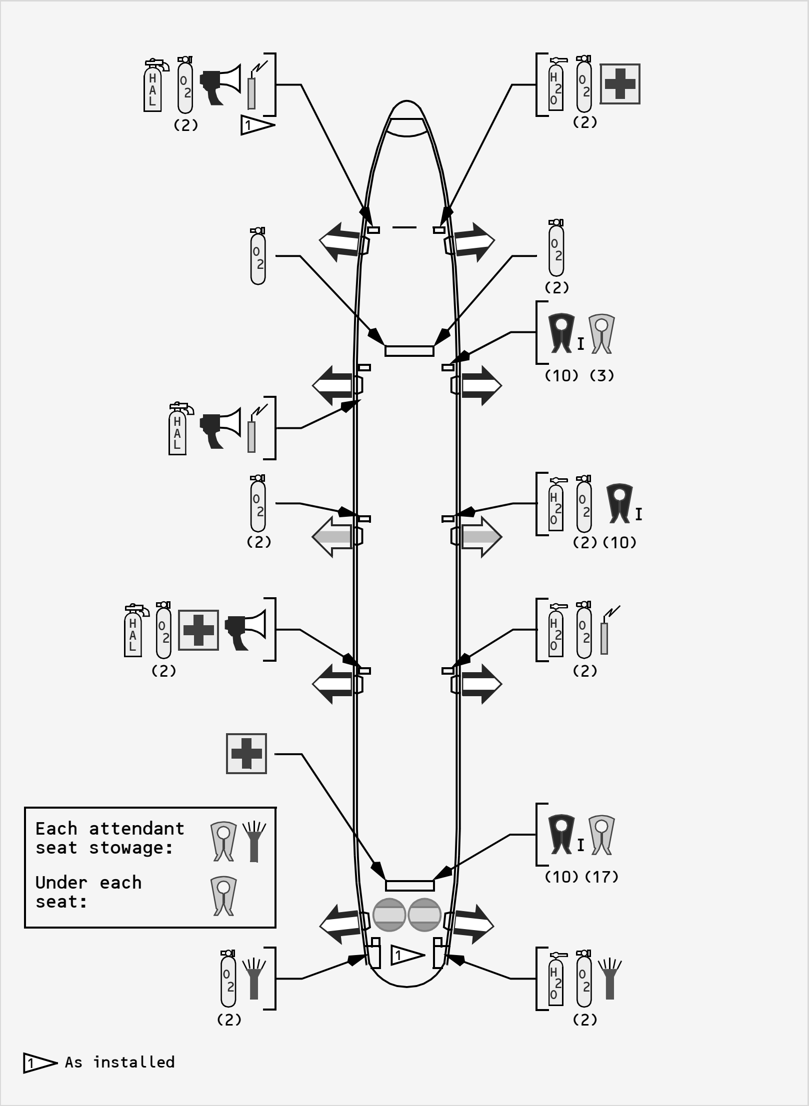
Note: Door 5 overhead crew rest installed.

Main Deck

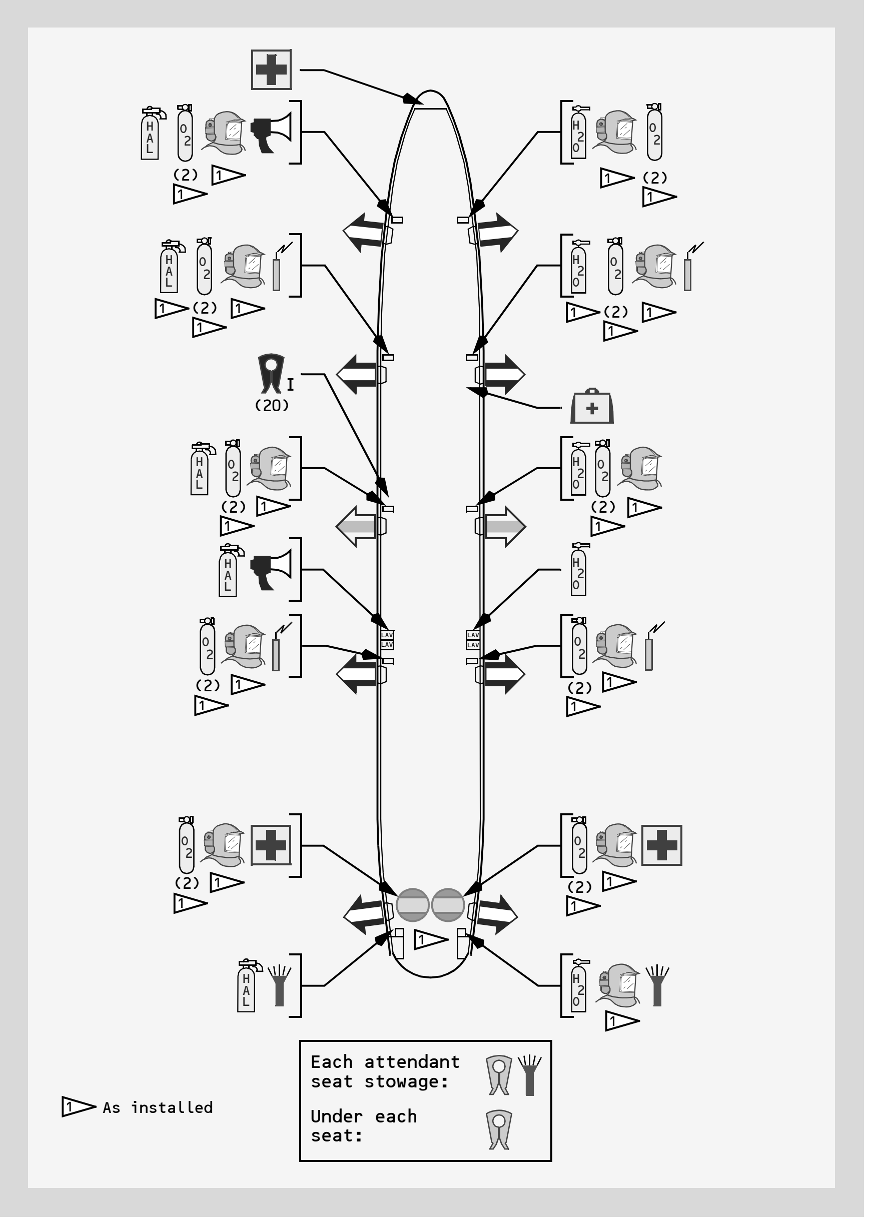
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

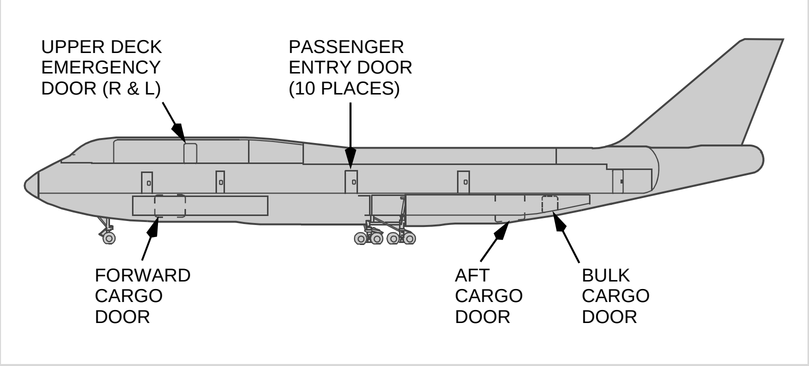


Doors

The airplane has ten main deck passenger entry doors, one flight deck door (the flight deck/passenger cabin entry), two upper deck emergency doors, and three cargo doors. It also has two electrical and electronic (E/E) equipment access doors.

CAUTION: Do not operate the entry or cargo doors with winds at the door of more than 40 knots. Do not keep doors open when wind gusts are more than 65 knots. Strong winds can cause damage to the structure of the airplane.

Door Locations



PASSENGER

Flight Deck Door

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The flight deck door meets requirements for resistance to ballistic penetration and intruder entrance. The door opens into the flight deck. When closed, the door locks when electrical power is available and unlocks when electrical power is removed. A viewing lens in the door allows observation of the passenger cabin. The door can be manually opened from the flight deck by turning the door handle.

The door incorporates a deadbolt with a key lock. Rotating both concentric deadbolt levers to the locked (horizontal) position prevents the passenger cabin key from unlocking the door. Rotating only the forward deadbolt lever to locked allows the key to unlock the door.

The flight deck access system consists of an emergency access panel, a chime module, a Door Lock selector, two indicator lights, and an Access System switch. The emergency access panel includes a six button keypad for entering the numeric emergency access code along with red, amber, and green lights. The red light illuminates to indicate the door is locked. When the correct emergency access code is entered, the amber light illuminates. The green light illuminates to indicate the door is unlocked.

Two indicator lights and a three position rotary Door Lock selector are located on the aft aisle stand. Illumination of the amber LOCK FAIL light indicates the door lock has failed or the Access System switch is in the OFF position.

The emergency access code is used to gain access to the flight deck in case of pilot incapacitation. Annunciation of a flight deck chime and illumination of the amber AUTO UNLK light indicates the correct emergency access code has been entered and the door is programmed to unlock after a time delay. Selecting the DENY position on the Door Lock selector denies entry and prevents further keypad entry for several minutes. To allow entry, the selector is turned to the UNLKD position which unlocks the door while held in that position. If the emergency access code is entered and the pilot takes no action, the door unlocks after expiration of the time delay. Before the door unlocks, the chime sounds continuously and the AUTO UNLK light flashes.

By pressing "1" then "ENT" keys on the emergency access panel, the flight deck chime will sound (if programmed).

The door latch system incorporates a pressure rate-sensor that unlocks the door in the event of flight deck depressurization.

Flight Deck Door

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Supplied by JAMCO, the flight deck door meets requirements for resistance to ballistic penetration and intruder entrance.

A view port on the door allows observation of the passenger cabin.

The flight deck access system consists of the flight deck door lock panel on the aft aisle stand, the FLIGHT DECK DOOR master caution light on the first officer panel, a keypad on the door post at the cabin side, two speakers on the overhead maintenance panel, and a control box.

The flight deck door lock panel consists of a three-position rotary Door Lock selector and two indicator lights.

The keypad is made up of five numeric keys and an ENT key, along with three indicator lights in red, amber, and green. A pre-programmed emergency access code is entered on the keypad to gain access to the flight deck in case of pilot incapacitation. By pressing “1” and then “ENT” keys on the keypad, a two-beep chime will sound in the flight deck as a door bell to provide a means for requesting routine flight deck entry.

The Door Lock selector is spring-loaded to the AUTO position. With the selector in this position, the door locks automatically whenever it is closed and electrical power is available. Two solenoids, primary and secondary, operate a solenoid catch for locking/unlocking the door. Normally, only the primary solenoid works. When the primary solenoid fails, the secondary solenoid will take over the function automatically.

To unlock the door, the Door Lock selector must be held at the UNLK position. With the door unlocked, the door must be pushed from the cabin side to open it. The door opens into the flight deck. The door can also be opened at any time by simply turning the door knob from the flight deck. When electrical power is removed, the door unlocks.

Illumination of the red light on the keypad indicates the door is locked; or, if the door is open, it will lock when closed. When the correct emergency access code is entered, the amber light illuminates. The green light illuminates to indicate the door is unlocked.

A continuous door horn sounds, the amber AUTO UNLK and the amber FLIGHT DECK DOOR lights flash to alert the flight crew that the correct emergency access code has been entered. If the flight crew takes no action, the door will auto-unlock for five seconds after a 30 second time delay (i.e. access time delay).

Selecting DENY on the Door Lock selector denies entry and prevents further keypad entry for five minutes (i.e. deny time delay). At the same time, the horn is silenced, the AUTO UNLK and FLIGHT DECK DOOR lights extinguish. To allow entry, the selector can be turned to UNLK position, which unlocks the door while held in that position.

The amber LOCK FAIL light illuminates (steady) to indicate the door is not properly locked due to incomplete mechanical engagement of the solenoid catch. Pushing the door from the flight deck side to ensure the door is properly locked should extinguish the steady light. Illumination of the LOCK FAIL light (flashing) indicates failure of both solenoids and the door unlocks. When the LOCK FAIL light illuminates, the FLIGHT DECK DOOR light will also illuminate (steady or flashing accordingly). A single solenoid failure is not indicated to the flight crew.

The dual speaker system generates the emergency access continuous door horn and the door bell chime. Green lights on the speaker panel illuminate when the speakers are activated.

The door latch system incorporates a pressure sensor that unlocks the door if the flight deck depressurizes. The door will open to equalize pressure.

The mechanical catch pin lock, stowed in and attached to a pouch located next to the door post at the flight deck side, provides an alternate means to lock the door when the automatic locking system fails (i.e. both solenoids fail). The catch pin lock is installed by inserting it into a hole on the door post (See Figure 1). An installed catch pin lock will not prevent the door from being unlocked and opened in the event of flight deck depressurization. With the catch pin installed, the door can still be opened by turning the door knob from the flight deck side to allow emergency egress.

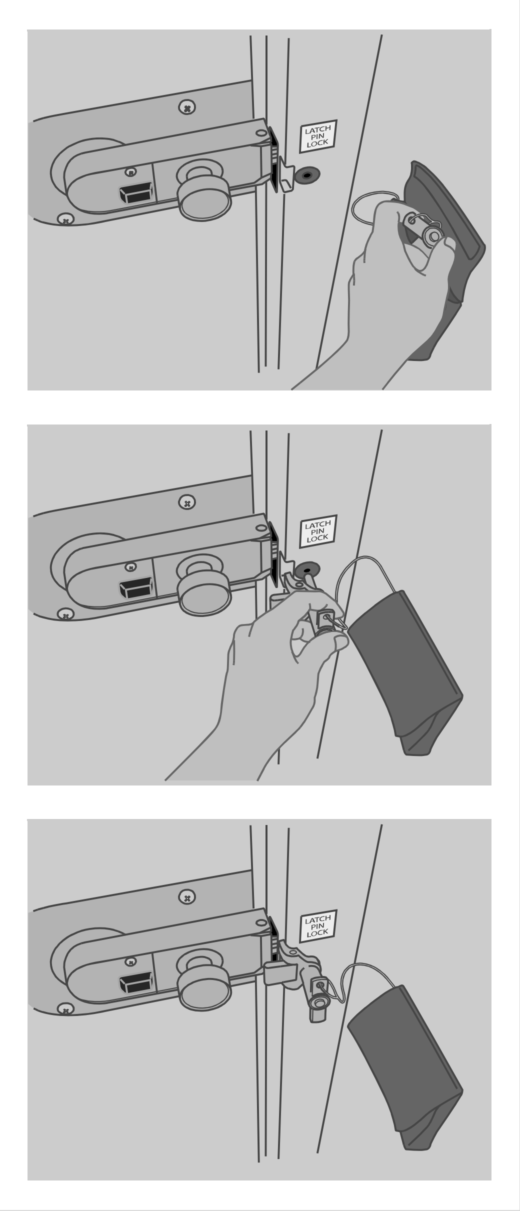


FIGURE 1

The door incorporates a dead bolt with a key lock. The primary purpose of the dead bolt is to allow the flight deck to be locked with key on the cabin side when power to the door is not available (e.g. overnight security). Locking the dead bolt on the flight deck side prevents the key from unlocking the door. The key is not kept on board, nor is it issued to the crew.

Features are included to enable egress during door jamming condition:

- If the door is jammed, it can be opened by pushing a manual release button, which is guarded by a red metal cover next to the door knob. This action allows the entire latch assembly to swing outwards, thereby releasing the latch bolt from the solenoid catch and enabling the door to open (See Figure 2).

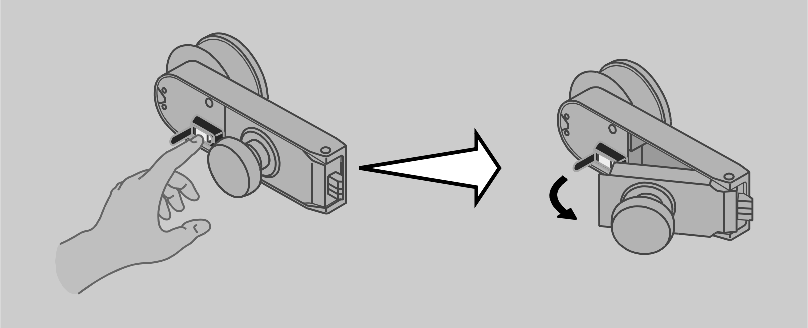


FIGURE 2

- If the door still cannot be opened, both the upper and lower hinge pins can be retracted to remove the entire door assembly from the door support structure (See Figure 3). The canvas handle on the door can be used to assist in door removal

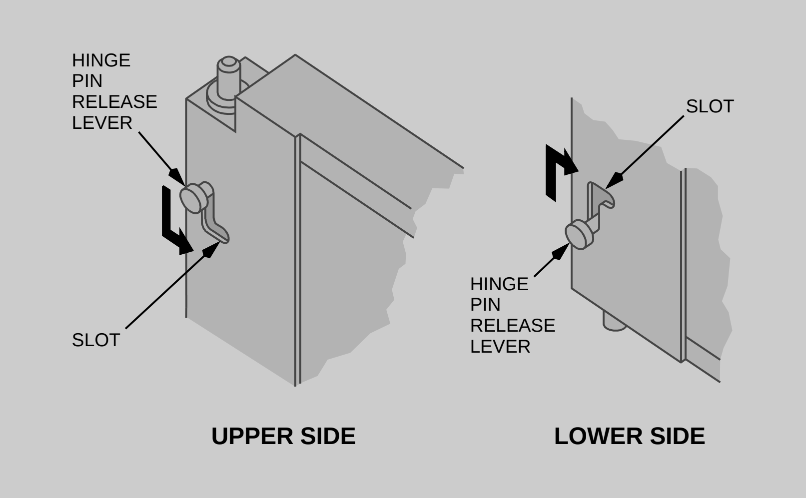


FIGURE 3

Passenger Entry Doors

The main deck passenger entry doors are used to enter and exit the airplane, and serve as emergency exits. The ten passenger entry doors are paired along the airplane fuselage. The doors are identified 1 through 5 left, and 1 through 5 right. The passenger entry doors can be opened or closed manually from inside or outside of the airplane.

The entry doors are translating, plug-type doors. During opening, the door first moves inward and upward, then translates outward and forward. Each door is held in the open position by a gust lock. The gust lock drops into a latch as the door nears its forward limit of travel. A window in each door allows observation outside the airplane.

Passenger Entry Door 1, 2, 4, and 5 Slide/Raft Operation

When the door mode select lever is in AUTOMATIC position and the door operating handle is rotated 180 degrees, the door begins to open and the power assist opening system activates.

The flight attendant must release the door operating handle and continue to assist the door opening motion by using the assist handles on the door and on the door surround panel until the door is in the full open and latched position. The door-mounted escape slide/raft deploys and inflates. If the slide/raft does not inflate automatically, pulling the manual inflation handle inflates the slide/raft.

When the door is to be opened from the interior and slide deployment is not desired, the door mode select lever must be in MANUAL position.

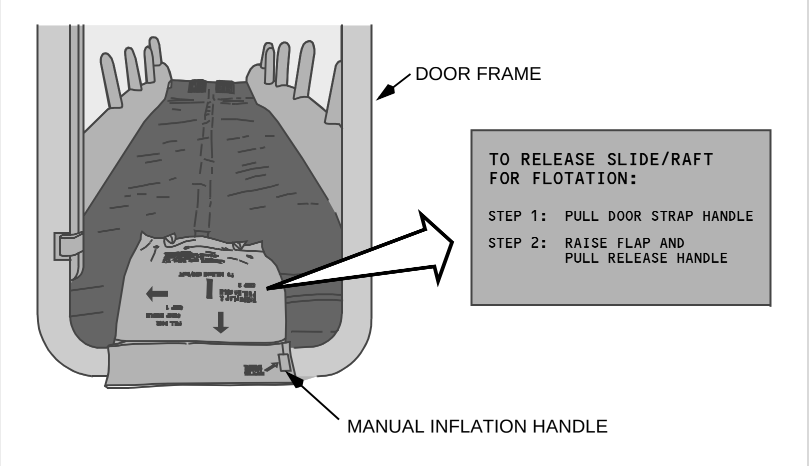
When the door mode select lever is in AUTOMATIC position and the door is opened using the exterior door handle, the door mode select lever mechanically positions to MANUAL and the door may be opened without slide deployment.

When the door is closed using either the exterior or interior door handles, the door mode select lever remains in MANUAL and must be positioned to AUTOMATIC to provide automatic slide deployment.

The door mode select lever should not be moved from MANUAL to AUTOMATIC or AUTOMATIC to MANUAL unless the door is fully closed.

Note: If both body gear are not extended, the airplane may tip tail down on the ground. Door 1 escape slides are then unusable.

Slide/Raft Deployed

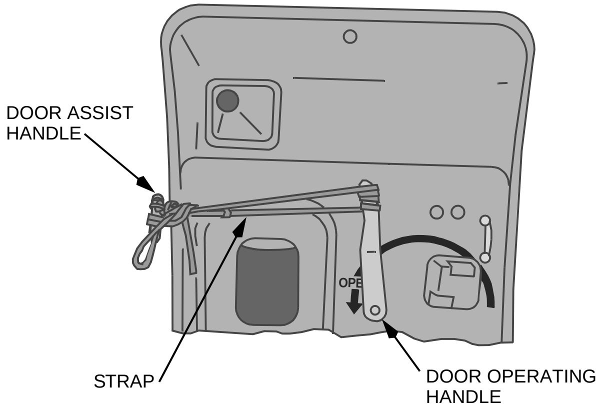


Securing Main Deck Doors 1, 2, 4, or 5 In The Open Position

To accomplish the smoke removal procedure, main entry doors (as designated by the Captain) need to be secured in the partially open position as follows:

- ditching straps forward of doors 3 left and right can be used to secure door 2 or 4 without detaching strap from its compartment
- attach snap end of strap to door assist handle on AFT door frame, place door operating handle to vertical (12 o’clock position), secure handle with several loops, return strap through assist handle and tie as shown below
- pressure on the door maintains tension on the strap so it may be left unattended

Note: If strap is not available, use any satisfactory item in the same manner to secure the doors.



DOOR SECURED WITH DITCHING STRAP

Passenger Door 3

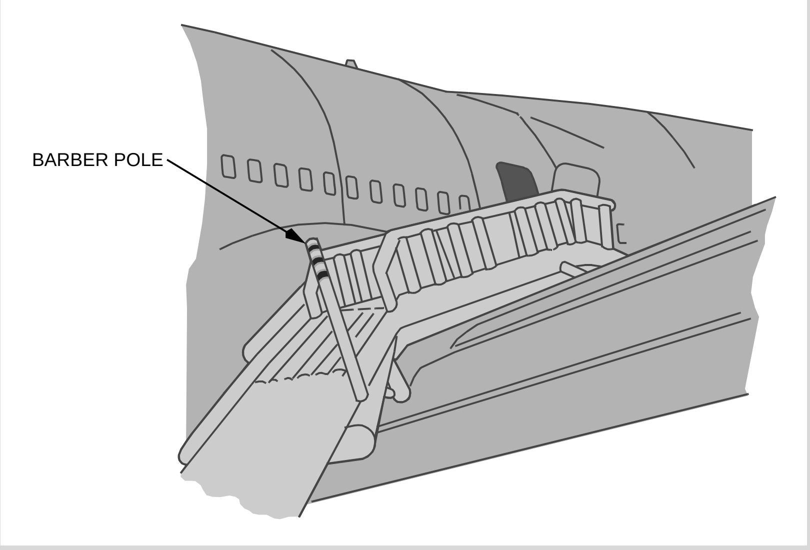
When the door mode select lever is in AUTOMATIC position and the door operating handle is rotated 180 degrees, the door begins to open and the power assist opening system activates.

The flight attendant must release the door operating handle and continue to assist the door opening motion by using the assist handles on the door and on the door surround panel until the door is in the full open and latched position. The door-mounted escape slide deploys and inflates. An off-wing deployment indicator is visible to the flight attendant at door 3 when the off-wing escape slide is properly deployed.

If the ramp/slide does not open automatically, pulling the manual inflation handle inflates it manually.

If door 3 is used during a ditching situation, placing the door mode select lever in MANUAL allows the door to be opened without deploying the ramp slide.

Door 3 Slide Deployed



Upper Deck Emergency Doors

Upper deck doors are used for emergency evacuation only. The escape slides cannot be used as rafts.

With the door mode select lever in AUTOMATIC position, lifting the door operating handle actuates the emergency power system for the door, moving the door up and out to full-open position. The escape slide deploys and inflates as the door opens.

A gas bottle powers each upper deck door opening mechanism. A pressure gage is located above each upper deck door for checking bottle pressure.

A green push-to-test battery OK light is located above each upper deck door.

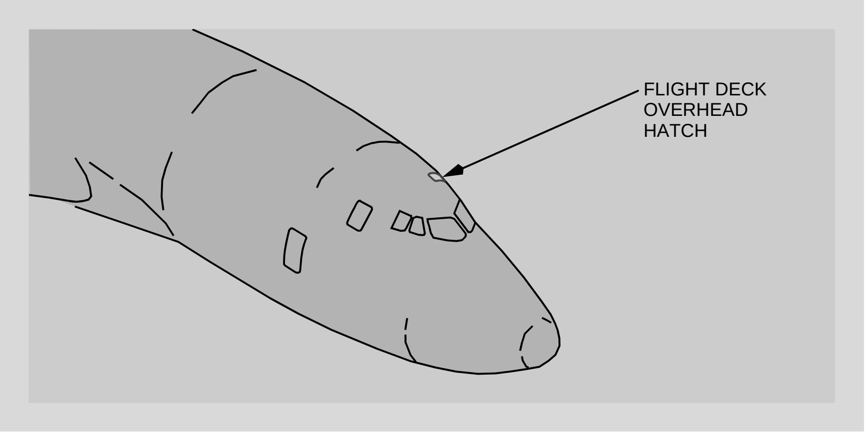
An automatic lock activates in flight to lock the upper deck door operating handles to prevent inadvertent operation. If the automatic lock fails to activate after takeoff, it is possible to open an upper deck door when cabin differential pressure is low.

Flight Deck Overhead Hatch

The flight deck overhead hatch located just aft of the overhead panels can be opened from either inside or outside the airplane.

The hatch is opened from inside the airplane by rotating the interior handle 180 degrees counterclockwise. The hatch is opened from the outside by pressing the release trigger which allows the exterior handle to spring out from its recessed position. Rotating the handle then unlocks the hatch.

Flight Deck Overhead Hatch Location

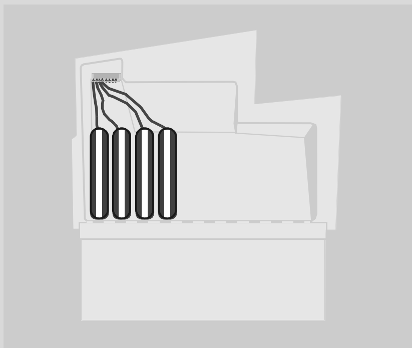


Emergency Escape Devices

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Four emergency escape devices are stowed adjacent to the flight deck overhead hatch.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



EMERGENCY ESCAPE DEVICES

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Six emergency escape devices are stowed adjacent to the flight deck overhead hatch.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

EMERGENCY ESCAPE DEVICES

The emergency escape device is used by removing it from the holder and departing through the escape hatch opening while holding the device handle. Inertial reels limit the speed of descent.

Cargo Doors

The three cargo doors are on the right side of the airplane. The cargo doors all open upward. The forward and aft cargo doors open outward and the bulk cargo door opens inward.

Both forward and aft cargo doors are normally operated electrically from an exterior or interior fuselage-mounted control panel located with each door. A control panel light indicates cargo door latching. Forward and aft cargo door locking is accomplished manually. If necessary, the forward and aft cargo doors may be operated manually.

The bulk cargo door is manually opened and closed, and is counterbalanced for ease of operation.

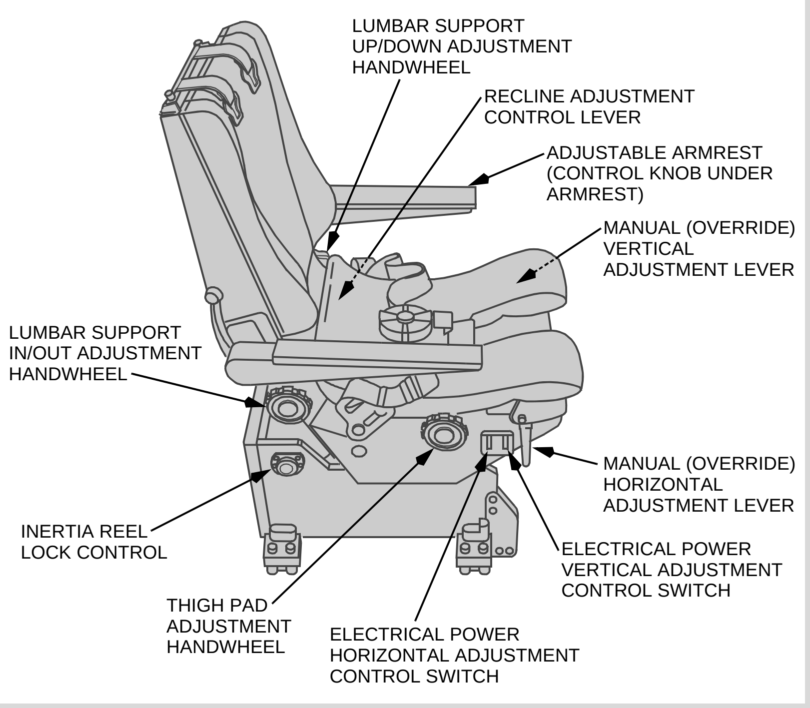
Flight Deck Seats

The flight deck has three seat types:

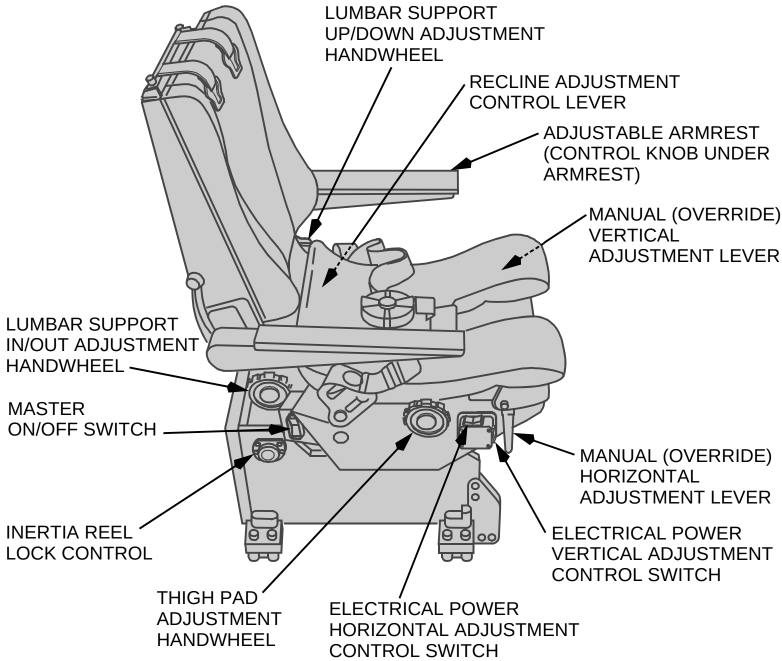
- pilot seats (captain and first officer)
- first observer seat
- second observer seat

Pilot Seats

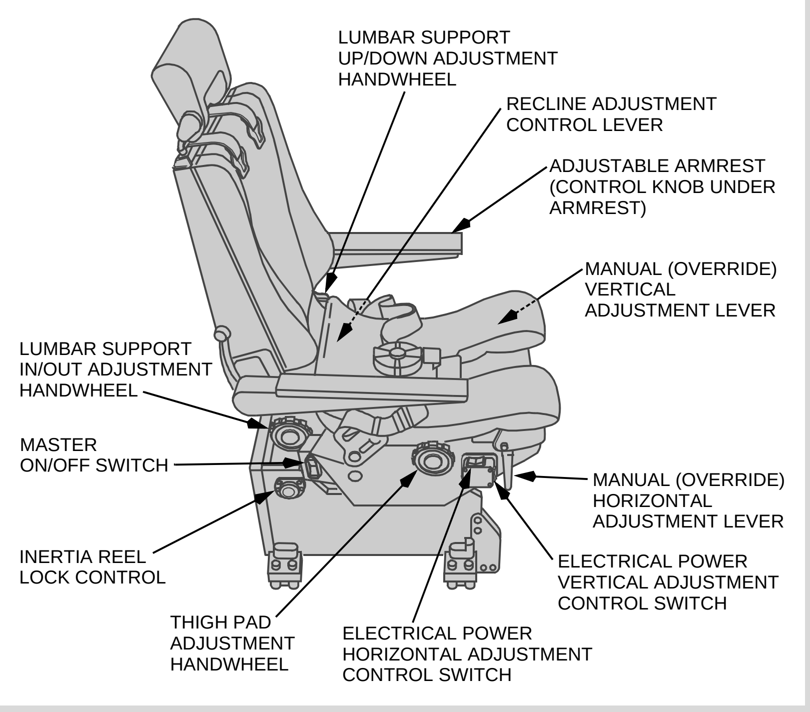
VP-BVR



EI-XLZ, VP-BKJ, VP-BKL



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



The pilot seats:

- recline
- adjust vertically
- adjust forward and aft
- adjust for thigh support
- adjust for the lumbar region of the back

The seats also have:

- adjustable armrests
- crotch straps
- inertial-reel shoulder harnesses with manual locks
- lap belts
- adjustable headrests

The seats move outboard during the last four inches of aft travel. Electric and manual controls provide forward, aft, and vertical adjustment. Manual levers provide other adjustments.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VQ-BHW, VQ-BHX

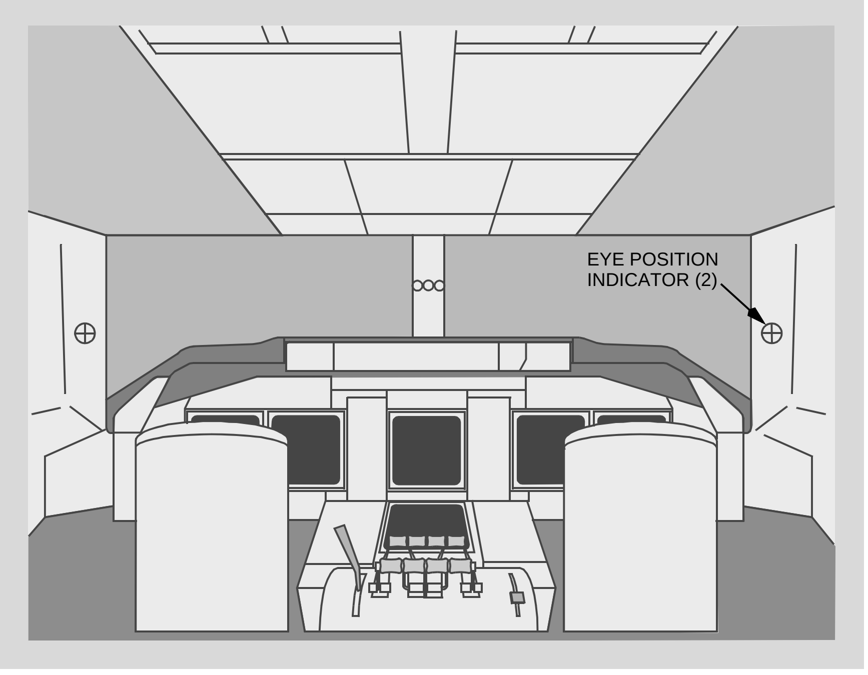
A master ON/OFF switch is located behind the lumbar support in/out adjustment handwheel.

Lumbar and thigh pad support can be adjusted using the adjustment hand wheels. Armrest pitch can be adjusted using the control knob under the armrest. The armrests can be stowed vertically for easier seat access.

Adjusting the seat obtains the optimum eye position as shown on the following illustration. The vertical line on the eye position indicator just passes out of peripheral vision (looking straight ahead) when the seat is properly adjusted.

Note: The recline adjustment will be in an optimum position near or slightly aft of the full upright position.

Pilot Seat Adjustment



Observer Seats

The first observer seat is pedestal-mounted. It adjusts manually in the vertical, forward, and aft directions. The seat has:

- a folding arm rest on the left side
- crotch strap
- inertial-reel shoulder harness with manual locks
- lap belt
- adjustable headrest

The second observer seat is not adjustable. The seat has:

- folding arm rests
- crotch strap
- shoulder harness with manual locks
- lap belt
- adjustable headrest

Door 5 Overhead Crew Rest

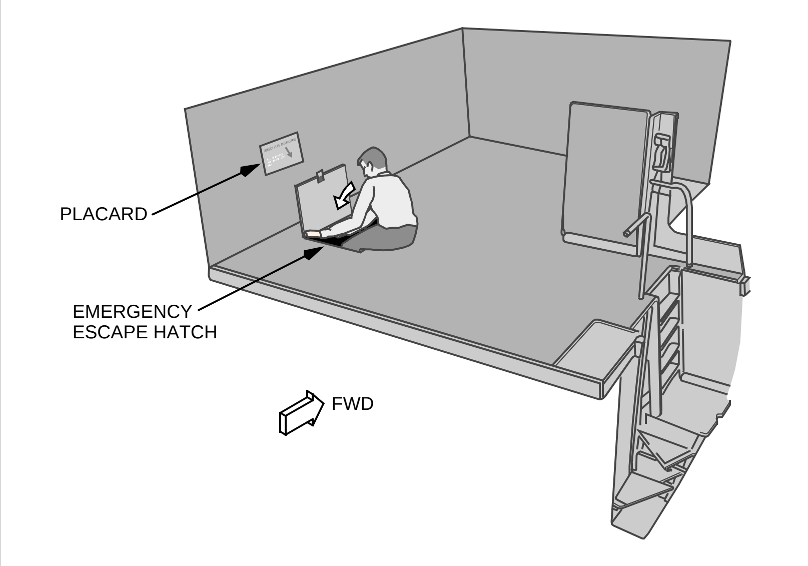
The door 5 overhead crew rest area is entered through a locked door on the right side of the airplane aft of door 5R. An emergency escape hatch is located on the floor on the left side of the crew rest area. To use the emergency escape hatch follow the placarded instructions. In some cases, a bunk must be moved to access the emergency escape hatch.

Crew members occupying crew rest must be trained in the use of evacuation routes in accordance with FAA approved evacuation procedures contained in Boeing document D926U303, Appendix D.

Evacuation Using Emergency Escape Hatch

The following can be used as a general guideline for evacuation of door 5 crew rest area. For egress, open the emergency escape hatch and latch it open. If the ceiling panel is in place, sit on floor with legs in hatch and kick out ceiling panel. Lower legs into hatch opening and sit on floor facing outboard, reach out and grab the outboard handholds (keeping elbows close to sides), and swing down to main deck.

Door 5 Overhead Crew Rest Emergency Escape Hatch



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Airplane General, Emergency Equipment, Doors EICAS Messages

The following EICAS messages can be displayed.

EICAS Alert Messages

Message	Level	Aural	Message Logic
>CREW OXY LOW	Advisory		Crew oxygen pressure low.
DOOR AFT CARGO	Caution	Beeper	Aft cargo door not closed and latched and locked condition sensed.
DOOR BULK CARGO	Advisory		Bulk cargo door not closed and latched condition sensed.
DOOR ELEC CTR	Advisory		Electrical equipment door not closed and latched condition sensed.
DOOR ELEC MAIN	Advisory		Electrical equipment door not closed and latched condition sensed.
DOOR ENTRY L 1, L 2, L 3, L 4, L 5, R 1, R 2, R 3, R 4, R 5	Advisory		Main deck entry door not closed and latched condition sensed.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

DOOR F/D OVHD	Advisory		Flight deck overhead door not closed and latched condition sensed.

DOOR FWD CARGO	Caution	Beeper	Forward cargo door not closed and latched and locked condition sensed.
DOOR L, R UPPER DK	Advisory		Upper deck door not closed and latched condition sensed.
DOOR U/D FLT LK	Caution	Beeper	Upper deck door automatic lock failed to activate after takeoff.

Message	Level	Aural	Message Logic
DOORS ELEC	Advisory		Both electrical equipment doors not closed and latched condition sensed.
DOORS ENTRY L, R	Advisory		Two or more entry doors on the same side not closed and latched condition sensed.
DOORS UPR DECK	Advisory		Both upper deck doors not closed and latched condition sensed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

>ELT ON	Advisory		Emergency locator transmitter activated.

>EMER LIGHTS	Advisory		Emergency Lights switch not ARMED, or Emergency Lights switch ARMED and emergency lights activated by switch at flight attendant's panel.
PASS OXYGEN ON	Advisory		Passenger oxygen system activated.

EICAS Memo Messages

EI-XLF, EI-XLG, EI-XLI, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Message	Level	Aural	Message Logic

VQ-BHW, VQ-BHX

DOORS AUTO	Memo		Indicates position of mode select levers for main deck and upper deck doors when on the ground.

VQ-BHW, VQ-BHX

DOORS AUTO/MAN	Memo		Indicates position of mode select levers for main deck and upper deck doors when on the ground.

Message	Level	Aural	Message Logic

VQ-BHW, VQ-BHX

Message	Level	Aural	Message Logic
DOORS MANUAL	Memo		Indicates position of mode select levers for main deck and upper deck doors when on the ground.

Message	Level	Aural	Message Logic
NO SMOKING ON	Memo		NO SMOKING signs manually selected ON.
PASS SIGNS ON	Memo		Passenger signs manually selected ON.
SEATBELTS ON	Memo		FASTEN BELTS signs manually selected ON.

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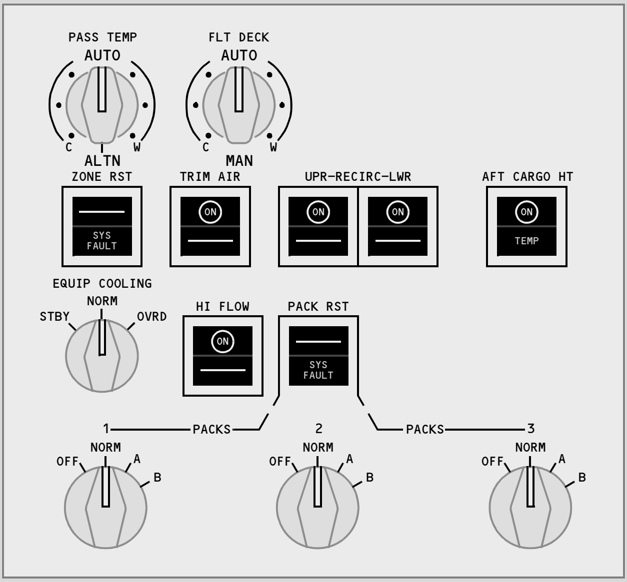
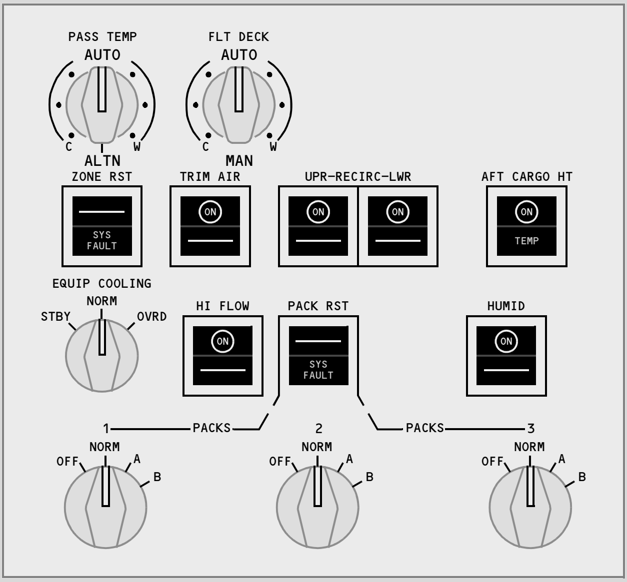
Air Conditioning System
Air Conditioning
ECS Control

EI-XLB, EI-XLD



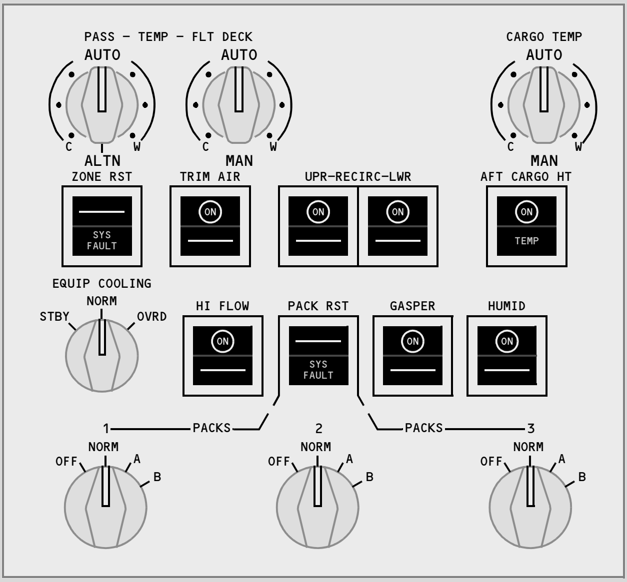
OVERHEAD PANEL

EI-XLC, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



OVERHEAD PANEL

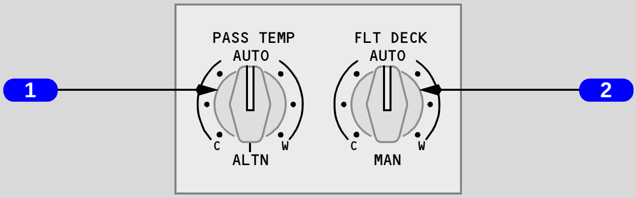
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



OVERHEAD PANEL

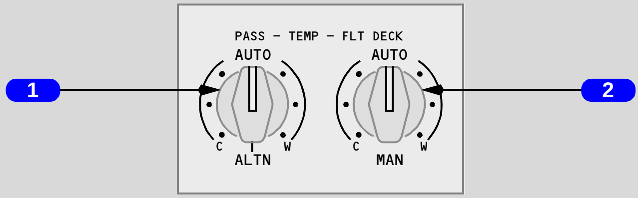
Passenger and Flight Deck Temperature Selectors

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



ECS PANEL

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



ECS PANEL

1 Passenger (PASS) Temperature (TEMP) Selector

AUTO -

- provides automatic control of passenger zone temperatures
- sets master temperature for all zones
- range C to W sets temperature from 65°F (18°C) to 85°F (29°C)
- in backup mode, range C to W sets average cabin temperature from 65°F (18°C) to 85°F (29°C) and cabin temperature panel control of zone temperatures is inhibited

ALTN -

- zone trim air valves remain in last position and master trim air valve remains open
- zone temperature controller bypassed
- pack output temperature regulated to provide average cabin temperature of 75°F (24°C)
- cabin temperature panel control of zone temperatures inhibited

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

2 Flight (FLT) DECK Temperature Selector

AUTO -

- provides automatic control of flight deck temperature
- range C to W sets flight deck temperature from 65°F (18°C) to 85°F (29°C)

MAN (spring loaded to 6 o’clock position) - flight deck trim air valve controlled manually.

C (cool) - valve moves toward closed to provide cooler air.

W (warm) - valve moves toward open to provide warmer air.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

2 Flight (FLT) DECK Temperature (TEMP) Selector

AUTO -

- provides automatic control of flight deck temperature
- range C to W sets flight deck temperature from 65°F (18°C) to 85°F (29°C)

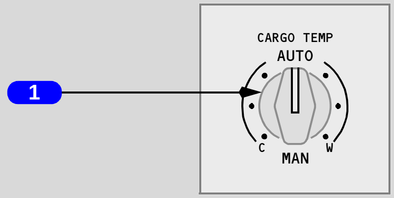
MAN (spring loaded to 6 o'clock position) - flight deck trim air valve controlled manually.

C (cool) - valve moves toward closed to provide cooler air.

W (warm) - valve moves toward open to provide warmer air.

Cargo Temperature Selector

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



ECS PANEL

1 CARGO Temperature (TEMP) Selector

AUTO -

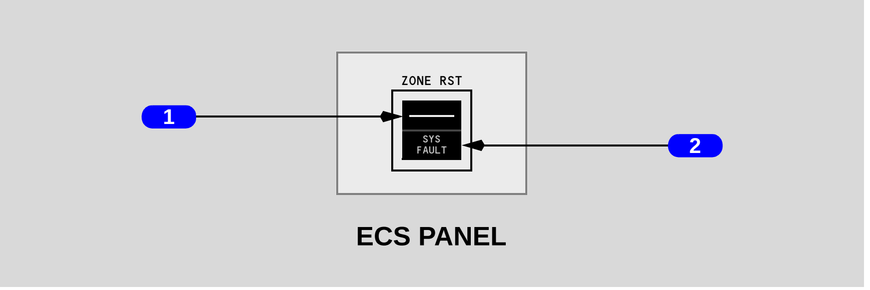
- provides automatic control of cargo conditioned air temperature when the Cargo Conditioned Air Flow Rate selector not OFF
- range C to W sets temperature from 40°F (4°C) to 80°F (27°C)

MAN (spring loaded to 6 o'clock position) - cargo conditioned air trim air valve controlled manually when Cargo Conditioned Air Flow Rate selector not OFF.

C (cool) - valve moves toward closed to provide cooler air.

W (warm) - valve moves toward open to provide warmer air.

Zone Reset Switch and Zone System Fault Light



1 ZONE Reset (RST) Switch

Push -

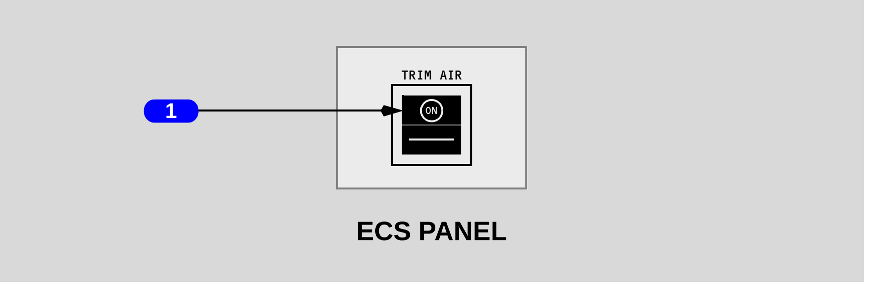
- resets zone temperature controller if fault no longer exists
- master trim air valve reopens if duct overheat no longer exists

2 Zone System (SYS) FAULT Light

Illuminated (amber) -

- temperature zone duct overheat or zone temperature controller fault has occurred, or
- master trim air valve failed closed, or
- Trim Air switch off, or
- master trim air valve closed and pack air continues to flow

Trim Air Switch



1 TRIM AIR Switch

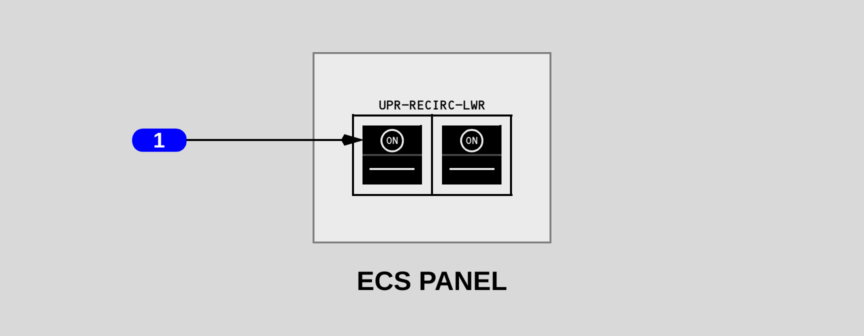
ON -

- master trim air valve open and zone trim air valves operate automatically
- automatic and manual selection of pack controller A or controller B enabled

Off -

- master trim air valve closed
- pack output temperature in backup mode regulated to provide average passenger cabin temperature from 65°F (18°C) to 85°F (29°C) as selected by Passenger Temperature selector in AUTO
- cabin temperature panel control of temperatures inhibited
- pack controller A selected and both automatic and manual selection of pack controller B inhibited
  - if pack controller A failed, pack controller B selected automatically

Recirculation Fans Switch

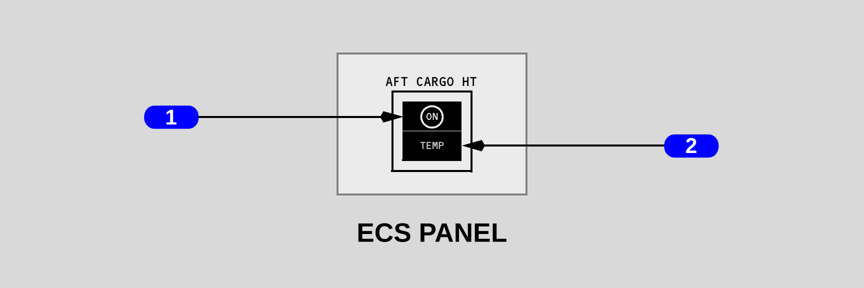


1 Recirculation (RECIRC) Fans Switch

ON - recirculation fans controlled automatically.

Off - recirculation fans off.

Aft Cargo Heat Switch



1 AFT CARGO Heat (HT) Switch

ON -

- overheat shutoff valve opens to provide bleed air heat to aft and bulk cargo compartments
- temperature control valve closes and opens to maintain temperature
- overheat shutoff valve closes and opens for overheat protection

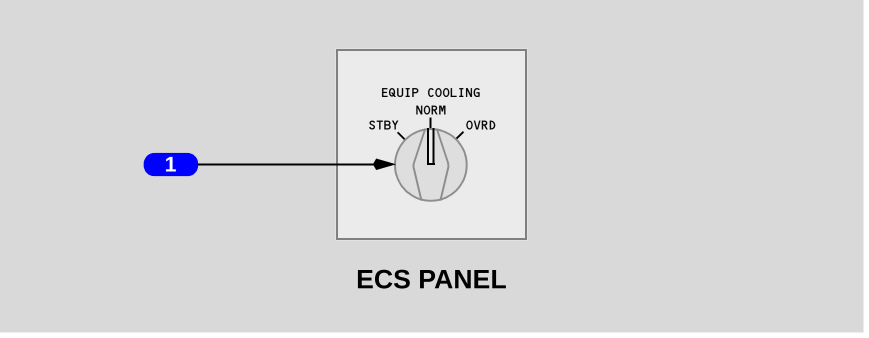
Off - shuts off aft cargo heat bleed air to compartment.

2 Aft Cargo Temperature (TEMP) Light

Illuminated (amber) -

- compartment temperature excessive
- overheat shutoff valve closes

Equipment Cooling Selector



1 Equipment (EQUIP) COOLING Selector

STBY -

- equipment cooling ground exhaust valve closed and inboard exhaust valve open; automatic control bypassed to configure system for flight
- all other automatic system operation same as in NORM

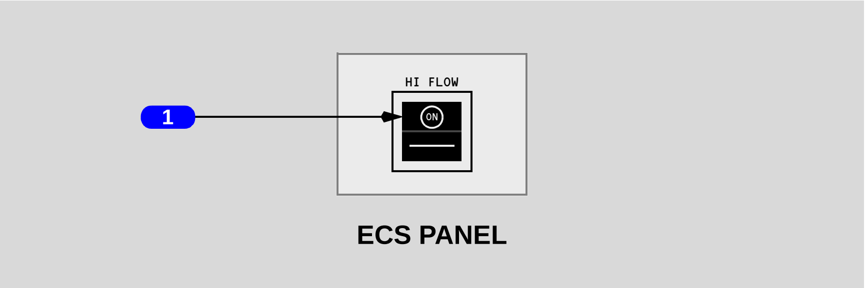
NORM -

- ground operation based on ambient temperature; equipment cooling air exhausted overboard or exhausted into forward cargo compartment
- with two or more engines running, cooling air exhausted into forward cargo compartment and equipment cooling ground exhaust valve closed
- with a single internal fault, inboard exhaust valve closes and cooling system reconfigures to allow internal closed loop recirculation of cooling air

OVRD -

- equipment cooling ground exhaust valve and inboard exhaust valve closed
- equipment cooling supply valve closed; cooling air supplied through flight panels
- smoke/override valve open; differential pressure exhausts cooling air overboard

Pack High Flow Switch



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

1 Pack High (HI) FLOW Switch

ON -

- all operating packs provide high air flow
- EICAS memo message PACKS HIGH FLOW displays

Off - pack air flow controlled automatically.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

1 Pack High (HI) FLOW Switch

EI-XLZ, VP-BKL
(VP-BKJ, VP-BVR ; SB installs three position selector)
ON (Cargo Conditioned Air Flow Rate selector in HI) -

- no effect on pack flow rates. Packs one and two remain in high flow. Pack three remains in normal flow.
- EICAS memo message PACKS HIGH FLOW displays

(VP-BKJ, VP-BVR ; before SB, four position selector is installed)
ON (Cargo Conditioned Air Flow Rate selector in MED) -

- no effect on pack flow rates. Packs one and two remain in high flow. Pack three remains in normal flow.
- EICAS memo message PACKS HIGH FLOW displays

ON (Cargo Conditioned Air Flow Rate selector in LO) -

- pack one configured to high flow. Pack two remains in high flow. Pack three remains in normal flow.
- EICAS memo message PACKS HIGH FLOW displays

ON (Cargo Conditioned Air Flow Rate selector in OFF) -

- all operating packs provide high air flow
- EICAS memo message PACKS HIGH FLOW displays

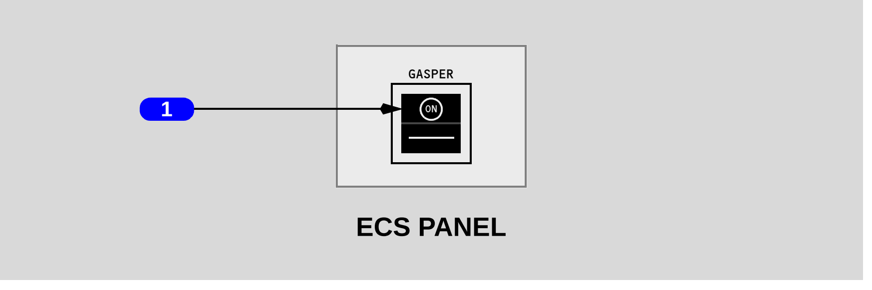
EI-XLZ, VP-BKL
(VP-BKJ, VP-BVR ; SB installs three position selector)
Off (Cargo Conditioned Air Flow Rate selector in HI) - no effect on pack flow rates. Packs one and two remain in high flow. Pack three remains in normal flow.

(VP-BKJ, VP-BVR ; before SB, four position selector is installed)
Off (Cargo Conditioned Air Flow Rate selector in MED) - no effect on pack flow rates. Packs one and two remain in high flow. Pack three remains in normal flow.

Off (Cargo Conditioned Air Flow Rate selector in LO) - pack one air flow controlled automatically. Packs one and two remain in high flow. Pack three remains in normal flow.

Off (Cargo Conditioned Air Flow Rate selector in OFF) - pack air flow controlled automatically.

Gasper Switch
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

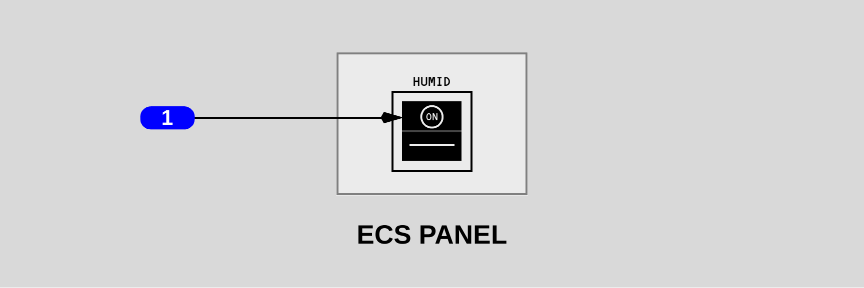


1 GASPER Switch

ON - gasper system operates.

Humidifier Switch

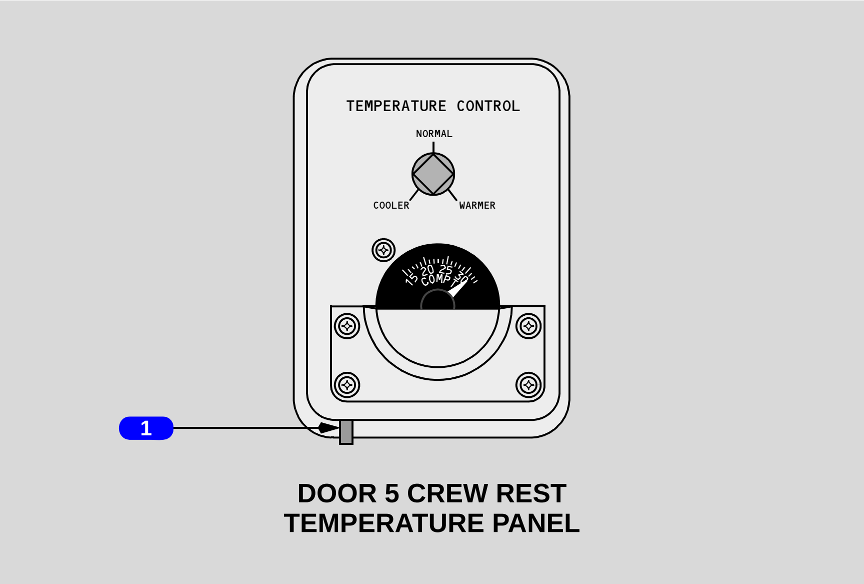
EI-XLC, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



1 Humidifier (HUMID) Switch

ON - flight deck humidifier operates automatically.

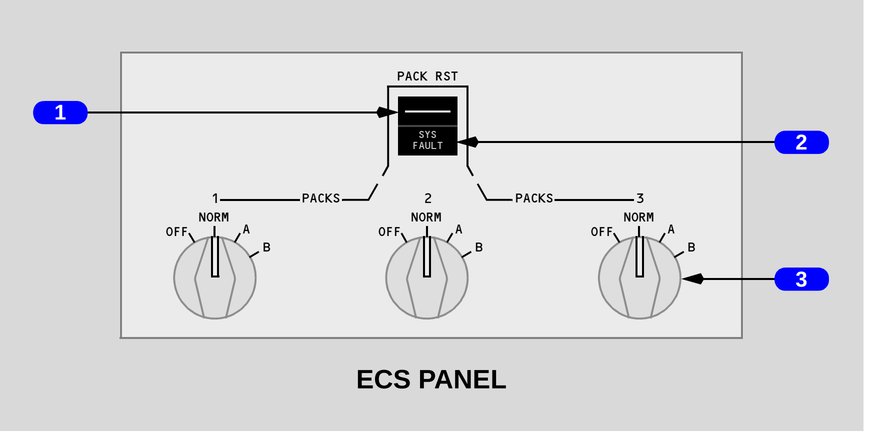
Crew Rest Reset Switch



1 Door 5 Crew Rest Reset Switch

Push - opens door 5 crew rest air supply valves, and resets recirculation fans and valves, if recirculation fans were shut down and valves were closed by crew rest smoke detection system and smoke is no longer detected.

Pack Control



1 PACK Reset (RST) Switch

Push -

- resets pack fault protection system
- restarts pack after automatic shutdown if fault no longer exists

2 Pack System (SYS) FAULT Light

Illuminated (amber) -

- pack overheat or other system fault has occurred

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

- may illuminate briefly when automatically or manually switching from pack temperature controller A to B or B to A

3 PACKS Control Selectors

OFF -

- pack valve closed
- extinguishes SYS FAULT light for pack selected off
- resets pack fault protection system

Normal (NORM) -

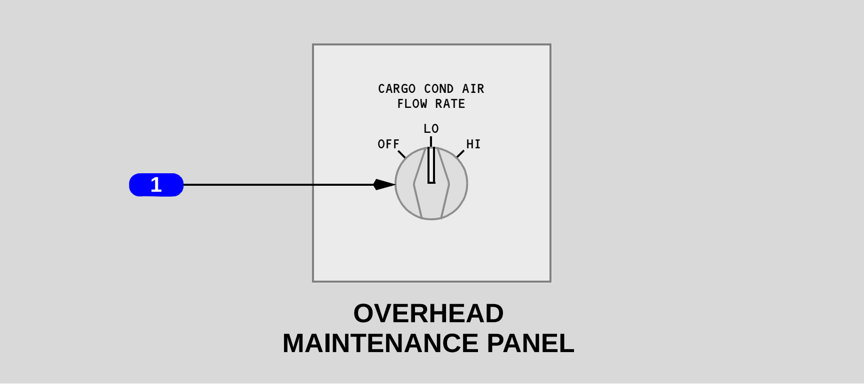
- pack controller A or B selected automatically on alternate flights
- selected controller is primary controller; selects secondary controller if primary controller fails

A - selects pack controller A as primary controller; selects B if A fails.

B - selects pack controller B as primary controller; selects A if B fails.

Cargo Conditioned Air Flow Rate Selector
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

EI-XLZ, VP-BKL
(VP-BKJ, VP-BVR ; SB installs three position selector)



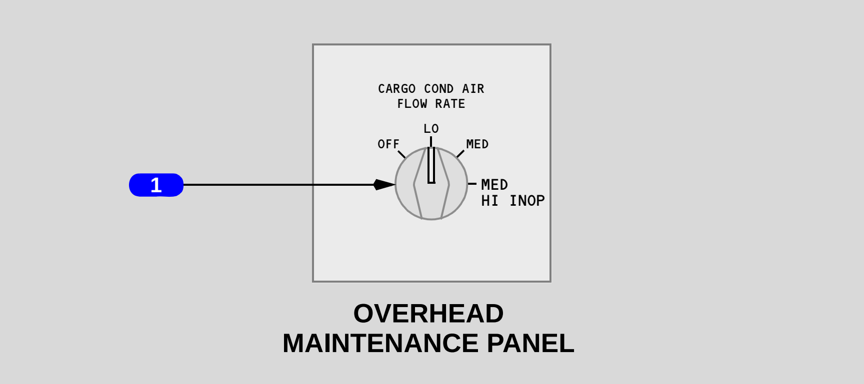
1 CARGO Conditioned (COND) AIR FLOW RATE Selector

OFF - cargo air conditioning off.

LO - pack three conditioned air distributed equally to aft cargo compartment and cabin.

HI - all pack three conditioned air distributed to aft cargo compartment.

(VP-BKJ, VP-BVR ; before SB, four position selector is installed)



1 CARGO Conditioned (COND) AIR FLOW RATE Selector

OFF - cargo air conditioning off.

LO - pack three conditioned air distributed equally to aft cargo compartment and cabin.

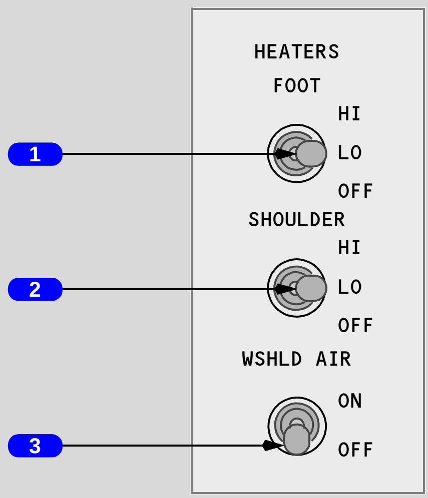
MED - all pack three conditioned air distributed to aft cargo compartment.

MED
HI INOP - all pack three conditioned air distributed to aft cargo compartment.

Pilot Auxiliary Heat and Windshield Air

Electric shoulder heater and foot heater operate only in flight.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



CAPTAIN AND FIRST OFFICER SIDEWALL PANELS

1 FOOT Heater Switch

Control temperature is the same in HI and LO. Heater is inhibited when temperature of foot heater plate is warmer than 65°F (18°C).

HI - under-floor electric heater operates at high heating rate.

LO - under-floor electric heater operates at low heating rate.

OFF - under-floor electric heater off.

2 SHOULDER Heater Switch

HI - electric heater adds heat at high setting to conditioned air flow to side windows.

LO - electric heater adds heat at low setting to conditioned air flow to side windows.

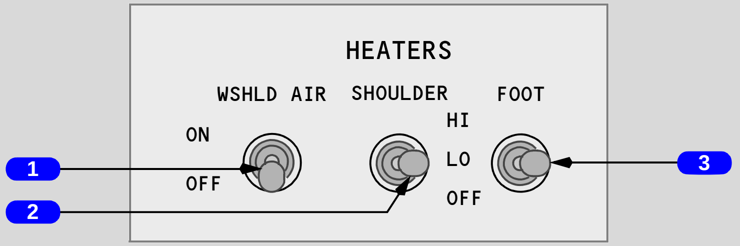
OFF - electric heater off.

3 Windshield (WSHLD) AIR Switch

ON - supplemental anti-fogging air supplied to windshield.

OFF - anti-fogging air off.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



CAPTAIN AND FIRST OFFICER SIDEWALL PANELS

1 Windshield (WSHLD) AIR Switch

ON - supplemental anti-fogging air supplied to windshield.

OFF - anti-fogging air off.

2 SHOULDER Heater Switch

HI - electric heater adds heat at high setting to conditioned air flow to side windows.

LO - electric heater adds heat at low setting to conditioned air flow to side windows.

OFF - electric heater off.

3 FOOT Heater Switch

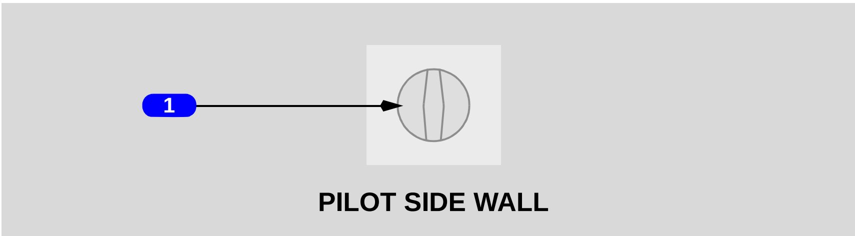
Control temperature is the same in HI and LO. Heater is inhibited when temperature of foot heater plate is warmer than 65°F (18°C).

HI - under-floor electric heater operates at high heating rate.

LO - under-floor electric heater operates at low heating rate.

OFF - under-floor electric heater off.

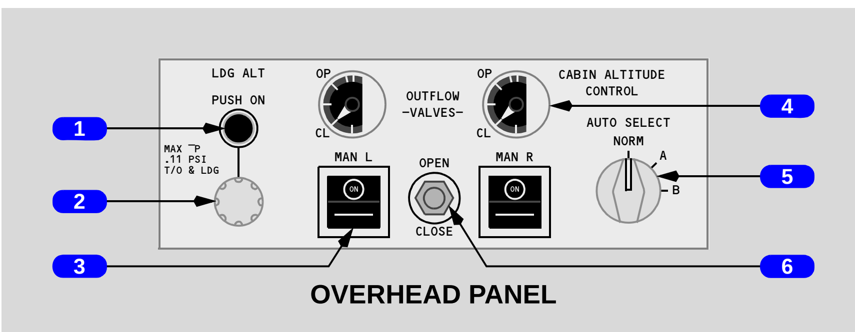
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX



1 Shoulder Air Selector

Rotate - Sets air flow to side window shoulder air outlet

Pressurization System
Cabin Altitude Control



1 Landing Altitude (LDG ALT) Switch

Push - alternately changes landing altitude control between Automatic and Manual.

Manual -

- landing altitude set by rotating Landing Altitude selector
- landing altitude followed by MAN displayed on primary EICAS
- the EICAS advisory message LANDING ALTITUDE is displayed

Automatic -

- landing altitude set automatically from FMC - Refer to Chapter 11, Flight Management Navigation, Approach
- landing altitude followed by AUTO displayed on primary EICAS

2 Landing Altitude (LDG ALT) Selector

Rotate - sets landing altitude when MAN displayed on primary EICAS.

3 Outflow Valve Manual (MAN) Switches

ON -

- outflow valve is controlled manually
- bypasses automatic outflow valve control and cabin altitude limiter

Off - outflow valve controlled automatically.

4 OUTFLOW VALVES Position Indicator

OP (Open) - outflow valve open.

CL (Closed) - outflow valve closed.

5 Cabin Altitude AUTO Selector (SELECT)

NORM -

- cabin altitude controller A or B selected automatically on alternate flights
- selected controller is the primary controller; selects secondary controller if primary controller fails

A - selects cabin altitude controller A as primary controller; selects B if A fails.

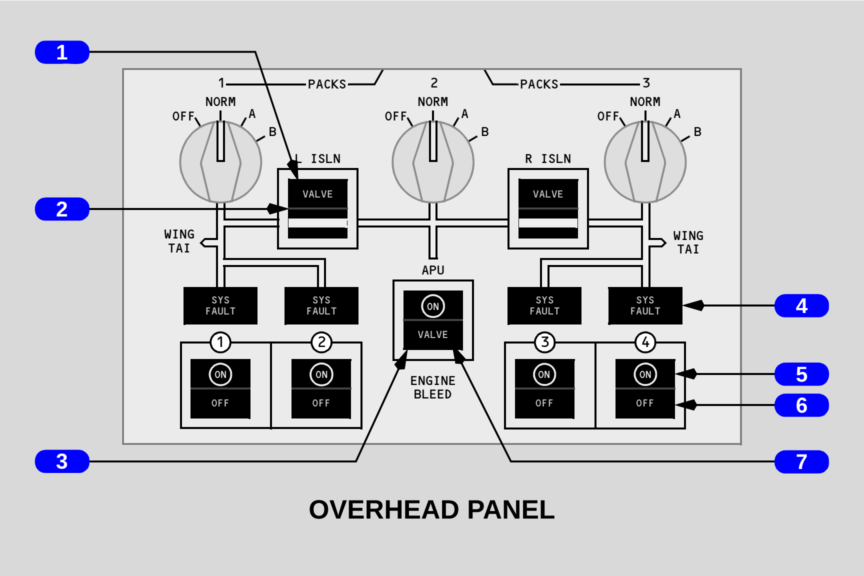
B - selects cabin altitude controller B as primary controller; selects A if B fails.

6 Outflow Valves Manual Control

OPEN - moves the outflow valve toward open.

CLOSE - moves the outflow valve toward closed.

Bleed Air Control



1 Isolation (ISLN) VALVE Lights

Illuminated (amber) - isolation valve position disagrees with switch position

2 Isolation (ISLN) Valve Switches

ON (bar in view) - valve open.

Off - valve closed.

3 APU Bleed Air Switch

ON - valve commanded open when EICAS memo message APU RUNNING displayed.

Off - valve closed.

4 Engine Bleed Air System (SYS) FAULT Lights

Illuminated (amber) -

- bleed air overheat, or
- bleed air overpressure, or
- HP bleed valve open when commanded closed, or

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

- PRV open when commanded closed

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- strut overheat, or

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- FWSOV open when commanded closed

5 ENGINE BLEED Air Switches

ON -

- engine bleed air valve opens for engine start

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
- engine bleed air valve, PRV, and HP bleed valve open by system logic when bleed air pressure available

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- engine bleed air valve, FWSOV, and HP bleed valve open by system logic when bleed air pressure available

Off -

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
- engine bleed air valve, PRV, and HP bleed valve closed

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- engine bleed air valve, FWSOV, and HP bleed valve closed

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- PRV opens when Nacelle Anti-ice switch ON, unless PRV closed by:
  - prior or present bleed air overheat, or
  - start valve not closed, or
  - HP bleed valve failed open

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
- PRV opens when nacelle anti-ice on, unless PRV closed by:
  - prior or present bleed air overheat, or
  - start valve not closed, or
  - HP bleed valve failed open

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- FWSOV opens when nacelle anti-ice on, unless FWSOVclosed by:
  - prior or present bleed air overheat, or
  - prior or present strut overheat, or
  - start valve not closed, or
  - HP bleed valve failed open

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

- HP bleed valve and PRV open for thrust reverse, unless PRV closed by:
    - prior or present bleed air overheat, or
    - start valve not closed

6 ENGINE BLEED Air OFF Lights

Illuminated (amber) - engine bleed air valve closed.

7 APU Bleed Air VALVE Light

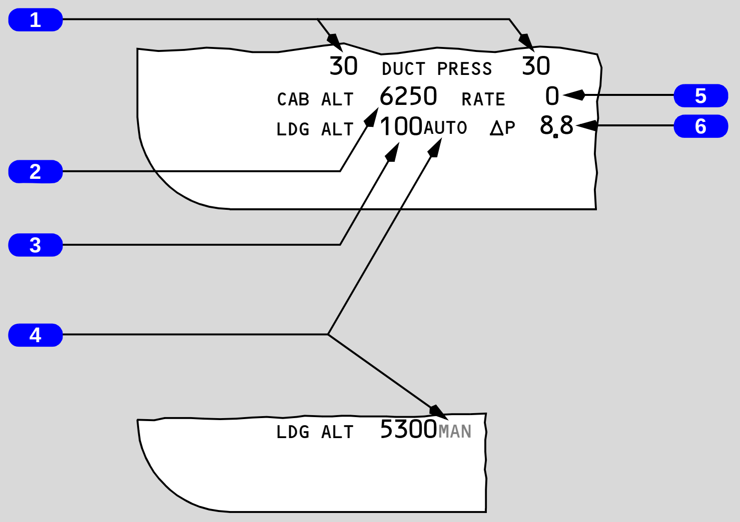
Illuminated (amber) - APU bleed air isolation valve position disagrees with switch position.

ECS Displays and Indications

Duct Pressure and Cabin Altitude Indications

Duct pressure, cabin altitude, rate, landing altitude, and differential pressure are displayed when:

- landing altitude MAN
- cabin altitude in caution (amber) or warning (red) range
- cabin differential pressure in caution (amber) or warning (red) range
- ECS or ENG synoptic selected on secondary EICAS display



PRIMARY EICAS DISPLAY

1 Bleed Air Duct Pressure

White - 12 psi and above.

Amber - 11 psi and below.

2 Cabin Altitude

White - normal range.

Amber - above normal range.

Red - excessive cabin altitude.

3 Landing Altitude

- inhibited if both cabin altitude controllers A and B fail
- inhibited if both outflow valves are in MAN

4 Landing Altitude Selection

AUTO (white) - altitude set automatically from FMC - Refer to Chapter 11, Flight Management Navigation, Arrivals Page - IFR Approaches.

MAN (amber) - altitude set by Landing Altitude selector.

5 Cabin Altitude Rate

+ (plus) - rate of climb.

- (minus) - rate of descent.

6 Cabin Differential Pressure

White - normal range.

Amber - above normal range.

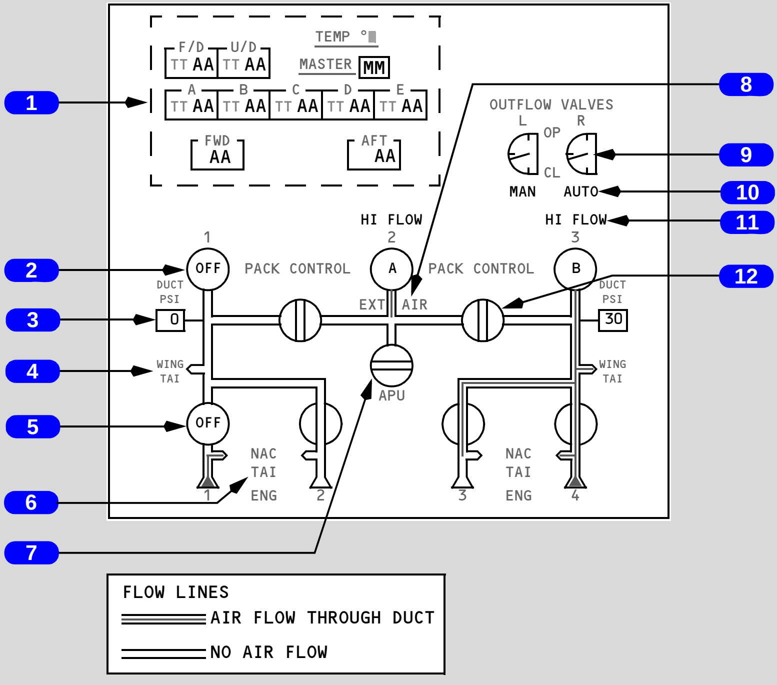
Red - excessive cabin differential pressure.

ECS Synoptic Display

The ECS synoptic is displayed by pushing the ECS switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

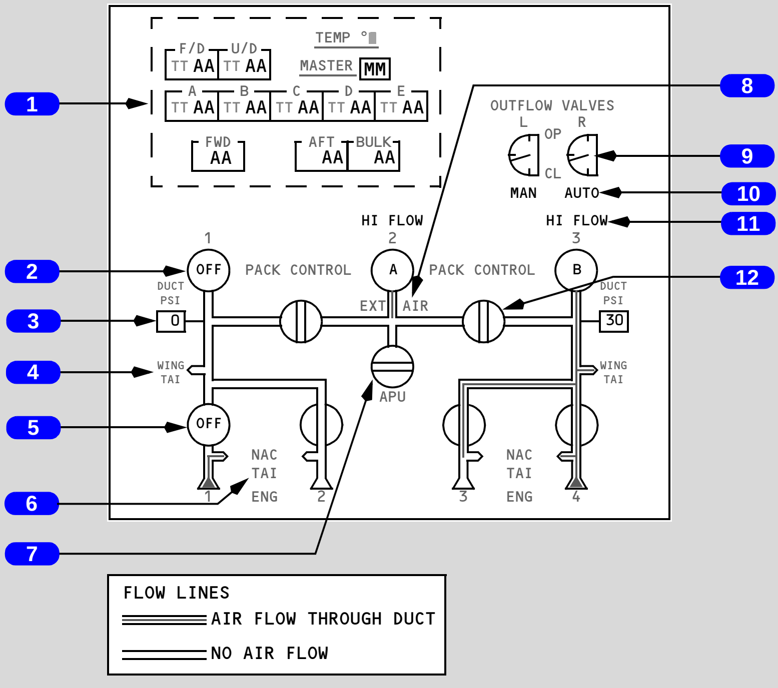
Air flow displayed is generated by displayed valve positions, switch positions, and pack status. Actual air flow is not displayed, therefore the display may not represent actual system operation.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



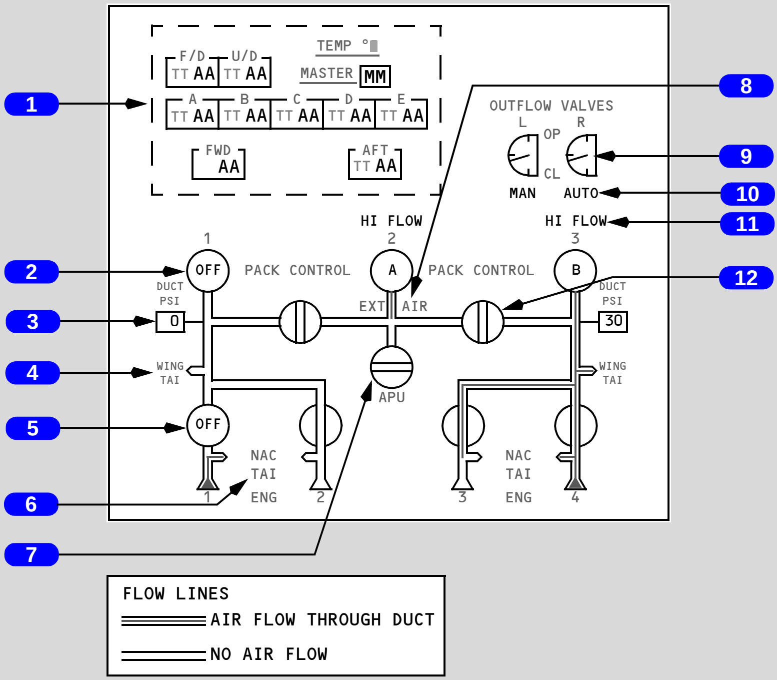
LOWER EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



LOWER EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



LOWER EICAS DISPLAY

1 Zone Temperature

F/D, U/D, A, B, C, D, and E - zone target and actual temperatures for respective air conditioning zone:

(TT) target temperature on left; displayed when:

- at least one pack is operating, and
- Passenger Temperature selector in AUTO, and
- temperature control is not in backup mode

- (AA) actual temperature on right

MASTER - (MM) temperature setting of Passenger Temperature selector.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
FWD, AFT, BULK - (AA) actual temperature of cargo compartment.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
FWD, AFT - (AA) actual temperature of cargo compartment.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
AFT -
- (TT) target temperature on left, (AA) actual temperature on right, when Cargo Conditioned Air Flow Rate selector is in LO or HI
- (AA) actual temperature only, when Cargo Conditioned Air Flow Rate selector is in OFF

2 Pack Control

A - pack controller A is controlling the pack.

B - pack controller B is controlling the pack.

OFF - pack valve is closed.

3 Bleed Air Duct Pressure

White - 12 psi or greater.

Amber - 11 psi or less.

4 Wing Anti-Icing

Wing anti-icing valve is open.

5 Engine Bleed Air Valve

Position of the engine bleed air valve.

6 Nacelle Anti-Icing

Nacelle anti-icing valve is open.

7 APU Bleed Air Isolation Valve

Position of the isolation valve.

8 External Air

- displayed if a pack is operating with APU and engines off, or
- bleed air ducts are pressurized with APU and engines off
- remains displayed momentarily after external air source is removed

9 Outflow Valve Position

OP - open.

CL - closed.

10 Outflow Valve

AUTO - outflow valve is controlled automatically.

MAN - outflow valve is controlled manually.

11 High Flow

HI FLOW - pack is in high flow

Blank - pack is in normal flow or pack is off.

12 Isolation Valve

Position of isolation valve.

Introduction

The air conditioning system supplies conditioned bleed air and recirculated cabin air at controlled temperature throughout the airplane.

The system supplies conditioned air to the flight deck shoulder heaters.

The system supplies ventilation for the passenger cabin:

- lavatories
- galleys
- flight deck crew rest

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- individual passenger seat gaspers
- door 5 crew rest

Pack control, zone temperature control, cabin air recirculation, fault detection, and overheat protection are all automatic. Backup system control modes operate in the event of system failures.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

There are seven temperature zones:

- flight deck
- upper deck
- five main deck cabin zones A through E

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

There are eight temperature zones:

- flight deck
- upper deck
- five main deck cabin zones A through E
- aft cargo zone.

Air Conditioning Packs

Three identical air conditioning packs cool bleed air from the engines, APU, or high pressure air from a ground source. Bleed air is precooled before entering the pack. The packs are controlled by two identical pack temperature controllers (PTCs), A and B. Each PTC has three separate channels, one for each pack. Control of the packs switches automatically to the other PTC at touchdown. If a PTC detects a fault in a pack channel, control of the respective pack switches to the other PTC.

When a PACKS Control selector is placed in NORM, A, or B, the respective pack valve opens, which allows bleed air to flow into the pack. The pack valve is controlled electrically by the PTC and opens by bleed air pressure.

Each pack valve has two flow rates, normal and high. During cruise, normal flow minimizes bleed air demand on the engine to reduce fuel consumption. Fuel consumption is reduced approximately 0.3% for each pack in normal flow.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
In cruise with the Lower Cargo Flow Rate selector in LO or OFF, pushing the Pack High Flow switch ON configures one or more packs to high flow.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
In cruise, pushing the pack High Flow switch ON configures all three packs to high flow.

Pack Non-Normal Operation

Pack control, fault detection, and overheat protection are all automatic. When an overheat or PTC fault is detected, the respective pack valve closes resulting in a pack shut down.

If a PTC does not switch automatically to the other PTC, selecting A or B manually selects the respective PTC when the Trim Air switch is ON. An attempt to restore pack operation may be made by pushing the Pack Reset switch.

If the pack cannot be reset, placing the respective Packs Control selector to OFF extinguishes the Pack System Fault light for use by the operating packs.

If both PTCs A and B fail, air conditioning packs continue to operate and the pack overheat protection system continues to operate normally. A pack overheat results in a shut down.

Conditioned Air Distribution

Recirculation fans assist the packs to maintain a constant ventilation rate throughout the passenger cabin. The fans draw cabin air through filters, then reintroduce the air into the conditioned air distribution system. Two fans are located above the main passenger compartments and two fans are located below the main passenger cabin floor. If a fan overheat is detected, electrical power is removed.

Pack flow rate and recirculation fan operation are configured by:

- the phase of flight,
- the number of air conditioning packs operating, and
- the number of recirculation fans operating.

The system reconfigures pack flow rate and recirculation fan operation automatically when fans or packs are shut down or fail.

Aft Cargo Conditioned Air Distribution

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Aft cargo conditioned air is supplied directly from pack three. The volume of conditioned air supplied to aft cargo is controlled by the position of the Cargo Conditioned Air Flow Rate selector.

EI-XLZ, VP-BKL
(VP-BKJ, VP-BVR ; SB installs three position selector)
With the selector in HI:

- all pack three air is distributed to aft cargo
- packs one and two remain in high flow and pack three remains in normal flow during all flight phases
- pushing the high flow switch has no effect on pack flow rates

(VP-BKJ, VP-BVR ; before SB, four position selector is installed)
With the selector in MED:

- all pack three air is distributed to aft cargo
- packs one and two remain in high flow and pack three remains in normal flow during all flight phases
- pushing the high flow switch has no effect on pack flow rates

With the selector in LO:

- pack three air is distributed to both aft cargo and the cabin
- pack two remains in high flow and pack three remains in normal flow during all flight phases
- during cruise, pushing the Pack High Flow switch ON configures pack one to high flow

With the Cargo Conditioned Air Flow Rate selector OFF, conditioned air to the aft lower cargo compartment is shut off. All pack three air is distributed to the cabin.

Aft cargo heat is normally selected ON when aft lower cargo conditioned air is selected. This configuration ensures the compartment floor temperature is maintained above freezing.

Cargo Fire Arm

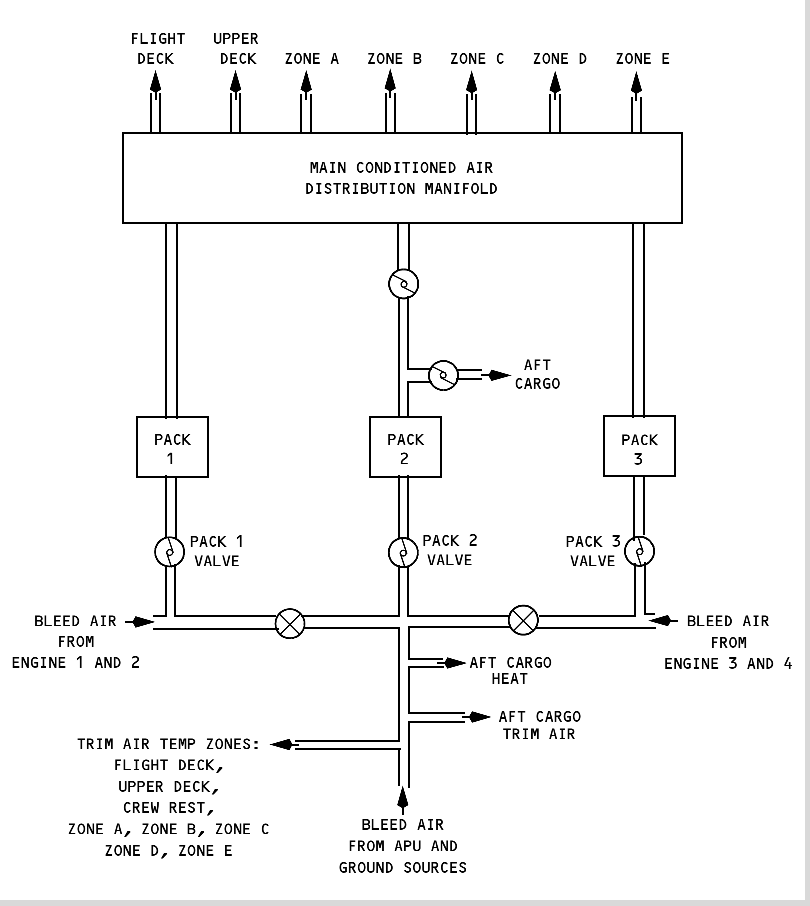
When a Cargo Fire Arm switch is pushed, pack operation and air distribution is configured to starve the affected zone of fresh air, minimize air movement, purge smoke from the flight deck and passenger cabin, and assure the supply of fresh air to the flight deck.

Crew Rest Smoke Detection Mode

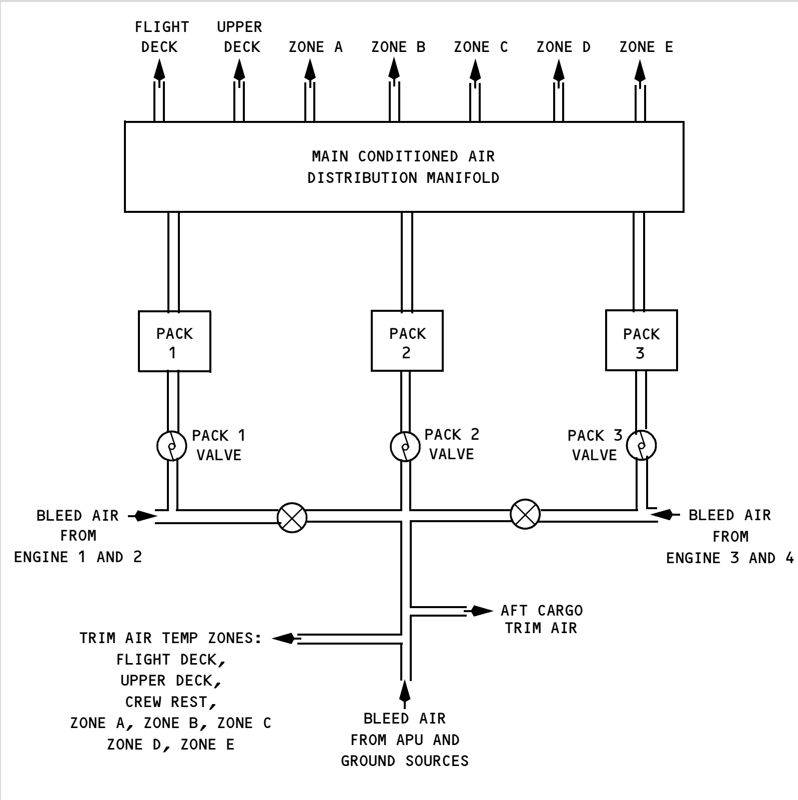
If smoke is detected in the door five crew rest, the crew rest air supply valves close and the recirculation fans shutdown. The valves remain closed and the fans remain shutdown until reset. Pushing the Door 5 Crew Rest Reset switch opens and resets the valves and resets the recirculation fans if smoke is no longer detected.

Air Distribution Diagram

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



Temperature Control

Zone temperatures are controlled by the zone temperature controller (ZTC).

Hot trim air from the bleed air system is added through trim air valves in the zone conditioned air supply ducts. The ZTC modulates the zone trim air valves to regulate the temperature of the conditioned air in each zone.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

The temperature zone requiring the coolest temperature controls pack outlet temperature.

Cargo Conditioned Air Flow Rate Selector OFF

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

When the Cargo Conditioned Air Flow Rate selector is OFF, the temperature zone requiring the coolest temperature controls pack outlet temperature.

EI-XLZ, VP-BKL
(VP-BKJ, VP-BVR ; SB installs three position selector)

Cargo Conditioned Air Flow Rate Selector in LO or HI

(VP-BKJ, VP-BVR ; before SB, four position selector is installed)

Cargo Conditioned Air Flow Rate Selector in LO or MED

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

EI-XLZ, VP-BKL
(VP-BKJ, VP-BVR ; SB installs three position selector)
When the Cargo Conditioned Air Flow Rate selector is in HI, pack three outlet temperature is controlled to maintain the cargo compartment at the temperature set by the Cargo Temperature selector. The flight deck or passenger temperature zone requiring the coolest temperature controls pack one and two outlet temperature.

(VP-BKJ, VP-BVR ; before SB, four position selector is installed)
When the Cargo Conditioned Air Flow Rate selector is in MED, pack three outlet temperature is controlled to maintain the cargo compartment at the temperature set by the Cargo Temperature selector. The flight deck or passenger temperature zone requiring the coolest temperature controls pack one and two outlet temperature.

When the Cargo Conditioned Air Flow Rate selector is in LO, the ZTC limits pack three outlet temperature to be not warmer than pack one and two outlet temperature. The ZTC regulates cargo temperature by;

- closing the trim air modulating valve and regulating pack three outlet temperature to supply cooler conditioned air, or
- modulating the cargo trim air valve to supply warmer conditioned air.

Cargo trim air is supplied directly from the bleed air duct and is not controlled by the Master Trim Air valve.

Passenger Zone Target Temperatures

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The Passenger Temperature selector sets the master passenger cabin temperature to between 65°F (18°C) and 85°F (29°C).

The target temperatures of each passenger zone may be modified plus or minus 10°F (6°C) within the range of 65°F (18°C) to 85°F (29°C) from the master temperature. This is accomplished with the cabin temperature panel located at door two right.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
The cabin temperature panel accepts temperature modifications when at least two engines are operating.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
The cabin temperature panel accepts temperature modifications when at least one engine is operating.

Passenger Zone Target Temperatures

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The Passenger Temperature selector sets the master passenger cabin temperature to between 65°F (18°C) and 85°F (29°C). The master passenger cabin temperature for all passenger temperature zones is automatically increased or decreased and may be manually modified to set target temperatures for each passenger temperature zone.

Automatic Passenger Comfort Compensation Of Zone Target Temperatures

For passenger comfort, the ZTC compensates for temperature changes as cabin air humidity and passenger activity decrease during flight. The passenger cabin zone target temperatures slowly increase automatically during the early part of the flight. The flight crew does not have to manually increase target temperatures to compensate for the increase in humidity and decrease in passenger activity. Target temperatures decrease slowly automatically during descent until all passenger comfort temperature compensation is removed.

Manual Modifications To Zone Target Temperatures

The target temperatures of each passenger zone may be further modified plus or minus 10°F (6°C) within the range of 65°F (18°C) to 85°F (29°C) from the comfort compensated master temperature. This is accomplished with the cabin temperature panel located at door two right.

VQ-BHW, VQ-BHX
The cabin temperature panel accepts temperature modifications after reaching cruise flight until start of descent.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
The cabin temperature panel accepts temperature modifications when at least two engines are operating.

Temperature Control With Loss of Trim Air System

Trim air is not available to the flight deck, upper deck, and main deck conditioned air distribution system if:

- the EICAS advisory message TEMP ZONE is displayed,
- the center section of the bleed duct is isolated,

- the EICAS advisory message TRIM AIR OFF is displayed, or
- the Master Trim Air switch is OFF.

If trim air is not available to the distribution system, backup modes control temperature in the passenger temperature zones of the cabin:

- if the Passenger Temperature selector setting is available to the PTC, pack outlet temperature is regulated to achieve an average temperature between 65°F (18°C) and 85°F (29°C), as set by the Passenger Temperature selector, or
- if the Passenger Temperature selector setting is unavailable to the PTC, pack outlet temperature is regulated to achieve the last passenger temperature set, or
- if the last passenger temperature set is unavailable to the PTC, pack outlet temperature is regulated to achieve an average cabin temperature of 75°F (24°C)

Temperature Control of Lower Aft Cargo With Loss of Trim Air
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Trim air is not available to the lower aft cargo compartment if:

- the center section of the bleed duct is isolated, or
- the EICAS advisory message TEMP CARGO A/C is displayed.

If trim air is not available to the lower aft cargo distribution system, backup modes control temperature in the cargo temperature zone:

- if the Cargo Temperature selector setting is available to the PTC, pack three outlet temperature is regulated to achieve the temperature set by the selector, or
- if the Cargo Temperature selector setting is unavailable to the PTC, pack three outlet temperature is regulated to achieve the cargo temperature sensed at the time backup mode was initiated, or
- if cargo temperature is unavailable to the PTC, pack three outlet temperature is controlled to the outlet temperature sensed at the time backup mode was initiated.

However, if trim air is not available to the lower aft cargo distribution system and the Cargo Conditioned Air Flow Rate selector is in LO, the PTC will not regulate lower aft cargo temperatures to be warmer than passenger cabin temperatures.

Temperature Control Non-Normal Operation

If a system fault or overheat occurs in the flight deck or a passenger zone, the master trim air valve closes and a backup mode controls cabin temperature. An attempt to restore zone temperature control can be made by pushing the Zone Reset switch.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

If a system fault or overheat occurs in the lower cargo air conditioning air zone, a cargo zone trim air shutoff valve closes and a backup mode controls temperature. Positioning the Cargo Temperature selector from AUTO to MAN or from MAN to AUTO resets cargo air conditioning, allows the cargo zone trim air shutoff valve to reopen, and clears the backup mode. Positioning the Cargo Conditioned Air Flow Rate selector to OFF also resets cargo air conditioning, allows the cargo zone trim air shutoff valve to reopen when cargo conditioned air is reselected, and clears the backup mode.

Cargo Heat

When the equipment cooling system inboard exhaust valve is open, the heated air exhausted from the electrical and electronic (E & E) compartment heats the forward cargo compartment.

Aft cargo heat is provided by bleed air from the center section of the bleed air duct. A thermal switch in the compartment opens and closes the temperature control valve. When the compartment is cool, the thermal switch opens the valve. When the compartment warms, the thermal switch closes the valve.

An overheat thermal switch provides overheat protection by opening and closing an overheat/shutoff valve at higher temperatures.

The Aft Cargo Heat switch is normally off until after engine start to increase bleed air available for engine start. With the switch off, the electrically operated aft cargo heat valves remain closed, thus decreasing bleed air demand from the APU and ground source.

Cargo Heat With Aft Cargo Conditioned Air

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The Aft Cargo Heat switch is normally pushed ON when aft cargo conditioned air is selected. This configuration ensures the compartment floor temperature is maintained above freezing.

Gasper System

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The gasper system supplies recirculated air drawn from the upper passenger cabin area. Gasper air is distributed to the passenger service unit air gasper outlets above each passenger seat.

Pilot Auxiliary Heat

Flight crew shoulder heat is provided by electric elements in the side window and pilot shoulder air diffusers. The foot heaters have electric heating elements under the pilot foot area. Shoulder heat and foot heat are available in flight.

Humidification

EI-XLC, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The humidification system operates when the Humidification switch is ON. The system uses water from the potable water system to introduce moisture into the circulation air. Minerals in the potable water may precipitate as solids when the humidification system operates. These solids may circulate in the cabin as dust or haze.

Lavatory and Galley Ventilation

Two ventilation fans, a primary and a backup, draw air from the galleys and lavatories. If the primary fan fails, the backup fan operates automatically.

Conditioned air is provided to the galleys from the air distribution system.

Equipment Cooling

The equipment cooling system provides cooling air for flight deck equipment and the electrical and electronic (E & E) compartment equipment racks. The system uses internal fans and valves to direct cool cabin air from inside the lower fuselage into the equipment racks. The warm exhaust air is ducted into the forward cargo compartment, recirculated in a closed loop mode through the E & E compartment cooling racks, or ducted overboard.

On the ground, with the engines not operating, the Equipment Cooling selector in NORM, and ambient temperatures moderate or high, the warm exhaust air is ducted overboard through the ground exhaust valve. With lower ambient temperatures, the ground exhaust valve is closed and the system is configured for flight.

On the ground, when one or more engines on each wing are operating, the system configures for flight to allow cabin pressurization. Positioning the Equipment Cooling selector to STBY closes the ground exhaust valve to manually configure the airplane for flight.

In flight configuration, the inboard exhaust valve is open and the warmed equipment cooling exhaust air discharges into the forward cargo compartment.

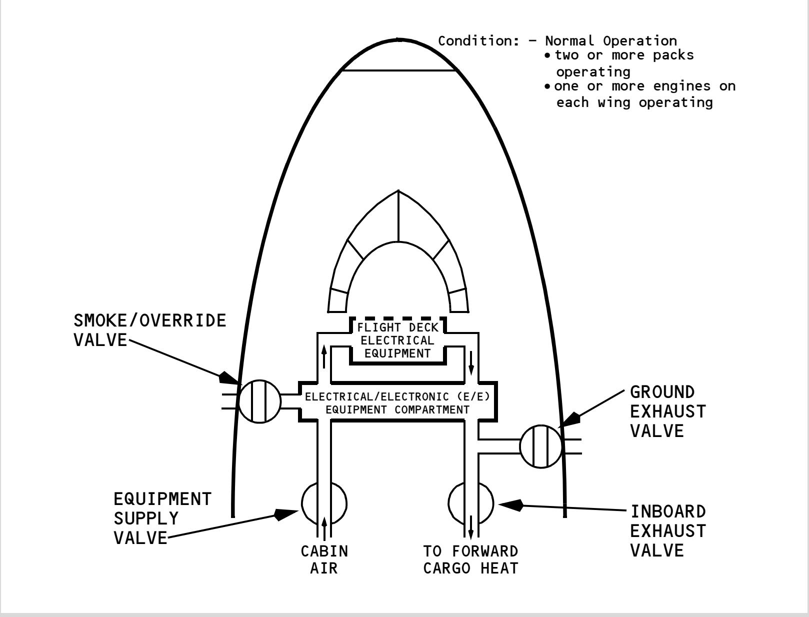
With the Equipment Cooling selector in NORM or STBY, the system normally configures to closed loop mode if a single internal fan fails. In closed loop mode, the inboard exhaust valve is closed.

Equipment Cooling Non-Normal Operation

With the Equipment Cooling selector in NORM, the airplane on the ground, and with one or more engines on each wing operating, the EICAS alert message EQUIP COOLING is displayed if the equipment cooling system is not configured for flight. Positioning the selector to STBY configures the system for flight.

An override mode provides equipment cooling in flight if internal fans are inoperative. With the Equipment Cooling selector in OVRD, the internal fans are not powered and the smoke/override valve opens with all other valves closed. The smoke/override valve opens to an overboard vent allowing cabin differential pressure to draw air from the panels area on the flight deck, through the equipment cooling ducts to the E & E compartment equipment racks, to create a reverse flow of air across the equipment, then through the supply duct, and overboard.

Equipment Cooling Diagram



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Introduction

Cabin pressurization is controlled by regulating the discharge of conditioned cabin air through the outflow valves.

Two outflow valves are installed at the rear of the cabin. The valves normally operate in parallel. Cabin altitude and full ventilation rates can be maintained by either valve.

There are two cabin altitude controllers, A and B. Each controller controls both outflow valves.

Positive and negative pressure relief valves protect the fuselage against excessive pressure differential.

The pressurization system has automatic and manual operating modes. Other than accomplishing normal procedures for entering FMC data, no specific flight crew action is required for fully automatic operation for all flights with a landing below 8,000 feet.

Pressurization System Automatic Operation

In flight, the cabin altitude controllers operate in a climb mode, a cruise mode, or a descent mode.

The controllers use ambient pressure and flight plan data from the FMC to calculate a cabin pressurization schedule. The schedule provides a comfortable cabin climb to cruise altitude.

For takeoff, the system provides a small positive pressurization prior to rotation to cause a smooth transition to the cabin altitude climb schedule.

In cabin altitude controller climb mode, cabin altitude increases on a schedule related to airplane climb rate and flight plan cruise altitude. When the FMC climb path has a planned level segment, it is included in the total time required for the airplane to reach the top of climb. Cabin altitude continues to increase during the level segment. When the airplane climb flight path is above the FMC climb path and maximum cabin pressure differential is reached during the climb, cabin rate then becomes a function of airplane climb rate so maximum cabin differential pressure is not exceeded.

If cruise altitude is unavailable from the FMC in AUTO, the cabin altitude controllers assume a cruise altitude of 39,000 feet.

In cabin altitude controller cruise mode, maximum cabin altitude is 8,000 feet. When the takeoff field elevation is higher than 8,000 feet, the cabin descends to the cabin cruise altitude while the airplane is climbing.

The cabin altitude controllers enter cabin altitude controller descent mode at T/D or at initial descent of approximately 1,000 feet from cruise altitude, regardless of T/D.

In cabin altitude controller descent mode, cabin altitude decreases or increases to slightly below the FMC planned landing altitude in AUTO or the landing altitude set in MAN. The slight altitude difference assures a small positive pressurization at touchdown. In MAN, FMC altitude information is bypassed and the cabin altitude controller uses internal rate schedules to control cabin altitude.

Landing elevation limits are 1,000 feet below sea level to 14,000 feet above sea level. The captain altimeter setting provides landing altitude barometric pressure correction.

At touchdown, the outflow valves open to depressurize the cabin.

The cabin altitude limiter closes both outflow valves if cabin altitude exceeds 11,000 feet.

Full automatic operation of cabin altitude is possible with one outflow valve operating automatically and the other outflow valve not operating. For this configuration, one pack is selected off to ensure cabin doors may be opened regardless of the position of the outflow valves if an emergency evacuation is required immediately after landing.

Supplemental Procedure Landing Airport Between 8,000 Feet and 10,000 Feet

To avoid the cabin altitude controllers inadvertently entering descent mode during cruise, which would allow cabin altitude to immediately begin increasing to FMC landing altitude, the landing altitude is set to 8,000 feet or in MAN during climb and cruise.

Cabin Altitude Controller Automatic Operation With Loss of Landing Altitude

If landing altitude is unavailable from the FMC and not set in MAN, the EICAS advisory message LANDING ALT is displayed and the cabin altitude controllers assume a landing altitude of 2,000 feet.

Pressurization System Manual Operation

If both Outflow Manual switches are ON, all automatic cabin altitude control functions are bypassed. For this configuration, one pack is selected off to ensure cabin doors may be opened regardless of the position of the outflow valves if an emergency evacuation is required immediately after landing.

Pressurization Relief

Two mechanical positive pressure relief valves prevent overpressurization of the airplane. One or both valves open if cabin pressure becomes excessive, and close when cabin pressure is no longer excessive. Pack two shuts down to assist in relieving excess cabin pressure. Pack two resets when both cabin pressure relief valves close.

Negative pressure relief valves in the forward and aft cargo doors open when the airplane cabin pressure is slightly less than outside air pressure. The valves also open to relieve any existing differential pressure when a cargo door is unlatched.

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Introduction

Bleed air can be supplied by the engines, APU, or a ground air source.

Bleed air is used for:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

- air conditioning
- pressurization
- wing and engine anti-icing
- engine start
- leading edge flaps
- aft cargo heat
- cargo smoke detection
- hydraulic reservoir pressurization
- potable water tank pressurization
- air driven hydraulic demand pumps
- thrust reversers

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

- air conditioning
- pressurization
- wing and engine anti–ice
- engine start
- leading edge flaps
- aft cargo heat
- cargo smoke detection
- hydraulic reservoir pressurization
- potable water tank pressurization
- air driven hydraulic demand pumps

Engine Bleed Air Supply

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Engine bleed air is supplied from either the IP or HP engine sections. IP air is used during high power setting operations. HP air is used during descent and other low power setting operations.

To prevent damage to ducting and equipment downstream, the PRV limits bleed air pressure. The fan air precooler regulates bleed air temperature.

With an Engine Bleed Air switch ON, system logic allows bleed air to open the HP bleed valve and the PRV and allows bleed air to open the respective engine bleed air valve and flow into the bleed air duct. The bleed air valves are pressure actuated and remain closed until engine bleed air pressure causes forward flow.

The engine bleed air valve regulates the engine bleed air to provide normal bleed air system pressure. It also prevents reverse flow of bleed air from the duct, except during the engine start sequence. When air pressure in the bleed air duct from the APU, ground air, or another engine is higher than the bleed air from an engine, the engine bleed air valve closes to prevent reverse flow.

During engine start, the engine bleed air valve opens and allows reverse flow of air from the bleed air duct to open the start valve. The PRV is positively closed to prevent reverse air flow into the engine compressor sections. Any time the engine start valve is not fully closed, the PRV remains positively closed. After N2 increases past 50%, the start valve closes which enables the PRV to open and the engine bleed air valve reverse flow prevention is enabled.

If the engine start valve fails to close, bleed air is isolated from the engine starter because both the PRV and the engine bleed air valve remain closed. Nacelle anti-ice is not available for the respective engine.

If an Engine Bleed Air switch is off, the respective engine bleed air valve, PRV, and HP bleed valve are closed.

If a bleed air overheat is detected, the PRV and HP bleed valves close. Pushing an Engine Bleed Air switch from off to ON resets the engine bleed fault detection system.

Bleed air is available for nacelle anti-ice operation with the Engine Bleed Air switch ON except when:

- the PRV has failed closed, or
- the PRV has been closed due a bleed air overheat, or
- the start valve is not closed

Bleed air is available for nacelle anti-ice operation with the Engine Bleed Air switch off except when:

- the PRV has failed closed, or
- the PRV has been closed due a bleed air overheat, or
- the start valve is not closed, or
- the HP bleed valve is failed open

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Bleed air is available for thrust reverser operation with the Engine Bleed Air switch either ON or off except when:

- the PRV has failed closed, or
- the PRV has been closed due a bleed air overheat, or
- the start valve is not closed

Engine Bleed Air Supply
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Engine bleed air is supplied from either IP or HP engine sections. IP air is used during high power setting operations. HP air is used during descent and other low power setting operations.

To prevent damage to ducting and equipment downstream, the FWSOV closes if the HP bleed valve fails to close when commanded. The fan air precooler regulates bleed air temperature.

With an Engine Bleed Air switch ON, system logic allows bleed air to open the HP bleed valve and the FWSOV and allows bleed air to open the respective engine bleed air valve and flow into the bleed air duct. The bleed air valves are pressure actuated and remain closed until engine bleed air pressure causes forward flow.

The engine bleed air valve regulates the engine bleed air to provide normal bleed air system pressure. It also prevents reverse flow of bleed air from the duct, except during the engine start sequence. When air pressure in the bleed air duct from the APU, ground air, or another engine is higher than the bleed air from an engine, the engine bleed air valve closes to prevent reverse flow.

If the engine start valve fails to close, bleed air is isolated from the engine starter because both the FWSOV and the engine bleed air valve remain closed. Nacelle anti-ice is not available for the respective engine.

During engine start, the engine bleed air valve opens and allows reverse flow of air from the bleed air duct to open the start valve. The FWSOV is positively closed to prevent reverse air flow into the engine compressor sections. Any time the engine start valve is not fully closed, the FWSOV remains positively closed. After N3 increases past 50%, the start valve closes which enables the FWSOV to open and the bleed air valve reverse flow prevention is enabled.

If an Engine Bleed Air switch is off, the respective engine bleed air valve, FWSOV, and HP bleed valve are closed.

If a bleed air overheat is detected, the FWSOV and HP bleed valves close. Pushing an Engine Bleed Air switch from off to ON resets the engine bleed fault detection system.

Bleed air is available for nacelle anti-ice operation with the Engine Bleed Air switch ON except when:

- the FWSOV is closed by a bleed air overpressure, or
- the FWSOV is closed by a prior or present strut overheat, or
- the start valve is not closed, or
- the HP bleed valve is failed open

Bleed air is available for nacelle anti-ice operation with the Engine Bleed Air switch off except when:

- the FWSOV has failed closed, or
- the FWSOV has been closed due a bleed air overheat, or
- the start valve is not closed, or
- the HP bleed valve is failed open

APU Bleed Air Supply

APU bleed air is used primarily during ground operations for pack operation and engine starting. APU bleed air is available in flight.

With the APU bleed air switch ON, the APU bleed valve opens when the APU can supply bleed air. The EICAS memo message APU RUNNING is displayed when APU N1 is 95% and higher. APU bleed air is supplied through the center section of the bleed air duct. The check valve in the APU supply line prevents reverse flow of bleed air from the duct into the APU.

Bleed duct overheat protection is provided in the APU bleed air system to detect leaks. If the APU shuts down for an overheat, it cannot be restarted.

Ground Bleed Air Supply

External connectors are provided to connect a ground source of high pressure air directly to the bleed air duct.

Check valves prevent reverse flow of bleed air from the bleed air duct to the connectors.

Bleed Air Duct System

The left and right isolation valves separate the bleed air duct into three sections: left, center, and right. The system normally operates with the isolation valves open. The valves are controlled by the left and right isolation valve switches.

Duct Leak and Overheat Detection System

A bleed duct overheat system is provided to detect leaks. If a duct leak is detected, the bleed air duct section affected can be isolated by closing the respective isolation and engine bleed air valves.

Bleed Air System Non-normal Operations

If a bleed duct leak is detected, closing the respective isolation and engine bleed valves prevents further air loss.

If the center duct section is isolated, pushing the Aft Cargo Heat switch off closes the electrically operated aft cargo heat valves to prevent cabin air flowing in reverse through the aft cargo heat supply duct and into the leaking center duct section. All temperature zones operate in backup temperature control mode without trim air. Potable water pressurization and cargo smoke detection are not available.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
If the left or right duct section is isolated, the respective leading edge flaps operate electrically in secondary mode. The respective hydraulic demand pump one or four is selected OFF to avoid the EICAS alert message HYD PRESS DEM from being displayed during approach. A maximum of one air conditioning pack on assures sufficient thrust is available from the two engines which supply air to the unaffected duct sections.

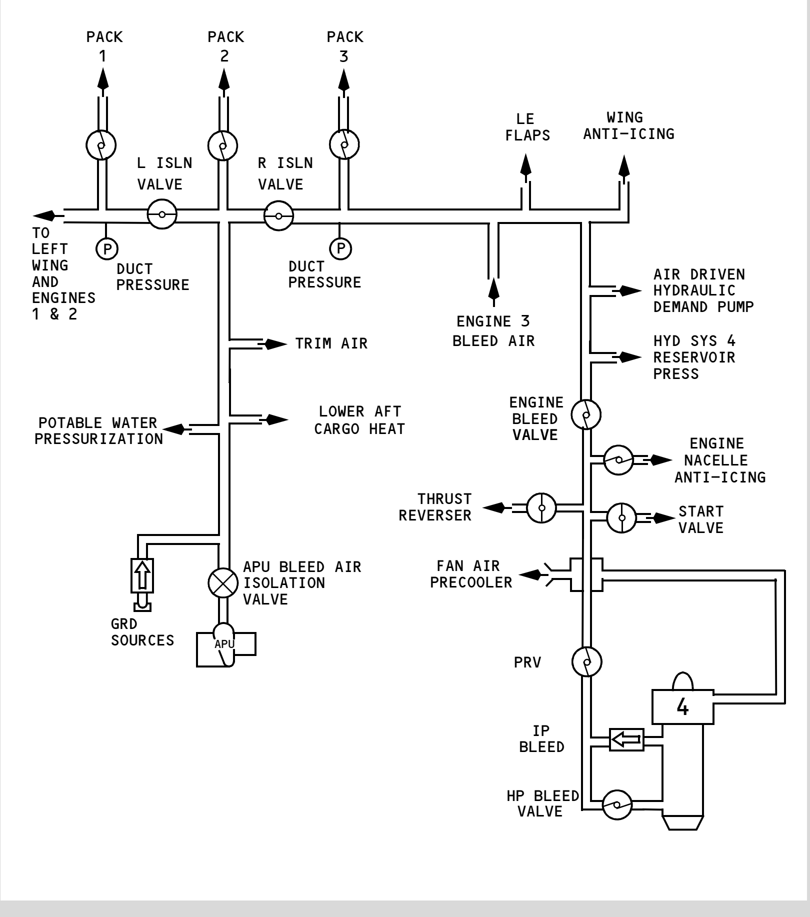
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
If the left or right duct section is isolated, the respective leading edge flaps operate electrically in secondary mode. The respective hydraulic demand pumps either one and two or three and four are selected OFF to avoid the EICAS alert message HYD PRESS DEM from being displayed during approach. A maximum of one air conditioning pack on assures sufficient thrust is available from the two engines which supply air to the unaffected duct sections.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
The EICAS alert message BLEED is displayed for bleed overpressure, or PRV or HP bleed valve failed to close when commanded. If the respective NAI VALVE message is displayed after pushing the related Nacelle Anti-ice switch ON, the PRV is closed because the HP bleed valve failed open and nacelle anti-ice is not available.

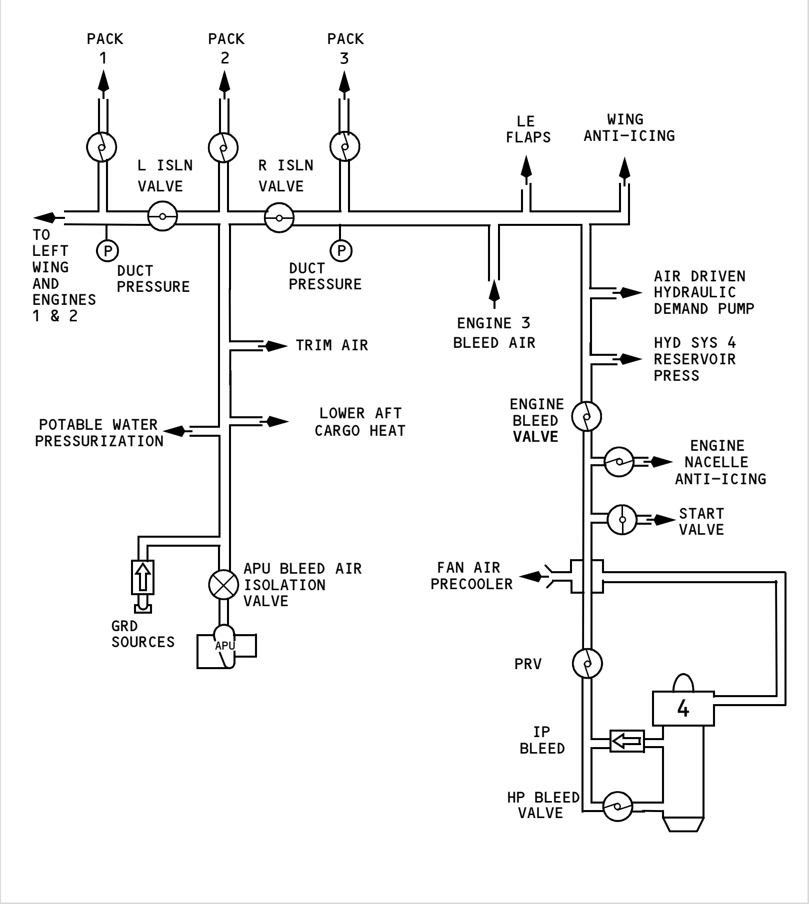
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
The EICAS alert message BLEED is displayed if the FWSOV or HP bleed valve fails to close when commanded. If the respective NAI VALVE message is displayed after pushing the related Nacelle Anti-ice switch ON, the FWSOV is closed because the HP bleed valve failed open and nacelle anti-ice is not available.

Bleed Air System Diagram

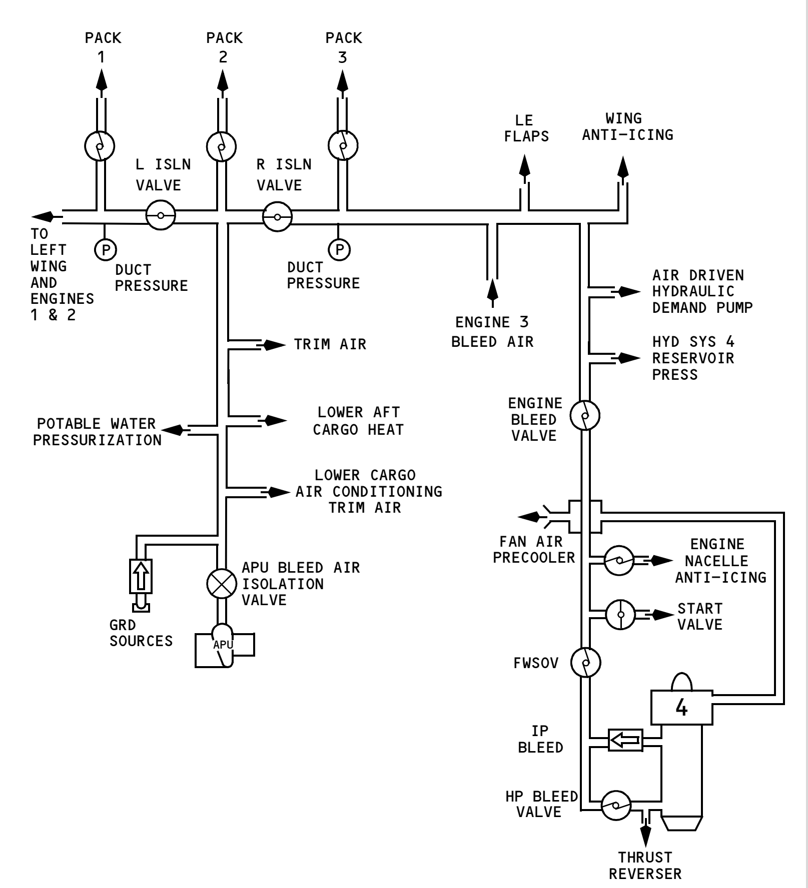
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



EICAS Alert Messages

Message	Level	Aural	Message Logic
BLD DUCT LEAK L, C, R	Caution	Beeper	Bleed air leak or overheat along left, center, or right duct section.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

BLD 1, 2, 3, 4 OVHT/PRV	Advisory		Engine bleed air overheat or PRV failed closed.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

BLD FWSOV 1, 2, 3, 4 OFF	Advisory		Engine bleed air overheat, engine bleed air overpressure, or FWSOV failed closed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

BLEED 1, 2, 3, 4	Advisory		Engine bleed air overpressure, or HP bleed valve or PRV failed to close when commanded.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

BLEED 1, 2, 3, 4	Advisory		FWSOV or HP bleed valve failed to close when commanded.

>BLEED 1, 2, 3, 4 OFF	Advisory		Engine Bleed Air switch OFF, engine operating, and engine bleed air valve closed.
BLEED HP ENG 1, 2, 3, 4	Advisory	Beeper	HP bleed valve failed closed..
>BLEED ISLN APU	Advisory		APU bleed isolation valve position disagrees with commanded position.
BLEED ISLN L, R	Advisory	Beeper	Isolation Valve switch position and valve position disagree.

Message	Level	Aural	Message Logic
CABIN ALT AUTO	Caution	Beeper	Both cabin altitude controllers failed or both Outflow Valve Manual switches ON.
CABIN ALTITUDE	Warning	Siren	Cabin altitude excessive.
>E/E CLNG CARD	Advisory		Fault in equipment cooling system and system not fully functional. Message inhibited in flight.
EQUIP COOLING	Caution	Beeper	With Equipment Cooling selector in NORM or STBY, airflow inadequate, or overheat or smoke detected; or with selector in OVRD, differential pressure for reverse flow cooling inadequate; or ground exhaust valve not in commanded position

EI-XLC, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

>HUMID FLT DK	Advisory		Fault in flight deck humidifier.

LANDING ALT	Advisory		Disagreement between controller landing altitude and FMC landing altitude, or landing altitude in MAN.
OUTFLOW VLV L, R	Advisory		Automatic control of outflow valve inoperative, or respective Outflow Valve Manual switch ON.
PACK 1, 2, 3	Advisory		Pack controller fault, or pack operation fault, or pack overheat, or pack 2 shutdown with either cabin pressure relief valve open.
PACK CONTROL	Advisory		Automatic control of outlet temperature of all packs has failed.
PRESS RELIEF	Advisory		Either pressure relief valve opens with all packs operating.

Message	Level	Aural	Message Logic
TEMP CARGO HEAT	Advisory		Overheat detected in aft cargo compartment when aft cargo heat system operating.
TEMP ZONE	Advisory		Zone duct overheat, or master trim air valve failed closed, or zone temperature controller failed. Master trim air valve driven closed and temperature controlled in backup mode.
>TRIM AIR OFF	Advisory		Master trim air valve closed. Flight deck and passenger cabin temperature controlled in backup mode.

EICAS Memo Messages

Message	Level	Aural	Message Logic
PACK 1, 2, 3 OFF	Memo		Pack switch off.
PACKS 1 + 2, 1 + 3, 2 + 3 OFF	Memo		Pack switches off.
PACKS HIGH FLOW	Memo		High flow switch ON. Pack flow setting not controlled automatically.
PACKS OFF	Memo		All pack switches off.

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Anti-Ice, Rain — Chapter 3

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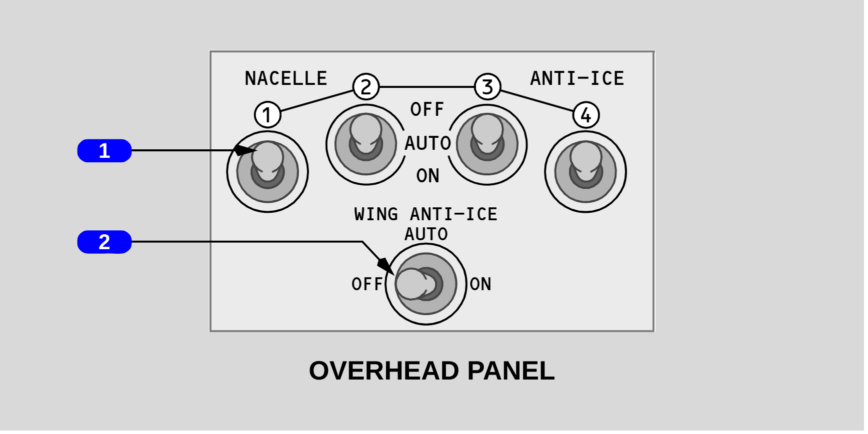
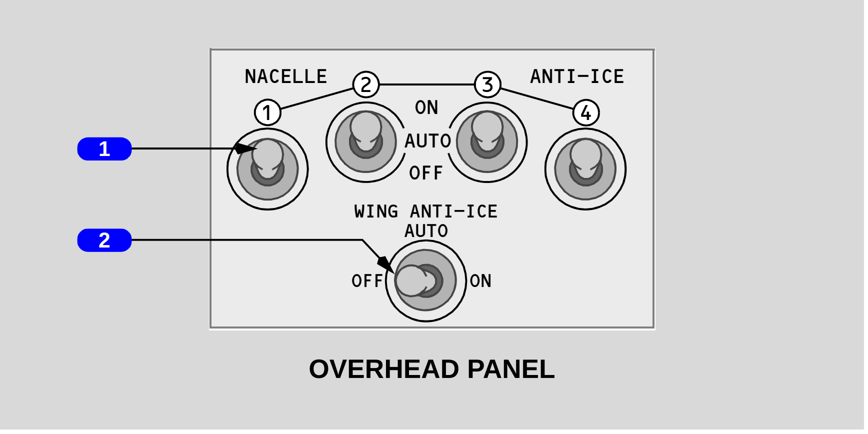
Nacelle and Wing Anti-Icing

Nacelle and Wing Anti-Ice Panel

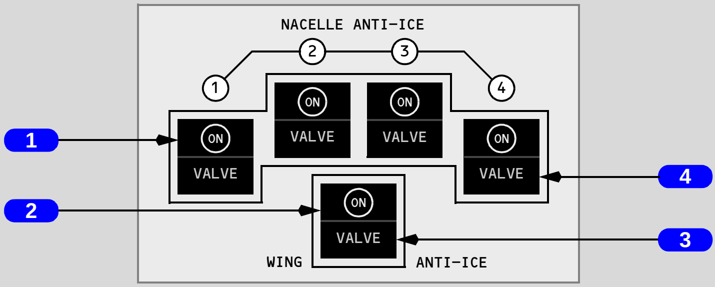
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



OVERHEAD PANEL

1 NACELLE ANTI-ICE Switches

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
OFF – the nacelle anti-icing valve is commanded closed

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Off – the nacelle anti-icing valve is commanded closed

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
AUTO – in flight, nacelle anti-icing operates when nacelle icing conditions exist. The requirements for valve operation are the same as the ON position.

ON–

- the nacelle anti-icing valve opens when engine bleed air pressure is available

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
- the engine igniters selected by the Auto Ignition selector and the EEC operate continuously
- the engine bleed PRV opens when the nacelle anti-icing valve is open, unless the PRV is closed by:
  - a prior or present bleed air overheat, or
  - the start valve not closed, or
  - the engine bleed HP valve failed open

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- the engine igniters selected by the Auto Ignition selector in 1, 2, or BOTH operate for the first 60 seconds

- the engine bleed FWSOV opens when the nacelle anti-icing valve is open, unless the FWSOV is closed by:
  - an overpressure, or
  - a prior or present strut overheat, or
  - the start valve not closed, or
  - the engine bleed HP valve failed open

2 WING ANTI-ICE Switch

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
OFF – the wing anti-icing valves are commanded closed.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Off – the wing anti-icing valves are commanded closed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
AUTO -

- in flight with leading edge flaps retracted, the wing anti-icing valves open when the icing detection system detects wing icing conditions
- on the ground, the system is off and the wing anti-icing valves are closed

ON -

- in flight, the wing anti-icing valves open to supply bleed air to the left and right wing leading edges
- on the ground, the system is off and wing ant-icing valves are closed

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

3 WING ANTI-ICE VALVE Light

Illuminated (amber) – the position of either wing anti-icing valve disagrees with the switch position.

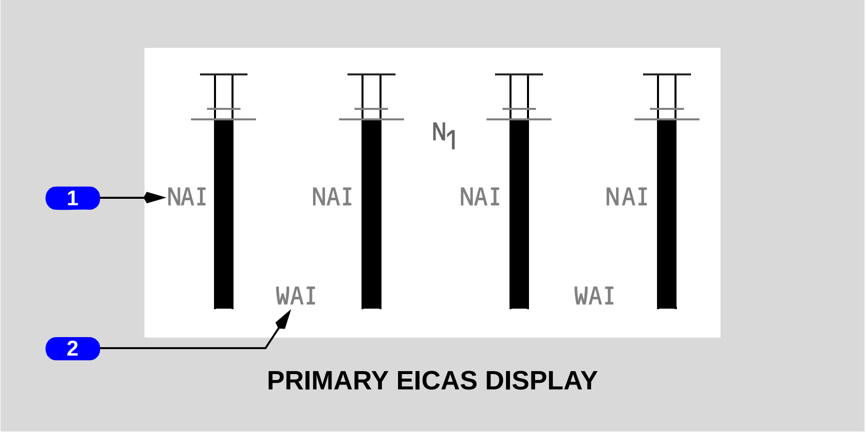
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

4 NACELLE ANTI-ICE VALVE Lights

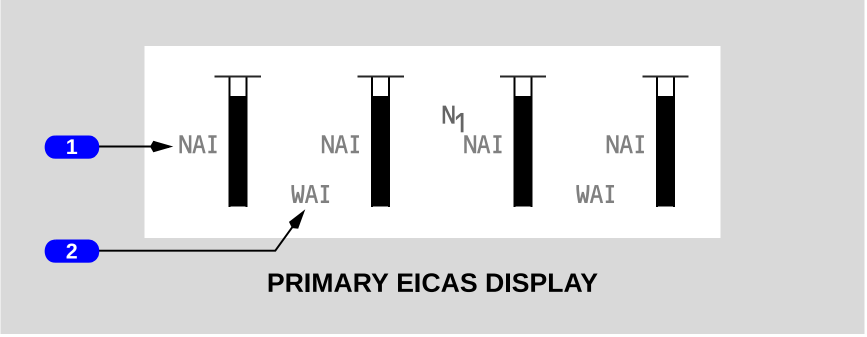
Illuminated (amber) – the position of the nacelle anti-icing valve disagrees with the switch position.

Anti-Icing Indications on EICAS Display

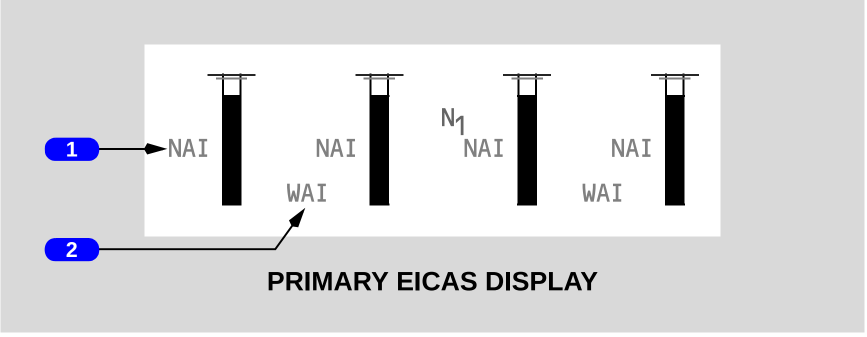
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Nacelle Anti-icing Indication

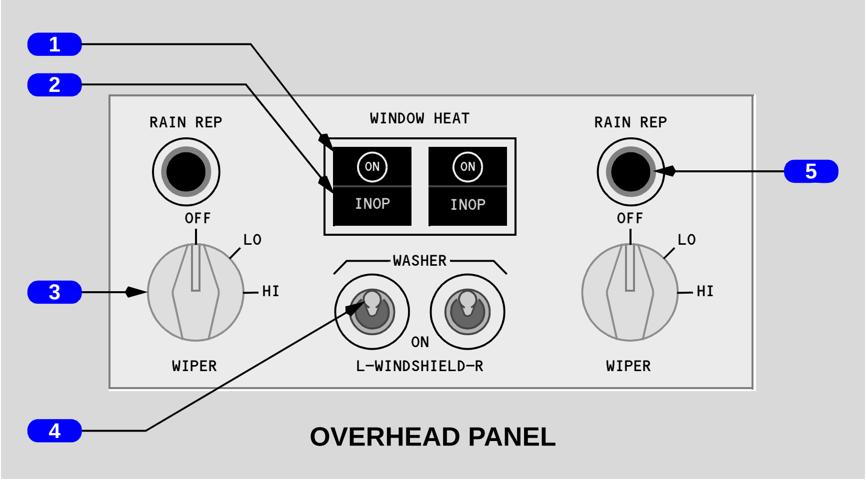
Displayed (green) – the nacelle anti-icing valve is open.

2 Wing Anti-Icing Indication

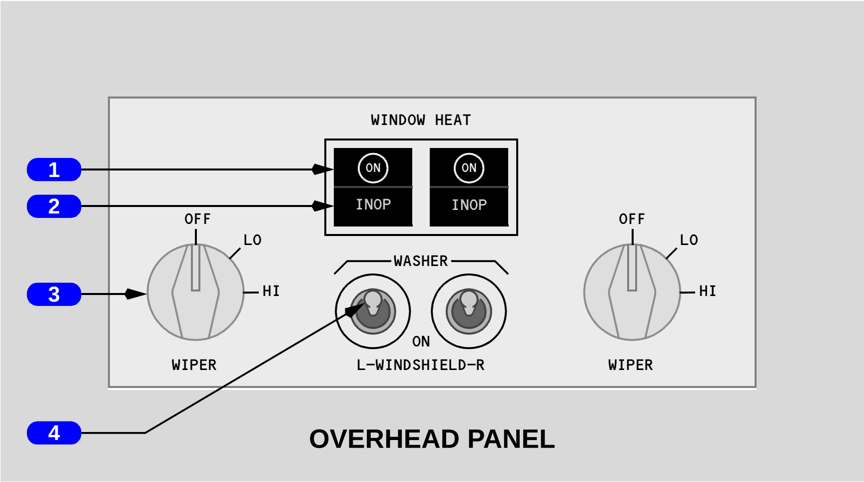
Displayed (green) – the wing anti-icing valve is open.

Windshield Heat and Washers
Windshield Heat and Washers Panel

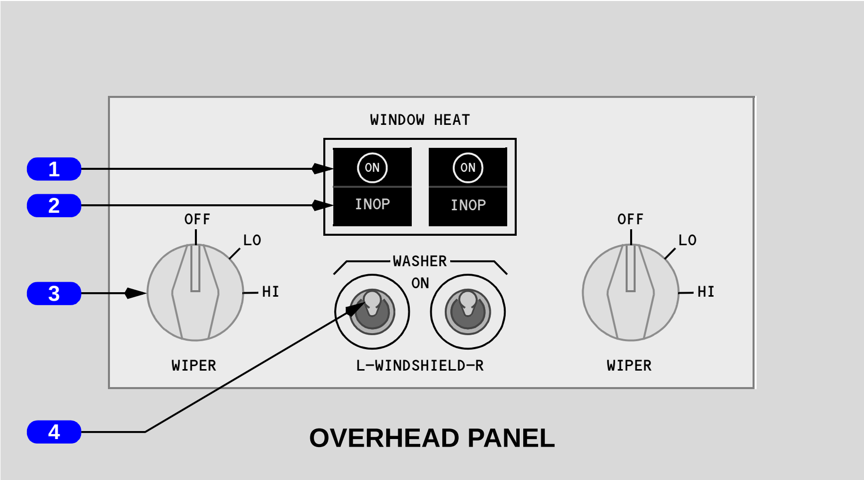
(VP-BKJ, VP-BVR ; before SB, rain repellent is installed)



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VP-BKJ, VP-BVR ; SB removes rain repellent)



VQ-BHW, VQ-BHX



1 WINDOW HEAT Switches

ON – controlled heat applied to the windshield

2 WINDOW HEAT Inoperative (INOP) Lights

Illuminated (amber) –

- The switch is off, or
- an overheat has occurred, or
- a system fault has occurred

3 Windshield WIPER Selectors

OFF – the wiper is off and is sequenced to stowed position

LO – the wiper operates at low speed

HI – the wiper operates at high speed

4 WINDSHIELD L, R WASHER Switches

Spring loaded to neutral

ON – applies washer fluid

(VP-BKJ, VP-BVR ; before SB, rain repellent is installed)

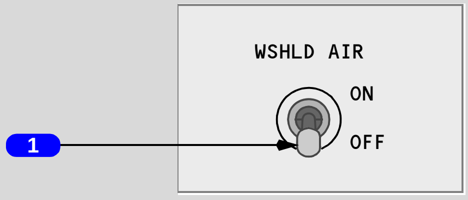
5 RAIN Repellent (REP) Switches

Push – a measured amount of rain repellent is applied to the windshield

Note: Do not use on a dry windshield.

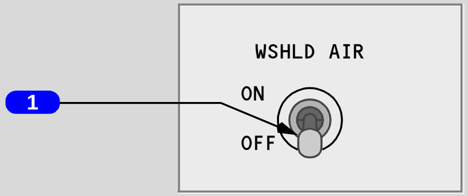
Windshield Air Switch

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



CAPTAIN AUXILIARY PANEL
FIRST OFFICER AUXILIARY PANEL

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

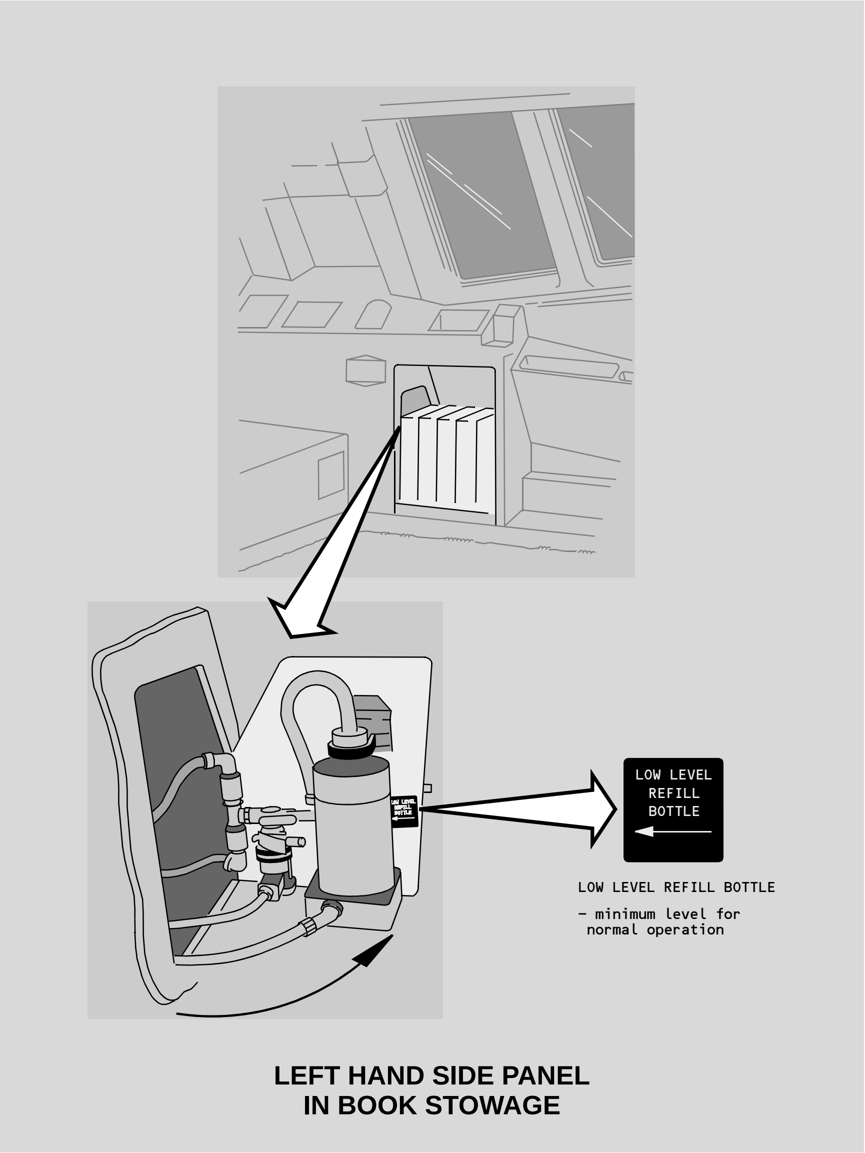


CAPTAIN AUXILIARY PANEL
FIRST OFFICER AUXILIARY PANEL

1 Windshield (WSHLD) AIR Switch

ON – air is provided to the windshield.

Windshield Washer Fluid



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Introduction

The anti-icing and rain systems include:

- icing detection
- engine nacelle inlet anti-icing
- wing anti-icing
- flight deck window heat
- windshield wipers
- probe heat

Anti-Icing Systems

Nacelle and wing anti-icing is provided by distributing engine bleed air to the nacelle inlets and to the wing leading edges.

Icing Detection

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The icing detection system detects airplane icing conditions in flight. Two probes on the forward fuselage and system logic:

- control nacelle and wing anti-icing valves,
- display anti-icing system operating indications on primary EICAS, and
- display EICAS alert messages

Icing Detection

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The icing detection system detects airplane icing conditions in flight. A probe on the left side of the forward fuselage and system logic:

- display anti-icing system operating indications on primary EICAS, and
- display EICAS alert messages

Nacelle Anti-Icing

The nacelle anti-icing valves are opened by engine bleed air pressure. When a nacelle anti-icing valve is open, NAI is displayed on the primary EICAS display.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
In flight, when a Nacelle Anti-Ice switch is in AUTO and nacelle icing conditions are detected, the respective nacelle anti-icing valve is commanded open.

When a Nacelle Anti-Ice switch is ON, the respective nacelle anti-icing valve is commanded open.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

When nacelle anti-icing is commanded on, the engine igniters selected by the Auto Ignition selector and EEC operate continuously.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

When nacelle anti-icing is commanded on, the engine igniters selected by the Auto Ignition selector operate for the first 60 seconds.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

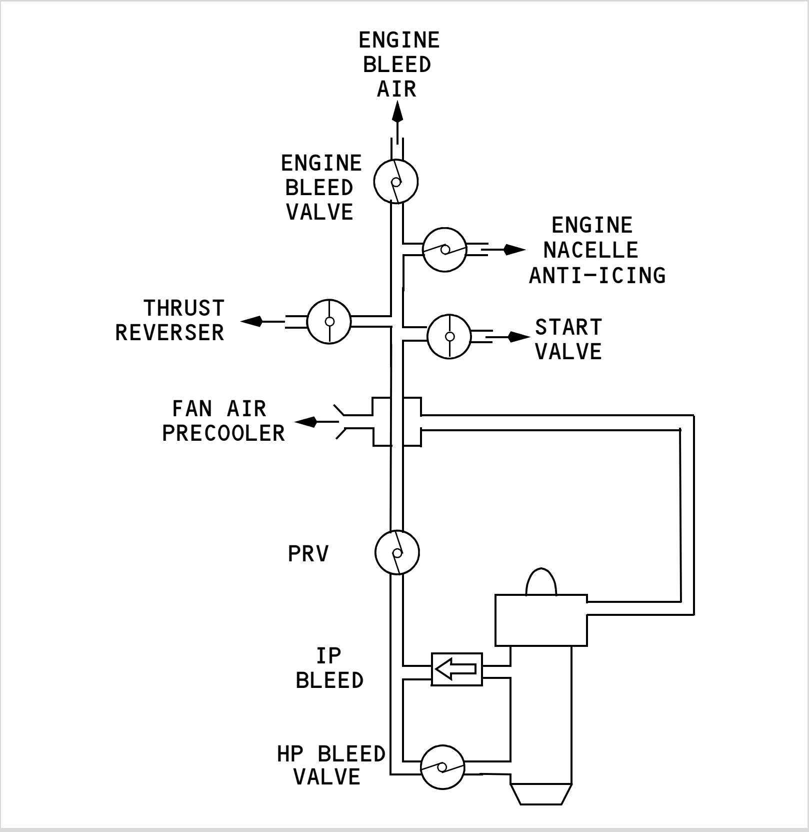
Bleed air is not available for nacelle anti-icing if the engine bleed PRV is closed because of:

- a prior or present bleed air overheat, or
- the start valve is not closed, or
- the engine bleed HP valve is failed open

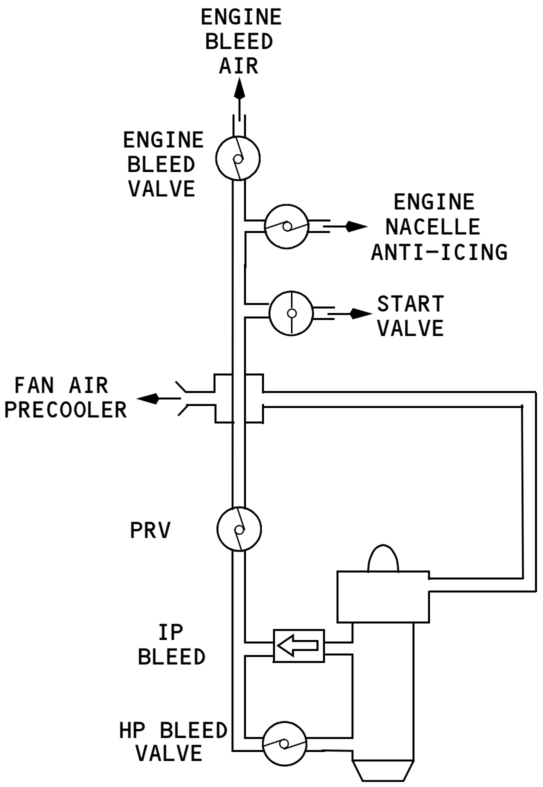
When nacelle anti-icing is commanded on with the engine bleed valve closed, the HP valve remains closed. Bleed air is supplied by IP bleed only.

Nacelle Anti-Icing System Diagram

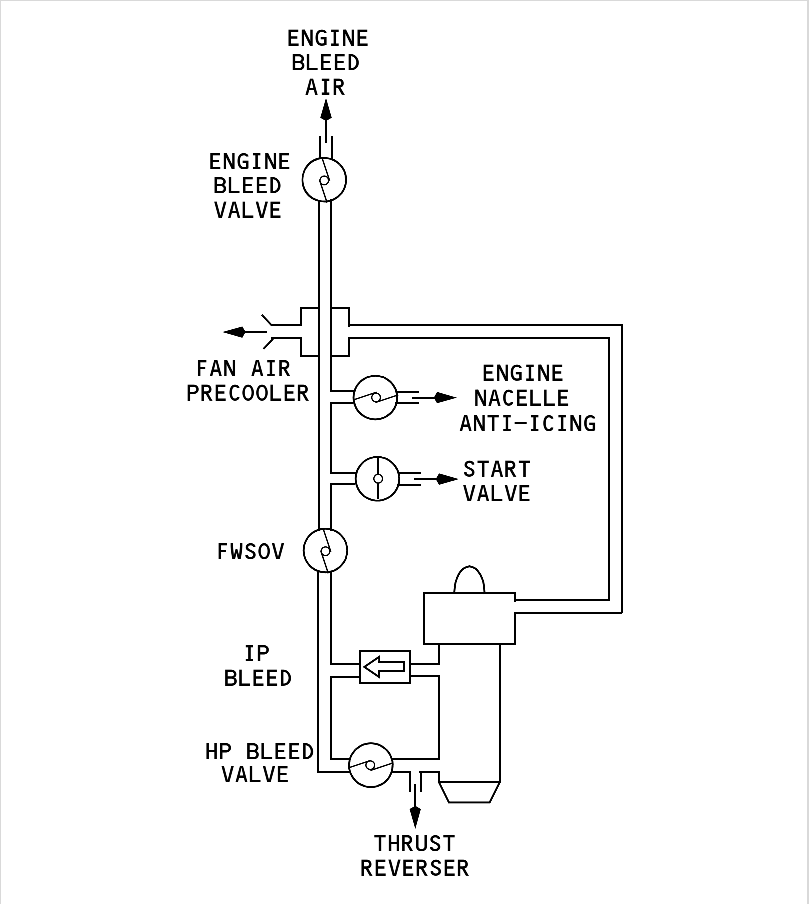
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



Wing Anti-Icing

When a wing anti-icing valve is open, WAI is displayed on the primary EICAS display.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

In flight, when the Wing Anti-Ice switch is in AUTO, the leading edge flaps are retracted, and wing icing conditions are detected, the wing anti-icing valves are commanded open.

In flight, when the Wing Anti-Ice switch is ON, the wing anti-icing valves open. Wing anti-icing is ineffective when the leading edge flaps are not retracted.

Flight Deck Windows

Flight deck windows are electrically heated. The forward windshields have anti-icing protection on the exterior surfaces, and anti-fogging heating on the interior surfaces. The side windows have controlled anti-fogging heating on the interior surfaces.

The window heat switches control heating for the forward windshields only. When the Window Heat switches are ON, electric power is supplied to the forward windshields.

Side window heating is automatic and no flight deck controls are provided. The system is powered whenever the AC electrical system is powered.

If a fault or overheat condition is sensed, power is disconnected from the respective forward windshield or side window system. Pushing a Window Heat switch off for 10 seconds, then ON, resets a forward windshield heat controller fault.

Windshield Wipers and Washers

The two speed windshield wipers are independently controlled. When a Wiper selector is OFF, the wiper is off and stowed.

If the wipers are used on a dry windshield, the wipers may scratch the windshield.

The Windshield Washer switches command a continuous application of washer fluid while held ON. The washer fluid reservoir is located behind the door in the book storage area on the Captain side panel. The reservoir has a sight gage and a refill reference mark.

Windshield Air

Windshield air switches on the Captain and First Officer auxiliary panels control anti-fogging air flow from the flight deck conditioned air supply.

Probe Heat

Four pitot-static probes and two angle of attack probes are electrically heated for anti-icing protection when any engine is operating. Two total air temperature probes are electrically heated for anti-icing protection in flight.

EICAS Alert Messages

Message	Level	Aural	Message Logic
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO			
>ANTI-ICE	Advisory		A Nacelle Anti-ice switch or the Wing Anti-ice switch is ON, and TAT is more than 12°C, and icing conditions do not exist.
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX			
>ANTI-ICE NAC	Advisory		A Nacelle Anti-ice switch is ON, and TAT is more than 12°C, and icing conditions do not exist.
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX			
>ANTI-ICE WING	Advisory		Wing Anti-ice switch is ON, and TAT is more than 12°C, and icing conditions do not exist.
HEAT L, R AOA	Advisory		AOA probe heat is failed.
HEAT L, R TAT	Advisory		TAT probe heat is failed, or on the ground, TAT probe is heated.
HEAT P/S CAPT, FO, L AUX, R AUX	Advisory		Pitot static probe heat is failed.
HEAT WINDOW L, R	Advisory		Forward window heat is not operating.
>ICE DETECTORS	Advisory		Icing detection system is failed.
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO			
>ICING	Caution	Beeper	Icing conditions exist, and Wing Anti-Ice switch is OFF or any Nacelle Anti-Ice switch is OFF.

Message	Level	Aural	Message Logic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

>ICING NAC	Caution	Beeper	Icing conditions exist and any Nacelle Anti-ice switch is OFF.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

>ICING WING	Advisory		Icing conditions exist and the Wing Anti-ice switch is OFF.

NAI VALVE 1, 2, 3, 4	Advisory		Nacelle anti-icing valve is not in the commanded position.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

>NO ICING	Advisory		Icing conditions do not exist.

WAI VALVE LEFT, RIGHT	Advisory		Wing anti-icing valve is not in the commanded position.

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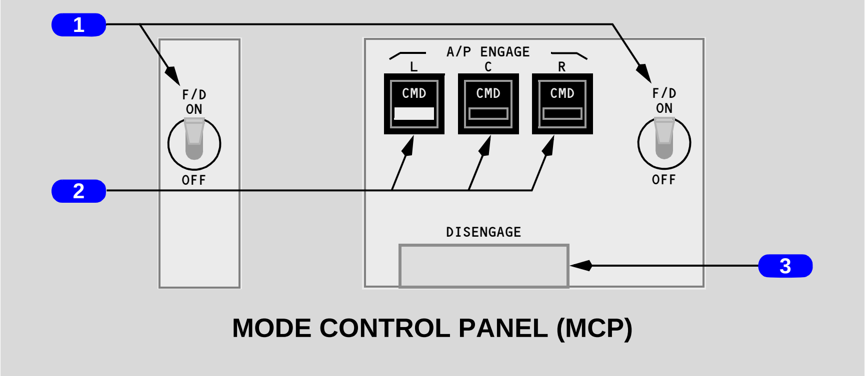
Mode Control Panel (MCP)

Autopilot Flight Director System (AFDS) Controls



1 Flight Director (F/D) Switches

The left F/D switch activates F/D steering indications on the left primary flight display (PFD). The right F/D switch activates F/D steering indications on the right PFD.

ON -

- on the ground with no autopilot (A/P) engaged and both F/D switches OFF, the first F/D switch positioned ON arms the F/D in the takeoff go-around (TO/GA) roll and pitch modes. Positioning the second F/D switch ON displays the flight direction steering indications on the second PFD
- in flight, with the A/P disengaged and both F/D switches OFF, the first F/D switch positioned to ON activates the F/D in:
  - vertical speed (V/S) as the pitch mode, and

  EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
  - heading hold (HDG HOLD) as the roll mode, or if bank angle greater than five degrees, attitude hold (ATT)

  EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
  - heading hold (HDG HOLD) as the roll mode

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
- in flight, with the A/P engaged and both F/D switches OFF, the first F/D switch positioned to ON activates the F/D in the selected A/P mode(s)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
- in flight, with the A/P engaged and both F/D switches OFF, the first F/D switch positioned to ON activates the F/D in the selected A/P mode(s). Command bars do not display when A/P and F/D using the same flight control computer

OFF -

- F/D steering indications do not display, unless
- a TO/GA switch is pushed when airspeed is greater than 80 knots and flaps out of up

2 Autopilot (A/P) ENGAGE Switches

Push (any switch engages the autopilot) -

- when either F/D switch is ON, the A/P engages in the selected F/D mode(s)
- when both F/D switches are OFF, the A/P engages in:
  - vertical speed (V/S) as the pitch mode and

  EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
  - heading hold (HDG HOLD) or attitude hold (ATT) as the roll mode

  EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
  - heading hold (HDG HOLD) as the roll mode

3 Autopilot DISENGAGE Bar

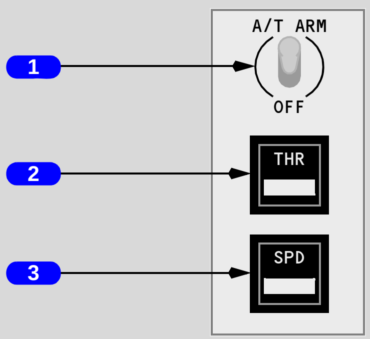
Push down -

- disengages all three A/Ps
- prevents A/P engagement
- exposes amber stripe

Lift up -

- enables A/P engagement
- conceals amber stripe

Autothrottle (A/T) System Controls



MODE CONTROL PANEL (MCP)

1 Autothrottle (A/T) ARM Switch

ARM -

- disconnects if more than one engine inoperative
- arms A/T system for mode selection
- A/T activates when VNAV, FLCH, or TO/GA switch pushed
- A/T activates when speed switch pushed and pitch mode is ALT, V/S, or G/S
- when A/T flight mode annunciation blank and pitch mode is VNAV XXX or FLCH SPD, cycling the A/T ARM switch to OFF and back to ARM activates the A/T

OFF -

- disconnects A/T
- disables A/T activation
- disables engine trim equalization

2 Thrust (THR) Switch

Operative from 400 feet after takeoff until landing; used to select climb thrust after takeoff or go-around.

Push -

Light remains extinguished (thrust limit function) -

- after takeoff with VNAV or FLCH selected, changes reference thrust limit to armed climb thrust limit, or CON if engine inoperative
- after go-around, changes reference thrust limit to CLB, or CON if engine inoperative or CON selected

Note: Reference thrust limit remains GA when flaps in landing position or pitch mode is G/S.

Light illuminates (A/T mode function) - Changes A/T mode to THR REF when:

- reference thrust limit is CLB, CLB1, CLB2, CRZ, or CON and pitch mode is ALT or V/S
- reference thrust limit is GA and pitch mode is G/S or FLARE, or pitch mode is ALT or V/S and flaps in landing position

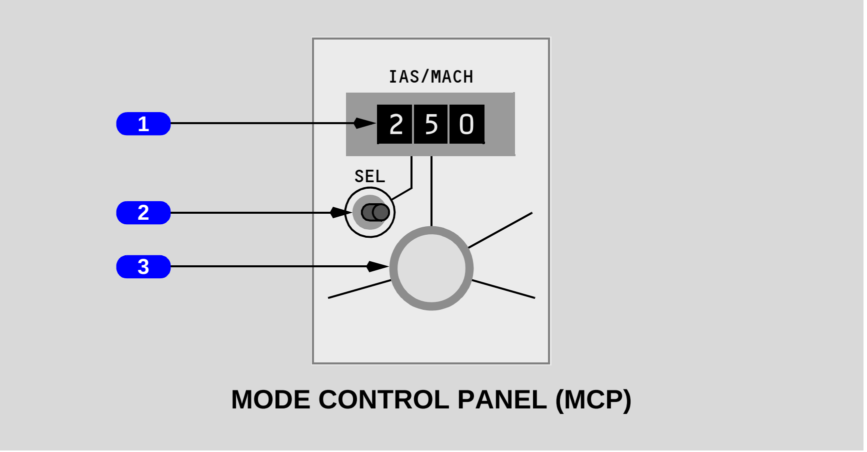
3 Speed (SPD) Switch

Operative from 400 feet after takeoff until landing.

Push (light illuminates) -

- selects A/T SPD mode
- displays SPD on both PFDs
- A/T controls thrust to maintain IAS or Mach displayed in IAS/MACH window subject to minimum and maximum speed limits
- inactive in VNAV XXX, FLCH SPD, or TO/GA pitch modes

Autopilot Flight Director IAS/Mach Controls



1 IAS/MACH Window

Displays selected speed when IAS/MACH selector controls command speed.

Blank when FMC controls command speed.

IAS/Mach window and PFD speeds set to 200 knots when power first applied.

Display range:

- 100 - 399 KIAS

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
- .40 - .95 Mach

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
- .400 - .950 Mach, three digit Mach displayed

Displays selected speed on PFD.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
In climb, changes from IAS to Mach at approximately .840 Mach.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
In climb, changes from IAS to Mach at approximately .84 Mach.

In descent, changes from Mach to IAS at approximately 310 knots.

2 IAS/MACH Select (SEL) Switch

Push -

- alternately changes the IAS/MACH window between IAS and Mach displays (Mach must be 0.4 or greater to switch from IAS to Mach)
- inoperative when the IAS/MACH window is blank

3 IAS/MACH Selector

Rotate -

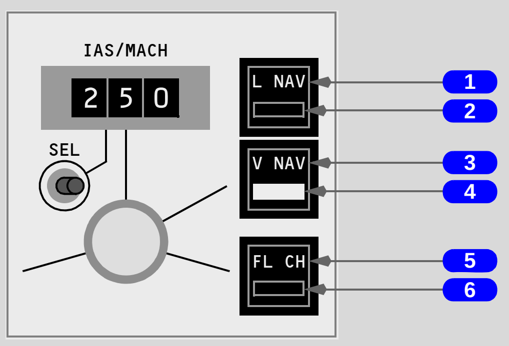
- sets speed in IAS/MACH window and command speed on both PFDs
- inoperative when IAS/MACH window blank

Push - with VNAV active, alternately opens or closes the IAS/MACH window:

- when window closed, FMC computed target speed is active and displays on PFDs
- when window open, FMC speed-intervention is active and IAS/MACH selector may be used to set command speed. Pitch mode annunciator changes to VNAV SPD when descending in VNAV PTH. Selected speed maintained by pitch until airplane intercepts an altitude constraint and VNAV PTH annunciates. When on approach, pitch mode remains VNAV PTH and A/T controls speed

IAS/MACH window open if pitch mode is FLCH SPD, V/S , TO/GA, ALT, or G/S.

Autopilot Flight Director Roll and Pitch Controls



MODE CONTROL PANEL (MCP)

1 Lateral Navigation (LNAV) Switch

Push -

- arms, selects, or disarms LNAV as roll mode
- displays LNAV in white (armed) on both PFD roll flight mode annunciations when armed. The previous roll mode remains active

- LNAV activates when the airplane is 50 feet above runway elevation and:
  - within 2.5 NM of the active leg
  - when not within 2.5 NM of the active leg but on an intercept heading to the active leg, remains armed then activates when approaching the active leg
  - when active, displays LNAV in green on PFD roll flight mode annunciation
- selection of LNAV with the airplane not on a heading to intercept the active leg, displays NOT ON INTERCEPT HEADING in the CDU scratch pad
- LNAV maintains current heading when:
  - passing the last active route waypoint
  - passing the last waypoint prior to a route discontinuity
  - passing the last route offset waypoint
  - activating the inactive route or activating an airway intercept and not within LNAV engagement criteria

LNAV deactivated:

- by selecting heading select (HDG SEL) or heading hold (HDG HOLD)
- by selecting TO/GA
- by disengaging autopilot and selecting both FDs OFF
- when localizer captures
- with dual FMC failure

LNAV is disarmed by pushing LNAV switch a second time or by selecting LOC or APP.

2 LNAV Light

Illuminated - LNAV roll mode armed or active.

3 Vertical Navigation (VNAV) Switch

Push -

- arms, selects, or disarms VNAV as pitch mode
- displays VNAV in white (armed) on both PFD pitch flight mode annunciations below 400 feet
- VNAV activates 400 feet above runway elevation
- when VNAV selected and FMC has insufficient data to provide VNAV guidance (such as invalid gross weight or there is no end-of-descent point in descent) displays PERF/VNAV UNAVAILABLE in CDU scratchpad
- VNAV SPD, VNAV PTH, or VNAV ALT pitch mode displays in green (active) on PFD pitch flight mode annunciator

- in VNAV SPD pitch mode, AFDS commands pitch to hold target airspeed. The A/T operates in THR REF, THR, IDLE or HOLD mode, as required by phase of flight
- in VNAV PTH pitch mode, AFDS commands pitch to maintain FMC target altitude or VNAV path; A/T operates in speed (SPD) mode
- in VNAV ALT pitch mode, AFDS commands pitch to maintain MCP selected altitude; A/T operates in SPD mode
- VNAV pitch guidance available with one or two engines inoperative

Note: In VNAV, if a conflict exists between the VNAV profile and the MCP altitude, the airplane levels and the pitch flight mode annunciation becomes VNAV ALT. Resetting the MCP altitude window and pushing the altitude selector continues the climb or descent. If below the VNAV path, resetting the MCP altitude window and intercepting the VNAV path will also continue the descent.

VNAV deactivated:

- by selecting TO/GA, FLCH SPD, V/S, ALT, or G/S pitch mode
- by disengaging autopilot and selecting both FDs OFF
- with a dual FMC failure

VNAV is disarmed by pushing VNAV switch a second time.

4 VNAV Light

Illuminated - VNAV pitch mode armed or active.

5 Flight Level Change (FLCH) Switch

Push -

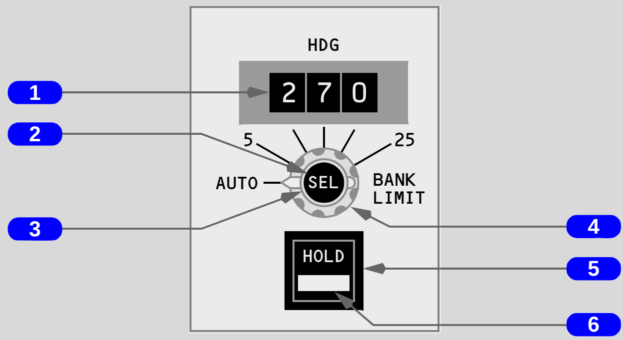
- selects FLCH SPD pitch mode
- FLCH SPD pitch mode displays in green (active) on PFD flight mode annunciator
- when IAS/MACH window blank, IAS/MACH window opens to FMC target speed, if valid. If not valid, IAS/MACH window opens to current speed
- when IAS/MACH window open, displays command speed
- when changing from TO/GA to FLCH, IAS/MACH window displays highest value of current airspeed or selected speed
- AFDS pitch holds selected speed. When selected altitude captured, pitch flight mode annunciator changes to ALT

- A/T operates in THR, followed by HOLD mode in descent. When selected altitude captured, A/T mode changes to SPD. A/T advances or retards thrust levers to maintain a vertical speed proportional to the altitude change requested
- with higher altitude set in the ALT window, reference thrust limit changes to CLB when CRZ displayed and to CON with an engine inoperative

6 Flight Level Change Light

Illuminated - flight level change pitch mode active.

Autopilot Flight Director Heading and Bank Angle Controls



MODE CONTROL PANEL (MCP)

1 Heading (HDG) Window

Displays selected heading.

Displays selected heading on PFDs and NDs.

HDG window, PFD, and ND headings set to 000 when power first applied.

Changes to ILS front course at LOC capture.

2 Heading Select (HDG SEL) Switch

Push -

- selects HDG SEL roll mode
- HDG SEL roll mode displays in green (active) on PFD roll flight mode annunciation
- AFDS controls roll to acquire and hold selected heading
- bank is limited by bank limit selector

3 Heading (HDG) Selector (inner)

Rotate - sets heading in HDG window and selected heading on PFDs and NDs.

4 BANK LIMIT Selector (outer)

Rotate - sets AFDS commanded bank limit when in heading select (HDG SEL) roll mode as follows:

- AUTO - varies between 15 - 25 degrees, depending on TAS, flap position, and V2
- 5, 10, 15, 20, or 25 - selected value is maximum, regardless of airspeed

5 Heading (HDG) HOLD Switch

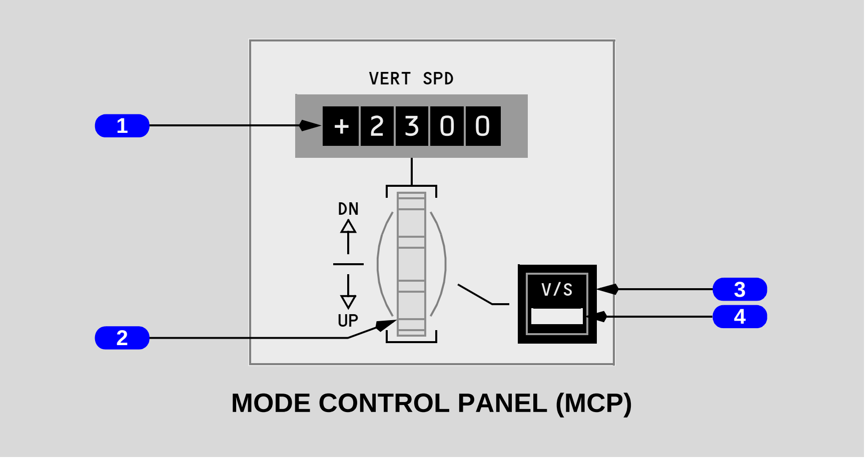
Push -

- selects HDG HOLD roll mode
- HDG HOLD roll mode displays in green (active) on PFD roll flight mode annunciation
- AFDS rolls wings level, then holds present heading

6 Heading Hold Light

Illuminated - HDG HOLD roll mode active.

Autopilot Flight Director Vertical Speed (V/S) Controls



1 Vertical Speed (VERT SPD) Window

Blank when vertical speed (V/S) pitch mode not selected.

Displays current V/S when V/S pitch mode selected.

Displays selected V/S in 100 fpm increments.

Display range is -8000 to +6000 fpm.

Vertical speed displays on the PFD V/S indication.

2 Vertical Speed (V/S) Selector

UP or Down (DN) - sets V/S in VERT SPD window and on both PFDs.

3 Vertical Speed (V/S) Switch

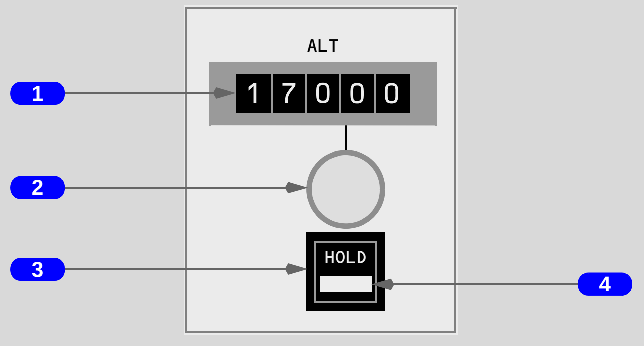
Push -

- selects V/S pitch mode
- V/S pitch mode displays in green (active) on PFD pitch flight mode annunciation
- displays current V/S in V/S window
- AFDS pitch maintains V/S displayed in the V/S window. When selected altitude reached, pitch flight mode annunciation changes to ALT
- A/T operates in speed (SPD) mode, if armed

4 Vertical Speed (V/S) Light

Illuminated - vertical speed pitch mode is active.

Autopilot Flight Director Altitude Controls



MODE CONTROL PANEL (MCP)

1 Altitude Window

Displays selected altitude in 100 feet increments. Display range is 0 to 50000 feet.

Displays selected altitude on PFDs.

Displayed altitude is reference altitude for altitude alerting and level off.

ALT window and PFD altitudes set to 10000 feet when power first applied.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; SB adds enhanced Mode S transponder information)
Displayed altitude transmitted to ATC when Eurocontrol-compliant transponder installed.

2 Altitude Selector

Rotate - sets altitude in ALT window and selected altitude on both PFDs.

Push -

- during climb or descent with altitude constraints, each push deletes the next waypoint constraint between the airplane altitude and the altitude window setting
- during climb with no altitude constraints, and the altitude window set above the FMC cruise altitude, changes cruise altitude to the altitude window value
- during cruise:
  - with the altitude window set above or below FMC cruise altitude, resets the FMC cruise altitude to the altitude window altitude
  - when in VNAV PTH or VNAV ALT pitch mode, initiates a climb or descent toward the altitude window altitude
  - within 50 NM of the top-of-descent (T/D) point with the altitude window set below cruise altitude, initiates descent now (DES NOW) with a reduced descent rate

3 Altitude HOLD Switch

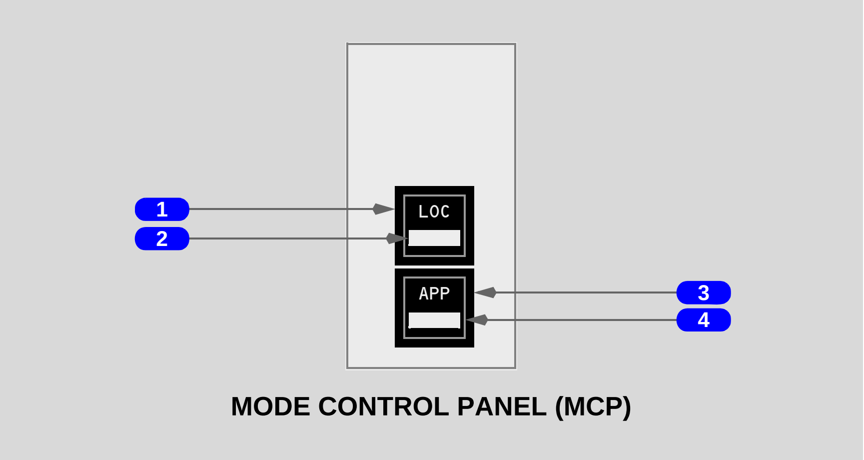
Push -

- selects altitude (ALT) pitch mode
- ALT pitch mode displays in green (active) on PFD pitch mode annunciation
- AFDS commands pitch to maintain the altitude when the switch was pushed

4 Altitude Hold Light

Illuminated - altitude hold mode active.

Autopilot Flight Director Approach Mode Controls



1 Localizer (LOC) Switch

Push -

- arms, disarms, or captures localizer (LOC) as roll mode
- displays LOC in white (armed) on PFD roll flight mode annunciations before localizer capture; current roll mode remains active until LOC capture
- displays LOC in green (active) on PFD roll flight mode annunciations after localizer capture
- arms AFDS to capture and track inbound on front course
- capture point varies based on range and intercept angle
- localizer capture can occur when intercept track angle is within 120 degrees of the localizer course

Note: After localizer capture, flight director roll commands may appear inconsistent with A/P roll maneuvers for one to two minutes.

Localizer mode can be disarmed before localizer capture by:

- pushing localizer switch a second time, or
- selecting LNAV

Localizer mode can be deactivated after localizer capture by:

- selecting a roll mode other than LNAV
- pushing a TO/GA switch
- disengaging the autopilot and positioning both F/D switches off

2 Localizer Light

Illuminated - localizer roll mode armed or active.

3 Approach (APP) Switch

Push -

- arms, disarms, or captures localizer (LOC) as roll mode and glideslope (G/S) as pitch mode
- displays LOC and G/S in white (armed) on PFD roll and pitch flight mode annunciations before localizer and glideslope capture
- displays LOC and G/S in green (active) on PFD roll and pitch flight mode annunciations after each is captured
- arms other A/P systems (CMD switch lights illuminated) for engagement at localizer and glideslope capture and radio altitude less than 1,500 feet
- A/P systems are powered by separate sources

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX (VP-BKL ; before SB, glideslope capture inhibit not active)

- either localizer or glideslope can be captured first
- localizer captures when intercept track angle is within 120 degrees of localizer course

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX (VP-BKL ; before SB, glideslope capture inhibit not active)

- glideslope captures when intercept track angle is within 80 degrees of localizer course

**EI-XLZ, VP-BKJ, VP-BVR
(VP-BKL ; SB activates glideslope capture before LOC capture inhibit)**

- glideslope capture is inhibited until localizer capture and intercept track angle is within 80 degrees of localizer course

Note: After localizer capture, flight director roll commands may appear inconsistent with A/P roll maneuvers for one to two minutes.

Approach mode can be disarmed before localizer or glideslope capture by:

- pushing approach switch a second time, or
- selecting LOC, LNAV, or VNAV

Approach mode deselects:

- with localizer captured and glideslope armed, by selecting another roll mode other than LNAV; selecting LOC mode initiates a localizer approach

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX (VP-BKL ; before SB, glideslope capture inhibit not active)

- with glideslope captured and localizer armed, by selecting another pitch mode other than VNAV
- after localizer and/or glideslope are captured, by selecting TO/GA mode or disengaging autopilot and positioning both F/D switches off

4 Approach Light

Illuminated - approach modes (LOC and G/S) armed or active.

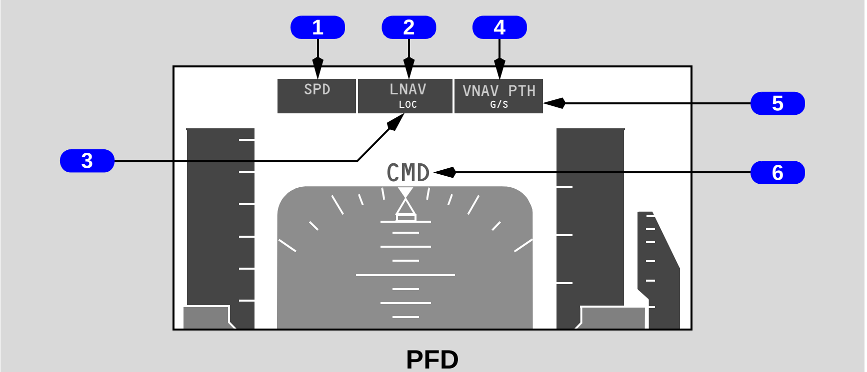
PFD Flight Mode Annunciations (FMAs)

Note: A/T, roll, or pitch mode changes are emphasized for 10 seconds by a green box around the mode.

Note: An amber horizontal line displays through the affected ACTIVE pitch or roll mode when a flight mode fault is detected.

Note: NO AUTOLAND displays on the PFD if failures cause the system to degrade from multi-channel engage status (LAND 3 or LAND 2) to single channel status during an autoland. The mode change is emphasized for 10 seconds by an amber box.

Note: NO AUTOLAND also displays on PFD if multi-channel approach selected but multi-channel engage status (LAND 3 or LAND 2) has not been annunciated by 600 feet AGL. Under these conditions, flare and rollout modes are not armed.



PFD

1 **Autothrottle Modes (Active)**

Displayed (green) -

- THR
- THR REF
- HOLD
- IDLE
- SPD

2 **AFDS Roll Modes (Active)**

Displayed (green) -

- HDG HOLD
- HDG SEL
- LNAV
- LOC
- ROLLOUT
- TO/GA

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- ATT

3 **AFDS Roll Modes (Armed)**

Displayed (white) -

- LOC
- ROLLOUT
- LNAV

4 **AFDS Pitch Modes (Active)**

Displayed (green) -

- TO/GA
- ALT
- V/S
- VNAV PTH
- VNAV SPD
- VNAV ALT
- G/S
- FLARE
- FLCH SPD

5 **AFDS Pitch Modes (Armed)**

Displayed (white) -

- G/S
- FLARE
- VNAV

6 **AFDS (Active)**

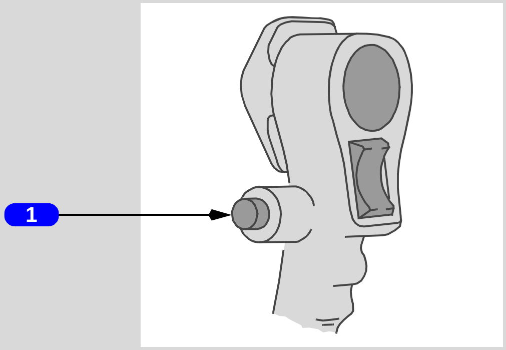
Displayed (green) -

- FD
- CMD
- LAND 3
- TEST

Displayed (green with white triangles) - ▷LAND2◁

Displayed (amber) - NO AUTOLAND

Autopilot Disengage Switch



CONTROL WHEELS

1 **Autopilot Disengage Switch**

First push (either switch) -

- disengages all autopilots
- master warning lights illuminate
- displays the EICAS warning message >AUTOPILOT DISC
- if A/P automatically disengages, resets master warning lights, EICAS warning message, and aural warning

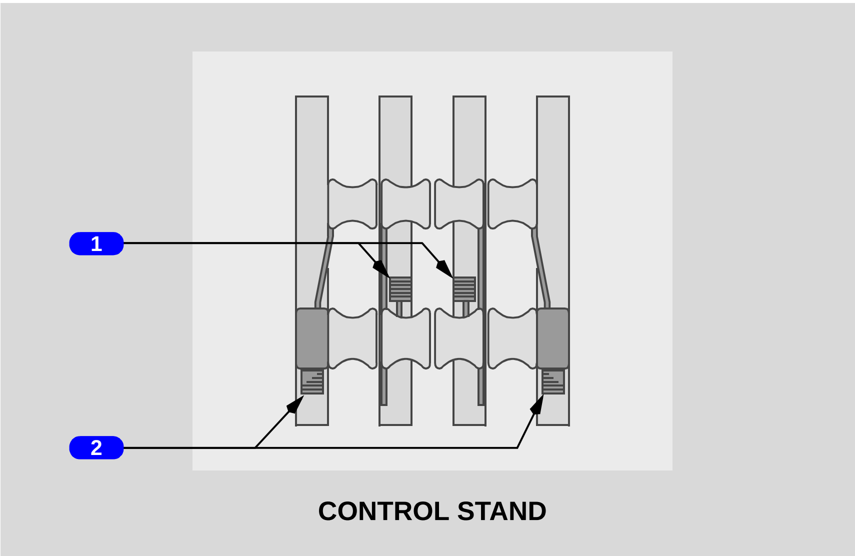
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- sounds a siren aural warning

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
- sounds a wailer aural warning for a minimum of one second

Second push - resets:

- master warning lights
- EICAS warning message
- aural warning

Autothrottle Disconnect and TO/GA Switches



1 Takeoff/Go-around (TO/GA) Switches

On the ground:

Push -

- below 50 knots and flaps out of up, activates A/T in THR REF mode at reference thrust limit selected on THRUST LIMIT page. If not pushed below 50 knots, A/T operation is inhibited until reaching 400 feet altitude

VP-BKJ, VP-BVR

- updates FMC position to runway landing threshold or position shift point.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

- updates FMC position to runway landing threshold or position shift point if GPS updating not active

In flight:

Push (after lift-off with takeoff reference thrust limit displayed) -

- removes takeoff and climb derates and assumed temperature thrust reduction
- A/T in HOLD, activates A/T in THR REF mode
- between 50 feet and 400 feet, selects TO/GA roll mode
- above 400 feet, selects TO/GA roll and pitch modes

Push (on approach with flaps out of up or glideslope captured) -

- activates A/T in THR mode with GA reference thrust limit displayed. Thrust adjusts to provide a 2000 feet per minute climb
- selects TO/GA roll and pitch modes
- with no A/P or F/D active and TO/GA armed for Go Around, activates A/T in THR mode with GA reference thrust limit displayed. Thrust adjusts to provide a 2000 feet per minute climb

Second push - activates autothrottle in THR REF using GA reference thrust.

2 Autothrottle Disconnect Switches

Push (either switch) -

- disconnects A/T
- illuminates master caution lights
- displays EICAS message >AUTOTHROT DISC
- if A/T automatically disconnects, resets master caution lights and EICAS message

Second push - resets master caution lights and EICAS message.

Autothrottle remains armed.

Intentionally
Blank

Introduction

The automatic flight control system consists of the autopilot flight director system (AFDS) and the autothrottle system (A/T). The mode control panel (MCP) and flight management computer (FMC) control the AFDS and the autothrottle system to perform climb, cruise, descent, and approach.

Autopilot Flight Director System

The AFDS consists of three flight control computers (FCC) and the MCP.

The MCP provides control of the autopilot, flight director, altitude alert, and autothrottle systems. The MCP selects and activates AFDS modes, and establishes altitudes, speeds, and climb/descent profiles.

The three FCCs, left, center, and right, control separate hydraulically powered A/P control servos to operate flight controls. The A/P controls ailerons and elevators. Rudder commands are added only during a multi-A/P approach. Nose wheel steering is also added during rollout from an automatic landing. During an ILS approach with all three A/Ps engaged, separate electrical sources power the three FCCs.

The FCCs also provide inputs for AFDS operating mode displays and FD commands on the PFD.

MCP Switches

MCP switches select automatic flight control and flight director modes. A light in the lower half of the switch illuminates PFD roll and pitch flight mode annunciations to indicate the mode is armed or active. Autothrottle modes are discussed later in this section.

Most modes activate with a single push. These modes include:

- flight level change (FLCH SPD)
- heading hold (HDG HOLD)
- heading select (HDG SEL)
- vertical speed (V/S)
- altitude hold (ALT)

Other modes arm or activate with a single push. These modes are:

- lateral navigation (LNAV)
- vertical navigation (VNAV)
- localizer (LOC)
- approach (APP)

All modes deactivate by disengaging the autopilot and turning both flight directors off. After localizer and glideslope capture, the localizer and glideslope modes can only be deactivated by disengaging the autopilot and turning both flight directors off or by selecting TO/GA mode. VNAV, LNAV, LOC, and APP modes can be disarmed by pushing the mode switch a second time.

Desired target values can be selected on the MCP for:

- airspeed
- Mach
- heading
- vertical speed
- altitude

All parameters except vertical speed can be preselected before autopilot and/or flight director engagement.

Autopilot Engagement

The autopilot is engaged by pushing one of the MCP autopilot engage switches.

Autopilot Disengagement

Normal autopilot disengagement is through either control wheel autopilot disengage switch. The autopilots can also be disengaged by the MCP autopilot disengage bar. The EICAS warning message AUTOPILOT DISC displays when the autopilot has been manually or automatically disengaged.

AFDS Failures

During autopilot operation, failures affecting the active mode annunciate on the PFD. If the failure affects only the active mode:

- the autopilot remains engaged in an attitude stabilizing mode
- an amber line is drawn through the mode annunciation
- the EICAS caution message AUTOPILOT displays

Failures affecting all autopilot modes result in an autopilot disengagement accompanied by an aural warning. Depending on the system failure, it may be possible to reengage an autopilot by pushing the autopilot engage switch.

A flight director mode failure, in either pitch or roll, causes the related command bar to disappear.

Flight Director Display

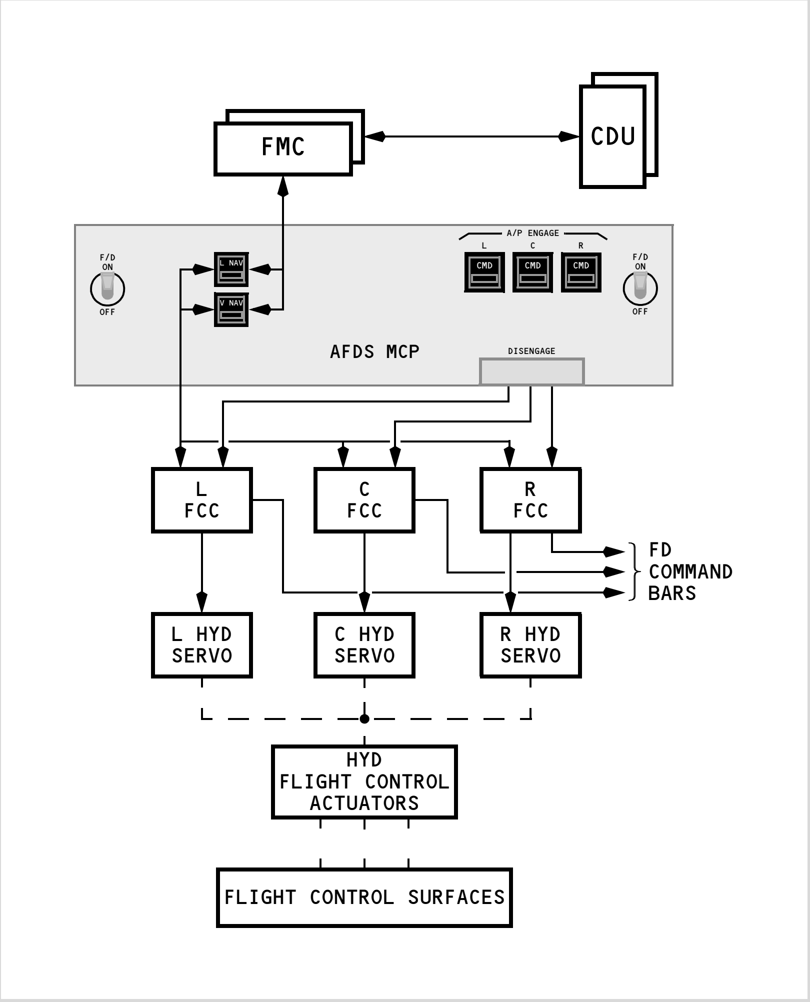
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The flight director steering indications normally display any time the related Flight Director switch is ON.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
The flight director steering indications normally display any time the related Flight Director switch is ON and the selected flight director source is not the same as the engaged A/P.

Pushing a TO/GA switch when airspeed is greater than 80 knots and the flaps are out of up displays steering indications when the Flight Director switch(es) is OFF. In this case, steering indications can be removed by cycling the flight director switch(es) ON and OFF.

Autopilot Flight Director System Schematic



AFDS Status Annunciation

The following AFDS status annunciations display above the attitude display:

- FD - flight director ON and autopilots not engaged
- CMD - autopilot engaged
- LAND 3 - three autopilots engaged and operating normally for an automatic landing
- LAND 2 - AFDS redundancy reduced; in some cases, only two autopilots available
- NO AUTOLAND - AFDS unable to make an automatic landing

With a LAND 3 indication, the autopilot system level of redundancy is such that a single fault cannot prevent the autopilot system from making an automatic landing (fail operational).

With a LAND 2 indication, the level of redundancy is such that a single fault cannot cause a significant deviation from the flight path (fail passive).

An EICAS message displays for any fault limiting the capability of the automatic landing system. Below 200 feet RA, a change from LAND 3 to LAND 2 is not annunciated. Faults not requiring immediate crew action or awareness are annunciated after touchdown.

AFDS Flight Mode Annunciations

Flight mode annunciations display above AFDS status annunciations. Mode annunciations, from left to right, are:

- autothrottle
- roll
- pitch

Active modes display at the top of the flight mode annunciation boxes in large green letters. Armed modes (except for TO/GA in flight) display in smaller white letters at the bottom of the flight mode annunciation boxes.

Autothrottle Modes

Autothrottle annunciations are:

THR - autothrottle applies thrust to maintain the climb/descent rate required by the pitch mode.

THR REF - thrust set to the reference thrust limit displayed on EICAS.

IDLE - displays while the autothrottle moves thrust levers to idle; IDLE mode is followed by HOLD mode.

HOLD - thrust lever autothrottle servos are inhibited. The pilot can set the thrust levers manually.

SPD - autothrottle maintains command speed. Command speed can be set using the MCP IAS/Mach selector or, by the FMC, as displayed on the CDU CLIMB, CRUISE, or DESCENT page. Autothrottle will not exceed thrust limits displayed on EICAS. Speed protection is not provided when the pitch mode is V/S.

Roll Modes

Roll annunciations are:

LNAV - arm LNAV by pushing the LNAV switch (the light illuminates and LNAV annunciates on the PFD roll mode annunciation in white characters below the current roll mode).

- LNAV (armed) - LNAV is armed to activate when parameters are met
- LNAV (active) - LNAV activates when above 50 feet and in position to turn onto the active route leg. In flight, selection causes immediate activation if within 2 1/2 NM of the active leg

HDG -

- HDG SEL (active) - airplane turns to or maintains the heading set in the MCP heading window
- HDG HOLD (active) - AFDS holds present heading. When turning, AFDS holds the heading reached after rolling wings level

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
ATT - (active) - when the autopilot is first engaged or the flight director is first turned on in flight, AFDS holds a bank angle between 5 and 30 degrees and will not roll to wings level. When the bank angle is less than 5 degrees, AFDS rolls to wings level (HDG HOLD). When the bank angle is greater than 30 degrees, AFDS rolls to 30 degrees of bank.

LOC -

- LOC (armed) - AFDS captures the localizer when within range and within 120 degrees of the localizer course
- LOC (active) - AFDS follows the localizer course

TO/GA -

- On the ground, TO/GA annunciates by positioning either flight director switch ON when both flight directors are OFF. TO/GA roll guidance becomes active at lift-off
- In flight, TO/GA is armed when flaps are out of up or glideslope is captured. There is no flight mode annunciation for TO/GA armed. TO/GA is activated in flight by pushing a TO/GA switch. The roll steering indication provides guidance to maintain the ground track present at mode engagement

ROLLOUT -

- ROLLOUT (armed) - displays below 1,500 feet radio altitude and activates below 5 feet
- ROLLOUT (active) - after touchdown, AFDS uses rudder and nosewheel steering to steer the airplane on the localizer centerline

Pitch Modes

Pitch annunciations are:

TO/GA -

- On the ground, TO/GA annunciates by positioning either flight director switch ON when both flight directors are OFF. The flight director pitch bar indicates an initial pitch of eight degrees up. TO/GA pitch guidance becomes active at rotation
- After takeoff, the AFDS commands a pitch attitude less than the pitch limit indicator to maintain:
  - a target speed of V2 plus 10 knots or airspeed at rotation (pitch attitude greater than two degrees) plus 10 knots, whichever is greater
  - if current airspeed remains above the target speed for 5 seconds, target airspeed resets to current airspeed, to a maximum of V2 plus 25 knots
  - IAS/MACH window speed if IAS/MACH window speed is changed to a speed greater than the target speed

Note: AFDS uses the speed set in the IAS/MACH window for V2.

- In flight, TO/GA is armed when flaps are out of up or glideslope is captured
- When a go-around is initiated, the command speed is the MCP IAS/Mach window or current airspeed, whichever is higher. If the airspeed increases and remains above the initial target airspeed for five seconds, target airspeed resets to current airspeed to a maximum of the IAS/MACH window speed plus 25 knots. If airspeed at initiation of go-around is greater than IAS/Mach window plus 25 knots, that speed is maintained. GA displays as the reference thrust limit on the primary EICAS engine display

VNAV - arm VNAV by pushing the VNAV switch (the light illuminates and VNAV annunciates on the PFD pitch mode annunciation in white characters below the current pitch mode).

- VNAV activates at 400 feet and provides pitch commands to maintain the FMC computed airspeed/path:
  - VNAV SPD (active) - AFDS maintains the FMC speed displayed on the PFD and/or the CDU CLIMB or DESCENT pages. During speed intervention, use the MCP IAS/MACH selector to manually set the speed
  - when a VNAV descent is initiated before the top of descent (T/D) and the airplane subsequently intercepts the VNAV descent path, the pitch annunciation may change from VNAV SPD to VNAV PTH
  - VNAV PTH (active) - AFDS maintains FMC altitude or descent path with pitch commands. For a non-entered headwind, thrust may increase to maintain the VNAV descent path. If the MCP altitude window remains set to the current cruise altitude and the airplane is within two minutes of the top of descent, the CDU scratchpad message RESET MCP ALT displays
  - VNAV ALT (active) - If a conflict occurs between the VNAV profile and the MCP altitude, the airplane levels and the pitch flight mode annunciation becomes VNAV ALT. The airplane maintains altitude. To continue the climb or descent, change the MCP altitude and push the altitude selector or change the pitch mode. If below the VNAV path, resetting the MCP altitude window and intercepting the VNAV path will also continue the descent

V/S - pushing the V/S switch opens the vertical speed window and displays the current vertical speed. It also opens the IAS/MACH window (if blanked). Pitch commands maintain the rate of climb or descent selected in the V/S window.

FLCH SPD - pushing the FLCH switch opens the IAS/MACH window (if blanked). Pitch commands maintain IAS/MACH window airspeed or Mach.

ALT - altitude hold mode is activated by:

- pushing the MCP altitude HOLD switch, or
- capturing the selected altitude from a V/S or FLCH climb or descent

G/S - AFDS follows the ILS glideslope.

FLARE -

- FLARE (armed) - during autoland, FLARE displays below 1,500 feet RA
- FLARE (active) - during autoland, flare activates between 60 and 40 feet RA. FLARE deactivates at touchdown and the nosewheel smoothly lowers to the runway

Autothrottle System

The autothrottle system provides thrust control from takeoff through landing.

Autothrottle operation is controlled from the MCP and the CDUs. The MCP allows mode and speed selection. The CDU allows FMC reference thrust limit selection. When a pitch mode is active, the FMC selects autothrottle modes and target thrust values. Refer to Chapter 11, Flight Management, Navigation, for FMS and CDU operation.

The autothrottle can be operated without using the flight director or the autopilot.

Autothrottle Thrust Lever Operation

The autothrottle system moves thrust levers to control speed or thrust, depending on the active mode.

Thrust levers can be manually positioned without disconnecting the autothrottle. After manual positioning and release, the autothrottle repositions thrust levers to comply with the active mode. The autothrottle system does not reposition thrust levers while in HOLD mode.

Autothrottle Disconnect

The autothrottle system can be disconnected manually by positioning the Autothrottle Arm switch to OFF or by pushing either Autothrottle Disconnect switch. The EICAS caution message >AUTOTHROT DISC displays when the autothrottle has been manually or automatically disconnected.

Autothrottle disconnect occurs if a fault in the active autothrottle mode is detected, or when a reverse thrust lever is raised to reverse idle. The autothrottle also disconnects and cannot be reactivated if both FMCs fail or two or more engines are shut down. The autothrottle disconnects when the FMC Master switch is switched, but can be reactivated.

Automatic Flight Operations

Automatic Flight - Takeoff and Climb

Takeoff is a flight director only function of the takeoff/go-around (TO/GA) mode. The autopilot may be engaged after takeoff.

During preflight:

- with the autopilot disengaged and both Flight Director switches OFF, activation of TO/GA roll and pitch mode occurs when the first Flight Director switch is positioned ON
- PFD displays FD as AFDS status and TO/GA as the pitch and roll flight mode annunciations

- pitch command is set to approximately eight degrees up
- roll command is wings level

During takeoff prior to lift-off:

- with speed less than 50 KIAS, pushing a TO/GA switch activates the autothrottle in thrust reference (THR REF) and advances thrust levers to the selected reference thrust limit. If the autothrottle is not active by 50 knots, it cannot be activated until above 400 feet
- at 65 knots, autothrottle annunciation changes to HOLD
- during takeoff, the FMC records barometric altitude as the airplane accelerates through 100 knots. This altitude is used to activate LNAV and VNAV, enable autothrottle activation (if not active), command acceleration for flap retraction, and set climb thrust if an altitude has been selected

At lift-off:

- pitch command target speed is V2 + 10. If current airspeed remains above target speed for 5 seconds, target airspeed is reset to current airspeed (limited to a maximum of V2 + 25)
- if an engine failure occurs on the ground, the pitch command target speed at lift-off is V2 or airspeed at lift-off, whichever is greater (limited to a maximun of V2 + 10)
- roll command maintains ground track

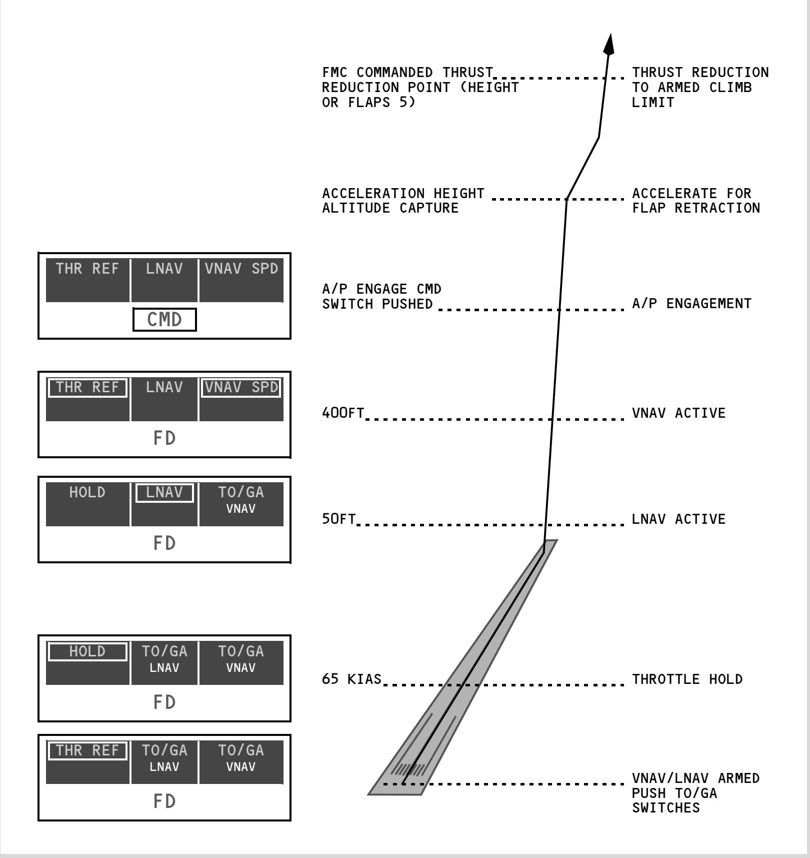
After lift-off:

- if an engine failure occurs, the pitch command target speed is:
  - V2, if airspeed is below V2
  - existing speed, if airspeed is between V2 and V2 + 10
  - V2 + 10, if airspeed is above V2 + 10
- if a TO/GA switch is pushed with the takeoff reference thrust limit displayed:
  - removes takeoff and climb derates and assumed temperature thrust reduction
  - A/T in HOLD, autothrottle annunciation is THR REF
  - between 50 feet and 400 feet, selects TO/GA roll mode
  - above 400 feet, selects TO/GA roll and pitch modes
- at 50 feet, LNAV activates when armed. Roll commands bank to track the active route
- at 400 feet, VNAV activates when armed. Pitch commands the current airspeed. Autothrottle sets the selected reference thrust and annunciates THR REF
- at acceleration height or altitude capture below acceleration height, pitch commands speed to 5 knots below takeoff flap placard speed. As flaps are retracted, pitch commands an acceleration to 5 knots below the placard speed of the commanded flap position

- When flaps are up, pitch commands an acceleration to VNAV climb speed. VNAV climb speed is the greater of:
  - VREF + 100 knots, or
  - speed transition associated with origin airport
- at thrust reduction point (either an altitude or flaps 5), the FMC changes the reference thrust limit to the armed climb limit (CLB, CLB 1, or CLB 2)

TO/GA mode terminates by selecting any other pitch and roll mode, or by activation of LNAV/VNAV modes

Automatic Flight Takeoff Profile



Automatic Flight - Cruise

The autopilot and/or flight director can be used after takeoff to fly a lateral navigation track (LNAV) and a vertical navigation track (VNAV) provided by the FMC. Using LNAV and VNAV ensures the most economical operation.

Profile illustrations show the use of LNAV and VNAV.

Automatic Flight - Approach and Landing

The AFDS provides guidance for single or multiple autopilot ILS approaches.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
(VP-BKL ; before SB, glideslope capture inhibit not active)
Pushing the APP switch arms localizer in roll mode and glideslope in pitch mode. Either localizer or glideslope can be captured first.

EI-XLZ, VP-BKJ, VP-BVR
(VP-BKL ; SB activates glideslope capture inhibit)
Pushing the APP switch arms localizer in roll mode and glideslope in pitch mode. Glideslope capture is inhibited until the localizer is captured.

Pushing the LOC switch arms only the localizer. Localizer capture can occur when the intercept angle is less than 120 degrees.

Runway Alignment and Asymmetric Thrust Compensation

AFDS controls the rudder during multiple A/P approaches to compensate for crosswind landings and engine-out asymmetric thrust conditions. With LAND 2 or LAND 3 annunciated, A/P control of the rudder is active.

For crosswinds requiring more than 10 degrees of crab angle, runway alignment occurs at 500 feet AGL. A sideslip of 5 degrees is established to reduce the crab angle. This configuration is maintained until touchdown. The airplane lands with the upwind wing low.

For crosswinds requiring a crab angle of between 5 and 10 degrees, an initial alignment occurs at 500 feet AGL, followed by a second alignment at 200 feet AGL. The initial alignment initiates a sideslip to reduce the crab angle to 5 degrees. This configuration is maintained to 200 feet AGL, where a second sideslip alignment increases the sideslip to further reduce the touchdown crab angle.

For crosswinds requiring a crab angle of less than 5 degrees, runway alignment occurs at 200 feet AGL, where a sideslip is introduced to align the airplane with the runway.

If an engine fails prior to the approach, AFDS introduces a sideslip at 1,300 feet AGL. This establishes a wings level configuration. If an engine fails during the approach, the wings level configuration is established when the engine failure is detected.

If moderate or strong crosswinds are from the side opposite the failed engine, no wings level sideslip is commanded, since the airplane is already banked into the wind.

If the A/Ps are disengaged, manually or automatically, in an asymmetric thrust condition with rudder control active, the rudder moves to the trimmed position. The pilot may need to exert rudder pedal force to maintain a smooth transition to manual flying.

Flare

The flare maneuver brings the airplane to a smooth automatic landing touchdown. The flare mode is not intended for single autopilot or flight director only operation.

Flare arms when LAND 3 or LAND 2 annunciates. At approximately 50 feet radio altitude, the autopilots start the flare maneuver. FLARE replaces the G/S pitch flight mode annunciation.

During flare:

- at 25 feet radio altitude, the autothrottle retards thrust levers to idle
- IDLE replaces the SPD autothrottle flight mode annunciation
- at touchdown, the FLARE annunciation no longer displays, and the nose lowers to the runway

Rollout

Rollout provides localizer centerline rollout guidance. Rollout arms when LAND 3 or LAND 2 annunciates.

At approximately five feet radio altitude, rollout activates. ROLLOUT replaces the LOC roll flight mode annunciation.

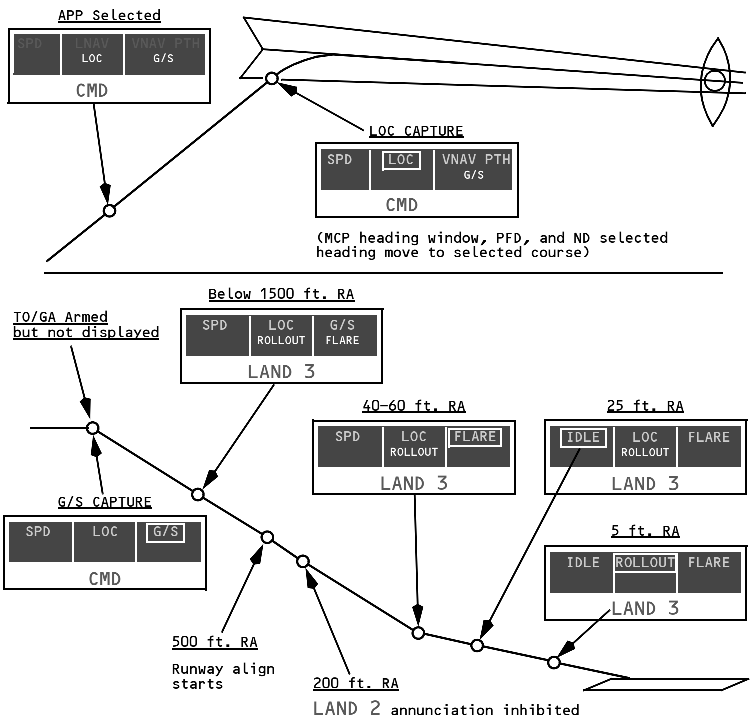
The autopilot controls rudder and nose wheel steering to track the localizer centerline.

During rollout, autothrottle IDLE mode remains active until the autothrottle disconnects with thrust levers in reverse.

Rollout guidance continues until the autopilots are disengaged.

Note: Ten seconds after reverse thrust levers are down, autothrottle is armed until flaps are UP. Pushing a TO/GA switch while the autothrottle is armed activates the autothrottle in THR REF mode.

Automatic Flight Approach Profile



Automatic Flight - Go-Around

TO/GA is armed when flaps are out of up or glideslope is captured. The reference thrust limit changes to GA when flaps are extended out of up, flaps are extended to landing position, or glideslope is captured. The reference thrust limit is locked in GA when flaps are in landing position or glideslope is captured.

With flaps out of up, but not in landing position, activation of VNAV in VNAV PTH changes the reference thrust limit to CRZ. However, pressing TO/GA changes the reference thrust limit to GA and GA thrust is available.

Pushing either TO/GA switch activates a go-around. The mode remains active even if the airplane touches down while executing the go-around.

When the flight director switches are not on, pushing either TO/GA switch displays the flight director bars.

An automatic go-around cannot be initiated after touchdown.

With the first push of either TO/GA switch:

- roll and pitch activate in TO/GA
- autothrottle activates in thrust (THR) to establish a 2000 FPM climb
- if current airspeed remains above the target speed for 5 seconds, the target airspeed is reset to current airspeed, (to a maximum of the IAS/MACH window speed plus 25 knots)

With the second push of either TO/GA switch:

- autothrottle activates in thrust reference (THR REF) at full go-around thrust

TO/GA level-off:

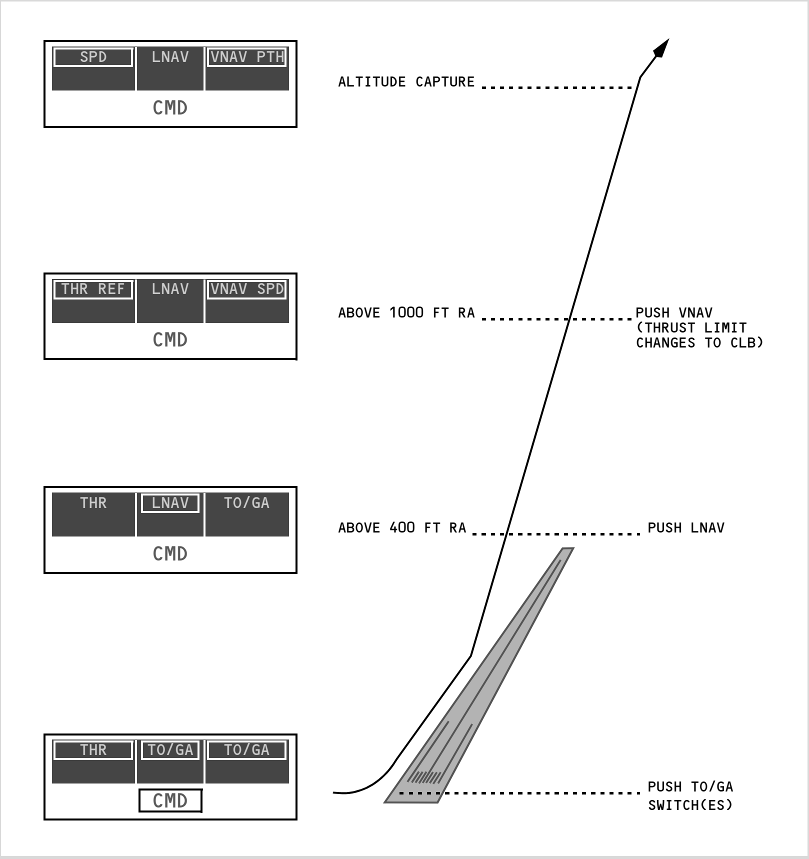
- at the set altitude, the AFDS pitch flight mode annunciation changes to altitude hold (ALT); all autopilots, except first in CMD, disengage
- A/T remains in THR or THR REF until SPD mode is selected. Speed protection prevents exceeding the maximum operating, gear extended, or flap placard speed
- TO/GA remains the active roll mode until another mode is selected

TO/GA mode termination:

- below 400 feet radio altitude, disengage autopilot and turn off both flight directors
- above 400 feet radio altitude, select a different roll or pitch mode; all autopilots, except first in CMD, disengage

If the A/P systems are compensating for an asymmetric thrust condition when they revert to a single A/P in CMD configuration, the rudder returns to the trimmed position unless the pilot exerts the rudder pedal force required to maintain the rudder position.

Automatic Flight Go-Around Profile



Automatic Flight Windshear Recovery

The AFDS provides windshear recovery guidance by means of the normal go-around pitch and roll modes. With go-around armed, pushing a TO/GA switch commands a pitch-up of 15 degrees or slightly below the pitch limit, whichever is lower.

As rate of climb increases from 600 to 1200 feet per minute (0 to 600 feet per minute with engine out), AFDS gradually transitions from pitch to airspeed control. The target airspeed is IAS/MACH window airspeed or current airspeed, whichever is greater when TO/GA is activated. If current airspeed remains above the selected speed for 5 seconds, the selected airspeed is reset to current airspeed, (to a maximum of the IAS/MACH window speed plus 25 knots).

When the autopilot is not engaged when go-around is initiated, the pilot must fly the windshear recovery following the flight director commands. If the autothrottle is not armed, the thrust levers must be advanced manually.

Flight Envelope Protection

The automatic flight control system provides stall and overspeed protection. Stall protection prevents speed reduction below the minimum maneuvering speed. Overspeed protection prevents exceeding the maximum operating, gear extended, or flap placard speed.

The FMC supplies minimum and maximum speeds to the automatic flight control system. To minimize transient speed overshoots of maximum operating, gear extended, or flap placard speed, and undershoot of flaps extended minimum speed, the FMC uses a five knot margin.

The autothrottle and AFDS independently provide speed protection for all operations except during V/S pitch mode or engine failure above maximum engine-out altitude. Autothrottle speed protection is limited by the reference thrust limit (CLB, CRZ, CON, etc.) and idle. AFDS speed protection is provided through the elevators in the following pitch modes: VNAV SPD, FLCH SPD, or TO/GA.

If FMC data is invalid, VNAV is unavailable and internal FCC speed limits are used for FLCH SPD or TO/GA. FCC minimum speed is a function of flap setting. FCC maximum speed is the air data computer VMO/MMO for flaps up and flap placard speed for flaps down.

During cruise, the AFDS maintains level flight. If an engine fails above maximum engine-out altitude, delaying descent results in a gradual airspeed loss.

Refer to Chapter 15, Warning Systems, for a description of stall and speed related warnings.

Automatic Flight EICAS Messages

The following EICAS messages can be displayed.

Message	Level	Aural	Message Logic
>AUTOPILOT	Caution	Beeper	Selected autopilot operating in degraded mode. Active roll and/or pitch mode may have failed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

>AUTOPILOT DISC	Warning	Siren	All engaged autopilots have disengaged.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

>AUTOPILOT DISC	Warning	Wailer	All engaged autopilots have disengaged.

>AUTOTHROT DISC	Caution	Beeper	Autothrottle has disconnected. Message and aural inhibited when disconnect occurs due to selection of reverse thrust.
>NO AUTOLAND			Autoland not available.
	Caution	Beeper	Message is a caution if fault occurs after LAND 3 or LAND 2 annunciates.
	Advisory		Message is an advisory if fault occurs before LAND 3 or LAND 2 annunciates.

Message	Level	Aural	Message Logic
>NO LAND 3			Autoland system does not have redundancy for triple channel autoland.
	Caution	Beeper	Message is a caution if fault occurs after LAND 3 annunciates.
	Advisory		Message is an advisory if fault occurs before LAND 3 annunciates.

Communications — Chapter 5

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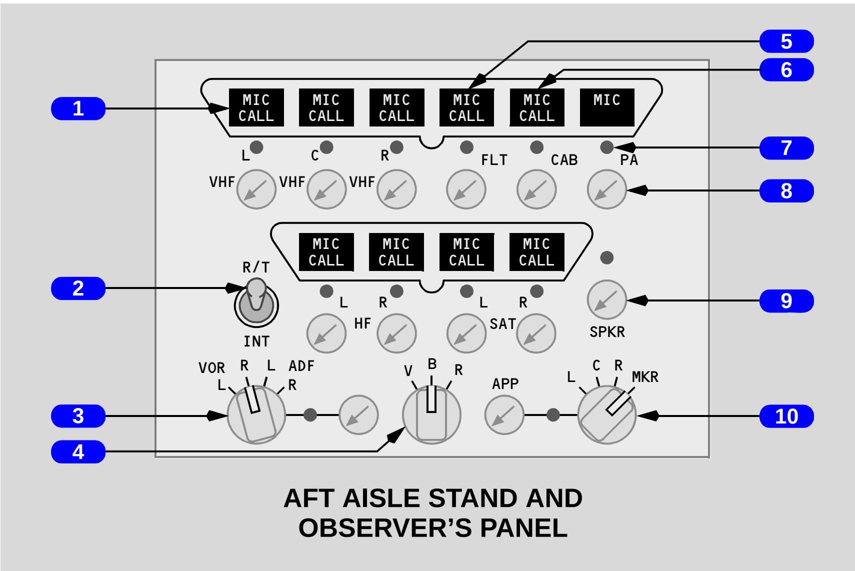
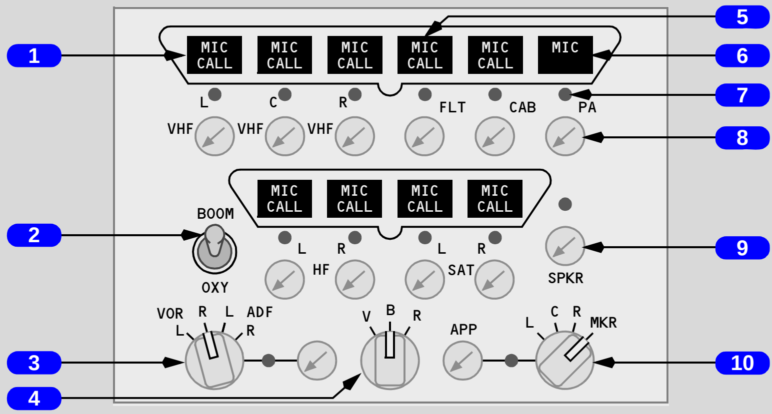
Intentionally
Blank

Audio Control Panel

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



AFT AISLE STAND AND
OBSERVER'S PANEL

1 Transmitter Select Switches

Push –

- MIC light illuminates
- MIC light for any other transmitter extinguishes
- selects respective transmitter (radio or intercommunications) for transmission from this crew station (only one can be selected at a time for each crew station).
- selects receiver audio on, if not previously selected on manually
- pushing CAB transmitter select switch twice within three seconds places a priority call to a selected cabin station

EI-XLB, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW

Note: Do not select VHF C for ATC voice communication with ACARS operational.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

2 Push To Talk Switch

R/T – keys boom microphone or oxygen mask microphone on the selected radio transmitter or interphone system.

Center - off.

INT - keys boom microphone or oxygen mask microphone on flight interphone.

Note: Oxygen mask microphone active when oxygen mask stowage box left-hand door open. Boom microphone active when oxygen mask stowage box left-hand door closed and RESET/TEST switch pushed and released.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

2 BOOM/Oxygen (OXY) Switch

BOOM – selects boom microphone.

OXY - selects oxygen mask microphone.

3 VOR/ADF Receiver Selector

Selects VOR or ADF receiver to be monitored:

- VOR L - left VOR
- VOR R - right VOR
- ADF L - left ADF
- ADF R - right ADF

4 Navigation Filter Selector

Filters VOR, ADF, or ILS audio:

- V (voice) – voice audio is heard
- B (both) – voice and range au dio are heard
- R (range) – range audio (navigation aid Morse code identifier) is heard

5 MIC Lights

Illuminated (white) – indicates respective transmitter is selected.

6 CALL Lights

Illuminated (white) - with aural chime, indicates a call on:

- cabin interphone (CAB)
- flight interphone (FLT)
- ACARS (VHF C)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

- SATCOM (SAT)
- SELCAL (VHF or HF)

Resets when respective transmitter select switch pushed or; when already pushed, by pressing a MIC/INTERPHONE switch.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
SATCOM CALL light remains illuminated until call ends.

PA does not have a call indication.

7 Receiver Lights

Illuminated (green) - indicates respective receiver audio manually selected on.

8 Receiver Volume Controls

Push - selects respective receiver audio on.

Rotate - controls receiver volume.

Second push - deselects respective receiver audio.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Note: Will not select off when respective transmitter selected ON, or 121.500 tuned in radio tuning panel Active Frequency indicator.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Note: Will not select off when respective transmitter selected ON.

9 Captain’s and First Officer’s Speaker (SPKR) Volume Control

Push - turns respective flight deck speaker on.

Rotate - controls flight deck speaker volume.

Second push - deselects respective receiver audio.

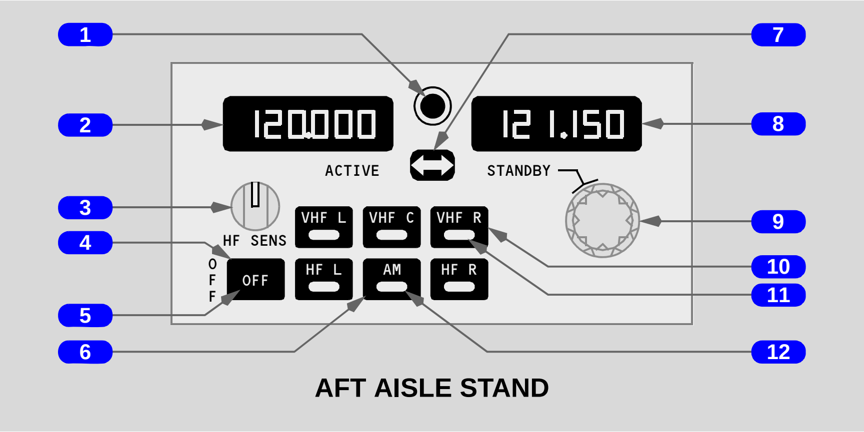
10 Approach (APP) Receiver Selector

Selects approach receiver to be monitored:

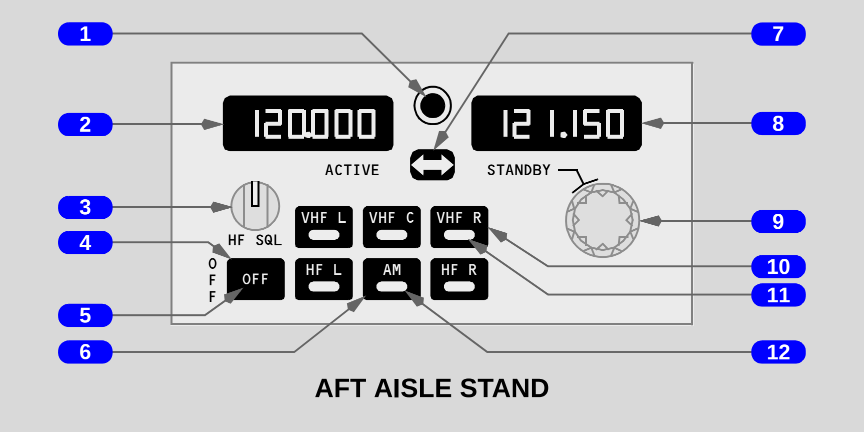
- APP L - left ILS
- APP C - center ILS
- APP R - right ILS
- MKR - marker beacon

Radio System
Radio Tuning Panel

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



1 Offside Tuning Light

Illuminated – indicates one of the following conditions:

- the radio tuning panel is being used to tune a radio not normally associated with this radio tuning panel
- the radio normally associated with this panel is being tuned by another radio tuning panel

Note: The left radio tuning panel is normally associated with VHF L and HF L. The right radio tuning panel is normally associated with VHF R and HF R. The center radio tuning panel is normally associated with VHF C.

2 ACTIVE Frequency Window

Displays tuned frequency of selected radio.

Displays ACARS on VHF C when ACARS selected.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

3 HF Sensitivity (SENS) Control

Rotate – adjusts sensitivity of respective HF receiver.

Control not affected by radio tuning panel failure or by OFF switch.

Note: Right radio tuning panel HF SENS control operative only when right HF radio installed. Center radio tuning panel HF SENS control inoperative.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

3 HF Squelch (SQL) Control

Rotate – adjusts squelch of respective HF receiver.

Control not affected by radio tuning panel failure or by OFF switch.

4 Radio Tuning Panel OFF Switch

Push – disconnects panel from communication radios.

5 Radio Tuning Panel OFF Light

Illuminated (white) – radio tuning panel is disconnected from communication radios.

6 AM Switch

Push – sets AM (amplitude modulation) or USB (upper side band) mode for selected HF.

7 Frequency Transfer Switch

Push –

- transfers STANDBY window frequency to ACTIVE window and tunes selected radio to new active frequency
- transfers ACTIVE window frequency to STANDBY window

8 STANDBY Frequency Window

Displays preselected or previously tuned frequency of selected radio.

Displays ACARS on VHF C when selection of the frequency transfer switch would reconfigure VHF C to the data mode.

9 Frequency Selector

Rotate – to set frequency in the STANDBY window:

- outer knob – selects the portion of the frequency to the left of the decimal point
- inner knob – selects the portion of the frequency to the right of the decimal point

10 Radio Tuning Switches

Push –

- selects radio to be tuned
- tuned frequency displays in ACTIVE frequency window
- standby frequency displays in STANDBY frequency window

EI-XLF, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
Push and hold – removes automatic squelch on selected VHF radio until switch is released.

EI-XLB, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW
Note: Do not select VHF C for ATC voice communication with ACARS operational.

11 Radio Tuning Lights

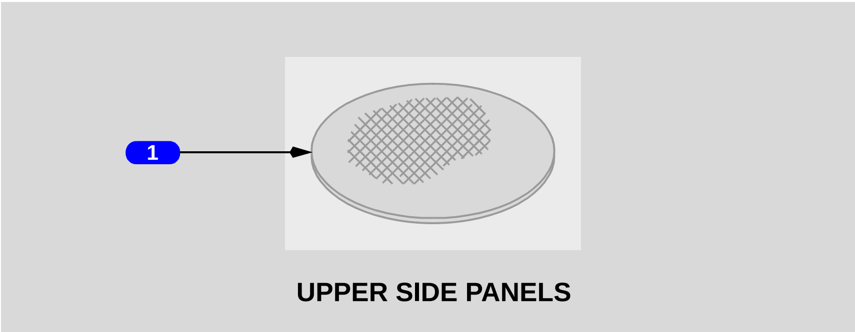
Illuminated (white) – indicates selected radio.

12 AM Light

Illuminated (white) – HF AM selected.

Extinguished – HF USB is selected.

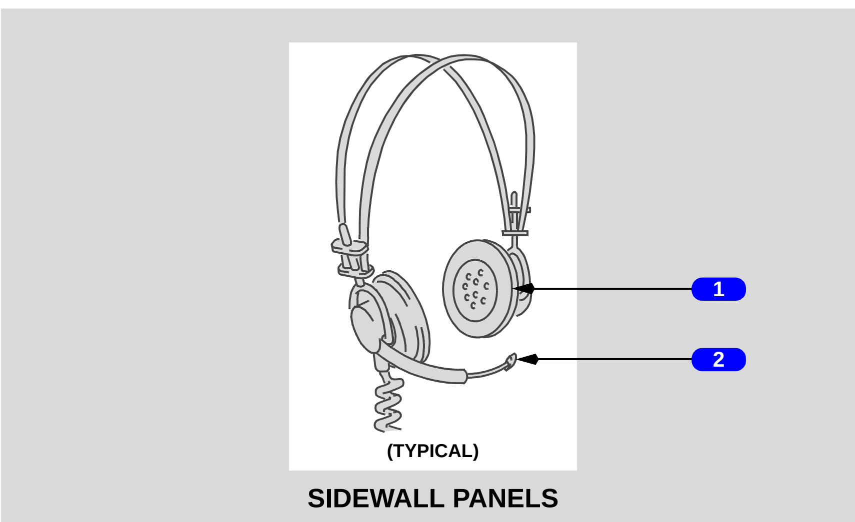
Miscellaneous Communication Controls
Flight Deck Speaker



1 Flight Deck Speaker

Controlled by speaker volume control on respective audio control panel.

Headphone/Boom Microphone



1 Headphone

Used to monitor audio from respective audio control panel.

Audio volume adjusted using audio control panel controls for the respective station.

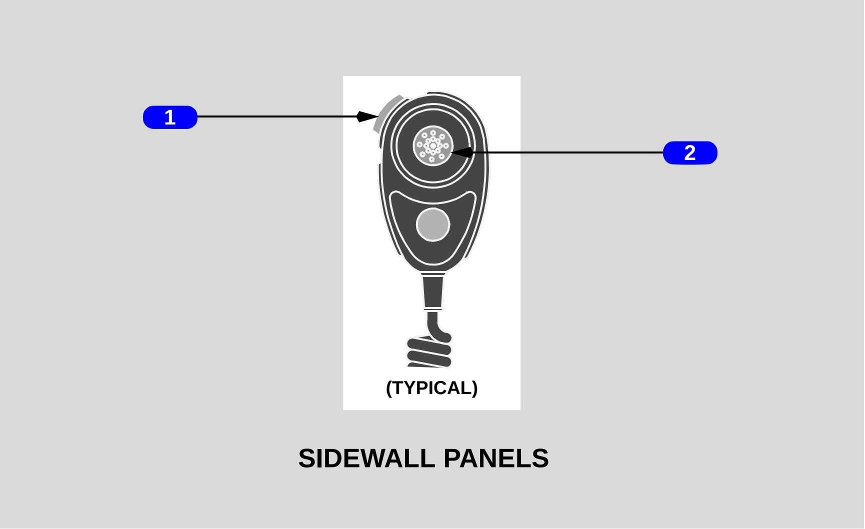
Available at all four flight deck stations.

2 Boom Mic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Activation of a control wheel, glareshield, or audio control panel mic/interphone switch transmits on the system selected for use at that station.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Activation of a control wheel or audio control panel mic/interphone switch transmits on the system selected for use at that station.

Hand Microphone



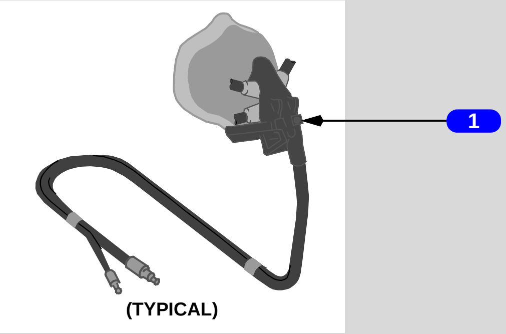
1 Hand Microphone Push To Talk Switch

Push – activates hand microphone.

2 Hand Microphone

Transmits on system selected by audio control panel.

Oxygen Mask Microphone



SIDEWALL PANELS

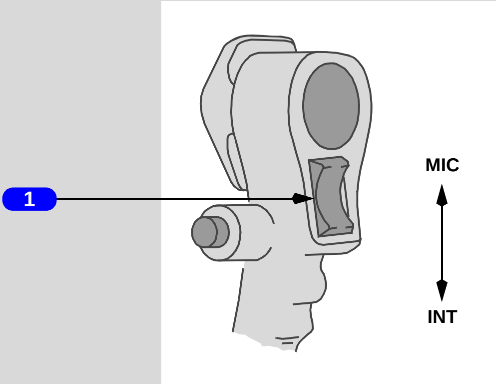
1 Oxygen Mask Microphone

Enabled when oxygen mask doors open. Boom microphone is disabled.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Activation of a control wheel, glareshield, or audio control panel mic/interphone switch transmits on the system selected for use at that station.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Activation of a control wheel or audio control panel mic/interphone switch transmits on the system selected for use at that station.

Control Wheel Microphone/Interphone Switch



CONTROL WHEELS

1 Control Wheel Mic/Interphone Switch

MIC – allows oxygen mask or boom microphone transmission on selected transmitter. Spring-loaded to center.

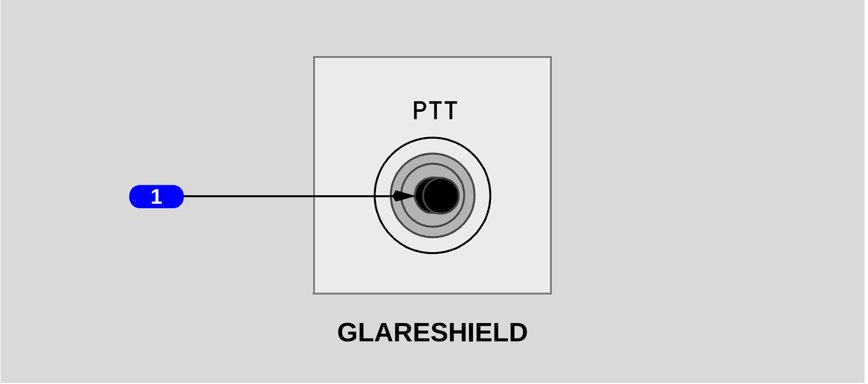
CENTER – off position.

EI-XLG, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
INT – allows oxygen mask or boom microphone transmission on flight interphone system. Latched in position.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
INT – allows oxygen mask or boom microphone transmission on flight interphone system. Spring-loaded to center.

Glareshield Microphone Switch

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

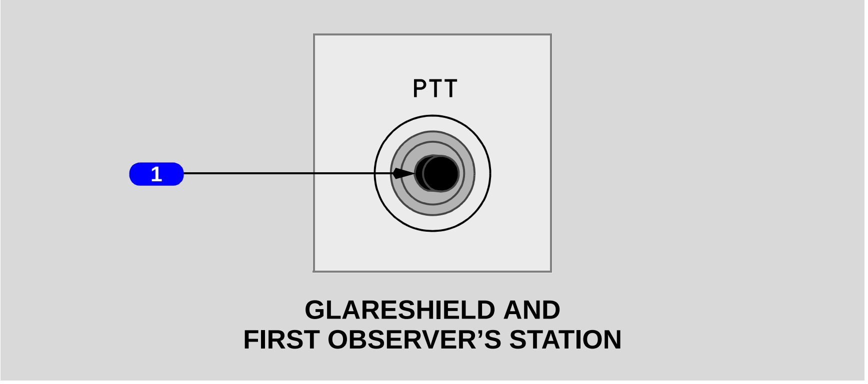


1 Glareshield Microphone (PTT) Switch

Push – allows oxygen mask or boom microphone transmission on selected transmitter.

Glareshield and Observer’s Microphone Switches

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

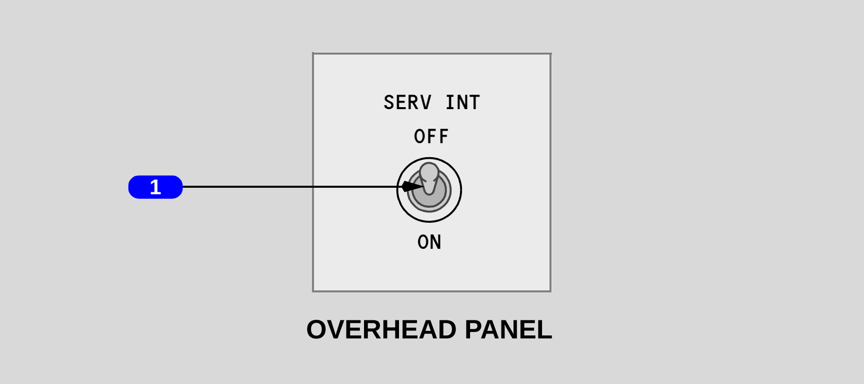


1 Glareshield and Observer’s Microphone (PTT) Switches

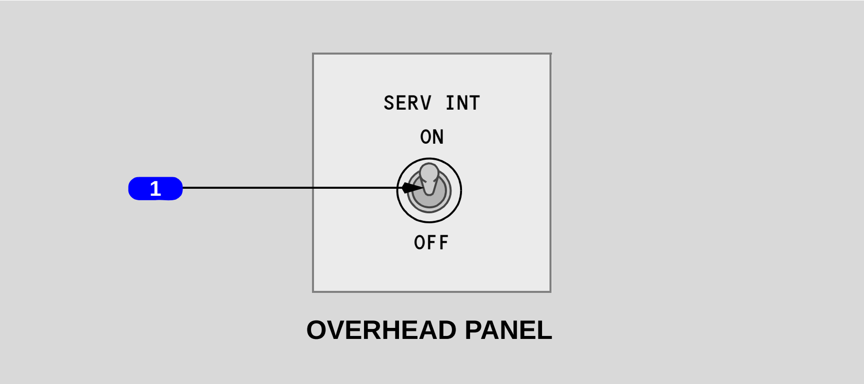
Push – allows oxygen mask or boom microphone transmission on selected transmitter.

Service Interphone Switch

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX

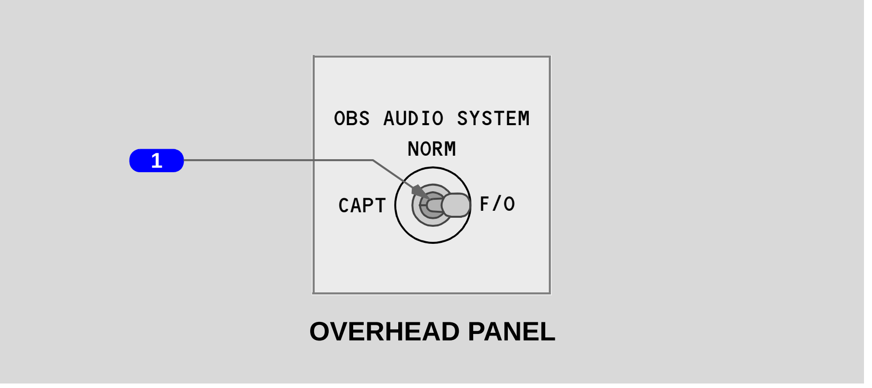


1 Service Interphone (SERV INT) Switch

OFF – allows independent operation of service and flight interphone systems.

ON – connects service and flight interphone systems.

Observer Audio System Switch



1 Observer (OBS) AUDIO SYSTEM Switch

Allows Captain or First Officer to use Observer's audio control panel.

CAPT - connects Observer's audio control panel to Captain's:

- hand mic
- boom mic/headset
- headphone
- oxygen mask mic
- speaker
- push to talk switches

NORM - audio control panel normal operation.

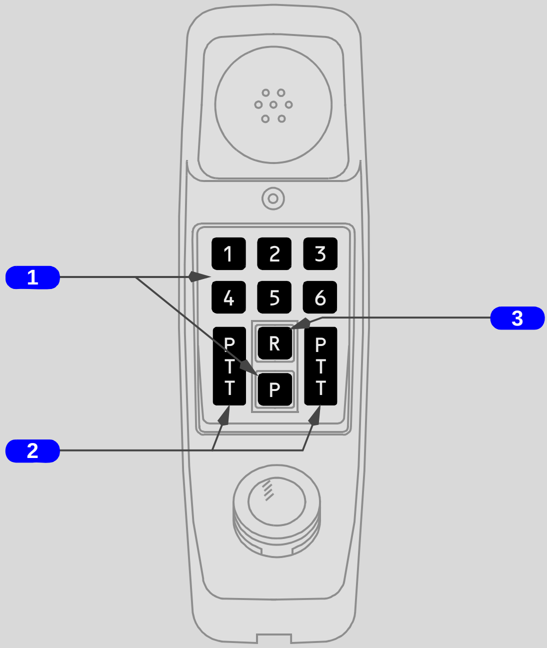
F/O - connects Observer's audio control panel to First Officer's:

- hand mic
- boom mic/headset
- headphone
- oxygen mask mic
- speaker
- push to talk switches

Handset

Handset provides communication with other handsets or PA system.

VQ-BHW, VQ-BHX



AFT AISLE STAND AND FLIGHT ATTENDANT PANELS

1 Interphone Keys

Push – selecting two digit code calls respective station or PA area.

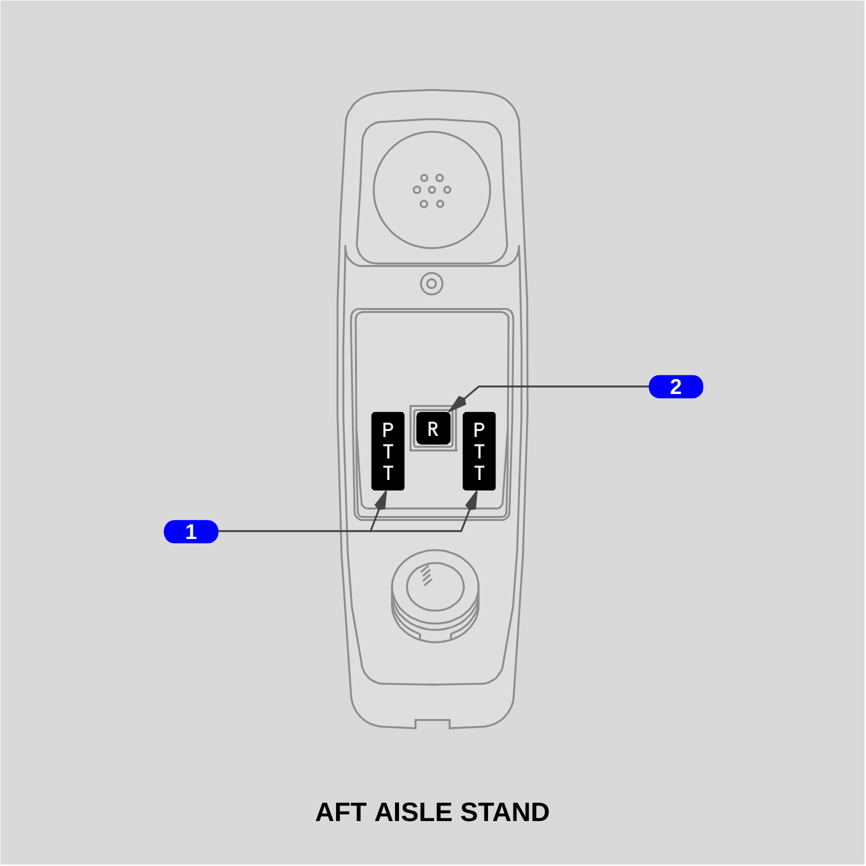
2 PA Push To Talk (PTT) Switches

Push – in PA mode connects handset mic to selected PA area.

3 Reset Switch

Push – cancels call or incorrectly selected code.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



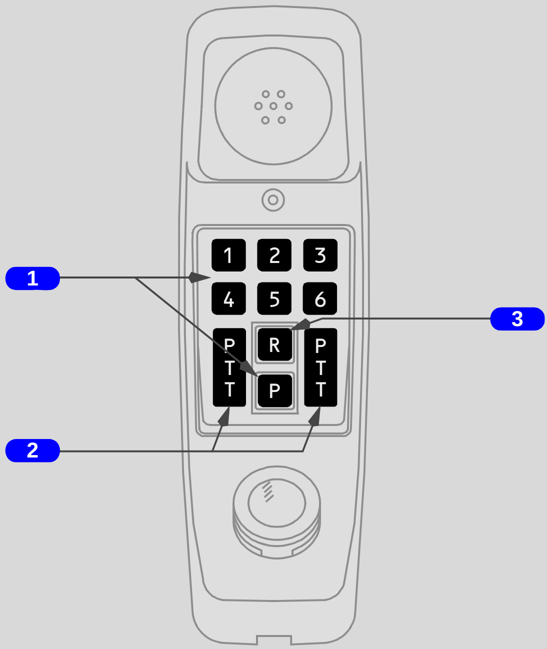
1 PA Push To Talk (PTT) Switches

Push – in PA mode connects handset mic to selected PA area.

2 Reset Switch

Push – cancels call.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



FLIGHT ATTENDANT PANELS

1 Interphone Keys

Push – selecting two digit code calls respective station or PA area.

2 PA Push To Talk (PTT) Switches

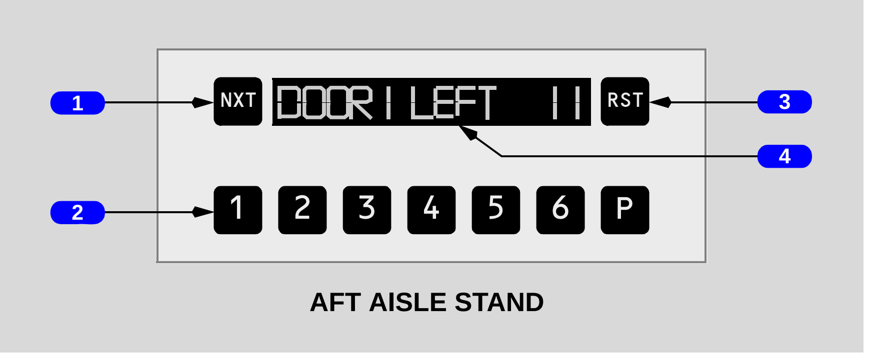
Push – in PA mode connects handset mic to selected PA area.

3 Reset Switch

Push – cancels call or incorrectly selected code.

Call Panel

Provides control for either PA (passenger address) or CAB (cabin) interphone communications using either the handset or an audio control panel.



1 Next (NXT) Switch

Push -

- reviews stored call locations
- when no other calls, scrolls through directory

2 Call Switches

Push -

- selecting two digit code calls respective station or PA area
- speak by selecting CAB (cabin) transmitter switch on audio control panel or handset

3 Reset (RST) Switch

Push - cancels call or incorrectly selected code, or displays DIRECTORY when scrolling through directory.

4 Call Station Indicator

Indicator displays:

- location and code of station calling or being called
- number of stored call locations
- station code and location when reviewing directory or other calls to the flight deck

Other call panel displays are:

- CABIN READY
- PA IN USE
- PILOT ALERT

- VIDEO IN USE

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VQ-BHW, VQ-BHX
(VP-BVR ; SB activates party line calling)

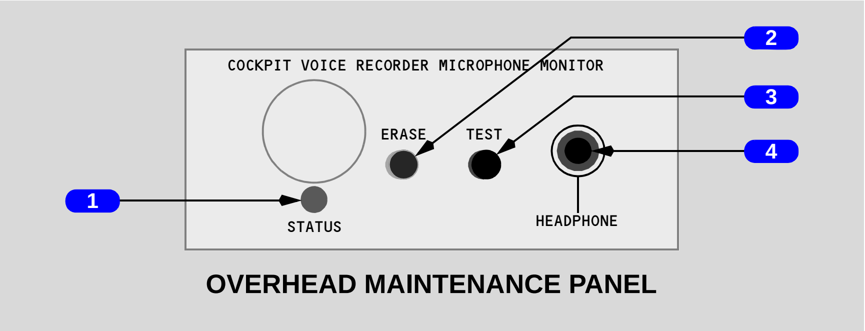
- PARTY LINE

Note: Call station directory located on handset. Light sensor adjusts intensity of call station indicator.

Cockpit Voice Recorder System

Cockpit Voice Recorder Panel

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKL



1 STATUS Light

Illuminated (green) – test completed successfully. Extinguished after one second.

2 ERASE Switch

Push and hold for three seconds - erases voice recorder if on the ground, AC power on, and parking brake set.

3 TEST Switch

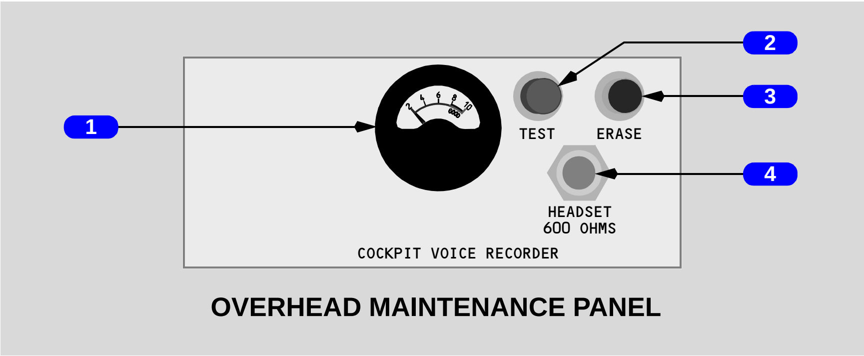
Push and hold for five seconds – tests all four cockpit voice recorder channels (1 per second).

4 Headset Jack

Headset can be plugged in to monitor playback of voice audio, or to monitor tone transmission during test.

Cockpit Voice Recorder Panel

EI-XLK, VQ-BHW, VQ-BHX



1 Monitor Indicator

2 TEST Switch

Push - tests all four channels.

3 ERASE Switch

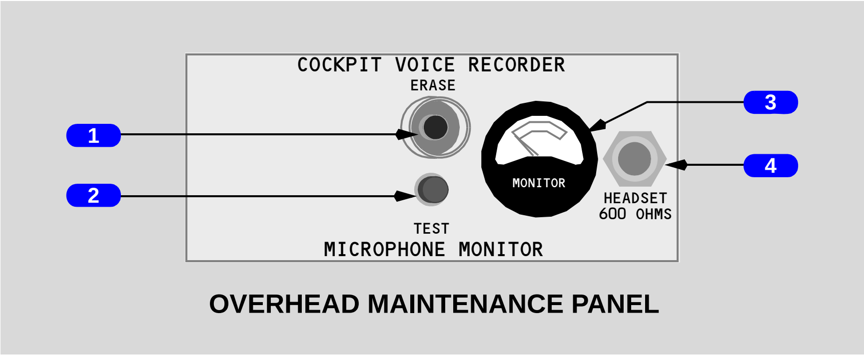
Push and hold for three seconds – erases voice recorder if on the ground, AC power on, and parking brake set.

4 Cockpit Voice Recorder Headset Jack

A headset can be plugged in to monitor playback of voice audio, or monitor tone during test.

Cockpit Voice Recorder Panel

VP-BKJ, VP-BVR



1 ERASE Switch

Push and hold for three seconds – erases voice recorder if on the ground, AC power on, and parking brake set.

2 TEST Switch

Push - tests all four channels.

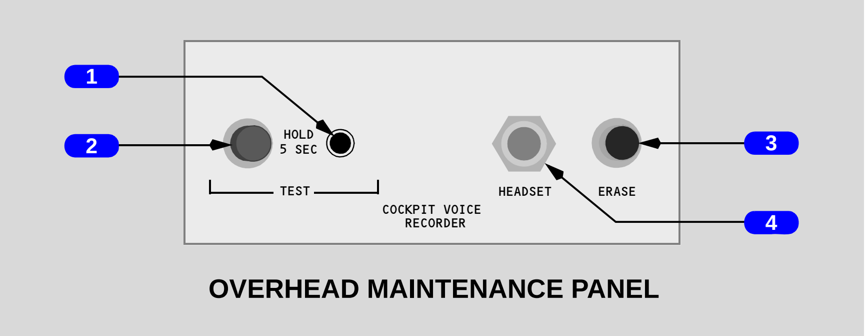
3 Monitor Indicator

4 Cockpit Voice Recorder Headset Jack

A headset can be plugged in to monitor playback of voice audio, or monitor tone during test.

Cockpit Voice Recorder Panel

EI-XLL, EI-XLM, EI-XLN, EI-XLO



1 STATUS Light

Illuminated – test completed successfully. Extinguished after button is released.

2 TEST Switch

Push and hold for five seconds – tests all four cockpit voice recorder channels (1 per second).

3 ERASE Switch

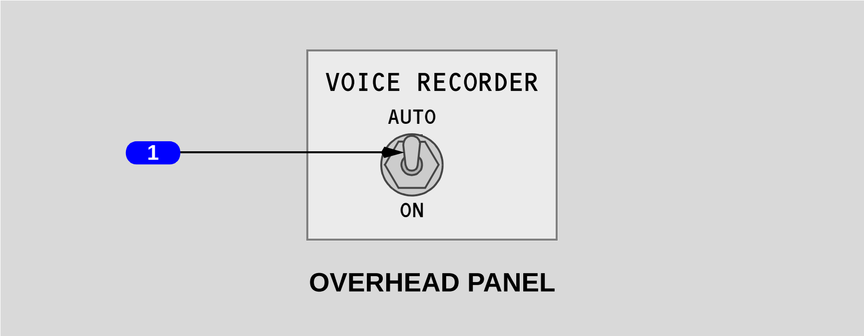
Push and hold for three seconds – erases voice recorder if on the ground, AC power on, and parking brake set.

4 Headset Jack

A headset can be plugged in to monitor playback of voice audio, or to monitor tone transmission during test.

Cockpit Voice Recorder Switch

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

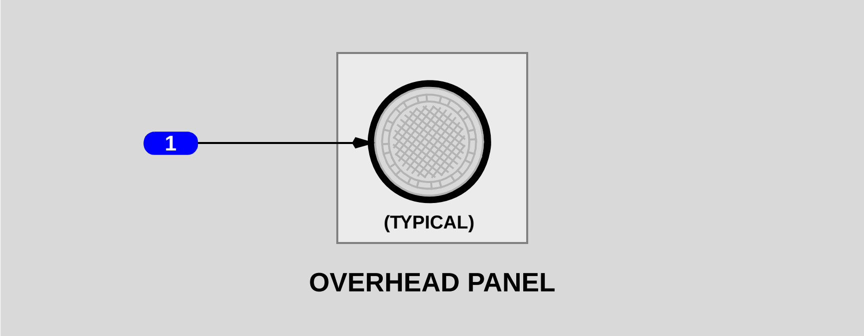


1 Cockpit VOICE RECORDER Switch

ON - records before engine start. Spring loaded to AUTO at engine start.

AUTO - records from first engine start until five minutes after last engine shut down. Always records in flight.

Cockpit Voice Recorder Microphone



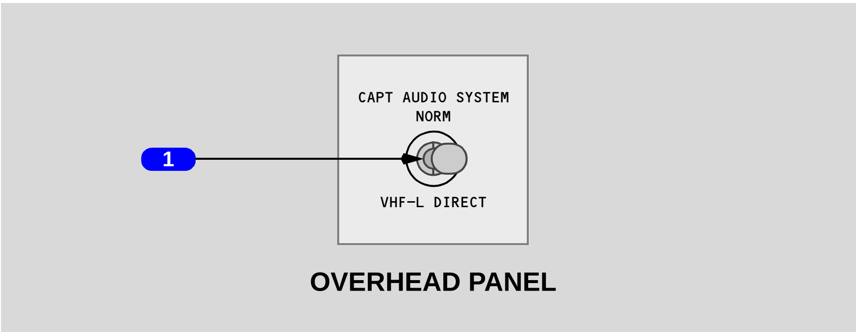
1 Cockpit Voice Recorder Microphone

Area microphone for the voice recorder.

Miscellaneous Communication Switches

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

Captain Audio System Switch



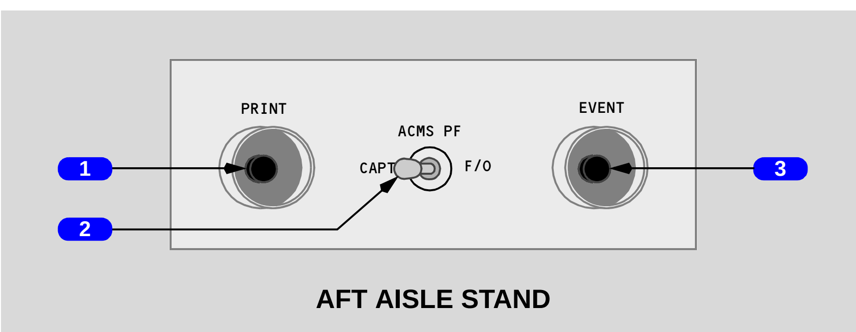
1 CAPT AUDIO SYSTEM Switch

Normal (NORM) - all communication systems operate normally.

VHF-L DIRECT - bypasses audio system by connecting Captain’s boom/mic headset and control wheel push to talk switches directly to VHF-L transceiver. Allows Captain to communicate on VHF-L transceiver if audio system failure causes loss of communication. Volume control is not available.

Aircraft Condition Monitoring System (ACMS) Switches

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



1 PRINT Switch

Push - prints ACMS report.

2 ACMS Pilot Flying (PF) Switch

CAPT - selects Captain as pilot flying input to ACMS.

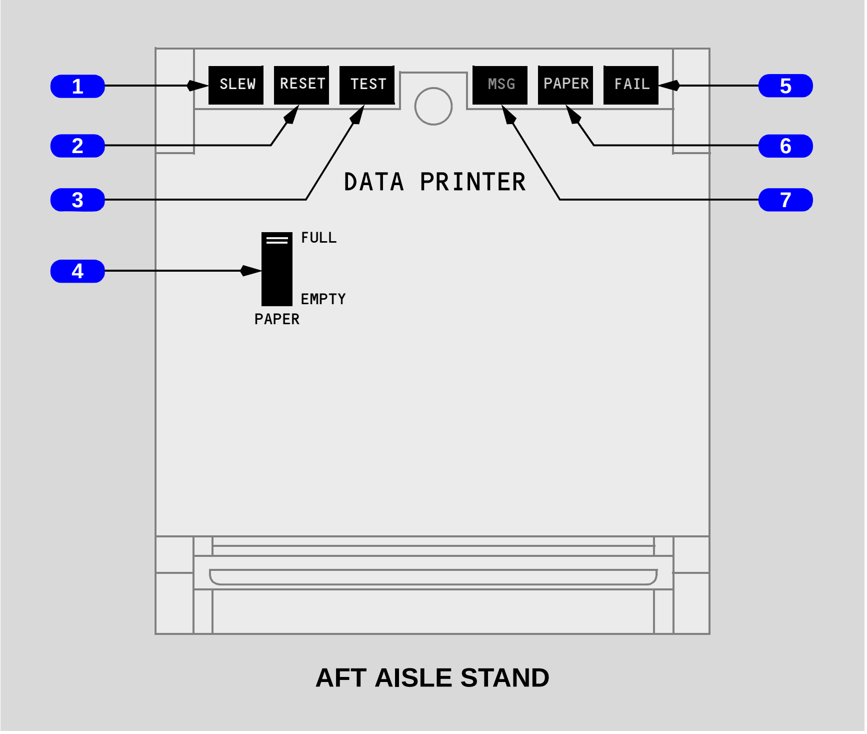
F/O - selects First Officer as pilot flying input to ACMS.

3 EVENT Switch

Push - records an event mark on ACMS.

Printer Controls

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



1 SLEW Switch

Push and hold - advances paper.

2 RESET Switch

Push - resets Message (MSG) light.

3 TEST Switch

Push –

- tests printer
- when pushed with RESET switch, prints test pattern

4 PAPER Indicator

Indicates amount of paper in printer.

5 FAIL Light

Illuminated (amber) - indicates printer failure.

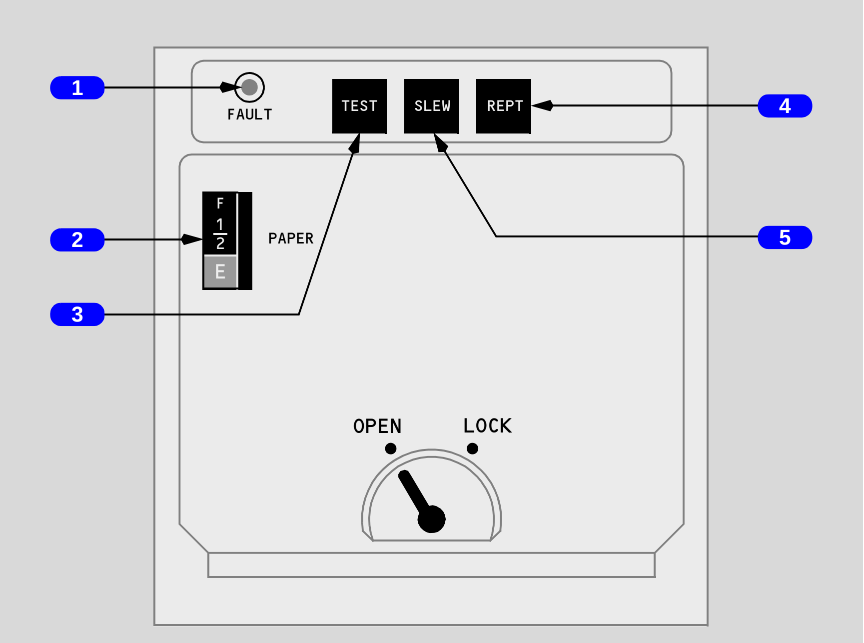
6 PAPER Light

Illuminated (amber) - indicates printer out of paper.

7 Message (MSG) Light

Illuminated (blue) - indicates message sent to printer.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



AFT AISLE STAND

1 FAULT Light

Illuminated (amber) - indicates printer failure.

2 PAPER Indicator

Indicates amount of paper in printer.

3 TEST Switch

Push –

- tests printer
- prints test pattern

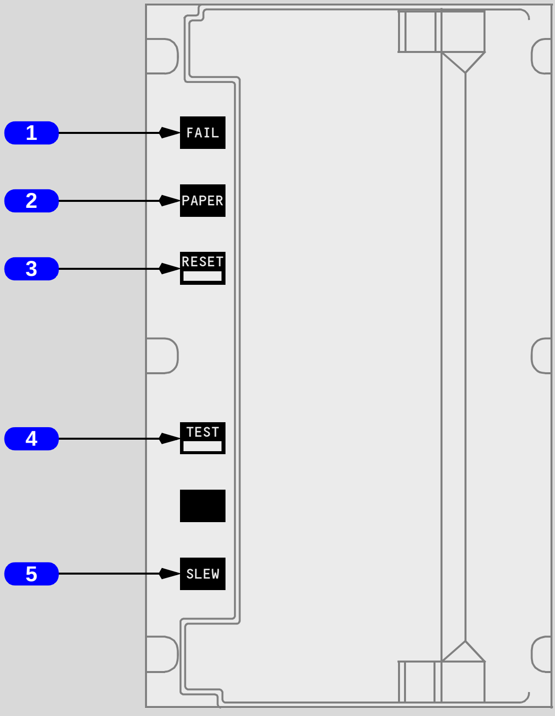
4 Repeat (REPT) Switch

Push - reprints last message.

5 SLEW Switch

Push and hold - advances paper.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



AFT AISLE STAND

1 FAIL Light

Illuminated (amber) –

- printer failure, or
- test in progress

2 PAPER Light

Illuminated (amber) -

- test in progress, or
- paper jam

3 RESET Switch

Push –

- aborts current print job
- deletes pending print job(s)
- resets printer

Illuminated (white) -

- reset in progress, or
- test in progress

4 TEST Switch

Push –

- tests printer
- prints test pattern

Illuminated (white) - test in progress.

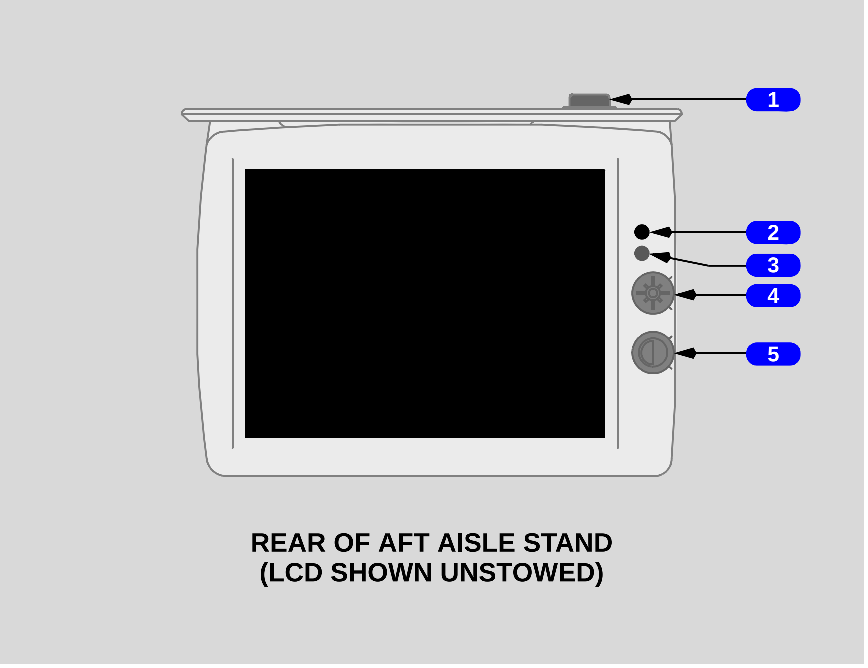
5 SLEW Switch

Push and hold – advances paper.

Cockpit Door Surveillance System (CDSS)

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Liquid Crystal Display (LCD) Monitor



1 VIEW SELECT Switch

2 Light Sensor

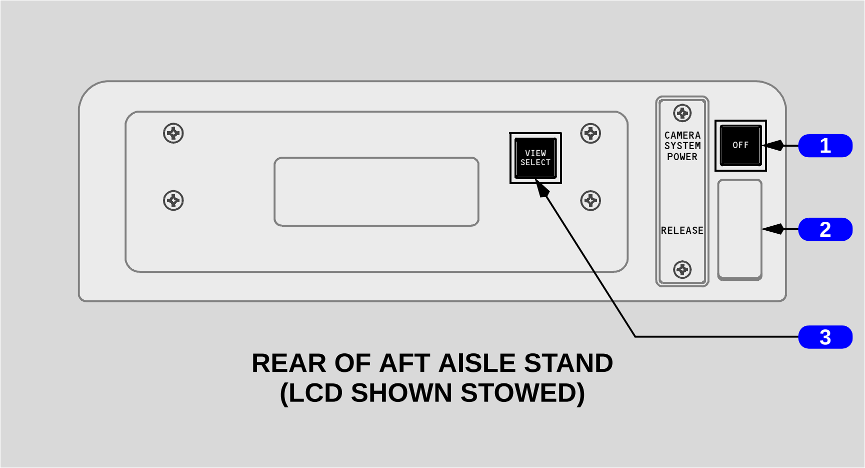
3 Power LED (Green)

LED Illumination	System Status
Steady	Power to system is ON and system is operational.
Flashing	System failure detected.
Not Illuminated	Power to system is OFF.

4 Brightness Control Knob

5 Contrast Control Knob

Plan View of LCD Enclosure Assembly



1 CAMERA SYSTEM POWER Switch (Alternate Action)

Switch "in" -

- CDSS power commanded to "on"
- LCD monitor unstowed: CDSS is powered and OFF light (white) extinguishes
- LCD monitor stowed: CDSS is unpowered and OFF light (white) illuminates

Switch "out" - turns off power to CDSS, regardless of LCD monitor’s position; OFF light (white) illuminates.

2 RELEASE Switch

Push - releases LCD monitor from the enclosure assembly; image appears on the LCD monitor after a few seconds when the Camera System Power switch is in.

3 VIEW SELECT Switch (Momentary Action)

Push - selects camera to provide view on the LCD monitor.

Introduction

The communication system includes:

- cockpit voice recorder system
- radio communication system
- interphone communication system

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS datalink)

- air traffic services datalink communications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

- company datalink communications

The radio tuning and audio control panels control the communication system.

Audio Control Panels

The audio control panels are used to manage radio and interphone communication systems. Navigation receiver audio can also be monitored.

The captain, first officer, and first observer audio control panels are installed on the aft aisle stand.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

The second observer audio control panel is installed on the sidewall panel.

Microphones are keyed by pushing the desired audio control panel transmitter select switch and then selecting one of the following:

- the MIC position of a control wheel switch

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

- the R/T position of an audio control panel PTT (Push To Talk) switch

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- the PTT position of a glareshield microphone switch
- the PTT position of a hand microphone switch

Systems are monitored using headphones or speakers.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

An oxygen mask microphone is enabled and the boom microphone is disabled when the oxygen mask left stowage door is open. The oxygen mask microphone is disabled and the boom microphone is enabled when the left oxygen mask stowage box door is closed and the RESET/TEST switch is pushed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

The oxygen mask microphone is enabled and the boom microphone is disabled when the audio control panel BOOM/OXY switch is in the OXY position. The oxygen mask microphone is disabled and the boom microphone is enabled when the audio control panel BOOM/OXY switch is in the BOOM position.

Cockpit Voice Recorder System

The cockpit voice recorder records any transmitted or received flight deck audio as selected on the audio control panels. It also records flight deck area conversations using an area microphone and crew member boom, oxygen mask, and hand microphones, independent of microphone/interphone switch position. All inputs are recorded continuously.

Radio Tuning Panels

The radio tuning panels tune the VHF and HF radios. The panels, designated left, center, and right, are normally associated with the respective VHF and HF radios.

If a radio tuning panel fails, the panel can be disconnected from the communication radios using the Off switch.

An offside tuning indicator on each radio tuning panel indicates one of the following conditions when illuminated:

- the panel is selected to a radio normally associated with another radio tuning panel
- a communication radio not normally associated with that radio tuning panel has been selected and may be tuned by another radio tuning panel

Radio Communication System

The radio communication system consists of:

- Very High Frequency (VHF)
- High Frequency (HF)
- Aircraft Communication Addressing and Reporting System (ACARS)
- Selective Calling (SELCAL)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

- Satellite Communications (SATCOM)

VHF and HF

There are three VHF radios (VHF L, C, R) and two HF radios (HF L, R). Any VHF or HF radio can be controlled by any radio tuning panel. The audio control panels control voice transmission and receiver monitoring.

VHF L and VHF R are configured for voice communication only. VHF C can be configured for voice or ACARS data communication. Normally, VHF C is configured for ACARS data communication.

EI-XLC, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
VHF radios are equipped with 8.33 kHz channel spacing.

The two HF radios share a common antenna. An HF voice transmission disables the opposite side HF radio during transmission. Simultaneous use of both HF radios is limited to receive only.

HF radio sensitivity can only be adjusted using the on-side radio tuning panel. Sensitivity control is not affected by radio tuning panel status.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
When an HF transmitter is keyed after a frequency change, the antenna tunes while a continuous tone can be heard through the audio system. A tone lasting longer than 7 seconds indicates failure of the system to tune.

VQ-BHW, VQ-BHX
When an HF transmitter is keyed after a frequency change, the antenna tunes while a continuous or intermittent tone may be heard through the audio system. A tone lasting longer than 7 seconds indicates failure of the system to tune. Data is stored in memory for the last 100 tuned frequencies. Stored frequencies may tune quickly and a tone may not be noticeable.

Stuck Mic Protection

On the ground, any VHF radio transmitting for longer than 35 seconds is disabled following annunciation of a warning beep. The radio is enabled when the microphone switch for that radio is released.

Aircraft Communication Addressing and Reporting System (ACARS)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS datalink)

ACARS datalink provides automatic and manual means to transmit and receive air traffic services, operational, maintenance, and administrative information between the airplane and a ground station. ACARS is operational when electrical power is established and is accessed by selecting the ACARS prompt on the CDU main menu.

VP-BKJ, VP-BVR (VQ-BHW, VQ-BHX ; before SB, ATS datalink not activated)

ACARS datalink provides automatic and manual means to transmit and receive operational, maintenance, and administrative information between the airplane and a ground station. ACARS is operational when electrical power is established and is accessed by selecting the ACARS prompt on the CDU main menu.

VP-BKJ, VP-BVR

ACARS communicates through VHF C.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

ACARS communicates through either VHF C or SATCOM.

If ACARS is not available due to lost communication, information to be transmitted is stored and transmitted automatically when communication is regained.

VHF C data mode can be selected and deselected by pushing the frequency transfer switch on the radio tuning panel. VHF C is in the data mode when the word ACARS is displayed in the radio tuning panel active frequency window.

EI-XLB, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW

If the data mode is deselected, ACARS is still operational and an ACARS failure may cause interference with voice operation of the radio. Therefore, ATC voice communication on VHF C is prohibited.

EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHX

When a VHF C standby frequency is transferred to the active window, ACARS is displayed in the standby window. If a new frequency is subsequently selected in the standby window, ACARS is replaced by the new frequency. ACARS can be returned to the standby window by selecting a frequency higher or lower than the allowable VHF frequency range. When in the data mode, VHF C is not available for voice communications. VHF C can be returned to the voice communication mode by transferring a voice frequency into the active frequency window.

Selective Calling (SELCAL)

The SELCAL system monitors the VHF and HF radios. When the system receives a call from a ground station, the respective radio CALL light illuminates and a chime sounds. The CALL light is reset by selecting the respective transmitter selector, or transmitting on that radio.

Satellite Communications (SATCOM)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

The SATCOM system provides ACARS data communications.

ACARS can use the SATCOM system when the airplane is beyond VHF communication range. Switching between VHF and SATCOM is automatic. ACARS data is controlled through the control display units (CDUs).

The SATCOM system also provides voice communications. Voice transmission is controlled using the CDUs and audio control panels. Calls can be initiated using the CDU.

Incoming SATCOM voice calls are answered automatically. Calls are annunciated by a SELCAL chime and illumination of a CALL light on the audio control panel. Pressing the respective transmitter select switch connects the call to the pilot headset/hand mic. SATCOM calls are terminated when the CALL light extinguishes (ground party hang-up or pilot ends call).

The SATCOM CDU control pages display by selecting SAT on the MENU page.

CDU Menu Page

Pushing the CDU MENU key displays the CDU menu page.

CDU ACARS Access

VP-BKJ, VP-BVR

Normally, ACARS displays are viewed on the center CDU. ACARS prompts are available on the menu page of all CDUs.

CDU

1 ACARS

Push -

- displays ACARS page
- activates ACARS control of CDU

CDU ACARS and SATCOM Access

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

Normally, ACARS and SATCOM displays are viewed on the center CDU. ACARS and SATCOM prompts are available on the menu page of all CDUs.

CDU

1 ACARS

Push -

- displays ACARS page
- activates ACARS control of CDU

2 SAT

Push -

- displays SATCOM page
- activates SATCOM control of CDU

SATCOM Main Menu Page [Typical]

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

The SATCOM main menu page allows the flight crew to initiate and terminate calls, monitor call status, and access lower-level pages. Control functions are active when displayed with an asterisk.

CDU

1 Channel L Control Field

Push – selects active control function. Channel L status/call information displays in small font.

2 Channel R Control Field

Push – selects active control function. Channel R status/call information displays in small font.

3 SUBMENU

Push – displays SATCOM submenu page which allows access to SATCOM log-on, SATCOM channel status, and SATCOM maintenance pages.

4 DIRECTORY

Push – displays directory page.

Directory Page [Typical]

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

The directory page is used to access category pages or preselect manual calls (as installed).

CDU

1 CATEGORY Pages

Push – displays category numbers page. Category numbers page labels and content are defined by the operator.

2 TRANSIT Ground Earth Station (GES)

Push – enters valid transit GES identification number from scratchpad. Entry results in sending the next flight deck call through displayed GES, then clearing of entry.

Push (after pressing CLR or DEL key with empty scratchpad) – clears entry.

3 MANUAL DIAL (as installed)

Push – enters valid phone number from scratchpad, preselects call, and returns display to SATCOM main menu page. System uses displayed phone number if scratchpad is empty.

4 SATCOM (SAT) Channel

Push – toggles between SAT L and R for selecting voice channel.

5 Priority (PRI)

The following call priority levels can display:

- 1 - emergency and distress calls (activates ground station alarm)
- 2 - regulatory and flight safety calls
- 3 - non-safety related service calls

Push – enters priority level from scratchpad for manually dialed phone number (as installed).

6 **RETURN**

Push – display returns to SATCOM main menu page.

Category Numbers Page [Typical]

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

The category numbers page contains a list of phone numbers used for making line-selectable calls.

CDU

1 **Phone Number List**

Push – preselects phone number for making call and returns display to SATCOM main menu page. Phone number labels and content are defined by the operator. Brackets in last position allow manual phone number entry (as installed).

2 **SORT**

Push – sorts phone number labels in alphanumeric order.

3 **RETURN**

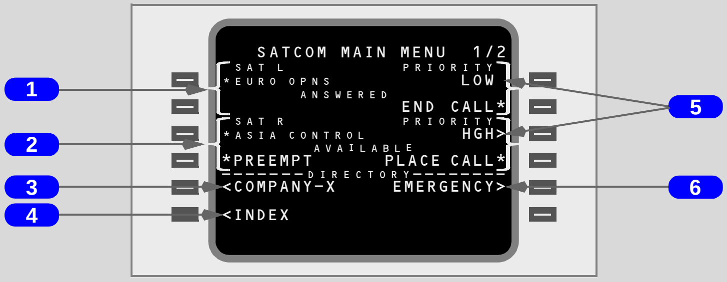
Push – display returns to directory page.

SATCOM Main Menu Pages [Typical]

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

The SATCOM main menu pages allow the flight crew to initiate and terminate calls, monitor call status, and access lower-level pages. Control functions are active when displayed with an asterisk.

SATCOM Main Menu Page 1/2



CDU

1 Channel L Control Field

Push – selects active control function, SATCOM priority page, or manual phone number entry (as installed). Channel L status information displays in center of field.

2 Channel R Control Field

Push – selects active control function, SATCOM priority page, or manual phone number entry (as installed). Channel R status information displays in center of field.

3 COMPANY-X

Displays last index label accessed. Index labels are defined by the operator.

Push – displays SATCOM directory page associated with displayed index label.

4 INDEX

Push – displays SATCOM directory (DIR) index page containing a list of index labels. Selecting desired index label displays associated SATCOM directory page.

5 PRIORITY

The following call priority levels can display:

- Emergency (EMG) - emergency and distress calls (activates ground station alarm)
- High (HGH) - regulatory and flight safety calls
- LOW - non-safety related service calls

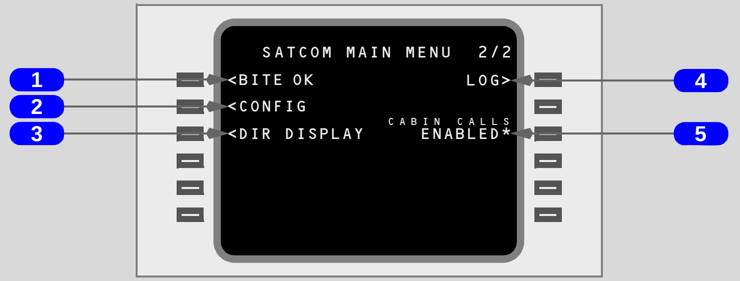
Push (channel not in use) – displays SATCOM priority page.

6 EMERGENCY

Displays label of first index (normally emergency).

Push – displays SATCOM directory page 1/20.

SATCOM Main Menu Page 2/2



CDU

1 Built-In-Test-Equipment (BITE)

Displays current BITE status.

Push – displays SATCOM BITE status page for access to system fault information.

2 CONFIG

Push – displays SATCOM config page for access to system configuration information.

3 Directory (DIR) DISPLAY

Prompt does not display if both voice channels unavailable.

Push – displays SATCOM directory display page (XX of 20).

4 LOG

Push – displays SATCOM log page for manual selection and control of log-on process.

5 CABIN CALLS

Push – selects desired cabin call status by toggling between enabled and disabled. Selecting enabled prompt displays the SATCOM cabin disable page for confirmation. If pilot confirms disabled, cabin calls in progress are terminated.

SATCOM Directory Page [Typical]

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

The SATCOM directory page (XX of 20) contains a list of phone numbers used for making line-selectable calls.

CDU

1 Phone Number List

Push – preselects phone number for making call, selects voice channel via left (SAT L) or right (SAT R) line select key, and returns display to SATCOM main menu page. Phone number labels and content are defined by the operator.

2 RETURN

Push – display returns to page displayed prior to entering SATCOM directory page.

3 Index Label

Displays index label associated with current SATCOM directory page. Index labels and content are defined by the operator.

SATCOM Directory Display Page [Typical]

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

The SATCOM directory display page (XX of 20) contains a list of phone number labels used to revise or add directory phone numbers.

CDU

1 Phone Number Labels

Push – displays SATCOM number (NUM) entry page used to revise or add related phone number.

2 RETURN

Push – display returns to SATCOM main menu page 2/2.

3 Index Label

Displays index label associated with current SATCOM directory display page. Index labels and content are defined by the operator.

Cockpit Door Surveillance System (CDSS)

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

General

The CDSS provides the pilots with live video images of the cockpit door entrance area, thus enabling them to positively identify, under all lighting conditions, person(s) requesting access to the flight deck.

The system consists of three black/white cameras with infrared illumination that are mounted on the cabin ceiling, and a liquid crystal display (LCD) enclosure assembly with a stowable LCD monitor. The LCD enclosure assembly is mounted on the rear of the aft aisle stand.

When unstowed, the LCD monitor can be rotated and tilted to adjust the viewing perspective.

The cameras are positioned such that views at different angles of the person(s) at the door entrance can be captured.

Control

The Release switch, located on the top face of the LCD enclosure assembly, mechanically releases the LCD monitor from its stowed position when the switch is depressed. The LCD monitor will pop up from the stowed position. Pushing the LCD monitor downwards returns it to its stowed position within the LCD enclosure and cuts off power to the CDSS, regardless of the position of the Camera System Power switch.

The Camera System Power switch, on the top face of the LCD enclosure assembly, controls power to the CDSS. It is an alternate action switch. When the switch is on, the CDSS will be powered when the LCD monitor is unstowed. When the switch is off, the CDSS will always be unpowered and the white OFF light in the switch illuminates.

The View Select switch located on the top of the LCD monitor, toggles the displayed image between views captured by different cameras. It is a momentary action switch.

Screen brightness is automatically controlled for the prevailing ambient light condition. Manual adjustment of screen brightness and contrast is possible using the two control knobs provided on the front face of the LCD monitor.

Operation

Releasing the LCD monitor from stowage turns on the CDSS and an image will appear on the LCD after a few seconds if the Camera System Power switch is on. If not, selecting the Camera System Power switch to the on position activates the system after the monitor is extended.

Toggling the View Select switch selects the three cameras to provide views from different cameras. The LCD enters the sleep mode after about 5 minutes of inactivity (i.e. when no change in LCD image is detected) and the display will go blank. Pushing the View Select switch restores image to the LCD immediately.

Pushing the LCD monitor downwards stows the LCD monitor and cuts off power to the CDSS. The OFF light in the Camera System Power switch will illuminate.

Intentionally
Blank

Interphone Communication System

The interphone communication system includes the:

- flight interphone system
- cabin interphone system
- passenger address (PA) system
- service interphone system

The flight interphone, service interphone, and PA systems are normally operated through the audio control panel.

The cabin interphone is operated through the audio control panel or flight deck handset.

Flight Interphone System

The flight interphone system provides communications between flight deck crew members. The flight interphone system also provides communications between the flight deck and ground crew through the flight interphone jack in the nose landing gear wheel well.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
The system is used by selecting the INT (interphone) position of a control wheel switch. The interphone can also be used by selecting the FLT transmitter select switch on an audio control panel and then selecting one of the following:

- the MIC position of a control wheel switch

the PTT position of a hand microphone switch

the PTT position of a glareshield microphone switch

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
The system is used by selecting the INT (interphone) position of a control wheel switch or an audio control panel PTT (Push To Talk) switch. The interphone can also be used by selecting the FLT transmitter select switch on an audio control panel and then selecting one of the following:

- the R/T position of an audio control panel PTT switch
- the MIC position of a control wheel switch
- the PTT position of a hand microphone switch

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- the PTT position of a glareshield microphone switch

Crew alerting of a ground crew initiated call is provided by an aural alert chime and illumination of the FLT call indication. The call indication is reset by selecting the FLT transmitter select switch or transmitting on that transmitter. The ground crew is called by selecting P-1 on the flight deck call panel.

Service Interphone System

The service interphone system provides voice communications between ground crew stations at various locations around the airplane. The system can be connected to the flight interphone system through the service interphone switch on the overhead panel.

Passenger Address System

The passenger address (PA) system is used by the flight crew to make cabin announcements. The PA system is accessed using the boom microphone, oxygen mask microphone, hand microphone, or flight deck handset.

The boom, oxygen mask, or hand microphone is used by pushing the PA transmitter select switch and activating a microphone or push to talk switch. The system is monitored by pushing the PA receiver volume control.

The PA system can also be selected through the cabin interphone system, as described in the Cabin Interphone System section.

Cabin PA announcement priorities are:

- flight deck announcements from an audio control panel
- cabin handset direct access announcements
- priority (all area) announcements
- normal announcements from flight attendant or flight deck handsets

Cabin Interphone System

The cabin interphone system provides voice communications between the flight deck and the flight attendant stations.

The cabin interphone system is accessed by using the boom microphone, oxygen mask microphone, hand microphone, or flight deck handset located behind the aisle stand.

The boom or oxygen mask microphone is used by selecting the CAB transmitter select switch and using the R/T position of a push to talk switch. The hand microphone is also used with the CAB transmitter selected. The system is monitored by selecting the CAB receiver volume control.

Selecting the CAB transmitter select switch or removing the flight deck handset from the hook activates the flight deck call panel. The call panel is used to select the desired station to be called.

Interphone system calls from the flight deck to attendant stations are prioritized according to the code dialed (PA announcements, Priority 33, ALL CALL, and station to station). A higher priority call will override and disconnect a lower priority call.

A priority line can be established only to the primary station (normally primary DR 1L), by dialing 33 or pushing the CAB transmitter select switch on the audio control panel twice within three seconds. This action also joins an existing priority call between the primary and alternate station.

Any station may call the flight deck on Pilot Alert and override a Priority call but not a PA announcement.

Calls may be transferred to any other station by dialing the code of the station the call is to be transferred to and then hanging up. Up to four stations may be connected in a conference call by dialing the station to be added.

Flight attendants desiring communication with the flight deck use the flight attendant handsets. The incoming call illuminates the CAB call indication on the audio control panel, displays the location of the calling station on the call panel, and sounds a chime.

The CAB call indication is reset by selecting the respective transmitter select switch, or transmitting on that transmitter. The call indication is also reset by picking up the flight deck handset.

(VP-BVR ; before SB, party line calling not activated)
If more than one call is made to the flight deck at a time, the other callers get a busy signal, but the caller location is stored.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VQ-BHW, VQ-BHX
(VP-BVR ; SB activates party line calling)
The flight deck can receive up to three incoming calls at the same time from callers using dial code 31. With a call in progress, up to two additional callers may access the same line and PARTY LINE displays on the flight deck call panel. When more than three calls are made to the flight deck at the same time from callers using dial code 31, the additional callers get a busy signal and the caller’s location is stored.

When calls are stored, the call panel displays a “W” followed by the number of stored calls. After completing the call, stored locations can be reviewed with the NXT switch on the call panel.

Intentionally
Blank

This Section Applies to EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
(VQ-BHW, VQ-BHX ; SB activates FANS/ATS functionality)

Air Traffic Control Datalink

For airplanes with the Air Traffic Control (ATC) datalink function installed, these functions are accomplished on the CDU. These functions include Air Traffic Services Facilities Notification, Automatic Dependent Surveillance (ADS), and ATC Datalink.

The ATC LOGON/STATUS page provides the capability to initiate an AFN downlink to a specified ATS facility and to display the ADS, ATC DL, and datalink status.

THE ATC UPLINK pages display messages uplinked by an ATS facility and provide the capability to respond to uplinked messages and to load clearances which contain loadable data. Display of the EICAS memo message ATC MESSAGE and a low level aural chime announce uplinked messages to the flight crew.

The ATC REQUEST pages provide capability to create downlink requests for vertical and speed clearances, lateral offsets, and route changes.

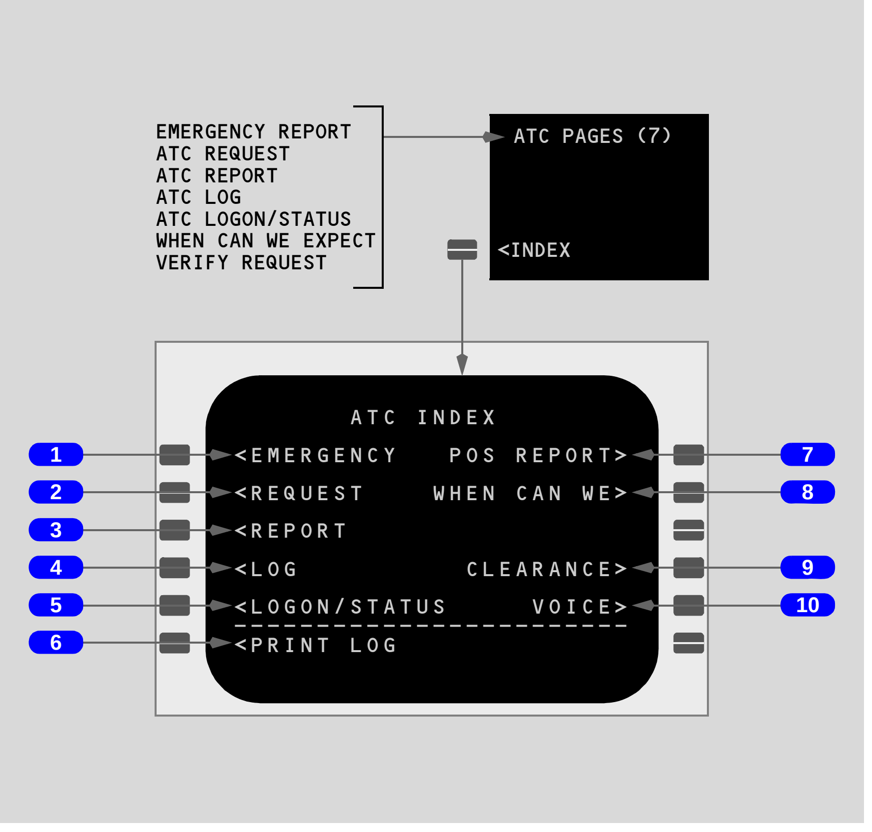
The FMC formats reports in response to requests from an ATS facility for reports and confirmation. These reports are accessible via the ATC REPORT page and display for review or modification on the VERIFY REPORT pages.

The ATC LOG page provides a list of all uplinks and downlinks stored in the ATC Log and provides access to the XXXXz ATC UPLINK, XXXXz ATC REQUEST, XXXXz ATC REPORT, and XXXXz EMERGENCY pages corresponding to each logged uplink or downlink.

To accomplish Automatic Dependent Surveillance, the FMC can simultaneously receive requests from four ATC centers and one airline center. Airline ADS addresses are stored in the airline policy file. The ADS functions include periodic, event, and on-demand reporting. The type and content of a report is initiated by uplink request. These functions are automatic. The flight crew can disable this function on the ATC LOGON/STATUS page.

ATC Index Page

The ATC INDEX page provides access to pages used for ATC datalink functions.



1 EMERGENCY

Push - displays EMERGENCY REPORT page.

2 REQUEST

Push - displays ATC REQUEST page.

3 REPORT

Push - displays ATC REPORT page.

4 LOG

Push - displays ATC LOG page.

5 LOGON/STATUS

Push - displays ATC LOGON/STATUS page.

6 PRINT LOG

Push - transmits contents of ATC log to printer.

7 Position (POS) REPORT

Push - displays POS REPORT page.

8 WHEN CAN WE

Push - displays WHEN CAN WE EXPECT page.

9 CLEARANCE

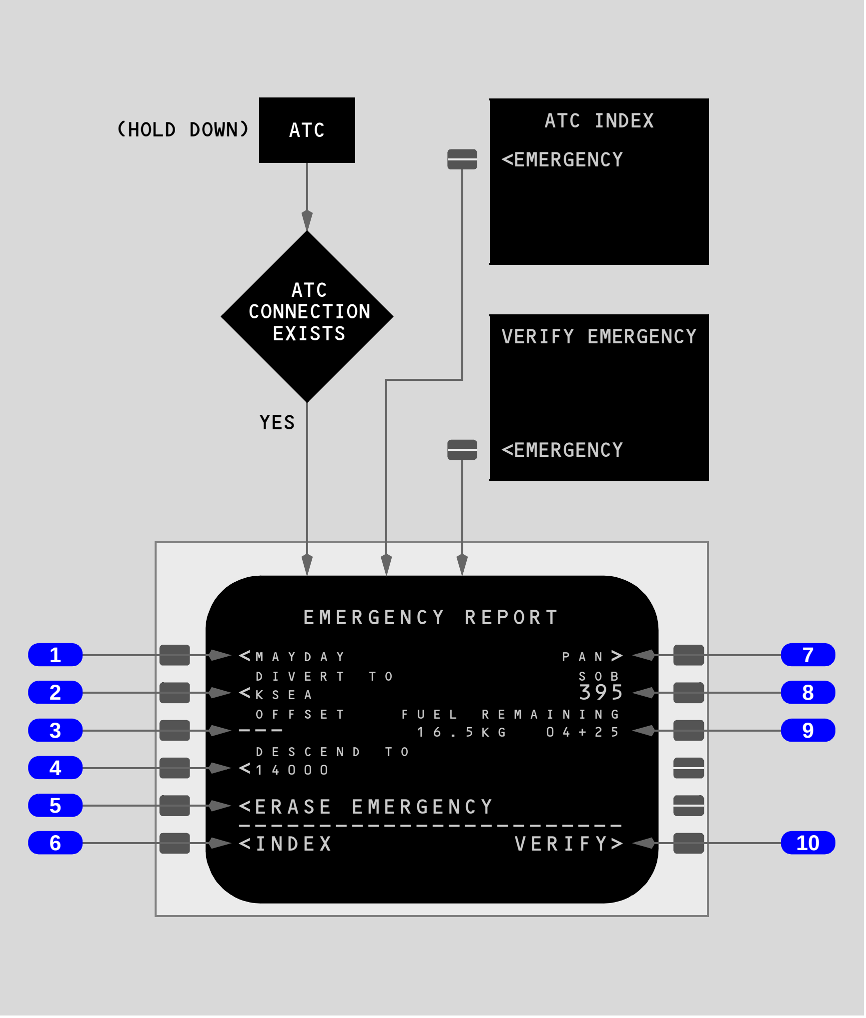
Push - displays VERIFY REQUEST pages for clearance request.

10 VOICE

Push - displays VERIFY REQUEST page for voice contact request.

Emergency Report Page

The EMERGENCY REPORT page provides the capability to create downlink messages to alert ATS to an aircraft emergency and to the lateral and vertical maneuvers the flight crew intend to execute.



1 MAYDAY

Push -

- displays VERIFY EMERGENCY page
- displays MAYDAY MAYDAY MAYDAY message

- selects, but does not display, additional POSITION REPORT message elements for inclusion in the emergency report downlink
- when current altitude more than 150 feet above altitude in 4L, displays DESCENDING TO on VERIFY EMERGENCY page

2 DIVERT TO

Displays active destination airport.

Valid entries are: waypoint, navaid, airport, latitude-longitude, or place bearing/distance.

Entered position may be deleted.

Push -

- message includes remainder of route if active destination airport displayed
- message includes direct to routing if entered position displayed

3 OFFSET

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
Valid entry is L (or R) XX. (XX is any number from 1 to 99).

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Valid entry is L (or R) XX, or just XX. (XX is any number from 1 to 99).

Message includes entered offset.

Entered offset may be deleted.

4 DESCEND TO

Displays MCP altitude.

Valid entry is XXX or FLXXX (flight level), XXXXX (feet), or XXXXXM.

Entered altitude may be deleted.

Push - message indicates crew intention to descend to displayed altitude.

5 ERASE EMERGENCY, CANCEL EMERGENCY

Initial display is blank.

Entry or selection of data on any line displays ERASE EMERGENCY.

Displays CANCEL EMERGENCY after EMERGENCY REPORT sent.

ERASE EMERGENCY -

Push - erases all emergency data.

CANCEL EMERGENCY -

Push - selects CANCEL EMERGENCY message.

6 **INDEX**

Push - displays ATC INDEX page.

7 **PAN**

Push -

- displays VERIFY EMERGENCY page
- displays PAN PAN PAN message

8 **Souls On Board (SOB)**

Entry of number of persons on airplane displays the lesser of the totalizer or FMC computed fuel remaining and souls on board message elements for inclusion in the emergency report downlink.

Causes remaining fuel quantity to display.

Deletion of SOB deselects the message element.

9 **FUEL REMAINING**

Initial display is blank.

Displays FMC computed fuel remaining in quantity and time when a SOB number is entered.

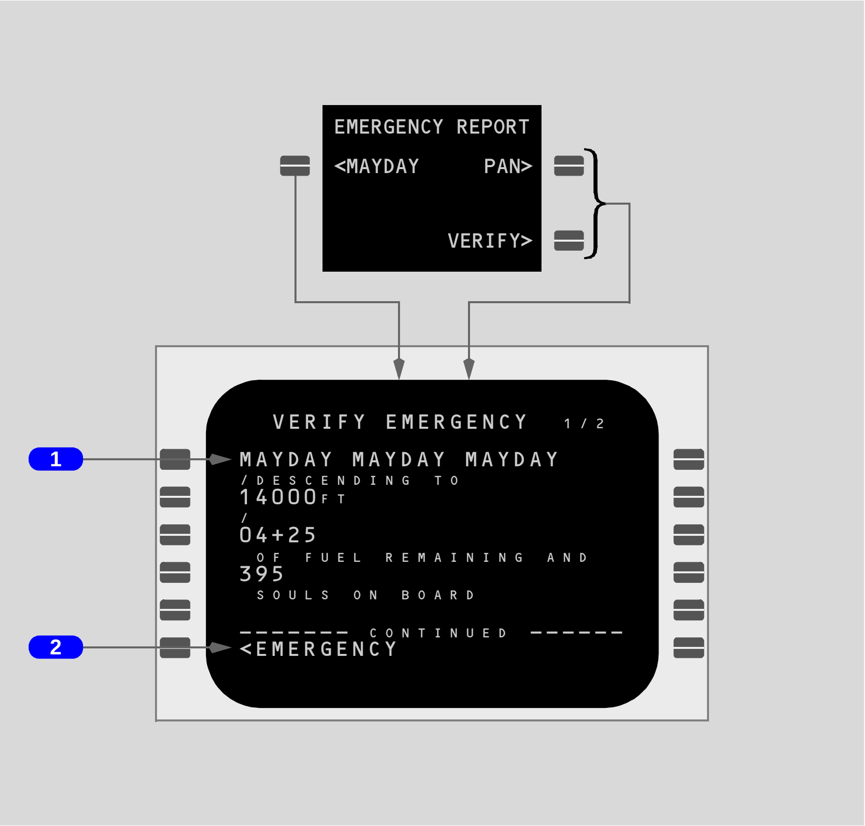
Valid entry is HH+MM (hours and minutes).

10 **VERIFY**

Push - displays VERIFY EMERGENCY page.

Verify Emergency Page 1/X

The VERIFY EMERGENCY page displays the text of the EMERGENCY REPORT which will be downlinked to ATC. The page allows entering free text in the downlink message.



1 Lines 1 - 5

Pages 1/X to X/X display data from the EMERGENCY REPORT page and provide at least one line for free text entry.

Page 1/X line 1 displays MAYDAY MAYDAY MAYDAY message or PAN PAN PAN message as selected on EMERGENCY REPORT page.

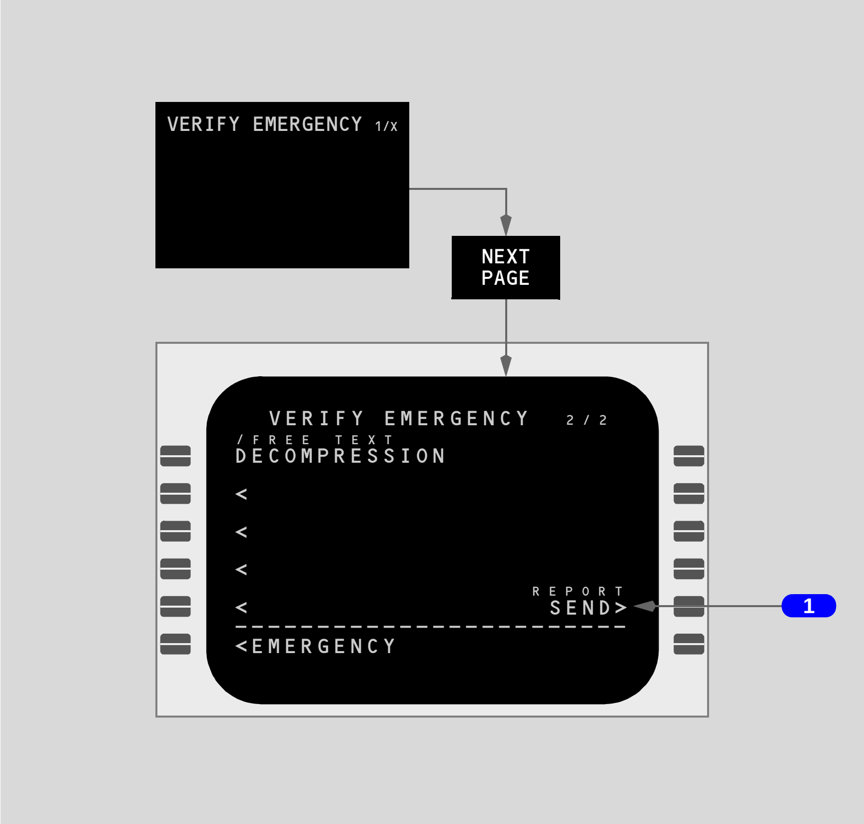
- MAYDAY MAYDAY MAYDAY message and PAN PAN PAN messages may be deleted
- deletion of MAYDAY MAYDAY MAYDAY message deletes DESCENDING TO line

2 EMERGENCY

Push - displays EMERGENCY REPORT page.

Verify Emergency Page X/X

Pages X/X are available when lines 1 - 5 are filled on page 1/X.



1 REPORT SEND

Push - displays XXXXz EMERGENCY page.

- transmits an emergency report message containing the information on the VERIFY EMERGENCY page
- creates log entry of transmitted message
- when MAYDAY selected and when enabled in airline policy file: transmits POSITION REPORT, activates ADS in emergency mode, and transmits an AOC emergency report

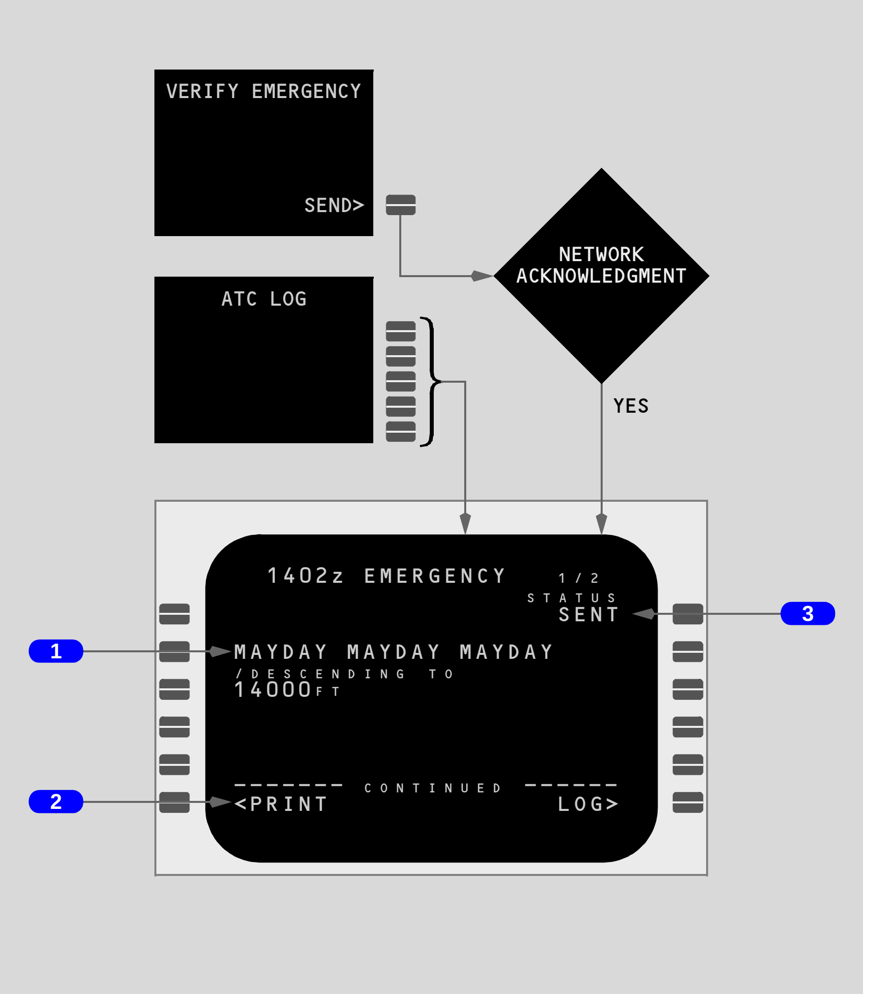
When CANCEL EMERGENCY selected on the EMERGENCY REPORT page:

Push -

- sends CANCEL EMERGENCY message
- deactivates ADS emergency mode
- creates ATC LOG entry of transmitted message
- displays SENDING before network acknowledgement within time limit
- displays RESEND when no network acknowledgement within time limit
- displays SEND upon network acknowledgement
- displays NO ATC COM when datalink READY and no ATC connection
- displays DATA LINK header and NO COMM, VOICE, or FAIL as appropriate for datalink fault

XXXXz Emergency Page X/X

XXXXz EMERGENCY page displays the transmitted report. XXXXZ is the time the report was transmitted.



1 Lines 1 - 5

Pages 1/X to X/X display message transmitted to ATC at time of page title. Line 1 is blank on page 1/X.

2 PRINT, PRINTERROR, PRINTING, BUSY, FAIL

Displays on last XXXXZ EMERGENCY page.

PRINT displayed - printer READY.

PRINTERROR displayed - printer state ERROR.

PRINTING displayed - printing displayed page.

BUSY displayed - printing other than displayed page.

FAIL displayed - printer failed.

PRINT -

Push - prints XXXXz EMERGENCY report.

PRINT ERROR -

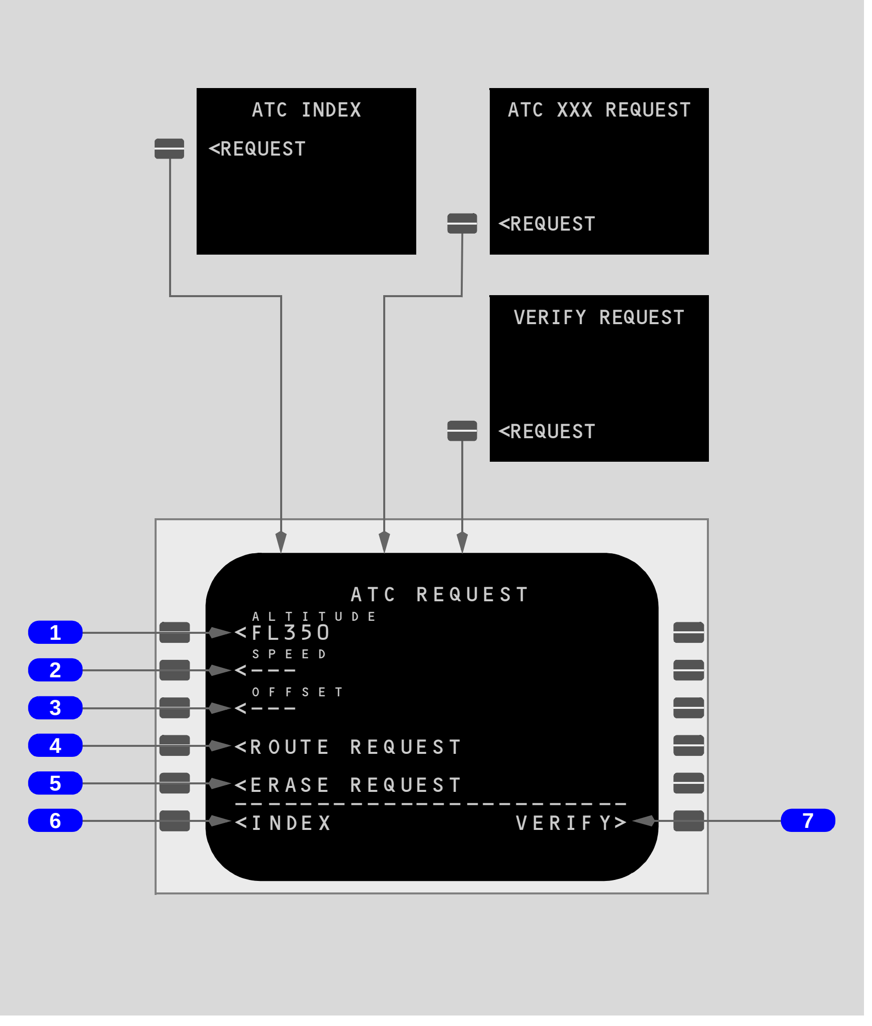
Push - prints XXXXz EMERGENCY report.

3 STATUS

Displays emergency report status from ATC LOG page.

ATC Request Page

The ATC REQUEST page allows entry of altitude, speed, and offset direction and distance requests.



1 ALTITUDE

Initially displays dashes.

Valid entries are XXX or FLXXX (flight level), XXXXX (feet), XXXXXM (meters), XXXXX/XXXXX, or FLXXX/FLXXX.

Entry may be deleted.

Push -

- with altitude/flight level entered, displays ATC ALT REQUEST page with altitude/flight level on altitude line
- with dashes displayed, displays ATC ALT REQUEST page with dashes on altitude line

2 SPEED

Intially displays dashes.

Valid entry is IAS or Mach.

Entry may be deleted.

Push -

- with speed/Mach entered, displays ATC SPEED REQUEST page with speed/Mach on speed line
- with dashes displayed, displays ATC SPEED REQUEST page with dashes on speed line

3 OFFSET

Initially displays dashes.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
Valid entry is L (or R) XX. (XX is any number from 1 to 99).

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Valid entry is L (or R) XX, or just XX. (XX is any number from 1 to 99).

Entry may be deleted.

Push -

- with offset entered, displays ATC OFFSET REQUEST page with offset on offset line
- with dashes displayed, displays blank ATC OFFSET REQUEST page

4 ROUTE REQUEST

Push - displays ATC ROUTE REQUEST page.

5 ERASE REQUEST

Push - erases entered or selected data and any or all of the ATC REQUEST pages.

6 INDEX

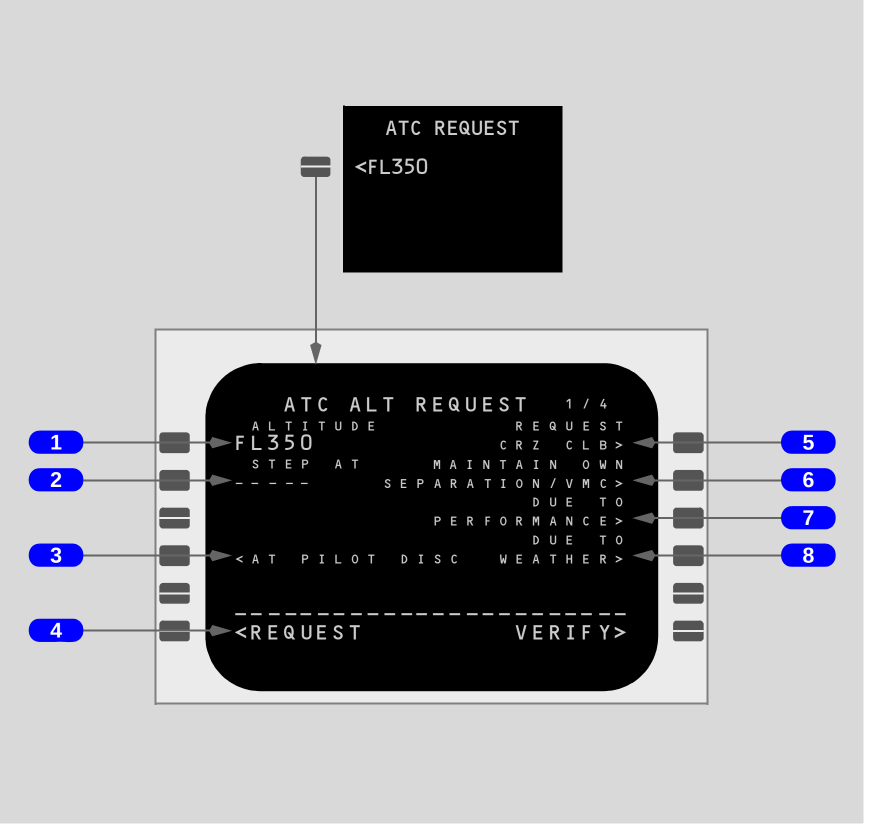
Push - displays ATC INDEX page.

7 VERIFY

Push - displays VERIFY REQUEST page.

ATC Altitude Request Page 1/4

The ATC ALT REQUEST page 1/4 allows downlink requests for altitude changes.



1 ALTITUDE

Initially displays dashes or altitude requested on ATC REQUEST page.

Valid entries are XXX or FLXXX (flight level), XXXXX (feet), XXXXXM (meters), XXXXX/XXXXX, or FLXXX/FLXXX.

Entry selects a message requesting a level altitude, climb, or descent based on current altitude.

Altitude may be deleted.

2 STEP AT

Initially displays dashes.

Valid entries are: fix name, navaid, airport, latitude-longitude, place bearing/distance, or time.

Entry of a position or time with an altitude request selects a message requesting a step up or down at a specified time based on current altitude.

Entry may be deleted.

3 AT PILOT Discretion (DISC)

Push - displays AT PILOTS DISCRETION in large font and selects as message element.

Selection may be deleted.

4 REQUEST

Push - displays ATC REQUEST page.

5 REQUEST Cruise Climb (CRZ CLB)

Push - displays CRZ CLB in large font and selects message requesting cruise climb to entered altitude.

Selection may be deleted.

6 MAINTAIN OWN SEPARATION/VMC

Push - displays SEPARATION/VMC in large font and selects MAINTAIN OWN SEPARATION/VMC mesage element.

Selection may be deleted.

7 DUE TO PERFORMANCE

Push - displays PERFORMANCE in large font and selects DUE TO PERFORMANCE message element.

Selection may be deleted.

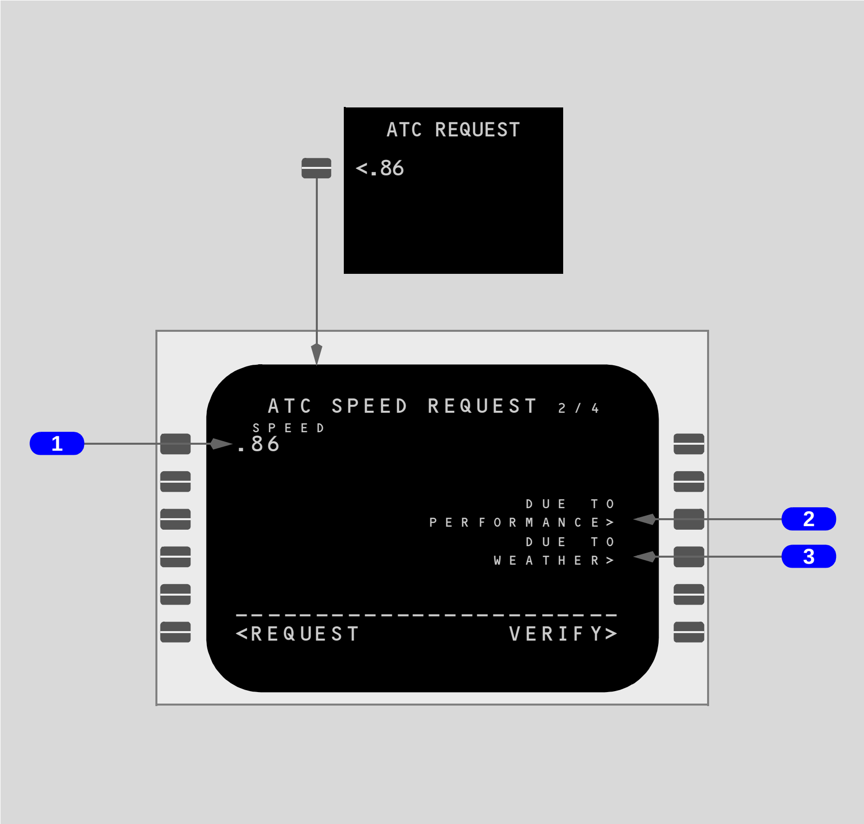
8 DUE TO WEATHER

Push - displays WEATHER in large font and selects DUE TO WEATHER message element.

Selection may be deleted.

ATC Speed Request Page 2/4

The ATC SPEED REQUEST page 2/4 allows downlink requests for speed changes.



1 **SPEED**

Initially displays dashes or speed/Mach requested on ATC REQUEST page.

Valid entry is IAS or Mach.

Entry selects a message requesting the speed or Mach.

Entry may be deleted.

2 **DUE TO PERFORMANCE**

Push - displays PERFORMANCE in large font and selects DUE TO PERFORMANCE message element.

Selection may be deleted.

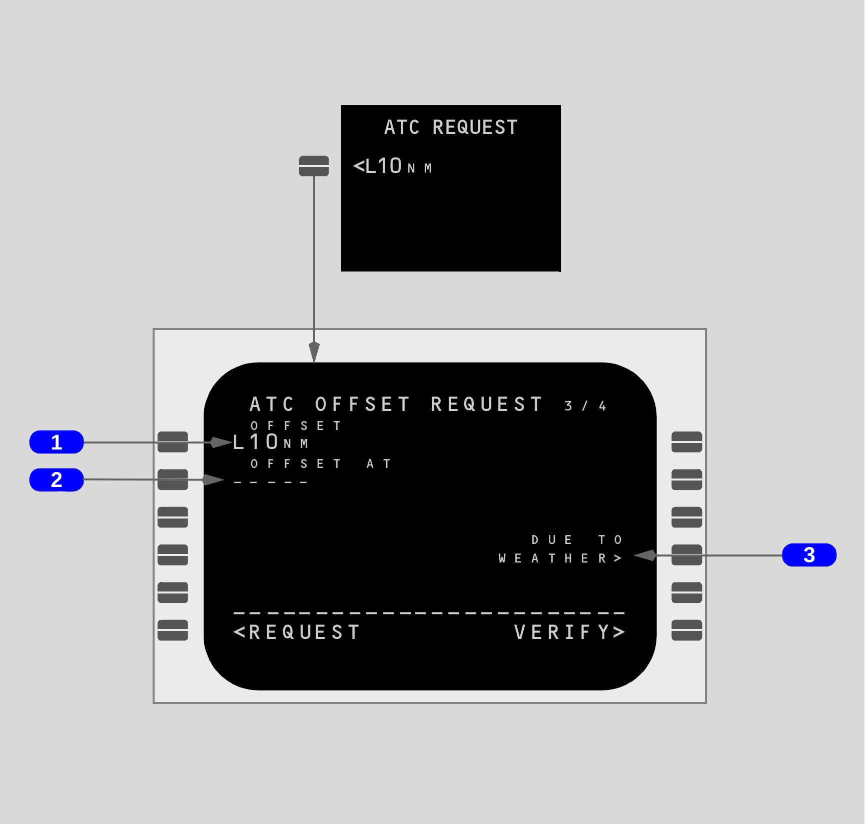
3 DUE TO WEATHER

Push - displays WEATHER in large font and selects DUE TO WEATHER message element.

Selection may be deleted.

ATC Offset Request Page 3/4

The ATC OFFSET REQUEST page 3/4 allows downlink requests for lateral offsets.



1 OFFSET

Initially displays dashes or offset requested on ATC REQUEST page.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
Valid entry is L (or R) XX. (XX is any number from 1 to 99).

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Valid entry is L (or R) XX, or just XX. (XX is any number from 1 to 99).

Entry selects a message requesting an offset from the active route.

Entry may be deleted.

2 OFFSET AT

Entry of a position or time with an offset request selects a message requesting an offset at the specified position or time.

Valid entries are: fix name, navaid, airport, latitude-longitude, place bearing/distance, or time.

Entry may be deleted.

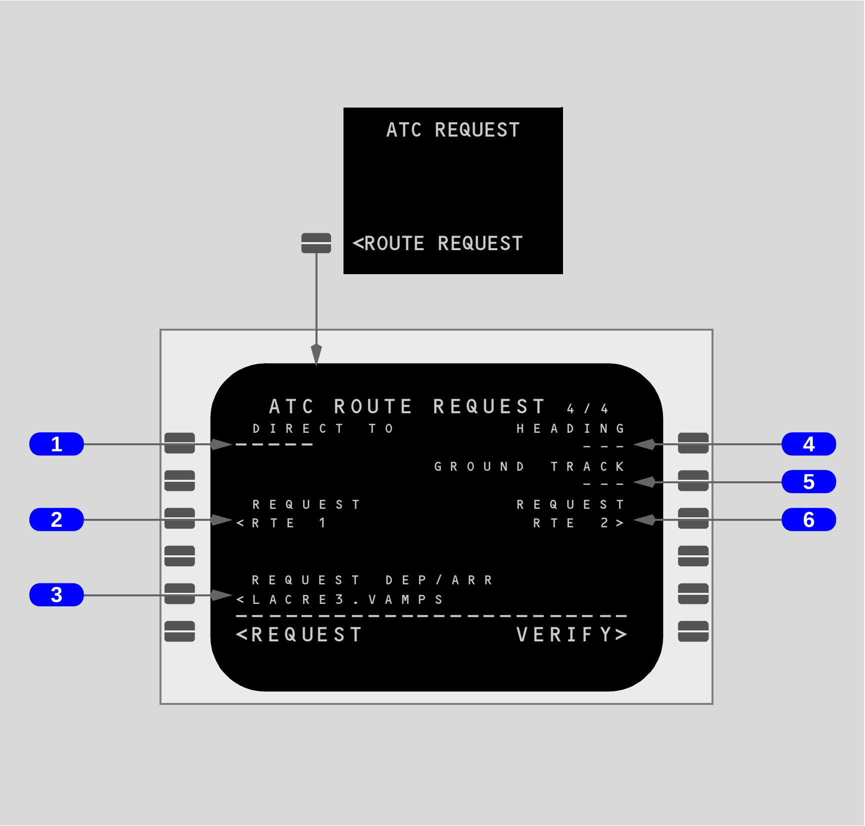
3 DUE TO WEATHER

Push - displays WEATHER in large font and selects REQUEST WEATHER DEVIATION UP TO entered message element.

Selection may be deleted.

ATC Route Request Page 4/4

The ATC ROUTE REQUEST page 4/4 allows downlink requests for route changes.



1 DIRECT TO

Entry selects a message requesting a clearance direct to the position.

Valid entries are: fix name, navaid, airport, latitude-longitude, or place bearing/distance.

Entry may be deleted.

2 REQUEST Route 1 (RTE 1)

Push - selects route stored in RTE 1 for route request. When RTE 1 has a pending modification, the modified route is requested.

Selection may be deleted.

3 **REQUEST Departure/Arrival/Transition (DEP/ARR)**

Initially displays dashes or selections made on DEP/ARR page.

Valid entry is departure or arrival, or departure or arrival and transition.

Entry may be deleted.

Push - displays selected entry in large font and selects a message element requesting the selected entry.

4 **HEADING**

Entry selects a message requesting the specified heading.

Valid entry is XXX (heading).

Entry may be deleted.

5 **GROUND TRACK**

Entry selects a message requesting the specified ground track.

Valid entry is XXX (ground track).

Entry may be deleted.

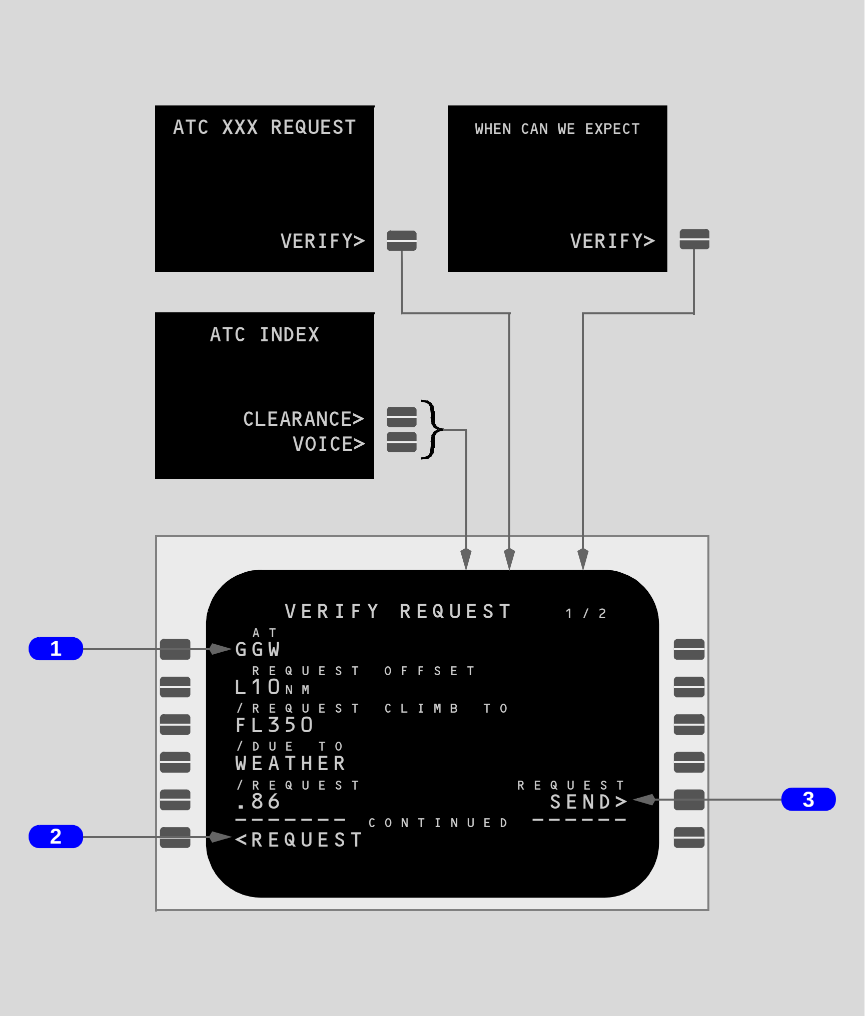
6 **REQUEST Route 2 (RTE 2)**

Push - selects route stored in RTE 2 for route request. When RTE 2 has a pending modification, the modified route is requested.

Selection may be deleted.

Verify Request Page X/X

The VERIFY REQUEST pages display the request for review before it is sent.



1 Lines 1 - 5

Pages 1/X to X/X display data which reflect the request and provide at least one line for free text entry.

Any entered free text included in downlink request.

2 REQUEST, INDEX, WHEN CAN WE

Displays REQUEST when page accessed from ATC REQUEST page.

Displays INDEX when page accessed from ATC INDEX page.

Displays WHEN CAN WE when page accessed from WHEN CAN WE EXPECT page.

REQUEST -

Push - displays ATC REQUEST page.

INDEX -

Push - displays ATC INDEX page.

WHEN CAN WE -

Push - displays WHEN CAN WE EXPECT page.

3 REQUEST SEND

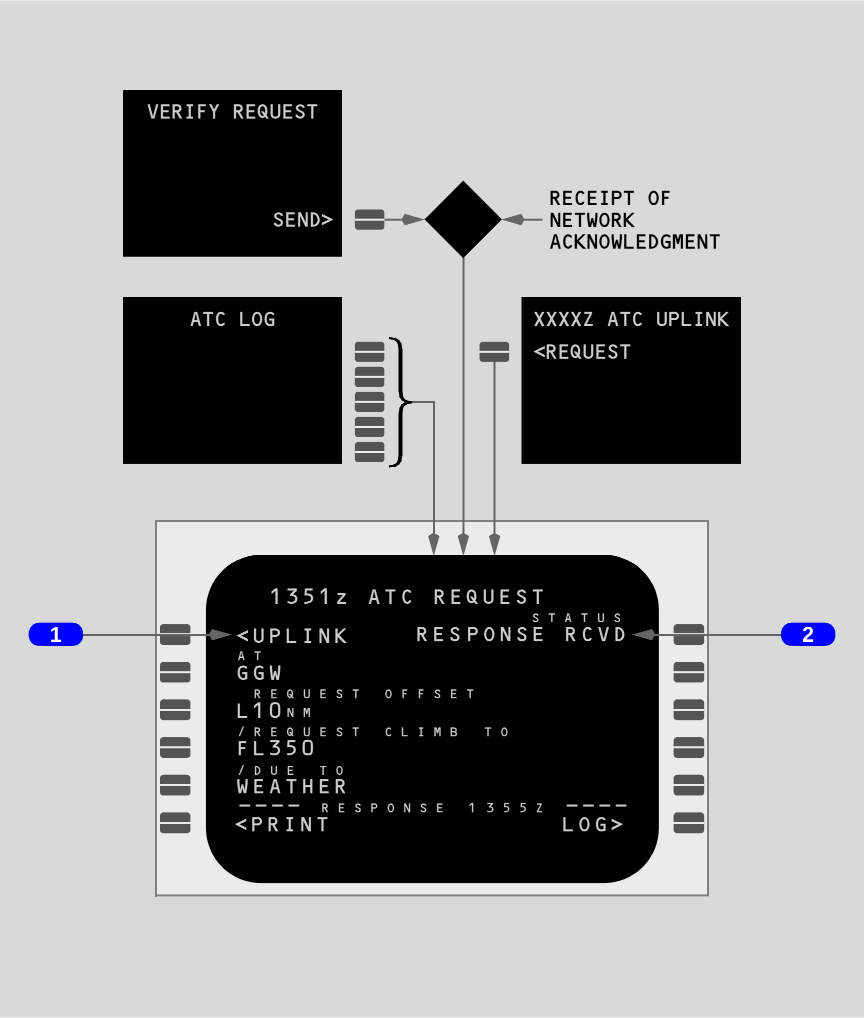
Displays on last VERIFY REQUEST page.

Push -

- initiates ATC request containing the information displayed on the VERIFY REQUEST page
- creates ATC LOG entry of transmitted message
- displays SENDING before network acknowledgement within time limit
- displays RESEND when no network acknowledgement within time limit
- displays SEND upon network acknowledgement
- displays NO ATC COM when datalink READY and no ATC connection
- displays DATA LINK header and NO COMM, VOICE, or FAIL as appropriate for datalink fault

XXXXz ATC Request Page X/X

The ATC REQUEST pages display the transmitted request. XXXXz is the time request was transmitted.



1 UPLINK

Push - displays the XXXXz ATC UPLINK 1/X page displaying ATC uplink response to displayed request.

Pages 1/X to X/X display data transmitted to ATC at the time in page title.

Page 1/X line 1 displays <UPLINK when ATC response to displayed downlink request exists.

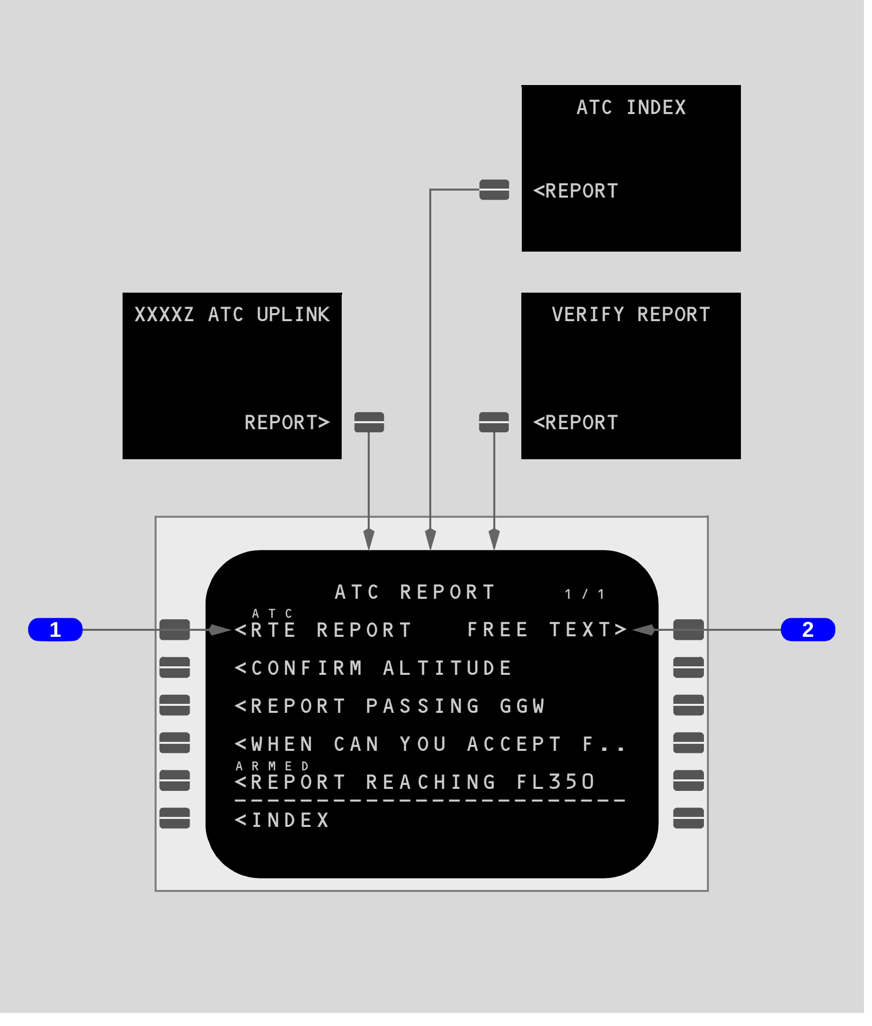
Response time of ATC uplink displays following text.

2 **STATUS**

Displays request downlink message status from ATC LOG page.

ATC Report Page X/X

The ATC REPORT pages provide access to VERIFY REPORT pages for ATC RTE REPORT and ATC request reports and confirmations.



1 Lines 1 - 5

Pages 1/X to X/X lines 1 to 5 display uplinked report or confirmation requests transmitted by ATC. Long messages are abbreviated and followed by two periods.

Page 1/X line 1 displays ATC RTE REPORT.

Title displays ARMED when report armed for automatic transmission.

ATC RTE REPORT -

Push - displays VERIFY REPORT page for the ATC assigned route message element.

Report or confirmation request -

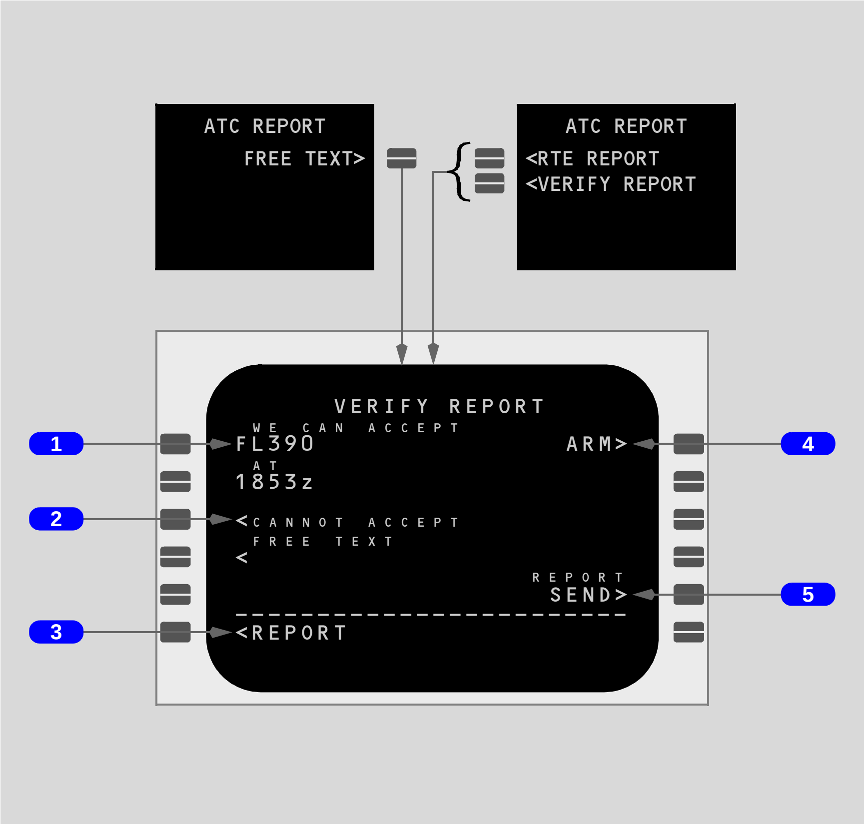
Push - displays ATC requested report or confirmation VERIFY REPORT page.

2 FREE TEXT

Push - displays a clear VERIFY REPORT page .

Verify Report Page

The VERIFY REPORT page displays reports in clearance language and allows review/modification and entry of free text before report is sent.



1 Lines 1 - 4

Display message text and data for each message.

Entry is allowed in any data line displaying boxes.

Entry includes data in report message.

Entry may be deleted.

At least one line is available for free text entry.

2 CANNOT ACCEPT

Displays in reponse to WHEN CAN YOU ACCEPT uplinks.

Push - selects a CANNOT ACCEPT messsage.

Selection may be deleted.

3 REPORT

Push - displays ATC REPORT page.

4 ARM

Push -

- arms report for transmission when condition is satisfied
- displays ARMED
- ARMED may be deleted

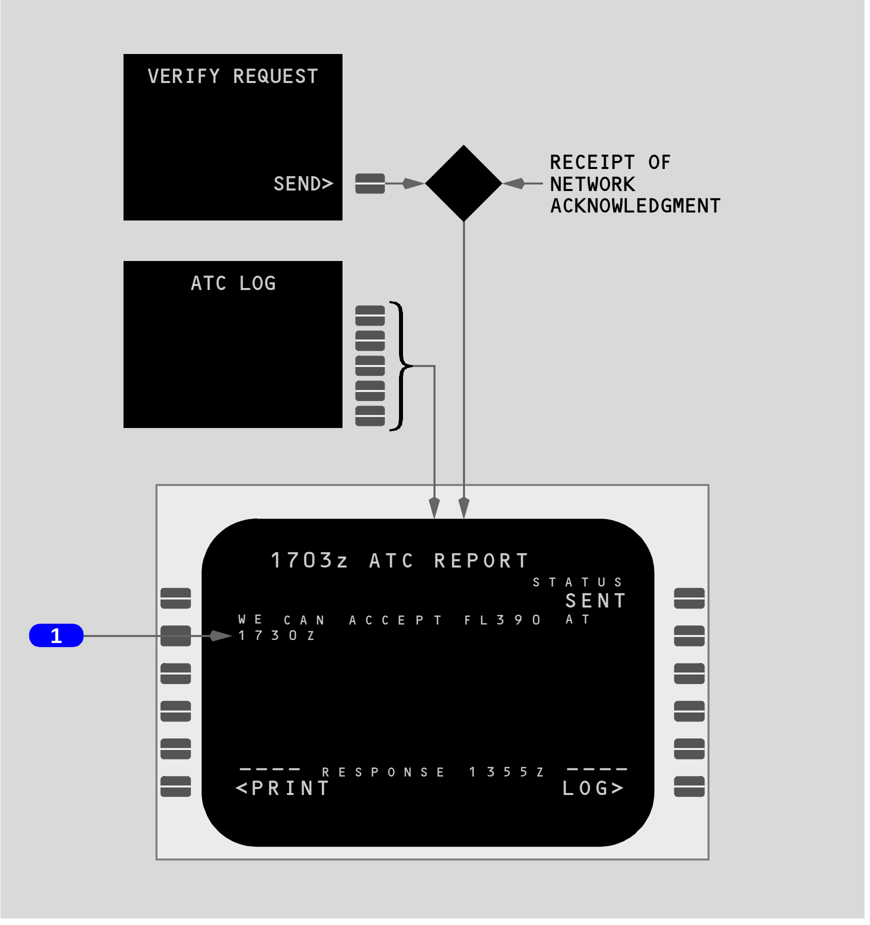
5 SEND

Push -

- transmits ATC REPORT
- creates ATC LOG entry of transmitted message
- displays SENDING before network acknowledgement within time limit
- displays RESEND when no network acknowledgement within time limit
- displays SENT upon network acknowledgement within time limit
- displays NO ATC COMM when datalink READY and no ATC connection
- displays DATA LINK header and NO COMM, VOICE, or FAIL as appropriate for datalink fault

XXXXz ATC Report Page

The ATC REPORT page displays the text of the report downlinked to ATC.

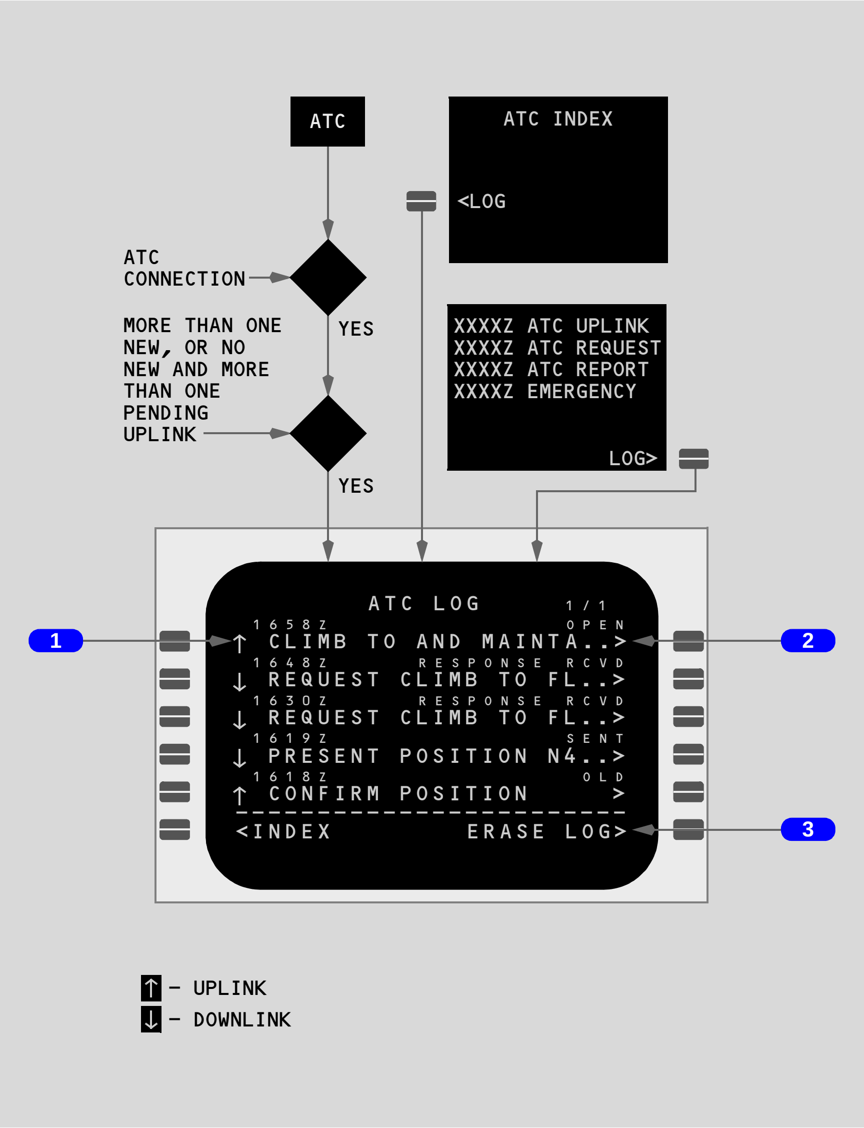


1 Report Text Lines 2 - 5

The text of the transmitted report or confirmation displays in Lines 2 - 5 in the order in which thry have been displayed on the VERIFY REPORT page.

ATC Log Page X/X

The ATC LOG pages display stored uplinks and downlinks. Log automatically erases after flight completion.



1 Lines 1 - 5

Display text of uplink and downlink messages. Long messages abbreviated and followed by two periods.

Deleting a line deletes the log entry.

Title displays message receipt (uplink) or transmission (downlink) time.

2 Message Status

Title displays one of six possible uplink or seven possible downlink states:

Uplink -

- NEW - message not reviewed by crew; message considered pending
- OLD - message reviewed by crew and message does not require response; message considered non-pending
- OPEN - message reviewed by crew, message requires response, crew has not sent response or has sent STANDBY; message considered pending
- ACCEPTED - message reviewed by crew, message requires response, positive response sent, network acknowledgement of positive response received; message considered non-pending
- REJECTED - message reviewed by crew, message requires response, negative response sent, network acknowledgement of negative response received; message considered non-pending
- ABORTED - message pending when all terminations terminated or transfer of communications occured

Downlink -

- SENDING - SEND or RESEND prompt selected, network acknowledgement not yet received, message considered pending. Displays SENDING in field 5R on page downlink was initiated
- NO ACK - SEND or RESEND prompt selected, network acknowledgement not received within time-out period; message considered non-pending. Displays SENDING in field 5R on page downlink was initiated
- SENT - SEND or RESEND prompt selected, network acknowledgement received, message does not require response; message considered non-pending
- OPEN - SEND or RESEND prompt selected, network acknowledgement received, message requires response, response not received or STANDBY response received, message considered pending
- DEFERRED - SEND or RESEND prompt selected, network acknowledgement received, message requires response, REQUEST DEFERRED response received; message considered pending
- RESPONSE RCVD - SEND or RESEND prompt selected, network acknowledgement received, message requires response, response other than STANDBY or REQUEST DEFERRED received; message considered non-pending
- ABORTED - message pending when all connections terminated

Push - displays XXXXz: ATC UPLINK, ATC REQUEST, ATC REPORT, or EMERGENCY page related to line selected.

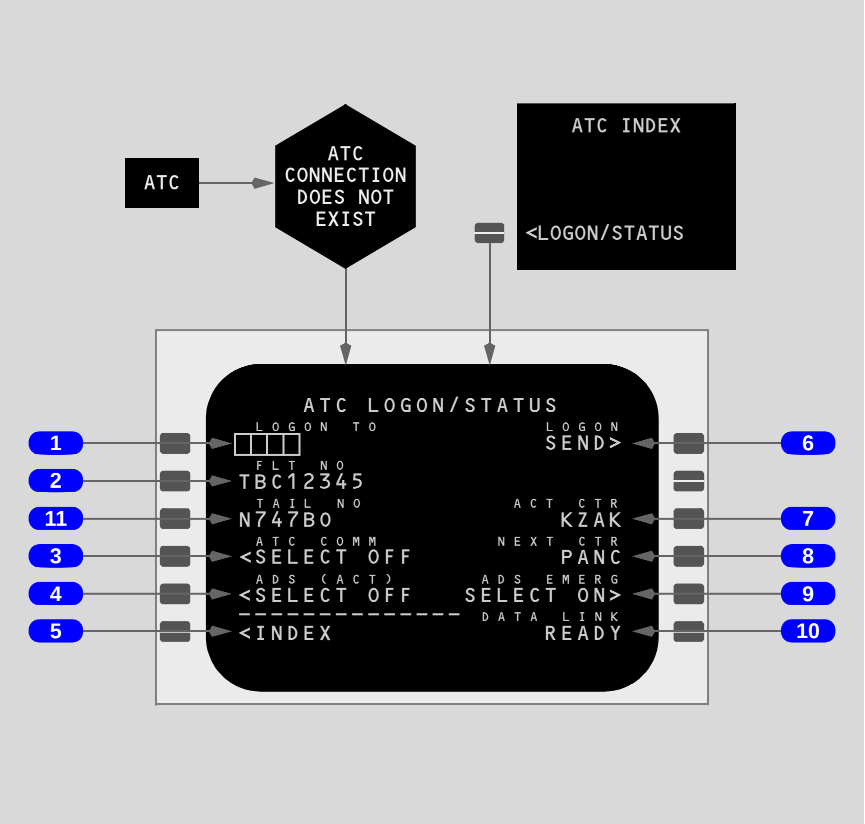
3 Erase Log

Push -

- arms deletion of all non-pending messages in the ATC Log
- displays CONFIRM
- selection of CONFIRM deletes all non-pending messages in the ATC log
- leaving the ATC Log page when CONFIRM is displayed cancels the ERASE selection

ATC Logon/Status Page

The ATC LOGON/STATUS page is used to initiate an ATC connection. The page displays ADS, ATC DL, and datalink status.



1 LOGON TO

Initial display is boxes.

Valid entry is a four letter ATC identifier.

Entry of an identifier and a flight number displays send in 1R when datalink status is ready.

Deletion of identifier displays boxes and blanks SEND.

Displays dashes when ATC COMM established.

2 Flight Number (FLT NO)

Displays flight number from route page.

Valid entry is flight number.

Display clears at flight completion.

3 ATC COMM

Display is blank when no ATC connection exists.

Displays SELECT OFF when ATC connection exists.

Push - terminates active ATC DL connection and next if it exits.

4 ADS (ARM), (ACT), (OFF)

ADS (ARM) -

- ADS armed and no ADS connection exists
- displays SELECT OFF prompt

Push -

- no ADS reporting
- displays ADS (OFF)
- displays SELECT ARM prompt

ADS (ACT) -

- ADS armed and one or more ADS connection exists
- displays SELECT OFF prompt

Push -

- terminates all ADS connections and ADS reporting
- displays ADS (OFF)
- displays SELECT ARM prompt

ADS (OFF)

- ADS selected off
- displays SELECT ARM prompt

Push -

- arms ADS reporting
- displays SELECT OFF prompt

5 **INDEX**

Push - displays ATC INDEX page.

6 **LOGON SEND**

Push -

- sends logon message to ATC center
- displays SENDING before network acknowledgement received
- displays SENT after network acknowledgement received
- displays RESEND if no network acknowledgement within time limit
- displays ACCEPTED or REJECTED after ATC response

7 **Active Center (ACT CTR)**

Displays four character identifier of active ATC center.

8 **Next Center (NEXT CTR)**

Displays four character identifier of next ATC center when known; otherwise, blank.

9 **ADS Emergency (EMER)**

Displays SELECT ON when ADS not in emergency mode.

Displays SELECT OFF when ADS in emergency mode.

Display is blank when ADS selected off.

SELECT ON -

Push - initiates ADS emergency mode.

SELECT OFF -

Push - terminates ADS emergency mode.

10 **DATA LINK Status**

Displays status: READY, NOCOMM, VOICE, or FAIL.

11 **Tail Number**

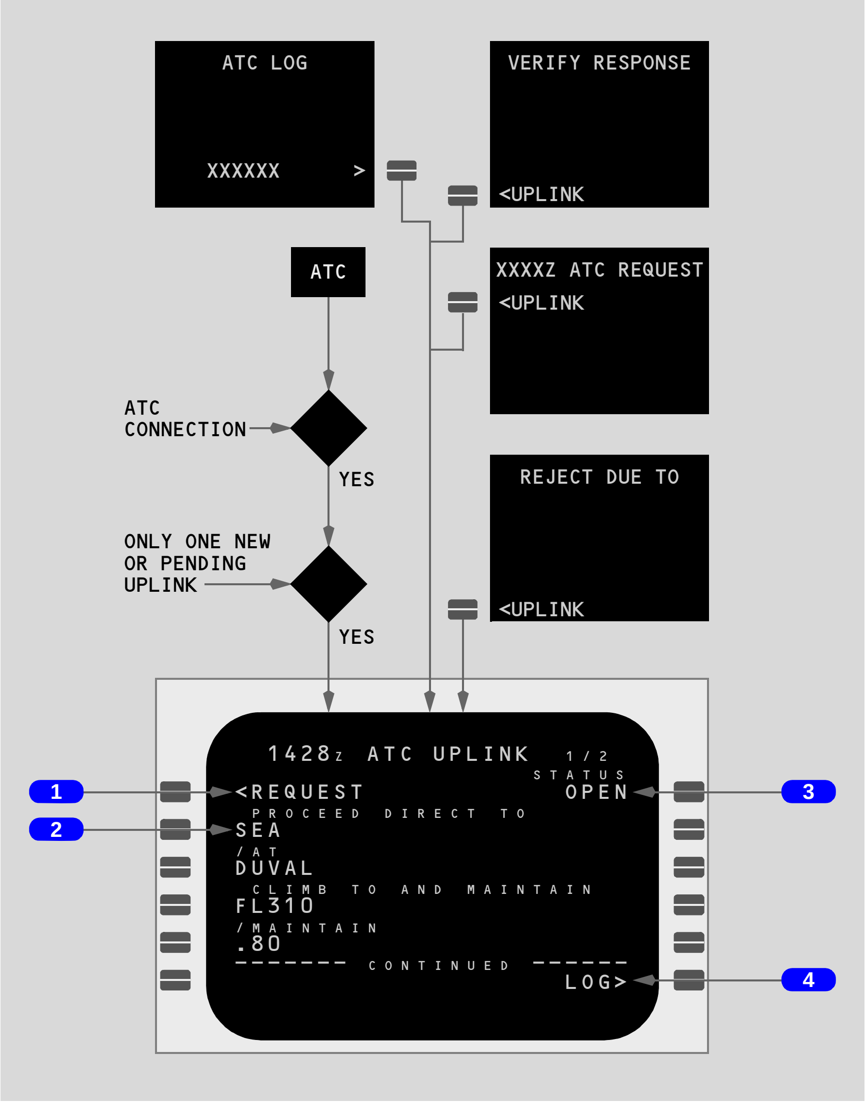
Displays tail number (Registry Number) stored in FMC.

Valid entry is one to seven alphanumeric tail number characters shown on the flight deck placard.

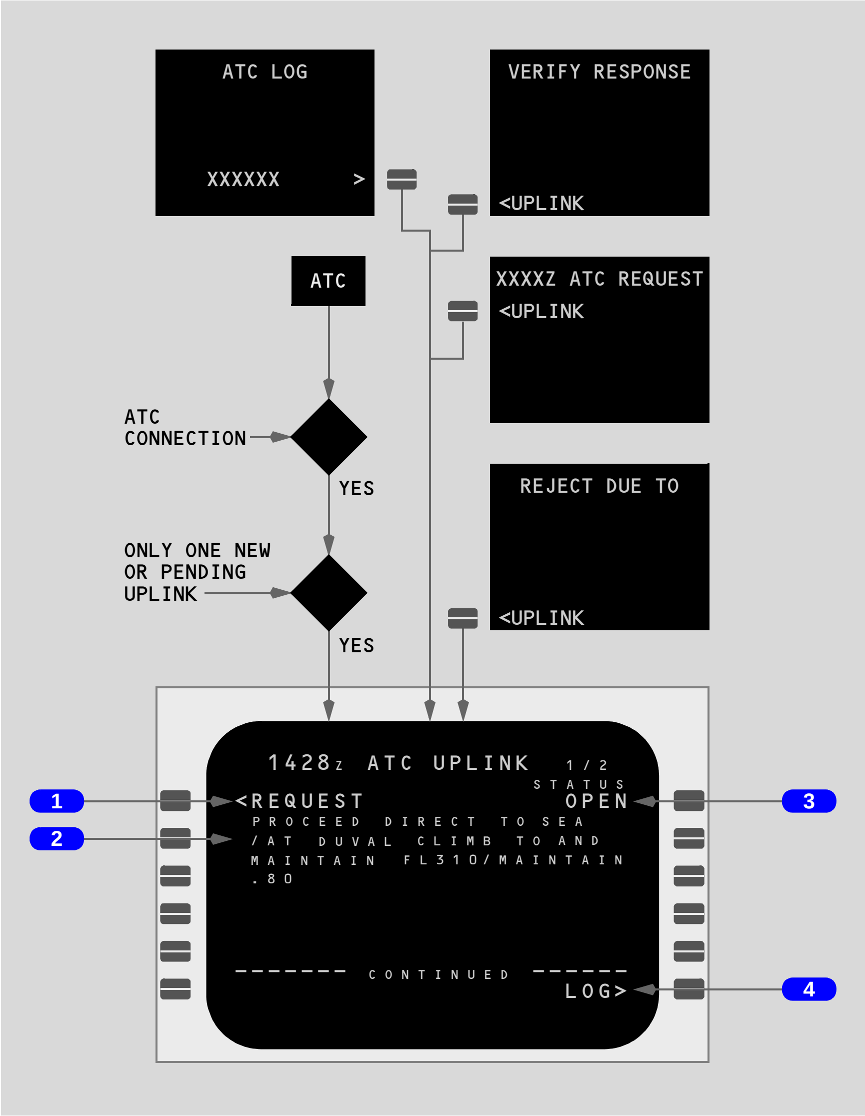
XXXXz ATC Uplink Page 1/X

The ATC UPLINK pages display messages uplinked by ATC. The pages provide the capability to respond to uplinked messages and to load clearances. XXXXz is the message receipt (uplink) time.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



1 REQUEST

Displays REQUEST when displayed uplink is in response to a downlink request not deleted from the ATC log.

Push - displays the related XXXXz ATC REQUEST page.

Title displays message receipt (uplink) or transmission (downlink) time.

2 Message Text

Lines 2 to 5 of XXXXz ATC uplink page 1/X display text of uplinked ATC message. When the uplink message can not be fully displayed on lines 2 to 5, the message can be printed to review the full message.

3 STATUS

Displays (on first page only) status of ATC uplink message from ATC log page.

4 LOG, REPORT

Displays LOG when uplink message does not include a REPORT, CONFIRM, or WHEN CAN YOU ACCEPT request.

Displays REPORT when uplink message includes a REPORT, CONFIRM, or WHEN CAN YOU ACCEPT request.

LOG -

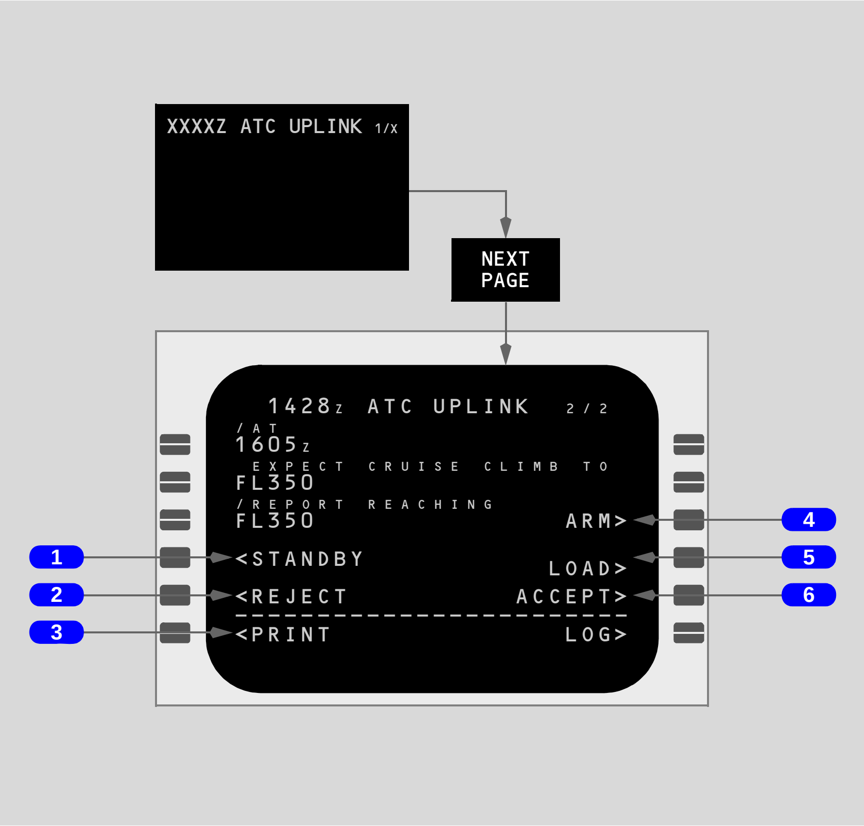
Push - displays ATC LOG page.

REPORT -

Push - displays ATC REPORT page.

XXXXz ATC Uplink Page X/X

Last XXXXz ATC UPLINK page continues text of uplinked ATC message. Page provides capabililty to respond to uplinked messages and to load clearances.



1 STANDBY

Displays STANDBY when response is required until response has been made.

Push - displays VERIFY RESPONSE page with STANDBY in 1L.

2 REJECT

Displays REJECT when UNABLE or NEGATIVE is a valid response until response has been made.

Push - displays REJECT DUE TO page.

3 PRINT, PRINTERROR, PRINTING, BUSY, FAIL

Displays on last page.

PRINT displayed - printer is READY.

PRINTERROR displayed - printer state is ERROR.

PRINTING displayed - printing displayed page.

BUSY displayed - printing other than displayed page.

FAIL displayed - printer is failed.

PRINT -

Push - prints XXXXZ ATC UPLINK text.

PRINT ERROR -

Push - prints XXXXZ ATC UPLINK text.

4 ARM, ARMED

Displays ARM when report is armable.

Push -

- arms report for transmission
- displays ARMED
- deleting ARMED displays ARM and disarms report transmission

5 LOAD

Displays LOAD when uplink message has loadable data.

Push - loads data into route.

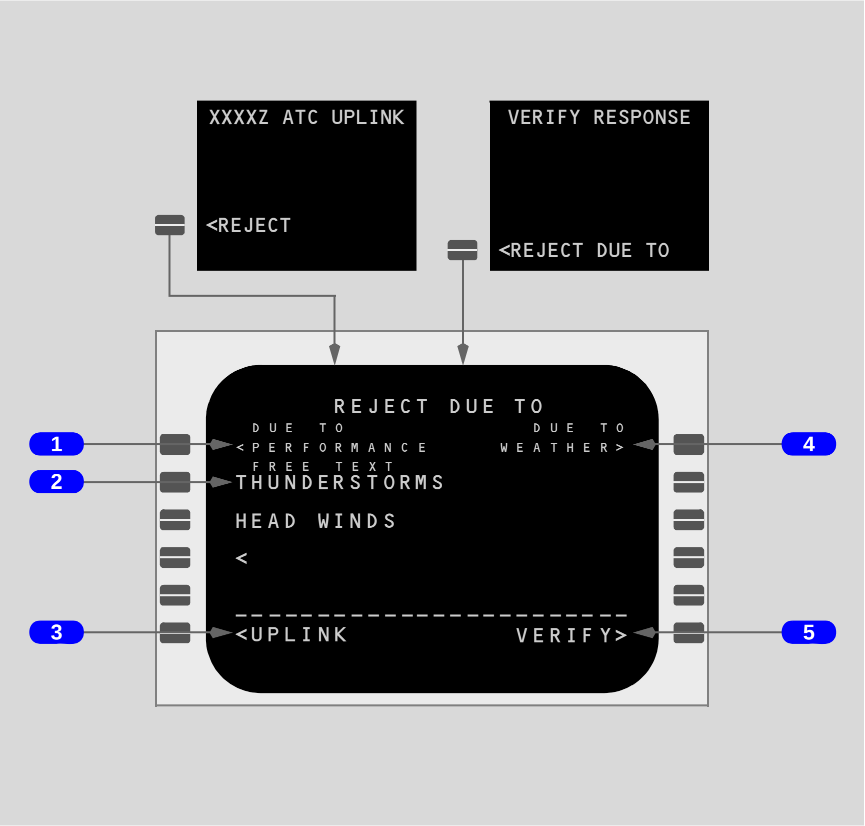
6 ACCEPT

Displays ACCEPT when WILCO, ROGER, or AFFIRM is a valid response until response has been made.

Push - displays VERIFY RESPONSE page with WILCO, ROGER, AFFIRM in 1L.

Reject Due To Page

The REJECT DUE TO page is used to include a reason for rejection of an ATC UPLINK message.



1 DUE TO PERFORMANCE

Initially displays PERFORMANCE in small font.

Push - selects DUE TO AIRCRAFT PERFORMANCE message element in response downlink message.

2 FREE TEXT

Text entered in lines 2 to 5 are included in response message.

Initial display is blank with a caret.

3 UPLINK

Push - displays XXXXz ATC UPLINK page.

4 **DUE TO WEATHER**

Initially displays WEATHER in small font.

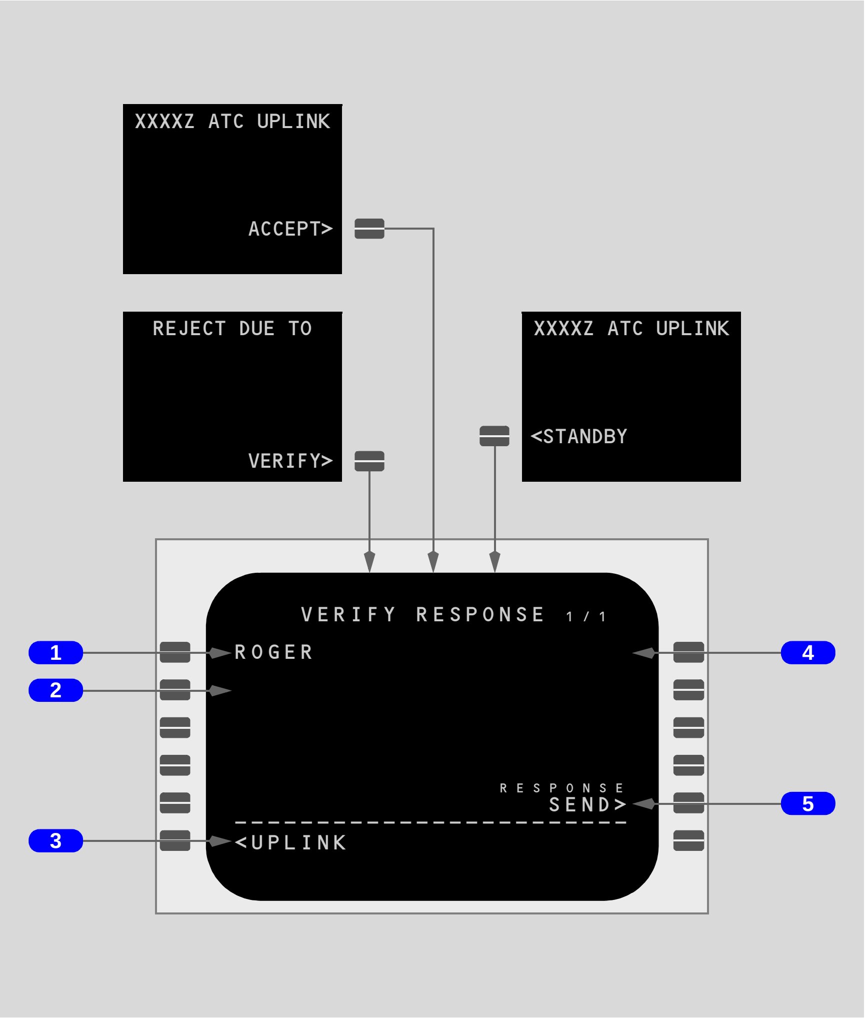
Push - selects DUE TO WEATHER message element in response downlink message.

5 **VERIFY**

Push - displays VERIFY RESPONSE page.

Verify Response Page

The VERIFY RESPONSE page provides capability to respond to uplinked messages.



1 ROGER, WILCO, AFFIRM, UNABLE, NEGATIVE, STANDBY

Displays ROGER, WILCO, or AFFIRM, as appropriate, when ACCEPT is selected on XXXXz ATC UPLINK page.

Displays UNABLE or NEGATIVE, as appropriate, when VERIFY is selected on REJECT DUE TO page.

Displays STANDBY when STANDBY selected on XXXXz ATC UPLINK page.

2 Lines 2 - 5

Display free text from REJECT DUE TO page.

3 UPLINK, REJECT DUE TO

Displays UPLINK when 1L is ROGER, WILCO, AFFIRM, or STANDBY.

Displays REJECT DUE TO when 1L is UNABLE or NEGATIVE.

UPLINK -

Push - displays XXXXz ATC UPLINK page.

REJECT DUE TO -

Push - displays REJECT DUE TO page.

4 STATUS ACCEPTED

Displays STATUS ACCEPTED when ATC acknowledges receipt of message.

5 RESPONSE SEND

Push -

- transmits downlink response to ATC uplink message
- creates ATC LOG entry of transmitted message
- displays SENDING before network acknowledgement within time limit
- displays RESEND when no network acknowledgement within time limit
- displays SEND upon network acknowledgement
- displays NO ATC COM when datalink READY and no ATC connection
- displays DATA LINK header and NO COMM, VOICE, or FAIL as appropriate for datalink fault

XXXX Position Report Page

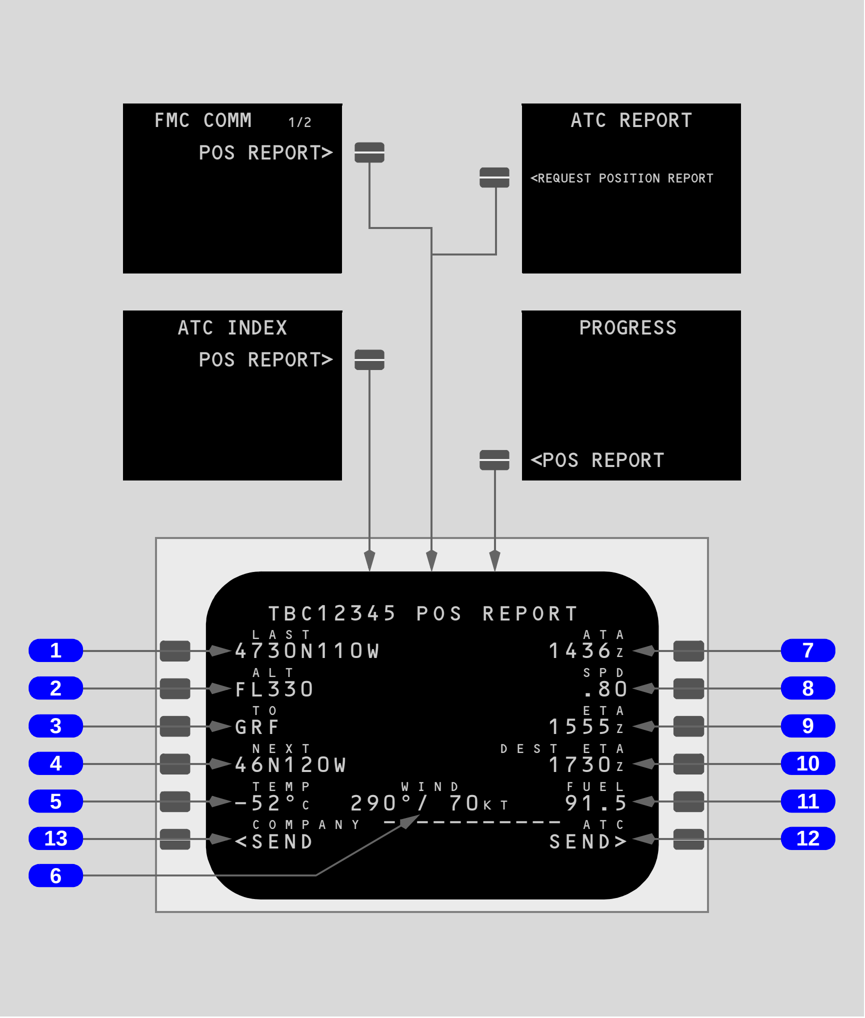
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

The XXXX POS REPORT page allows review and sending of position report to company and/or ATC. Entered data is sent to ATC only. XXXX is the flight number.

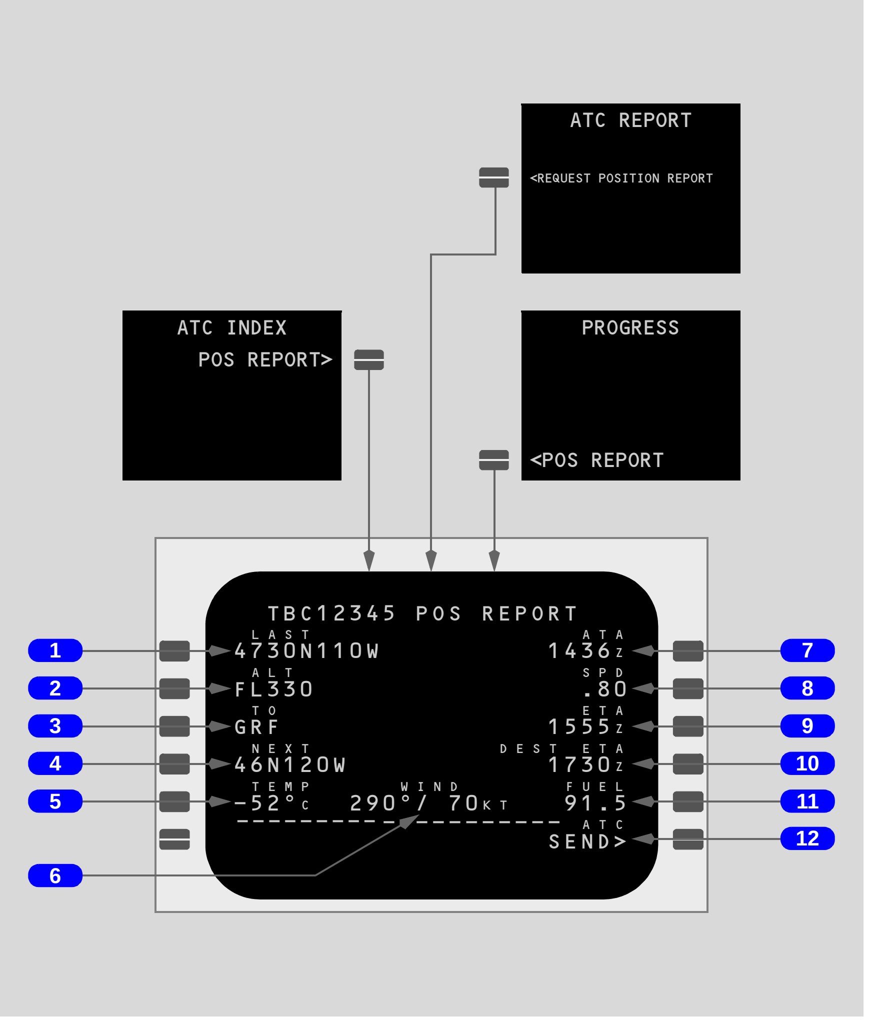
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ (VQ-BHW, VQ-BHX ; SB activates ATS)

The XXXX POS REPORT page allows review and sending of position report to ATC. Entered data is sent to ATC only. XXXX is the flight number.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ (VQ-BHW, VQ-BHX ; SB activates ATS)



1 **LAST Waypoint**

Displays waypoint identifier for last sequenced leg.

2 **Altitude (ALT)**

Displays current altitude.

3 **TO Waypoint**

Displays waypoint identifier of current leg.

Valid entries are waypoint identifiers in the active flight plan.

Entry overrides displayed waypoint.

Deletion of entry returns current leg waypoint.

4 NEXT Waypoint

Displays waypoint identifier of leg following the TO leg.

Valid entries are waypoint identifiers in the active flight plan.

Entry overrides displayed waypoint.

Deletion of entry returns default waypoint.

5 Temperature (TEMP)

Displays current static air temperature.

6 WIND

Displays current wind direction and magnitude.

7 Actual Time of Arrival (ATA)

Displays ATA at last sequenced waypoint.

8 Speed (SPD)

Displays current Mach.

Valid entry is Mach; ".xx".

Entry overrides displayed Mach.

Deletion or page change returns default Mach.

9 Estimated Time of Arrival (ETA)

Displays ETA at TO waypoint.

Valid entry is XXXXz.

Entry overrides displayed time.

Deletion of entry returns default time.

10 Destination Estimated Time of Arrival (DEST ETA)

Displays ETA at destination.

Valid entry is XXXXz.

Entry overrides displayed time.

Deletion of entry returns default time.

11 FUEL

Displays lesser of calculated or totalizer fuel remaining at LAST waypoint.

12 ATC SEND

Push -

- sends downlink position report to ATC
- creates ATC LOG entry of transmitted message
- displays SENDING before network acknowledgement within time limit
- displays RESEND when no network acknowledgement within time limit
- displays SENT upon network acknowledgement
- reset to SEND (from SENDING or SENT) when TO waypoint sequenced or flight plan madification made which changes the TO waypoint.
- displays NO ATC COM when datalink READY and no ATC connection
- displays DATA LINK header and NO COMM, VOICE, or FAIL as appropriate for datalink fault

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

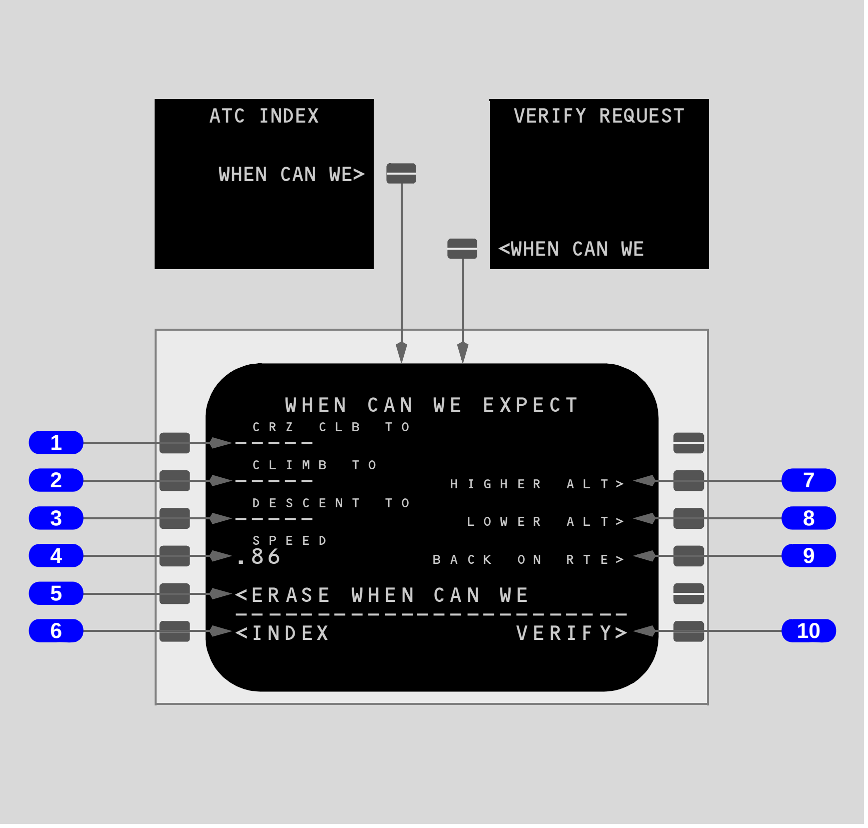
13 COMPANY SEND

Push -

- sends downlink position report to company
- default values are used for TO, NEXT, SPD, and ETA
- creates ATC LOG entry of transmitted message
- displays SENDING before network acknowledgement within time limit
- displays SEND when no network acknowledgement
- displays SENDSENT upon network acknowledgement
- displays DATA LINK header and NO COMM, VOICE, or FAIL as appropriate for datalink fault

When Can We Expect Page

The WHEN CAN WE EXPECT page allows query to ATC about when to expect a certain clearance.



1 Cruise Climb To (CRZ CLB TO)

Entry of an altitude selects a message querying ATC when to expect a cruise climb to the entered altitude.

Valid entry is XXX or FLXXX (flight level), XXXXX (feet), or XXXXXM (meters).

Entry may be deleted.

2 CLIMB TO

Entry of an altitude selects a message querying ATC when to expect a climb to the entered altitude.

Valid entry is XXX or FLXXX (flight level), XXXXX (feet), or XXXXXM (meters).

Entry may be deleted.

3 DESCENT TO

Entry of an altitude selects a message querying ATC when to expect a descent to the entered altitude.

Valid entry is XXX or FLXXX (flight level), XXXXX (feet), or XXXXXM (meters).

Entry may be deleted.

4 SPEED

Entry of a speed selects a message querying ATC when to expect the entered speed.

Valid entry is IAS or Mach.

Entry may be deleted.

5 ERASE WHEN CAN WE

Push - erases all entered or selected data and returns default values.

6 INDEX

Push - displays ATC INDEX page.

7 HIGHER Altitude (ALT)

Push - selects a message querying ATC when to expect a higher altitude.

Selection may be deleted.

8 LOWER Altitude (ALT)

Push - selects a message querying ATC when to expect a lower altitude.

Selection may be deleted.

9 BACK ON Route (RTE)

Push - selects a message querying ATC when to expect to be cleared back on route.

Selection may be deleted.

10 VERIFY

Push - displays VERIFY REQUEST page.

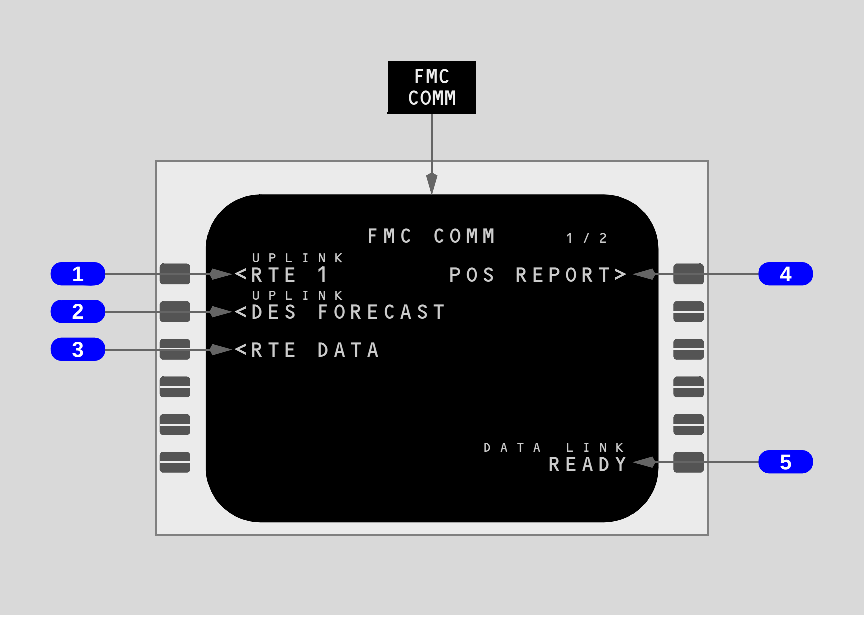
This Section Applies to EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

Company Datalink

For airplanes with the company datalink function installed, the airplane communications system enables two-way datalink communications between the FMC and airline operations. A downlink occurs when data is transferred from the FMC and transmitted through the airplane communications system to a receiver on the ground. Data may be downlinked from the FMC either manually or automatically. An uplink is the opposite of a downlink; data is transmitted from a ground station for input to the FMC. Data may be uplinked at the discretion of the airline operations dispatcher or in response to a downlink request.

FMC Communications Page 1/2

FMC COMM page 1/2 provides access to pages used for company datalink functions.



1 UPLINK Route (RTE)

Displays UPLINK in line title when an uplink containing flight plan information has been received.

Push - displays ROUTE page.

2 **UPLINK Descent (DES) FORECAST**

Displays UPLINK in line title when an uplink containing descent forecast data has been received.

Push - displays DESCENT FORECAST page.

3 **Route (RTE) DATA**

Display is blank when there is no active route.

Displays UPLINK in line title when an uplink containing route wind information has been received.

Push - displays ROUTE DATA page.

4 **Position (POS) REPORT**

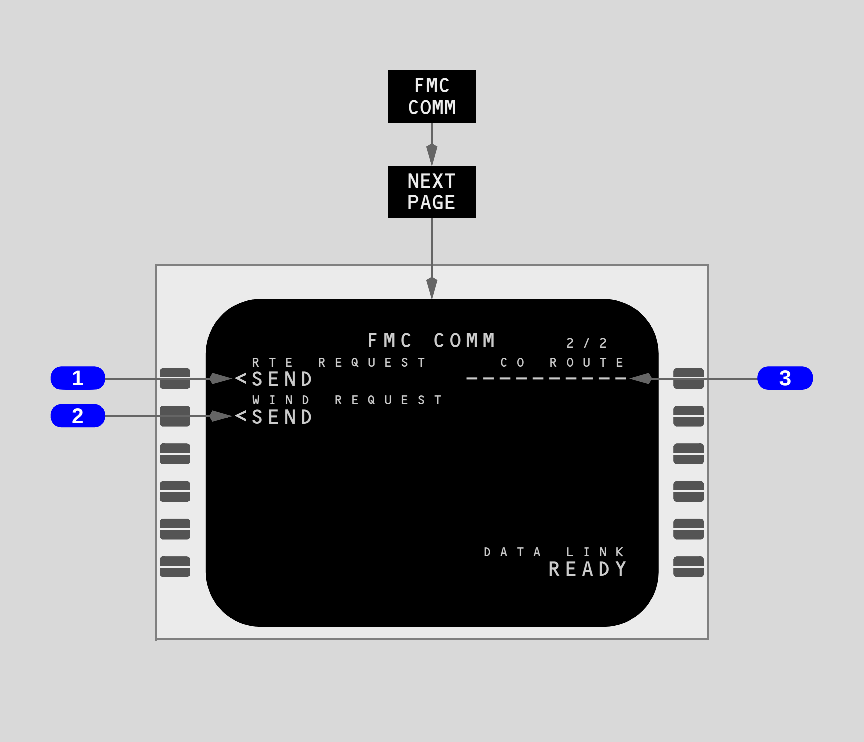
Push - displays POS REPORT page.

5 **DATA LINK**

Displays datalink status: READY, NO COMM, VOICE, or FAIL.

FMC Communications Page 2/2

FMC COMM page 2/2 allows writing a downlink request for flight plan information or wind data.



1 Route (RTE) REQUEST

Push -

- initiates downlink request for flight plan information
- when company route identifier displayed, the request includes the company route
- displays SENDING
- after network acknowledgement, displays SENDsent

2 WIND REQUEST

Push -

- initiates downlink request for wind information and descent forecast data
- displays SENDING
- after network acknowledgement, displays SENDsent

3 Company (CO) ROUTE

Valid entry is a company route request identifier. The identifier need not be in the navigation data base.

Deletion invalidates company route request and resets downlink request status to SEND.

EICAS Alert Messages

Message	Level	Aural	Message Logic
>DATALINK AVAIL	Advisory		ACARS datalink is available after a temporary loss.
>DATALINK LOST	Advisory		ACARS datalink is temporarily lost.
>DATALINK SYS	Advisory		ACARS datalink is failed and not available.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
(VQ-BHW, VQ-BHX ; SB installs IDS 505 or later software)

RADIO TRANSMIT	Advisory		VHF or HF radio keyed for 30 seconds or longer.

(VQ-BHW, VQ-BHX ; before SB, IDS 505 or later software not installed)

>RADIO TRANSMIT	Advisory		VHF or HF radio keyed for 30 seconds or longer.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; SB installs IDS 505 or later software)

RADIO TRANSMIT	Advisory		VHF or HF radio keyed for 60 seconds or longer.

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; before SB, IDS 505 or later software not installed)

>RADIO TRANSMIT	Advisory		VHF or HF radio keyed for 60 seconds or longer.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

>SATCOM	Advisory		SATCOM system is failed.

Message	Level	Aural	Message Logic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

>SATCOM DATA	Advisory		ACARS data communication through SATCOM system not available.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

>SATCOM VOICE	Advisory		SATCOM voice communication is not available. ACARS data communication through SATCOM is available. Loss due to SATCOM voice system failure.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

>SATVOICE AVAIL	Advisory		SATCOM voice communication is available after a temporary loss.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

>SATVOICE LOST	Advisory		SATCOM voice communication is temporarily lost. Loss due to a reason other than SATCOM system failure.

EICAS Memo Messages

Message	Message Logic
ACARS MESSAGE	Crew required to access ACARS on CDU or when a message has been received for viewing on the CDU.

Message	Message Logic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS datalink)

ATC MESSAGE	ATC uplinked message received.

PRINTER MESSAGE	ACARS message printing.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

SATCOM CALL	Ground-to-air voice call received.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

SATCOM MESSAGE	Information of voice call status available on CDU SATCOM pages.

VHF DATA OFF	VHF C radios in voice mode and not available for ACARS data communication.

FMC Messages

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS/AOC datalink)

For FMC Message information, refer to Chapter 11.60.

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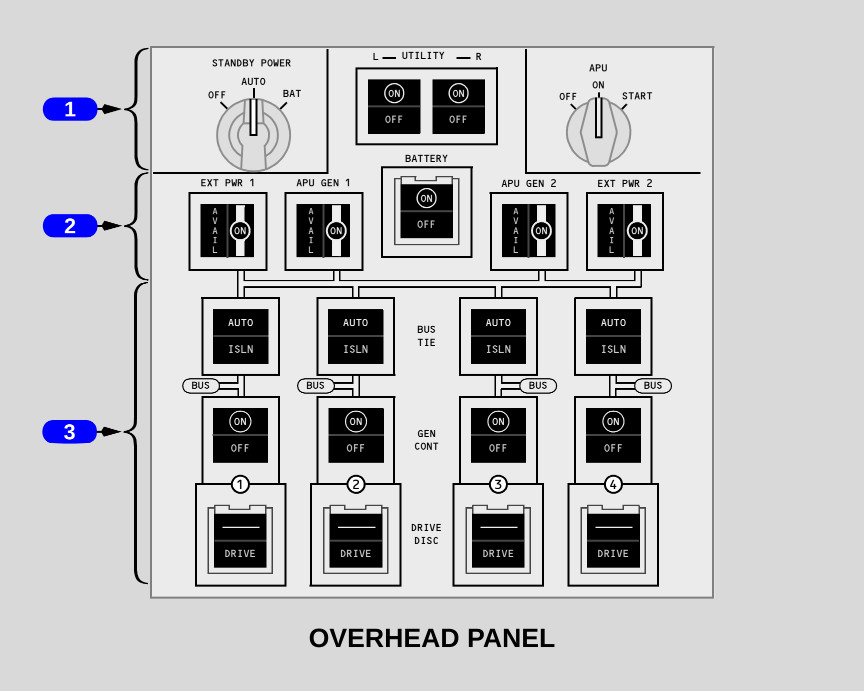
Electrical Panel

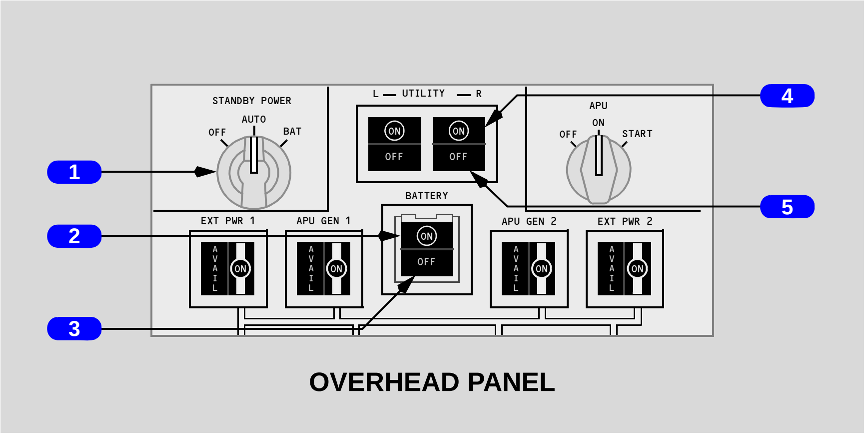


1 Standby Power, Battery, and Utility Bus Controls

2 APU Generators and External Power Controls

3 AC Bus and Generator Controls

Standby Power, Battery, and Utility Bus Controls



1 STANDBY POWER Selector

Push to turn.

OFF -

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
- standby power not available

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- standby and APU alternate power not available

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
- main and APU standby busses disconnected from all power sources

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- standby bus and APU alternate power disconnected from all power sources

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
AUTO - allows main and APU standby busses to be powered from available sources.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
AUTO - allows standby bus and APU alternate power to be powered from available sources.

BAT -

- powers main battery bus from main battery through the main hot battery bus with battery switch ON
- powers APU battery bus from APU battery through the APU hot battery bus with battery switch ON

- disables main and APU battery chargers

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

- powers main and APU standby busses from their related batteries through their hot battery busses and standby inverters with Battery switch ON

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

- powers standby bus and APU alternate power from their related batteries through their hot battery busses and inverters with Battery switch ON

Note: BAT position for ground maintenance use only.

2 BATTERY Switch

ON -

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

- main battery available as backup power source for main battery bus and main standby bus
- APU battery available as backup power source for APU battery bus and APU standby bus

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

- main battery available as backup power source for main battery bus and standby bus
- APU battery available as backup power source for APU battery bus and APU alternate power

OFF - disconnects main and APU batteries from related battery busses.

3 BATTERY Switch OFF Light

Illuminated (amber) - Battery switch off

4 UTILITY Power Switches

ON - each switch powers two utility Electrical Load Control Units (ELCUs) and two galley ELCUs.

OFF -

- removes power from related ELCUs
- resets fault logic circuitry

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; SB installs Utility Power switches modified to control IFE and cabin night lights)

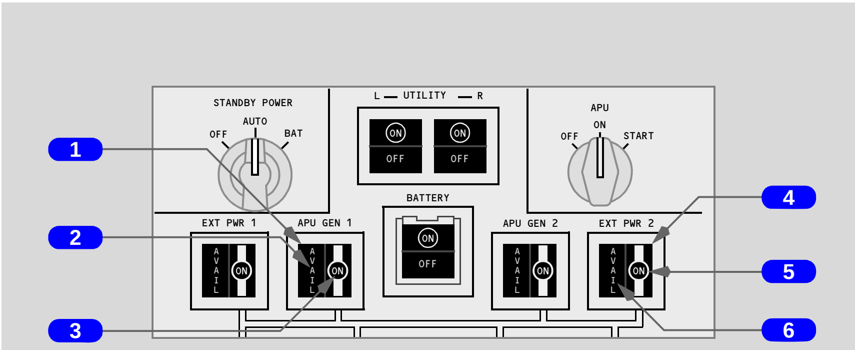
- both OFF, removes all power from IFE and turns on cabin night lighting

5 UTILITY Power OFF Lights

Illuminated (amber) -

- power removed from related ELCUs by fault protection logic, or
- related Utility Power switch OFF, or
- one or more Galley Emergency Power Off switches OFF
- not illuminated during load shedding

APU Generator and External Power Controls



OVERHEAD PANEL

1 APU Generator (APU GEN) Control Switches

Push -

- AVAIL light illuminated: connects related APU generator to AC electrical system
- ON light illuminated: disconnects related APU generator from AC electrical system

2 APU Generator Power Available (AVAIL) Lights

Illuminated (white) -

- APU generator power quality acceptable
- extinguishes when ON light illuminates

3 APU Generator Power ON Lights

Illuminated (white) -

- related APU generator connected to AC electrical system
- extinguishes when AVAIL light illuminates

4 External Power (EXT PWR) Control Switches

Push -

- AVAIL light illuminated: connects related external power to AC electrical system
- ON light illuminated: disconnects related external power from AC electrical system

5 External Power ON Lights

Illuminated (white) -

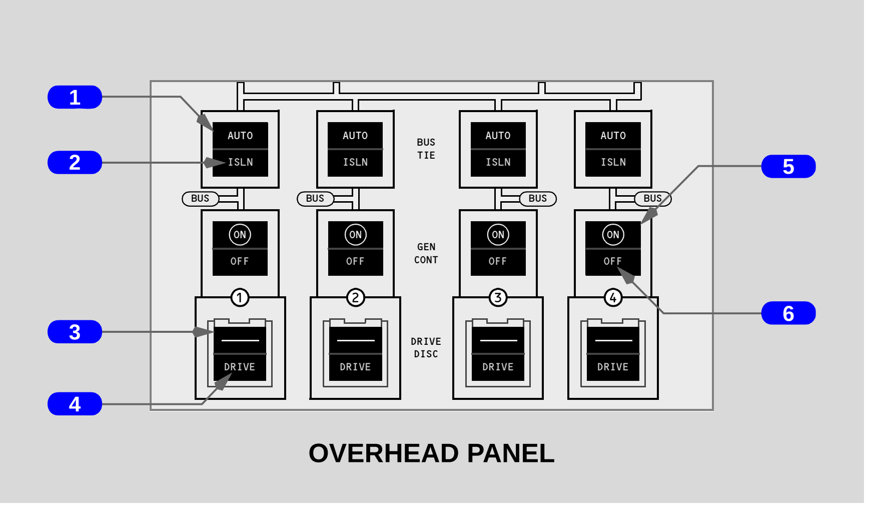
- related external power connected to AC electrical system
- extinguishes when AVAIL light illuminates

6 External Power Available (AVAIL) Lights

Illuminated (white) -

- related external power source plugged in, power quality acceptable
- extinguishes when ON light illuminates

AC Bus and Generator Controls



1 BUS TIE Switches

AUTO -

- arms automatic AC bus tie circuitry
- closes related DC isolation relay (DCIR)

OFF -

- opens BTB and related DCIR
- resets fault logic circuitry

2 Bus Isolation (ISLN) Lights

Illuminated (amber) -

- BTB open
- AC bus isolated from synchronous bus

3 Generator Drive Disconnect (DRIVE DISC) Switches

Push -

- disconnects IDG from engine when above idle speed
- opens related Generator Control Breaker (GCB)

Note: Ground maintenance action required to reconnect IDG.

4 Generator DRIVE Lights

Illuminated (amber) -

- IDG oil pressure low, or
- IDG oil temperature high, or
- GCB open due to uncorrectable generator frequency fault

5 Generator Control (GEN CONT) Switches

ON - arms GCB to close when generator power quality acceptable

OFF -

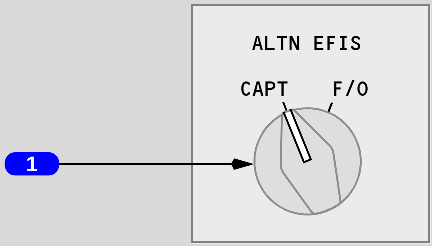
- opens generator field and GCB
- resets fault control logic circuitry
- isolates generator from its related AC bus

6 Generator OFF Lights

Illuminated (amber) - GCB open

Alternate EFIS Selector

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



LEFT FORWARD PANEL

1 ALTERNATE EFIS Selector

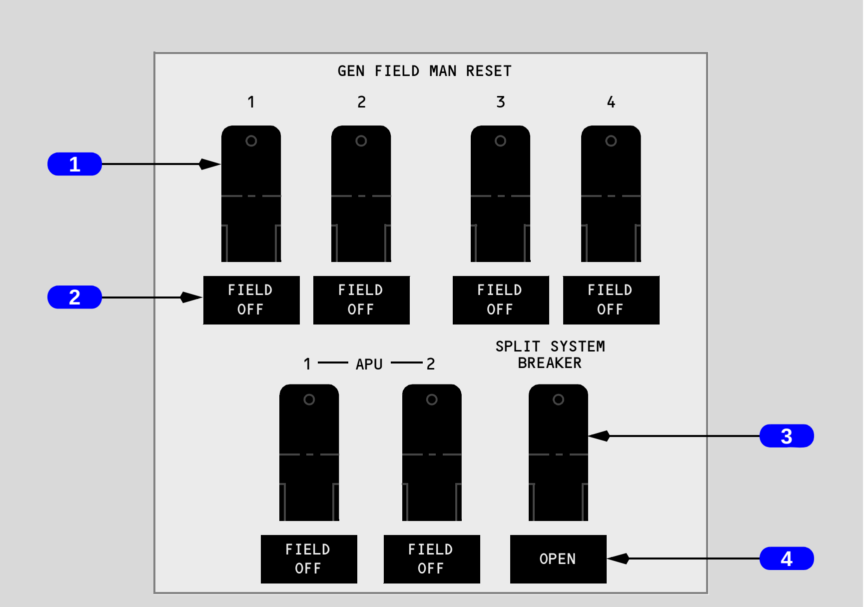
CAPT - left FMC, and left PFD and ND powered by APU alternate power if captain transfer bus unpowered. Right PFD and ND unpowered if both transfer busses unpowered.

F/O - right FMC and first officer PFD and ND powered by APU alternate power if first officer transfer bus is unpowered. Left PFD and ND unpowered if both transfer busses unpowered.

Note: Selector not functional during normal electrical system operation, or with failure of only captain transfer bus.

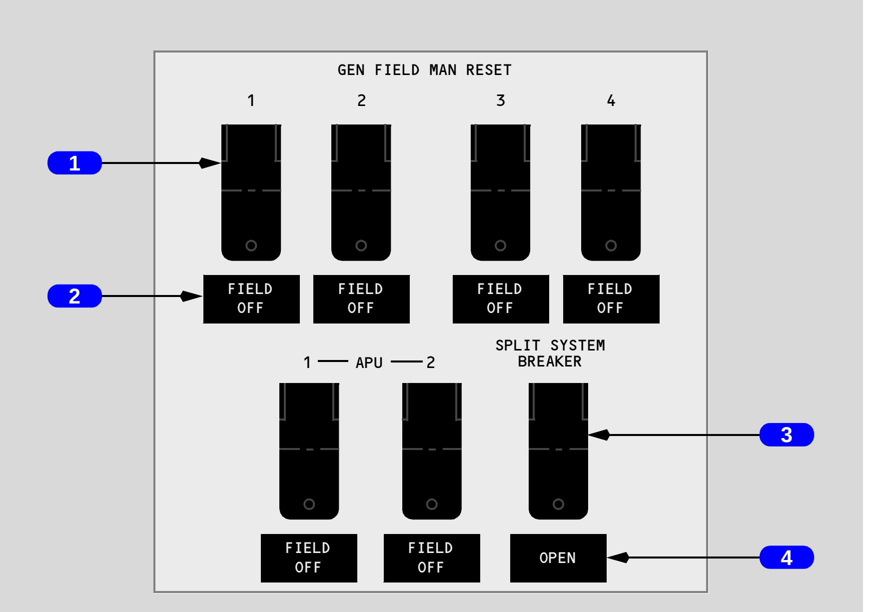
Overhead Maintenance Panel
Generator Field Manual Reset and Split System Breaker Switches

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



OVERHEAD MAINTENANCE PANEL

VQ-BHW, VQ-BHX



OVERHEAD MAINTENANCE PANEL

1 Generator Field Manual Reset (GEN FIELD MAN RESET) Switches

Push - (spring-loaded toggle, guarded) opens or closes generator field if related Generator Control or APU Generator Control switch off

2 Generator FIELD OFF Lights

Illuminated (white) - generator field open.

3 SPLIT SYSTEM BREAKER Switch

Push - (spring-loaded toggle, guarded) opens or closes split system breaker

Note: Operative on ground only.

4 Split System Breaker OPEN Light

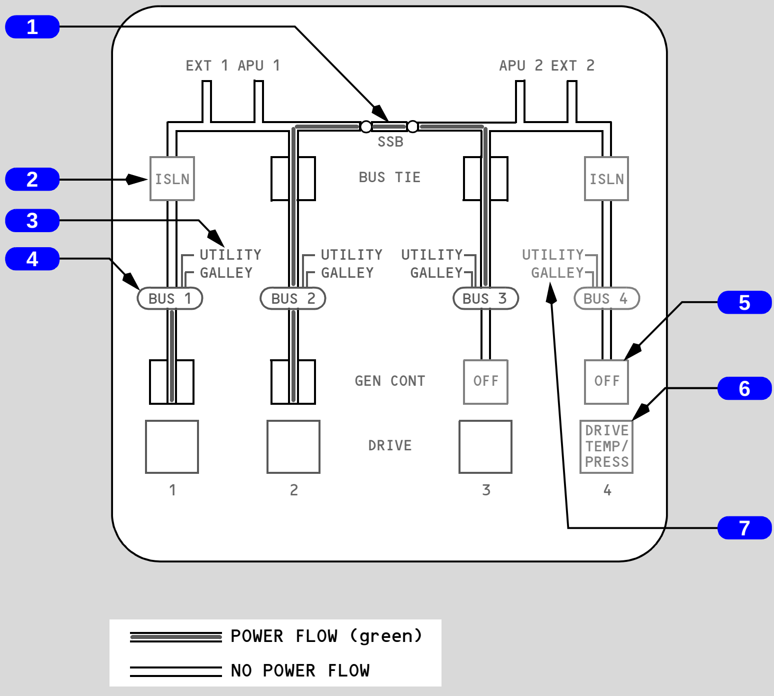
Illuminated (white) - split system breaker open

Electrical Synoptic Display

The electrical synoptic displays by pushing the ELEC Synoptic switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

The synoptic displays the configuration of the AC power system in a simplified schematic format. DC power flow is not represented. The depiction is generated by the status of various system breakers and conductors and does not represent actual power flow. Therefore, the display may not be an accurate representation of system operation. Symbols display in low intensity white when source data is invalid or unavailable.

During autoland, with bus tie breakers 1, 2, and 3 open, the message "ELECTRICAL SYNOPTIC INHIBITED FOR AUTOLAND" appears on the synoptic display.



LOWER EICAS DISPLAY

1 **SSB (Split System Breaker)**

Closed - SSB closed, both sides of synchronous bus connected

Open - synchronous bus split.

2 **BUS TIE**

- power flow bar present - BTB closed
- ISLN (amber) - BTB open

3 **UTILITY**

- green - utility bus powered
- amber - utility bus not powered

4 **BUS**

- green - AC bus powered
- amber - AC bus not powered

5 **GEN CONT**

- power flow bar present - GCB closed
- OFF (amber) - GCB open

6 **DRIVE**

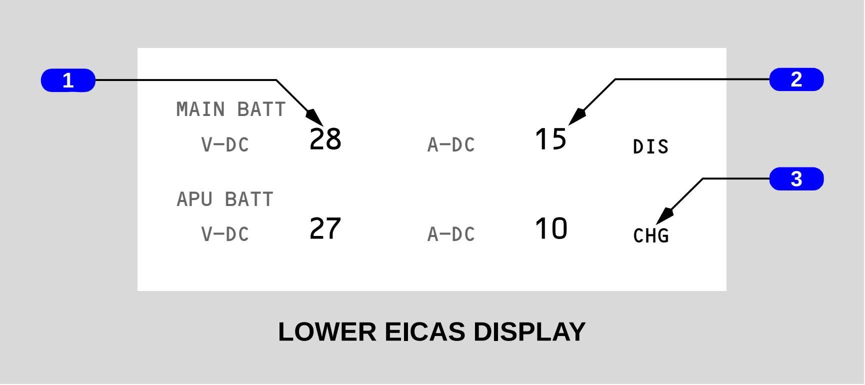
- blank (green) - normal operation
- DRIVE TEMP/PRESS (amber) - IDG has high oil temperature or low oil pressure

7 **GALLEY**

- green - galley bus powered
- amber - galley bus unpowered

Battery Condition

Battery condition displays on the status page by pushing STAT Display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.



1 Battery Voltage (V-DC)

Main and APU battery voltage

2 Battery Current (A-DC)

Main and APU battery amperage

3 Battery Charge Status

DIS (Discharge) - battery discharging

CHG (Charge)

- battery charging
- if battery current is zero, charge status is blank

Intentionally
Blank

Electrical — Chapter 6
System Description — Section 20

Introduction

The electrical system generates and distributes AC and DC power to other airplane systems and is comprised of main AC power, DC power, and standby power components. System operation is automatic. Electrical faults are automatically detected and isolated.

AC Electrical System

The AC electrical system is the main source of airplane electrical power.

Electrical Load Management and Load Shedding

Electrical system overload protection is provided by a load management system configured to ensure power is available to critical and essential equipment.

If electrical loads exceed power available (airplane or external), the load management system sheds AC loads by priority until the loads are within the capacity of airplane or ground power generators. Loads are shed one at a time through ELCUs in a programmed sequence until the overload condition is relieved. Galley busses are shed first, followed by utility busses. When an additional AC power source is available, loads are restored in reverse order.

During load shedding, the ELEC UTIL BUS L and R messages and utility off lights are inhibited. However, the following EICAS alert messages may display in the order shown depending upon fuel system configuration and the extent of load shedding:

- FUEL PUMP 3 FWD
- FUEL OVRD 2 FWD
- FUEL OVRD 3 FWD
- FUEL PRESS CTR L
- FUEL PUMP 2 FWD

AC Electrical System Power Sources

The main AC electrical power sources are:

- four IDGs
- two auxiliary power sources (APU generators)
- two external power sources

During normal operation, IDG power output to the four AC busses is synchronized. Each bus is interconnected through a single synchronous bus, which distributes electrical power and allows individual AC busses to remain powered when their related generators are inoperative. The split system breaker (SSB) divides the synchronous bus allowing each side of the AC electrical system to be powered by separate auxiliary or external power sources.

IDGs

One IDG is mounted on each engine accessory gearbox. Each IDG incorporates an AC generator, drive unit with self-contained lubrication system, and automatic control and protection components.

When an engine is started with auxiliary or external power connected to each side of the electrical system (SSB open), the IDG powers its side of the synchronous bus when voltage and frequency are acceptable. The previous power source is disconnected. When an engine on the opposite side of the airplane is started, the IDG powers its side of the synchronous bus. The previous power source is disconnected and the SSB closes.

When a single auxiliary or external power source is powering the electrical system and an engine is started, the IDG powers the entire synchronous bus when voltage and frequency are acceptable. The SSB remains closed and the original power source is disconnected.

During power source transfers on the ground, such as switching from IDG to auxiliary or external power, output from IDG and another power source is momentarily synchronized before one source is disconnected. This provides smooth, uninterrupted electrical power switching.

Each IDG can be electrically disconnected from its related bus by pushing the Generator Control switch OFF. On the ground, an IDG can also be disconnected from its related bus by selecting an available auxiliary or external power source.

IDG Disconnect

Each IDG can be mechanically disconnected from its engine accessory gearbox by pushing the Generator Drive Disconnect switch. When an IDG is disconnected, generator power output is lost and cannot be restored by flight crew action.

The EICAS message ELEC DRIVE displays for low IDG oil pressure or high IDG oil temperature.

The ELEC DRIVE message also displays if a GCB is open due to an uncorrectable generator frequency fault.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

Excessively high drive oil temperature disconnects the IDG automatically if not manually disconnected by flight crew action. The resulting loss of generator power output opens the GCB and displays the EICAS message ELEC GEN OFF. Pushing the Generator Drive Disconnect switch after automatic disconnect replaces the ELEC DRIVE message with the DRIVE DISC message.

Auxiliary and External Power

Auxiliary power is available only on the ground from generators mounted on the APU. External power is available from ground sources through two power receptacles located on the lower right forward fuselage. Either source can power main AC busses through connection to the synchronous bus. Auxiliary and external power sources cannot be connected to the same side of the synchronous bus simultaneously. The SSB is commanded open or closed to ensure all AC main busses are powered on the ground.

On an unpowered airplane with auxiliary and external power available, when a single power source is selected, the SSB closes and power is provided to the entire synchronous bus by the selected source. When the other same-type power source is selected on the opposite side, the SSB opens and each source powers its side of the synchronous bus. If one power source is disconnected or fails, the SSB closes maintaining power to the entire synchronous bus from the remaining source.

When IDGs are powering the electrical system with auxiliary or external power available, selecting a single power source disconnects IDGs on the same side and opens the SSB. The selected source powers its side of the synchronous bus, while the opposite side remains powered by IDGs. Selecting a second auxiliary or external power source on the opposite side disconnects the remaining IDGs and completes the power transfer from IDG to auxiliary/external power; the SSB remains open.

AC Electrical Power Distribution

AC power is distributed by the following busses:

- four main busses
- two transfer busses
- ground service and ground handling busses

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- APU alternate power
- four galley busses
- four utility busses

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- one standby bus

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

- two standby busses

AC Main Busses

Each IDG normally powers its related AC bus through a GCB. Each AC bus is connected to the synchronous bus by a BTB. With the Bus Tie switch in AUTO, the related BTB controls the AC bus connection to the synchronous bus.

If power on an AC bus is unacceptable, the related BTB opens and the bus disconnects from the synchronous bus. However, the AC bus remains powered by its IDG. If the IDG is not able to maintain acceptable power quality, the GCB opens and the BTB closes to provide power from the synchronous bus.

The EICAS message ELEC BUS ISLN displays if the BTB is open. Pushing the Bus Tie switch OFF, then AUTO, resets logic circuitry and allows the BTB to close if the fault is corrected. The AC bus is reconnected to the synchronous bus.

The main AC busses power individual equipment items such as:

- TRUs
- navigation radios and flight control computers
- flight deck lighting
- pitot and window heat

The main AC busses also power other AC busses:

- AC bus 1 powers the ground service bus and provides back-up power for both transfer busses
- AC bus 2 powers the first officer transfer bus
- each AC bus powers a utility and galley bus

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

- AC bus 3 powers the captain transfer bus and the standby bus

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

- AC bus 3 powers the captain transfer bus and the main standby bus

Ground Service Bus

The ground service bus is powered on the ground and in flight whenever AC bus 1 is powered. The ground service bus powers individual equipment items such as:

- main and APU battery chargers
- fuel pumps for APU start
- upper deck emergency doors
- flight deck flood, navigation, and service lights
- miscellaneous service outlets and equipment

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

- horizontal stabilizer fuel pump for defueling

On the ground when AC bus 1 is not powered, the ground service bus can be connected to the same source powering the ground handling bus by pushing the Ground Service switch on the flight attendant's panel at door 2L.

Ground Handling Bus

The ground handling bus is powered on the ground when APU generator 1 or external power 1 is available. If both are available, external power is automatically used. The ground handling bus powers individual equipment items such as:

- lower cargo handling equipment and compartment lights
- fueling system

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- auxiliary hydraulic pumps 1 and 4

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

- auxiliary hydraulic pump 4

Transfer Busses

Two transfer busses provide AC power to critical flight-related equipment. The transfer busses have a common back-up power source. Transfer to the back-up power source is automatic.

Captain Transfer Bus

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The captain transfer bus is normally powered by AC bus 3. If AC bus 3 is unpowered, AC bus 1 powers the captain transfer bus.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The captain transfer bus is normally powered by AC bus 3. If AC bus 3 is unpowered, AC bus 1 powers the captain transfer bus. The captain transfer bus powers the APU standby bus.

The captain transfer bus powers individual equipment items such as:

- center EFIS/EICAS Interface Unit (EIU)
- left HF

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- center ADC

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

- left FMC, left ND, left PFD

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- PVD

First Officer Transfer Bus

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The first officer transfer bus is normally powered by AC bus 2. If AC bus 2 is unpowered, AC bus 1 powers the first officer transfer bus. The first officer transfer bus powers individual equipment items such as:

- autothrottle servo
- lower EICAS display
- right ADC, right EFIS control, right EIU, right FMC
- right CDU, right HF, right ND, right PFD

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The first officer transfer bus is normally powered by AC bus 2. If AC bus 2 is unpowered, AC bus 1 powers the first officer transfer bus. The first officer transfer bus powers individual equipment items such as:

- right ND and PFD
- autothrottle servo
- lower EICAS display
- right ADC, right EFIS control, right EIU, right FMC
- right CDU, right HF

Utility and Galley Busses

Each main AC bus powers one utility bus and one galley bus. Each utility/galley bus is controlled by an ELCU that protects the electrical system from utility and galley bus faults, and provides load management through automatic load shedding. With the Left Utility Power switch ON, utility busses 1 and 2 and galley busses 1 and 2 are powered according to ELCU logic. With the Right Utility Power switch ON, utility busses 3 and 4 and galley busses 3 and 4 are powered according to ELCU logic.

Utility busses power individual equipment items such as:

- forward main fuel pumps 2 and 3
- forward override/jettison pumps 2 and 3
- center override/jettison pump
- recirculating fans

Galley busses power the galleys located throughout the cabin.

The EICAS message ELEC UTIL BUS displays and the utility OFF light illuminates if one or more utility or galley bus become unpowered due to a fault. Cycling the Utility Power switch OFF, then ON restores power to the affected bus if the fault is corrected.

A guarded ON Galley Emergency Power Off switch is located at each galley. If a Galley Emergency Power Off switch is selected OFF, the related EICAS message ELEC UTIL BUS displays and utility OFF light illuminates. Cycling the flight deck Utility Power switch OFF, then ON will not reset the indications. The flight deck Utility Power switch should remain ON after cycling, which permits the remaining utility and galley busses to be powered and controlled by their related ELCU.

IFE and Cabin Lighting Control

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; SB installs Utility Power switches modified to control IFE and cabin night lights)

Electrical power to the IFE and some cabin lighting is controlled from the flight deck through the Utility Power switches on the electrical panel. Pushing both Utility Power switches OFF removes all power from the IFE and turns on cabin night lighting.

With the Utility Power switches OFF, the following cabin lights transfer to an alternate source and remain available for illumination:

- passenger reading lights
- crossover and upper deck ceiling lights
- attendant work lights

Note: All utility and galley bus power is lost with both Utility Power switches OFF.

Electrical bus Isolation during Autoland

During automatic ILS approach, AC and DC busses 1, 2, and 3 are isolated from the synchronous bus to provide independent power sources for the three autopilots. AC bus 4 continues to power the synchronous bus.

If any AC or DC source fails when busses are isolated for autoland, the system reconfigures automatically to maintain independent power sources for the three autopilots.

During autoland:

- AC bus isolation lights 1, 2, and 3 remain extinguished,
- the EICAS message ELEC BUS ISLN is not displayed,
- the message “ELECTRICAL SYNOPTIC INHIBITED FOR, and AUTOLAND” is displayed on the electrical synoptic.

The electrical system is no longer configured for autoland bus isolation when:

- all autopilots disengage, or
- TO/GA mode is annunciated and the airplane is higher than 100 feet radio altitude, or

- approach mode is disarmed or deselected, or
- the electrical system is unable to maintain a configuration for autoland bus isolation.

AC Standby Power System

The AC standby power system provides electrical power to critical flight deck equipment.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Major components of the system include:

- main and APU standby busses
- main and APU batteries
- main and APU standby inverters
- Standby Power selector

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Major components of the system include:

- standby bus and APU alternate power
- main and APU batteries
- main standby and APU alternate power inverters
- Alternate EFIS and Standby Power selectors

Standby Bus

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The standby bus is normally powered by AC bus 3. With the Alternate EFIS Selector in either CAPT or F/O and AC bus 3 not powered, the standby bus is powered by the main standby inverter. The main standby inverter, normally unpowered, is activated and receives power from the main battery charger through the main hot battery bus. The main battery charger is normally powered by AC bus 1 through the ground service bus.

With the Alternate EFIS Selector in CAPT or F/O and the captain transfer bus not powered, the standby bus is powered by the main standby inverter. The main standby inverter is activated and receives power from the main battery through the main hot battery bus. The main battery can provide power to the standby bus for a minimum of 30 minutes.

Note: The Alternate EFIS Selector has no effect on power to the standby bus.

The standby bus powers individual equipment items such as:

- left EIU, left FMS-CDU, left ILS, left VOR
- left ADC, left EFIS control panel
- various flight control components

- standby ignition for all engines
- primary EICAS display, RMI, standby instrument lights

Main Standby Bus

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The main standby bus is normally powered by AC bus 3. With the Battery switch ON, Standby Power selector in AUTO, and AC bus 3 not powered, the main standby bus is powered by the main standby inverter. The main standby inverter, normally unpowered, is activated and receives power from the main battery charger through the main hot battery bus. The main battery charger is normally powered by AC bus 1 through the ground service bus.

With the Battery switch ON, Standby Power selector in AUTO, and both AC bus 1 and AC bus 3 not powered, the main standby bus is powered by the main standby inverter. The main standby inverter, normally unpowered, is activated and receives power from the main battery through the main hot battery bus. With the main battery charger unpowered, the main battery can provide power to the main standby bus for a minimum of 30 minutes.

The main standby bus powers individual equipment items such as:

- left EIU, left CDU, left ILS, left VOR
- various flight control components
- standby ignition for all engines
- primary EICAS display, RMI, standby instrument lights

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
- left ADC, left transponder, left EFIS control panel

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
- left ADC, left EFIS control panel

APU Standby Bus

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The APU standby bus is normally powered by the captain transfer bus. With the Battery switch ON, Standby Power selector in AUTO, and the captain transfer bus not powered (loss of AC busses 1 and 3), the APU standby bus is powered by the APU standby inverter. The APU standby inverter, normally unpowered, is activated and receives power from the APU battery through the APU hot battery bus. With the APU battery charger unpowered, the APU battery can provide power to the APU standby bus for a minimum of 30 minutes.

The APU standby bus powers these equipment items:

- left FMC
- left ND
- left PFD

APU Alternate power

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

APU alternate power is supplied by the APU alternate power inverter and provides standby power to the following equipment items:

- left FMC
- left PFD and ND, or
- right PFD and ND

The left FMC, and left PFD and ND are normally powered by the captain transfer bus. The right PFD and ND are normally powered by the first officer transfer bus.

With the Alternate EFIS Selector in CAPT or F/O and the captain transfer bus not powered, the left FMC and left PFD and ND are powered by the APU alternate power inverter. The APU alternate power inverter, normally unpowered, is activated and receives power from the APU battery through the APU hot battery bus. The right PFD and ND remain powered by their normal source.

With the Alternate EFIS Selector in CAPT and both captain and first officer transfer busses not powered, the left FMC and left PFD and ND are powered by the APU alternate power inverter. The APU alternate power inverter, normally unpowered, is activated and receives power from the APU battery through the APU hot battery bus. The right PFD and ND are not powered. Moving the Alternate EFIS Selector to F/O provides APU alternate inverter power to the right PFD and ND, and removes power from the left PFD and ND. The left FMC remains powered by the APU alternate power inverter.

Note: The Alternate EFIS Selector has no effect on power to the left FMC.

With the Alternate EFIS Selector in F/O and the first officer transfer bus not powered, the right PFD and ND are powered by the APU alternate power inverter. The APU alternate power inverter, normally unpowered, is activated and receives power from the APU battery through the APU hot battery bus.The left FMC and left PFD and ND are powered by their normal source. Moving the Alternate EFIS Selector to CAPT removes APU alternate inverter power from the right PFD and ND. The left FMC and left PFD and ND remain powered by their normal source.

The APU battery can provide power to the APU alternate power system for a minimum of 30 minutes.

Standby Power Selector - BAT Position

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
With the Standby Power Selector in BAT, both main and APU battery chargers are disabled and the captain and first officer transfer busses isolated from the standby power system. The standby bus is powered by the main standby inverter through the main hot battery bus and main battery. The APU alternate power system is powered by the APU alternate power inverter through the APU hot battery bus and APU battery. The main and APU batteries can provide power to the standby bus and APU alternate power system for at least 30 minutes.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
With the Battery switch ON and Standby Power selector in BAT, main and APU battery chargers are disabled. Each AC standby bus is powered by its related battery and inverter. Each battery can provide power for a minimum of 30 minutes.

Note: The Standby Power selector must be in AUTO for flight. The BAT position is for ground maintenance use only.

DC Electrical System

The DC electrical system includes the main DC electrical system and the battery busses.

Main DC Electrical System

The main DC electrical system uses four transformer-rectifier units (TRUs) to produce DC power. Each TRU is powered by its related AC bus and provides DC power to a DC bus. The four DC busses are connected through DC isolation relays (DCIRs) to the DC tie bus, which allows each DC bus to remain powered if its related AC bus is unpowered or TRU fails. Pushing the Bus Tie switch to AUTO closes the related BTB and DCIR. Pushing the Bus Tie switch OFF opens the BTB and DCIR. This isolates the DC bus from the DC tie bus, leaving it powered by its AC bus and TRU. Automatic isolation of an AC bus due to an electrical fault opens the BTB, but does not open the DC isolation relay.

Main DC Power Distribution

TRU DC electrical power is distributed to four main DC busses. Main DC busses power individual equipment items such as:

- cabin pressure, fuel jettison, and pack temperature controllers
- wing anti-ice control
- engine-driven and hydraulic demand pump control
- fuel transfer and jettison valve control
- individual nacelle anti-ice control

Battery Busses

The following battery busses distribute DC power in addition to the four main DC busses:

- Main battery bus
- APU battery bus
- Main hot battery bus
- APU hot battery bus

The main and APU battery busses are normally powered by DC bus 3. If either AC bus 3 or DC bus 3 is unpowered, each battery bus is powered by its related hot battery bus.

The main battery bus provides power to individual equipment such as:

- APU controller (alternate), fuel valves (all engines), all crossfeed valves
- dome, storm, and selected indicator lights
- IDG disconnect (all engines), manual pressurization control, trailing edge flap control
- captain interphone, left radio tuning panel, left VHF

The APU battery bus powers individual equipment items such as:

- APU DC fuel pump, engine start air control
- cargo, first officer, and service interphones, PA system
- APU and engine fire/overheat detection loops A and B
- APU fire warning horn

Each hot battery bus is normally powered by the ground service bus through its related battery charger, which acts as a TRU for the hot battery bus while simultaneously maintaining its related battery fully charged. Each battery is directly connected to its related hot battery bus.

With the Battery switch ON, the main and APU hot battery busses power their related battery busses if either AC bus 3 or DC bus 3 is unpowered.

The main hot battery bus powers individual equipment items such as:

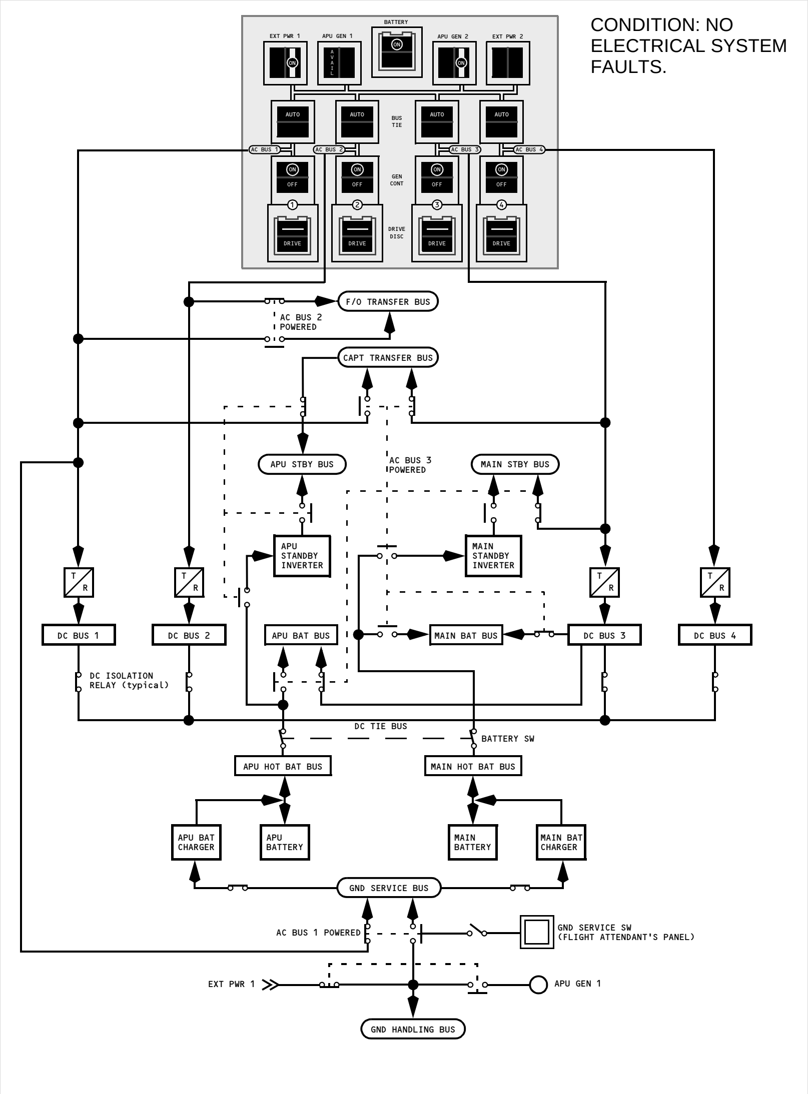
- APU fuel shutoff valve, spar valves (all engines)
- APU and lower cargo fire extinguishers
- engine fire extinguishers (all engines), fire switch unlock (all engines)

The APU hot battery bus powers individual equipment items such as:

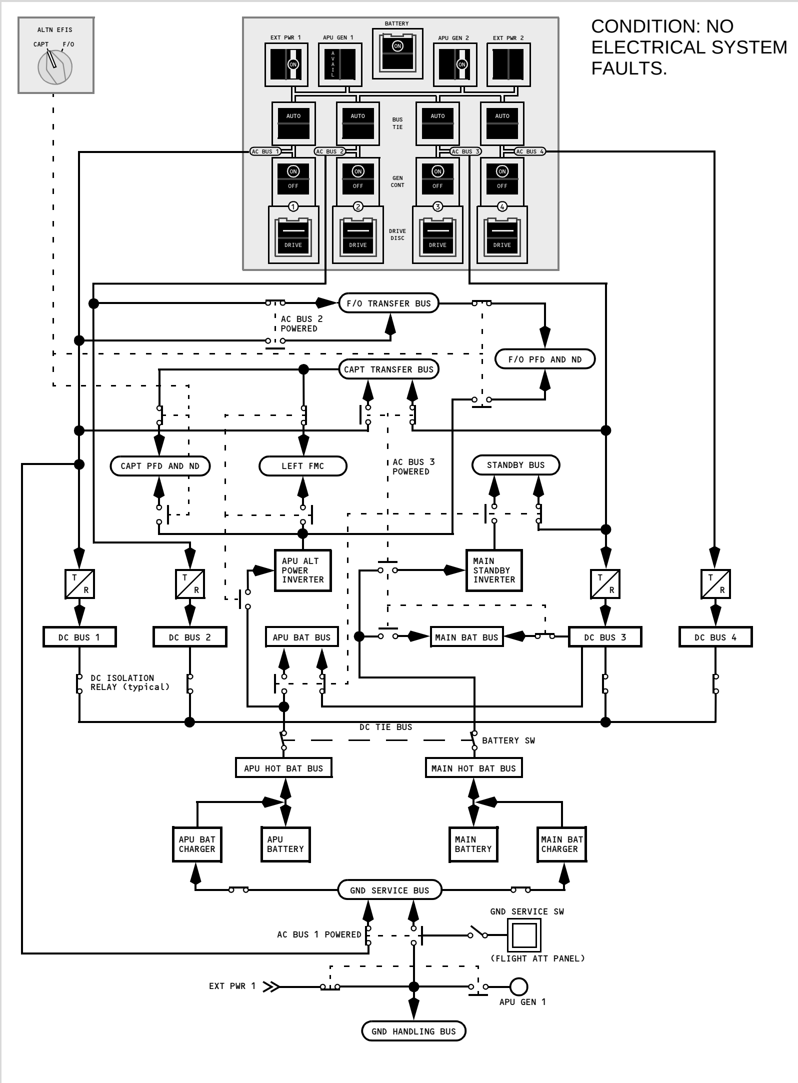
- IRU left, center, right DC power
- left and right outflow valves
- APU inlet door, APU controller (primary)

Electrical System Diagram

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



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EICAS Alert Messages

Message	Level	Aural	Message Logic
>BAT DISCH APU	Advisory		APU battery discharging.
>BAT DISCH MAIN	Advisory		Main battery discharging.
>BATTERY OFF	Advisory		Battery switch OFF.
>DRIVE DISC 1, 2, 3, 4	Advisory		Generator Drive Disconnect switch pushed, IDG disconnected.
ELEC AC BUS 1, 2, 3, 4	Caution	Beeper	AC bus unpowered. Additional related messages displayed for unpowered equipment items.
ELEC BUS ISLN 1, 2, 3, 4	Advisory		Bus tie breaker open. Inhibited when ELEC AC BUS message displayed.
ELEC DRIVE 1, 2, 3, 4	Advisory		IDG oil pressure low, oil temperature high, or GCB open due to uncorrectable generator frequency fault. Inhibited when Generator Drive Disconnect switch pushed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

ELEC GEN OFF 1, 2, 3, 4	Advisory		Generator control breaker open. Inhibited when ELEC AC BUS message displayed.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

ELEC GEN OFF 1, 2, 3, 4	Caution	Beeper	Generator control breaker open. Inhibited when ELEC AC BUS message displayed.

>ELEC SSB OPEN	Advisory		Split system breaker (SSB) open when commanded closed.
ELEC UTIL BUS L, R	Advisory		One or more galley or utility busses unpowered, or Galley Emergency Power switch off. Busses may be unpowered due to electrical fault, or related Utility Power switch or Galley Emergency Power switch off. Inhibited during load shedding.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

>STBY BUS APU	Advisory		APU standby bus not powered.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

>STBY BUS MAIN	Advisory		Main standby bus not powered.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

>STBY POWER OFF	Advisory		Standby bus not powered.

Engines, APU — Chapter 7
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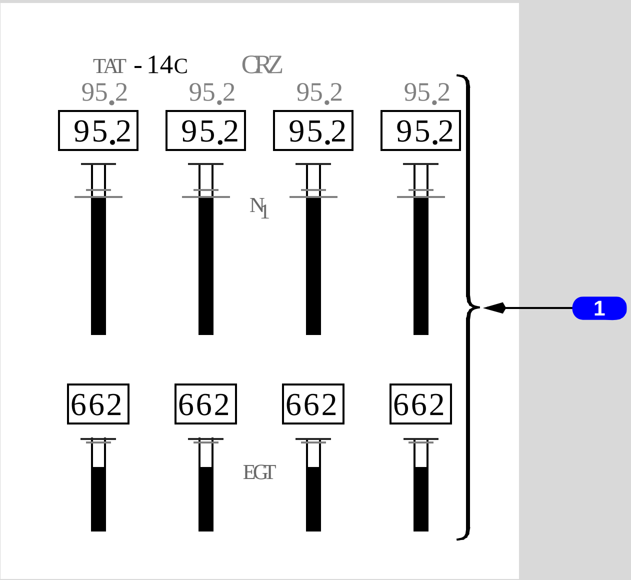
Primary Engine Indications

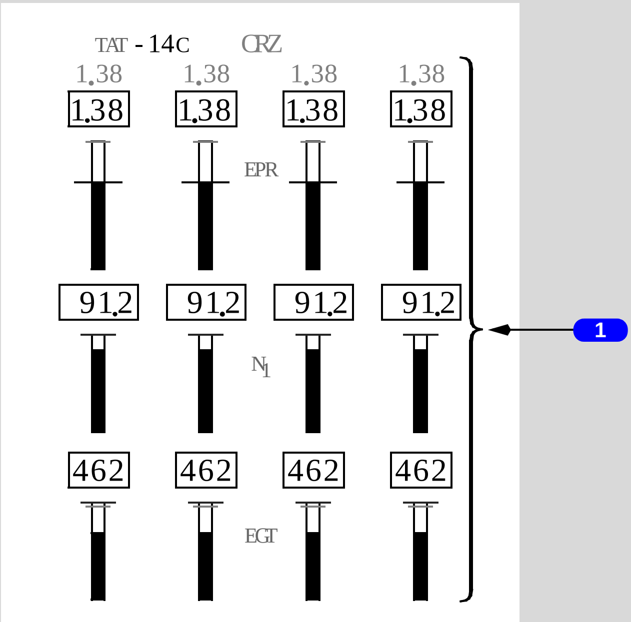
Primary Engine Display

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



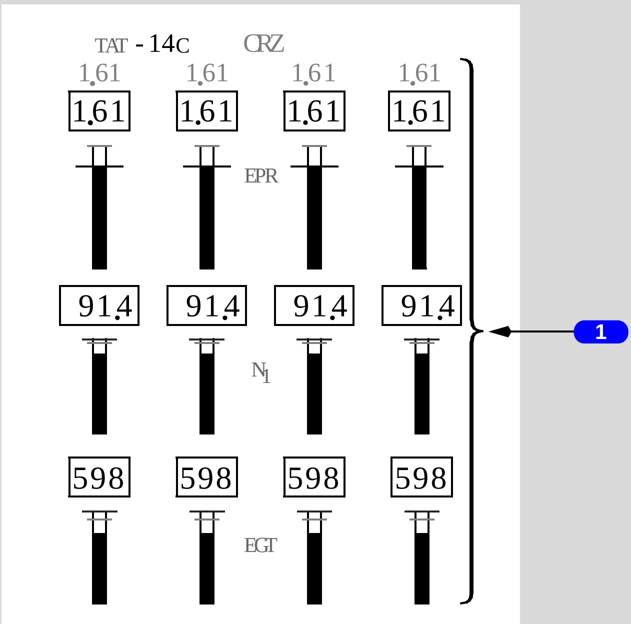
PRIMARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



PRIMARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



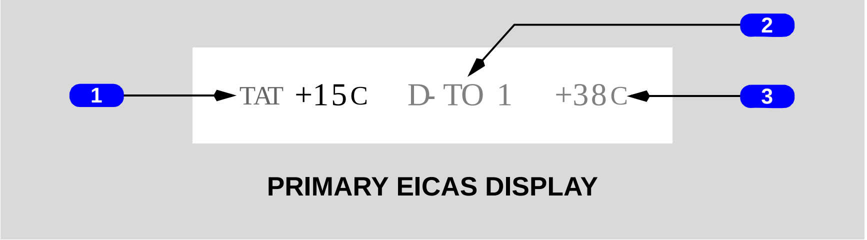
PRIMARY EICAS DISPLAY

1 Primary Engine Indications

Displayed full time on EICAS display:

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- EPR
- N1
- EGT

Mode Indications



1 Total Air Temperature (TAT)

Displayed (white) - TAT (degrees C).

2 Thrust Reference Mode

Displayed (green) - selected FMS thrust reference mode:

- TO - maximum rated takeoff thrust
- TO 1 - derate one takeoff thrust
- TO 2 - derate two takeoff thrust
- D-TO - assumed temperature derated takeoff thrust
- D-TO 1 - derate one assumed temperature derated takeoff thrust
- D-TO 2 - derate two assumed temperature derated takeoff thrust
- CLB - maximum rated climb thrust
- CLB 1 - derate one climb thrust
- CLB 2 - derate two climb thrust
- CON - maximum rated continuous thrust
- CRZ - maximum rated cruise thrust
- GA - maximum rated go-around thrust

3 Assumed Temperature

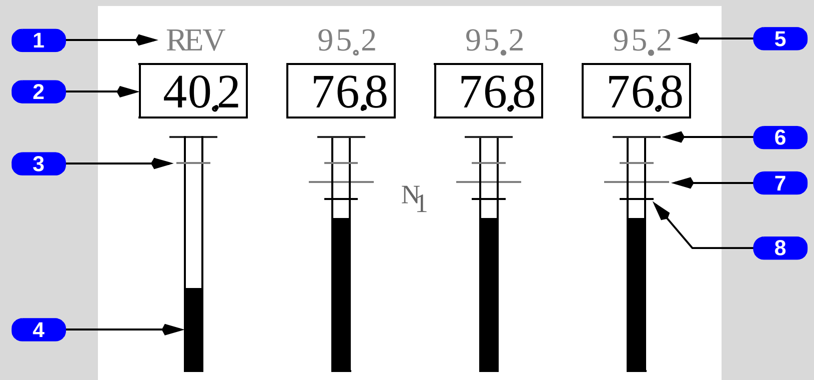
Displayed (green) - selected assumed temperature (degrees C) for reduced thrust takeoff.

N1 Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Note: When reverse thrust is activated, the following indications are not displayed:

- command N1
- reference N1



PRIMARY EICAS DISPLAY

1 Thrust Reverser Indication

Displayed REV (amber) - reverser in transit.

Displayed REV (green) - reverser fully deployed.

2 N1

Digital N1% RPM displayed:

- (white) - normal operating range
- (red) - operating limit reached

3 Maximum N1 Line

Displayed (amber).

4 N1 Indication

N1 RPM, displayed:

- (white) - normal operating range
- (red) - operating limit reached

5 Reference N1

Displayed (digital, green) - reference thrust selected by FMC.

6 N1 Red Line

Displayed (red) - N1 RPM operating limit.

7 Reference N1 Indicator

Displayed (green) - reference N1.

Displayed (magenta) - target N1 commanded by FMC.

8 Command N1 Indicator

Displayed (white) - N1 RPM commanded by thrust lever position.

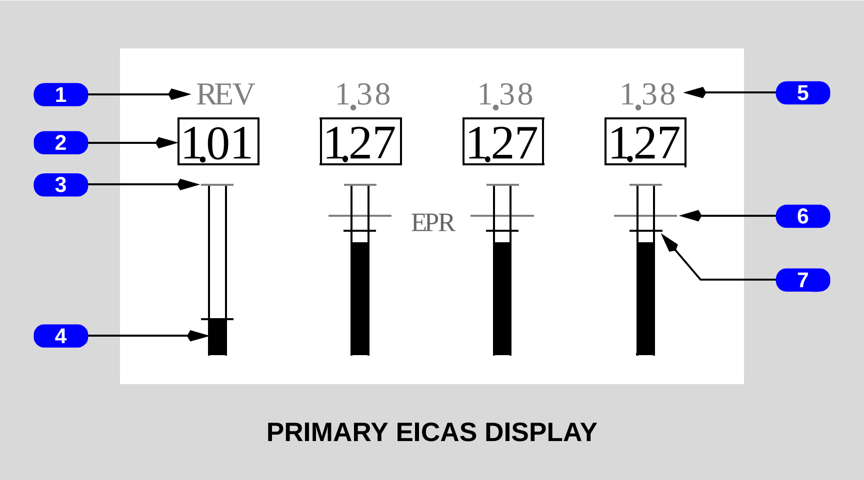
EPR Indications

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

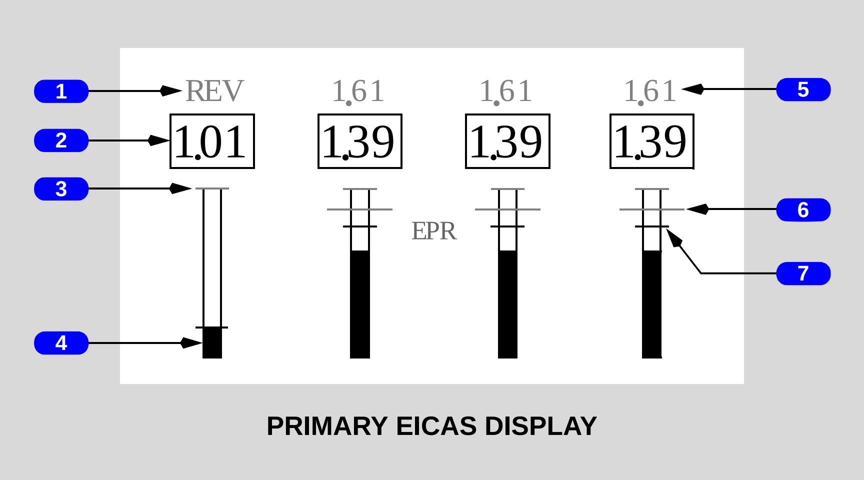
Note: During tailwind conditions, slight EPR fluctuations may occur prior to five knots airspeed.

Note: When reverse thrust is activated, reference EPR is not displayed.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Thrust Reverser Indication

Displayed REV (amber) - reverser in transit.

Displayed REV (green) - reverser fully deployed.

2 EPR

Digital EPR displayed (white).

3 Maximum EPR Line

Displayed (amber) - maximum allowable thrust.

Displayed (white) - maximum EPR is invalid.

4 EPR Indication

EPR, displayed:

- (white) - normal operating range
- (red) - operating limit reached

5 Reference EPR

Displayed (digital, green) - reference thrust selected by FMC.

6 Reference EPR Indicator

Displayed (green) - reference EPR.

Displayed (magenta) - target EPR commanded by FMC.

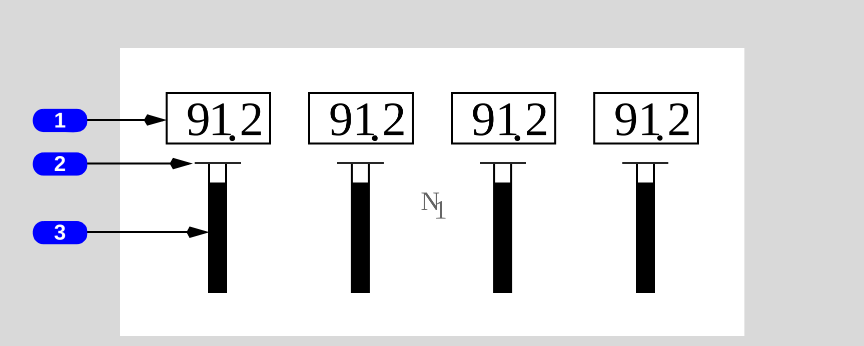
7 Command EPR Indicator

Displayed (white) - EPR commanded by thrust lever position.

N1 Indications

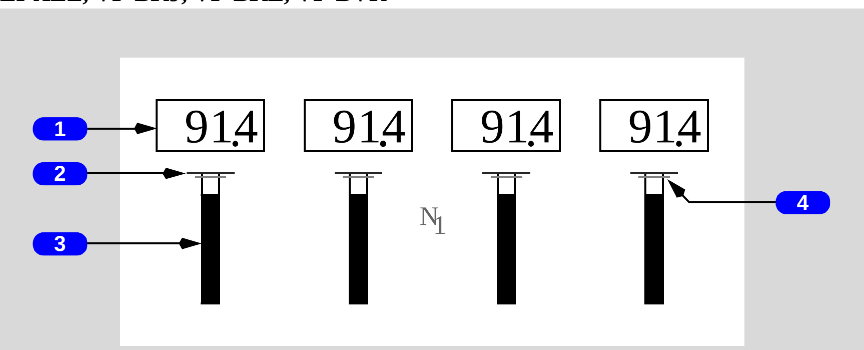
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



PRIMARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



PRIMARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

1 N1 RPM

Digital N1% RPM displayed:

- (white) - normal operating range
- (red) - operating limit reached

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

1 N1 RPM

Digital N1% RPM displayed:

- (white) - normal operating range
- (amber) _ caution range reached
- (red) - operating limit reached

2 N1 Red Line

Displayed (red) _ N1 RPM operating limit.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

3 N1 RPM Indicator

N1 RPM, displayed:

- (white) - normal operating range
- (red) - operating limit reached

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

3 N1 RPM Indicator

N1 RPM, displayed:

- (white) - normal operating range
- (amber) _ caution range reached
- (red) - operating limit reached

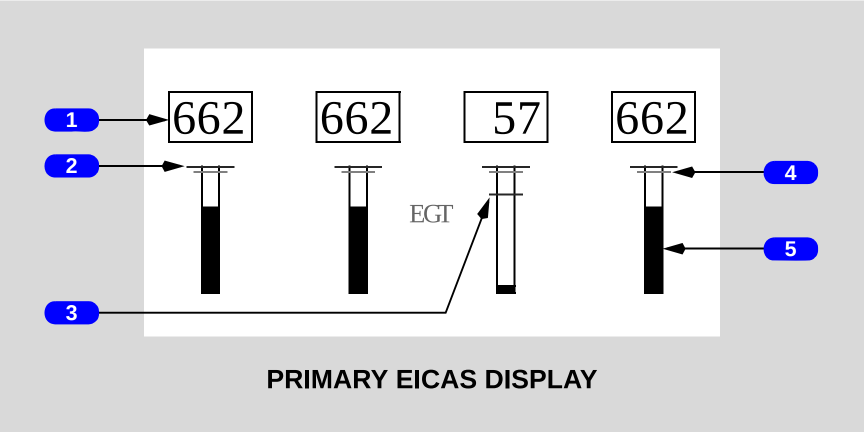
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

4 N1 Amber Band

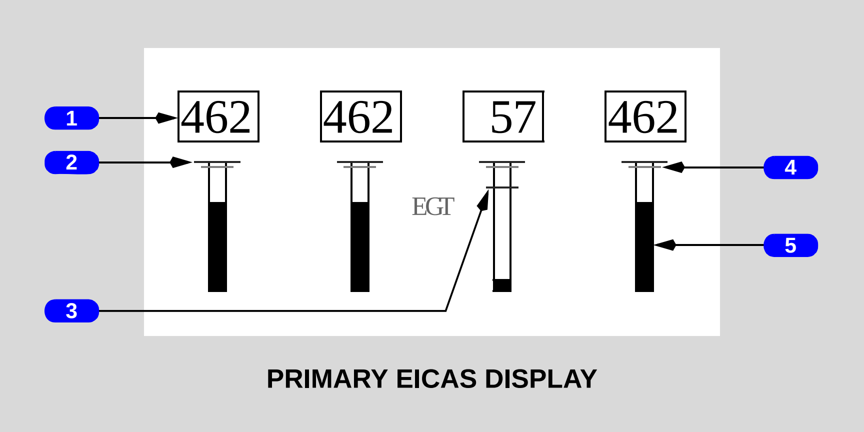
Displayed (amber) _ N1 caution range.

EGT Indications

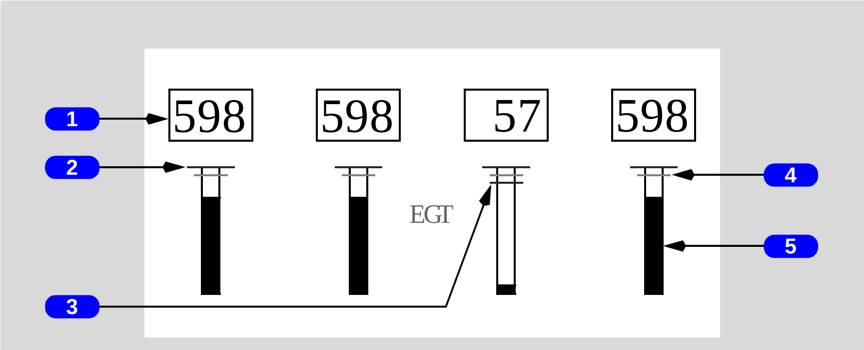
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



PRIMARY EICAS DISPLAY

1 EGT

EGT (degrees C), displayed:

- (white) - normal operating range
- (amber) - continuous limit reached
- (red) - start or takeoff limit reached

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Note: Indication remains white during TO or GA for five minutes even though continuous EGT limit is reached.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Note: Indication remains white during TO or GA for five minutes (or ten minutes if one engine fails or is shut down) even though continuous EGT limit is reached.

2 EGT Red Line

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Displayed (red) - takeoff EGT limit.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Displayed (red) - takeoff or in-flight start EGT limit.

3 EGT Start Limit Line

Displayed (red):

- with Fuel Control switch in CUTOFF

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
until N2 reaches a predetermined RPM

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- until N3 reaches a predetermined RPM

4 EGT Amber Band

Displayed (amber) - continuous EGT limit.

5 EGT Indication

Displayed:

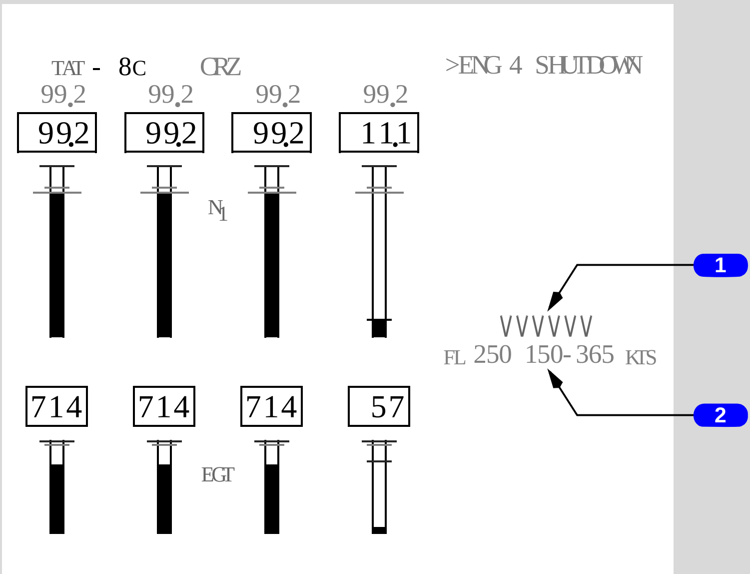
- (white) - normal operating range
- (amber) - continuous limit reached
- (red) - start or takeoff limit reached

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Note: Indication remains white during TO or GA for five minutes even though continuous EGT limit is reached.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Note: Indication remains white during TO or GA for five minutes (or ten minutes if one engine fails or is shut down) even though continuous EGT limit is reached.

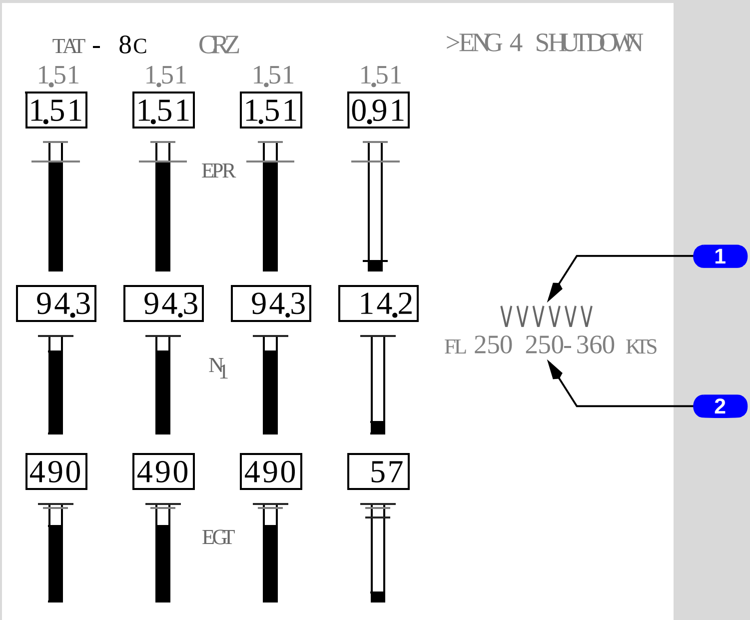
Secondary Exceedance Cue and In-flight Start Envelope

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



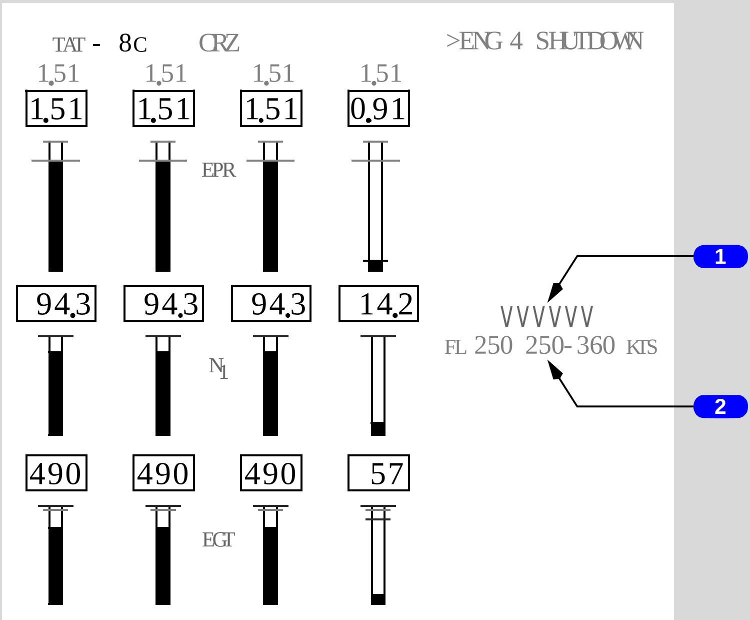
PRIMARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



PRIMARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



PRIMARY EICAS DISPLAY

1 Secondary Engine Exceedance Cue

Displayed (cyan) -

- when a secondary engine parameter exceedance occurs
- until exceeding parameter returns to normal operating range
- uses same character field as status cue (replaces status cue if displayed)

2 In-Flight Start Envelope

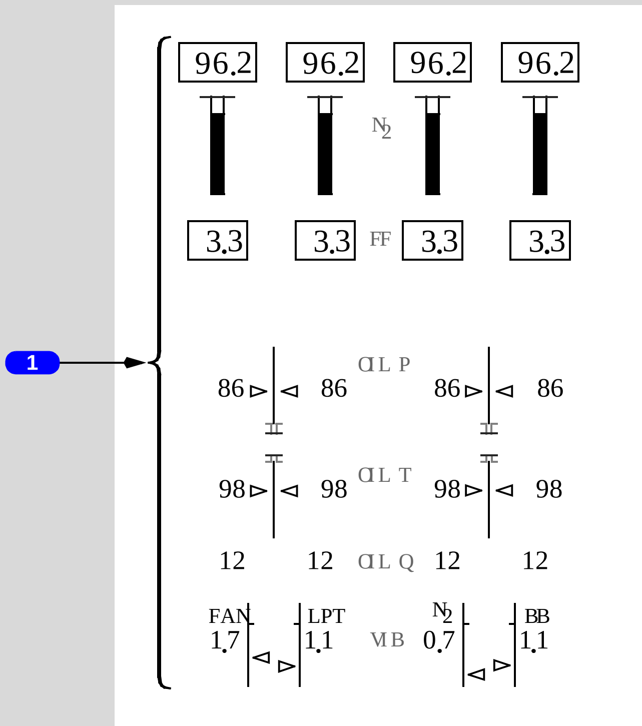
Displayed (magenta) - airspeed range for an in-flight start at the current flight level or maximum flight level (whichever is less) when the related Engine Fire switch is in and a Fuel Control switch is in CUTOFF.

Secondary Engine Indications

See Chapter 10, Flight Instruments, Displays, for display selection of Secondary Engine indications.

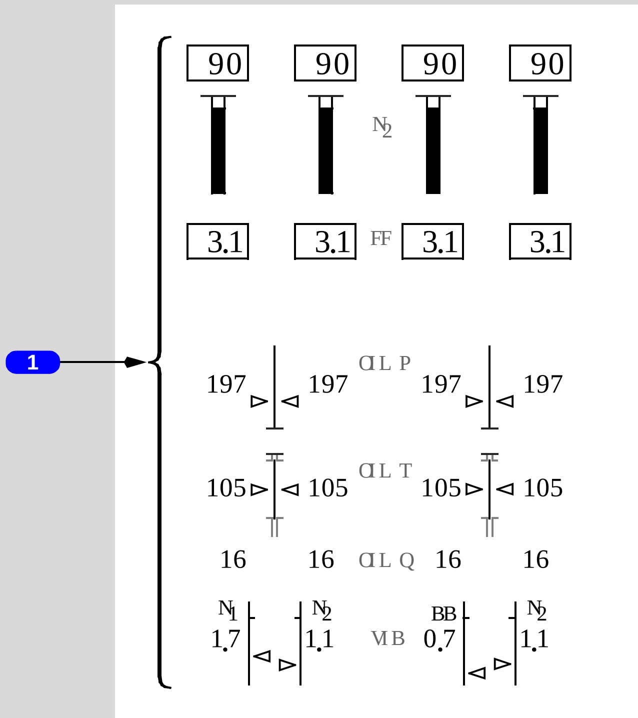
Secondary Engine Display

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



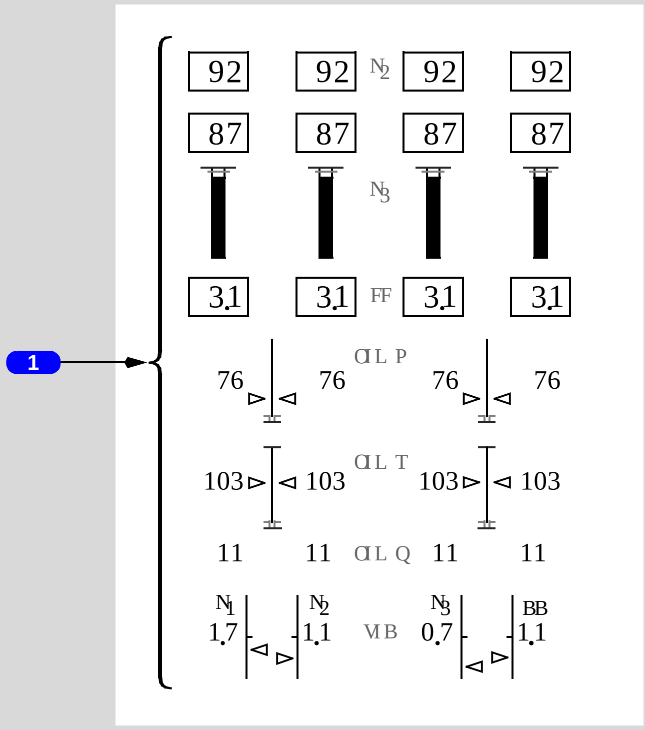
SECONDARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



SECONDARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



SECONDARY EICAS DISPLAY

1 Secondary Engine Display

Displays:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

- N2 RPM
- fuel flow (FF)
- oil pressure (OIL P)
- oil temperature (OIL T)
- oil quantity (OIL Q)
- vibration (VIB)

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

- N2 RPM
- fuel flow (FF)
- oil pressure (OIL P)
- oil temperature (OIL T)
- oil quantity (OIL Q)
- vibration (VIB)

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

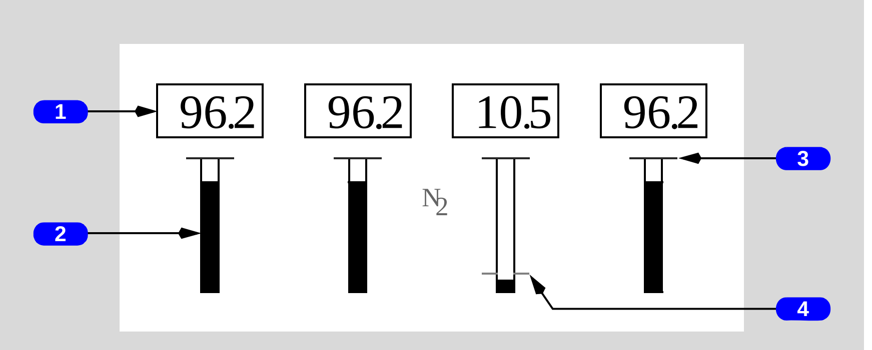
- N2/N3 RPM
- fuel flow (FF)
- oil pressure (OIL P)
- oil temperature (OIL T)
- oil quantity (OIL Q)
- vibration (VIB)

Displays when:

- EICAS initially receives power
- in flight, when a Fuel Control switch is moved to CUTOFF

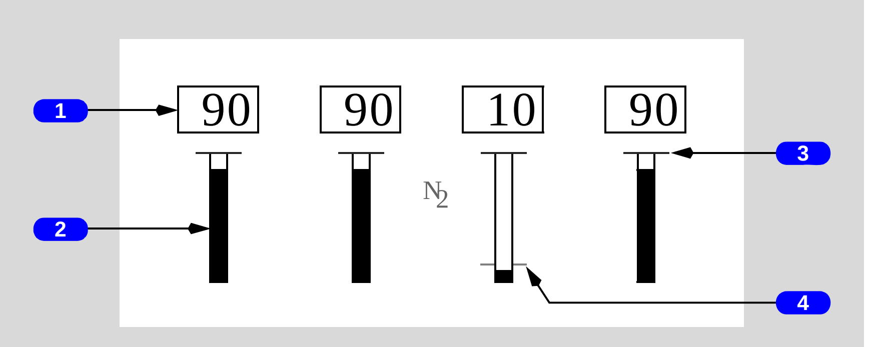
N2 Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



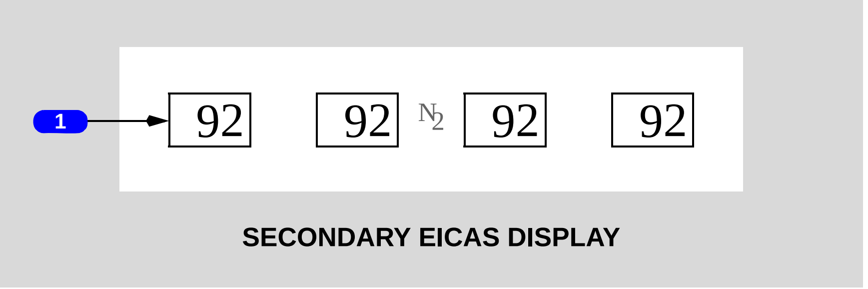
SECONDARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



SECONDARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

1 N2

N2 RPM (%), displayed:

- (white) - normal operating range
- (red) - operating limit reached

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

1 N2

N2 RPM (%), displayed:

- (white) - normal operating range
- (red) - operating limit reached

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

1 N2

N2 RPM (%), displayed:

- (white) - normal operating range
- (amber) - caution range reached
- (red) - operating limit reached

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

2 N2 Indication

N2 RPM, displayed:

- (white) - normal operating range
- (red) - operating limit reached

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

2 N2 Indication

N2 RPM, displayed:

- (white) - normal operating range
- (red) - operating limit reached

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

3 N2 Red Line

N2 RPM operating limit, displayed (red).

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

3 N2 Red Line

N2 RPM operating limit, displayed (red).

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

4 Fuel-On Indicator

Displayed - minimum N2 RPM at which Fuel Control switch should be moved to RUN during a manual start.

Displayed when Fuel Control switch in CUTOFF.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

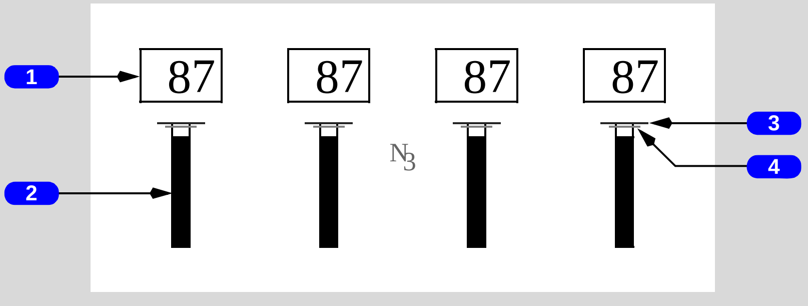
4 Fuel-On Indicator

Displayed - minimum N2 RPM at which Fuel Control switch should be moved to RUN during start.

Displayed when Fuel Control switch in CUTOFF.

N3 Indications

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



SECONDARY EICAS DISPLAY

1 **N3**

N3 RPM (%), displayed:

- (white) - normal operating range
- (amber) - caution range reached
- (red) - operating limit reached

2 **N3 Indication**

N3 RPM, displayed:

- (white) - normal operating range
- (amber) - caution range reached
- (red) - operating limit reached

3 **N3 Red Line**

N3 RPM operating limit, displayed (red).

4 **N3 Amber Band**

N3 RPM caution range, displayed (amber).

Fuel Flow Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

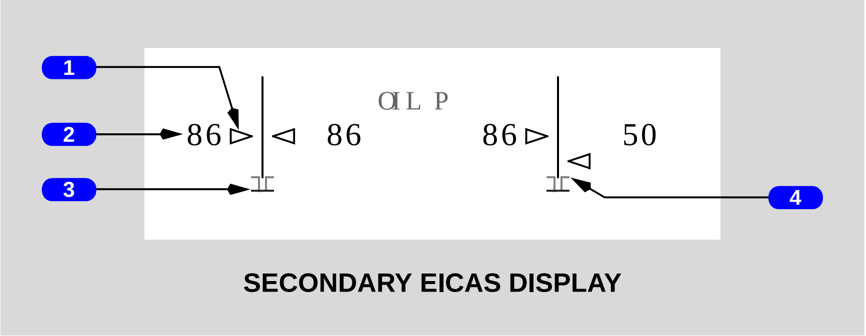
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

1 **Fuel Flow**

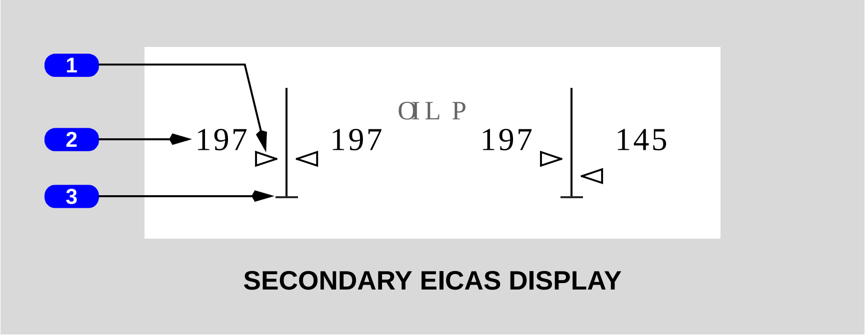
Displayed (white) - fuel flow to the engine (kilograms per hour x 1000).

Oil Pressure Indications

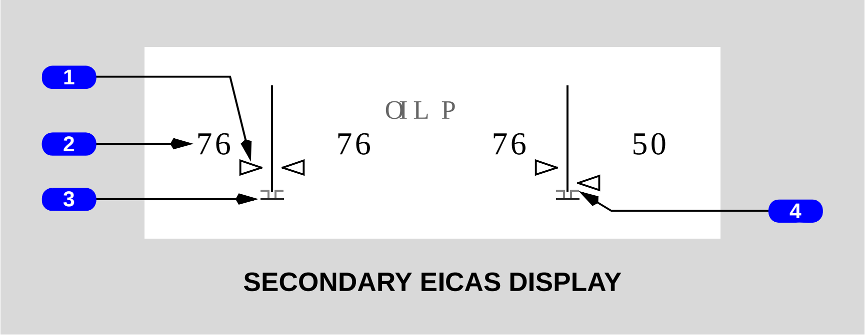
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Oil Pressure Indicator

Engine oil pressure, displayed:

- (white) - normal operating range

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

- (amber) - caution range reached
- (red) - operating limit reached
- indication remains white when engine shutdown and during start

2 Oil Pressure

Engine oil pressure (psi), displayed:

- (white) - normal operating range

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

- (amber) - caution range reached
- (red) - operating limit reached
- indication remains white when engine shutdown and during start

3 Oil Pressure Red Line

Displayed (red) - oil pressure operating limit.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

4 Oil Pressure Amber Band

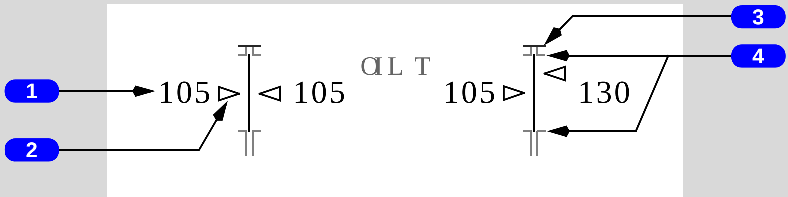
Displayed (amber) - oil pressure caution range.

Oil Temperature Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

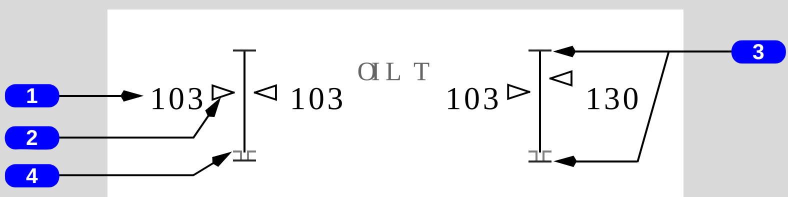
SECONDARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



SECONDARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



SECONDARY EICAS DISPLAY

1 Oil Temperature

Engine oil temperature (degrees C), displayed:

- (white) - normal operating range
- (amber) - caution range reached
- (red) - operating limit reached

2 Oil Temperature Indicator

Engine oil temperature, displayed:

- (white) - normal operating range
- (amber) - caution range reached
- (red) - operating limit reached

3 Oil Temperature Red Line

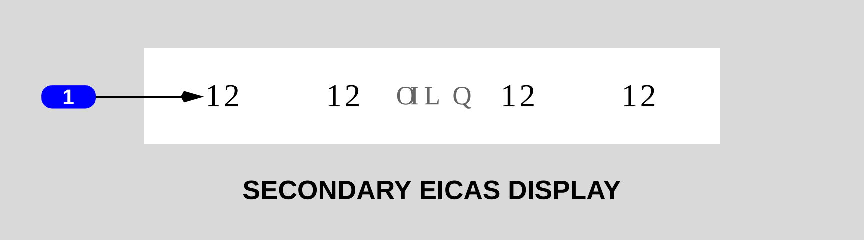
Displayed (red) - oil temperature operating limit.

4 **Oil Temperature Amber Band**

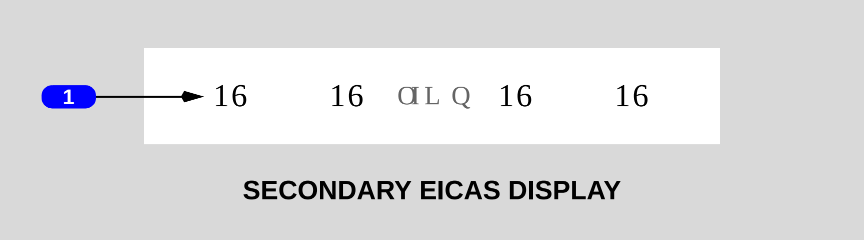
Displayed (amber) - oil temperature caution range.

Oil Quantity Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 **Oil Quantity**

Usable oil quantity (liters).

Displayed:

- (white) - normal quantity

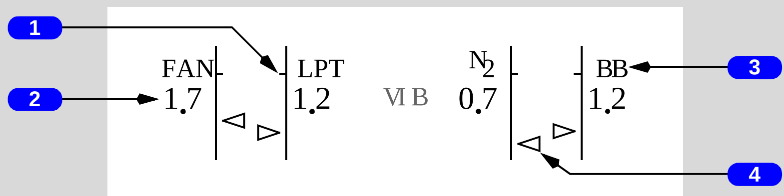
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
- (magenta) - low quantity, or oil differential reached

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- (magenta) - low quantity, or oil differential reached

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- (magenta) - low quantity reached

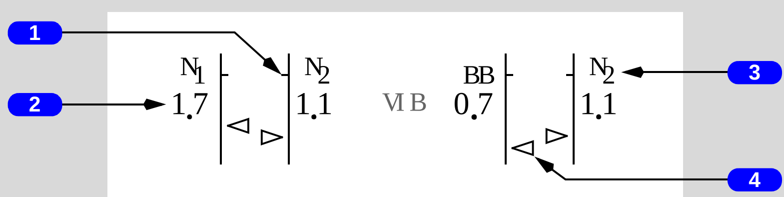
Engine Vibration Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



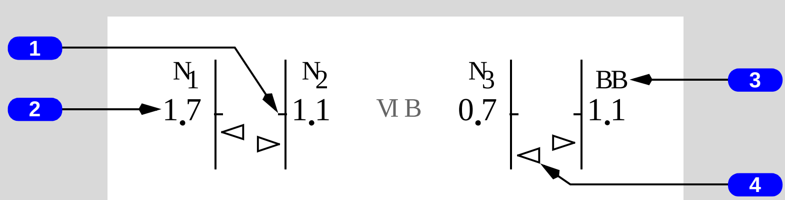
SECONDARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



SECONDARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



SECONDARY EICAS DISPLAY

1 Engine Vibration High Band

Displayed (white) - vibration level at which automatic display of vibration indications occurs.

2 Engine Vibration

Displayed (white) - engine vibration.

3 Engine Vibration Source

Identifies the vibration source being displayed.

Displayed (white) - vibration source with the highest vibration:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

- FAN - fan vibration
- LPT - Low Pressure Turbine vibration
- N2 - N2 rotor vibration

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

- N1 - N1 rotor vibration
- N2 - N2 rotor vibration

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- N1 - N1 rotor vibration
- N2 - N2 rotor vibration
- N3 - N3 rotor vibration

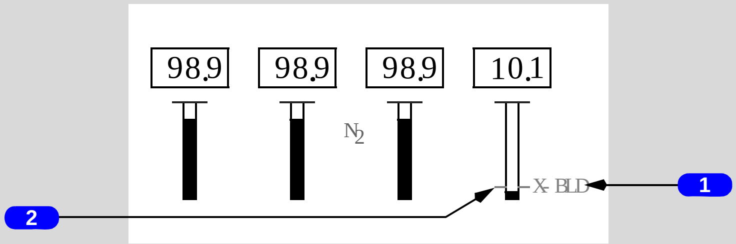
If vibration source BB (broad band vibration) displayed, source is unknown and average vibration displayed.

4 Engine Vibration Indicator

Displayed (white) - engine vibration.

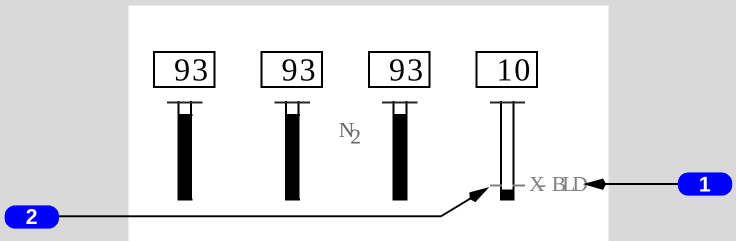
Crossbleed Start Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



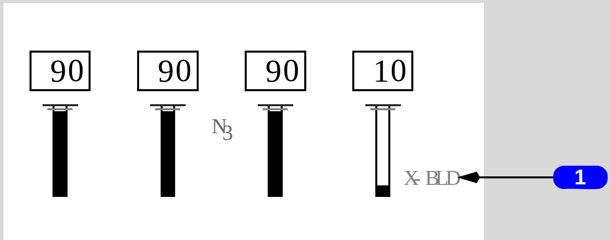
SECONDARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



SECONDARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



SECONDARY EICAS DISPLAY

1 Crossbleed (X-BLD) Start Indication

Indicates crossbleed air is recommended for in-flight start.

Displayed (magenta):

- in-flight start envelope displayed, and
- airspeed lower than for a windmilling start

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

2 Fuel-on Indicator

Displayed (magenta):

- a Fuel Control switch is in CUTOFF
- minimum N2 RPM at which Fuel Control switch should be moved to RUN during a manual start

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

2 Fuel-on Indicator

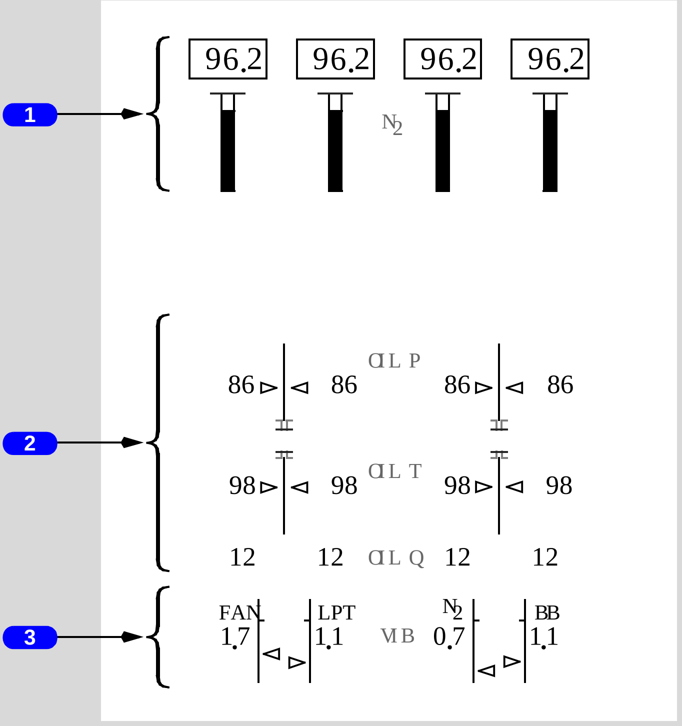
Displayed (magenta):

- a Fuel Control switch is in CUTOFF
- minimum N2 RPM at which Fuel Control switch should be moved to RUN during start

Partial Secondary Engine Indications

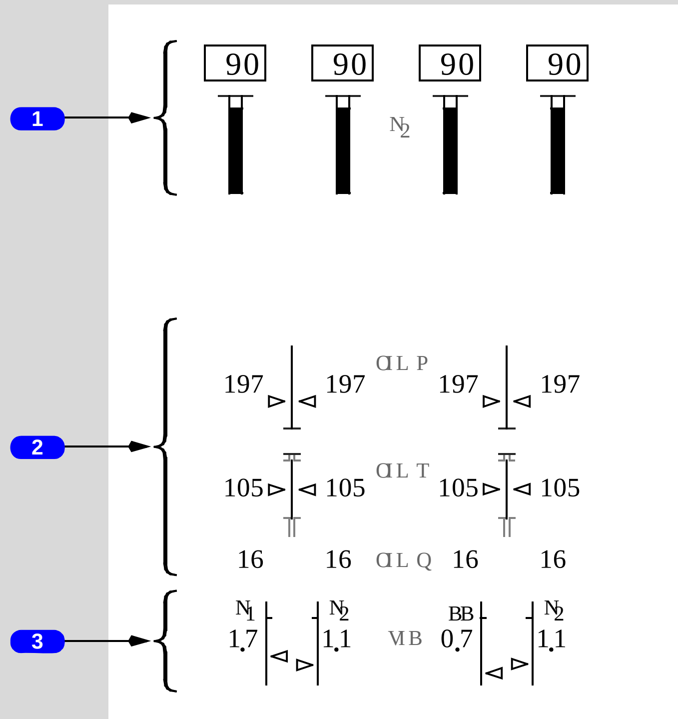
Partial secondary engine indications can display when the secondary engine display is not selected.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



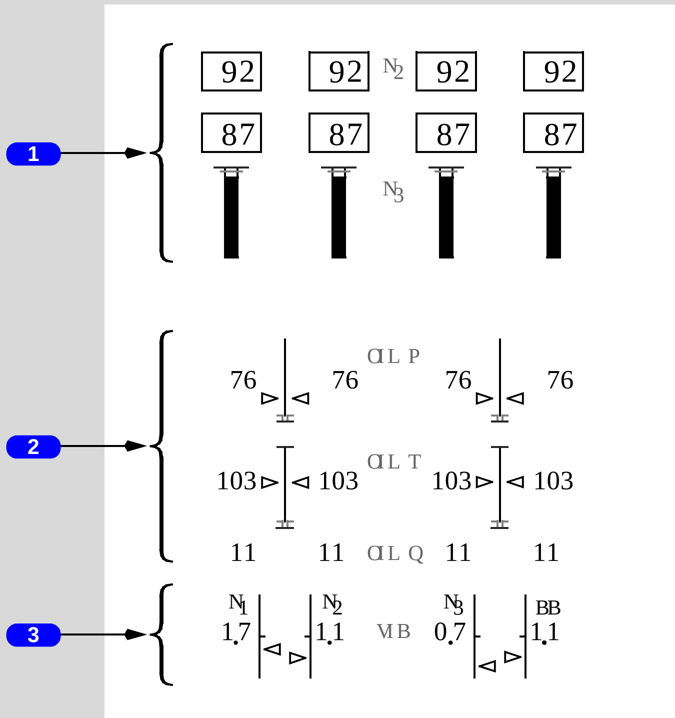
SECONDARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



SECONDARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



SECONDARY EICAS DISPLAY

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

1 N2

Displays if an operating limit reached.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

1 N2

Displays if an operating limit reached.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

1 N2, N3

Displays if an operating limit reached.

2 OIL P, OIL T, OIL Q

Displays if:

- a caution range or operating limit reached

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

- oil differential exceeded

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- oil differential exceeded
- oil quantity low

3 VIB

Displays if a display indicator reached.

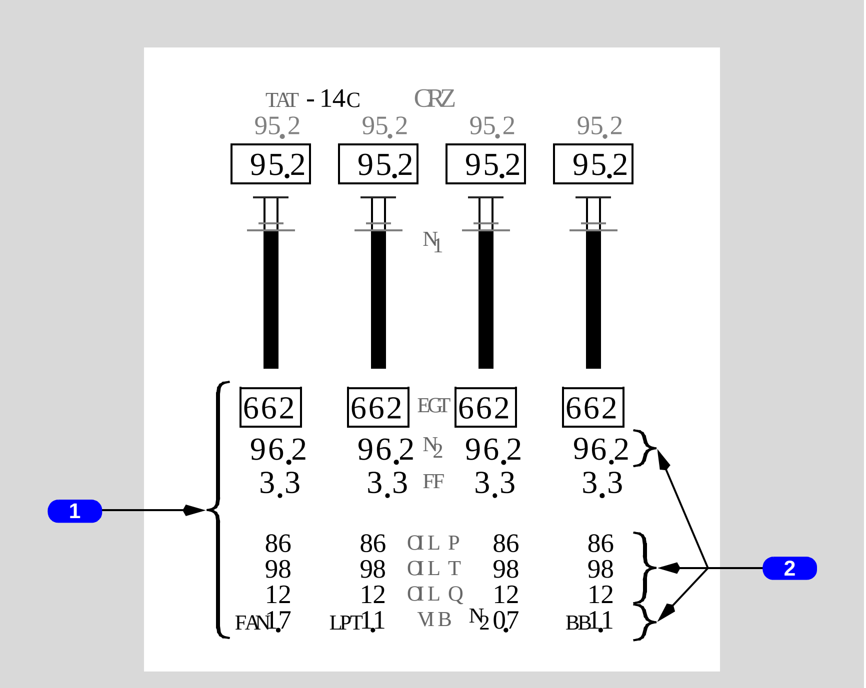
Intentionally
Blank

Compact Engine Indications

Compact engine indications are used when only one display unit is available for EICAS.

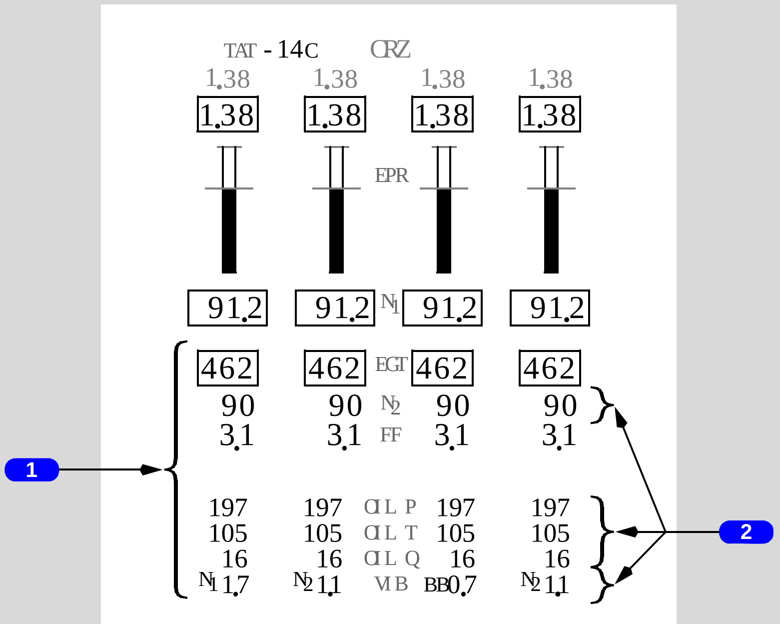
Compact Engine Display

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



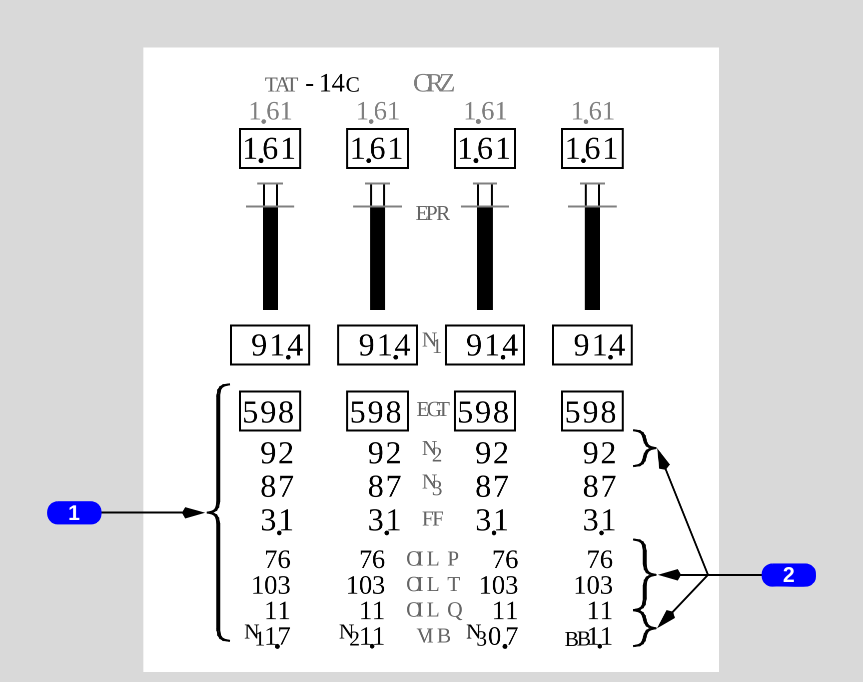
PRIMARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



PRIMARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



PRIMARY EICAS DISPLAY

1 Compact Engine Indications

Displayed continuously:

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- EPR
- N1
- EGT

Displayed when selected by secondary engine display switch, or in flight if a Fuel Control switch is moved to CUTOFF:

- N2

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- N3
- FF
- OIL P
- OIL T

- OIL Q
- VIB

2 Partial Compact Engine Indications

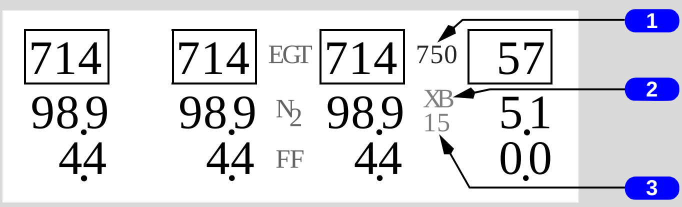
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
N2, or OIL P, OIL T, OIL Q, or VIB display if:

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
N2, N3, or OIL P, OIL T, OIL Q, or VIB display if:

- a secondary engine parameter exceedance occurs when secondary engine indications are not selected, or
- a secondary EICAS display other than secondary engine is selected when partial secondary engine indications are displayed on secondary EICAS

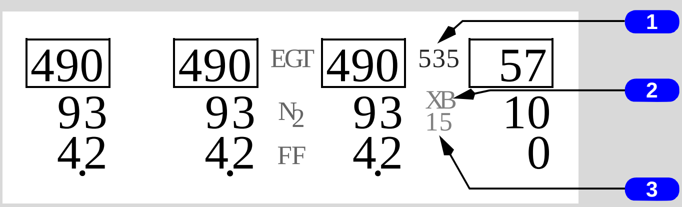
Compact Start Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



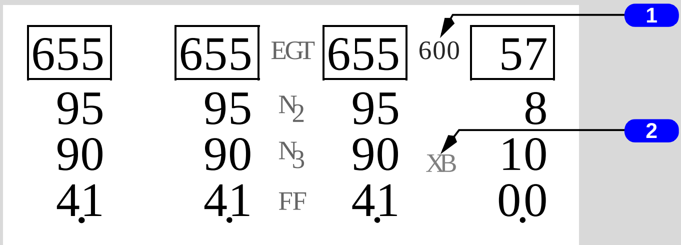
PRIMARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



PRIMARY EICAS DISPLAY

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



PRIMARY EICAS DISPLAY

1 EGT Start Limit

Displays red.

2 Crossbleed Start

Displays magenta.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

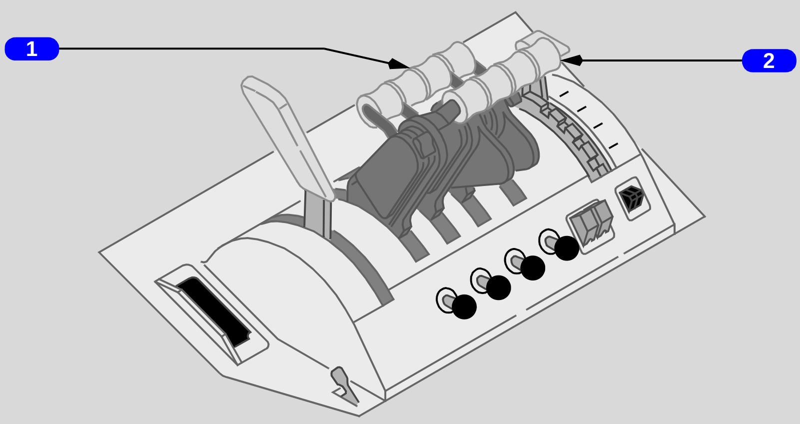
3 Fuel-on Indicator

Displays magenta.

Intentionally
Blank

Engine Controls

Thrust Levers



CONTROL STAND

1 Reverse Thrust Levers

Control engine reverse thrust.

Reverse thrust can only be selected when Forward Thrust levers are closed.

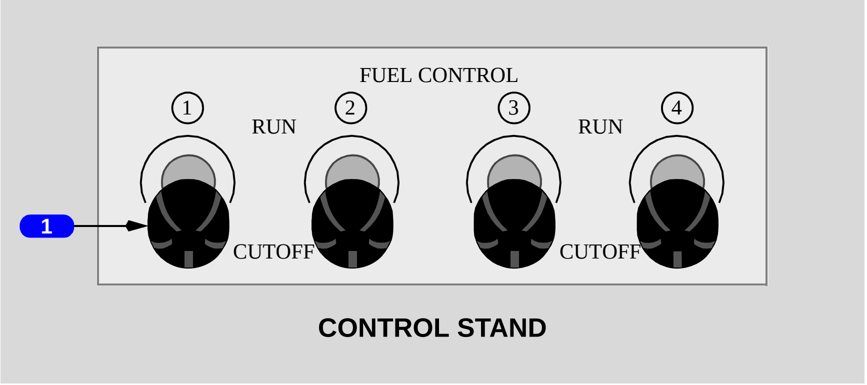
Actuates automatic speedbrakes (refer to Chapter 9, Flight Controls).

2 Forward Thrust Levers

Controls engine forward thrust.

Thrust levers can only be advanced when Reverse Thrust levers are down.

Fuel Control Switches



1 FUEL CONTROL Switches

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
RUN (Autostart switch ON) -

- opens spar fuel valve
- opens engine fuel valve
- EEC sequences start valve, fuel metering valve, and igniter operation

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
RUN (Autostart switch OFF) -

- opens spar fuel valve
- opens engine fuel valve
- energizes igniter(s)

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
RUN -

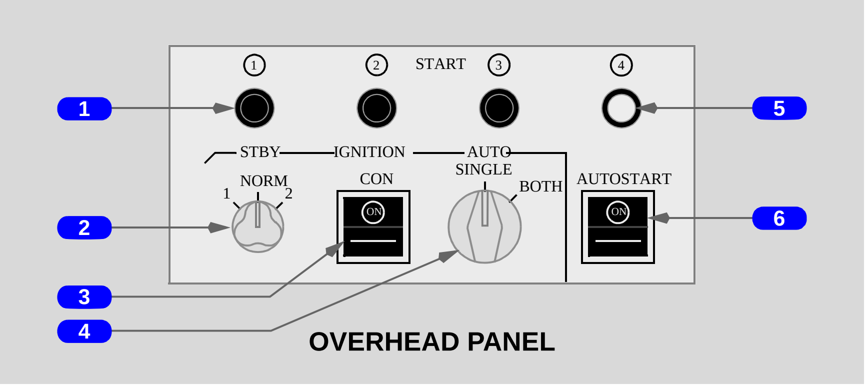
- opens spar fuel valve
- opens engine fuel valve
- energizes igniter(s)

CUTOFF -

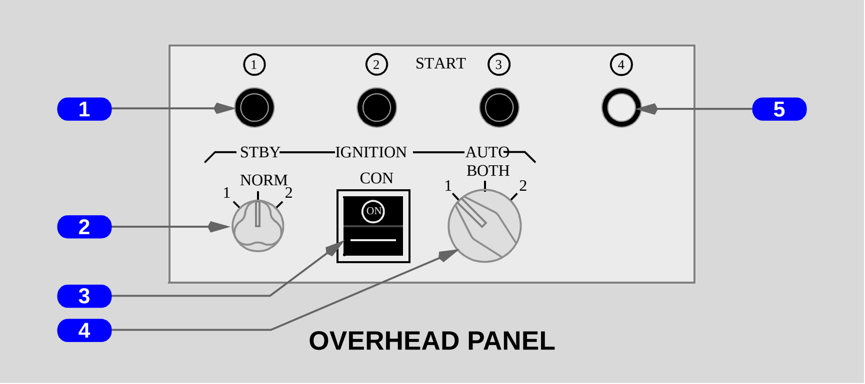
- closes fuel valves
- removes igniter power
- commands respective hydraulic demand pump to operate when Demand Pump selector in AUTO
- unlocks Engine Fire switch

Engine Start Panel

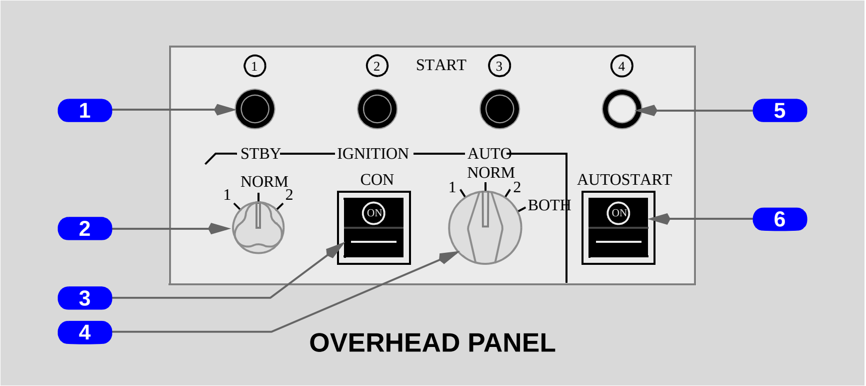
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Engine START Switches

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Pull (Autostart switch ON) -

- arms start valve
- opens engine bleed air valve

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Pull (Autostart switch OFF) -

- opens start valve
- opens engine bleed air valve

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Pull -

- opens start valve
- opens engine bleed air valve

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Releases at 50% N2 RPM -

- start valve closes
- engine bleed air valve closes

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Releases at 50% N3 RPM -

- start valve closes
- engine bleed air valve closes

2 **Standby (STBY) IGNITION Selector**

NORM -

- AC power system supplies power to selected igniters

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

- standby power system supplies power continuously to all igniters if AC power system is not powered

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- standby power system supplies power continuously to number 1 igniters if AC power system is not powered

1 or 2 - standby power system supplies power continuously to respective igniters.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

3 **Continuous (CON) IGNITION Switch**

ON - selected igniters operate continuously.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

3 **Continuous (CON) IGNITION Switch**

ON -

- selected igniters operate continuously
- commands approach idle minimum

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

3 **Continuous (CON) IGNITION Switch**

ON -

- selected igniters operate continuously
- commands approach idle minimum

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

4 **AUTO IGNITION Selector**

SINGLE -

- EEC alternates igniter 1 and igniter 2 for each ground start
- EEC selects both igniters for in-flight start or flameout

BOTH - selects all igniters.

Selected igniters operate when any of the following occur:

- during start when N2 RPM less than 50%
- trailing edge flaps out of up position
- nacelle anti-ice ON
- engine flameout

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

4 AUTO IGNITION Selector

1, BOTH, or 2 - selects respective igniters.

Selected igniters operate when any of the following occur:

- during start when N2 RPM less than 50%
- trailing edge flaps out of up position
- nacelle anti-ice ON

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

4 AUTO IGNITION Selector

Both igniters energize for in-flight start or when flameout detected.

1, 2, or BOTH - selected igniters operate when any of the following occur:

- during start when N3 RPM less than 50%
- trailing edge flaps out of up position
- first 60 seconds nacelle anti-ice ON

NORM - EEC alternates igniter 1 and igniter 2 for each ground start.

5 Engine Start Lights

Illuminated (white) - start valve is open.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

6 AUTOSTART Switch

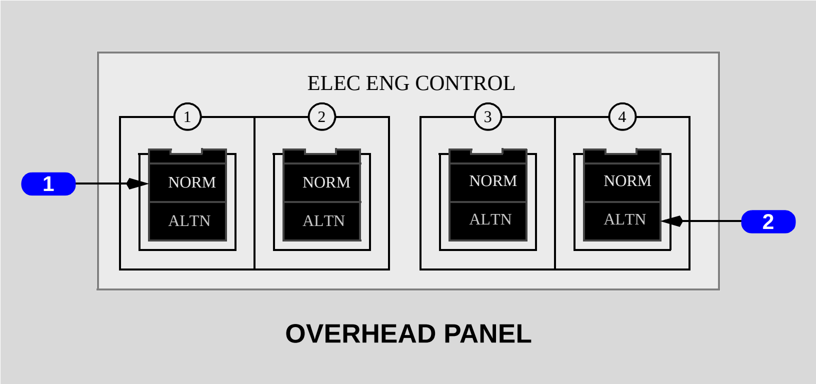
ON - arms the autostart system.

OFF -

- autostart system is disabled
- start is manually controlled

Electronic Engine Control

Electronic Engine Control Panel



1 Electronic (ELEC) Engine (ENG) CONTROL Switches

NORM (Normal) -

- selects normal engine control mode

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

- electronic engine control sets thrust using N1 RPM as the controlling parameter

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- electronic engine control sets thrust using EPR as the controlling parameter

Alternate -

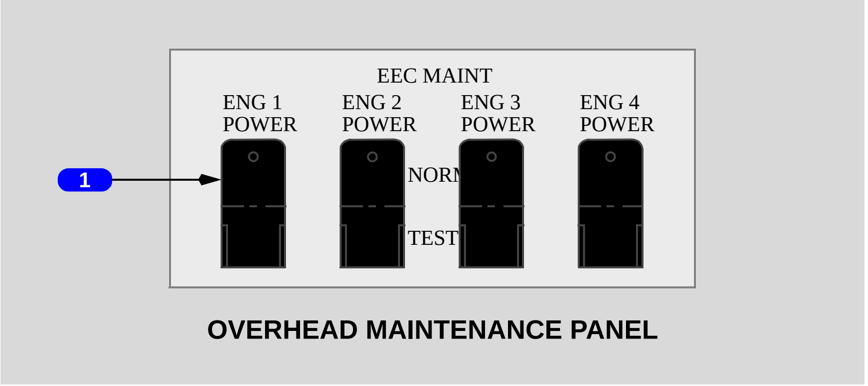
- selects alternate engine control mode
- thrust set using N1 RPM as controlling parameter

2 EEC Alternate (ALTN) Lights

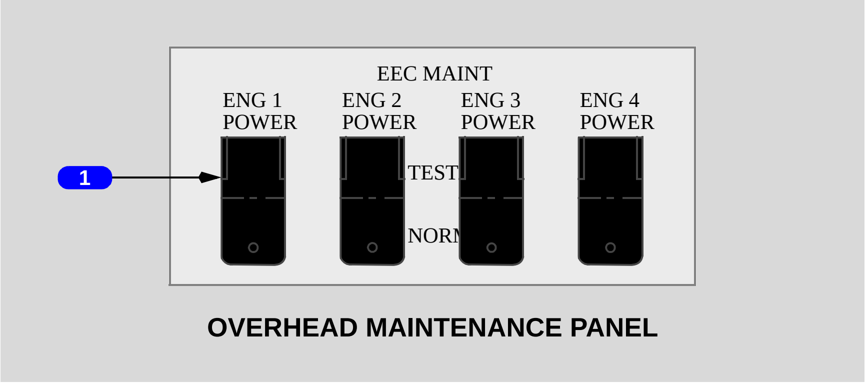
Illuminated (amber) - alternate engine control mode selected.

Electronic Engine Control Maintenance Panel

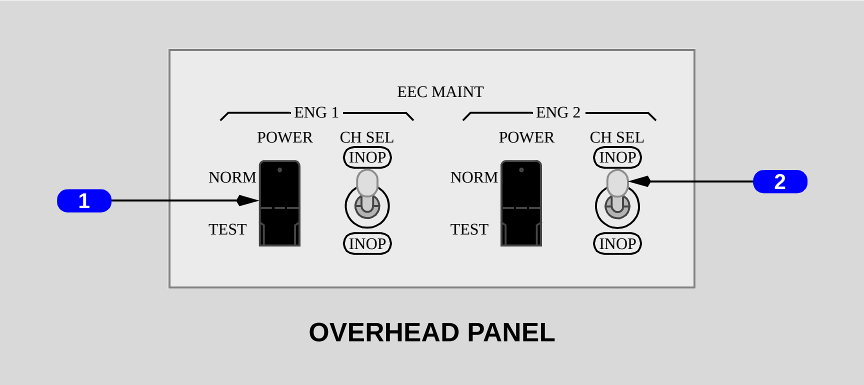
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



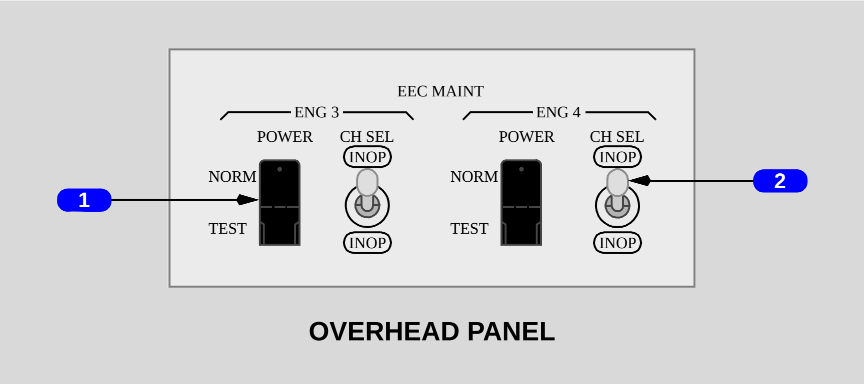
VQ-BHW, VQ-BHX



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 EEC Maintenance (MAINT) POWER Switches

Normal (NORM) - supplies electrical power for normal EEC operation.

TEST - supplies electrical power for EEC maintenance testing when engine not running.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

2 EEC Maintenance Channel (CH) Select (SEL) Switch

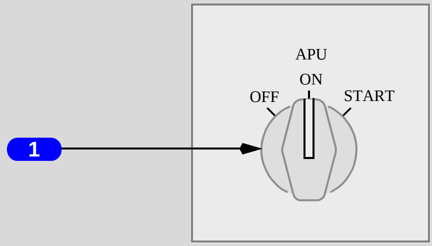
Inoperative.

NORM - EEC selects controlling channel

CH B - selects channel B for EEC maintenance testing.

Intentionally
Blank

APU Controls and Indications
APU Selector



OVERHEAD PANEL

1 APU Selector

OFF -
- closes APU bleed air isolation valve
- initiates normal shutdown
- resets auto shutdown fault logic except when shutdown due to APU bleed duct leak

ON (APU operating position) -
- opens APU fuel valve and inlet door
- arms APU bleed air isolation valve

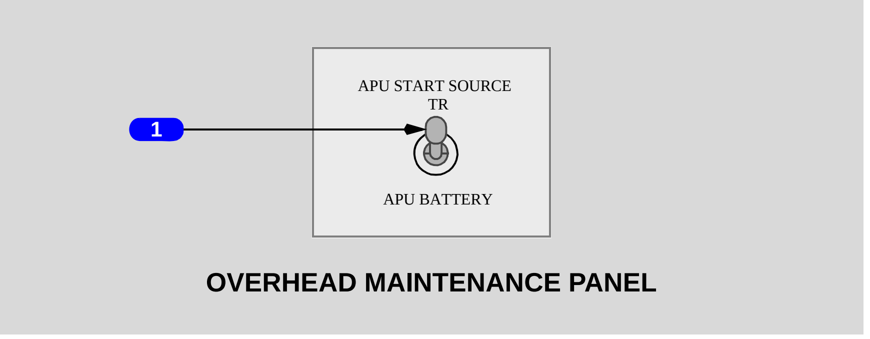
VP-BVR
(VP-BKJ ; before SB, Main Pump 3 Aft modification not installed)
- activates DC or AC fuel pump

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
(VP-BKJ ; SB installs Main Pump 3 Aft modification)
- activates DC or two AC fuel pumps

START (momentary position, spring-loaded to ON) - initiates automatic start sequence.

APU Start Source

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



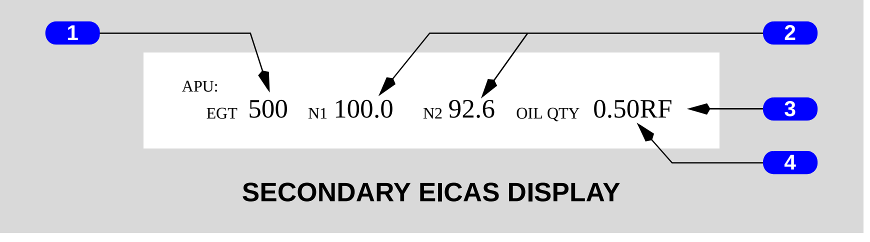
1 APU START SOURCE

TR - normal switch position. Selects TR or APU battery for start (except when TR fails).

APU BATTERY - selects APU battery power for APU starting. Removes TR from APU starting circuit.

APU Indications

Located on status (STAT) display.



1 EGT

APU exhaust gas temperature in degrees Celsius.

2 RPM

APU rotation speeds in percent.

3 Refill (RF)/Low (LO)

Displayed RF or LO (magenta) - oil quantity below prescribed level.

4 APU OIL Quantity

APU oil quantity (1.00 indicates full).

Intentionally
Blank

Introduction

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
The airplane is powered by four General Electric CF6-80C2-B1F engines. The engines are rated at 56,500 pounds takeoff thrust each.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
The airplane is powered by four Pratt & Whitney PW-4056 engines. The engines are rated at 57,100 pounds takeoff thrust each.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
The airplane is powered by four Rolls Royce RB211-524H engines. The engines are rated at 59,500 pounds takeoff thrust each.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
The engines are dual rotor axial flow turbofans of high compression and bypass ratio. The N1 rotor consists of a fan, a low pressure compressor section, and a low pressure turbine section. The N2 rotor consists of a high pressure compressor section and a high pressure turbine section. The N1 and N2 rotors are mechanically independent. The N2 rotor drives the engine accessory gearbox.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
The engines are three rotor axial flow turbofans of high compression and bypass ratio. The N1 rotor consists of a fan and a low pressure turbine section. The N2 rotor consists of an intermediate pressure compressor section and an intermediate pressure turbine section. The N3 rotor consists of a high pressure compressor and a high pressure turbine section. The N1, N2, and N3 rotors are mechanically independent. The N3 rotor drives the engine accessory gearbox.

Each engine has individual flight deck controls and an electronic engine controller (EEC). The Thrust levers are positioned by the autothrottle system or by the flight crew. See Chapter 11, Flight Management, Navigation, Section 32, for a description of FMC thrust management functions.

Engine Indications

Engine indications display on the engine indication and crew alerting system (EICAS) display.

Primary Engine Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
N1 and EGT are primary engine indications and always display on primary EICAS.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
EPR, N1, and EGT are primary engine indications and always display on primary EICAS.

Secondary Engine Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
N2, fuel flow, oil pressure, oil temperature, oil quantity, and engine vibration are secondary engine indications and normally display on secondary EICAS. The secondary engine indications display when:

- selected using the Secondary Engine Display switch (the ENG switch on the Display Select panel)
- the displays initially receive electrical power
- a Fuel Control switch is moved to CUTOFF in flight

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
N2, N3, fuel flow, oil pressure, oil temperature, oil quantity, and engine vibration are secondary engine indications and normally display on secondary EICAS. The secondary engine indications display when:

- selected using the Secondary Engine Display switch (the ENG switch on the Display Select panel)
- the displays initially receive electrical power
- a Fuel Control switch is moved to CUTOFF in flight

The secondary engine parameters can be cleared by pushing the Secondary Engine Display switch.

Normal Display Format

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Each engine indication consists of a digital indicator and, except for fuel flow and oil quantity, a moving vertical indicator. The digital readouts display numerical values while the moving indicators display relative value. The digital indicator for N1, EGT, N2, and fuel flow is enclosed in a box. The vertical indicator displays the normal operating range, caution range, and operating limit.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Each engine indication consists of a digital indicator and, except for N2, fuel flow, and oil quantity, a moving vertical indicator. The digital readouts display numerical values while the moving indicators display relative value. The digital indicator for N1, EGT, N2, N3, and fuel flow is enclosed in a box. The vertical indicator displays the normal operating range, caution range, and operating limit.

The normal operating range display on the vertical indicator is white. An indication is white when the engine parameter is in the normal operating range.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Oil pressure and oil temperature indicators have caution ranges displayed by amber bands. The indication changes color to amber if the parameter reaches the caution range.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
The oil temperature indicator has caution ranges displayed by amber bands. The indication changes color to amber if the parameter reaches the caution range.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
N1, N3, oil pressure, and oil temperature indicators have caution ranges displayed by amber bands. The caution range for N2 is not displayed. The indication changes color to amber if the parameter reaches the caution range.

The EGT indicator has a continuous limit displayed by an amber band. The indication changes color to amber if EGT reaches the continuous limit.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
EGT indications are inhibited from changing color to amber during takeoff or go-around for five minutes after the TO/GA switch is pushed, even though EGT reaches the continuous limit.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
EGT indications are inhibited from changing color to amber during takeoff or go-around for five minutes after the TO/GA switch is pushed, even though EGT reaches the continuous limit. The amber color change is inhibited for ten minutes if one engine fails or is shutdown.

The EGT indicator has a takeoff limit displayed by a red line. The indication changes color to red if EGT reaches the takeoff limit.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
N1, N2, oil pressure, and oil temperature indicators have operating limits displayed by red lines. The indication changes color to red if the parameter reaches the operating limits.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
N1, N3, oil pressure, and oil temperature indicators have operating limits displayed by red lines. The operating limit for N2 is not displayed. The indication changes color to red if the parameter reaches the operating limits.

An indication changes color back to white when the parameter returns to the normal operating range. The box enclosing the digital indicator remains red as a reminder of the exceedance. The red box color can be selectively canceled to white or recalled to red by pushing the cancel or recall switch on the EICAS Display Select panel.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
The oil quantity indication changes color to magenta if low oil quantity is detected or if the oil quantity differential is exceeded.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
The oil quantity indication changes color to magenta if low oil quantity is detected.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Maximum N1 is displayed by an amber line. The N1 indication does not change color when maximum N1 is reached. The reference N1 indicator displays the reference N1 selected by the FMC. The command N1 indicator displays N1 RPM commanded by Thrust lever position. It equals actual N1 RPM when the engine is stabilized. The command N1 indicator moves when the Thrust lever moves to display the new commanded N1.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Maximum EPR is displayed by an amber line. The EPR indication changes color to red when maximum EPR is reached. The reference EPR indicator displays the reference EPR selected by the FMC. The command EPR indicator displays EPR commanded by Thrust lever position. It equals actual EPR when the engine is stabilized. The command EPR indicator moves when the Thrust lever moves to display the new commanded EPR.

Compact Display Format

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
If only one display unit is available for use by EICAS, primary EICAS always displays. Primary engine indications display in the normal format. Secondary engine indications are selected by pushing the Secondary Engine Display switch. Pushing the switch displays the primary and secondary engine indications on primary EICAS in compact format. In compact format, N1 displays by digital and vertical indicators while all other engine indications display by digital indicators. Pushing the switch again removes the secondary engine indications and returns the primary engine indications to normal format.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
If only one display unit is available for use by EICAS, primary EICAS always displays. Primary engine indications display in the normal format. Secondary engine indications are selected by pushing the Secondary Engine Display switch. Pushing the switch displays the primary and secondary engine indications on primary EICAS in compact format. In compact format, EPR displays by digital and vertical indicators while all other engine indications display by digital indicators. Pushing the switch again removes the secondary engine indications and returns the primary engine indications to normal format.

Partial Display Format

Secondary engine indications display in partial format if a secondary engine parameter exceeds the normal operating range when the secondary engine display is not selected. The secondary engine exceedance cue displays on primary EICAS when an exceedance occurs.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
If an N2 RPM increases to the operating limit, the N2 indications display. If an oil pressure decreases or an oil temperature increases to the caution range or operating limit, or if an oil quantity decreases to the low level, or the oil quantity differential is exceeded, the oil indications display. If an engine vibration increases to the display indicator, the vibration indications display.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
If an N2 RPM increases to the operating limit, the N2 indications display. If an oil pressure decreases to the operating limit, if an oil temperature increases to the caution range or operating limit, or if an oil quantity decreases to the low level, the oil indications display. If an engine vibration increases to the display indicator, the vibration indications display.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
If an N2 or N3 RPM increases to the caution range or operating limit, the related N2 or N3 indications display. If an oil pressure decreases to the caution range or operating limit, if an oil temperature increases to the operating limit, or if an oil quantity decreases to the low level, or the oil quantity differential is exceeded, the oil indications display. If an engine vibration increases to the display indicator, the vibration indications display.

Pushing the Secondary Engine Display switch while the secondary engine display is in the partial format displays the entire secondary engine display. Pushing the switch again returns the secondary engine display to partial format.

Selecting another secondary EICAS display while the secondary engine display is in partial format removes the secondary engine display from secondary EICAS. The partial secondary engine indications display with the primary engine indications on primary EICAS in compact format.

If only one display unit is available for use by EICAS and a secondary engine parameter exceedance occurs, the primary and partial secondary engine indications display on primary EICAS in compact format.

If the secondary engine exceedance cue displays and partial secondary engine indications are not displayed, pushing the Status Display switch displays the primary and partial secondary engine indications on primary EICAS in compact format.

In all cases, the partial secondary engine indications and secondary engine exceedance cue remain displayed until the exceeding engine parameter returns to the normal operating range.

Electronic Engine Control (EEC)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Each EEC has full authority over engine operation. The EEC uses Thrust lever inputs to control forward and reverse thrust. The EEC has two control modes: normal and alternate. In both normal and alternate modes, the EEC uses N1 RPM as the controlling parameter for setting thrust. Electrical power for each EEC is provided by an alternator mounted on the engine accessory gearbox.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Each EEC has full authority over engine operation. The EEC uses thrust lever inputs to control forward and reverse thrust. The EEC has two control modes: normal and alternate. In the normal mode, the EEC uses EPR as the controlling parameter for setting thrust. In the alternate mode the EEC uses N1 as the controlling parameter. Electrical power for each EEC is provided by an alternator mounted on the engine accessory gearbox.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

The EEC calculates an N1 value between idle and maximum N1. Maximum N1 is the maximum allowable thrust available from the engine. The calculated N1 is compared to actual N1 RPM. The EEC commands the fuel metering unit to adjust fuel flow until actual N1 equals calculated N1.

EEC Normal Mode

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

In normal mode, the EEC sets thrust by controlling N1 based on Thrust lever position. N1 is commanded by positioning the Thrust levers either with the autothrottles, or by the flight crew.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
In normal mode, the EEC sets thrust by controlling EPR based on Thrust lever position. EPR is commanded by positioning the Thrust levers either with the autothrottles, or by the flight crew. The EEC calculates an EPR value between idle and maximum EPR. Maximum EPR is the maximum allowable thrust available from the engine. The calculated EPR is compared to actual EPR. The EEC commands the fuel metering unit to adjust fuel flow until actual EPR equals calculated EPR.

When the engine is stabilized, the EEC keeps thrust constant independent of outside air temperature and pressure. The EEC adjusts thrust for changes in nacelle and wing anti-ice and airplane pressurization bleed requirements. This allows a fixed Thrust lever position throughout a climb.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Maximum N1 represents the maximum rated thrust available from the engine. The EEC continuously computes maximum N1. Thrust is limited to maximum N1 at the full forward Thrust lever position. Maximum thrust is available during any phase of flight by moving the Thrust lever to the full forward position.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Maximum EPR represents the maximum rated thrust available from the engine. The EEC continuously computes maximum EPR. Thrust is limited to maximum EPR at the full forward thrust lever position. Maximum thrust is available during any phase of flight by moving the thrust lever to the full forward position.

EEC Alternate Mode

The EEC uses alternate mode as a backup to normal mode. If the EEC detects a fault and can no longer control the engine using the normal mode, it transfers control to alternate mode. Alternate mode can also be selected manually using the EEC Mode switch.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Alternate mode does not provide thrust limiting at maximum N1. Maximum N1 is reached at a Thrust lever position less than full forward. Thrust levers must be adjusted to maintain desired thrust as environmental conditions and bleed requirements change.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Alternate mode does not provide thrust limiting at maximum EPR. Maximum EPR is reached at a Thrust lever position less than full forward. Thrust levers must be adjusted to maintain desired thrust as environmental conditions and bleed requirements change.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Alternate mode provides equal or greater thrust than normal mode for the same Thrust lever position. Thrust does not change when the EEC transfers control from normal mode to alternate mode. Thrust increases when alternate mode is selected manually. When thrust is greater than idle, the Thrust lever should be moved aft prior to manually selecting alternate mode so thrust does not exceed maximum N1.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Alternate mode provides equal or greater thrust than normal mode for the same Thrust lever position. Thrust does not change when the EEC transfers control from normal mode to alternate mode. Thrust increases when alternate mode is selected manually. When thrust is greater than idle, the Thrust lever should be moved aft prior to manually selecting alternate mode so thrust does not exceed maximum EPR.

If the EECs are in the alternate mode, advancing the Thrust levers full forward provides some overboost and should be considered only during emergency situations when all other actions have been taken and terrain contact is imminent.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

If control for any EEC transfers from normal to alternate, the autothrottle disconnects. The autothrottle can be activated after all EECs are manually transferred to alternate mode.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

If control for any EEC transfers from normal to alternate, the autothrottle disconnects. The autothrottle can be activated after all EECs are again in the normal mode.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The EEC selects an unannunciated alternate mode when reverse thrust is used due to EPR sensing inaccuracies during reverser operation.

EEC Idle Selection

The EEC selects minimum idle or approach idle. Minimum idle is a lower thrust than approach idle. Approach idle is selected in flight when:

- nacelle anti-ice is ON
- flaps are in landing position

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

- Continuous Ignition switch is ON

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

- Continuous Ignition switch is ON

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Approach idle decreases acceleration time for go-around. Approach idle is maintained until five seconds after touchdown, when minimum idle is selected.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Approach idle decreases acceleration time for go-around. Approach idle is maintained until five seconds after touchdown, when minimum idle is selected. Approach idle is selected during thrust reverser operation.

EEC Overspeed Protection

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

At thrust settings above idle, the EEC monitors N1 and N2 RPM to prevent rotor overspeed. If a rotor approaches overspeed, the EEC commands the fuel metering unit to reduce fuel flow to keep rotor speed from exceeding the operating limit even though the Thrust lever is commanding more thrust.

EEC Overspeed Protection

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

At thrust settings above idle, the EEC monitors N1, N2, and N3 RPM to prevent rotor overspeed. If a rotor approaches overspeed, the EEC commands the fuel metering unit to reduce fuel flow to keep rotor speed from exceeding the operating limit even though the Thrust lever is commanding more thrust.

Engine Start and Ignition System

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The engines can be started using the autostart system or manually. Autostart is the normal starting mode. During autostart, the EEC sequences start valve, engine fuel valve, and igniter operation. Selecting OFF on the Autostart switch disables autostart and allows manual, pilot-monitored, starting. During manual start, the flight crew sequences the operation of the start valve, engine fuel valve, and the selected igniter.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Air from the bleed air duct powers the starter motor, which is connected to the N2 rotor. The starter air source is normally the APU, but air from ground carts or another running engine can be used.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Air from the bleed air duct powers the starter motor, which is connected to the N3 rotor. The starter air source is normally the APU, but air from ground carts or another running engine can be used.

Start Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Start indicators display with engine indications when an engine is shutdown. A start limit displays on the EGT indication when the Fuel Control switch is in CUTOFF. The start limit remains displayed until N2 reaches a predetermined RPM. The EGT indication changes color to red if the EGT start limit is reached.

A fuel-on indicator displays on the N2 indication when the Fuel Control switch is in CUTOFF. The fuel-on indicator displays the minimum N2 RPM at which the Fuel Control switch should be moved from CUTOFF to RUN during a manual start.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Start indicators display with engine indications when an engine is shutdown. A start limit displays on the EGT indication when the Fuel Control switch is in CUTOFF. The start limit remains displayed until N3 reaches a predetermined RPM. The EGT indication changes color to red if EGT start limit is reached.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

An in-flight start envelope displays on primary EICAS and the secondary engine indications display when a Fuel Control switch is moved to CUTOFF in flight. The in-flight start envelope displays the airspeed range to ensure an in-flight start at the current flight level. If the current flight level is greater than the maximum start altitude, the maximum start altitude and related airspeed range display.

X-BLD displays next to the N2 indication if crossbleed air is necessary for start.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
An in-flight start envelope displays on primary EICAS and the secondary engine indications display when a Fuel Control switch is moved to CUTOFF in flight. The in-flight start envelope displays the airspeed range to ensure an in-flight start at the current flight level. If the current flight level is greater than the maximum start altitude, the maximum start altitude and related airspeed range display.
X-BLD displays next to the N3 indication if crossbleed air is necessary for start.

Autostart

Autostart allows the EEC to control fuel and ignition and automatically abort the start for certain malfunctions. Pushing the Autostart switch ON arms autostart. Pulling the Start switch out (held out by a solenoid) arms the start valve and opens the engine bleed air valve. Moving the Fuel Control switch to RUN initiates the autostart sequence.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
The EEC opens the start valve and the Start light illuminates. At a predetermined N2, the EEC opens the fuel metering valve and energizes the selected igniter. One igniter is normally selected for ground start, while two igniters are selected for in-flight start.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
The EEC opens the start valve and the Start light illuminates. After N3 increases to maximum motoring RPM, the EEC opens the fuel metering valve and energizes the selected igniter. One igniter is normally selected for ground start, while two igniters are selected for in-flight start.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Starter cutout occurs at 50% N2 RPM. At starter cutout, the Start switch is released to the in position, the start and engine bleed air valves close, the Start light extinguishes, and ignition discontinues.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Starter cutout occurs at 50% N3 RPM. At starter cutout, the Start switch is released to the in position, the start and engine bleed air valves close, the Start light extinguishes, and ignition discontinues.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
During autostart, the EEC monitors EGT and N2 RPM until the engine stabilizes at idle.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
During autostart, the EEC monitors EGT, N1, N2, and N3 RPM, until the engine stabilizes at idle.

Ground Autostart

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
During ground start, the autostart system monitors engine parameters and aborts the start for any of the following malfunctions:

- hot start
- hung start
- no EGT rise

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
During ground start, the autostart system monitors engine parameters and aborts the start for any of the following malfunctions:

- hot start
- hung start
- no EGT rise
- no N1 rotation
- no N2 rotation

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Note: The autostart system does not monitor oil pressure or N1 rotation.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Note: The autostart system does not monitor oil pressure.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
If the EEC detects no EGT rise, it cuts off fuel and ignition. The engine motors for 30 seconds. The EEC applies fuel and ignition to both igniters for another attempt. The EEC makes three attempts before aborting the autostart sequence. The engine motors for 30 seconds before the start and bleed air valves close.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
If there is an EGT rise, but the EEC detects an impending hot start or a hung start before starter cutout, it cuts off fuel, adjusts the fuel schedule, then reapplies fuel for another attempt. The EEC makes three attempts before aborting the autostart sequence. Fuel and ignition are cut off. The engine motors for 30 seconds before the start and bleed air valves close.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
If the EEC detects an impending hot start or a hung start after starter cutout, the autostart sequence is aborted immediately. The engine does not motor.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
The EEC makes two start attempts before aborting the autostart sequence.

- If the EEC detects no EGT rise 30 seconds after fuel is applied, it cuts off fuel and ignition and the engine motors for 30 seconds.
- If the EEC detects a hung start or a hot start before starter cutout, it cuts off fuel and ignition. If N3 is above 30%, the starter air is also shut off until N3 is below 30% before the starter is re-engaged. The engine motors until EGT is equal to or less than 100°C.
- The EEC applies fuel and ignition to both igniters for the second start attempt. If the autostart sequence is aborted, fuel and ignition are cut off, and the engine motors for 30 seconds before the start and bleed air valves close.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
If the EEC detects an impending hot start after starter cutout, the autostart sequence is aborted immediately. The engine does not motor.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
An autostart can be aborted manually by moving the Fuel Control switch to CUTOFF. When the Fuel Control switch is moved to CUTOFF, the start and engine bleed air valves close and the engine does not motor. Pushing the Autostart switch OFF allows crew control of the start valve for manual engine motoring.

In-flight Autostart

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
During in-flight flameout and/or start, the EEC reacts to a hung start or to EGT reaching the takeoff limit. If the EEC detects the EGT reaching the takeoff limit or a hung start, it cuts off and then reapplies fuel. The EEC allows the EGT to increase past the start limit to the takeoff limit before cutting off fuel. The autostart sequence is not automatically aborted. The EEC continues making start attempts until the engine stabilizes at idle or the Fuel Control switch is moved to CUTOFF.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
During in-flight flameout and/or start, the EEC reacts to no EGT rise or an engine fuel shutoff valve failed closed. If the EEC detects no EGT rise, it cuts off fuel and ignition for 30 seconds and then attempts unlimited restarts. If the EEC detects the EGT reaching the takeoff limit, fuel and ignition are cut off until the EGT reaches 150°C, and the EEC reapplies fuel and ignition for continuous restart attempts. The EEC allows the EGT to increase past the start limit to the takeoff limit before cutting off fuel. The autostart sequence is not automatically aborted unless the EEC detects an engine fuel shutoff valve failed closed. The EEC continues making start attempts until the engine stabilizes at idle or the Fuel Control switch is moved to CUTOFF.

Auto-Relight

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

An auto-relight capability is provided for flameout protection. Whenever the EEC detects an engine flameout, both igniters are activated. A flameout is detected when a rapid decrease in N2 occurs, or N2 is less than idle RPM.

During an in flight start or auto-relight the EEC will first stabilize the engine at idle before advancing the engine to thrust lever position if forward of idle.

Manual Start

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

The Autostart switch must be OFF to accomplish a manual start. The start is accomplished in accordance with the Manual Engine Start procedure (refer to Chapter SP.7). Pulling the Start switch out (held out by a solenoid) opens the start and engine bleed air valves. The Start light illuminates. When N2 RPM reaches the fuel-on indicator, the Fuel Control switch is moved to RUN. The spar, fuel metering, and engine fuel valves open and the selected igniter energizes. One igniter is normally selected for ground start while two igniters are selected for in-flight start. Starter cutout occurs at 50% N2 RPM. At starter cutout, the Start switch is released to the in position, the start and bleed air valves close, the Start light extinguishes, and ignition discontinues. The start must be monitored until the engine stabilizes at idle.

Manual Start

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The Autostart switch must be OFF to accomplish a manual start. The start is accomplished in accordance with the Manual Engine Start procedure (refer to Chapter SP.7). Pulling the Start switch out (held out by a solenoid) opens the start and engine bleed air valves. The Start light illuminates. At 25% N3 or maximum motoring, the Fuel Control switch is moved to RUN. The spar, fuel metering, and engine fuel valves open and the selected igniter energizes. One igniter is normally selected for ground start while two igniters are selected for in-flight start. Starter cutout occurs at 50% N3 RPM. At starter cutout, the Start switch is released to the in position, the start and bleed air valves close, the Start light extinguishes, and ignition discontinues. The start must be monitored until the engine stabilizes at idle.

Engine Ignition

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Each engine has two igniters. The igniters operate separately or together as selected by the Auto Ignition selector and the EEC.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Ignition is selected for each engine when the related Start switch is out, nacelle anti-ice is on, or a flameout is detected. Ignition is selected for all engines when trailing edge flaps are out of the up position or the Continuous Ignition switch is ON. When ignition is selected, the selected igniter on each engine energizes when the related Fuel Control switch is in RUN and, during autostart, when commanded by the EEC. The selected igniter deenergizes when the Fuel Control switch is placed in CUTOFF.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

The AC power system is the normal power source for ignition. The standby power system provides a backup source. When the Standby Ignition selector is in NORM, the AC power system supplies power to the selected igniters. If the AC power system is not powered, the standby power system supplies power continuously to both igniters. When the Standby Ignition selector is in 1 or 2, the standby power system supplies power continuously to the related igniter regardless of Auto Ignition selector position or EEC selection.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Each engine has two igniters. The igniters operate separately or together as selected by the Auto Ignition selector and the EEC.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

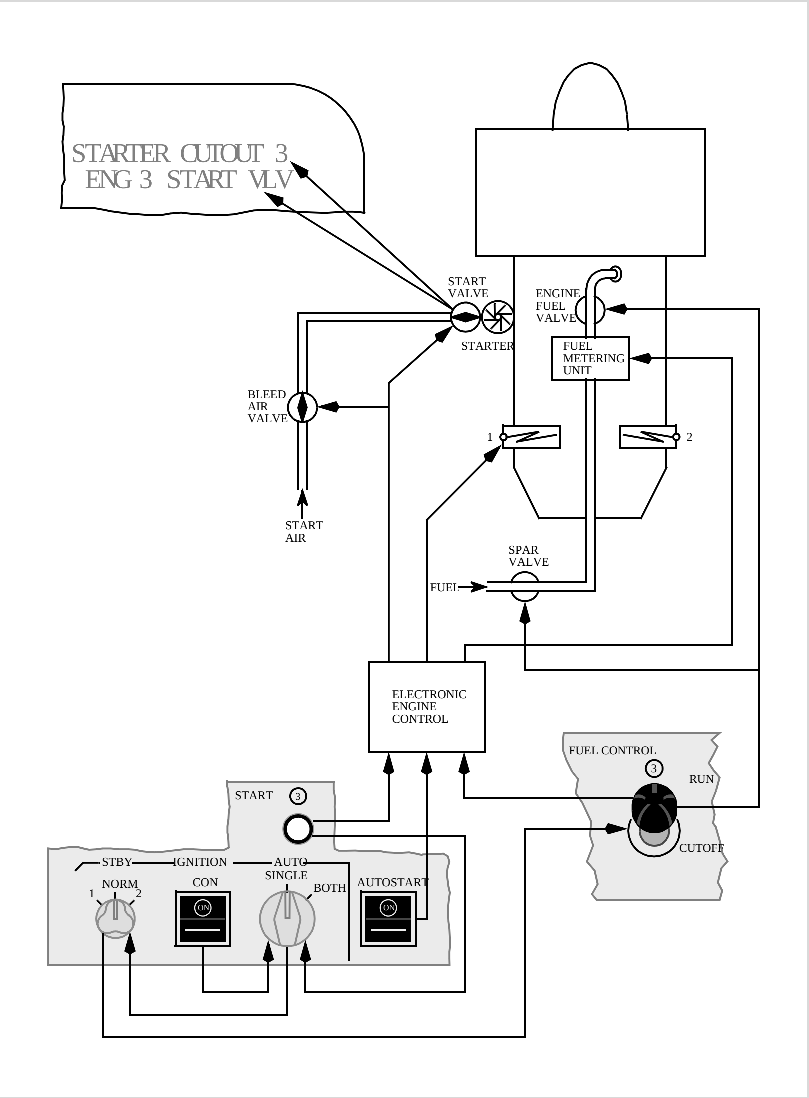
Both igniters for each engine are selected during an in-flight start or when a flameout is detected. With the Auto Ignition selector in 1, 2, or BOTH, the selected igniter(s) are energized for each engine when the relative Start switch is out, the first 60 seconds nacelle anti-ice is on, the trailing edge flaps are out of up, or the Continuous Ignition selector is ON. With the Auto Ignition selector in NORM, both igniters on each engine are selected if the Continuous Ignition selector is ON. When ignition is initiated, the selected igniter on each engine energizes when the related Fuel Control switch is in RUN and, during autostart, by EEC command. The selected igniter deenergizes when the Fuel Control switch is placed in CUTOFF.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

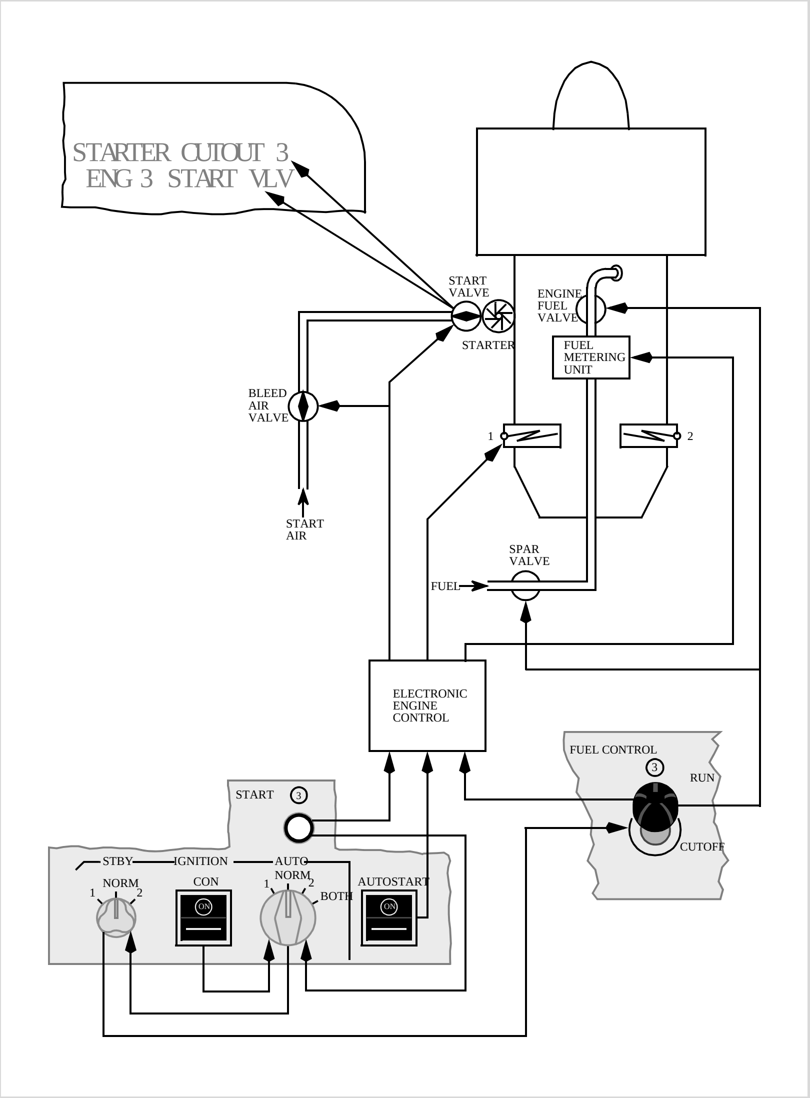
The AC power system is the normal power source for ignition. The standby power system provides a backup source. When the Standby Ignition selector is in NORM, the AC power system supplies power to the selected igniters. If the AC power system is not powered, the standby power system supplies power continuously to igniter 1. When the Standby Ignition selector is in 1 or 2, the standby power system supplies power continuously to the related igniter regardless of Auto Ignition selector position or EEC selection.

Engine Start and Ignition System Schematic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



Engine Fuel System

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Fuel is supplied under pressure from pumps located in the fuel tanks. Fuel for each engine flows through a spar fuel valve located in the respective main tank. The first and second stage engine fuel pumps add additional pressure to the fuel. Engine oil heats the fuel as it flows through the fuel/oil heat exchanger. A fuel filter removes contaminants. The fuel metering unit adjusts fuel flow to meet thrust requirements. The fuel flows through the engine fuel valve to the engine.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Fuel is supplied under pressure from fuel pumps located in the fuel tanks. Fuel for each engine flows through a spar valve located in the respective main tank. The first stage engine fuel pump adds additional pressure to the fuel. Engine oil heats the fuel as it flows through the fuel/oil heat exchanger. A fuel filter removes contaminants. The second stage engine fuel pump adds final pressure to the fuel. The fuel metering unit adjusts fuel flow to meet thrust requirements. The fuel flows through the engine fuel valve before distribution to the engine.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Fuel is supplied under pressure from fuel pumps located in the fuel tanks. Fuel for each engine flows through a spar valve located in the respective main tank. The first stage engine fuel pump adds additional pressure to the fuel. Engine oil heats the fuel as it flows through the fuel/oil heat exchanger. A fuel filter removes contaminants. The second stage engine fuel pump adds final pressure to the fuel. The fuel metering unit adjusts fuel flow to meet thrust requirements. The fuel then flows through the engine fuel valve. The fuel is additionally heated by the high pressure fuel/oil heat exchanger before distribution to the engine.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

The engine fuel valve, fuel metering valve, and spar valve allow fuel flow to the engine when all valves are open. The valves open when the Engine Fire switch is in and the Fuel Control switch is in RUN, and the engine pumps are supplying fuel pressure. The pumps supply pressure when the N2 rotor is turning. During autostart, the fuel metering valve is additionally controlled by the EEC. The engine fuel valve, fuel metering valve, and spar valve close when either the Fuel Control switch is in CUTOFF or the Engine Fire switch is out.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The engine fuel valve, fuel metering valve, and spar valve allow fuel flow to the engine when all valves are open. The valves open when the Engine Fire switch is in and the Fuel Control switch is in RUN, and the engine pumps are supplying fuel pressure. The pumps supply pressure when the N3 rotor is turning. During autostart, the fuel metering valve is additionally controlled by the EEC. The engine fuel valve, fuel metering valve, and spar valve close when either the Fuel Control switch is in CUTOFF or the Engine Fire switch is out.

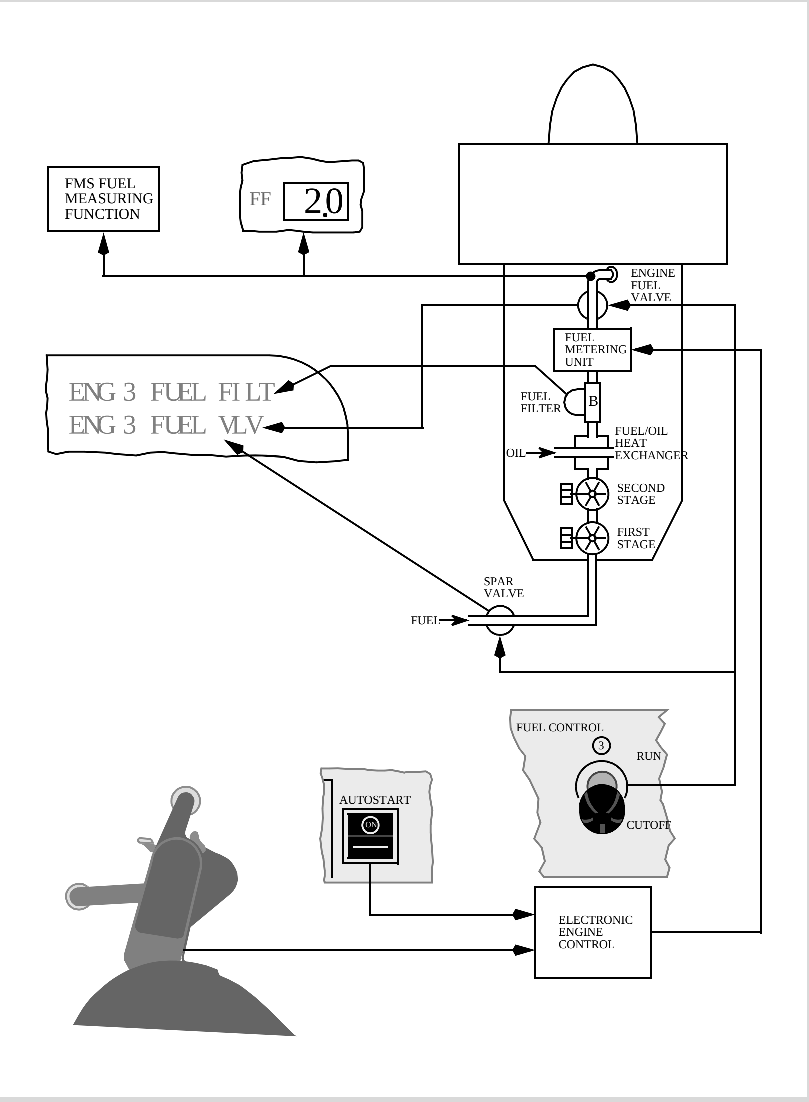
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The engine fuel valve, fuel metering valve, and spar valve allow fuel flow to the engine when all valves are open. The valves open when the Engine Fire switch is in and the Fuel Control switch is in RUN, and the engine pumps are supplying fuel pressure. The pumps supply pressure when the N2 rotor is turning. The engine fuel valve, fuel metering valve, and spar valve close when either the Fuel Control switch is in CUTOFF or the Engine Fire switch is out.

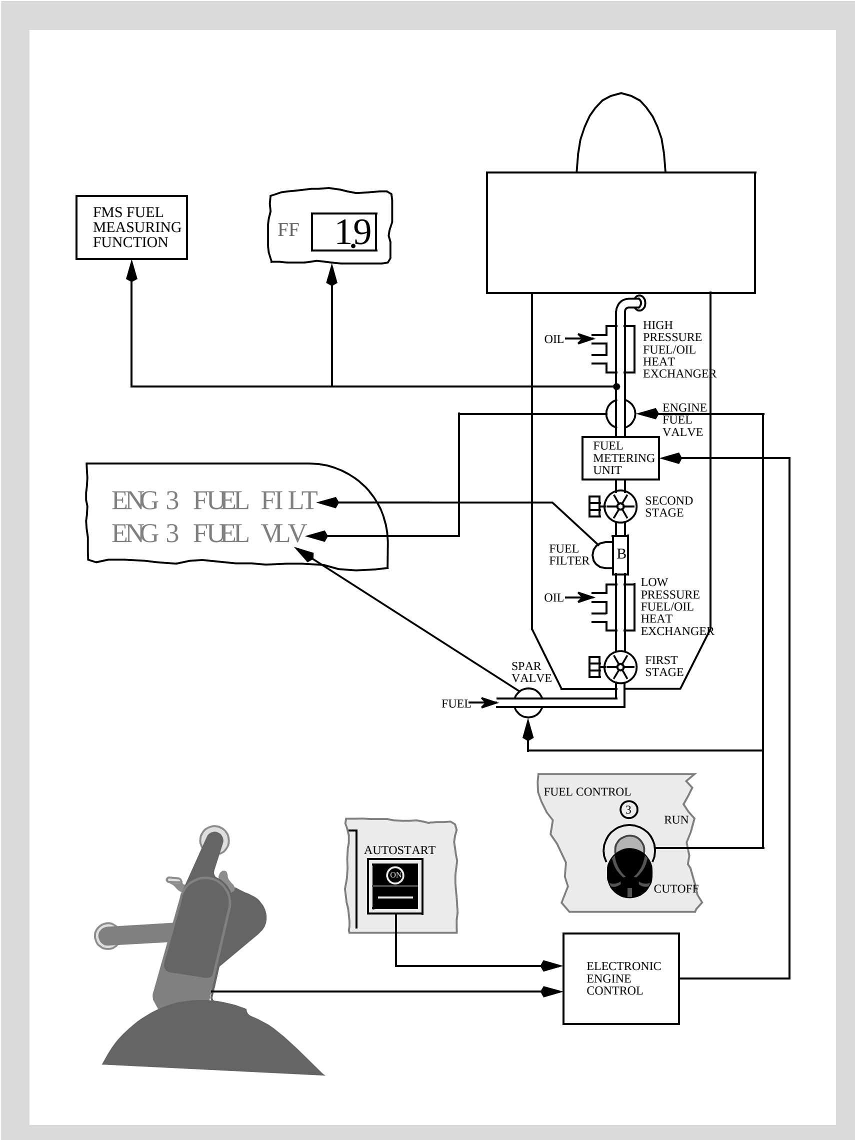
Fuel flow is measured downstream of the engine fuel valve and displays on the secondary engine display. Fuel flow information is also provided to the FMS.

Engine Fuel System Schematic

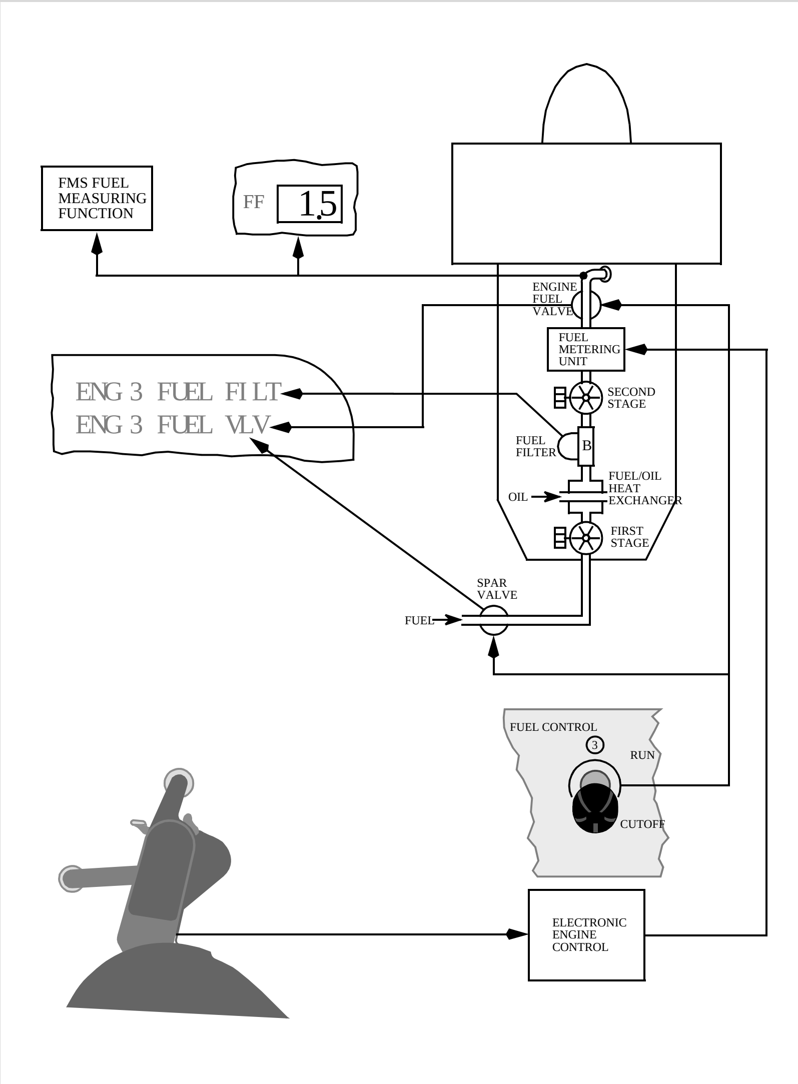
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



Engine Oil System

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

The oil system cools and lubricates engine bearings and the accessory gearbox. Oil is pressurized by an oil pump. The oil cools and lubricates the engine. The scavenge pump scavenges oil from the engine. The oil is cooled by fuel as it flows through the fuel/oil heat exchanger. An oil filter removes contaminants. If the filter becomes saturated with contaminants, oil bypasses the filter. Oil then returns to the oil reservoir.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The oil system cools and lubricates engine bearings and the accessory gearbox. Oil is pressurized by an oil pump. A dual oil filter removes contaminants. If the primary filter becomes saturated with contaminants, oil bypasses the primary filter. The oil is cooled first by fan air as it flows through the air/oil heat exchanger and then by fuel as it flows through the fuel/oil heat exchanger. The oil cools and lubricates the engine and a scavenge pump returns it to the oil reservoir.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The oil system cools and lubricates engine bearings and the accessory gearbox. Oil is pressurized by the primary oil pump. An oil filter removes contaminants. The oil is cooled by fuel as it flows through the fuel/oil heat exchangers. Depending on low pressure fuel temperature, the control valve directs oil to either the low pressure heat exchanger or the high pressure heat exchanger, or to both. Oil is further pressurized by the secondary oil pump. The oil cools and lubricates the engine and a scavenged pump returns it to the oil reservoir.

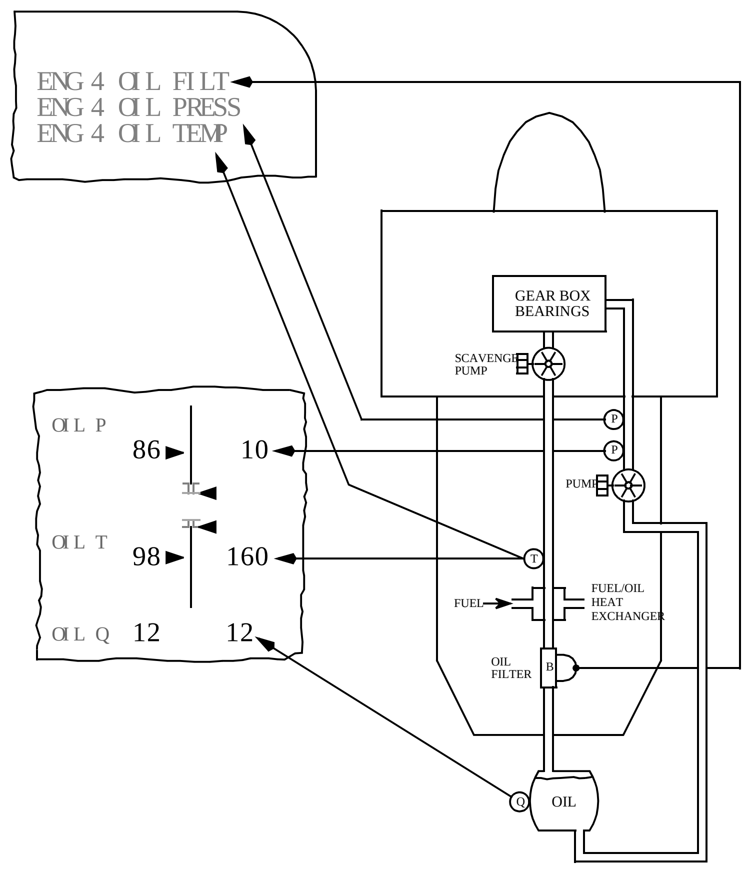
Oil pressure, temperature, and quantity display on the secondary engine display. Oil pressure is measured upstream of the engine. Oil temperature is measured downstream of the engine.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

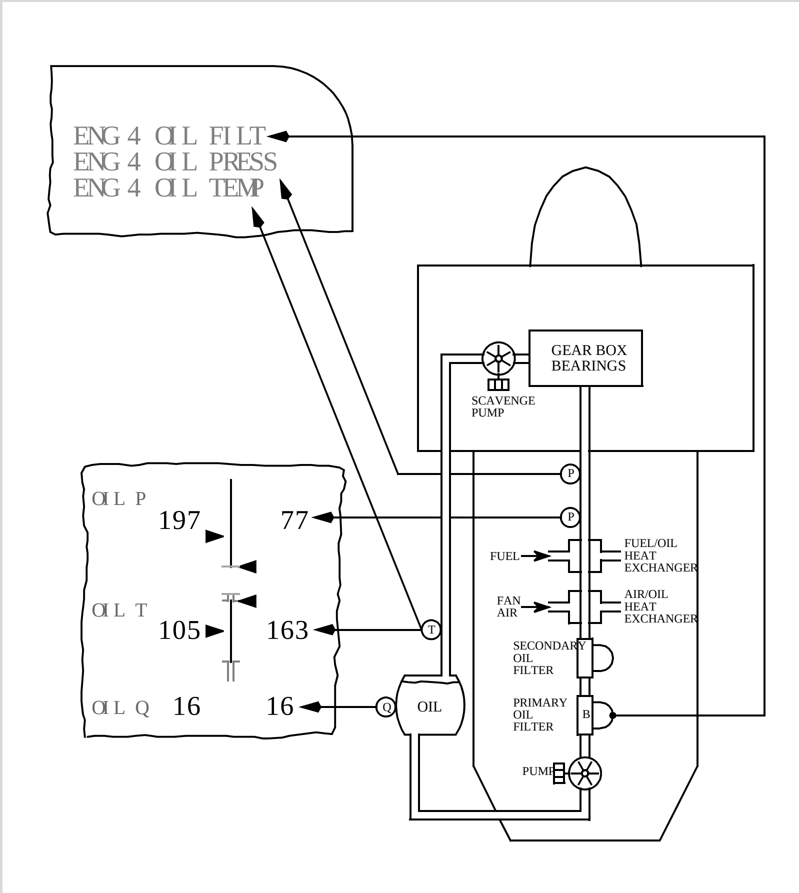
During cruise, oil quantity displays on EICAS whenever oil quantity on one engine differs from any other engine by a predetermined amount. When this occurs, the lowest oil quantity is shown in magenta. If there is an increase in oil quantity during cruise (indicator malfunction or leaking fuel/oil heat exchanger), the EICAS oil partial engine indications display may appear. However, for this condition the low quantity displays in magenta, even though that oil quantity may be normal.

Engine Oil System Schematic

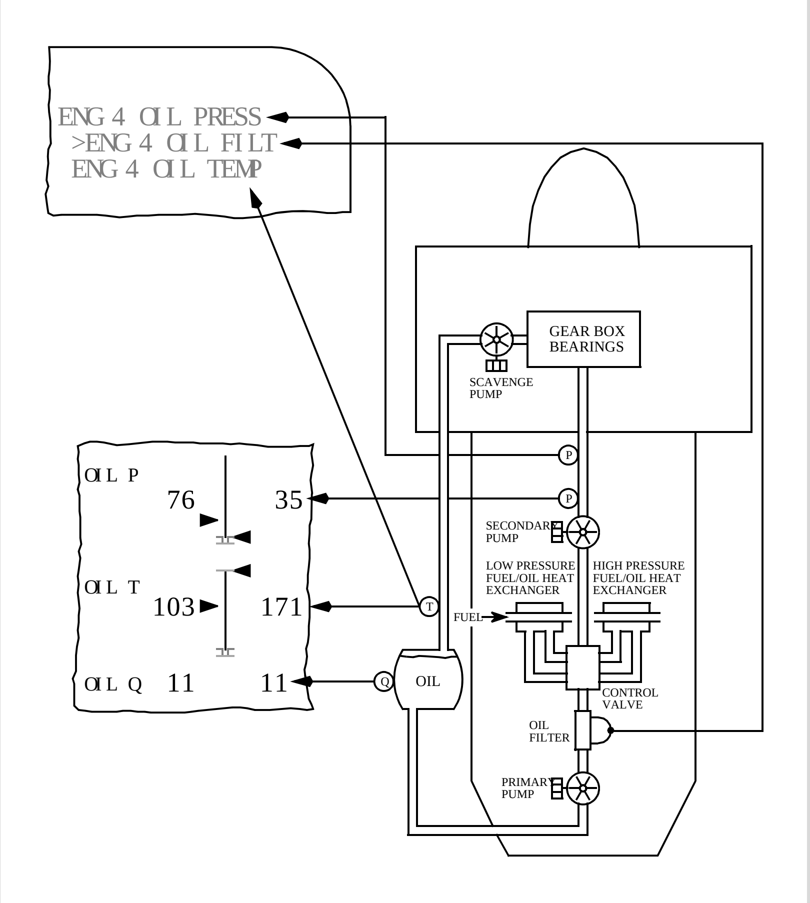
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



Thrust Reverser System

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Each engine has a pneumatically actuated fan air thrust reverser. Each thrust reverser is powered by bleed air from the related engine. The reverser does not operate if the engine is not running. Reverse thrust is available only on the ground.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Each engine has a pneumatically actuated fan air thrust reverser. Each thrust reverser is powered by bleed air from the related engine. Reverse thrust is available only on the ground.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Each engine has a hydraulically actuated fan air thrust reverser. Each thrust reverser is powered by hydraulic pressure from the related hydraulic system. The reverser does not operate if the hydraulic system loses pressure. Reverse thrust is available only on the ground.

An interlock mechanism in the Thrust lever assembly prevents simultaneous movement of the Forward and Reverse Thrust levers. The Reverse Thrust levers can be raised only when the Forward Thrust levers are in the closed position. When the Reverse levers are down, the reversers are locked in the stowed position.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Raising the Reverse Thrust levers to the idle detent locks the Forward Thrust levers in position. Bleed air unlocks and extends the reversers aft to the deployed position. A thrust reverser status annunciator displays above the digital indicator of each N1 indication. The annunciator displays in amber when the related reverser is unlocked or moving. The annunciation changes color to green when the reverser is fully deployed. The interlock releases and the Reverse Thrust levers can be moved to full reverse,.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Raising the Reverse Thrust levers to the idle detent locks the Forward Thrust levers in position. Hydraulic pressure unlocks and extends the reversers aft to the deployed position. A thrust reverser status annunciator displays above the digital indicator of each EPR indication. The annunciator displays in amber when the related reverser is unlocked or moving. The annunciation changes color to green when the reverser is fully deployed. The interlock releases and the Reverse Thrust levers can be moved to full reverse,.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Raising the Reverse Thrust levers to the idle detent locks the Forward Thrust levers in position. Bleed air unlocks and extends the reversers aft to the deployed position. A thrust reverser status annunciator displays above the digital indicator of each EPR indication. The annunciator displays in amber when the related reverser is unlocked or moving. The annunciation changes color to green when the reverser is fully deployed. The interlock releases and the Reverse Thrust levers can be moved to full reverse,.

Pushing the Reverse Thrust levers to the full down position retracts the reversers to the stowed and locked position. The REV indication changes color back to amber while the reverser is moving. When the reverser is stowed and locked, the REV indication is removed. The Thrust levers cannot be moved forward until the Reverse Thrust levers are fully down.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

The thrust reversers are protected against deploying inadvertently. If a reverser unlocks and deploys inadvertently, the reverser system applies bleed air to stow and lock the reverser.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The thrust reversers are protected against deploying inadvertently. If a reverser unlocks and deploys inadvertently, the reverser system applies hydraulic pressure to stow and lock the reverser.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The thrust reversers are protected against deploying inadvertently.

Airborne Vibration Monitoring System

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

The airborne vibration monitoring system monitors engine vibration levels. The vibration indications display on the secondary engine display. The vibration source indication also displays. If the vibration monitoring system cannot determine the source (fan, LPT, or N2), broadband (BB) displays for the affected engine. Broadband vibration is the average vibration detected.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Thrust reduction at top of descent may cause momentary peak vibration increases. Minor throttle movements may improve, or remove, these momentary peak vibrations.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The airborne vibration monitoring system monitors engine vibration levels. The vibration indications display on the secondary engine display. The vibration source indication also displays. If the vibration monitoring system cannot determine the source (N1 or N2), broadband (BB) displays for the affected engine. Broadband vibration is the average vibration detected.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The airborne vibration monitoring system monitors engine vibration levels. The vibration indications display on the secondary engine display. The vibration source indication also displays. If the vibration monitoring system cannot determine the source (N1, N2, or N3), broadband (BB) displays for the affected engine. Broadband vibration is the average vibration detected.

Certain engine malfunctions can result in airframe vibrations from the windmilling engine. As the airplane transitions from cruise to landing, there can be multiple, narrow regions of altitudes and airspeeds where the vibration level can become severe. In general, airframe vibrations can best be reduced by descending and reducing airspeed. However, if after descending and reducing airspeed, the existing vibration level is unacceptable, and if it is impractical to further reduce airspeed, the vibration level may be reduced to a previous, lower level by a slight increase in airspeed.

Intentionally
Blank

Introduction

The auxiliary power unit (APU) is a self-contained gas turbine engine located in the airplane tail cone.

The APU can be started on the ground and when left running for takeoff can be operated in flight up to 20,000 feet.

The APU drives two generators capable of supplying the entire electrical load of the airplane for normal ground operations. Electrical power is not available in flight. The APU also provides air to the pneumatic system for operation of components which require bleed air. The APU has bleed air capacity to run all air conditioning packs except during engine start. APU bleed air is available in flight for one pack up to 15,000 feet.

Refer to the following chapters for additional information:

- Chapter 2, Air Systems, for a description of APU bleed air operation
- Chapter 6, Electrical, for a description of APU electrical operation
- Chapter 8, Fire Protection, for a description of the APU fire protection system
- Chapter 12, Fuel, for a description of the APU fuel system

APU Operation
APU Start

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

The APU DC electric starter is powered by an APU start transformer rectifier (TR) whenever galley bus 2 is powered. Galley bus 2 may be powered from either an external or internal AC power source through the synchronous bus. If galley bus 2 is not powered, starter power is supplied by the 24 volt APU battery. The battery has a charger which disconnects during APU starter engagement. The APU battery powers the inlet door, APU controller, DC fuel pump, and APU fire detection system. The main battery supplies power for the APU fire extinguisher, APU fuel valve, and standby power for the APU controller. During a battery start sequence, the APU starter is powered by the APU battery and all APU components except the starter are powered by the main battery while the APU starter is engaged.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

An APU start requires both the main and APU batteries. The APU battery supplies power to the starter, air inlet door, APU controller, DC fuel pump, and APU fire detection system. The main battery supplies power for the APU fire extinguisher, APU fuel valve, and standby power for the APU controller. All APU components except the starter are powered by the main battery while the APU starter is engaged during a start sequence.

Rotating the APU selector momentarily to START begins the start sequence. The APU fuel valve and inlet door open simultaneously. Starter engagement occurs when the inlet door is fully open. The start sequence continues with ignition, lightoff, and engine acceleration to rated speed.

APU start cycle restrictions are:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Between starts	TR wait:	Battery wait:
1 and 2	1 minute	1 minute
2 and 3	10 minutes	5 minutes
3 and 4	20 minutes	1 minute
4 and 5	20 minutes	20 minutes
5 and 6	20 minutes	1 minute
For additional starts with TR power, wait 20 minutes between each start. For additional starts with battery power, wait 20 minutes then alternate between 1 and 20 minutes for further starts.		

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Between starts	Battery wait:
1 and 2	1 minute
2 and 3	5 minutes
3 and 4	1 minute
4 and 5	20 minutes
5 and 6	1 minute
For additional starts, wait 20 minutes then alternate between 1 and 20 minutes for further starts.	

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
If the TR should overheat with the start source switch in TR, starting power is transferred to the battery and the start continued on battery power. Any further start attempts with an overheated TR are inhibited.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
A failure of the TR, other than an overheat, does not provide automatic switching to the APU battery. Under these conditions, moving APU Start Source switch to BATTERY removes the TR from the starting circuit and allows APU starting on battery power.

APU Run

The EICAS memo message APU RUNNING is displayed when the APU selector is ON and APU N1 RPM exceeds 95% N1.

APU Shutdown

Rotating the APU selector to OFF begins the shutdown cycle by closing the APU bleed air valve. The APU continues running unloaded for a sixty second cooldown period. When the cooldown period finishes, the APU shuts down.

Shutdown may be monitored on the EICAS status display if AC power is not available. The Battery switch should remain ON until APU shutdown is complete.

Note: If the Battery switch is positioned OFF prior to completion of the cooldown period, the APU will shut down immediately.

A complete shutdown sequence with fire detection capability can be assured by waiting at least 2 minutes after the APU selector is rotated to OFF before placing the battery switch OFF.

If a limit is exceeded or a fire detected, the APU shuts down immediately.

EICAS Alert Messages

Message	Level	Aural	Message Logic
APU	Advisory		Automatic shut down of APU with APU selector ON, or APU N1 RPM exceeds 95% with APU selector OFF, or overheat detected in APU bleed air supply line.
APU DOOR	Advisory		APU door not in commanded position.
APU FUEL	Advisory		Low pump pressure detected when pump activated, or APU fuel valve not in commanded position.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

>AUTOSTART OFF	Advisory		Autostart switch OFF.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

>EEC 1, 2, 3, 4 TEST PWR	Advisory		EEC maintenance power switch in TEST.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

ENG 1, 2, 3, 4 AUTOSTART	Caution	Beeper	EGT start limit has been exceeded, or during a ground start, autostart did not start the engine or Fuel Control switch is in RUN at low engine RPM with the Autostart switch off.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

ENG 1, 2, 3, 4 AUTOSTART	Caution	Beeper	EGT start limit has been exceeded, or during a ground start, autostart did not start the engine or Fuel Control switch is in RUN at low engine RPM with the Autostart switch off.

Message	Level	Aural	Message Logic

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Message	Level	Aural	Message Logic
>ENG 1, 2, 3, 4, CH INHIBIT	Advisory		EEC channel A inhibited.
>ENG 1, 2, 3, 4 CONTROL	Advisory		EEC system fault present. Inhibited in flight.
>ENG CONTROLS	Advisory		Three or four EEC systems operating in a degraded condition and lack complete redundancy. Inhibited in flight.
ENG 1, 2, 3, 4 EEC MODE	Advisory		EEC in alternate control mode.
ENG 1, 2, 3, 4 FAIL	Caution	Beeper	Engine failure or flameout. Inhibited on the ground.
ENG 1, 2, 3, 4 FUEL FILT	Advisory		Impending fuel filter bypass exists on affected engine.
ENG 1, 2, 3, 4 FUEL VLV	Advisory		Engine fuel valve or fuel spar valve position disagrees with commanded position.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Message	Level	Aural	Message Logic
ENG IGNITION	Advisory		Ignition system fails to provide ignition when Continuous Ignition switch ON.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Message	Level	Aural	Message Logic
ENG IGNITION	Advisory		Ignition system fails to provide ignition when Continuous Ignition switch ON or trailing edge flaps out of up.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

Message	Level	Aural	Message Logic
>ENG 1, 2, 3, 4 LIM PROT	Caution	Beeper	EEC in alternate control mode and command N1 exceeds maximum rating.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Message	Level	Aural	Message Logic
>ENG 1, 2, 3, 4 LIM PROT	Caution	Beeper	EEC in alternate control mode and thrust approaching maximum rating.

Message	Level	Aural	Message Logic
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR			
>ENG 1, 2, 3, 4 LOW IDLE	Advisory		Engine idle not in approach setting when commanded.
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX			
ENG 1, 2, 3, 4 LOW IDLE	Advisory		Engine idle not in approach setting when commanded.
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX			
ENG 1, 2, 3, 4 OIL FILT	Advisory		Engine oil filter contamination approaching bypass condition.
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR			
>ENG 1, 2, 3, 4 OIL FILT	Advisory		Engine oil filter contamination approaching blocking condition.
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO			
ENG 1, 2, 3, 4 OIL FILT	Advisory		Primary engine oil filter contamination approaching bypass condition.
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX			
ENG 1, 2, 3, 4 OIL PRESS	Advisory		Oil pressure reaches red line limit.
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO			
ENG 1, 2, 3, 4 OIL PRESS	Advisory		Oil pressure reaches red line limit.
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR			
ENG 1, 2, 3, 4 OIL PRESS	Caution	Beeper	Oil pressure in amber band or reaches red line limit.
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX			
ENG 1, 2, 3, 4 OIL TEMP	Advisory		Oil temperature reaches amber band.
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR			
ENG 1, 2, 3, 4 OIL TEMP	Advisory		Oil temperature reaches red line limit.

Message	Level	Aural	Message Logic
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR			
ENG 1, 2, 3, 4 REV LIMTD	Advisory		Fault detected in thrust reverser system.
>ENG 1, 2, 3, 4 REVERSER	Advisory		Fault detected in thrust reverser system on the ground.
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX			
>ENG 1, 2, 3, 4 RPM LIM	Advisory		Engine thrust limited by N2 red line limit.
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO			
>ENG 1, 2, 3, 4 RPM LIM	Advisory		Engine thrust limited by N1 or N2 red line limit.
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR			
>ENG 1, 2, 3, 4 RPM LIM	Advisory		Engine thrust limited by N1, N2, or N3 red line limit.
>ENG 1, 2, 3, 4 SHUTDOWN	Caution		Engine Fire switch pulled, or engine Fuel Control switch in CUTOFF. Master Caution lights do not illuminate.
ENG 1, 2, 3, 4 START VLV	Advisory		Start valve position disagrees with commanded position.
>IDLE DISAGREE	Advisory		One or more engine idle settings disagrees with idle commanded.
STARTER CUTOUT 1, 2, 3, 4	Caution	Beeper	Start valve fails to close.

EICAS Memo Messages

Message	Level	Message Logic
APU RUNNING	Memo	APU selector in ON and APU N1 RPM exceeds 95%.
CON IGNITION ON	Memo	Continuous Ignition switch ON. Inhibited if ENG IGNITION message displayed.

Message	Level	Message Logic
STBY IGNITION ON	Memo	Standby Ignition selector is in 1 or 2.

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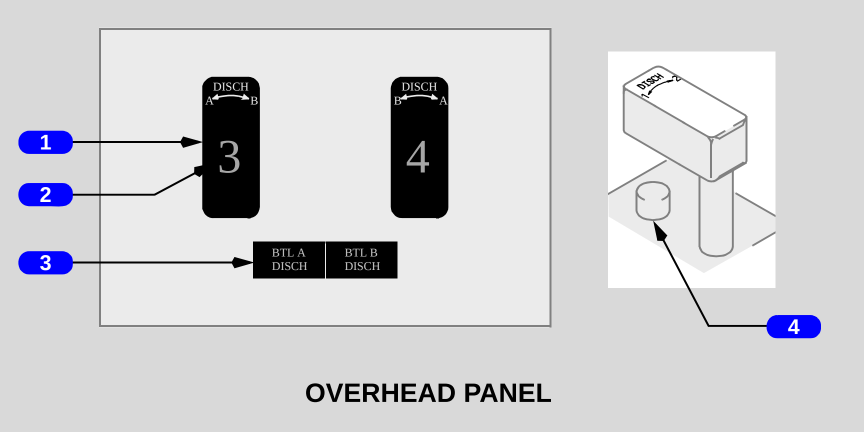
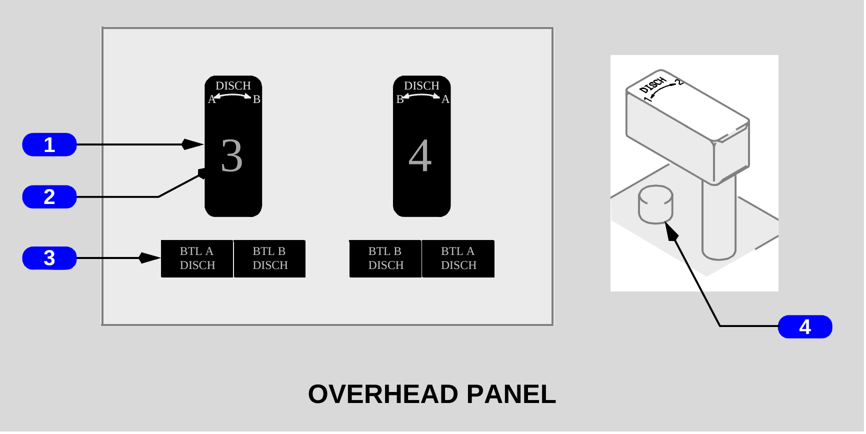
Engine Fire Protection
Engine Fire Panel

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Engine Fire Switches

In (normal position, mechanically locked) - unlocks for a fire warning, or when the Fuel Control switch is in CUTOFF.

Out -

- closes the related engine and spar fuel valves
- closes the related engine bleed air valve
- trips off the related engine generator
- shuts off hydraulic fluid to the related engine-driven hydraulic pump
- depressurizes the related engine-driven hydraulic pump
- arms both related engine fire extinguishers

Rotate to A or B - discharges selected fire extinguisher into the engine nacelle.

2 Engine Fire Warning Lights

Illuminated (red) -

- an engine fire is detected, or

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

- the Fire/Overheat Test switch is pushed

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- either Fire/Overheat Test switch is pushed

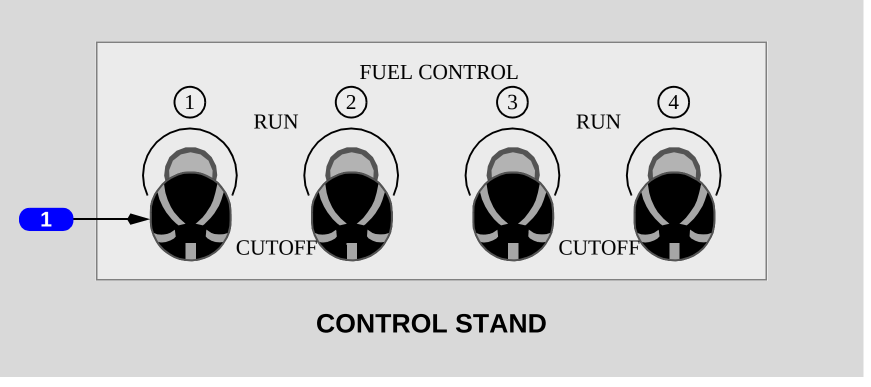
3 Bottle Discharged (BTL DISCH) Lights

Illuminated (amber) - the extinguisher bottle is discharged or has low pressure.

4 Engine and APU Fire Override Switches

Push - unlocks the fire switch.

Fuel Control Switches



1 FUEL CONTROL Switch Fire Warning Lights

Illuminated (red) -

- a related engine fire is detected, or

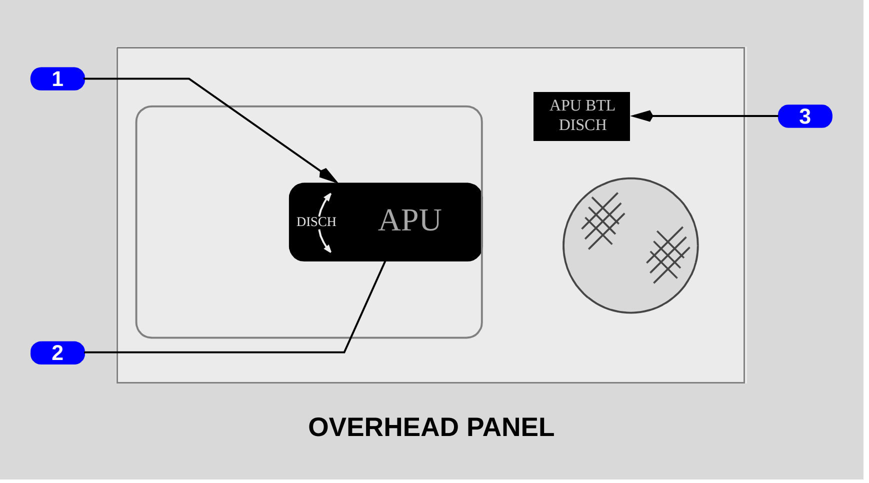
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

- the Fire/Overheat Test switch is pushed

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- either Fire/Overheat Test switch is pushed

APU Fire Panel



1 APU Fire Switch

In - normal position, mechanically locked; unlocks for a fire warning.

Out -

- arms APU fire extinguisher bottle
- closes APU fuel valve
- closes APU bleed air valve
- closes APU air inlet door
- trips APU generator field and generator breaker
- shuts down APU (if automatic shutdown does not occur)

Rotate - discharges APU fire extinguisher into APU compartment.

2 APU Fire Warning Light

Illuminated (red) -

- an APU fire is detected, or

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
- the Fire/Overheat Test switch is pushed

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
- the Fire/Overheat Test Engine/APU Cargo switch is pushed

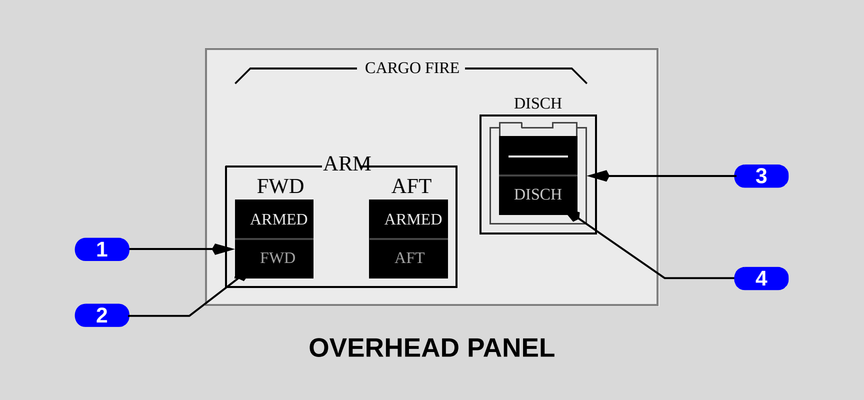
APU automatically shuts down for a detected fire.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
On the ground, the APU extinguisher automatically discharges.

3 APU Bottle Discharged (BTL DISCH) Light

Illuminated (amber) - extinguisher bottle is discharged or has low pressure.

Cargo Fire Panel



1 CARGO FIRE ARM Switches

Push -

FWD - ARMED -

- arms cargo fire extinguishers
- configures equipment cooling to override mode and turns off airflow and heat into forward compartment
- turns off pack 3 and all fans

AFT - ARMED -

- arms cargo fire extinguishers
- configures equipment cooling to override mode and turns off airflow and heat into forward compartment
- turns off aft cargo heat
- turns off pack 3 and all fans

2 CARGO FIRE Warning Light

Illuminated (red) -

- fire in related cargo compartment, or

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

- the Fire/Overheat Test switch is pushed

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- the Fire/Overheat Test Engine/APU Cargo switch is pushed

3 CARGO FIRE Discharge (DISCH) Switch

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Push - initiates extinguisher discharge sequence to provide effective agent concentration for 215 minutes.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

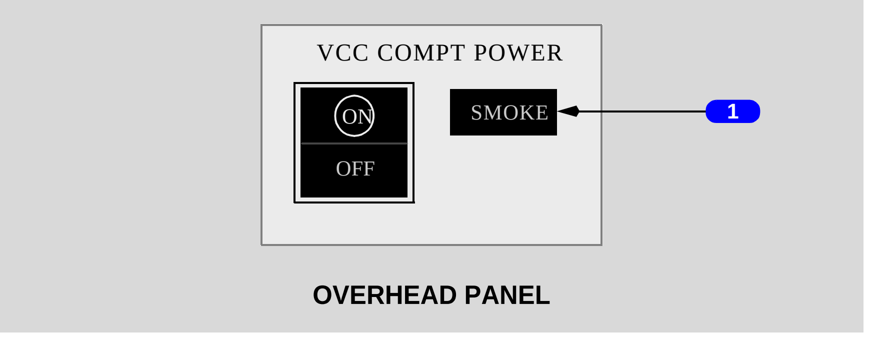
Push - initiates extinguisher discharge sequence to provide effective agent concentration for 195 minutes.

4 CARGO FIRE Discharged (DISCH) Light

Illuminated (amber) - cargo fire extinguishers discharged.

Video Control Center

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; system installed by STC)

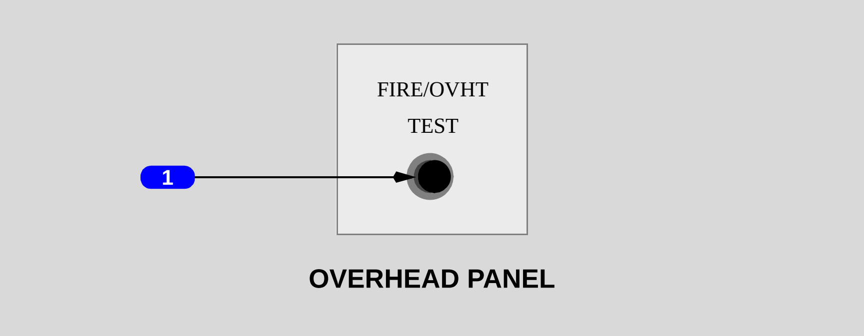


1 Video Control Center (VCC) Smoke Detection Light

Illuminated (amber) - smoke detected in VCC or audio-video on-demand server (ASR). Power automatically removed from VCC, ASR, and in flight entertainment (IFE).

Fire/Overheat Test Switch

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



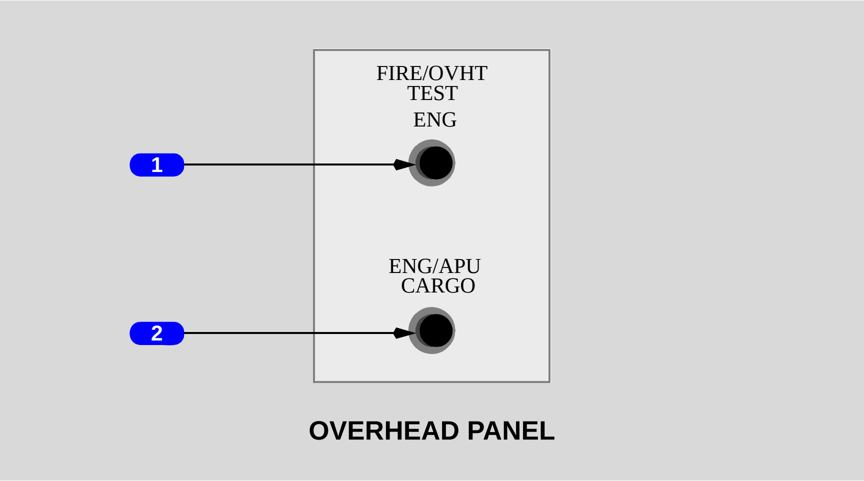
1 FIRE/Overheat (OVHT) TEST Switch

Push and hold -

- sends fire/overheat test signals to the engine, APU, wheel well, cargo, and bleed duct leak detectors
- tests flight deck fire and overheat indications (see Fire and Overheat Detection System Manual Fault Test, Section 20)

Fire/Overheat Test Switches

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 FIRE/Overheat (OVHT) TEST Engine (ENG) Switch

Push and hold -

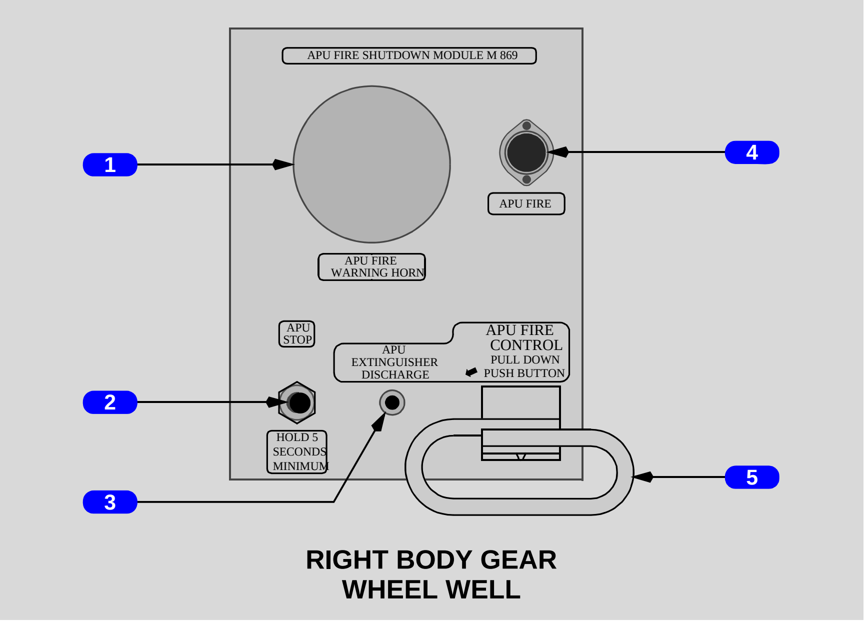
- sends fire/overheat test signals to the engine turbine overheat detectors
- tests flight deck fire and overheat indications (see Fire and Overheat Detection System Manual Fault Test, Section 20)

2 FIRE/Overheat (OVHT) TEST Engine (ENG)/APU CARGO Switch

Push and hold -

- sends fire/overheat test signals to the engine strut and cowl overheat detectors; engine, APU, wheel well and cargo fire detectors; and bleed duct leak detectors
- tests flight deck fire and overheat indications (see Fire and Overheat Detection System Manual Fault Test, Section 20)

APU Ground Control Fire Protection Panel



1 APU FIRE WARNING HORN

Sounds during ground operation for an APU fire or fire test.

2 APU STOP Switch

Push - shuts down APU.

3 APU EXTINGUISHER DISCHARGE Switch

Push - discharges APU fire extinguisher, when armed, into APU compartment.

4 APU FIRE Light

The APU automatically shuts down for a detected fire.

Illuminated (red) -

- fire in APU compartment, or

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

- the Fire/Overheat Test switch is pushed

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- the Fire/Overheat Test Engine/APU Cargo switch is pushed

5 APU FIRE CONTROL Switch

Pull down -

- shuts down APU
- arms APU fire extinguisher

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Introduction

There are fire detection and extinguishing systems for the:

- APU
- cargo compartments
- engines
- lavatories

The crew rest compartments and main gear wheel wells have fire detection systems, but no fire extinguishing systems.

The engines also have overheat detection systems.

Refer to the following chapters for additional information:

- Chapter 2 - Air Systems, for descriptions of equipment smoke evacuation, and bleed duct leak and overheat detection
- Chapter 3 - Anti-Ice, Rain, for a description of engine anti-ice system protection

Fire Warnings

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
If a fire is detected, the flight deck warning bell rings one second on, then 10 seconds off. If an APU fire occurs on the ground, the APU fire warning horn also sounds on the APU ground control panel in the right body gear wheel well.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
If a fire is detected (or turbine overheat), the flight deck warning bell rings one second on, then 10 seconds off. If an APU fire occurs on the ground, the APU fire warning horn also sounds on the APU ground control panel in the right body gear wheel well.

VQ-BHW, VQ-BHX
If a fire is detected, the flight deck warning bell rings two seconds on, then 3 seconds off. If an APU fire occurs on the ground, the APU fire warning horn also sounds on the APU ground control panel in the right body gear wheel well.

The fire bell can be silenced by extinguishing the fire or pushing either Master Warning/Caution Reset switch.

The wheel well horn for APU fire can be silenced by extinguishing the fire or pulling the APU Fire Control switch in the right wheel well.

In addition to the aural warning, an EICAS FIRE message is displayed as long as the fire condition exists.

The following lights illuminate if a fire is detected and remain illuminated as long as the fire signal exists:

- both Master Warning lights (may be reset while fire signal exists)
- respective Engine, APU, or Cargo Fire Warning lights
- for an engine fire, respective Fuel Control switch Fire light

Overheat Cautions

If an engine overheat condition is detected, the caution beeper sounds, the Master Caution lights illuminate, and an EICAS overheat message displays.

Fire/Overheat Detection

Engine Fire/Overheat Detection

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
A dual loop fire detector is installed in each engine nacelle. In addition, each engine has a dual loop overheat detector. In normal operation, both loops in a detector must detect a fire or overheat condition to cause an engine fire warning or overheat caution unless configured for single loop operation.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
A dual loop fire detector is installed in each engine nacelle. In addition, each engine has a single loop cowl overheat detector, a dual loop strut overheat detector, and a dual loop turbine overheat detector. In normal operation, both loops of a dual loop detector must detect a fire or overheat condition to activate the respective warning or caution.

APU Fire/Overheat Detection

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
A dual loop fire detector is installed in the APU compartment. There is no overheat detection in the APU compartment. Either loop detecting a fire activates an APU fire warning which shuts down the APU.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
A dual loop fire detector is installed in the APU compartment. There is no overheat detection in the APU compartment. Either loop detecting a fire activates an APU fire warning which shuts down the APU and, on the ground, discharges the APU fire extinguisher bottle.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
A dual loop fire detector is installed in the APU compartment. There is no overheat detection in the APU compartment. Both fire loops are required for fire detection from first engine start until last engine shutdown. When the engines are shut down, either loop can activate a fire warning. An APU fire warning shuts down the APU and, on the ground, discharges the APU fire extinguisher bottle.

Cargo Compartment Fire Detection

The forward and aft cargo compartments each have two dual loop smoke detectors. Sample air from throughout each compartment is drawn through the detectors by center bleed duct air. Both loops in a detector must sense smoke to activate the cargo fire warning unless reconfigured for single loop operation.

Wheel Well Fire Detection

Each main gear wheel well has a single loop detector.

Video Control Center Smoke Detection

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; system installed by STC)

A smoke detector and no-airflow sensing systems are installed in Video Control Center. Power to the system is automatically shut off by smoke detection or no-airflow. An aural warning sounds in the Video Control Center when smoke is detected in that compartment. After automatic smoke detection shutdown, power can not be restored to the VCC without maintenance action.

Crew Rest Smoke Detection

Smoke detectors are installed in crew rest areas. An aural warning sounds in the crew rest compartment when smoke is detected in that compartment.

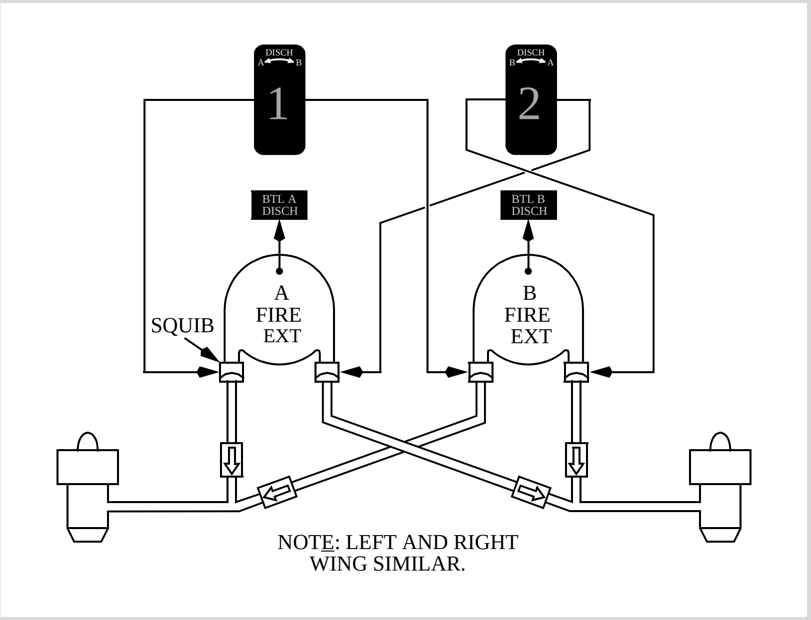
Lavatory Smoke Detection

Smoke detectors are installed in the lavatories. An aural warning sounds in a lavatory when smoke is detected in that lavatory. An automatic fire extinguisher is located in the waste compartment in each lavatory.

Fire Extinguishing

Engine Fire Extinguishing

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



There are two fire extinguisher bottles in each wing for the two engines on that wing. One or both bottles can be discharged in either engine on a wing.

The Engine Fire switches are mechanically locked in. If an engine fire occurs, the respective switch is electrically unlocked and can be pulled out.

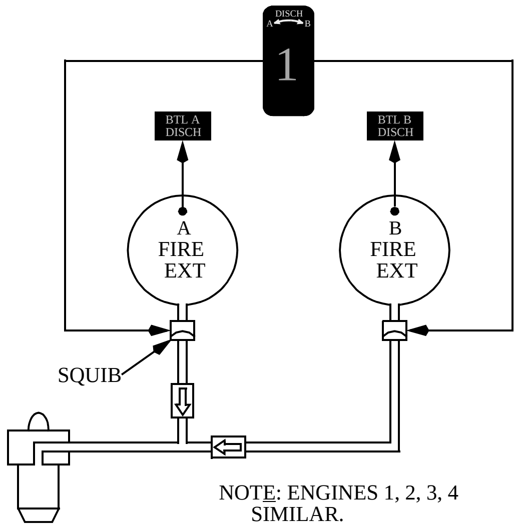
Pulling an Engine Fire switch arms a squib in each bottle for discharge to the respective engine. Rotating the Fire switch selects a fire extinguishing bottle and discharges it into the respective engine nacelle.

The switches can be individually unlocked by pushing the Fire Override switch beneath each Fire switch. The Engine Fire switches are unlocked when the respective Fuel Control switches are in CUTOFF.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Engine Fire Extinguishing

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



There are two fire extinguisher bottles for each engine. One or both bottles can be discharged in the engine.

The Engine Fire switches are mechanically locked in. If an engine fire occurs, the respective switch is electrically unlocked and can be pulled out.

Pulling an Engine Fire switch arms a squib in each bottle for discharge to the respective engine. Rotating the Fire switch selects a fire extinguishing bottle and discharges it into the respective engine nacelle.

The switches can be individually unlocked by pushing the Fire Override switch beneath each Fire switch. The Engine Fire switches are unlocked when the respective Fuel Control switches are in CUTOFF.

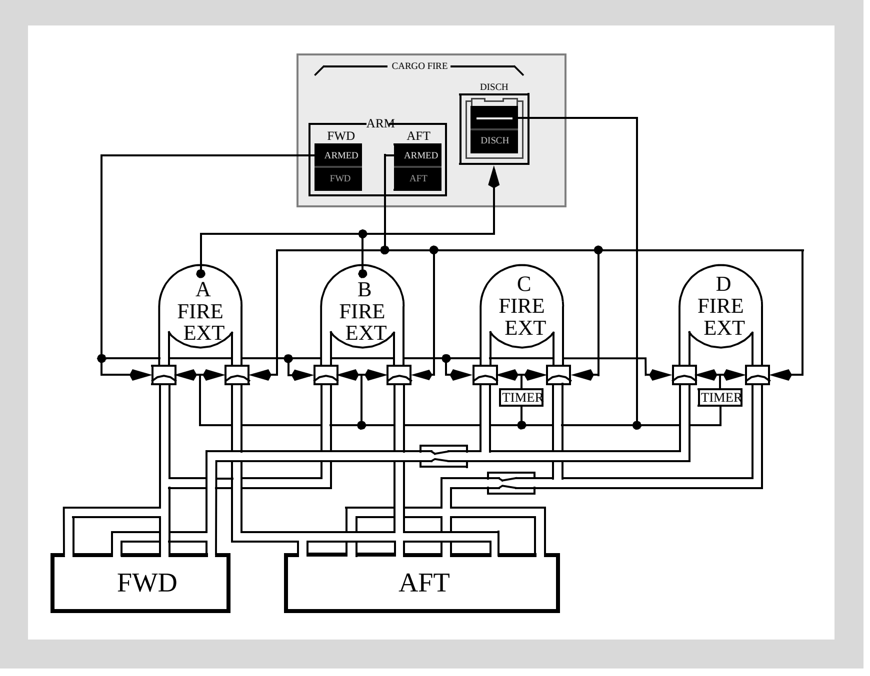
APU Fire Extinguishing

There is one APU fire extinguisher bottle controlled by the APU Fire switch.

The APU Fire switch is mechanically locked in. If an APU fire occurs, the respective switch is electrically unlocked and can be pulled out. Pulling the APU Fire switch arms the fire extinguisher discharge squibs. Rotating the APU Fire switch discharges a fire extinguisher into the APU compartment.

The APU Fire switch can be unlocked by pushing the Fire Override switch beneath the Fire switch.

Cargo Compartment Fire Extinguishing



There are four fire extinguisher bottles for the forward and aft cargo compartments. Pushing the Cargo Fire Discharge switch discharges two bottles immediately. The other two bottles discharge after a brief delay, or upon touchdown.

Fire and Overheat Detection System Fault Test

The fire overheat detection system has automatic and manual fault testing.

Fire and Overheat Detection System Automatic Fault Test

The engine detector loops are continuously monitored for faults. In addition to continuous testing of engine detection systems, testing of all dual loop fire/overheat detectors occurs when electrical power is initially applied.

Fully operable systems configure for dual loop operation upon completion of any test. Systems with a fault in one loop reconfigure for single loop operation. If the operable loop senses a fire or overheat condition, the respective fire warning or overheat caution activates.

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; SB installs -136 AFOLTS Card)
Additional testing of cargo smoke detectors is initiated when a detection loop senses a fire condition. If the other loop fails or senses a fire condition, a fire signal is activated. If the other loop passes the test and does not sense a fire condition, a fault code is generated for the failed loop, the zone is configured for single loop operation, and automatic testing is conducted every 60 minutes.

EI-XLF, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO (EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLG, EI-XLH ; SB installs -136 AFOLTS Card)
Additional testing of cargo smoke or bleed duct leak detectors is initiated when a detection loop senses an overheat condition. If the other loop fails or senses an overheat condition, an overheat signal is activated. If the other loop passes the test and does not sense an overheat condition, a fault code is generated for the failed loop, the zone is configured for single loop operation, and automatic testing is conducted every 60 minutes.

Fire and Overheat Detection System Manual Fault Test

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

The fire and overheat detection systems can be tested manually by pushing and holding the FIRE/Overheat (OVHT) TEST switch.

The indications for a manual fire and overheat detection system test are:

- the fire bell rings
- the APU fire warning horn sounds (on the ground)
- the EICAS message TEST IN PROG is displayed
- these lights illuminate:
  - the master WARNING lights
  - the engine fire warning lights
  - the APU fire warning light
  - the FWD and AFT cargo fire warning lights
  - the Fuel Control switch fire warning lights

When the test is complete, the EICAS warning message FIRE TEST PASS or FIRE TEST FAIL replaces the TEST IN PROG message; the switch can be released. Failed system EICAS messages are displayed with the FIRE TEST FAIL message.

All test messages clear when the test switch is released. If the switch is released with the TEST IN PROG message displayed, the test ends without completing.

The wheel well fire detector loop and the bleed duct leak detector loops are tested only during the manually initiated test. The EICAS warning message FIRE WHEEL WELL may momentarily display during the test.

Fire and Overheat Detection System Manual Fault Test

The fire and overheat detection systems can be tested manually by pushing and holding the desired FIRE/Overheat (OVHT) TEST switch.

The indications for a manual Engine (ENG) fire and overheat detection system test are:

- the fire bell rings
- these lights illuminate:
  - the master WARNING lights
  - the engine fire warning lights
  - the Fuel Control switch fire warning lights.
- The EICAS warning message FIRE ENG displays and the EICAS advisory message DET FIRE/OHT is not displayed.

The indications for a manual ENG/APU CARGO test are:

- the fire bell rings
- the APU fire warning horn sounds (on the ground)
- the EICAS message TEST IN PROG is displayed
- these lights illuminate:
  - the master WARNING lights
  - the engine fire warning lights
  - the Fuel Control switch fire warning lights.
  - the APU fire warning light
  - the FWD and AFT cargo fire warning lights
- When the test is complete, the EICAS warning message FIRE TEST PASS or FIRE TEST FAIL replaces the TEST IN PROG message; the switch can be released. Failed system EICAS messages display with the FIRE TEST FAIL message.
- All test messages clear when the test switch is released. If the switch is released with the TEST IN PROG message displayed, the test ends without completing.
- The wheel well fire detector loop and the bleed duct leak detector loops are tested only during the manually initiated test. The EICAS warning message FIRE WHEEL WELL may momentarily display during the test.

Squib Test

All extinguisher discharge squibs are tested for electrical continuity and the squib control circuit is tested using the Squib Test switches and Squib lights located on the overhead maintenance panel.

Intentionally
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EICAS Alert Messages

Message	Level	Aural	Message Logic
>BOTTLE LOW APU	Advisory		APU fire extinguisher bottle pressure is low.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

>BTL LO L, R ENG A, B	Advisory		Engine fire extinguisher bottle pressure is low.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

>BTL LOW ENG 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B	Advisory		Engine fire extinguisher bottle pressure is low

>CARGO DET AIR	Advisory		Cargo smoke detection airflow is insufficient.
>CGO BTL DISCH	Advisory		On the ground, a cargo fire extinguisher bottle pressure is low. In flight, cargo fire extinguisher bottles A and B are discharged.
>DET FIRE APU	Advisory		APU fire detection loops A and B are failed.
>DET FIRE/OHT 1, 2, 3, 4	Advisory		Engine fire or overheat detection loops A and B are failed.
FIRE APU	Warning	Fire Bell	Fire is detected in the APU.
FIRE CARGO AFT, FWD	Warning	Fire Bell	Smoke is detected in the lower cargo compartment.
FIRE ENG 1, 2, 3, 4	Warning	Fire Bell	Fire is detected in the engine.

Message	Level	Aural	Message Logic
FIRE WHEEL WELL	Warning	Fire Bell	Fire is detected in a main wheel well.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

OVHT ENG 1, 2, 3, 4 COWL	Caution	Beeper	Overheat is detected in the engine cowl.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

OVHT ENG 1, 2, 3, 4 NAC	Caution	Beeper	Overheat is detected in the engine nacelle.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

OVHT ENG 1, 2, 3, 4 SRUT	Caution	Beeper	Overheat is detected in the engine strut.

SMOKE DR 5 REST	Caution	Beeper	Smoke is detected in the door 5 crew rest area.

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; system installed by STC)

>SMOKE LAV/COMP	Caution	Beeper	Smoke is detected in one or more lavatories, or in the video control center (VCC), or in the audio-video on-demand server rack (ASR).

System Test Messages

The following messages are associated only with the manually-initiated fire test.

Message	Level	Aural	Message Logic
>FIRE TEST FAIL	Warning		One or more fire/overheat detection systems have failed to successfully complete the manually initiated fire/ overheat test.
>FIRE TEST PASS	Warning		A manually initiated test of the fire/overheat detection system has been completed.

Message	Level	Aural	Message Logic
>TEST IN PROG	Warning		A manually initiated fire/overheat detection system test is in progress.

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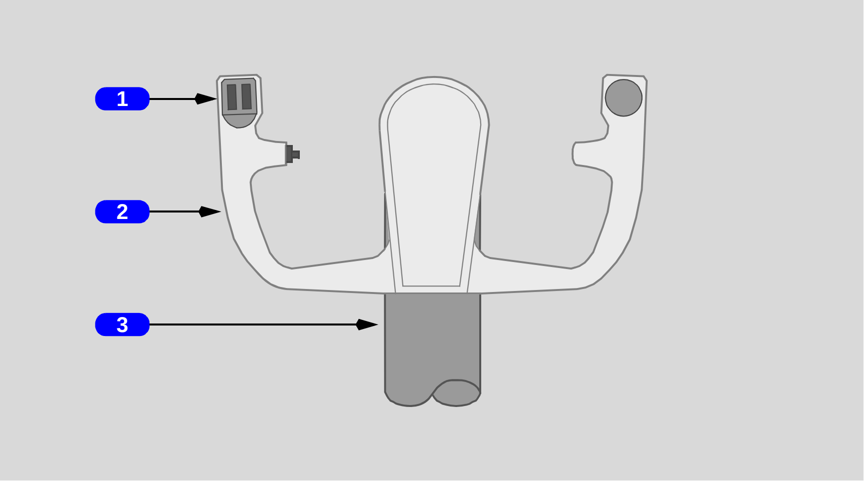
Pitch and Stabilizer Trim Systems
Control Wheel and Column



1 Stabilizer Trim Switches

Spring-loaded to neutral.

Push (both switches) - trims stabilizer in desired direction.

2 Control Wheel

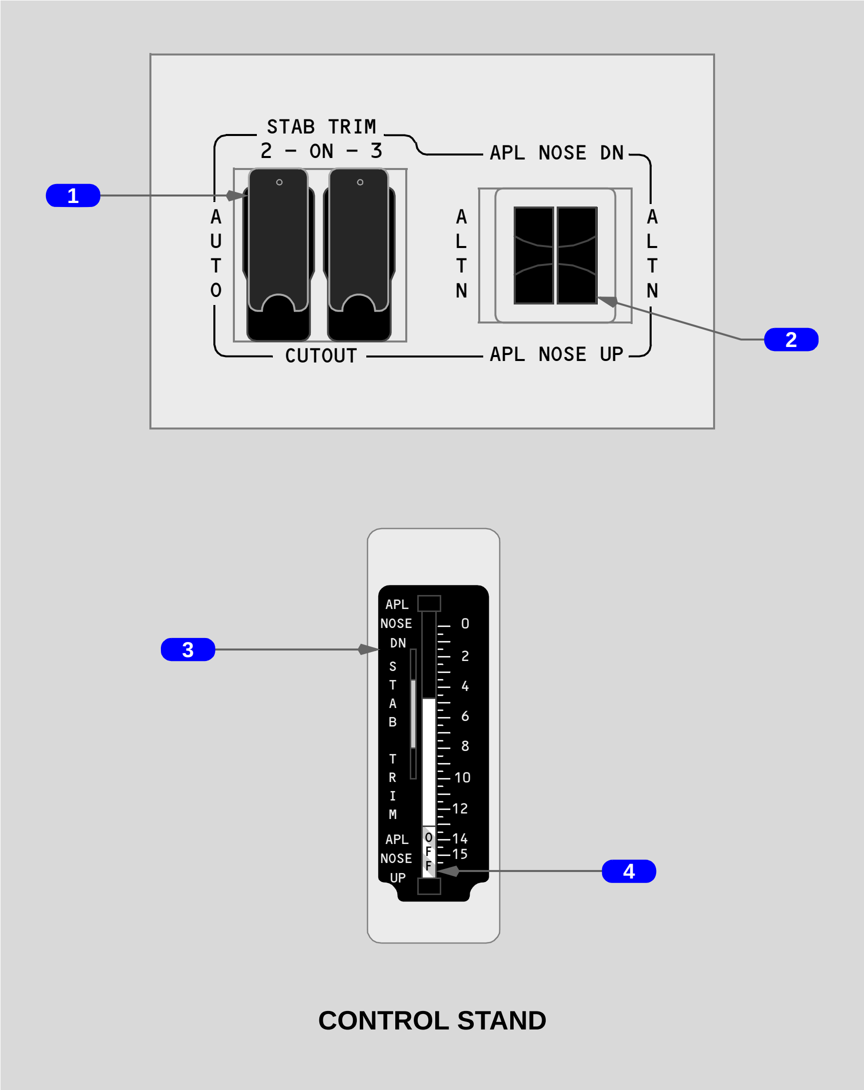
Rotate - deflects ailerons and spoilers in desired direction.

3 Control Column

Push/pull -

- deflects elevators in desired direction
- prevents stabilizer trim in opposite direction

Stabilizer Trim Controls



1 Stabilizer (STAB) TRIM CUTOUT Switches

ON - supplies hydraulic power for stabilizer trim.

AUTO (guard closed) -

- supplies hydraulic power for stabilizer trim
- shuts off related system hydraulic power if unscheduled trim detected

CUTOUT - shuts off related hydraulic power to stabilizer trim.

2 Alternate (ALTN) Stabilizer Trim Switches

Push (both switches) - trims stabilizer in desired direction using alternate control channel.

3 Stabilizer Trim Indicator

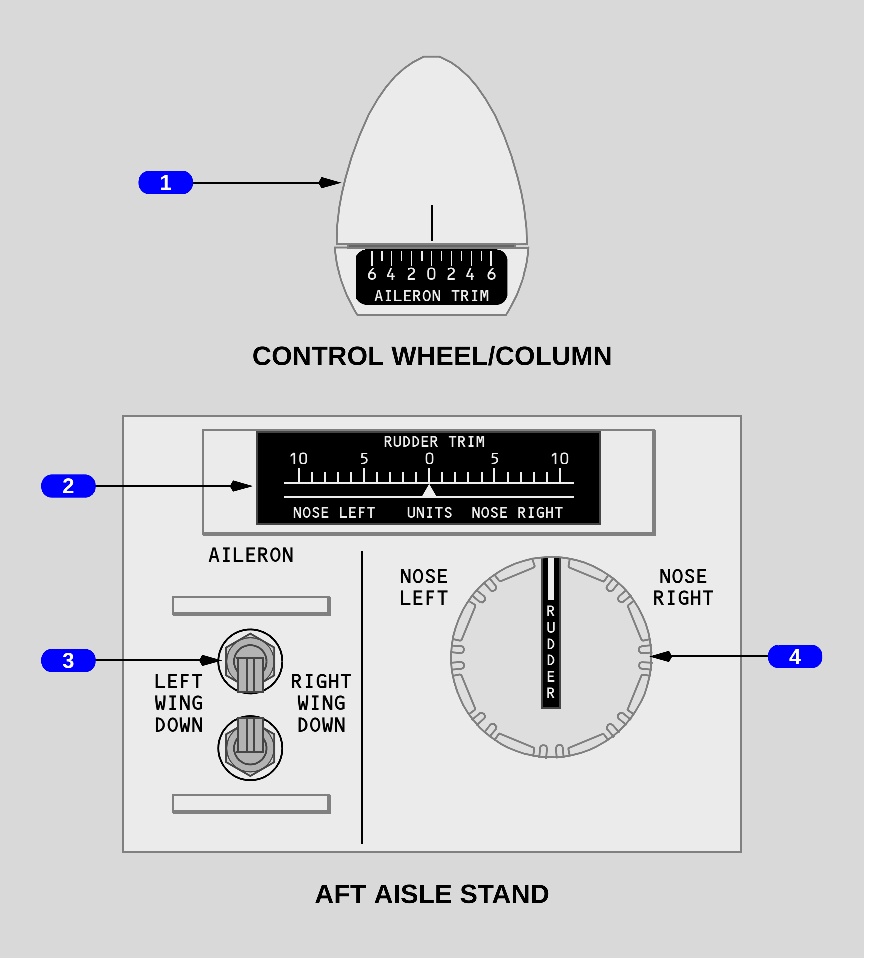
- indicates stabilizer position in units of trim
- illuminated green band indicates allowable range for takeoff

4 Stabilizer Trim Indicator Off Flag

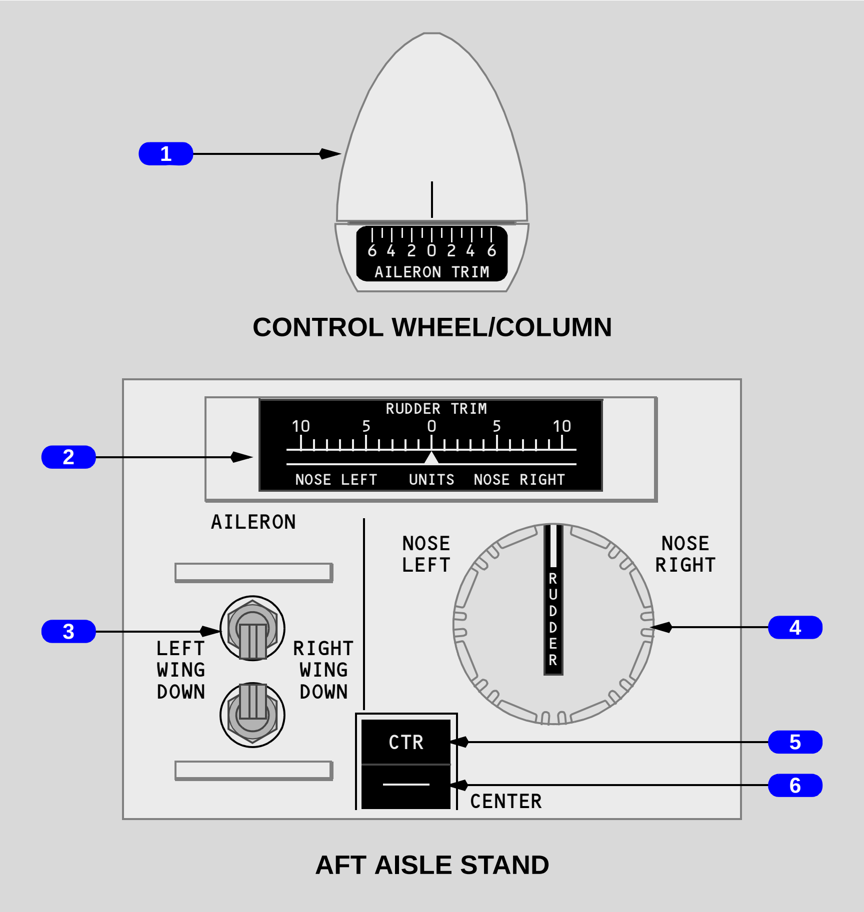
In View - trim indicator inoperative.

Aileron and Rudder Trim Controls

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



1 AILERON TRIM Indicator

Indicates units of aileron trim.

2 RUDDER TRIM Indicator

Indicates units of rudder trim.

3 AILERON Trim Switches

Push (both switches) - trims ailerons in desired direction.

4 RUDDER Trim Selector

Spring-loaded to neutral.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Rotate - trims rudder in desired direction.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
Rotate -

- trims rudder in desired direction
- cancels rudder trim centering

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

5 Rudder Trim Centering (CTR) Light

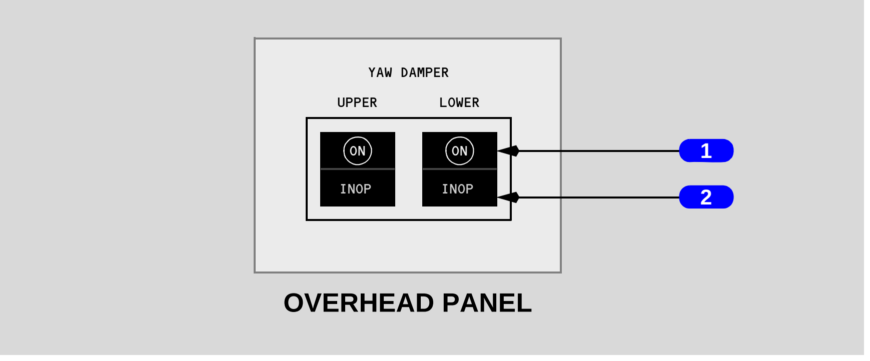
Illuminated - Rudder Trim Center switch has been pushed and trim is moving to zero.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

6 Rudder Trim Centering (CENTER) Switch

Push - rudder trim moves to zero units.

Yaw Damper Controls



1 YAW DAMPER Switches

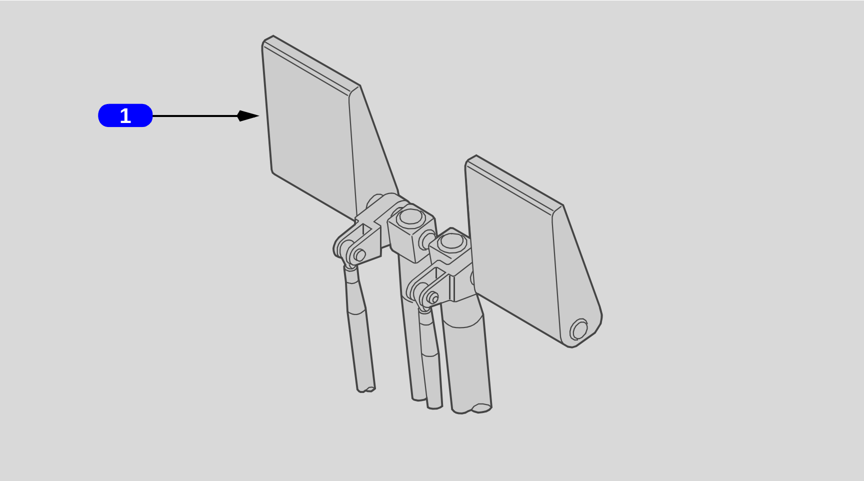
ON - yaw damper powered.

2 Yaw Damper Inoperative (INOP) Light

Illuminated -

- Yaw Damper switch off, or
- yaw damper inoperative

Rudder/Brake Pedals



1 Rudder Pedals

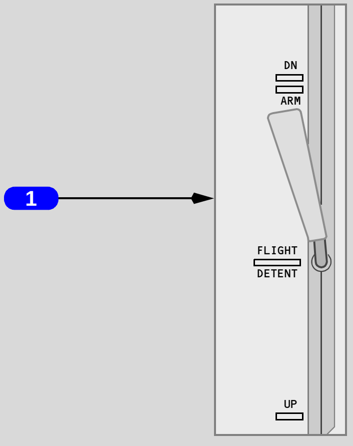
Push - deflects rudders in desired direction.

Refer to Chapter 14, Landing Gear, for brakes and nosewheel steering description.

Speedbrake Lever

On the ground -

- Speedbrake lever moves to UP and all spoiler panels extend when either engine 2 or engine 4 reverse Thrust lever raised to idle detent with engine 1 and engine 3 Thrust levers retarded
- Speedbrake lever moves to DN and all spoiler panels retract if engine 1 or engine 3 Thrust lever advanced



CONTROL STAND

1 Speedbrake Lever

DN (down) (detent) - all spoiler panels retracted

ARM (armed) -

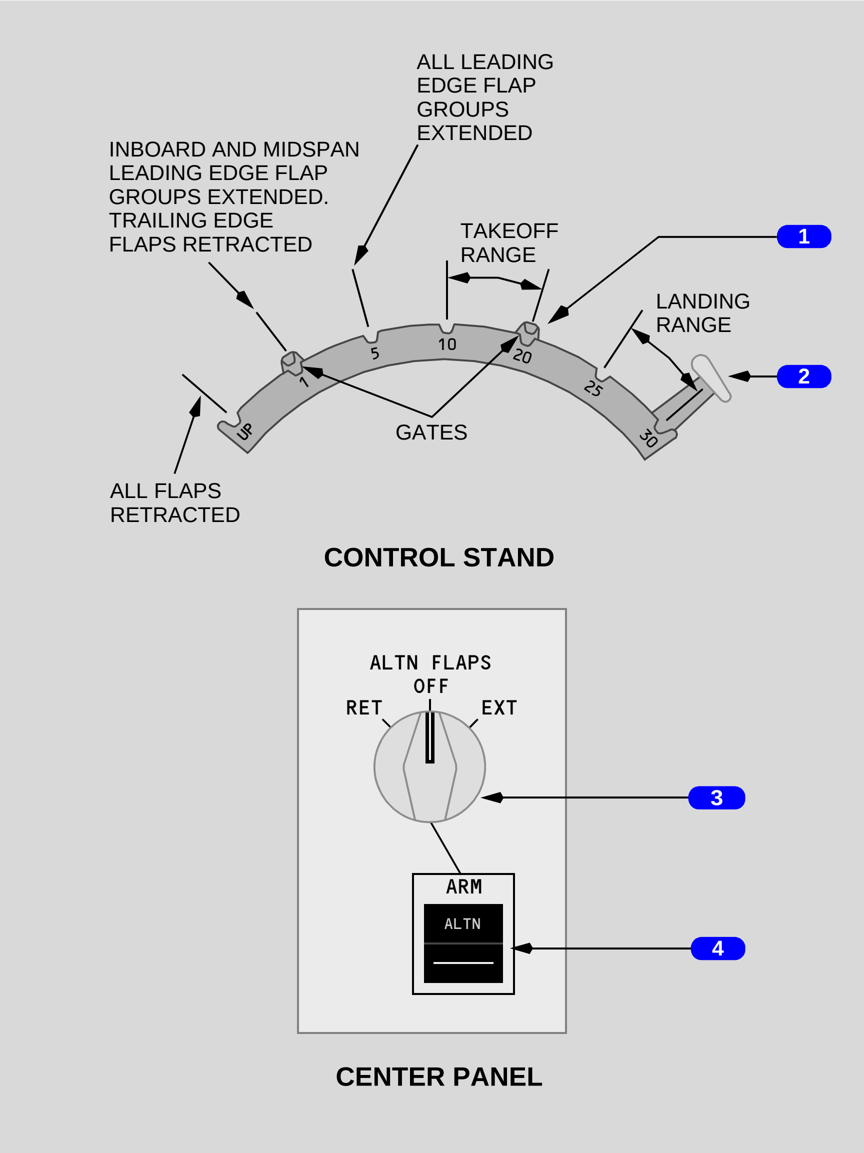
- automatic speedbrake system armed
- after landing, Speedbrake lever moves to UP and spoiler panels extend if engine 1 and engine 3 Thrust levers retarded

FLIGHT DETENT -

- spoiler panels extend to their maximum in-flight positions
- in flight, aft movement of Speedbrake lever limited to FLIGHT DETENT by an automatic stop

UP - all spoiler panels extend to their maximum on-ground position (intermediate positions can be selected).

Flap System
Flap Controls



1 Flap Gate

1 - prevents inadvertent retraction of remaining leading edge flap groups

20 - prevents inadvertent retraction of flaps past go-around position.

2 Flap Lever

Primary mode - positions leading edge flaps pneumatically and trailing edge flaps hydraulically.

Secondary Mode - positions leading and/or trailing edge flaps electrically if flaps fail to drive pneumatically or hydraulically.

3 Alternate (ALTN) Flaps Selector

RET (retract) - leading and trailing edge flaps electrically retracted.

OFF - alternate flaps deactivated.

EXT (extend) -

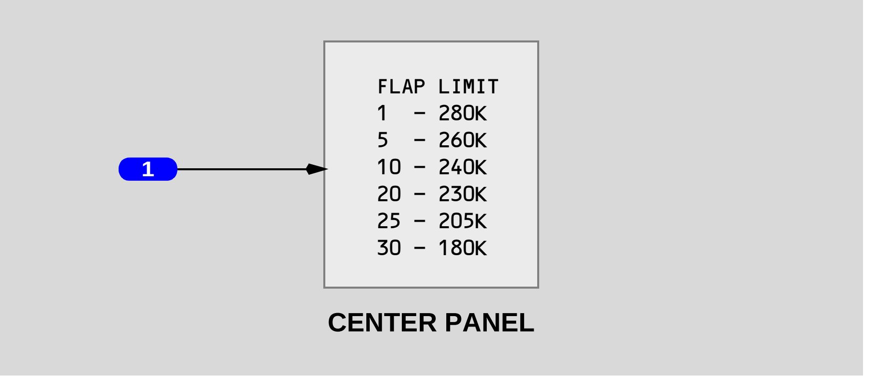
- leading and trailing edge flaps electrically extend
- maximum extension is flaps 25

4 Alternate (ALTN) Flaps ARM Switch

ALTN -

- arms flap alternate control mode
- arms Alternate Flaps selector
- shuts off primary and secondary mode operation
- asymmetry protection not available
- Flap lever inoperative

Flap Limit Placard



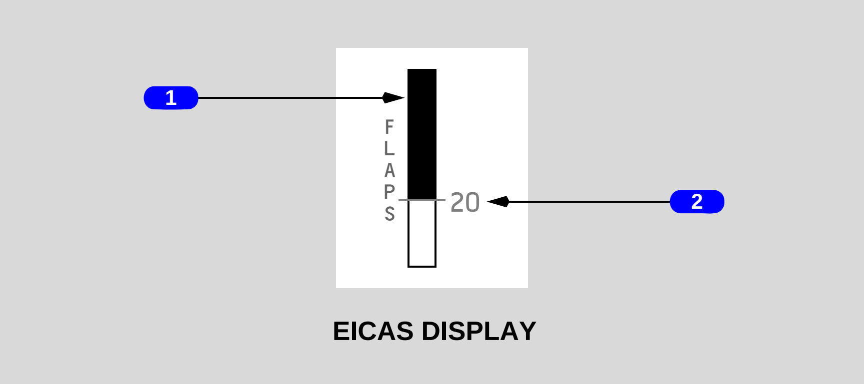
1 FLAP LIMIT Placard

Flaps extended speed limits.

Normal Flap Position Indication

Displays combined leading and trailing edge flap positions when all surfaces are operating normally and control is in the primary mode. The indicator shows continuous motion.

Indication is no longer displayed 10 seconds after flap retraction.



1 Flap Position (white)

UP - all leading and trailing edge flaps retracted.

Between UP and 1 -

- inboard and midspan leading edge flap groups in transit
- all trailing edge flaps retracted

1 -

- inboard and midspan leading edge flap groups extended
- all trailing edge flaps retracted

Between 1 and 30 - actual position of slowest trailing edge flap group.

2 Flap Lever Position (line and number)

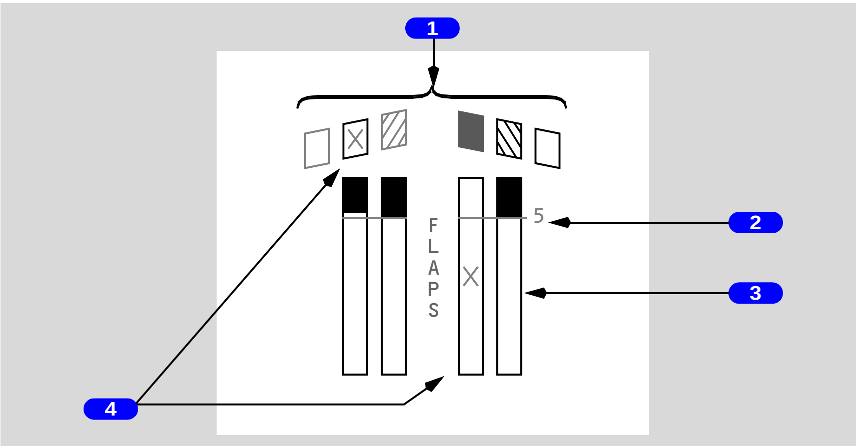
Magenta - flaps in transit to position selected by Flap lever.

Green - flaps in selected position.

Secondary Mode Expanded Flap Position Indication

If any flap position is non-normal or if flap control is in secondary mode, all flap positions are displayed.

Indicator motion is continuous between flap detents.



EICAS DISPLAY

1 Leading Edge Flaps Indication

White Box Outline - leading edge flap group retracted.

White Crosshatch - leading edge flap group in transit.

Solid Green Box - leading edge flap group extended.

Amber Border - drive unit is inoperative with flap group retracted.

Amber Solid Box - drive unit is inoperative with flap group extended.

Amber Crosshatch - drive unit is inoperative with flap group partially extended.

2 Flap Lever Position (line and number)

Magenta - flaps in transit to position selected by Flap lever.

Green - all leading and trailing edge flaps in position selected by Flap lever.

3 Trailing Edge Flaps Indication

White - position of inboard and outboard trailing edge flaps.

Amber - asymmetry or drive failure has occurred in related group.

4 Inoperative Sensor

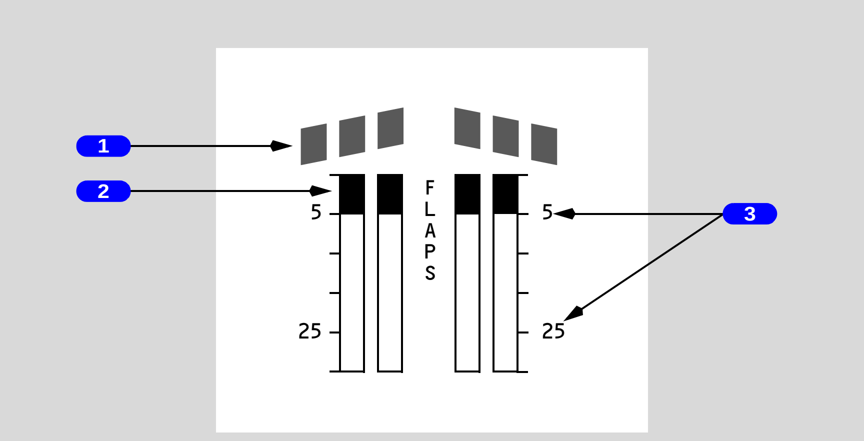
X (amber) - position sensor for respective flap has failed.

Note: The flaps operate normally unless the FLAPS CONTROL, FLAPS DRIVE, or FLAPS PRIMARY EICAS message is displayed.

Alternate Mode Expanded Flap Position Indication

If alternate flaps armed, expands to display all flap positions. May also display without position data if all three FCUs fail.

Indicator motion is continuous between flap detents.



EICAS DISPLAY

1 Leading Edge Flaps Indication

Position of leading edge flap groups.

2 Trailing Edge Flap Indication

Position of inboard and outboard trailing flaps.

3 Flap Position Index Marks

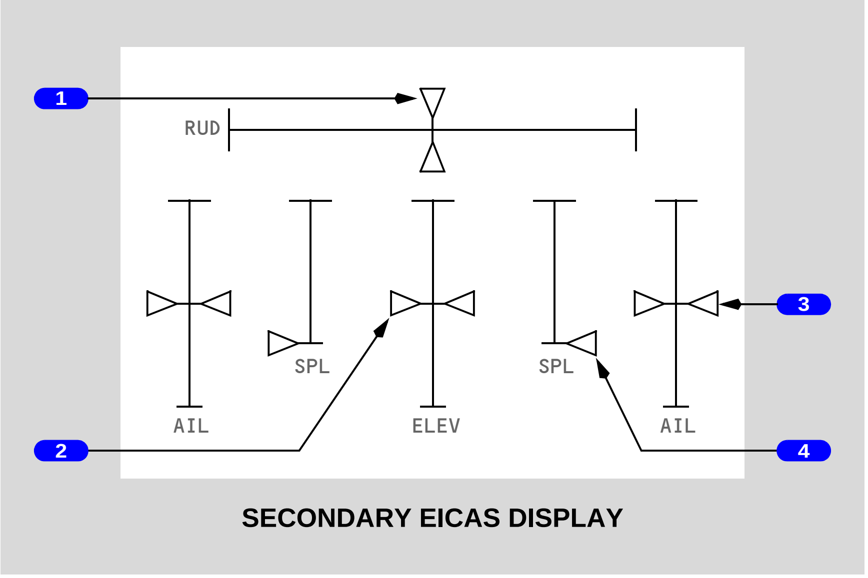
Reference flaps 5 and 25 positions.

Surface Position Indication

The surface position indication is displayed by pushing the STAT Display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

Full pointer deflection indicates full control surface displacement.

Surface Position Indication



1 Rudder (RUD) Position

Indicates upper and lower rudder positions.

2 Elevator (ELEV) Position

Indicates left and right outboard elevator positions.

3 Aileron (AIL) Position

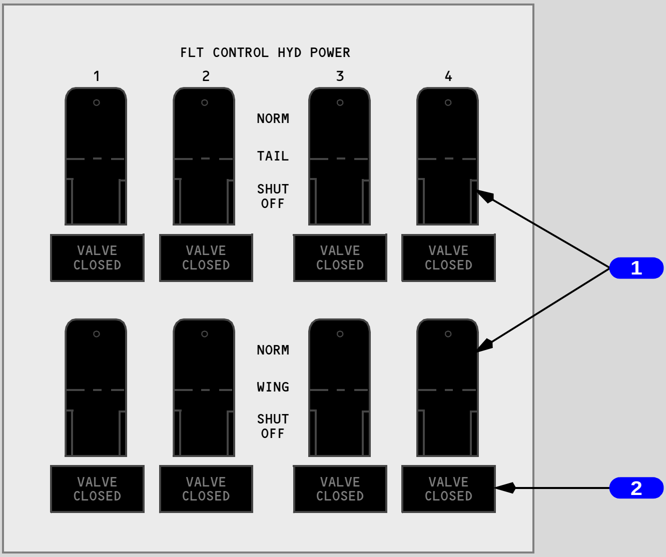
Indicates inboard and outboard aileron positions.

4 Spoiler (SPL) Position

- indicates flight spoiler positions
- indicates in-flight speedbrake position on left wing only

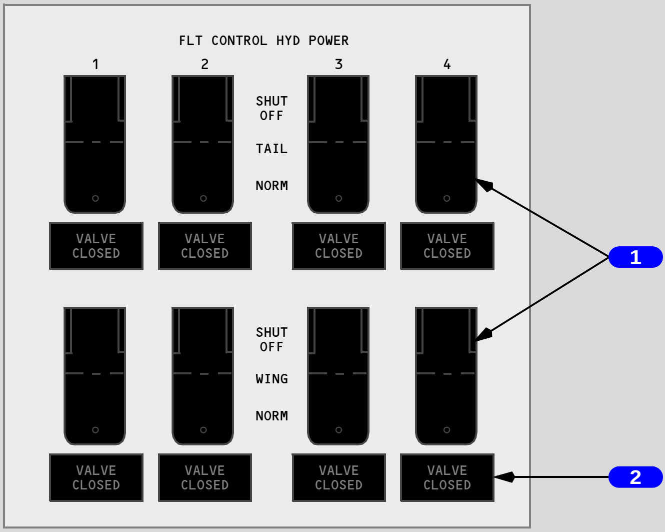
Flight Control Hydraulic Power Controls

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



OVERHEAD MAINTENANCE PANEL

VQ-BHW, VQ-BHX



OVERHEAD MAINTENANCE PANEL

1 Flight (FLT) CONTROL Hydraulic (HYD) POWER SHUTOFF Switches

NORM (guard closed) - supplies hydraulic power for flight control surfaces.

SHUT OFF - shuts off hydraulic power to respective flight control surfaces.

2 VALVE CLOSED Light

Illuminated (amber) - hydraulic system flight control valve is closed.

Flight Controls — Chapter 9
System Description — Section 20

Introduction

The primary flight controls are elevators, ailerons, and rudders. The control column, control wheel, and rudder pedals control these flight control surfaces. The primary flight controls are redundantly powered from the four airplane hydraulic systems; there is no manual reversion.

Secondary flight controls include a moveable horizontal stabilizer, spoilers, and leading and trailing edge flaps. Spoilers operate differentially to assist ailerons for roll control and symmetrically as speedbrakes.

Pilot Controls

The pilot controls consist of:

- two control columns
- two control wheels
- two pairs of rudder pedals
- control wheel Stabilizer Trim switches
- Alternate Stabilizer Trim switches
- Speedbrake lever
- Flap lever
- Aileron Trim switches
- Rudder Trim selector

Control wheels are connected through jam override and shearout mechanisms. If a jam occurs, the pilots can maintain control by applying force to the other control.

The Speedbrake lever allows manual or automatic symmetric actuation of the spoilers.

Trim switches allow the pilots to adjust flight control surfaces to reduce flight control pressures.

Flight Control Surfaces

Pitch control is provided by:

- four elevator surfaces
- a moveable horizontal stabilizer

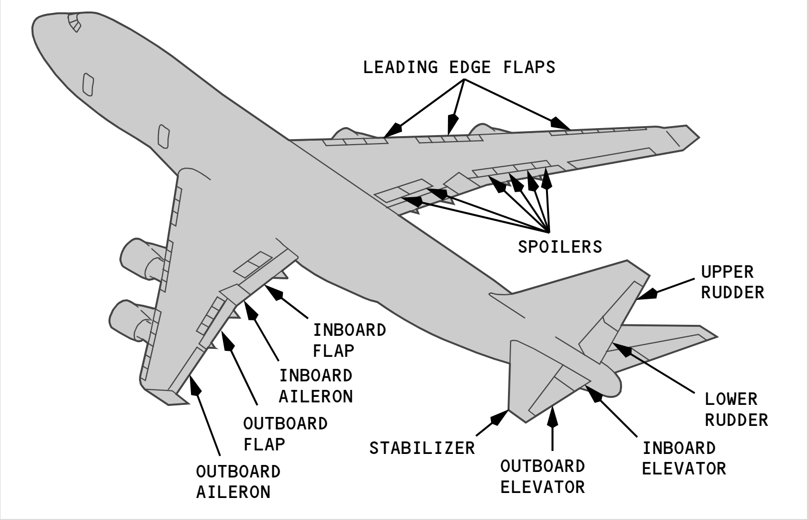
Roll control is provided by:

- four ailerons
- ten spoilers

Yaw control is provided by an upper and lower rudder.

Increased lift and decreased stall speed for takeoff and landing are provided by leading and trailing edge flaps.

Flight Control Surface Locations



Pitch Control

Four elevator surfaces hinged at the rear of the horizontal stabilizer and a moveable horizontal stabilizer provide pitch control.

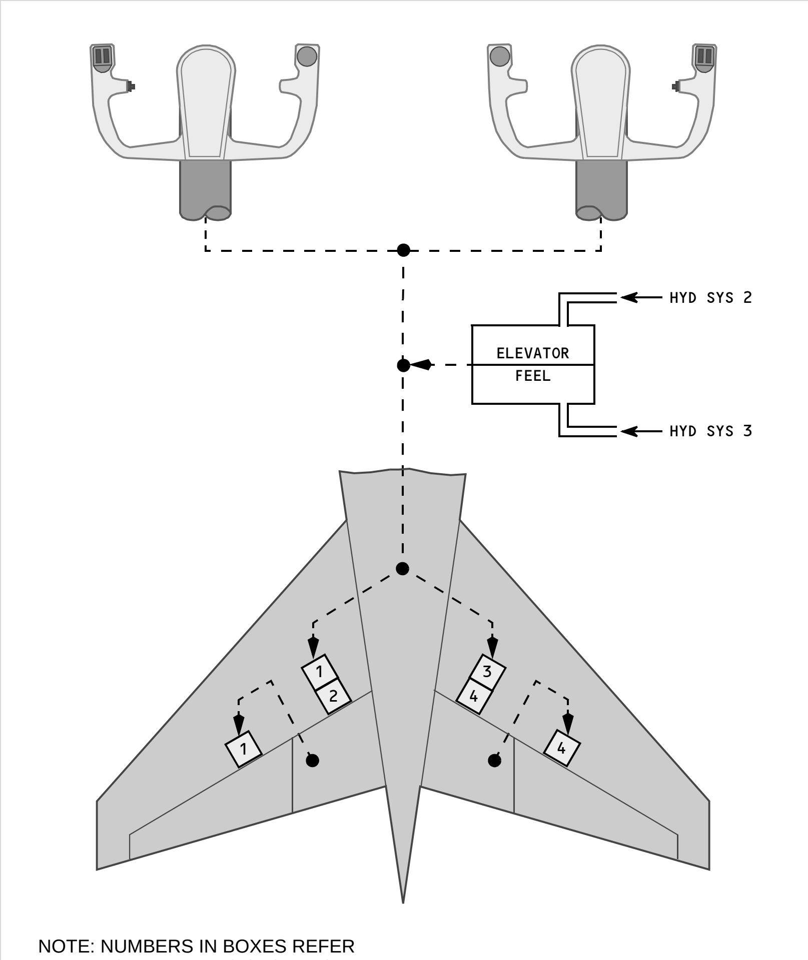
Elevator Control

Control column inputs transfer mechanically to hydraulic actuators on the inboard elevator control surfaces. Inboard elevator position controls input for the related adjacent outboard elevator actuator. Shearouts between the inboard and outboard elevators allow elevator control to be regained if a jam occurs and a significant manual force is applied to the control columns.

Left and right outboard elevator positions display on the EICAS status display. A full scale indication corresponds to maximum elevator deflection.

An elevator feel and centering mechanism provides artificial feel at control columns. The force increases as airspeed increases. Hydraulic systems 2 and 3 power the feel mechanism. Loss of one of the hydraulic systems does not affect feel forces. If both hydraulic systems fail, mechanical springs provide feel forces and feel force is no longer a function of airspeed.

Elevator Control Diagram



Stabilizer Trim

The stabilizer trim system provides pitch trim by varying the angle of incidence of the horizontal stabilizer. Normal and alternate electrical channels control two stabilizer trim control modules. Each control module hydraulically powers a trim actuator. Actuator outputs mechanically sum to drive the stabilizer. Trim rate is reduced at high airspeeds.

Trim Control

Stabilizer Trim switches on the pilots' control wheels or Alternate Stabilizer Trim switches on the control stand control stabilizer trim. Pushing both switches in a pair in the same direction power the actuators, which drive the stabilizer in the desired direction. The Alternate Stabilizer Trim switches provide trim commands in the same manner as the Stabilizer Trim switches through a separate control channel. The Alternate Stabilizer Trim switches also provide an increased range of stabilizer travel. If the Alternate Stabilizer Trim switches and control wheel switches are held in opposite directions, no trim is commanded. Holding the captain's and first officer's control wheel switches in opposite directions commands no trim.

Stabilizer Trim Position Indication and Green Band

Stabilizer position, measured in trim units, displays on trim indicators on both sides of the control stand. A stabilizer trim indicator OFF flag displays if the trim indicator is inoperative.

The stabilizer trim indicators incorporate a multiple green band which indicates the acceptable range of trim settings for takeoff. There are three possible green bands: a mid-band, a nose down band which includes the mid-band plus additional nose down trim, and a nose up band which includes the mid-band plus additional nose up trim.

The green band and takeoff trim setting are calculated based on the FMC calculated gross weight, center of gravity, and takeoff thrust derate selection. The position of the nose gear oleo pressure switch is compared to the calculated green band as a crosscheck to ensure the correct green band is displayed.

The mid-band segment is a highly visible green paint stripe illuminated by ambient light and integral panel lighting.

Stabilizer Trim Cutout

Hydraulic systems 2 and 3 power stabilizer trim. Two guarded Stabilizer Trim Cutout switches control stabilizer trim. With the guards closed, the switches are held in AUTO position, allowing automatic cutout of the related hydraulic system if unscheduled stabilizer trim is detected. With a Stabilizer Trim Cutout switch in CUTOUT, hydraulic power to the related trim control module is shut off. Positioning a switch to ON overrides the automatic cutout function and supplies hydraulic power to the related control module. If automatic cutout has occurred, hydraulic power remains shut off until the respective cutout switch is placed ON. If one actuator fails to operate, trim commanded by the flight crew reduces to half the normal scheduled rate.

Trimming with Autopilots Engaged

If a single autopilot is engaged, using the control wheel Stabilizer Trim switches causes the autopilot to disengage and the stabilizer to move in the desired direction. If multiple autopilots are engaged, the control wheel Stabilizer Trim switches are inhibited. The Alternate Stabilizer Trim switches override autopilot trim commands with any number of autopilots engaged and do not cause disengagement.

Control Column Cutoff

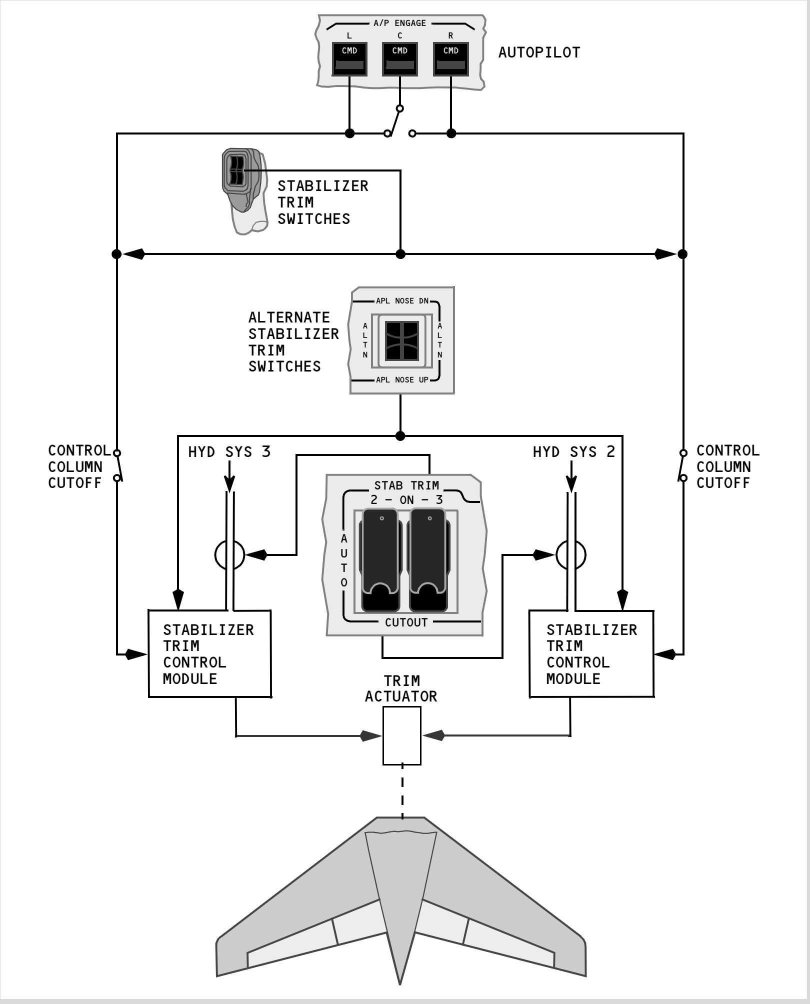
Control column inputs in the direction opposing stabilizer trim will cutoff electric trim commands to the control modules. The control column trim cutoff function does not affect alternate trim inputs.

Speed Stability Trim

Speed stability trim uses stabilizer trim to improve handling characteristics of the airplane in the lower speed range.

Activating the Stabilizer Trim switches or engaging an autopilot inhibits speed stability trim.

Stabilizer Control Diagram



Roll Control

Hydraulically powered inboard and outboard ailerons and spoilers provide roll control.

Aileron and Spoiler Roll Control

Rotating either control wheel positions ailerons and spoilers to provide roll control. An aileron lockout system locks the outboard ailerons in the neutral position at 238 knots and permits full travel of the outboard ailerons at lower airspeeds. This prevents overcontrolling at high airspeeds and provides the required roll authority at low airspeeds.

All spoilers, except the inboard spoiler on each wing, function as flight spoilers which operate with the ailerons to provide roll control. Spoiler mixers combine Speedbrake lever and control wheel inputs allowing roll inputs to deflect spoiler panels up or down from their deployed positions when speedbrakes or ground spoilers are in use.

Aileron positions display on the EICAS status display. Separate pointers indicate the inboard and outboard aileron positions on each wing. A full scale deflection of the position indicator corresponds to maximum aileron travel.

The control wheels connect through an override mechanism which allows either wheel to move independently if the other wheel jams and significant manual force is applied to the free wheel. Roll control is then available through the ailerons on the wing corresponding to the free wheel. Approximately half of the flight spoilers are also available for roll control under these conditions.

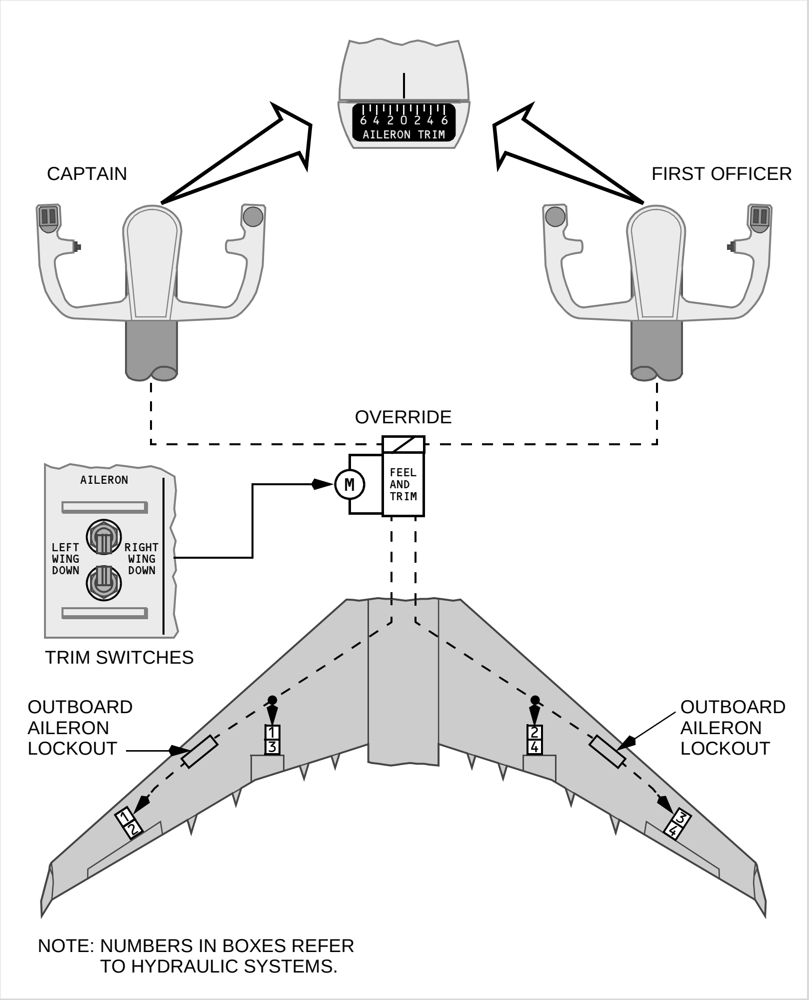
Each side of the mechanical system also incorporates shearouts which may allow the jammed control wheel to be freed when a significant manual force is applied to the jammed wheel.

Aileron Trim

Pushing both Aileron Trim switches in the desired direction causes the feel and trim mechanism to reposition the aileron neutral point. Both control columns have an aileron trim indicator.

If the Aileron Trim switches are activated with an autopilot engaged, the aileron neutral point is repositioned. When the autopilot is disengaged, the wheel and ailerons move to the repositioned aileron neutral point. The airplane responds with roll proportional to the amount of aileron trim input.

Aileron Control Diagram



Yaw Control

The rudder control system provides yaw control.

Rudder Control and Trim

Either pilot's rudder pedals control the hydraulically powered upper and lower rudders. Rudder pedal inputs mechanically transfer to a single feel and trim mechanism, then transfer through separate ratio changers to the upper and lower rudder hydraulic actuators.

Rudder positions display on the EICAS status display. On the ground, pushing a rudder pedal to the stop causes a full scale deflection of the upper and lower rudder position indicators.

The rudder system shearouts allow upper or lower rudder to be controlled if a jam occurs downstream of the rudder ratio changer and a significant manual force is applied to the rudder pedals.

When the Rudder Trim selector is rotated in the desired direction, the rudder feel and trim mechanism repositions the rudder pedal neutral point. The rudder trim indicator displays units of rudder trim. A black tape is displayed with pointer out of view if the trim indicator is inoperative.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
Pushing the Rudder Trim Center switch causes rudder trim to move to the zero units position. Rudder trim centering can be cancelled by using the Rudder Trim selector or pushing the Rudder Trim Center switch a second time. The zero position achieved by the centering function is not as accurate as manually trimming to zero units.

Rudder Ratio Changers

Two rudder ratio changer systems gradually reduce each rudder surface's response to pedal inputs as airspeed increases. This protects the vertical tail structure from stresses which could result from large rudder surface deflections at high airspeeds.

If a ratio changer system fails, the response of the related rudder surface to pedal inputs remains the same as when the failure occurred, regardless of changes in airspeed. Pilot inputs to the rudder may no longer be limited by the ratio changer and abrupt rudder pedal inputs at high airspeeds could result in excessive rudder deflections. At low airspeeds, full rudder deflection may not be available. The airplane crosswind capability is reduced for both manual and automatic landings.

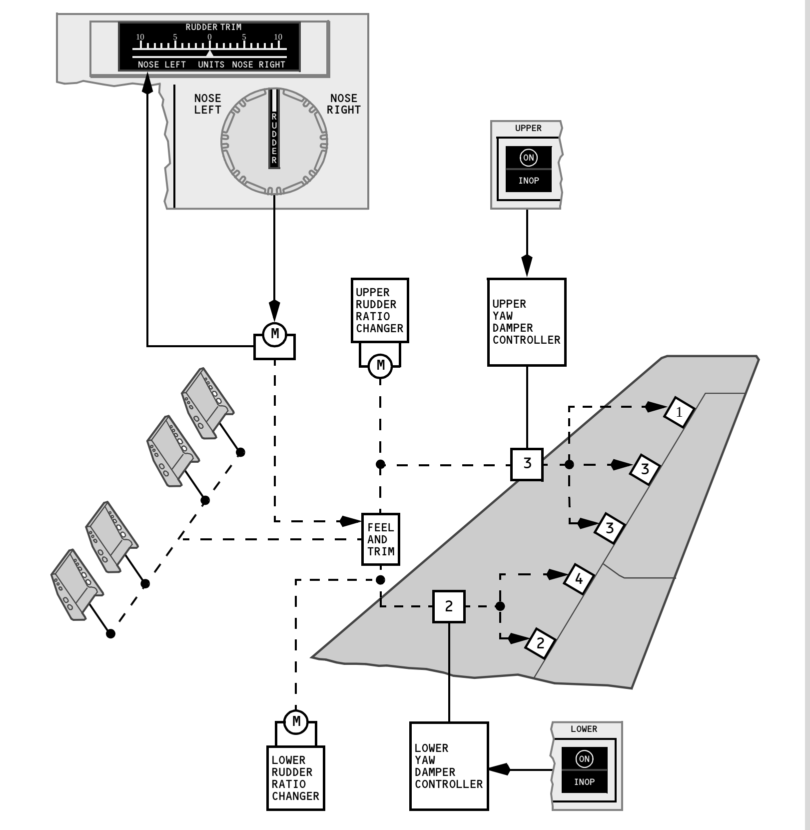
Yaw Dampers

Two independent yaw damper systems operate continuously in flight to improve airplane lateral and directional stability and provide turn coordination. The upper and lower yaw damper actuators are powered by hydraulic systems 3 and 2 respectively. Yaw damper inputs do not result in rudder pedal motion.

With the Yaw Damper switches ON, the systems are powered. If a yaw damper fault exists, hydraulic power is removed from the system and the related yaw damper INOPERATIVE light illuminates.

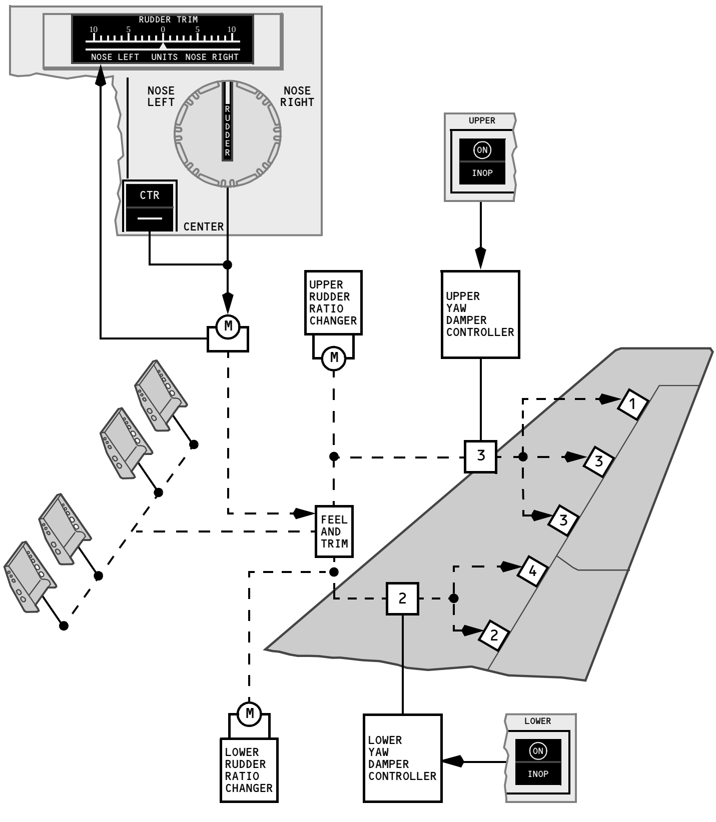
Rudder Control Diagram

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



NOTE: NUMBERS IN BOXES REFER TO HYDRAULIC SYSTEMS.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



Spoilers

There are six spoiler panels on each upper wing surface just forward of the trailing edge flaps. The four inboard panels on each wing function as speedbrakes in flight. On the ground, all six spoiler panels on each wing function as ground spoilers. The speedbrake and ground spoiler functions are controlled with the Speedbrake lever.

The position of one spoiler on each wing is displayed on the EICAS status display. On the left wing, the position of the fourth spoiler panel in from the wingtip is displayed. This panel functions as a flight spoiler, speedbrake, and ground spoiler. On the right wing, the position of the outboard-most spoiler panel is displayed. This panel functions as a flight spoiler and ground spoiler only. Therefore, speedbrake extension is not indicated on the right wing spoiler position indicator.

Speedbrakes

Speedbrake lever in-flight input is limited to mid-travel position by an automatic stop. With the Speedbrake lever in flight detent position, the two inboard spoiler panels on each wing extend to mid-travel position and the two middle spoiler panels on each wing extend to full travel position.

Ground Spoilers

On the ground, the Speedbrake lever stop retracts allowing the Speedbrake lever to be moved fully aft to UP position. All six spoiler panels on each wing extend to their full travel positions.

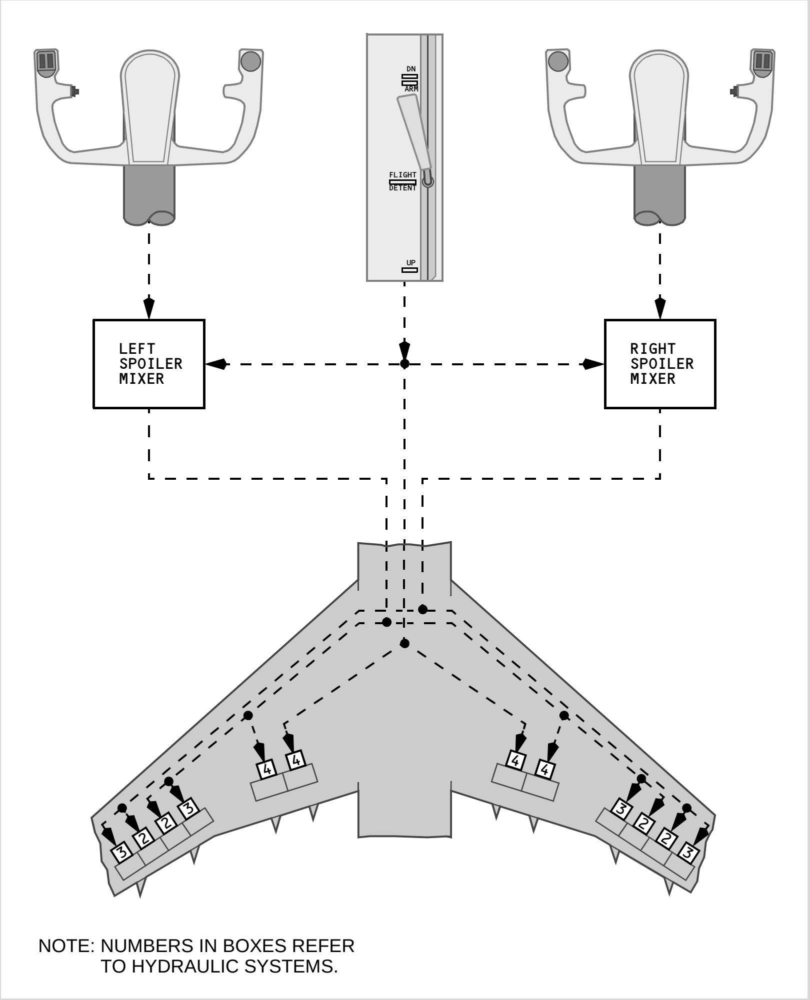
When the Speedbrake lever is in the ARM position, Thrust levers 1 and 3 are near the idle position, and the main landing gear touch down, the Speedbrake lever is driven to the UP position, extending all spoiler panels.

The Speedbrake lever is driven to the UP position from the DN position when the main gear are on the ground, Thrust levers 1 and 3 are near the idle position, and reverse Thrust levers 2 or 4 are pulled up to idle detent. This automatic ground spoiler extension is a backup for landing when the Speedbrake lever is not armed during approach.

For go-around protection, if Thrust lever 1 or 3 is advanced from idle position, the Speedbrake lever is driven to the DN position. This occurs whether ground spoilers were automatically or manually extended. The Speedbrake lever can be manually returned to the DN position.

The EICAS advisory message SPEEDBRAKE AUTO indicates a fault that may cause the loss of the automatic ground spoiler function. If the Speedbrake lever is in the ARM position, the message indicates a fault which could result in inadvertent spoiler extension in flight. No inadvertent spoiler extension can occur with the Speedbrake lever in the DN position. The spoilers can be operated manually.

Spoiler Control Diagram



Flaps

There are three groups of leading edge flaps on each wing: outboard flap section, midspan section, and inboard section. The leading edge flaps are normally pneumatically powered from the bleed air duct.

The trailing edge flaps consist of an inboard group normally powered by hydraulic system 1 and an outboard group normally powered by hydraulic system 4. Opposite trailing edge flaps are mechanically connected to maintain symmetry.

Flap Control Units

Flap lever position is transmitted to three identical flap control units (FCUs) which sequence and monitor flap operation. Each FCU performs any or all of the three basic functions:

- primary control
- secondary control
- indication and annunciation

The FCUs also control flap sequencing and trailing edge flap asymmetry, disagree, and uncommanded motion protection in the primary and secondary modes, control the flap load relief function in primary mode only, and send all flap position information to EICAS and other systems.

FCU Primary Mode

In primary mode, the FCUs drive the leading edge flaps pneumatically and drive the trailing edge flaps hydraulically to the selected position.

If a trailing edge asymmetry is detected, primary mode operation is immediately shut down for the failed group and the FCUs do not use secondary mode. The EICAS message FLAPS CONTROL is displayed if all three FCUs fail in their control function. EICAS flap indications from the FCUs may still be valid.

Flap Load Relief in Primary Mode

Flap load relief protects the flaps from excessive air loads if flap airspeed limits are exceeded with flaps 25 or 30 selected. If the airspeed limit is exceeded, the flaps will retract to 25 or 20 as required to reduce/eliminate the exceedance.

The Flap lever does not move. The flaps extend to the selected position when airspeed is sufficiently reduced.

Maximum flap speeds are placarded on the center panel.

FCU Secondary Mode

If any flap group fails to move to the commanded position, the FCUs switch to secondary mode driving the flap group through electric motors. The change from primary to secondary mode for both leading and trailing edge flaps is by symmetrical flap groups on both wings.

If a primary control failure occurs in either the inboard or midspan leading edge flap group, both groups switch to secondary mode. For all other flap groups, only the failed group operates in secondary mode. Secondary mode flap operation is much slower than primary mode operation.

If a failure occurs in a leading edge flap group on one wing, the flap groups on both wings change to secondary mode after a short time delay. However, due to the rapid rate of primary mode flap movement, the non-affected side completes movement before changing to secondary mode.

If a trailing edge flap group is driven in secondary mode due to a lack of hydraulic system pressure, the FCUs switch back to primary mode operation once hydraulic pressure is restored. However, if a trailing edge flap group is driven in secondary mode with hydraulic pressure available, the group remains in secondary mode until fully retracted.

For leading edge flaps, if any groups are driven in secondary mode, the groups remain in secondary mode until they are fully retracted.

Alternate Mode

An alternate control mode which bypasses the FCUs can be manually selected. In alternate mode, all flaps are extended or retracted by a simplified control system and electric motors. There is no protection provided by the FCUs in alternate mode.

When the Alternate Flaps Arm switch is pushed to ALTN, flaps are extended and retracted using the Alternate Flaps selector. In ALTN, the Flap lever is inoperative.

Flap Sequencing

When the Flap lever is moved from UP detent to flaps 1 detent, the trailing edge flaps remain retracted and the inboard and midspan leading edge flap groups extend. When the Flap lever is moved from flaps 1 detent to flaps 5 detent, the trailing edge flaps move to flaps 5 position and the outboard leading edge flap groups extend. When the Flap lever is moved to the flaps 10, 20, 25, or 30 detents, the trailing edge flaps move to the selected position. The reverse sequence occurs during flap retraction. Secondary mode sequencing is the same as primary mode.

During alternate control mode extension, all leading and trailing edge flap groups begin extending immediately. Trailing edge flaps extend to a maximum position of flaps 25. During retraction, all leading edge flap groups retract after the inboard trailing edge flaps are completely retracted.

Flap Indications

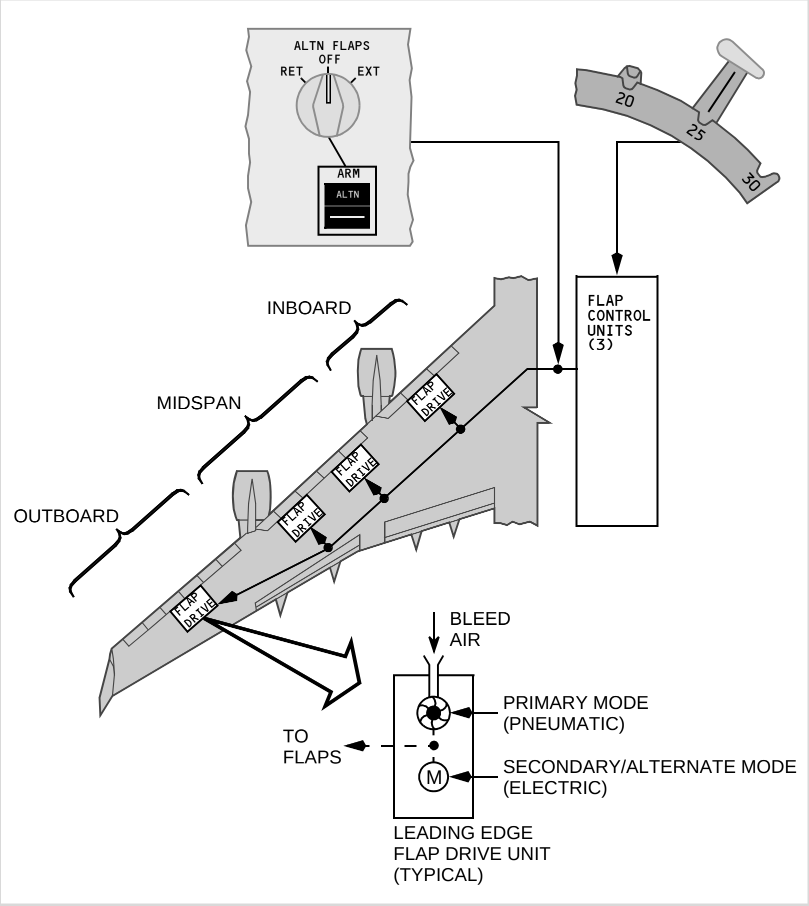
Flap position indications are displayed on the primary EICAS display. A single vertical indicator displays combined leading and trailing edge flap position. The position commanded by the Flap lever is also displayed. Ten seconds after all flaps are up, the entire indication is no longer displayed.

If flap control is in secondary or alternate mode, or if any non-normal flap position is detected, an expanded flap indication is displayed. The position of each flap group is separately indicated. In alternate mode, the position commanded by the Flap lever is replaced by flap position index marks at flaps 5 and flaps 25. The index marks are used by the flight crew as a guide to position the flaps at the desired setting.

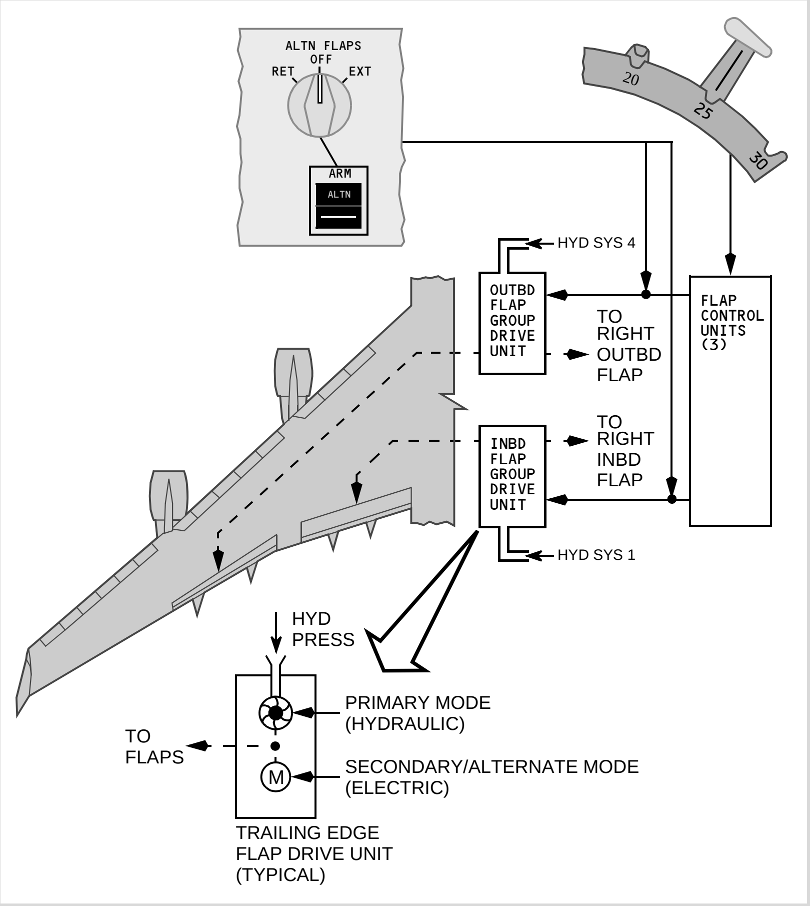
If the standby bus is the only powered AC bus, the left wing trailing edge flap position sensors are not powered. An expanded indication is displayed with an amber X on the left outboard and inboard trailing edge flap indications.

During engine reverse thrust operation, automatic retraction of inboard and midspan leading edge flaps changes the flap position indicator to reflect flaps in transit.

Leading Edge Flaps Control Diagram



Trailing Edge Flaps Control Diagram



EICAS Alert Messages

Note: Configuration (CONFIG) warning messages are described in Chapter 15, Warning Systems.

Message	Level	Aural	Message Logic
AILERON LOCKOUT	Advisory		Aileron lockout actuator position disagrees with commanded position. One or both outboard ailerons may be unlocked at high airspeeds or locked out at low airspeeds.
>FLAP RELIEF	Advisory		Flap load relief system operating.
FLAPS CONTROL	Caution	Beeper	Flap control units inoperative, or Alternate Flaps Arm switch in ALTN.
FLAPS DRIVE	Caution	Beeper	One or more flap groups have failed to drive in secondary mode, or an asymmetry condition detected.
FLAPS PRIMARY	Caution	Beeper	One or more flap groups operating in secondary control mode.
>FLT CONT VLVS	Advisory		One or more flight control shutoff valves closed.
RUD RATIO DUAL	Advisory		Upper and lower rudder ratio changers have failed.
RUD RATIO SNGL	Advisory		Upper or lower rudder ratio changer has failed.
SPEEDBRAKE AUTO	Advisory		Fault detected in automatic ground spoiler system. Fault could result in loss of automatic ground spoiler function, or in flight with Speedbrake lever in ARM position could result in inadvertent spoiler extension.

Message	Level	Aural	Message Logic
>SPEEDBRAKES EXT	Caution	Beeper	Speedbrakes extended at an inappropriate flight condition. Occurs when Speedbrake lever aft of ARM detent and radio altitude is between 800 feet and 15 feet, or flaps are in a landing position, or two or more Thrust levers are forward of closed position.
>STAB GREENBAND	Advisory		Nose gear pressure switch disagrees with calculated stabilizer green band.
>STAB TRIM 2, 3	Advisory		Stabilizer trim automatic cutout has occurred, or a Stabilizer Trim Cutout switch in CUTOUT, or trim commanded and respective actuator failed to function.
STAB TRIM UNSCHD	Caution	Beeper	Uncommanded stabilizer motion detected and automatic cutout does not occur, or Alternate Stabilizer Trim switches used with autopilot engaged.
>YAW DAMPER LWR, UPR	Advisory		Yaw damper failure or power failure. May be due to module fault, actuator fault, IRUs off or in align, Yaw Damper switch off, or module power off.

EICAS Memo Messages

Message	Level	Aural	Message Logic
SPEEDBRAKE ARMED	Memo		Speedbrake lever in ARM position.

Flight Instruments, Displays — Chapter 10

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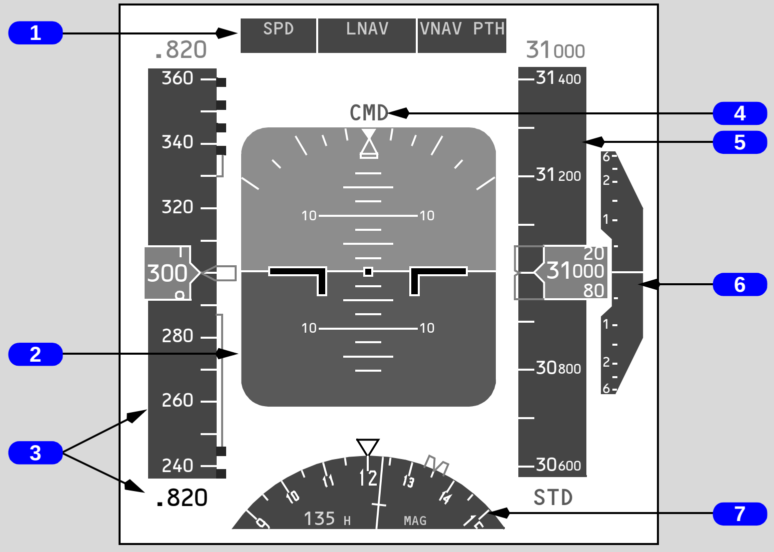
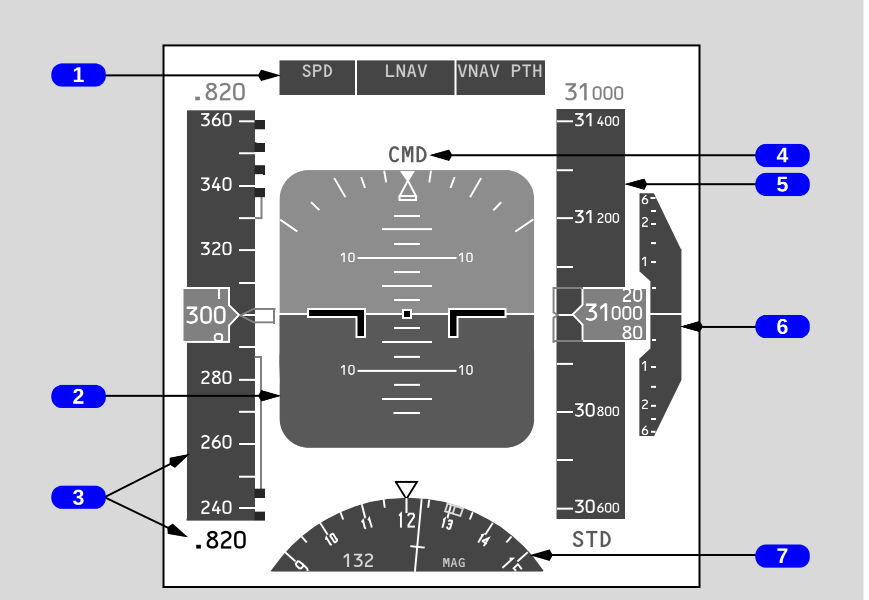
Primary Flight Display (PFD)
Liquid Crystal Display



LEFT AND RIGHT FORWARD PANELS

Cathode Ray Tube



LEFT AND RIGHT FORWARD PANELS

1 **Flight Mode Annunciations**

Refer to Chapter 4, Automatic Flight.

2 **Attitude, Steering, and Miscellaneous Displays**

Displays IRU attitude information.

3 **Airspeed/Mach Displays**

Displays ADC airspeed information and other airspeed related information.

4 **Autopilot, Flight Director System Status**

Refer to Chapter 4, Automatic Flight.

5 **Altitude Displays**

Displays ADC altitude and other altitude-related information.

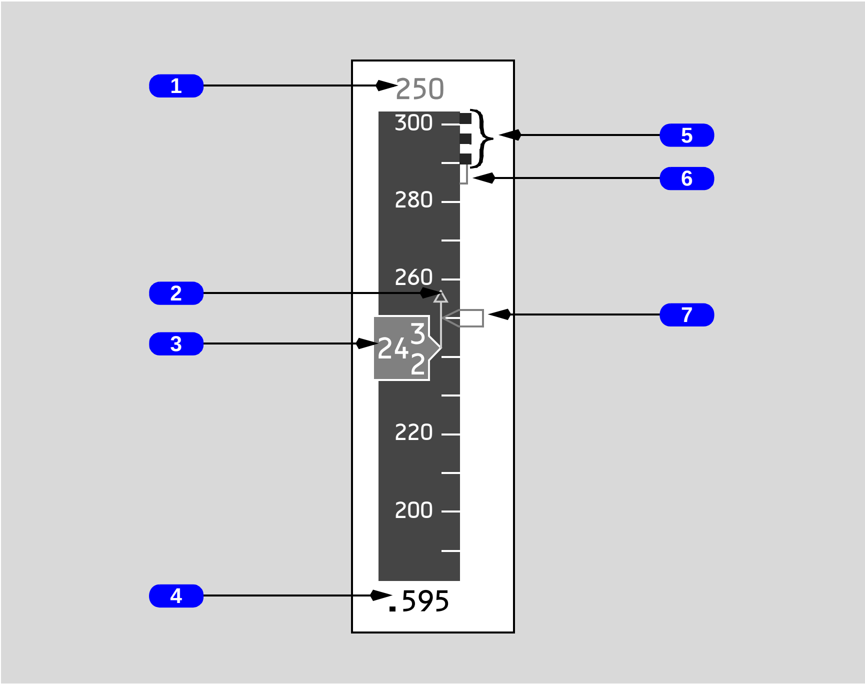
6 **Vertical Speed Display**

Displays ADC vertical speed as dampened by the IRS.

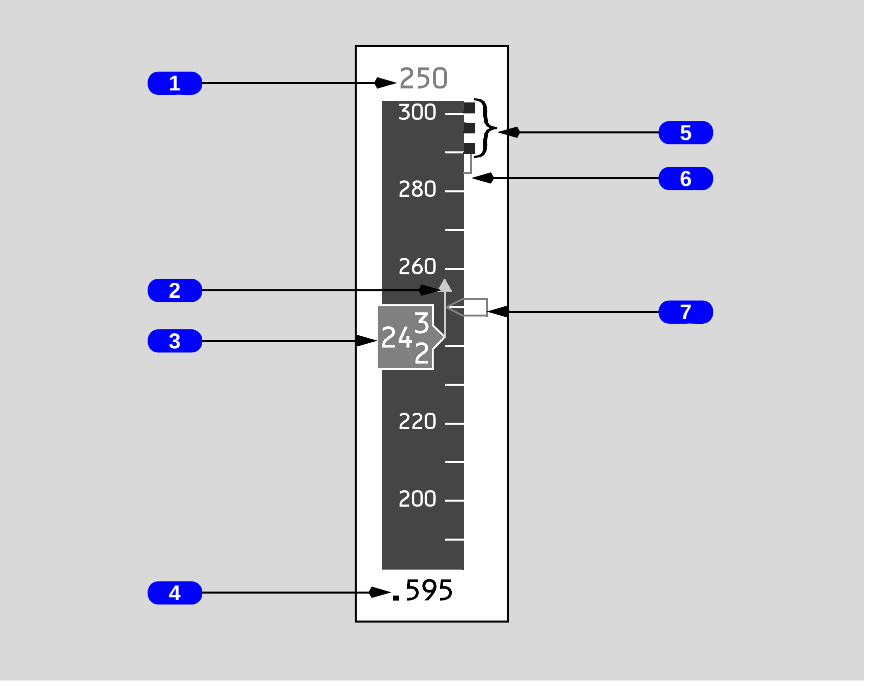
7 **Heading and Track Displays**

Displays current IRS heading, track, and other heading information.

Airspeed Displays
Liquid Crystal Display



Cathode Ray Tube



1 Command Speed

Displays airspeed/Mach set in the MCP IAS/MACH window (refer to Chapter 4, Automatic Flight).

Displays FMC-computed airspeed/Mach when the IAS/MACH window is blank.

2 Trend Indication

Indicates predicted airspeed in ten seconds based on current acceleration or deceleration.

3 Current Airspeed

Displays ADC airspeed.

Displays 30 knots with no computed information.

Airspeed box changes to amber if current airspeed less than minimum maneuvering speed.

4 Current Mach

Displays ADC Mach when Mach .40 or greater.

5 Maximum Speed

Indicates maximum airspeed limited by lowest of the following:

- Vmo/Mmo
- landing gear placard speed, or
- flap placard speed

6 Maximum Maneuvering Speed

Bottom of amber bar indicates the maximum maneuvering speed. This airspeed provides 1.3g maneuver capability to high speed buffet (or an alternative approved maneuver capability as preset by maintenance). May be displayed when operating at high altitude at relatively high gross weights.

Note: 1.3g maneuver capability occurs at 40 degrees of bank in level flight.

CAUTION: Reduced maneuver capability exists when operating within the amber regions above the maximum maneuvering speed.

7 Command Speed

Points to airspeed/Mach set in MCP IAS/MACH window.

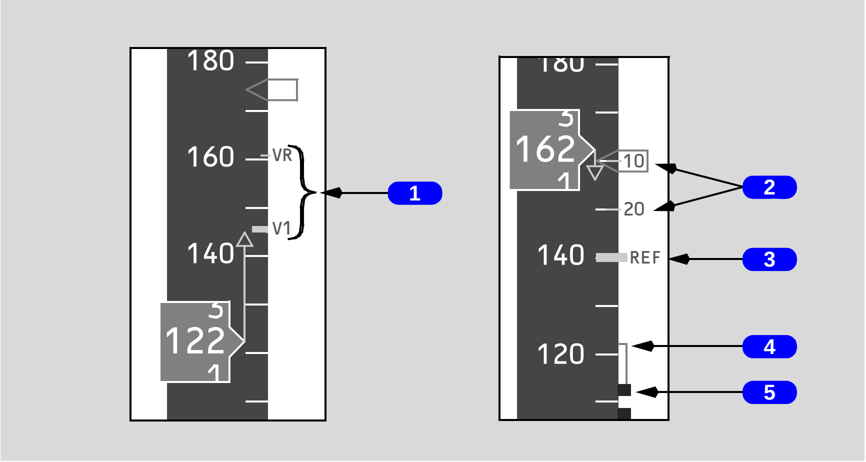
Points to FMC-computed airspeed when MCP IAS/MACH window blank.

Pointer is five knots in height.

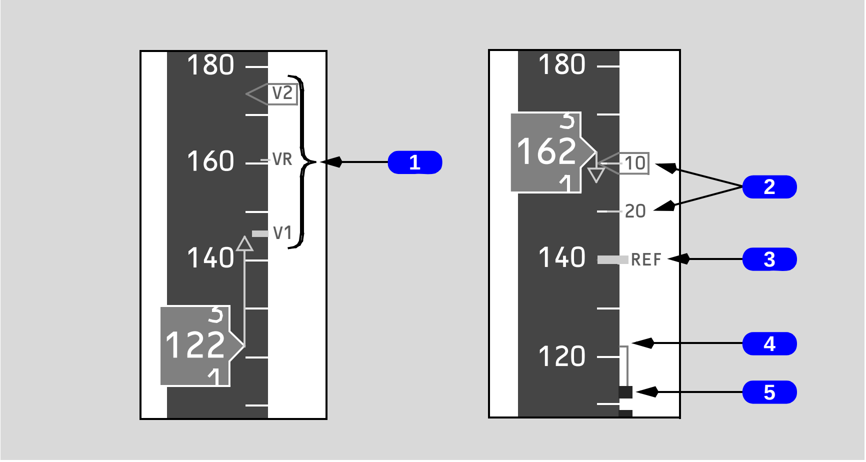
When the selected speed is off scale, the pointer is parked at the top or bottom of the tape, with half the pointer visible.

Reference Speeds
Liquid Crystal Display

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



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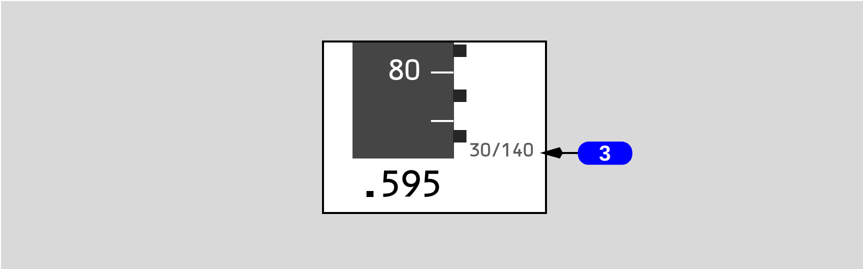
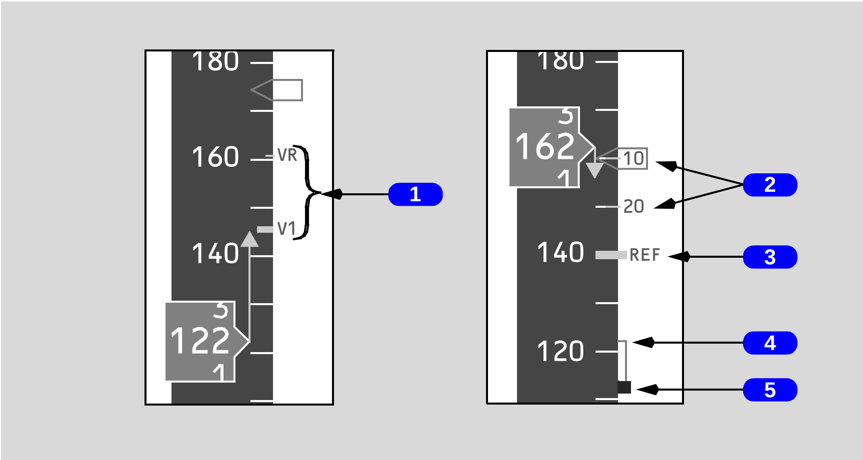
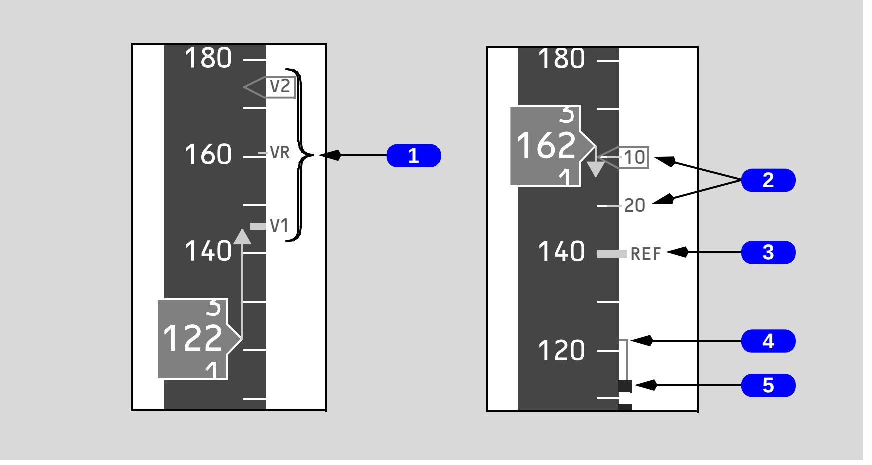


Cathode Ray Tube

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



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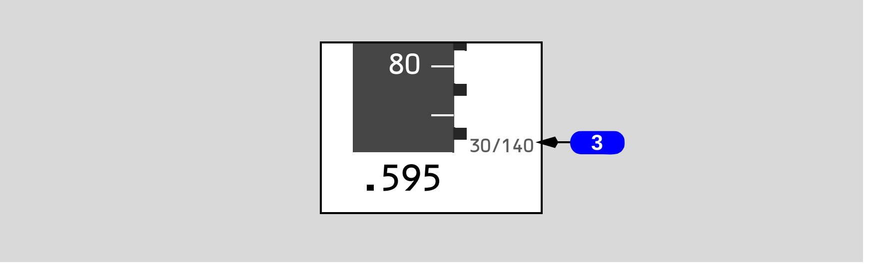


EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

1 Takeoff Reference Speeds

Displays takeoff reference speeds V1 and VR (displays R when VR within 4 knots of V1) selected on the CDU (refer to Chapter 11, Flight Management, Navigation):

- displayed for takeoff
- NO V SPD displays when V speeds are not selected on the CDU
- V1 displays at the top of the airspeed indication when selected and if the value is off the scale
- V1 and VR are removed at lift-off

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

1 Takeoff Reference Speeds

Displays takeoff reference speeds V1, VR (displays R when VR within 4 knots of V1), and V2 selected on the CDU (refer to Chapter 11, Flight Management, Navigation):

- displayed for takeoff
- NO V SPD displays when V speeds are not selected on the CDU
- V1 displays at the top of the airspeed indication when selected and if the value is off the scale
- V1 and VR are removed at lift-off
- V2 is removed on climb-out when flap retraction begins

2 Flap Maneuvering Speeds

Displays flap maneuvering speed for flap retraction or extension for current flap setting and next lesser flap setting.

Not displayed above approximately 20,000 feet altitude.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

3 Landing Reference Speed

Displays VREF speed selected on the CDU (refer to Chapter 11, Flight Management, Navigation).

VREF speed displays at the bottom of the airspeed indication when the value is off the scale.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

3 Selected Landing Flap/Landing Reference Speed

Displays landing flaps and VREF speed selected on the CDU (refer to Chapter 11, Flight Management, Navigation).

VREF speed displays at the bottom of the airspeed indication when the value is off the scale.

4 Minimum Maneuvering Speed

Top of amber bar indicates minimum maneuvering speed. This airspeed provides:

- 1.3g maneuver capability to stick shaker with flaps down
- 1.3g maneuver capability to stick shaker or VREF+80, whichever is less, with flaps up at approximately 20,000 FT
- 1.3g maneuver capability to low speed buffet (or an alternative approved maneuver capability as preset by maintenance) with flaps up at approximately 20,000 FT

Displayed with first flap retraction after takeoff.

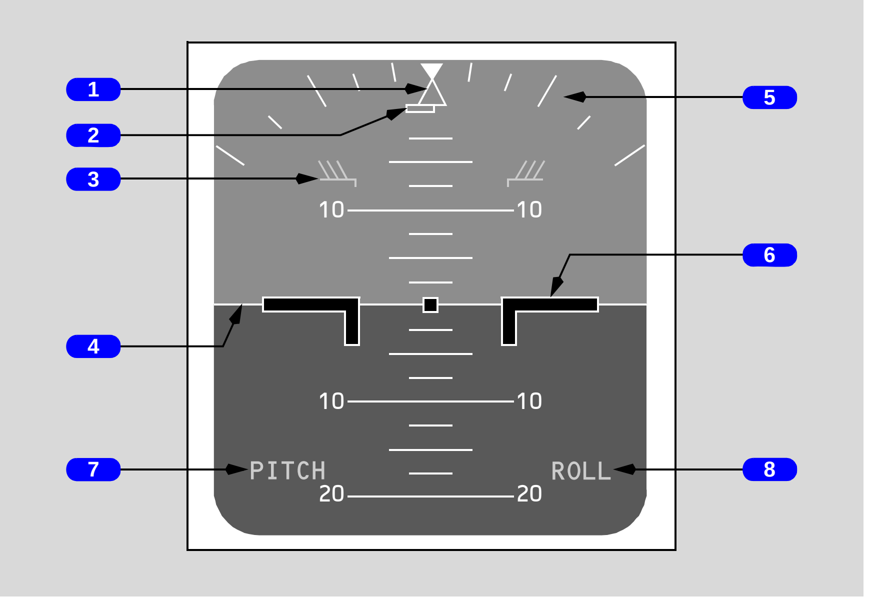
Note: 1.3g maneuver capability occurs at 40 degrees of bank in level flight.

CAUTION: Reduced maneuver capability exists when operating within the amber regions below the minimum maneuvering speed. During non-normal conditions the target speed may be below the minimum maneuvering speed.

5 Minimum Speed

Indicates airspeed where stick shaker or low speed buffet occurs.

Attitude Indications
Liquid Crystal Display



1 Bank Pointer

Indicates IRS bank in reference to bank scale.

Fills solid amber when bank angle is 35 degrees or greater.

2 Slip/Skid Indication

Displaces beneath bank pointer to indicate slip or skid.

When bank angle is less than 35 degrees, indicator fills solid white when fully displaced.

When bank angle is 35 degrees or greater, indicator outline changes to amber.

When bank angle is 35 degrees or greater, indicator fills solid amber when fully displaced.

3 Pitch Limit Indication

Indicates pitch limit (stick shaker activation point for existing flight conditions).

(EI-XLG, EI-XLH, EI-XLJ ; SB activates flaps up PLI)
Displayed when flaps are not up, or at slow speeds with flaps up.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLI, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX (EI-XLG, EI-XLH, EI-XLJ ; before SB, flaps up PLI not active)
Displayed when flaps are not up.

4 Horizon Line and Pitch Scale

Indicates IRS horizon relative to the airplane symbol.

Pitch scale is in 2.5 degree increments.

5 Bank Scale

Fixed reference for the bank pointer.

Scale marks are at 0, 10, 20, 30, 45, and 60 degrees.

6 Airplane Symbol

Indicates airplane attitude with reference to the IRS horizon.

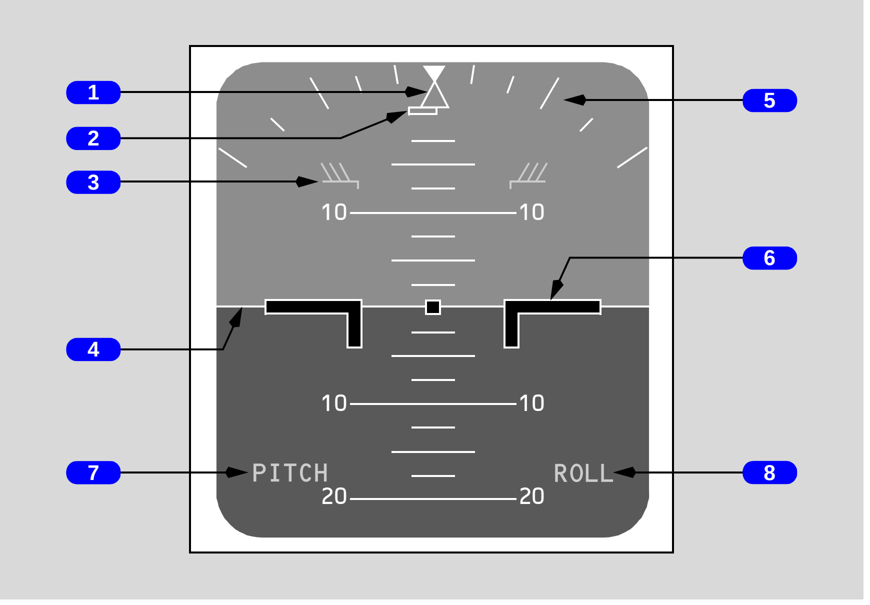
7 PITCH Disagree Flag

Displays if Captain’s and First Officer’s PFD pitch attitude disagree.

8 ROLL Disagree Flag

Displays if Captain’s and First Officer’s roll attitude disagree.

Cathode Ray Tube



1 Bank Pointer

Indicates IRS bank in reference to bank scale.

2 Slip/Skid Indication

Displaces beneath bank pointer to indicate slip or skid.

3 Pitch Limit Indication

Indicates pitch limit (stick shaker activation point for existing flight conditions).

(EI-XLG, EI-XLH, EI-XLJ ; SB activates flaps up PLI)
Displayed when flaps are not up, or at slow speeds with flaps up.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLI, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX (EI-XLG, EI-XLH, EI-XLJ ; before SB, flaps up PLI not active)
Displayed when flaps are not up.

4 Horizon Line and Pitch Scale

Indicates IRS horizon relative to the airplane symbol.

Pitch scale is in 2.5 degree increments.

5 **Bank Scale**

Fixed reference for the bank pointer.

Scale marks are at 0, 10, 20, 30, 45, and 60 degrees.

6 **Airplane Symbol**

Indicates airplane attitude with reference to the IRS horizon.

7 **PITCH Disagree Flag**

Displays if Captain’s and First Officer’s PFD pitch attitude disagree.

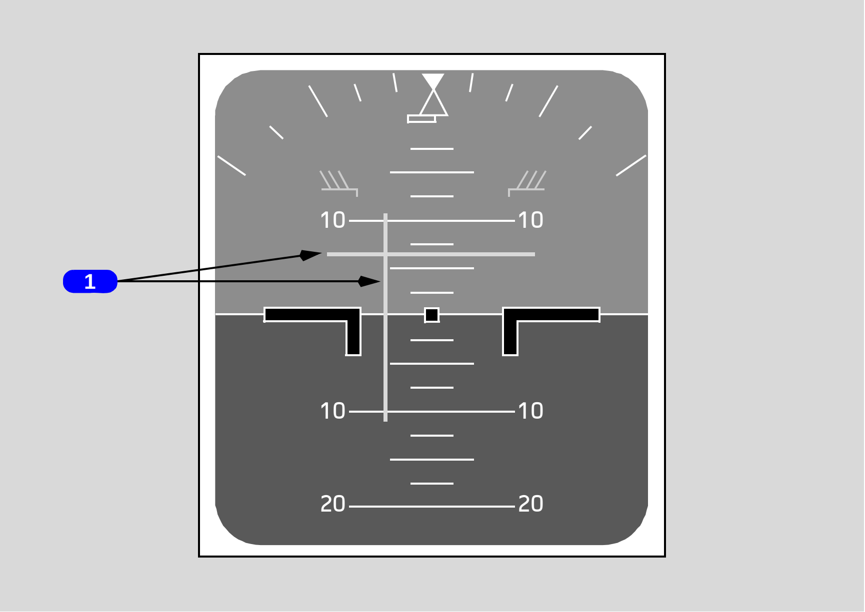
8 **ROLL Disagree Flag**

Displays if Captain’s and First Officer’s roll attitude disagree.

Steering Indications

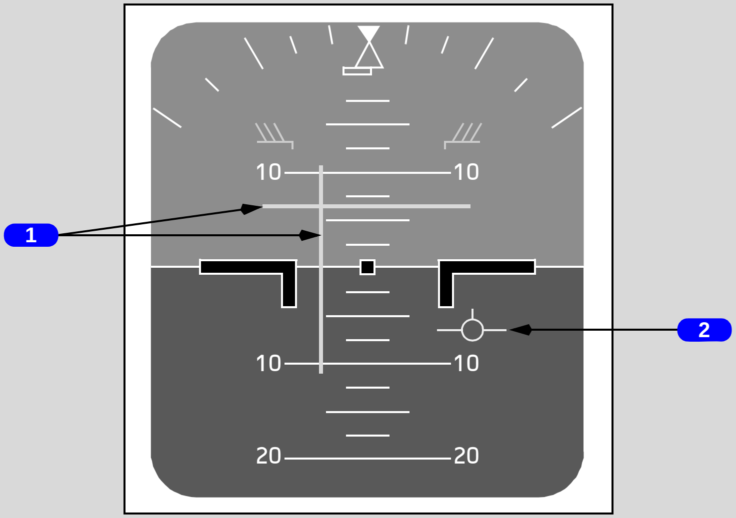
Note: Refer to Chapter 15, Warning Systems, for TCAS Steering Indications and Time Critical Warnings.

VQ-BHW, VQ-BHX



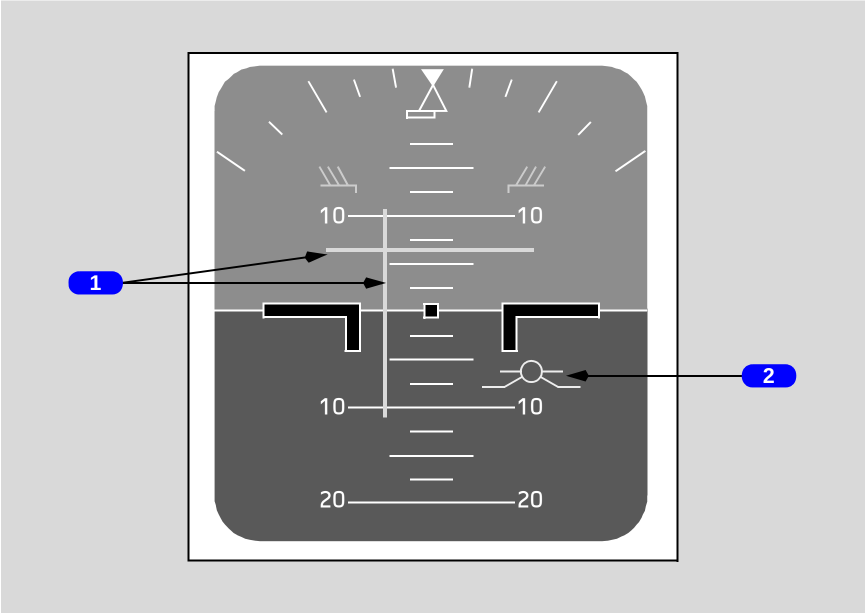
Liquid Crystal Display

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



Cathode Ray Tube

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Flight Director Command Bars

Indicates flight director pitch and roll steering commands.

Refer to Chapter 4, Automatic Flight.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

2 Flight Path Vector

Displays flight path angle and drift angle when selected on EFIS control panel.

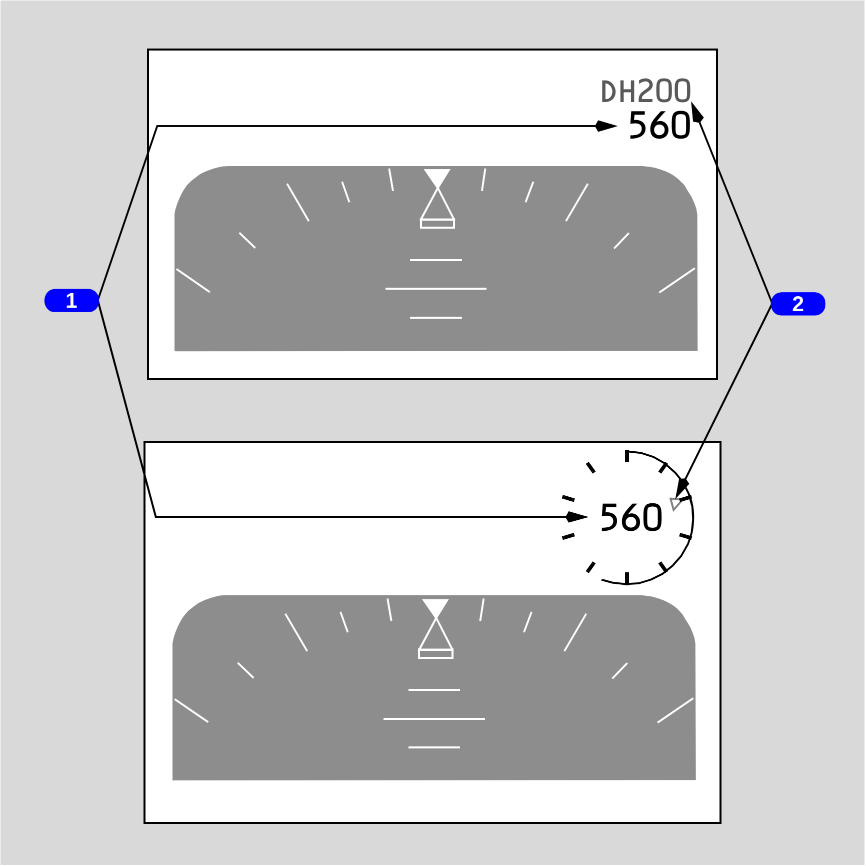
Flight path angle displays relative to the horizon line.

Drift angle is represented by the perpendicular distance from the centerline of the pitch scale to the FPV symbol.

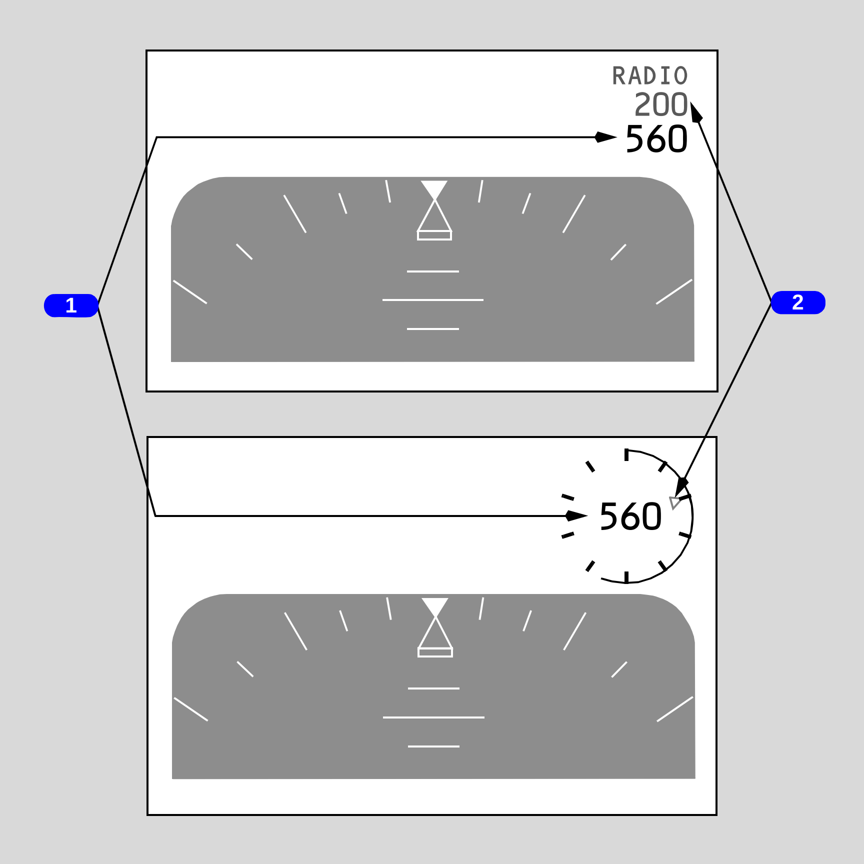
“Arms” are parallel to the horizon line and “feet” are parallel to the airplane symbol (CRT).

Radio Altitude Indications

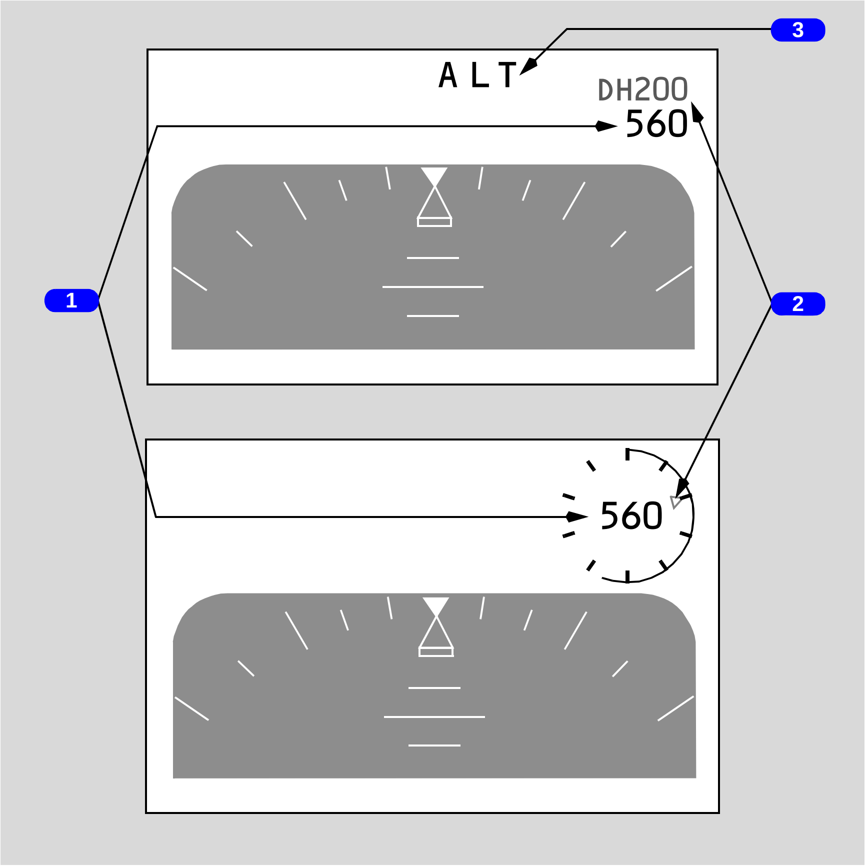
VP-BKL



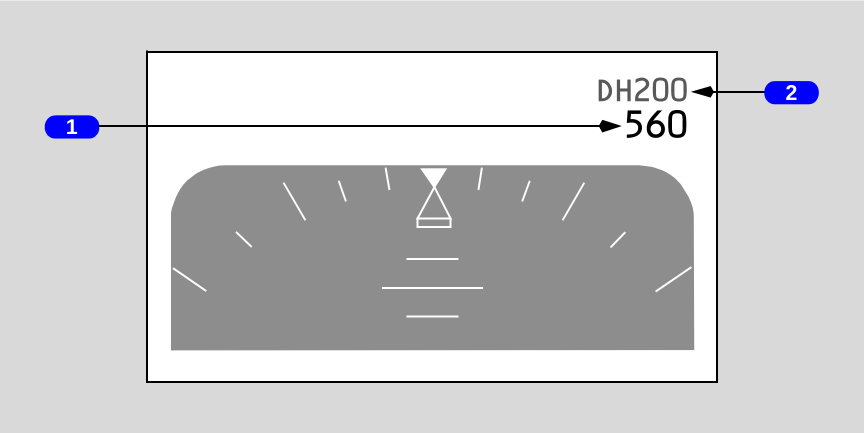
EI-XLZ



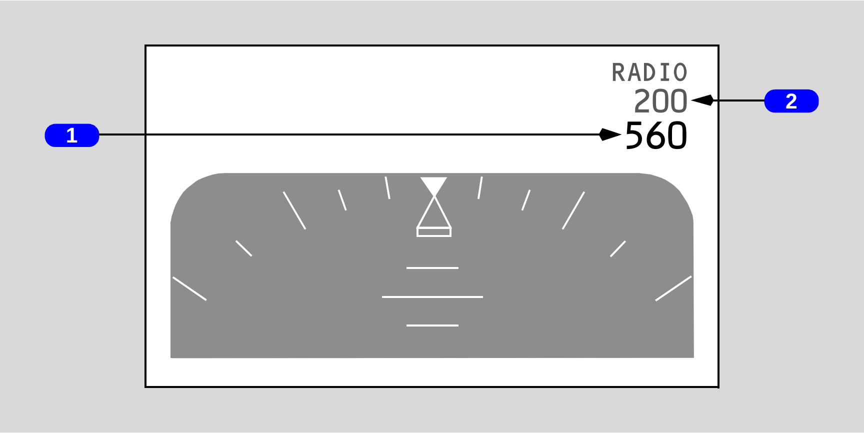
VP-BKJ, VP-BVR



VQ-BHW, VQ-BHX

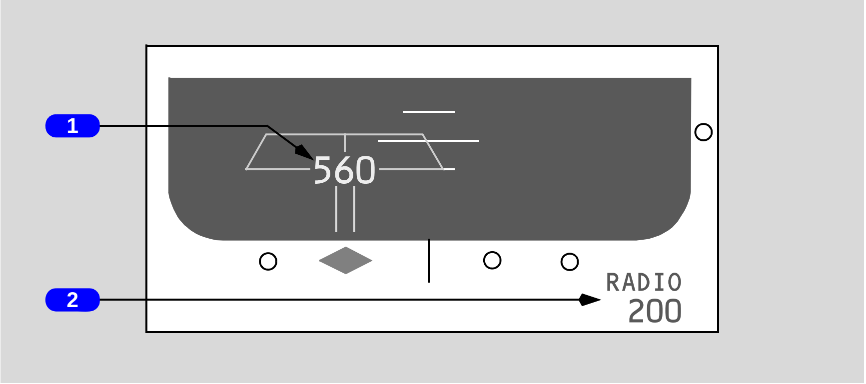


EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



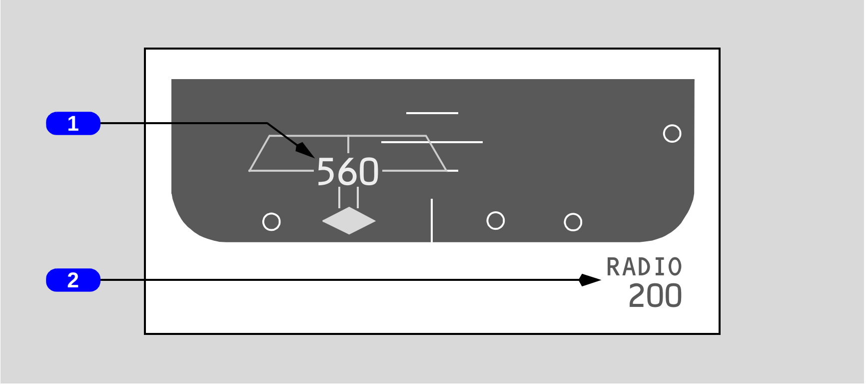
Liquid Crystal Display

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



Cathode Ray Tube

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

1 Radio Altitude

Displays airplane radio altitude below 2,500 feet AGL.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

1 Radio Altitude

Displays airplane radio altitude below 2,500 feet AGL:

- centered over the localizer scale between 2,500 feet and 1,000 feet AGL
- centered over the localizer deviation indicator below 1,000 feet AGL
- centered at the bottom of the attitude indication if localizer scale not displayed
- centered over the localizer scale while flying a backcourse approach (backcourse sensing)

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

1 Radio Altitude

Digital - displays radio altitude:

- on the ground, when speed less than 50 knots
- in flight, between 1,000 feet and 2,500 feet AGL

Analog -

- displays radio altitude between 50 knots ground speed and 1,000 feet AGL.
- index marks located at 100 foot intervals
- 0 foot and 1,000 feet index mark at 12 o'clock
- length of arc indicates radio altitude
- digital radio altitude displays in the center

VP-BKJ, VP-BKL, VP-BVR

2 Decision Height

Digital - displays decision height:

- on the ground, when speed less than 50 knots
- in flight, between 1,000 feet and 2,500 feet AGL
- when DH is set to an altitude higher than 1,000 feet AGL, entire DH display is replaced by a flashing amber DH descending through the set DH

Analog -

- displays decision height between 50 knots ground speed and 1,000 feet AGL, pointer indicates DH set on the EFIS control panel
- when DH is set to an altitude lower than 1,000 feet AGL, entire analog display changes color to amber and flashes descending through the set DH

DH not displayed when set below 0 feet.

Flashing amber DH resets:

- upon landing
- on go-around at 75 feet above the set DH
- when DH reset switch is pushed

EI-XLZ

2 RADIO Minimums

Digital - displays selected radio altitude:

- on the ground, when speed less than 50 knots
- in flight, between 1,000 feet and 2,500 feet AGL
- when radio altitude is set to an altitude higher than 1,000 feet AGL, entire RADIO display is replaced by a flashing amber RADIO descending through the set radio altitude

Analog -

- displays radio altitude between 50 knots ground speed and 1,000 feet AGL, pointer indicates RADIO altitude set on the EFIS control panel
- when radio altitude is set to an altitude lower than 1,000 feet AGL, entire analog display changes color to amber and flashes descending through the set radio altitude

RADIO not displayed when set below 0 feet.

Flashing amber RADIO resets:

- upon landing
- on go-around at 75 feet above the set radio altitude
- when MINS RST switch is pushed

VQ-BHW, VQ-BHX

2 Decision Height

Displays radio altitude set on EFIS control panel.

Display replaced with a large flashing amber DH when radio altitude is at or below the set DH.

DH not displayed when set below 0 feet.

Flashing amber DH resets:

- upon landing
- on go-around at 75 feet above the set DH
- when DH reset switch is pushed

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

2 RADIO Minimums

Displays radio altitude set on EFIS control panel.

RADIO and the altitude setting change color to amber and flash when radio altitude is at or below the setting.

RADIO not displayed when set below 0 feet.

Flashing amber RADIO and the altitude setting reset:

- upon landing
- on go-around at 75 feet above the setting
- when MINS RST switch is pushed

VP-BKJ, VP-BVR

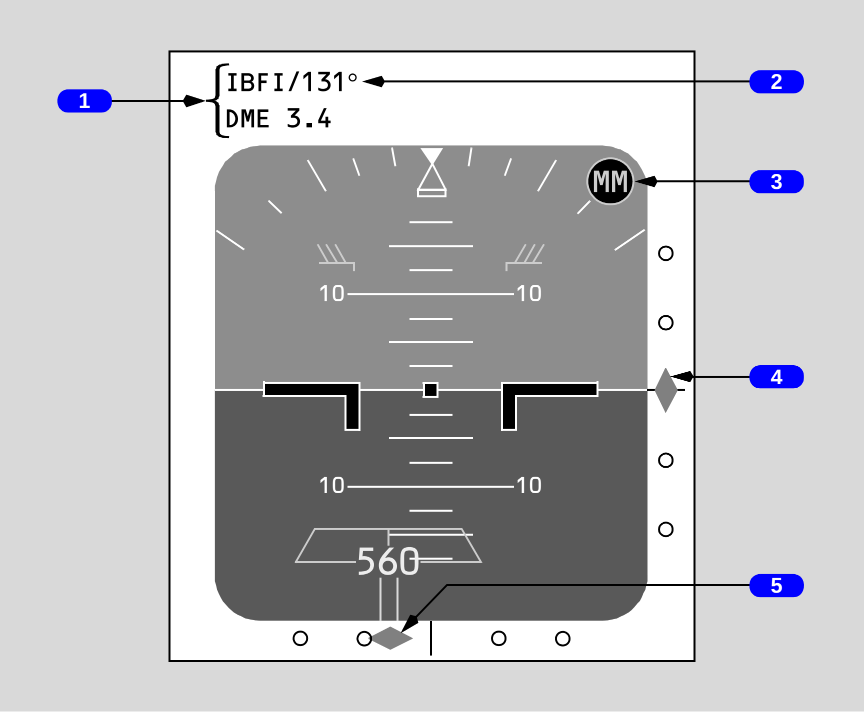
3 Height Alert

Displays between 1,500 feet and 500 feet AGL during descent.

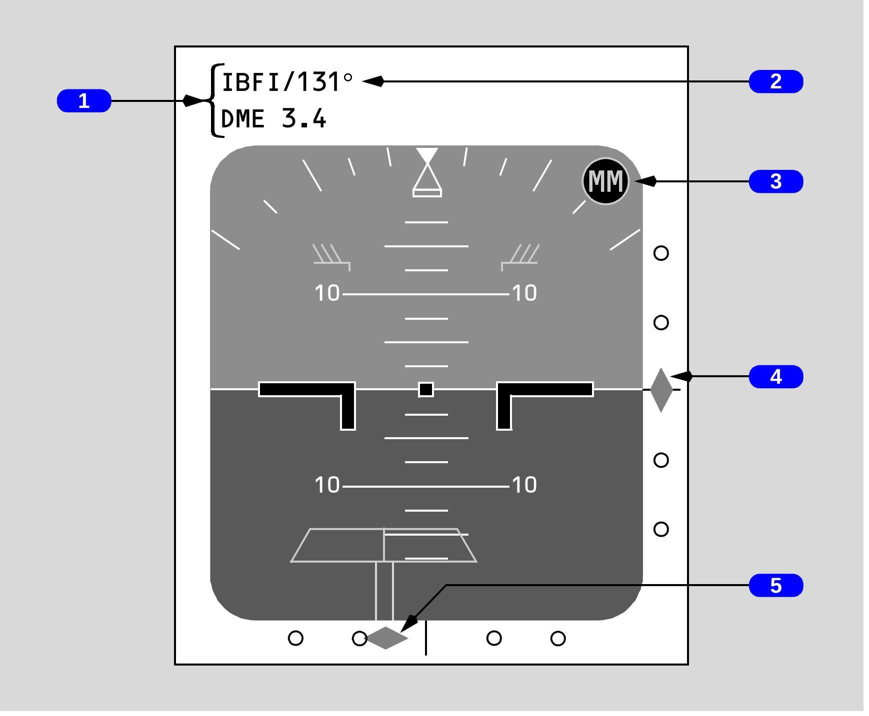
Does not display when DH reset switch pushed.

Instrument Landing System Indications
Liquid Crystal Display

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

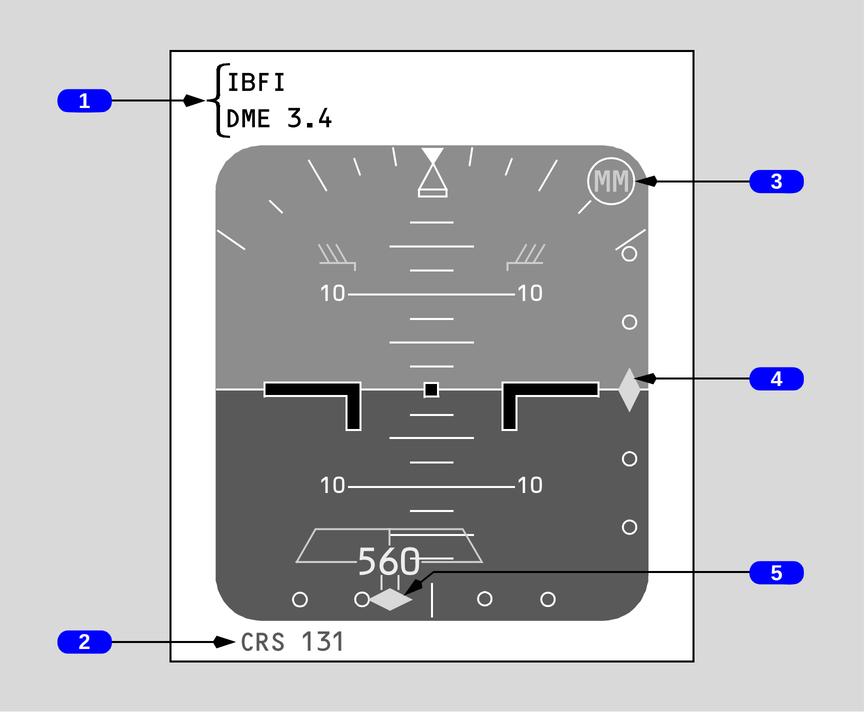


EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

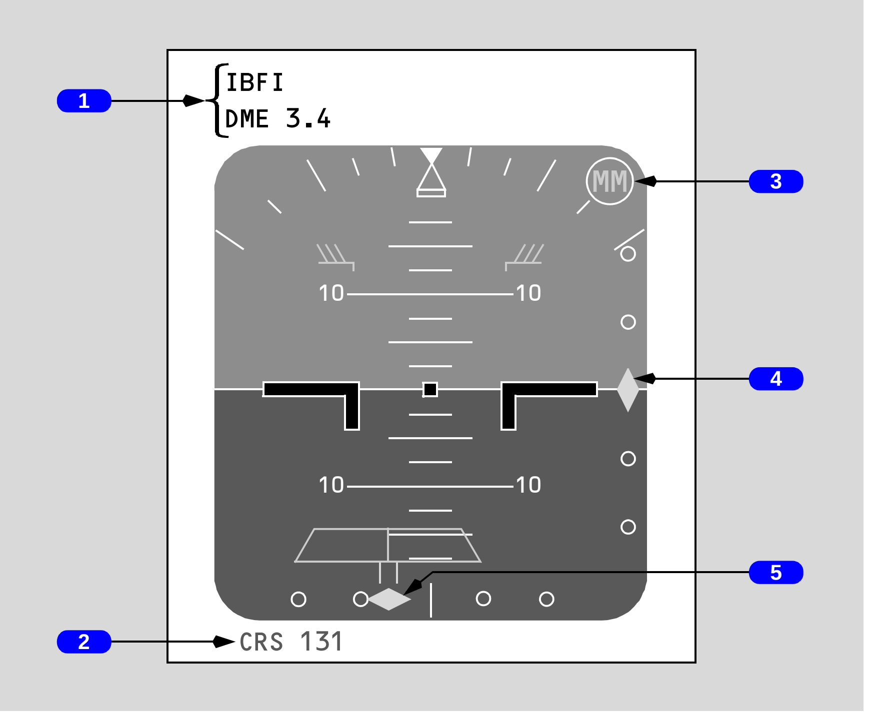


Cathode Ray Tube

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



1 Approach Reference

Displays the selected ILS identifier or frequency and ILS DME distance.

If the tuned ILS frequencies disagree, an amber horizontal line is drawn through the frequency.

Refer to Chapter 11, Flight Management, Navigation.

2 Approach Course

Displays the selected ILS approach course.

If the approach courses in the ILS receivers disagree, an amber horizontal line is drawn through the course.

3 Marker Beacon Annunciation

The marker beacon annunciation appears flashing when over one of the marker beacon transmitters:

- IM - an airway or inner marker beacon (white)
- MM - a middle marker beacon (amber)
- OM - an outer marker beacon (blue)

Annunciation flashes in cadence with the beacon identifier.

Annunciation not available if left VOR has failed.

4 Glideslope Pointer and Scale

Glideslope pointer indicates glideslope position relative to the airplane and:

- is in view when receiving the glideslope signal
- fills in solid when within 2 1/3 dots of the scale center

Scale is in view after the frequency is tuned.

At low radio altitudes, with the autopilot or flight director engaged, scale turns amber and the pointer flashes to indicate excessive glideslope deviation.

5 Localizer Pointer and Scale

Localizer pointer:

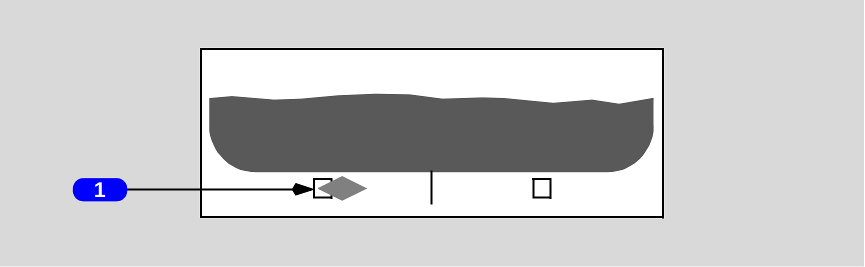
- indicates localizer position relative to the airplane
- is in view when the localizer signal is received
- fills in solid when within 2 1/3 dots from the center

Scale is in view after the frequency is tuned.

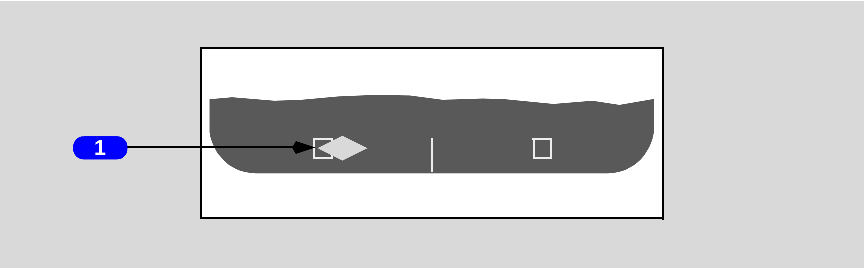
At low radio altitudes, with the autopilot or flight director engaged, scale turns amber and the pointer flashes to indicate excessive localizer deviation.

At low altitudes, with LNAV engaged and LOC armed, localizer scale turns amber and the pointer flashes if localizer is not captured.

Expanded Localizer Indications
Liquid Crystal Display



Cathode Ray Tube



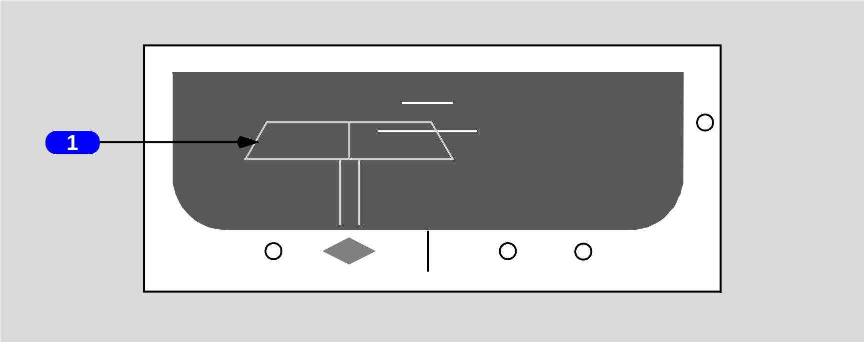
1 Expanded Localizer Deviation Scale

Displays when the airplane is close to the localizer centerline. Provides a more sensitive display.

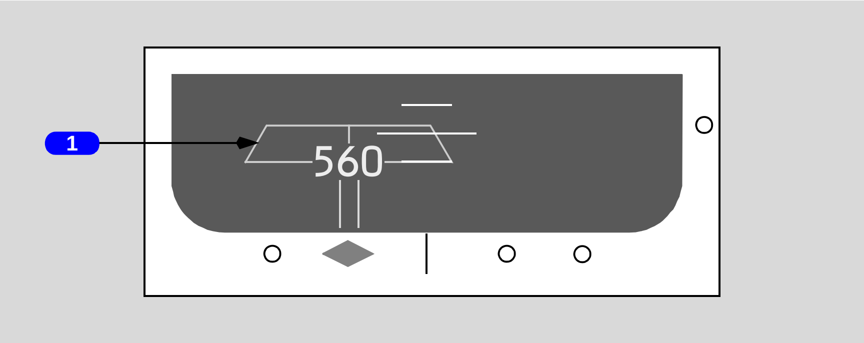
A rectangle equals 1/2 dot deviation.

Rising Runway Indications
Liquid Crystal Display

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

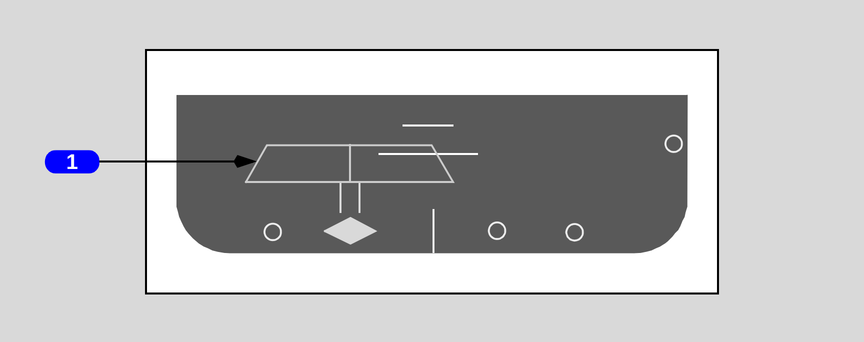


EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

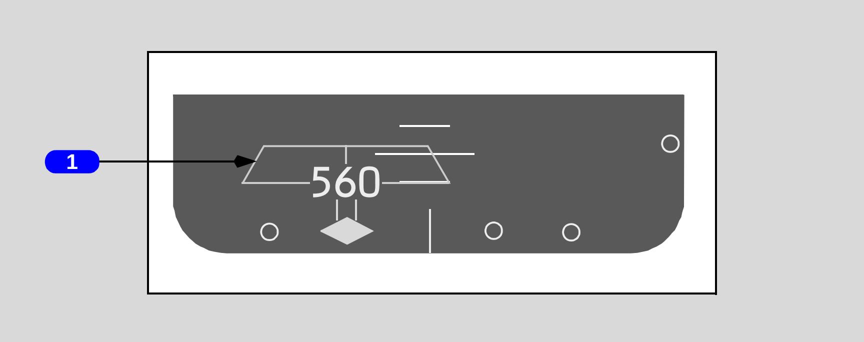


Cathode Ray Tube

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



1 **Rising Runway**

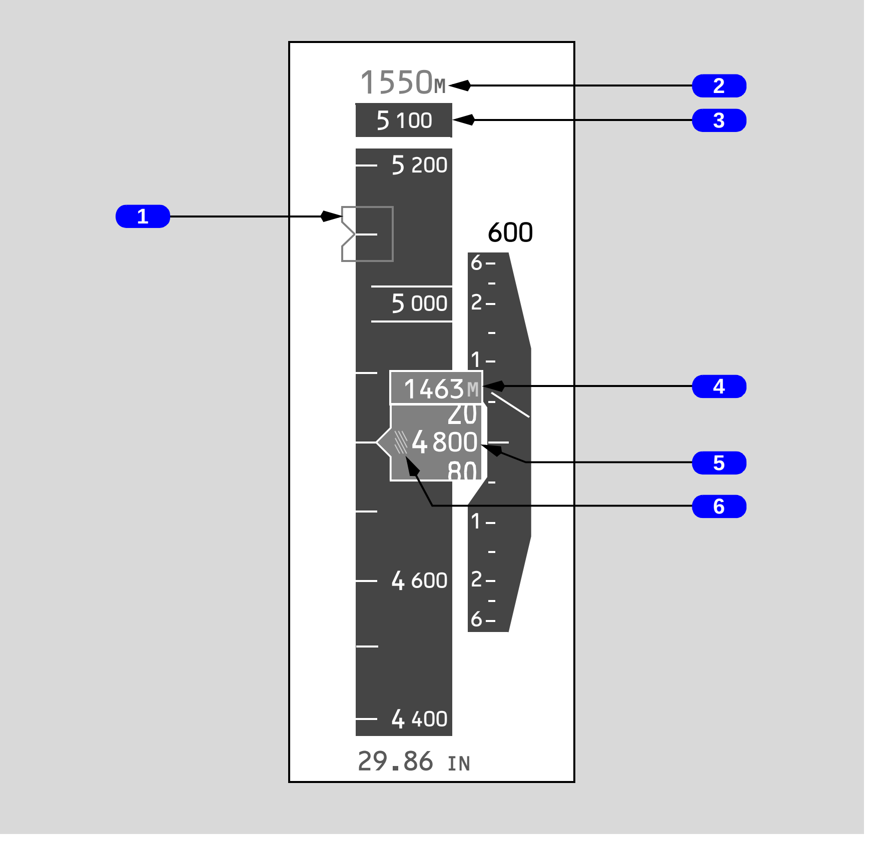
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Displays below 2,500 feet radio altitude when the localizer pointer is in view.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
Displays below 1,000 feet radio altitude when the localizer pointer is in view.

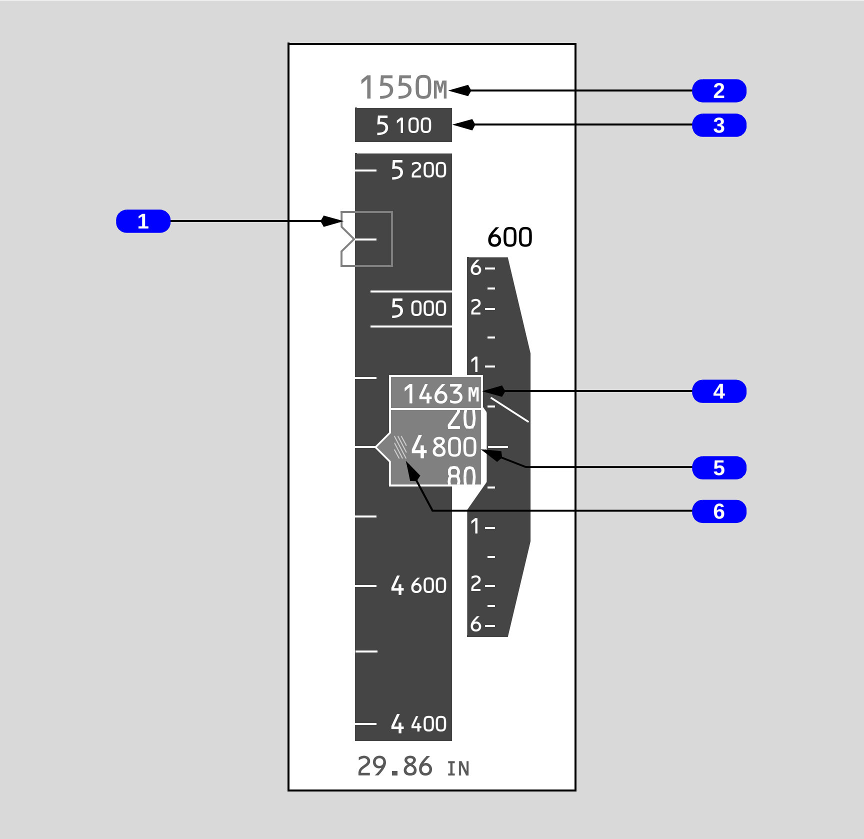
Moves toward the airplane symbol below 200 feet radio altitude.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
Removed while flying a backcourse approach (backcourse sensing).

Altitude Indications
Liquid Crystal Display



Cathode Ray Tube



1 Selected Altitude Pointer

Indicates altitude set in the MCP altitude window.

When selected altitude is off scale, pointer displays at the top or bottom of the tape with half the pointer visible.

2 Selected Altitude - Meters

Displays when MTRS selected on EFIS control panel MTRS switch.

Indicates selected altitude in meters (selected in feet in MCP altitude window).

Displays in 10 meter increments.

3 Selected Altitude

Displays altitude set in altitude window on MCP.

Selected altitude box is highlighted in white between 900 feet and 300 feet prior to reaching the selected altitude.

4 Current Altitude - Meters

Displays when MTRS selected on EFIS control panel MTRS switch.

Displays altitude in meters.

5 Current Altitude

Displays barometric altitude from selected ADC.

Altitude box is highlighted in white between 900 feet and 300 feet when approaching selected altitude.

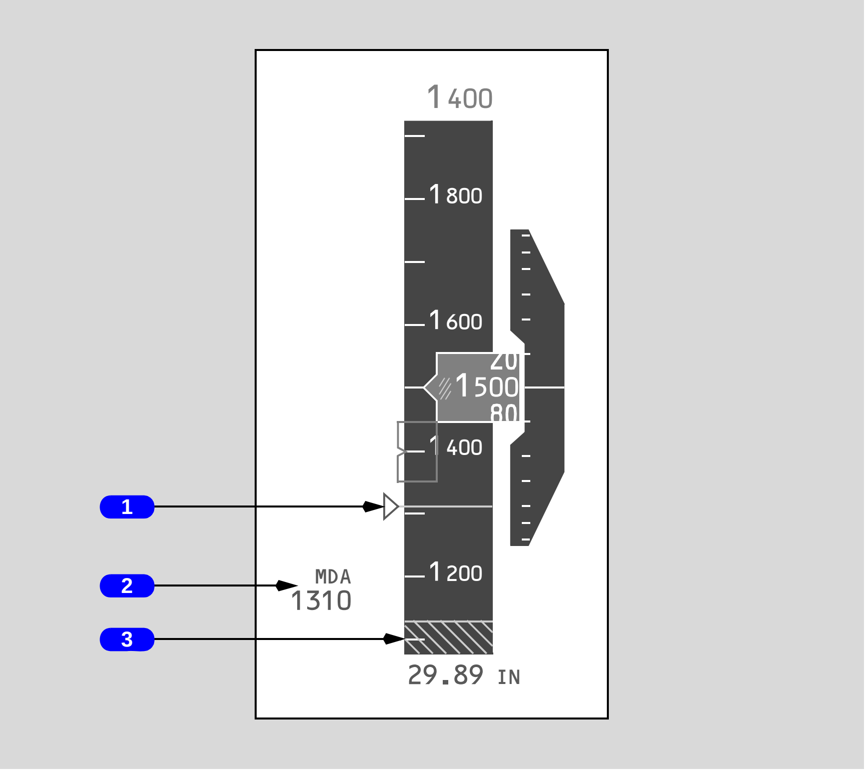
Altitude box changes to amber when deviating from selected altitude between 300 feet and 900 feet.

6 Ten Thousand Digit Display

Cross hatch displays when altitude is below 10,000 feet.

Landing Altitude/Minimums Indications

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



1 MDA Pointer

Indicates barometric altitude set on EFIS control panel.

2 MDA Display

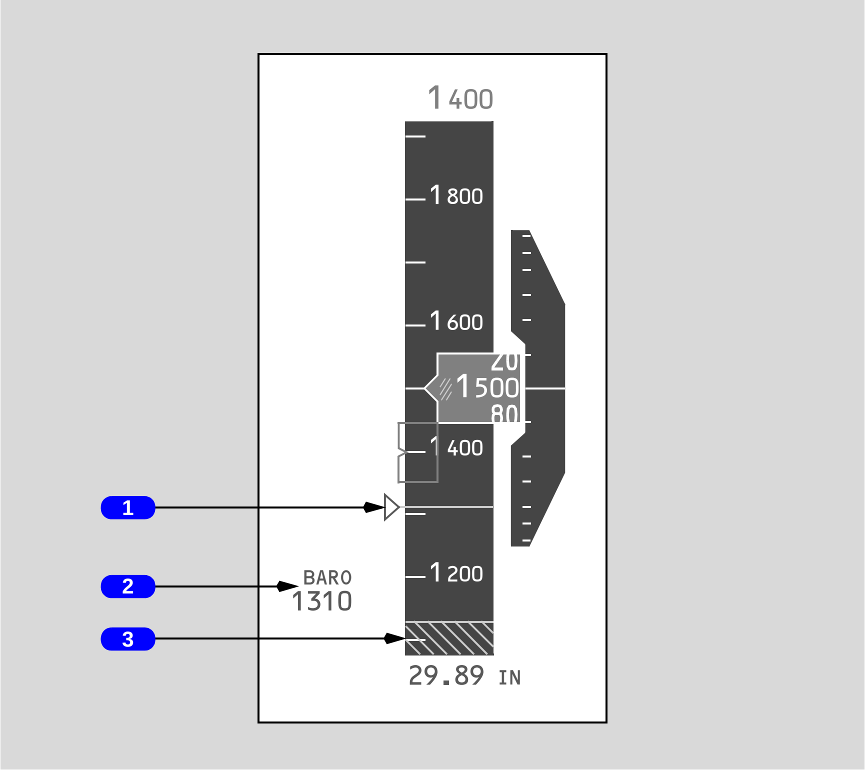
Displays barometric altitude set on EFIS control panel.

Not displayed when MDA set below -100 feet.

3 Touchdown Zone Indicator

Upper edge of crosshatched area indicates FMC landing altitude for destination runway or airport.

Indicates the landing altitude for the departure runway or airport until 400 NM or one-half the distance to the destination whichever occurs first. See Chapter 11, Flight Management, Navigation, Section 43, arrivals page information.



1 BARO Pointer

Indicates barometric altitude set on EFIS control panel.

2 BARO Display

Displays barometric altitude set on EFIS control panel.

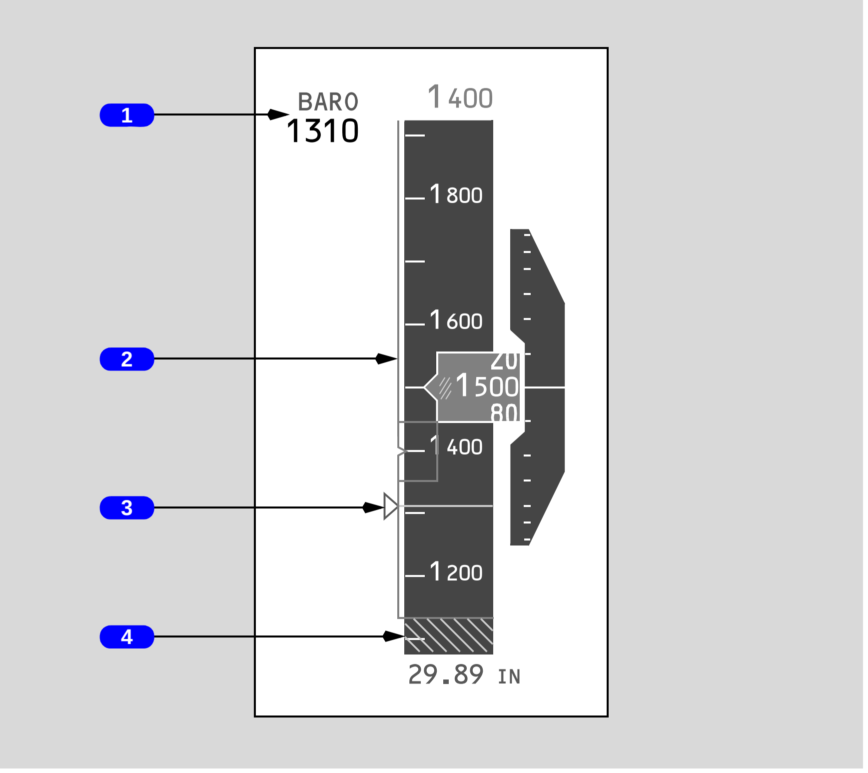
Not displayed when BARO set below -100 feet.

3 Touchdown Zone Indicator

Upper edge of crosshatched area indicates FMC landing altitude for destination runway or airport.

Indicates the landing altitude for the departure runway or airport until 400 NM or one-half the distance to the destination whichever occurs first. See Chapter 11, Flight Management, Navigation, Section 43, arrivals page information.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



1 BARO Display

Displays barometric altitude set on EFIS control panel.

Not displayed when BARO set below -100 feet.

2 Landing Altitude Reference Bar

Indicates height above touchdown.

White bar - 500 to 1,000 feet above landing altitude.

Amber bar - 0 to 500 feet above landing altitude.

3 BARO Pointer

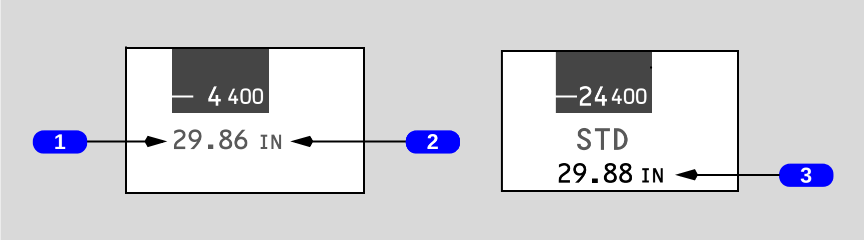
Indicates barometric altitude set on EFIS control panel.

4 Touchdown Zone Indicator

Upper edge of crosshatched area indicates FMC landing altitude for destination runway or airport.

Indicates the landing altitude for the departure runway or airport until 400 NM or one-half the distance to the destination whichever occurs first. See Chapter 11, Flight Management, Navigation, Section 43, arrivals page information.

Barometric Indications



1 Barometric Setting

Displays barometric setting set on EFIS control panel barometric control.

STD displays when STD selected on EFIS control panel barometric standard switch.

Display is boxed and changes to amber if a barometric setting is set, MCP altitude above transition altitude, and airplane climbs 300 feet above transition altitude, or if STD is selected, MCP altitude below transition flight level, and airplane descends 300 feet below transition flight level.

2 Barometric Reference

Displays barometric units selected on EFIS control panel barometric reference selector:

- IN - inches of mercury
- HPA - Hectopascals

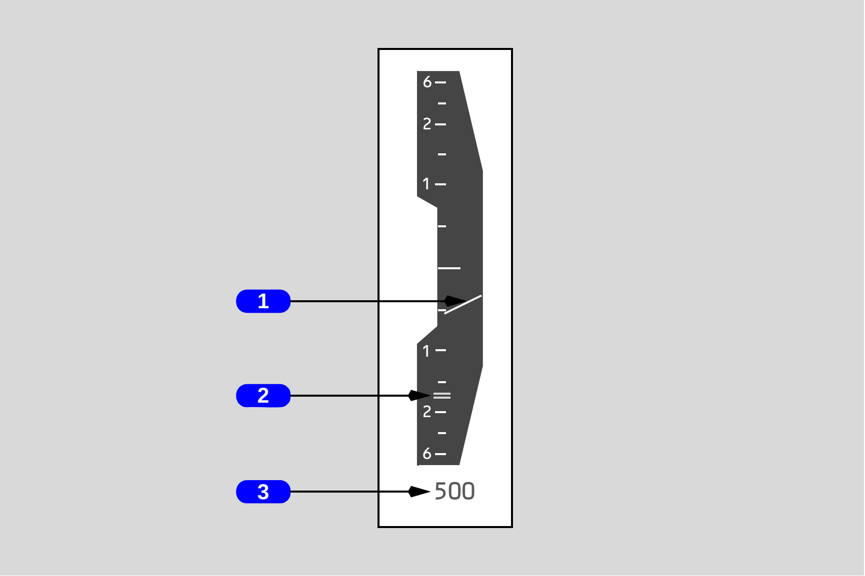
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
QNH/QFE display -

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- displays QNH or QFE when selected on the APPROACH REF page (refer to Chapter 11, Flight Management, Navigation, Section 43)
- display defaults to QNH after landing or long term power interruption
- QFE and QNH alternately displayed and emphasized for 10 seconds by a highlight box when the QFE/QNH line select key pushed on the APPROACH REF page
- QNH or QFE not displayed when STD is displayed

3 Preset Barometric Setting

When STD is displayed, a preset barometric setting can be set using the barometric selector on EFIS control panel.

Vertical Speed Indications



1 Vertical Speed Pointer

Indicates ADC vertical speed as dampened by the IRS.

2 Selected Vertical Speed Pointer

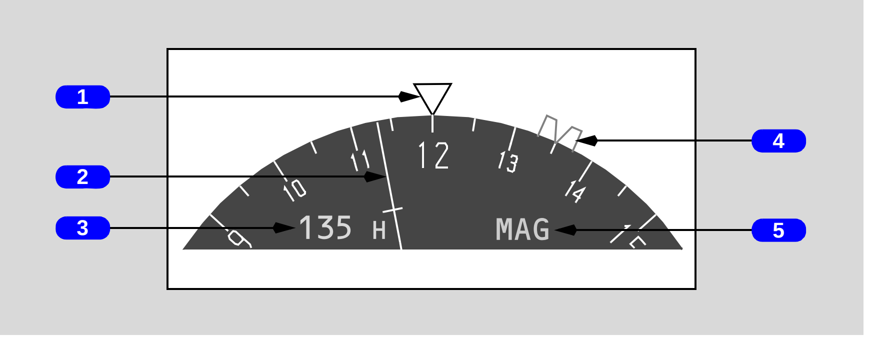
Indicates vertical speed set in MCP vertical speed window with V/S pitch mode active.

3 Vertical Speed

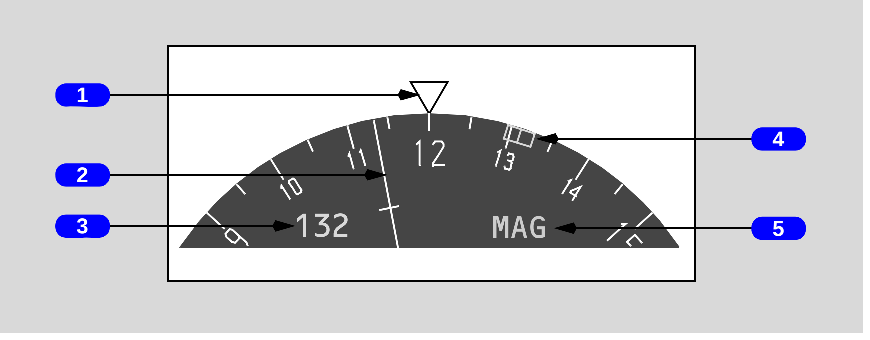
Displays vertical speed when greater than 400 feet per minute.

Display is above the vertical speed display when climbing and below when descending.

Heading/Track Displays
Liquid Crystal Display



Cathode Ray Tube



1 Heading Pointer

Indicates IRS heading.

2 Track Indicator

Indicates airplane track from selected FMC or selected IRU if FMC data invalid.

3 Selected Heading

Displays heading set in heading window.

4 Selected Heading Indicator

Indicates heading set in heading window.

5 Heading Reference

Displays selected heading reference:

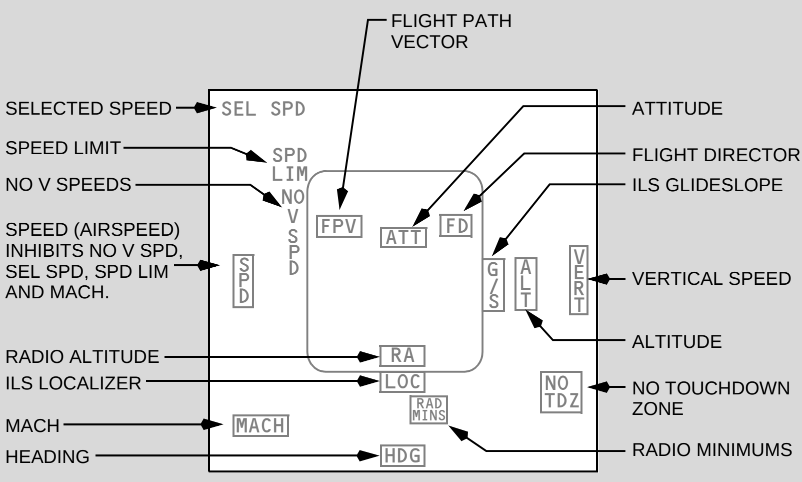
- MAG - magnetic north
- TRU - true north, boxed for emphasis

PFD Failure Flags

Note: PFD failure flags replace the appropriate display to indicate source system failure, or lack of computed information.

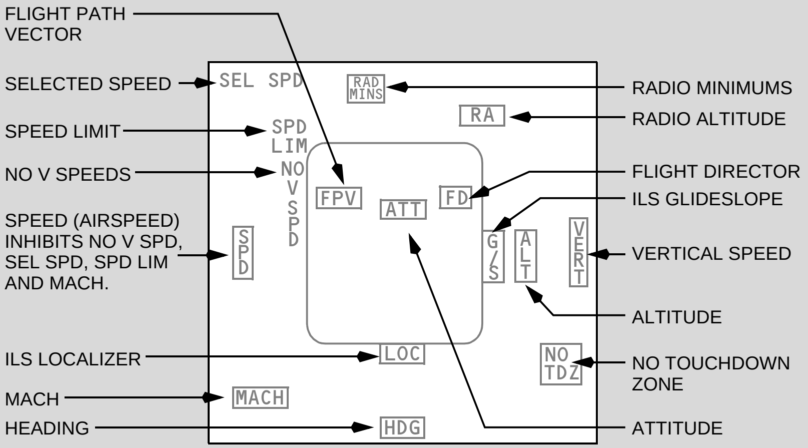
Liquid Crystal Display

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



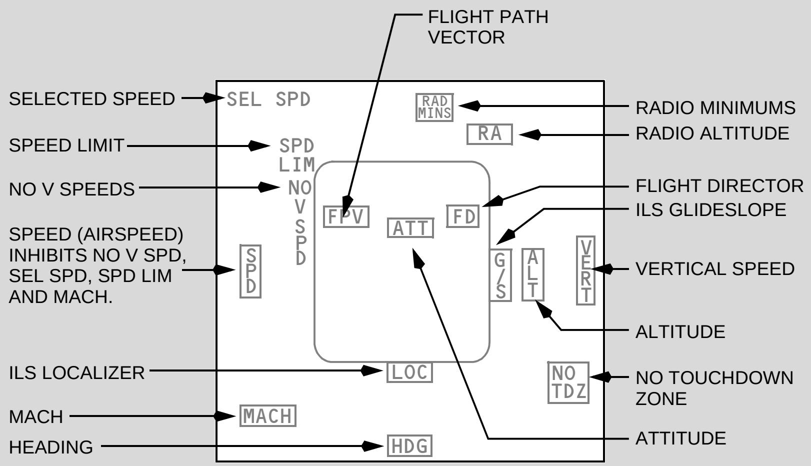
PFD

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



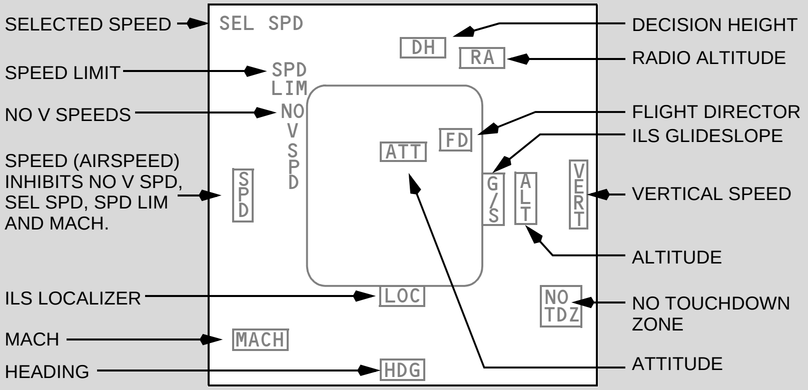
PFD

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



PFD

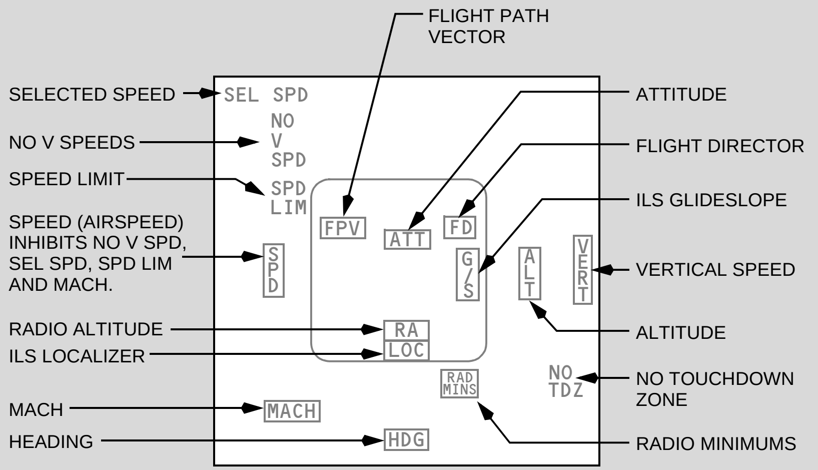
VQ-BHW, VQ-BHX



PFD

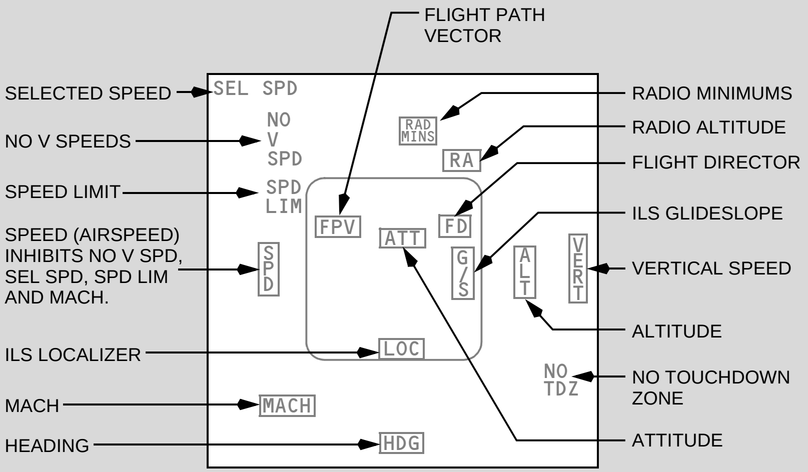
Cathode Ray Tube

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



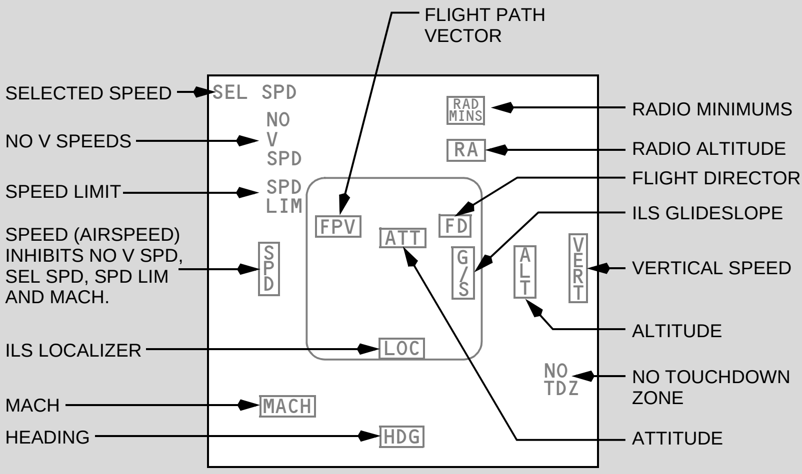
PFD

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



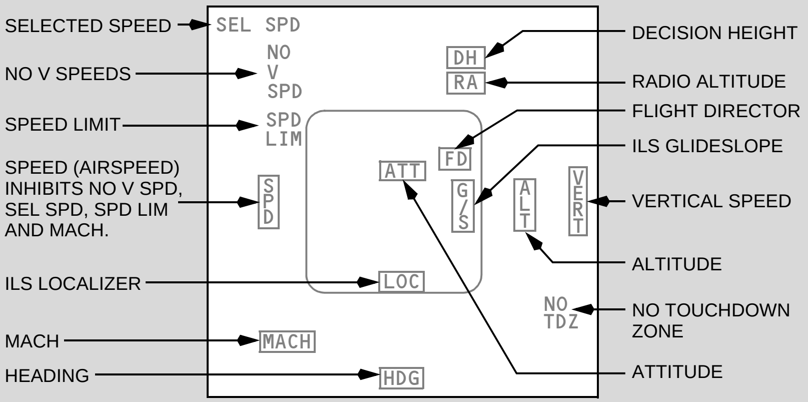
PFD

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



PFD

VQ-BHW, VQ-BHX



PFD

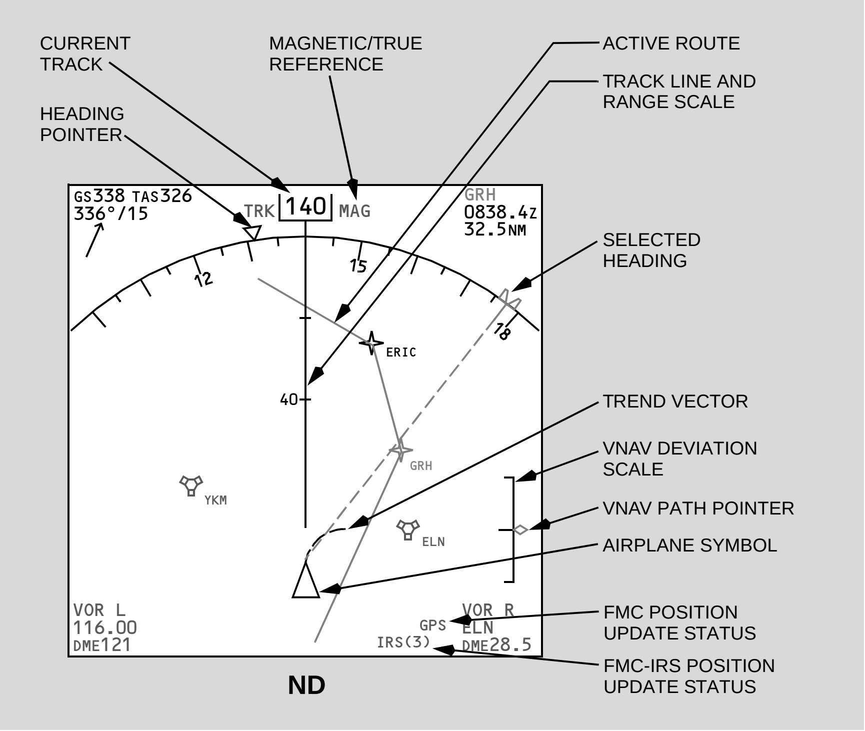
Navigation Display (ND)

Note: Refer to Navigation Display section of this chapter for a detailed explanation of ND symbology shown on the following pages.

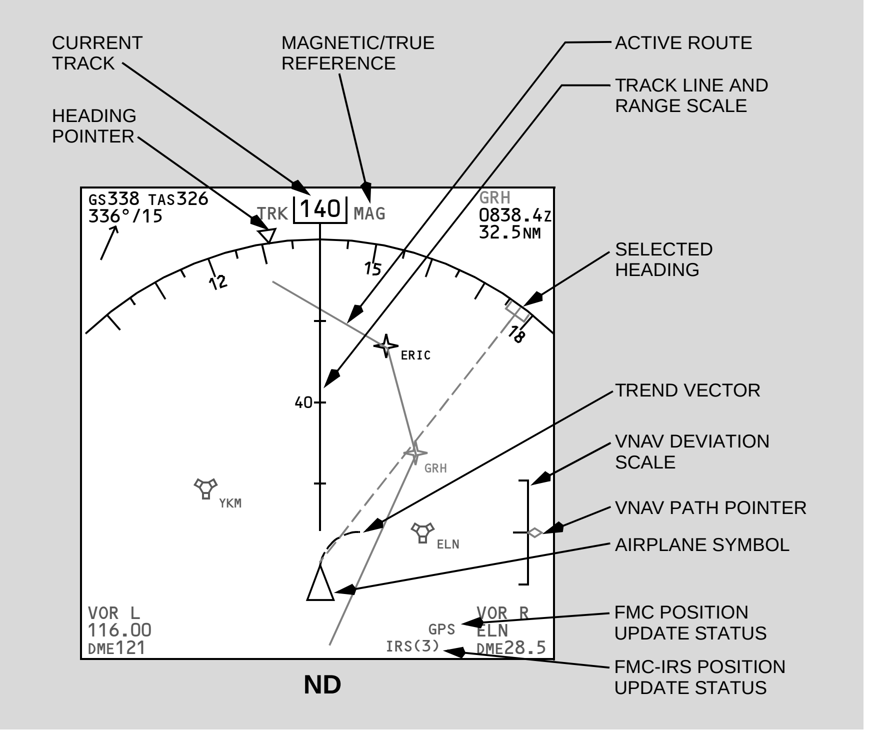
Map Mode

Expanded Map Mode

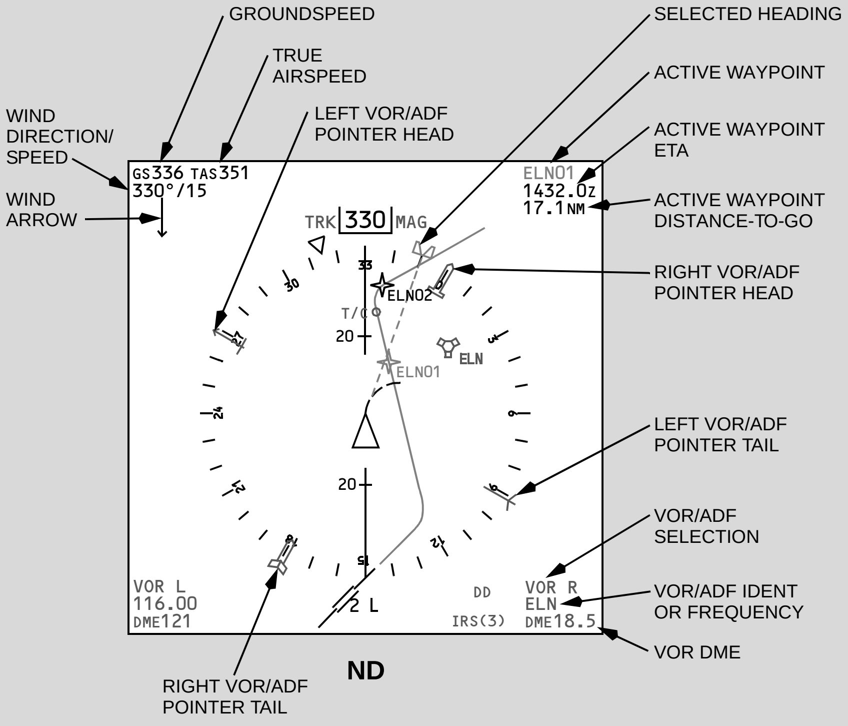
Liquid Crystal Display



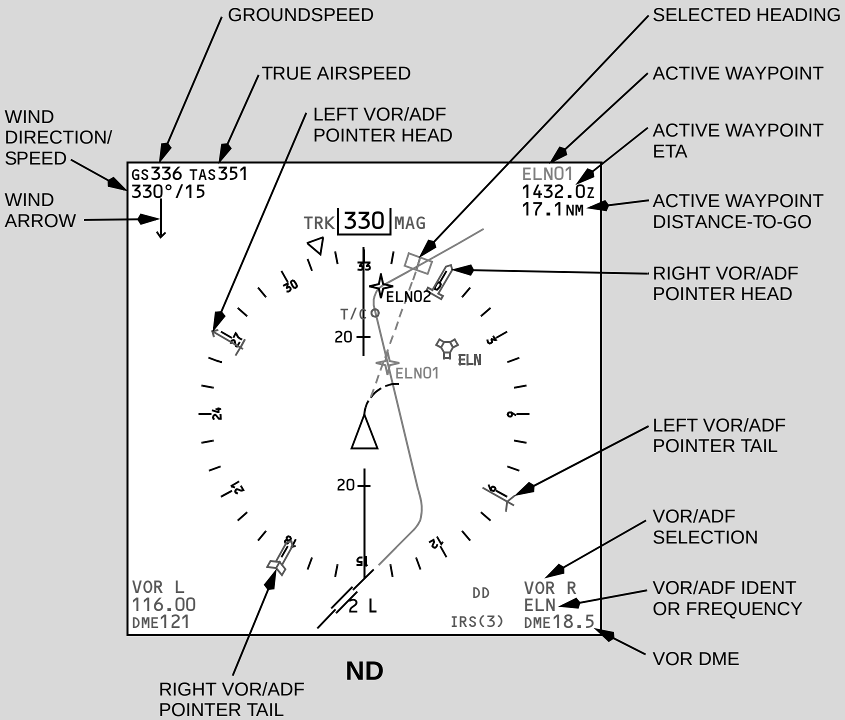
Cathode Ray Tube



Centered Map Mode
Liquid Crystal Display

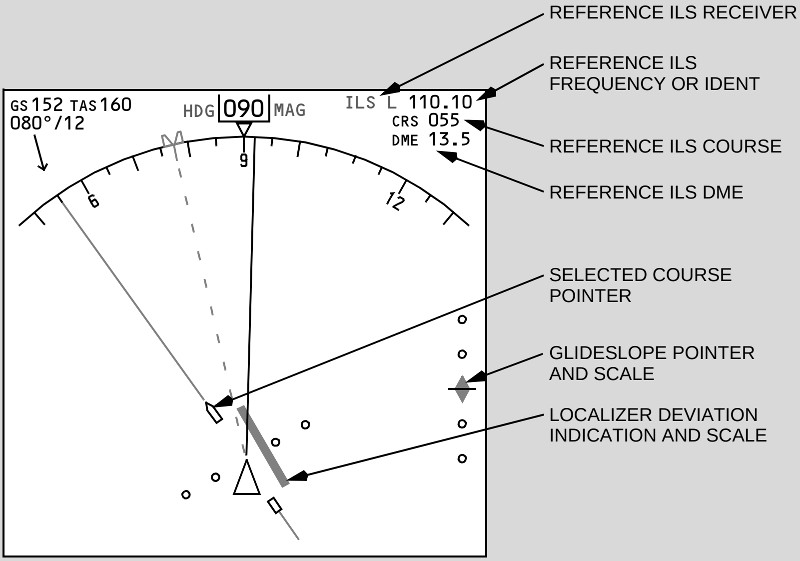


Cathode Ray Tube

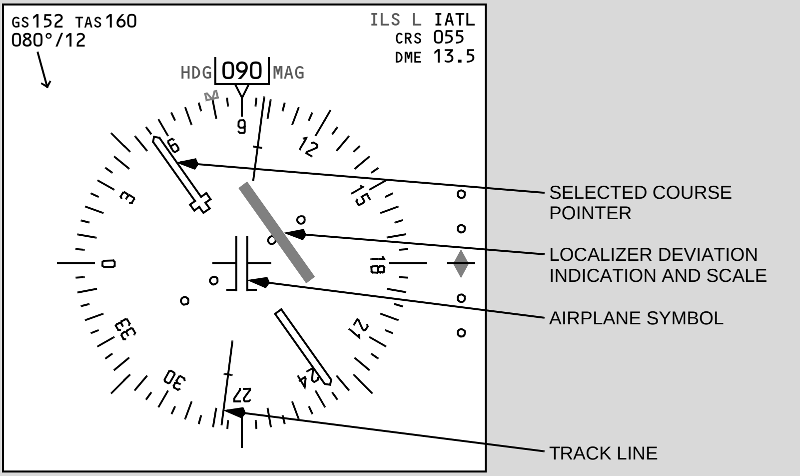


ND

Approach Mode
Liquid Crystal Display

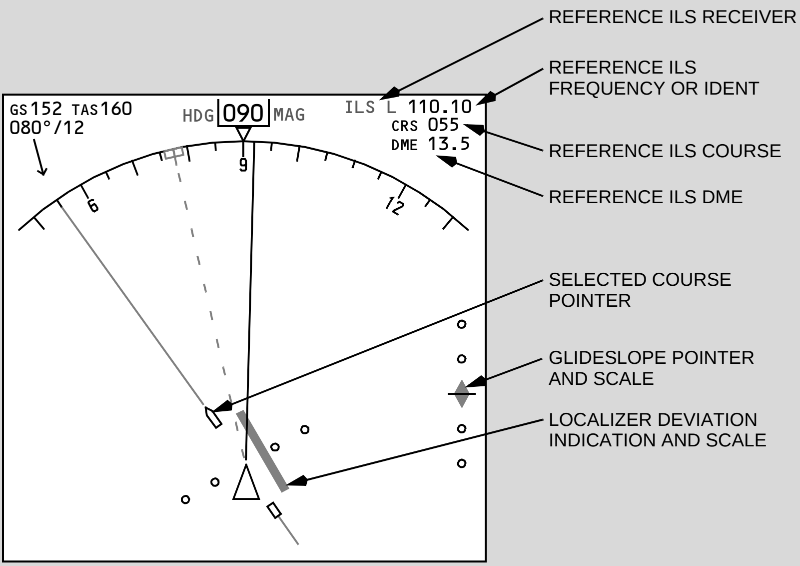


ND
EXPANDED APPROACH MODE

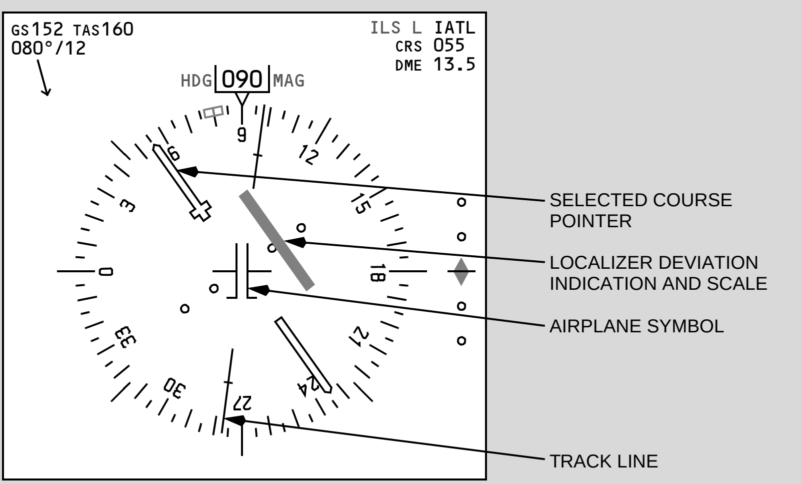


CENTERED APPROACH MODE

Cathode Ray Tube

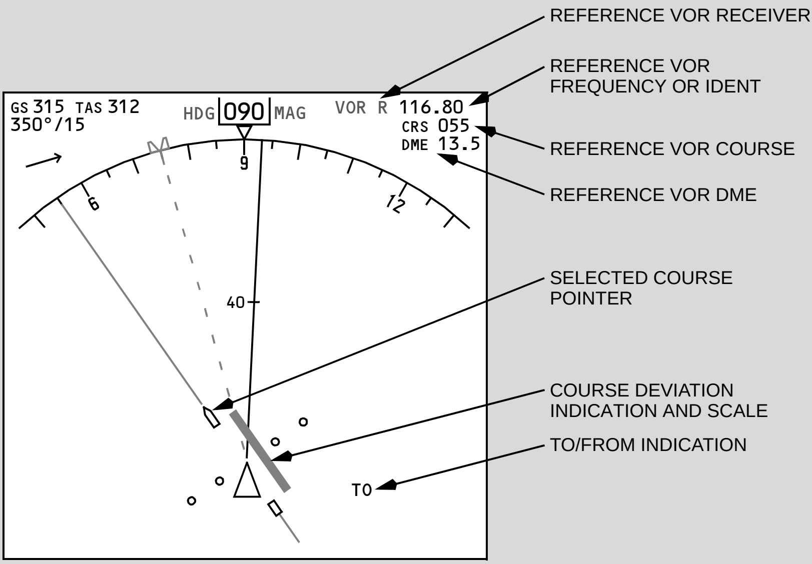


ND
EXPANDED APPROACH MODE

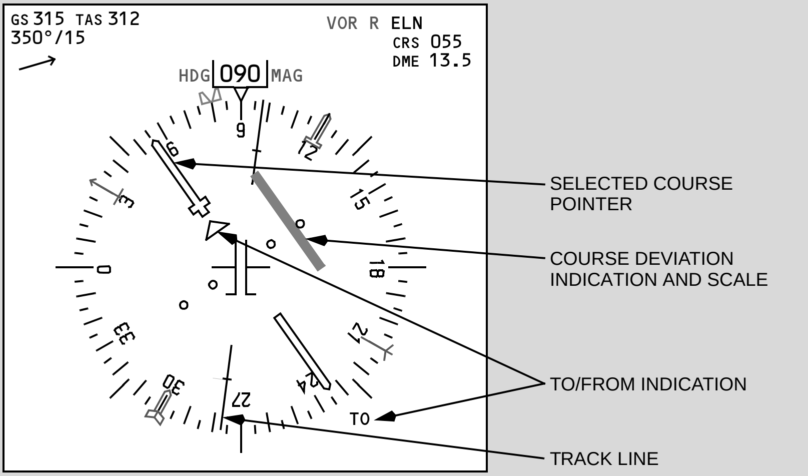


CENTERED APPROACH MODE

VOR Mode
Liquid Crystal Display

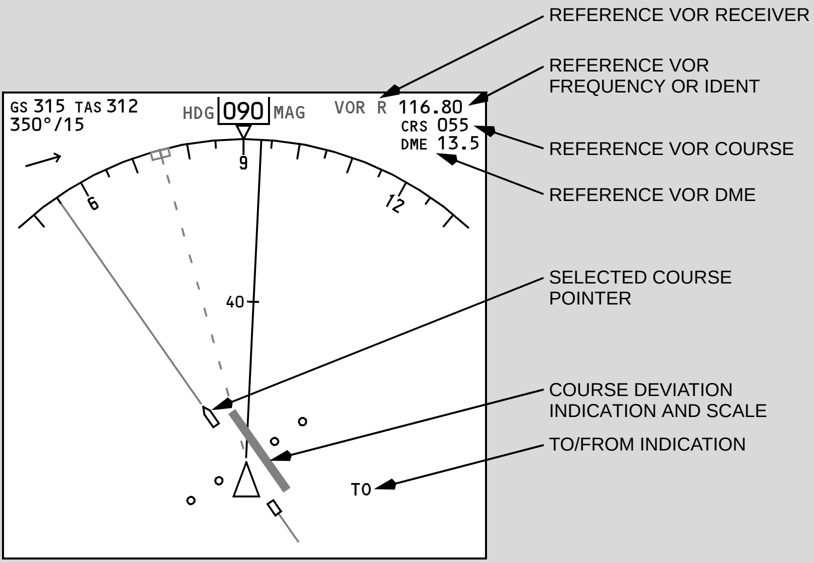


ND
EXPANDED VOR MODE

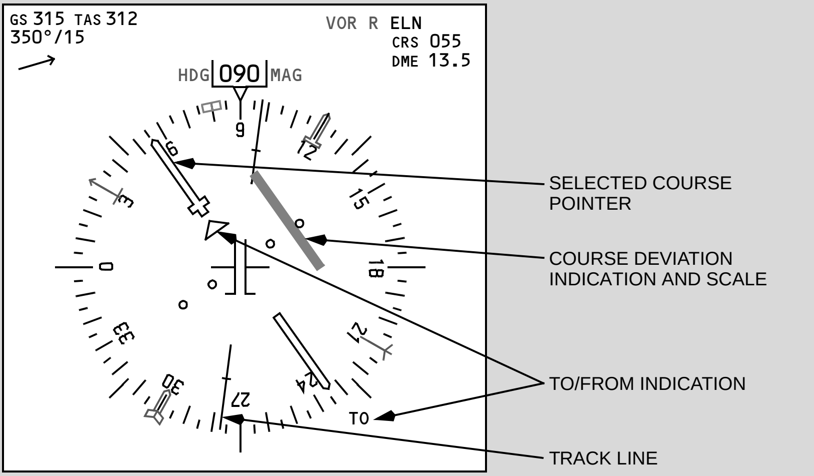


CENTERED VOR MODE

Cathode Ray Tube

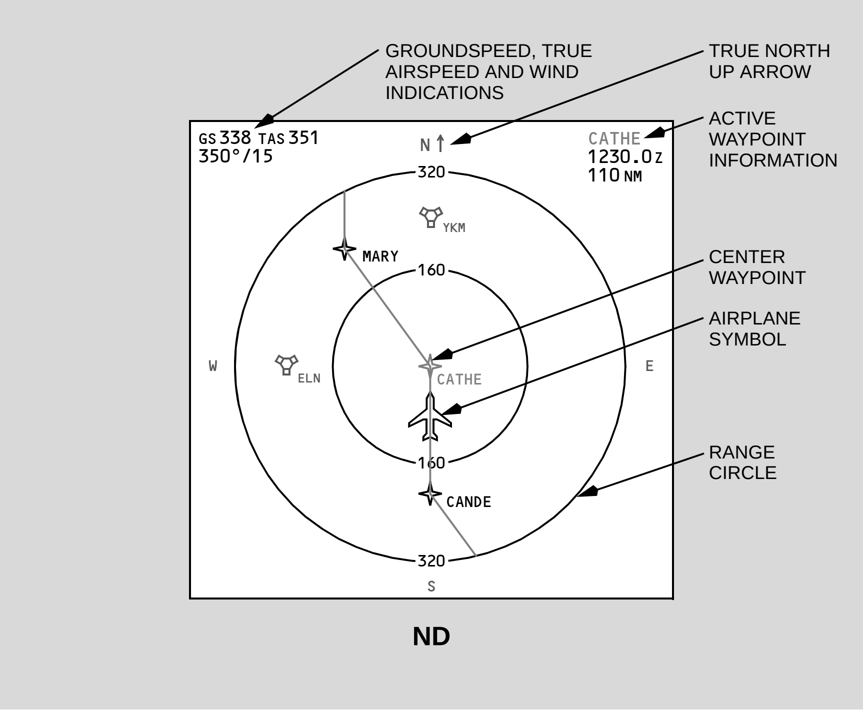


ND
EXPANDED VOR MODE

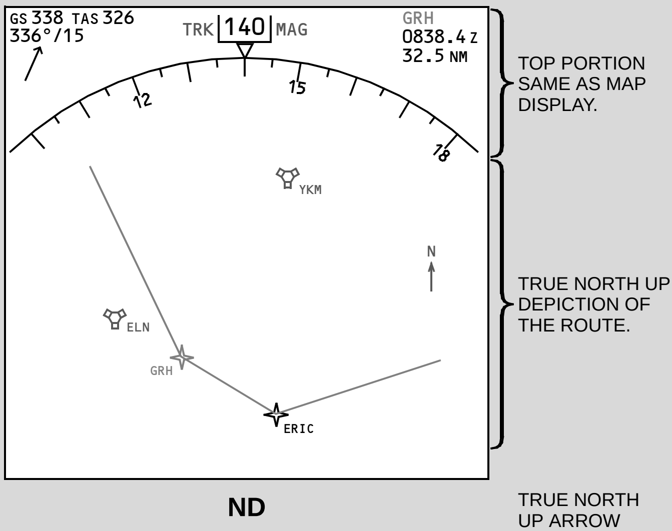


CENTERED VOR MODE

Plan Mode
Liquid Crystal Display

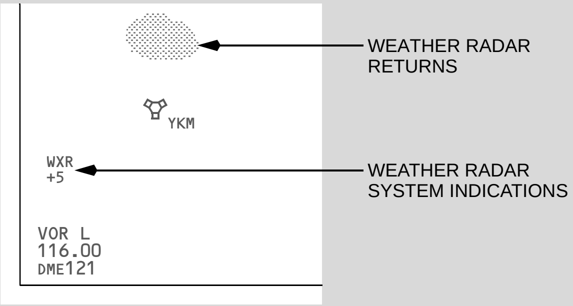


Cathode Ray Tube



ND

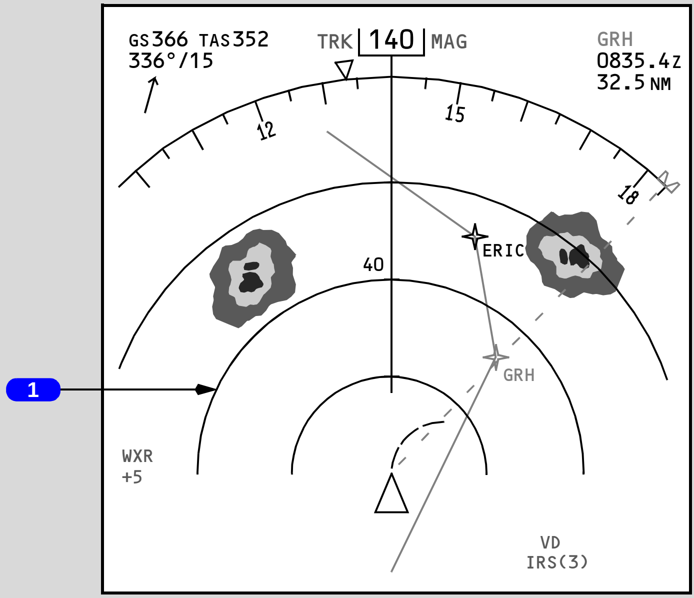
Weather Radar System Display Indications



ND

Liquid Crystal Display

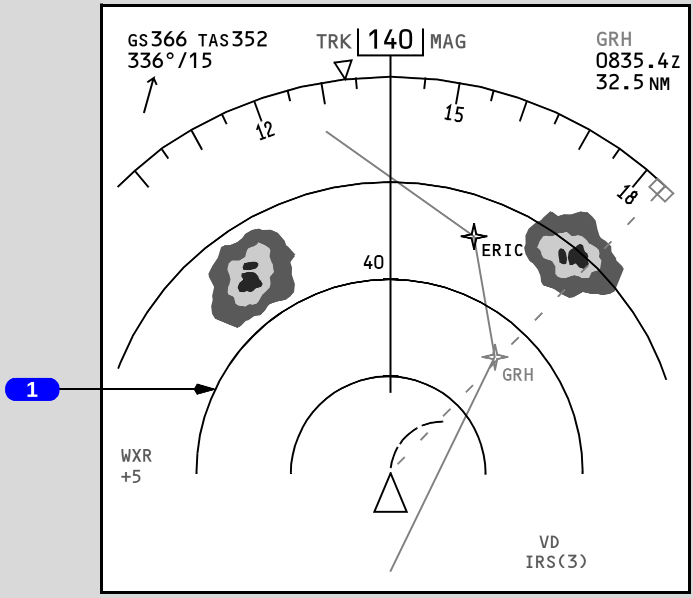
VQ-BHW, VQ-BHX



ND

Cathode Ray Tube

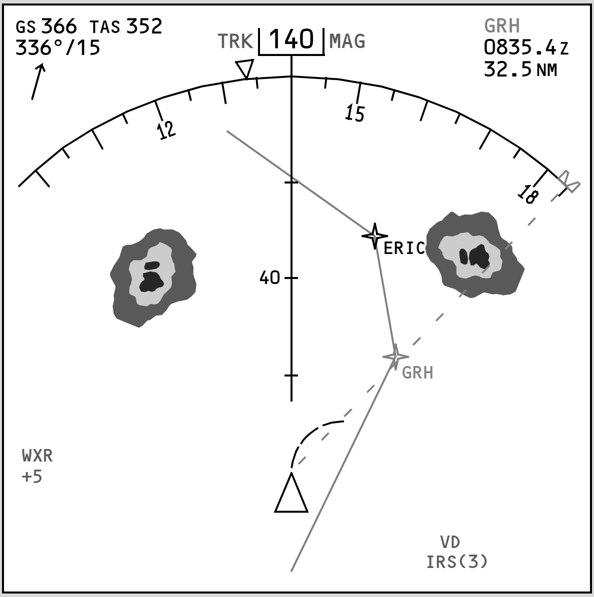
VQ-BHW, VQ-BHX



ND

Liquid Crystal Display

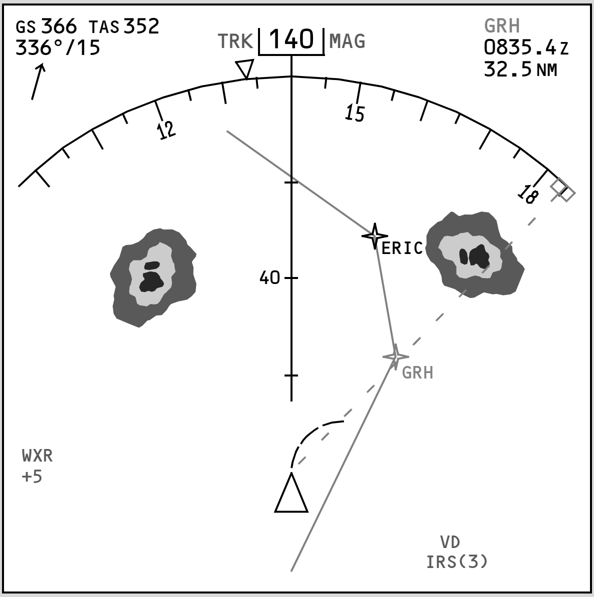
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



ND

Cathode Ray Tube

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



ND

VQ-BHW, VQ-BHX

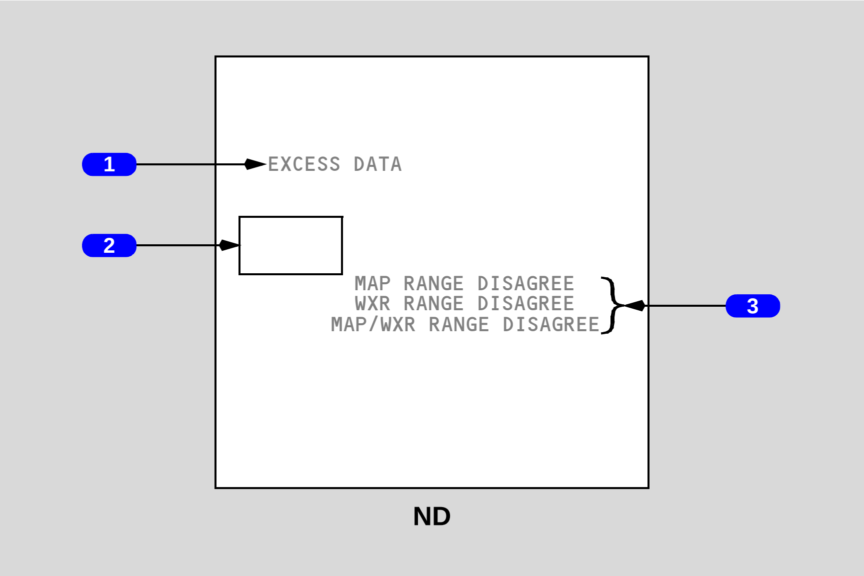
1 Weather Radar Range Arcs

Three range arcs display in place of range scale tics on map when weather radar selected.

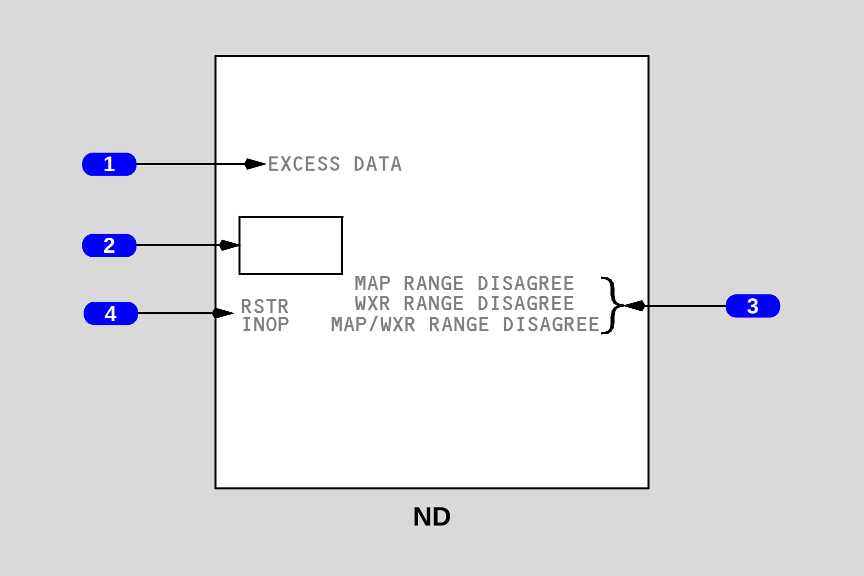
ND Failure Indications and Flags

Failure Messages

Liquid Crystal Display



Cathode Ray Tube



1 Excess Data

Amount of map information sent to the primary display system is too great to display. Deselecting EFIS WXR, STA, WPT, ARPT, DATA, or POS switches may clear the condition.

2 System Failures

Displays system failure messages (refer to section 40, this chapter).

3 MAP/WXR Range Disagree

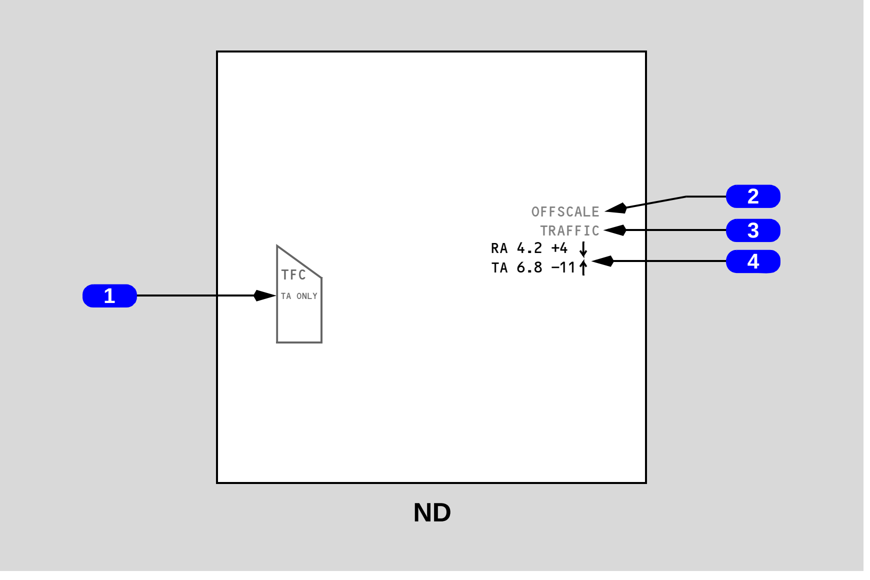
Selected range and range of display information disagree.

Map information is removed.

4 Raster Inoperative (RSTR INOP)

Displays overheat condition.

TCAS Messages



1 TCAS Mode Display

TCAS modes displayed -

TFC (blue) - traffic selected for display on ND from EFIS control panel in MAP, MAP CTR, VOR, and APP ND modes.

TCAS TEST (blue) - TCAS in test mode and displayed in all ND modes.

TCAS FAIL (amber) - TCAS failed and displayed in MAP, MAP CTR, VOR, and APP ND modes with TFC selected.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
TA ONLY (blue) - TCAS TA ONLY mode selected; displayed in all ND modes.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
TA ONLY (blue) - TCAS TA mode selected; displayed in all ND modes.

TCAS OFF (amber) - TCAS selected off and displayed in MAP, MAP CTR, VOR, and APP ND modes with TFC selected.

2 Offscale

TA (amber) or RA (red) traffic beyond ND display range.

Displayed in MAP, MAP CTR, VOR, and APP ND modes with TFC selected.

3 Traffic

Displayed during a TA (amber) or RA (red) condition.

Displayed in all ND modes.

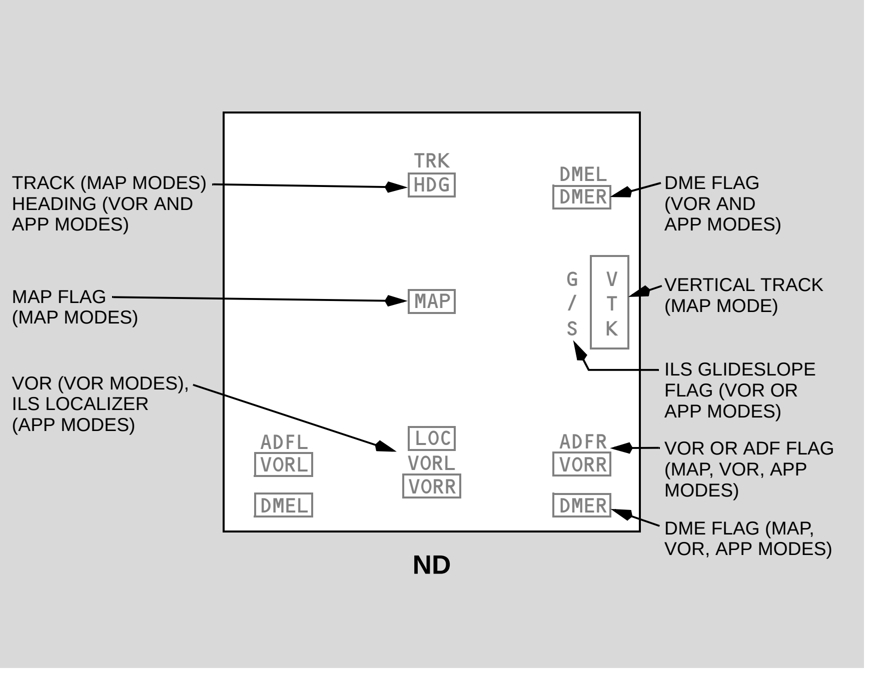
4 No Bearing Traffic Messages

Displayed when no bearing information is available for traffic (see ND symbology chart for display).

Displayed in MAP, MAP CTR, VOR, and APP ND modes with TFC selected.

Failure Flags

Dashes replace numbers if there is no computed information. Failure flags replace symbols, or failure messages are displayed, as appropriate. Flag location varies, depending on ND mode selected. Expanded compass rose locations are shown in the following displays.



EFIS Control Panels

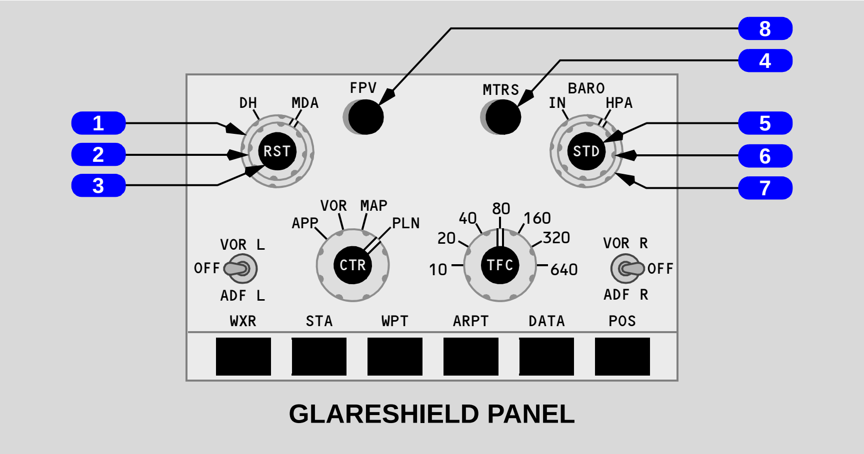
The left EFIS control panel controls the left PFD and ND. The right EFIS control panel controls the right PFD and ND.

If an EFIS control panel fails, displays are controlled through the respective CDU (CDU-152).

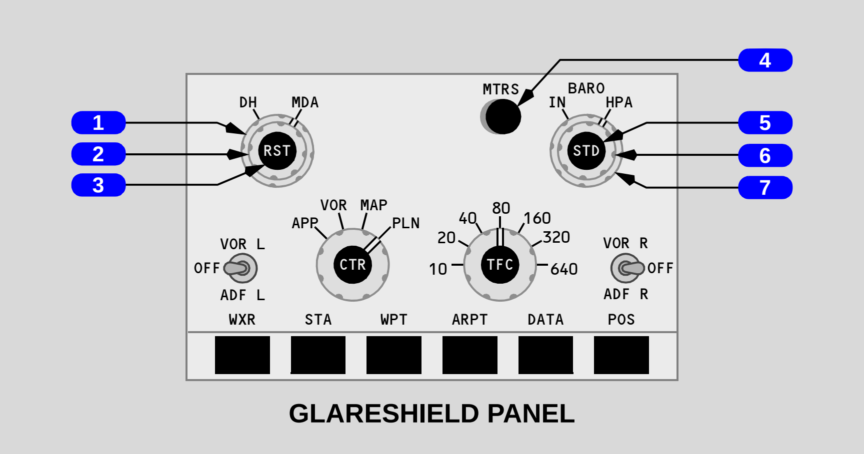
Displays can also be controlled through the respective CDU (CDU-161).

Control Panel PFD Controls

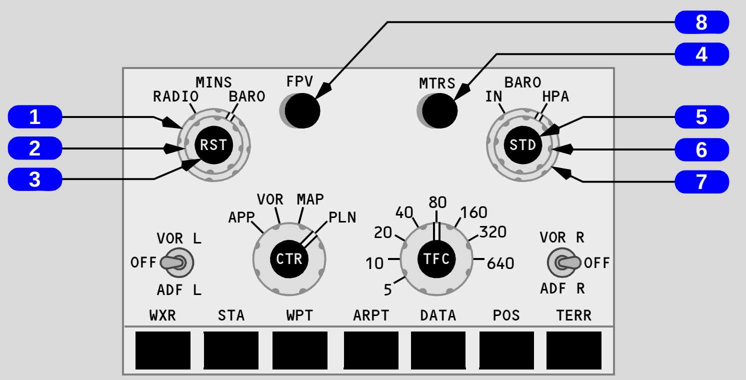
VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ



GLARESHIELD PANEL

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

1 Decision Height/Minimium Descent Altitude Selector (outer)

DH - selects radio altitude as PFD minimums reference.

MDA - selects barometric altitude as PFD minimums reference.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ

1 Minimums (MINS) Selector (outer)

RADIO - selects radio altitude for display on the PFD.

BARO - selects barometric altitude for display on the PFD.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

1 Minimiums (MINS) Selector (outer)

RADIO - selects radio altitude for display on the PFD and as reference for minimums voice alert.

BARO - selects barometric altitude for display on the PFD and as reference for minimums voice alert.

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

2 Decision Height (DH)/Minimum Descent Altitude (MDA) Control (middle)

Rotate -

- when DH selected, sets a radio altitude reference in DH display
- when MDA selected, sets a barometric altitude reference in MDA display. MDA pointer indicates the same altitude on the altitude display

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

2 RADIO Altitude/Barometric (BARO) Altitude Control (middle)

Rotate -

- when RADIO selected, sets a radio altitude reference in RADIO display in one foot increments
- when BARO selected, sets a barometric altitude reference in BARO display, in increments of ten feet (EFIS CP 112), or one foot increments (EFIS CP 113 or later). BARO pointer indicates the same altitude on the altitude display

VP-BKL, VQ-BHW, VQ-BHX

3 Decision Height Reset (RST) Switch (inner)

Push - resets PFD flashing amber DH.

VP-BKJ, VP-BVR

3 Decision Height Reset (RST) Switch (inner)

Push - resets PFD flashing amber DH.

Clears HEIGHT ALERT display on the respective PFD.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

3 Minimums Reset (MINS RST) Switch (inner)

Push - resets PFD flashing amber RADIO.

4 Meters (MTRS) Switch

Push - displays PFD altitude meters indications.

5 Barometric Standard (BARO STD) Switch (inner)

Push -

- selects standard barometric setting (29.92 inches Hg/1013 HPA) for PFD barometric reference
- when STD displayed, selects preselected barometric setting
- if no preselected barometric setting displayed, displays the last value before STD was selected

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

- when QFE displayed, selects STD on display and QNH LANDING on the FMC APPROACH REF page (refer to Chapter 11, section 43)

6 Barometric (BARO) Selector (middle)

Rotate -

- adjusts PFD barometric reference
- preselects PFD barometric reference

7 Barometric (BARO) Reference Selector (outer)

IN - selects inches of mercury as PFD barometric reference.

HPA - selects Hectopascals as PFD barometric reference.

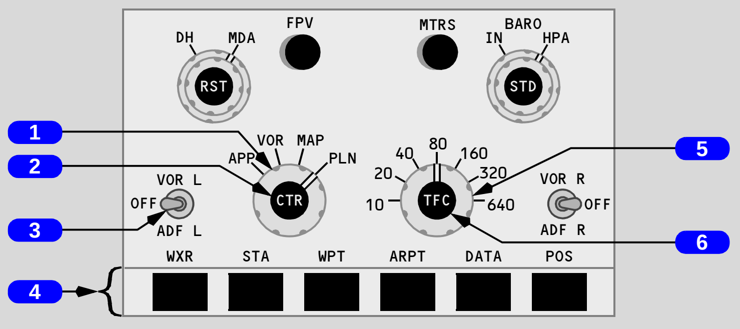
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

8 Flight Path Vector (FPV) Switch

Push - displays PFD flight path vector.

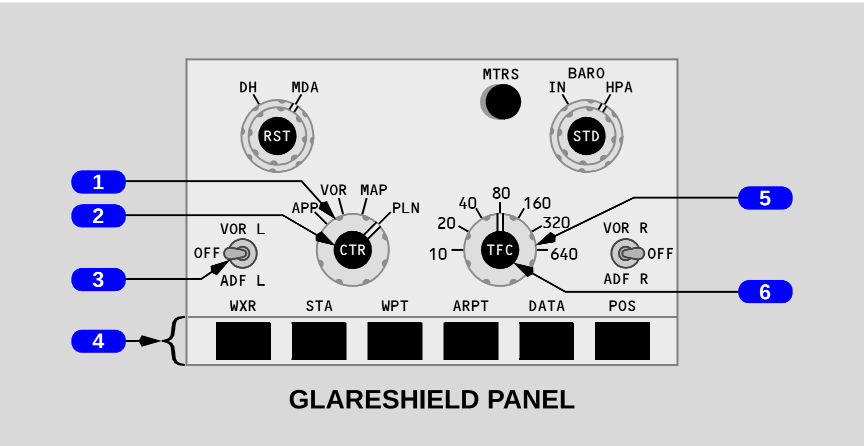
Control Panel ND Controls

VP-BKJ, VP-BKL, VP-BVR



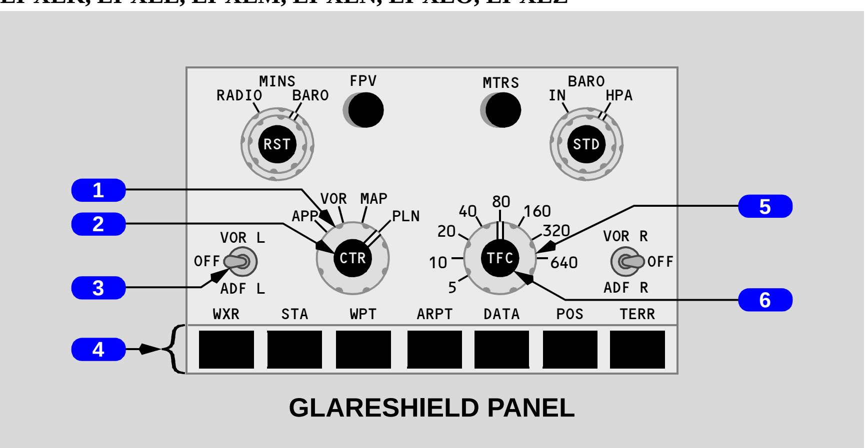
GLARESHIELD PANEL

VQ-BHW, VQ-BHX



GLARESHIELD PANEL

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ



GLARESHIELD PANEL

VP-BKL

1 ND Mode Selector (outer)

Selects desired ND display.

APP -

- displays localizer and glideslope information in heading-up format
- displays reference ILS receiver, ILS frequency or identification, course, and DME
- weather radar, PWS, and TCAS are not displayed in APP CTR mode

VOR -

- displays VOR navigation information in heading-up format
- displays reference VOR receiver, VOR frequency or identification, course, DME, and TO/FROM indication
- weather radar, PWS, and TCAS are not displayed in VOR CTR mode

MAP -

- displays track up, full compass rose, FMC-generated route and map information, airplane position, heading, and track
- displays active waypoint data
- displays vertical path deviation at T/D

PLN -

- displays a non-moving, true north-up, route depiction
- airplane symbol represents actual airplane position
- allows route step-through using CDU legs page
- weather radar, PWS, and TCAS are not displayed in PLN mode

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

1 ND Mode Selector (outer)

Selects desired ND display.

APP -

- displays localizer and glideslope information in heading-up format
- displays reference ILS receiver, ILS frequency or identification, course, and DME
- look-ahead terrain, weather radar, PWS, and TCAS are not displayed in APP CTR mode

VOR -

- displays VOR navigation information in heading-up format
- displays reference VOR receiver, VOR frequency or identification, course, DME, and TO/FROM indication
- look-ahead terrain, weather radar, PWS, and TCAS are not displayed in VOR CTR mode

MAP -

- displays track up, full compass rose, FMC-generated route and map information, airplane position, heading, and track
- displays active waypoint data
- displays vertical path deviation at T/D

PLN -

- displays a non-moving, true north-up, route depiction
- airplane symbol represents actual airplane position

- allows route step-through using CDU legs page
- look-ahead terrain, weather radar, PWS, and TCAS are not displayed in PLN mode

EI-XLB, EI-XLD, EI-XLE, EI-XLG

1 ND Mode Selector (outer)

Selects desired ND display.

APP -

- displays localizer and glideslope information in heading-up format
- displays reference ILS receiver, ILS frequency or identification, course, and DME
- look-ahead terrain, weather radar, and TCAS are not displayed in APP CTR mode

VOR -

- displays VOR navigation information in heading-up format
- displays reference VOR receiver, VOR frequency or identification, course, DME, and TO/FROM indication
- look-ahead terrain, weather radar, and TCAS are not displayed in VOR CTR mode

MAP -

- displays track up, full compass rose, FMC-generated route and map information, airplane position, heading, and track
- displays active waypoint data
- displays vertical path deviation at T/D

PLN -

- displays a non-moving, true north-up, route depiction
- airplane symbol represents actual airplane position
- allows route step-through using CDU legs page
- look-ahead terrain, weather radar, and TCAS are not displayed in PLN mode

VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX

1 ND Mode Selector (outer)

Selects desired ND display.

APP -

- displays localizer and glideslope information in heading-up format
- displays reference ILS receiver, ILS frequency or identification, course, and DME
- weather radar and TCAS are not displayed in APP CTR mode

VOR -

- displays VOR navigation information in heading-up format
- displays reference VOR receiver, VOR frequency or identification, course, DME, and TO/FROM indication
- weather radar and TCAS are not displayed in VOR CTR mode

MAP -

- displays track up, full compass rose, FMC-generated route and map information, airplane position, heading, and track
- displays active waypoint data
- displays vertical path deviation at T/D

PLN -

- displays a non-moving, true north-up, route depiction
- airplane symbol represents actual airplane position
- allows route step-through using CDU legs page
- weather radar and TCAS are not displayed in PLN mode

2 ND Center (CTR) Switch (inner)

Push -

- displays full compass rose (centered) for APP, VOR, and MAP modes
- subsequent pushes alternate between expanded and centered displays

3 VOR/ADF Switches

Display VOR or ADF information on the respective ND.

VOR - displays VOR pointer, VOR frequency or identification and associated DME information in all modes except PLAN.

OFF - removes VOR and ADF displays.

ADF - displays ADF pointer and frequency or identification in all modes except PLAN.

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

4 WXR, STA, WPT, ARPT, DATA, POS, Switches

The switches:

- select detailed ND data displays
- displays can be selected simultaneously
- EXCESS DATA message displays on ND if amount of data selected is more than can be displayed
- second push removes data

WXR (weather radar) -

- powers radar transceiver selected on weather radar control panel
- displays in MAP, MAP CTR, VOR, and APP modes

- displays weather radar information (refer to Chapter 11, Flight Management, Navigation)
- with WXR FAIL displayed on ND, cancels WXR FAIL message

STA (station) - MAP modes:

- displays high and low altitude navigation aids when ND Range selector is in 10, 20, or 40 NM range
- displays high altitude navigation aids when ND Range selector is in 80, 160, 320, or 640 NM range.

WPT (waypoint) - MAP modes, displays waypoints when ND Range selector is in the 10, 20, or 40 NM range.

APRT (airport) - MAP modes, displays airports on all ranges.

DATA - PLAN, MAP modes, displays FMC estimated time of arrival, altitude at each waypoint, and altitude constraints at each waypoint.

POS (position) - in MAP modes:

- displays VOR raw data radials extended from the nose of the airplane to the VOR stations displayed on the CDU NAV RAD page. When co-located DME data received, tick mark displayed at DME distance; radial extends to edge of display if no valid DME data received

VP-BKL, VQ-BHW, VQ-BHX

- displays IRU and GPS positions

VP-BKJ, VP-BVR

- displays IRU positions

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

4 WXR, STA, WPT, ARPT, DATA, POS, TERR Switches

The switches:

- select detailed ND information displays
- displays can be selected simultaneously
- EXCESS DATA message displays on ND if amount of data selected is more than can be displayed
- second push removes data

WXR (weather radar) -

- powers radar transceiver selected on weather radar control panel
- displays in MAP, MAP CTR, VOR, and APP modes
- displays weather radar information (refer to Chapter 11, Flight Management, Navigation)
- with WXR FAIL displayed on ND, cancels WXR FAIL message

STA (station) - MAP modes:

- displays high and low altitude navigation aids when ND Range selector is in 5, 10, 20, or 40 NM range
- displays high altitude navigation aids when ND Range selector is in 80, 160, 320, or 640 NM range

WPT (waypoint) - MAP modes, displays waypoints when ND Range selector is in the 5, 10, 20, or 40 NM range.

APRT (airport) - MAP modes, displays airports on all ranges.

DATA - in PLAN, MAP modes, displays FMC estimated time of arrival, altitude at each waypoint, and altitude constraints at each waypoint.

POS (position) - in MAP modes:

- displays VOR raw data radials extended from the nose of the airplane to the VOR stations displayed on the CDU NAV RAD page. When co-located DME data received, tick mark displayed at DME distance; radial extends to edge of display if no valid DME data received
- displays IRU and GPS positions

TERR (terrain) - GPWS look-ahead terrain mode is described in Chapter 15, Warning Systems.

5 ND Range Selector (outer)

Selects desired ND nautical mile range scale.

6 ND Traffic (TFC) Switch (inner)

Push - in VOR, APP, MAP, and MAP CTR modes:

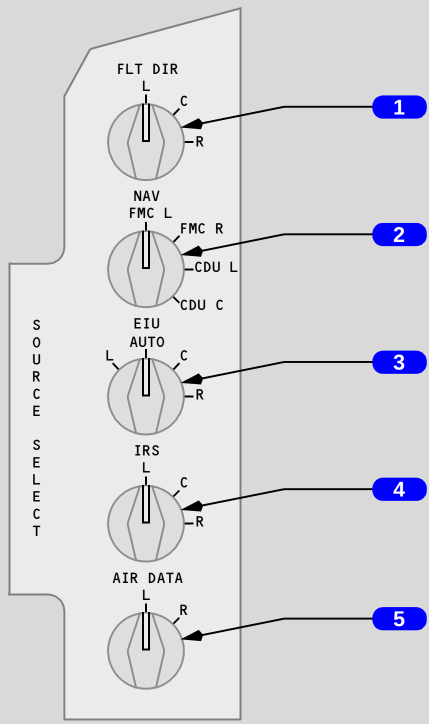
- enables TCAS traffic display (Refer to Chapter 15, Warning Systems)
- with TCAS FAIL displayed on ND, cancels TCAS FAIL message.

Instrument Source Select Panels

The left source select panel controls the left PFD and ND. The right source select panel controls the right PFD and ND.

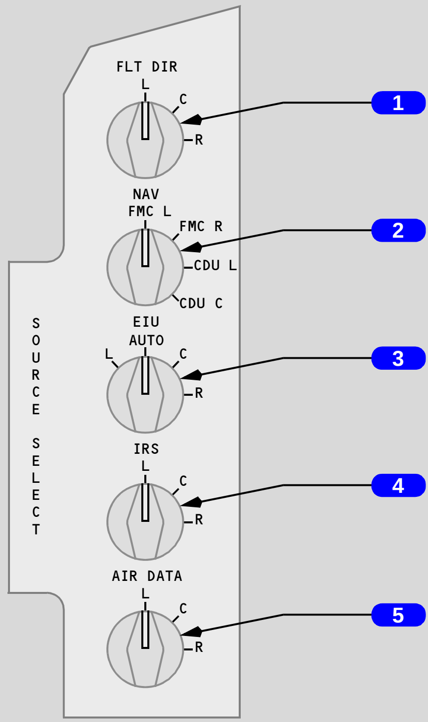
The left panel is shown.

VQ-BHW, VQ-BHX



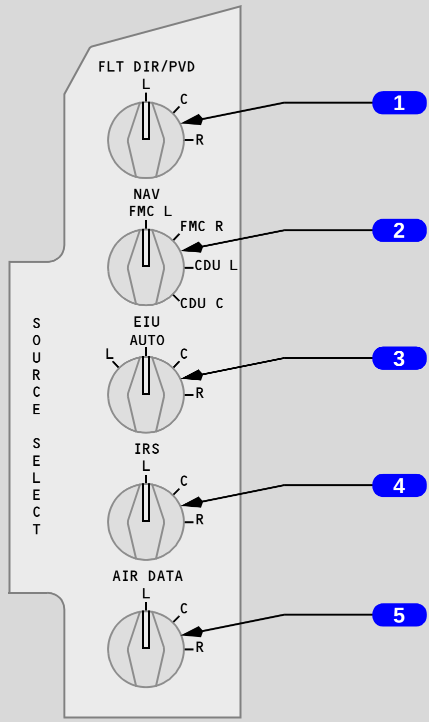
PILOT'S PANELS

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



PILOT'S PANELS

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



PILOT'S PANELS

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

1 Flight Director (FLT DIR) Source Selector

L - left FCC selected

C - center FCC selected

R - right FCC selected

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

1 Flight Director/Paravisual Display(FLT DIR/PVD) Source Selector

L - left FCC selected

C - center FCC selected

R - right FCC selected

2 Navigation (NAV) Source Selector

FMC L - left FMC provides information to PFD and ND.

FMC R - right FMC provides information to PFD and ND.

CDU L (Captain’s panel) - left CDU provides information to ND during alternate navigation.

CDU C - center CDU provides information to ND during alternate navigation.

CDU R (F/O’s panel) - right CDU provides information to ND during alternate navigation.

3 EFIS/EICAS Interface Unit (EIU) Source Selector

L - left EIU provides information to PFD and ND.

AUTO - selects operable EIU. Captain’s selects left, then center, then right; F/O’s selects right, then center, then left.

C - center EIU provides information to PFD and ND.

R - right EIU provides information to PFD and ND.

Determines which localizer and glideslope receivers provide information to the respective PFD and ND.

4 IRS Source Selector

L - left IRU provides attitude and vertical speed information to PFD.

C - center IRU provides attitude and vertical speed information to PFD.

R - right IRU provides attitude and vertical speed information to PFD.

Source for heading, wind direction and speed, slip/skid, track angle, drift angle, and ground speed displayed on PFD and ND depends on the status of the FMCs, IRUs, and position of the Navigation and IRS source selectors.

IRU selected by Captain provides autobrake reference. IRU selected by F/O provides RMI reference.

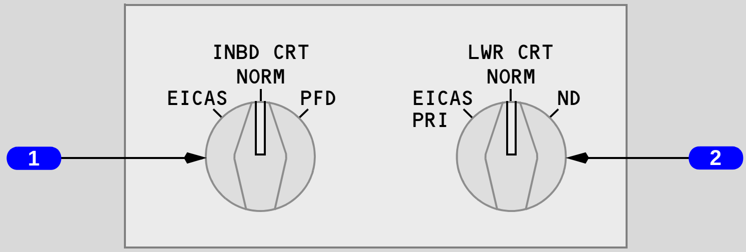
5 AIR DATA Source Selector

L - left ADC provides information to the PFD and ND.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
C - center ADC provides information to the PFD and ND.

R - right ADC provides information to the PFD and ND.

Heading Reference, Inboard and Lower Displays
Inboard and Lower Display Controls



FORWARD PANELS

1 Inboard (INBD) Display Selector

EICAS - displays secondary or primary EICAS display on inboard unit.

NORM - displays ND on inboard display unit. Displays PFD if outboard display unit fails.

PFD - displays PFD on inboard display unit.

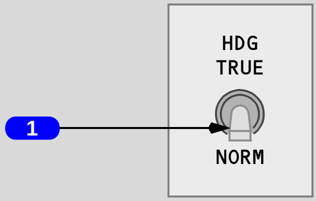
2 Lower (LWR) Display Selector

EICAS PRI - displays primary EICAS on lower display unit.

NORM - displays on lower display unit as selected on EICAS display select panel. Displays primary EICAS if upper display unit fails.

ND - displays ND on lower display unit.

Heading Reference Switch



CENTER PANEL

1 Heading (HDG) Reference Switch

Selects heading reference for PFDs, NDs, AFDS, FMCs and RMI.

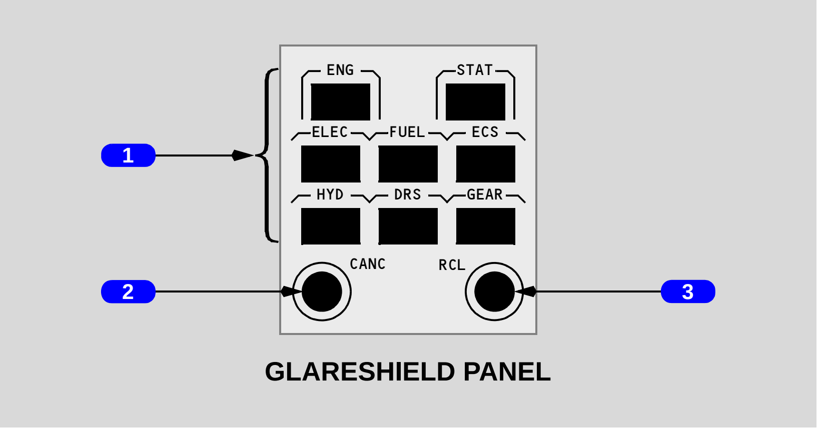
TRUE - references true north.

NORM -

- references magnetic north
- references true north when north of 82°N latitude (or north of 70°N between 80°W and 130°W) or south of 82°S latitude (or south of 60°S between 120°E and 160°E) for PFDs, NDs, and FMCs. Provides no reference for RMI and AFDS roll modes other than LNAV in these areas; HDG SEL, HDG HOLD, and localizer modes are inoperative.

When AFDS roll mode is HDG SEL, switching the Heading Reference switch from NORM to TRUE or TRUE to NORM activates HDG HOLD mode.

Display Select Panel



1 Display Switches

Pushing a switch displays the respective synoptic/display on the lower display unit. Pushing the same switch a second time blanks the display. Pushing STAT pages through more than one page of status messages. Synoptics present a simplified view of system status as an aid for crew situational awareness.

If the display select panel fails, displays are controlled through the CDU (CDU-152).

Displays can also be controlled through the CDU (CDU-161).

ENG - secondary engine display (Ch 7).

STAT - status display, (Ch. 15).

ELEC - electrical system synoptic (Ch. 6).

FUEL - fuel quantity indications and fuel system synoptic (Ch. 12).

ECS - air systems synoptic (Ch. 2).

HYD - hydraulic system synoptic (Ch. 13).

DRS - doors synoptic (Ch. 1).

GEAR - landing gear and brake systems synoptic (Ch. 14).

2 Cancel (CANC) Switch

Refer to Warning Systems, Chapter 15.

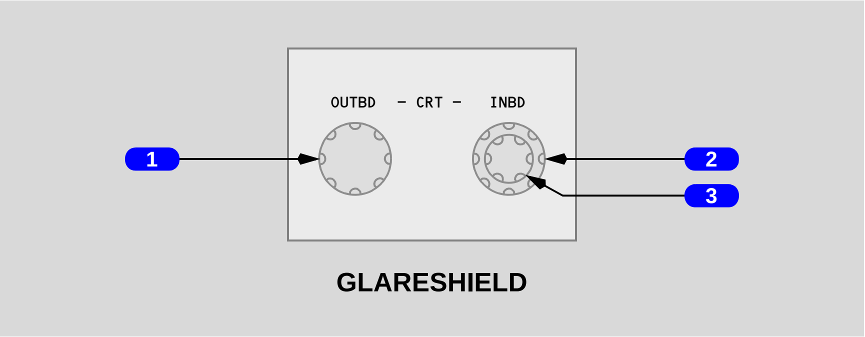
3 Recall (RCL) Switch

Refer to Warning Systems, Chapter 15.

Display Brightness Controls

The left panel is shown.

Outboard/Inboard Display Brightness Controls



1 Outboard (OUTBD) Display Brightness Control

Rotate - adjusts brightness of outboard display.

2 Inboard (INBD) Display Brightness Control (outer)

Rotate - adjusts brightness of inboard display.

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

3 Inboard (INBD) Display Brightness Control (inner)

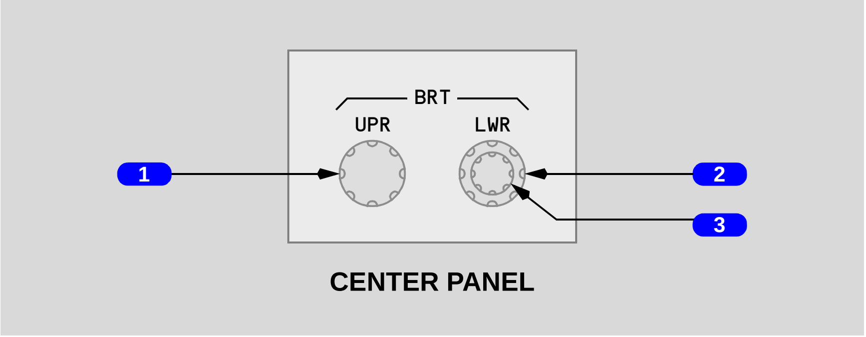
Rotate - adjusts weather radar display brightness on inboard display.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

3 Inboard (INBD) Display Brightness Control (inner)

Rotate - adjusts weather radar or terrain display brightness on inboard display.

Upper/Lower Display Brightness Controls



1 Upper (UPR) Display Brightness Control

Rotate - adjusts brightness of upper display.

2 Lower (LWR) Display Brightness Control (outer)

Rotate - adjusts brightness of lower display.

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

3 Lower (LWR) Display Brightness Control (inner)

Rotate - adjusts weather radar brightness on lower display.

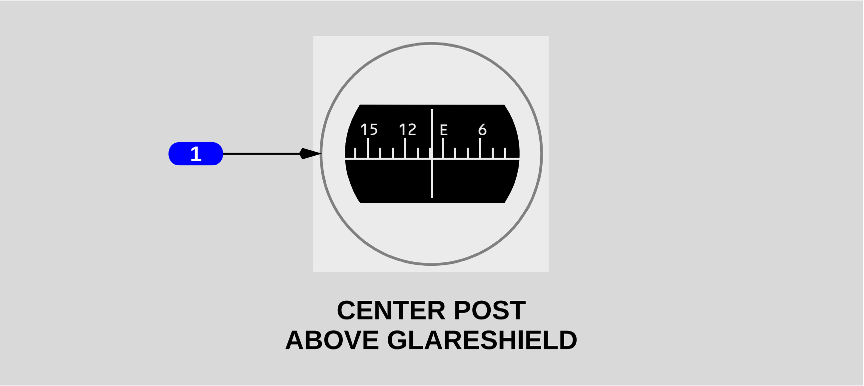
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

3 Lower (LWR) Display Brightness Control (inner)

Rotate - adjusts weather radar or terrain display brightness on lower display.

Standby Flight Instruments

Standby Magnetic Compass

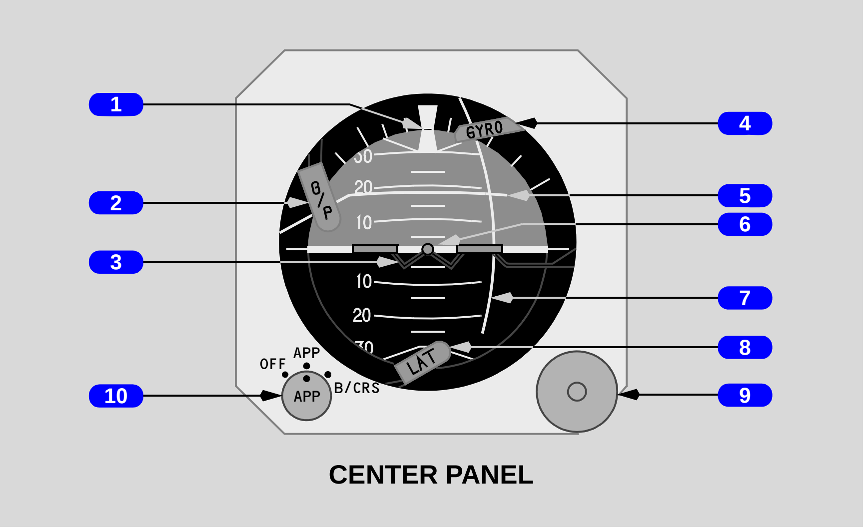


1 Standby Magnetic Compass

Displays magnetic heading.

Standby Attitude Indicator

Standby attitude indicator provides an independent source of airplane attitude.



1 Bank Indicator and Scale

Indicates airplane bank.

Scale marks at 0, 10, 20, 30, 45, and 60 degrees.

2 Glide Path (G/P) Flag

Displays when glide slope information unreliable.

3 Airplane Symbol

Indicates airplane position.

4 Attitude (GYRO) Flag

Displays when attitude information unreliable.

5 Glide Slope Indicator

Indicates glide slope position relative to the airplane.

6 Horizon Line and Pitch Scale

Indicates position of horizon relative to the airplane.

Scale marks in five degree increments.

7 Localizer Indicator

Indicates localizer position relative to the airplane.

8 Localizer (LAT) Flag

Displays when localizer information unreliable.

9 Caging Control

Pull - levels horizon with airplane symbol.

10 Approach Selector

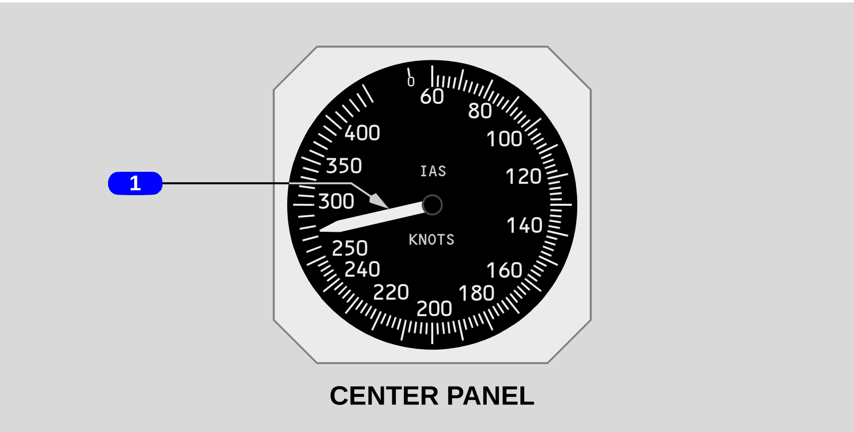
OFF - glide slope and localizer indicators and flags retracted from view.

APP (Approach) - glide slope and localizer information displayed. Left ILS receiver used.

B/CRS (Back Course) - reverses sensing for localizer information.

Standby Airspeed Indicator

Standby airspeed indicator displays airspeed from auxiliary pitot 1 and alternate static source.

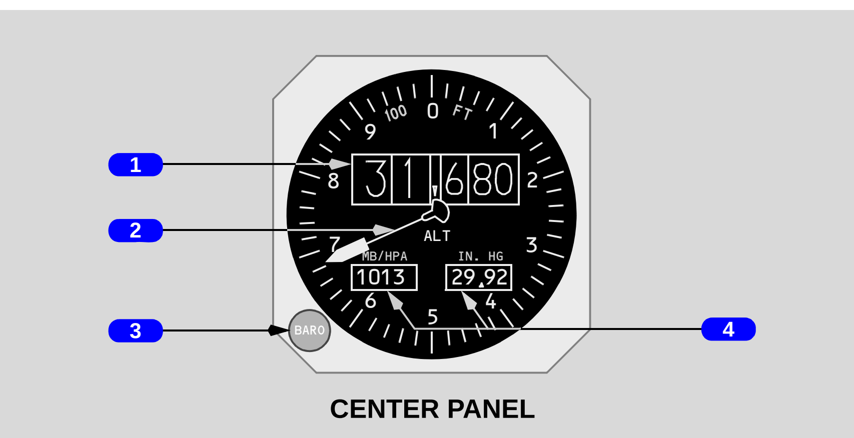


1 Airspeed Pointer

Indicates uncorrected airspeed.

Standby Altimeter

Standby altimeter displays barometric altitude from alternate static source.



1 Altitude Display

Displays uncorrected barometric altitude.

2 Altitude Pointer

Indicates uncorrected barometric altitude.

One full rotation of pointer is 1,000 feet.

3 Barometric Setting Control

Rotate - sets altimeter barometric setting.

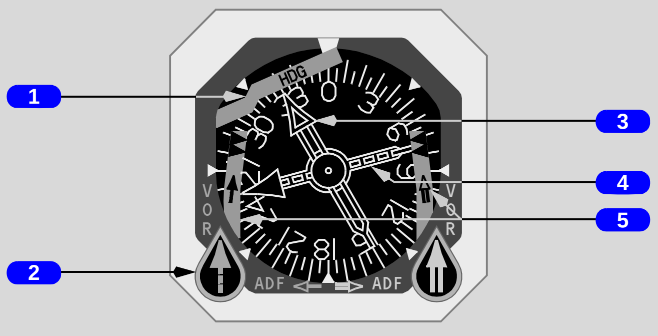
1 Barometric Setting Display

Displays selected barometric reference in Hectopascals (MB/HPA) and inches (IN. HG).

Radio Magnetic Indicator

Radio magnetic indicator displays heading and VOR and ADF bearing to the selected station.

Heading information is provided by the right or center IRU as selected by the F/O IRS source selector.



CAPTAIN'S PANEL

1 Heading (HDG) Flag

Displays when heading invalid.

2 VOR/ADF Selectors

VOR - VOR information provided to respective pointer.

ADF - ADF information provided to respective pointer.

3 Wide Pointer

Indicates right VOR or ADF bearing to selected station.

4 Narrow Pointer

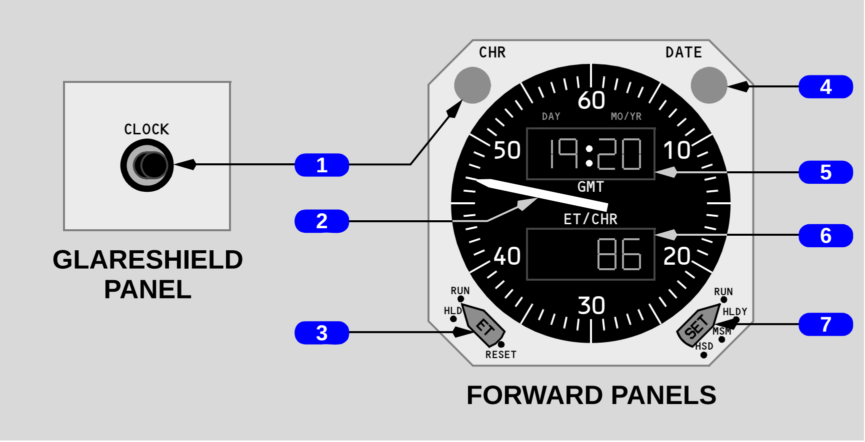
Indicates left VOR or ADF bearing to selected station.

5 Pointer Flags

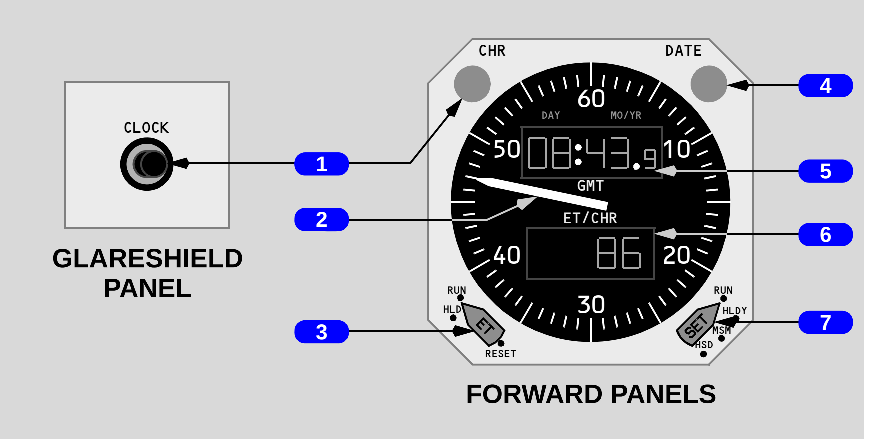
Display when selected information invalid.

Clock

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



1 Chronograph (CHR or CLOCK) Switch

Push - subsequent pushing starts, stops, resets the chronograph.

2 Chronograph Pointer

Indicates chronograph seconds.

3 Elapsed Time (ET) Selector

Controls elapsed time function.

RESET - returns elapsed time display to zero (spring loaded to HLD).

HLD (Hold) - stops elapsed time display.

RUN - starts elapsed time display.

4 DATE Switch

Push -

- displays date (alternates day and month, then year) on GMT display

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
- subsequent push returns display to time (hours, minutes) on GMT display.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- subsequent push returns display to time (hours, minutes, tenths of minutes) on GMT display.

5 GMT Display

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Displays time (hours, minutes).

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Displays time (hours, minutes, tenths of minutes).

Displays date when date switch pushed.

6 Elapsed Time (ET)/Chronograph (CHR) Display

Displays elapsed time (hours, minutes) or chronograph minutes.

Chronograph display replaces elapsed time display.

Elapsed time continues to run in the background and will be displayed after chronograph is reset.

7 Clock Set Selector

Sets time and date.

Hours Slew, Day (HS D) -

- advances hours when time selected with DATE switch
- advances days when date selected with DATE switch

Minutes Slew, Month (MS M) -

- advances minutes when time selected with DATE switch
- advances months when date selected with DATE switch

Hold, Year (HLD Y) -

- stops time indicator and sets seconds to zero when time selected with DATE switch
- advances years when date selected with DATE switch

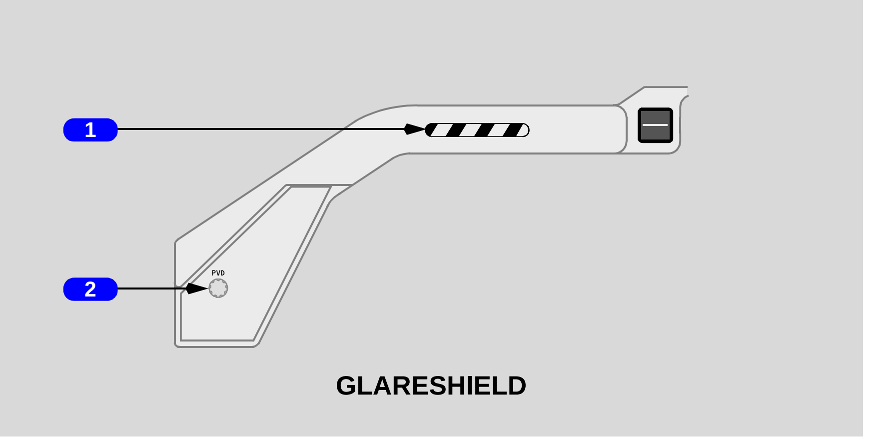
RUN - starts time indicator.

Para-Visual Display

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The PVD system consists of one PVD computer and two PVD indicators. The PVD computer receives guidance commands from the FCCs. The FCC source is selected with the FD/PVD source selector for the respective display.

Using the tuned runway localizer, the PVD provides guidance to runway centerline during ground operations.



1 Para-Visual Display (PVD)

Unshuttered -

- PVD selected on, within valid localizer region, within 45° of runway heading, and on the ground
- “barber pole” rotates in direction of runway centerline

Shuttered - PVD off -

- not within valid localizer region or not within 45° of runway heading
- above 5 feet altitude
- selected PVD source invalid

2 PVD Switch

Push - enables the PVD display unit to unshutter

Second Push - shutters the PVD display unit

Rotate - adjusts brightness.

EFIS Control Panel and Display Select Panel (DSP) - CDU Alternate Control

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
The CDU provides an alternate way to control the functions of the EFIS control panel and the display select panel except for TCAS if the panel fails (CDU-152).

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ
The CDU provides an alternate way to control the functions of the EFIS control panel and the display select panel except for TCAS and GPWS if the panel fails (CDU-152).

The CDU provides an alternate way to control the functions of the EFIS control panel and the display select panel (CDU-161).

Note: The control callouts on the following pages correspond to the control names on the EFIS control panels and the display select panel. Explanations of the CDU functions are the same as on the respective control panels except where described.

CDU EFIS/DSP Control Selection (CDU-152)

CDU-152

1 Alternate EFIS Control

Push -

- displays alternate EFIS control page
- available if EFIS control panel fails

2 Alternate EICAS Control

Push -

- displays alternate EICAS control page
- available if EICAS control panel fails

CDU EFIS/DSP Control Selection (CDU-161)

CDU-161

1 Alternate EFIS Control

Push - (with SELECT displayed) displays alternate EFIS CONTROL page.

SELECT is displayed when the control panel (CTL PNL) prompt is selected ON or there is a failure of the associated control panel. The line title EFIS CP remains when the SELECT prompt is removed.

2 Alternate EICAS Control

Push - (with SELECT displayed) displays alternate EICAS CONTROL page.

SELECT is displayed when the control panel (CTL PNL) prompt is selected ON or there is a failure of the control panel. The line title EICAS CP remains when the SELECT prompt is removed.

3 Control Panel Switch

Push - alternately selects the EFIS and EICAS CP SELECT prompts ON and OFF. ON is displayed if the associated control panel fails. The selected mode (ON or OFF) is displayed in large font. The SELECT prompts are blank when OFF is displayed in large font.

EFIS Control Page (CDU-152)

CDU-152

1 Barometric (BARO) Reference SET

Valid entry is reference barometric setting.

Entry of S or STD displays 29.92 IN or 1013 HPA on BARO SET line and displays STD on the PFD.

2 Decision Height (DH) SET

Valid entry is decision height.

3 Decision Height (DH) RESET

Push - resets PFD flashing amber DH.

4 **Minimum Descent Altitude (MDA SET)**

Valid entry is minimum descent altitude.

5 **RANGE Increase (INCR)**

Push - increases ND nautical mile range scale.

6 **RANGE Decrease (DECR)**

Push - decreases ND nautical mile range scale.

7 **MODE**

Push - selects desired ND display.

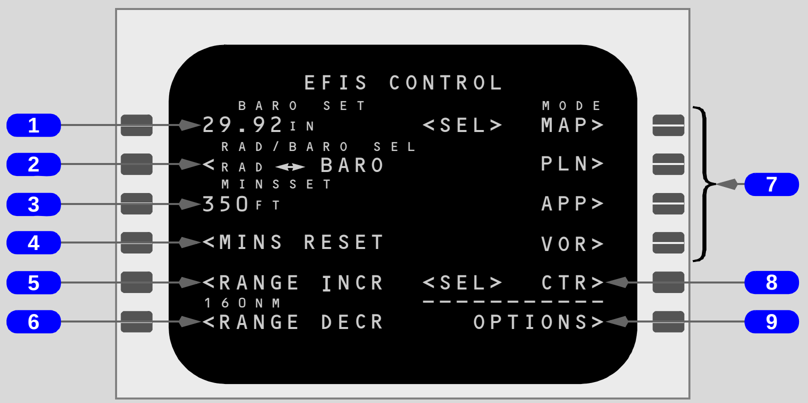
8 **Center (CTR)**

Push - alternately displays centered and expanded APP, VOR, and MAP modes.

9 **OPTIONS**

Push - displays EFIS OPTIONS page.

EFIS Control Page (CDU-161)



CDU-161

1 Barometric (BARO) SET Reference

Valid entry is reference barometric setting.

- entries of 22.00 to 32.00 or 2200 to 3200 display as inches of Hg
- entries of 745 to 1084 display as hecto pascals
- entry of "I" to change the displayed value to inches Hg
- entry of "H" to change the displayed value to hPa
- entry of "S" or "STD" displays 29.92 IN or 1013 HPA (depending on units being displayed on BARO SET line) and displays STD on the PFD.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

2 Radio (RAD) or Barometric (BARO) Select (SEL)

- Push - alternately selects radio altimeter (RAD) or barometric altimeter (BARO) as the minimums reference on the PFD. Selected mode displays in large font.

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

2 Radio (RAD) or Barometric (BARO) Select (SEL)

Not available.

3 Minimums (MINS) SET

- Entered minimums display on respective PFD.
- BARO selected in 2L, valid entries are -1001 to 15000 feet.
- RAD selected in 2L, valid entries are -20 to 999 feet.

4 Minimums (MINS) RESET

Push - resets the minimums alert on the PFD.

5 RANGE Increase (INCR)

Push - increases ND nautical mile range scale.

6 RANGE Decrease (DECR)

Push - decreases ND nautical mile range scale.

7 MODE

Push - selects desired ND display.

8 Center (CTR)

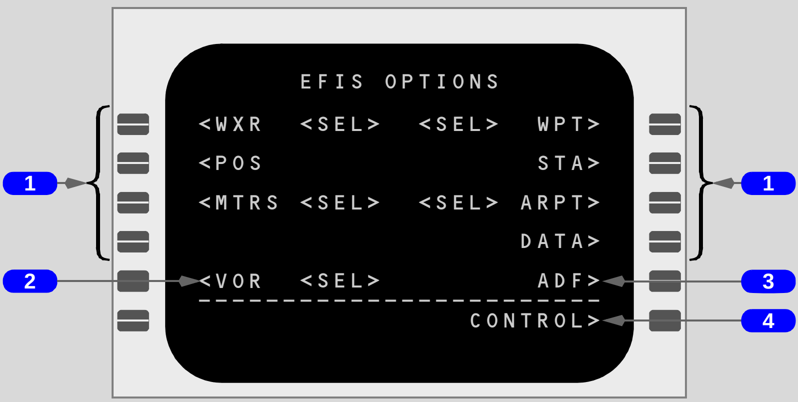
Push - alternately displays centered and expanded APP, VOR, and MAP modes.

9 **OPTIONS**

Push - displays EFIS OPTIONS page.

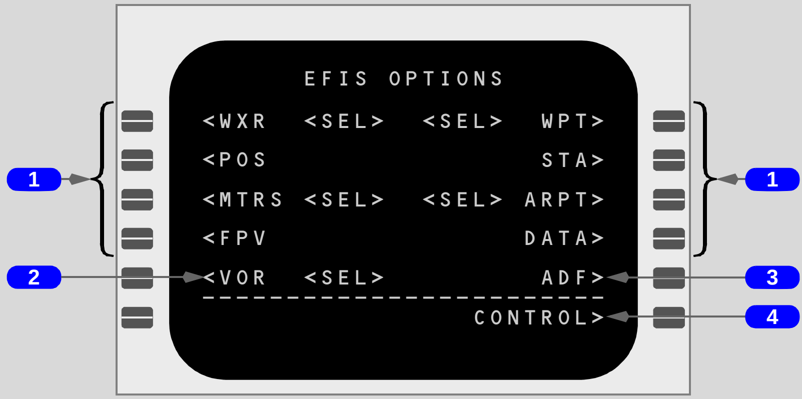
EFIS Options Page (CDU-152)

VQ-BHW, VQ-BHX



CDU-152

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



CDU-152

VQ-BHW, VQ-BHX

1 WXR, POS, MTRS, WPT, STA, ARPT, DATA

Push - select related PFD/ND options.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

1 WXR, POS, MTRS, FPV, WPT, STA, ARPT, DATA

Push - select related PFD/ND options.

2 VOR

Push - selects left and right VORs for display on ND and deletes ADFs when previously selected.

3 ADF

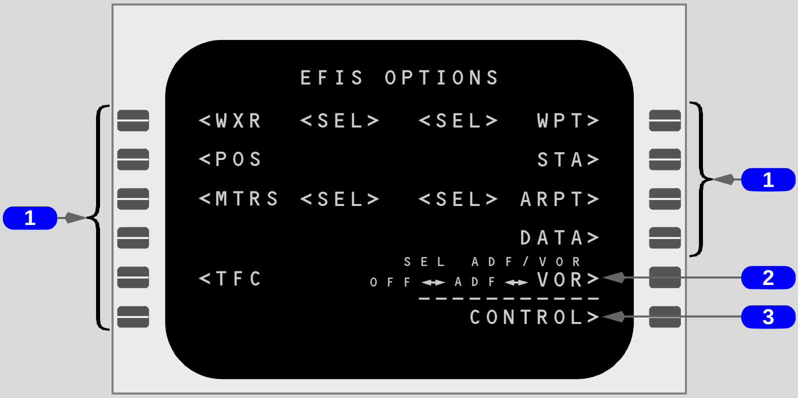
Push - selects left and right ADFs for display on ND and deletes VORs when previously selected.

4 CONTROL

Push - selects EFIS CONTROL CDU page.

EFIS Options Page (CDU-161)

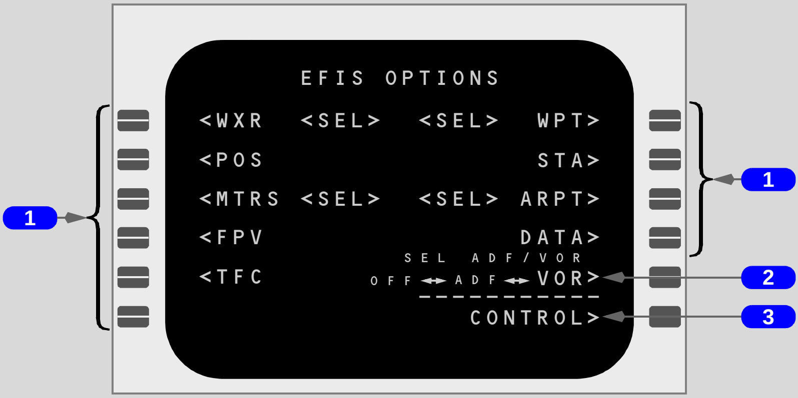
VQ-BHW, VQ-BHX



CDU-161

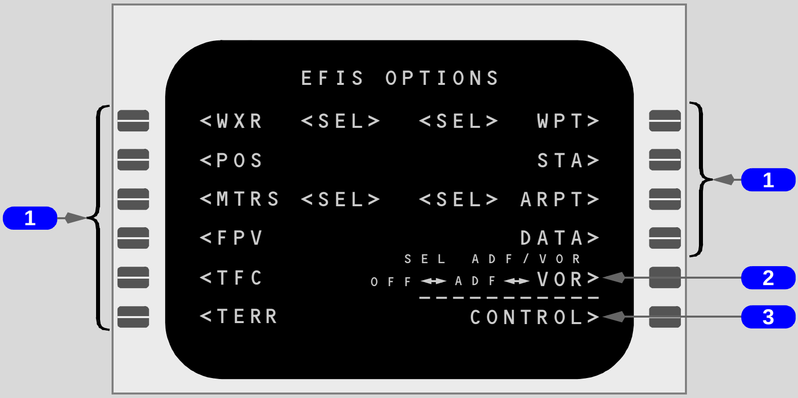
BOEING
Flight Instruments, Displays -
Controls and Indicators
747 Flight Crew Operations Manual

VP-BKJ, VP-BKL, VP-BVR



CDU-161

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ



CDU-161

VQ-BHW, VQ-BHX

1 WXR, POS, MTRS, TFC, WPT, STA, ARPT, DATA

Push - selects related PFD/ND options.

VP-BKJ, VP-BKL, VP-BVR

1 WXR, POS, MTRS, FPV, TFC, WPT, STA, ARPT, DATA

Push - selects related PFD/ND options.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

1 WXR, POS, MTRS, FPV, TFC, TERR, WPT, STA, ARPT, DATA

Push - selects related PFD/ND options.

2 ADF/VOR

Push - sequentially selects ADF, VOR, or OFF for the pointer display on the ND.

ADF - displays the ADF pointers and frequency on the ND in all modes except PLAN.

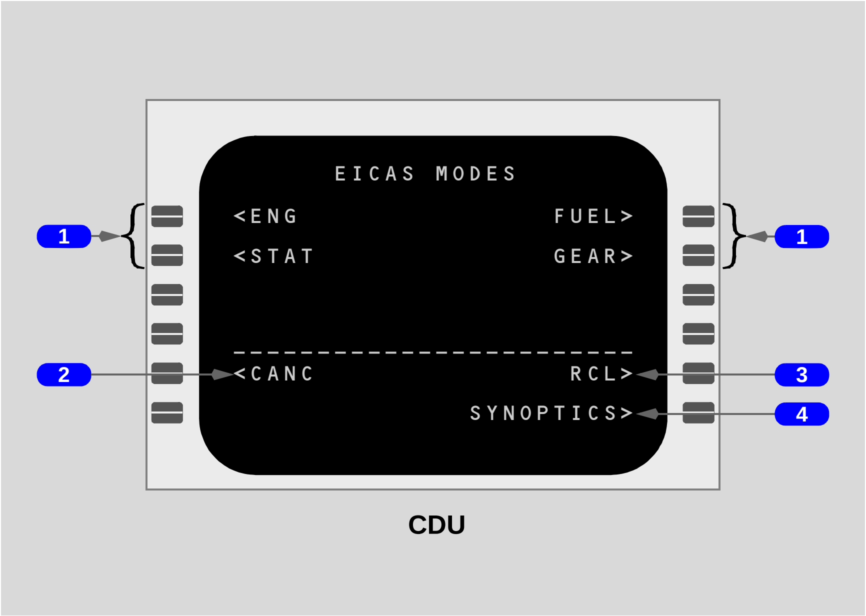
VOR - displays the VOR pointer, frequency, and associated DME on the ND in all modes except PLAN.

OFF - removes ADF and VOR data from the ND.

3 CONTROL

Push - selects EFIS CONTROL CDU page.

EICAS Modes Page



1 Synoptic/Display

Push - displays respective synoptics/displays.

2 Cancel (CANC)

Refer to Warning Systems, Chapter 15.

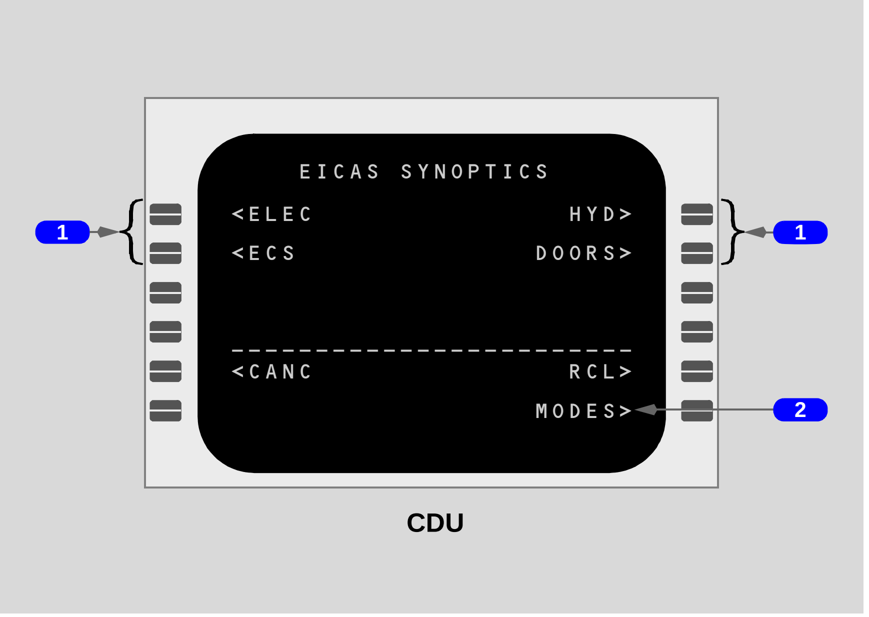
3 Recall (RCL)

Refer to Warning Systems, Chapter 15.

4 SYNOPTICS

Push - selects EICAS SYNOPTICS page.

EICAS Synoptics Page



1 **Synoptic/Display**

Push - displays respective synoptics/display.

2 **MODES**

Push - selects EICAS MODES page.

Flight Instruments, Displays — Chapter 10
System Description — Section 20

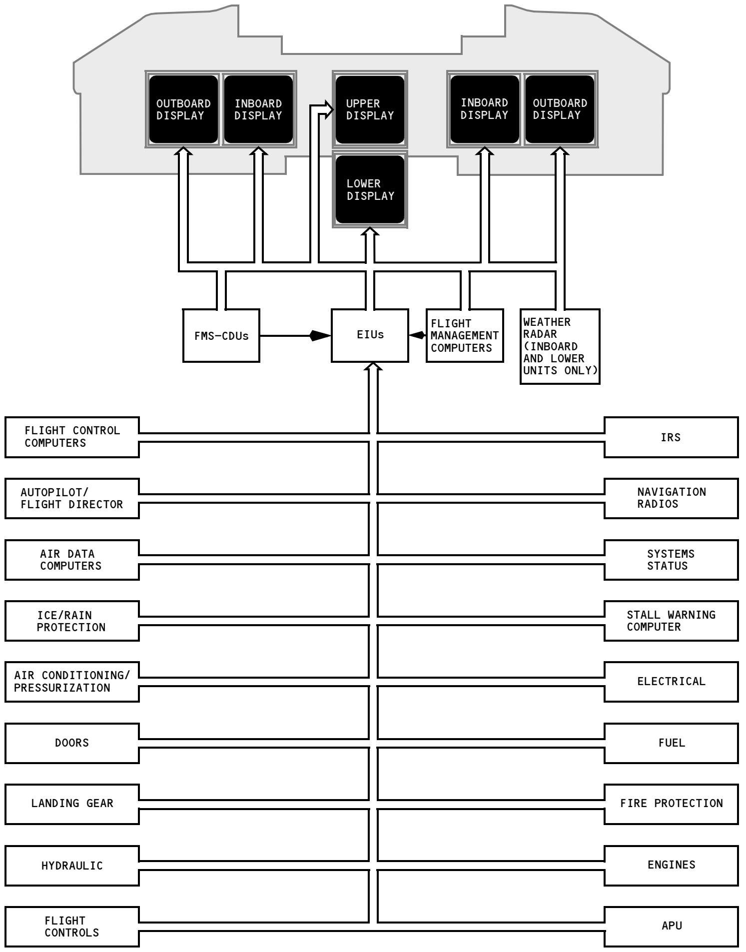
Introduction

The integrated display system consists of three identical EFIS/EICAS interface units (EIUs) which receive airplane systems information. The EIUs supply information to the flight crew on six display units. The units display three primary groups of information:

- primary flight display (PFD)
- navigation display (ND)
- engine indication and crew alerting system (EICAS)

The Electronic Flight Instrument System (EFIS) consists of the PFD and ND. Detailed information on the PFD and ND is found in Sections 30 and 40 of this chapter.

Integrated Display System



Para-Visual Display (PVD) System

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The PVD system consists of one PVD computer and two PVD indicators. The PVD computer receives guidance commands from three FCCs. The FCC source is selected with the FD/PVD source selector for the respective display.

Using the runway localizer tuned on the Navigation Radio page, the PVD provides guidance to runway centerline during ground operations.

Display Selection and Control

During normal operations:

- inboard and lower display selectors are set to NORM
- PFDs display on two outboard display units
- NDs display on two inboard display units
- EICAS displays on upper and lower display units

Instrument Display Source Selection

The information sources for PFDs and NDs are selected with the source selectors. The desired flight director, navigation source, EIU, IRU, and ADC can be selected.

Display Brightness Control

The brightness of each display can be adjusted. The outboard and inboard display brightness controls are on the glareshield. The upper and lower display brightness controls are on the center panel. The inner brightness control for the inboard and lower display units control the weather radar returns.

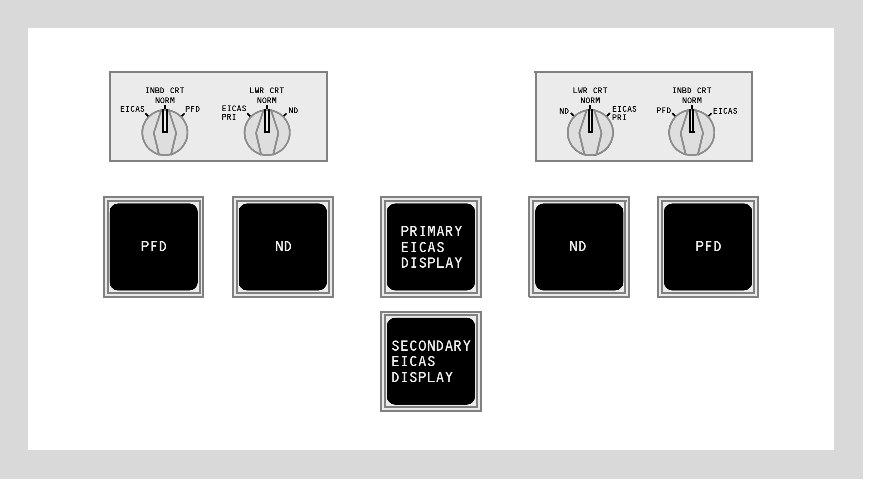
If a display color fails, the display changes color but all indications remain distinguishable and no information is lost.

Light sensors above the glareshield and near each display and CDU measure ambient light level and adjust display brightness to maintain the desired illumination.

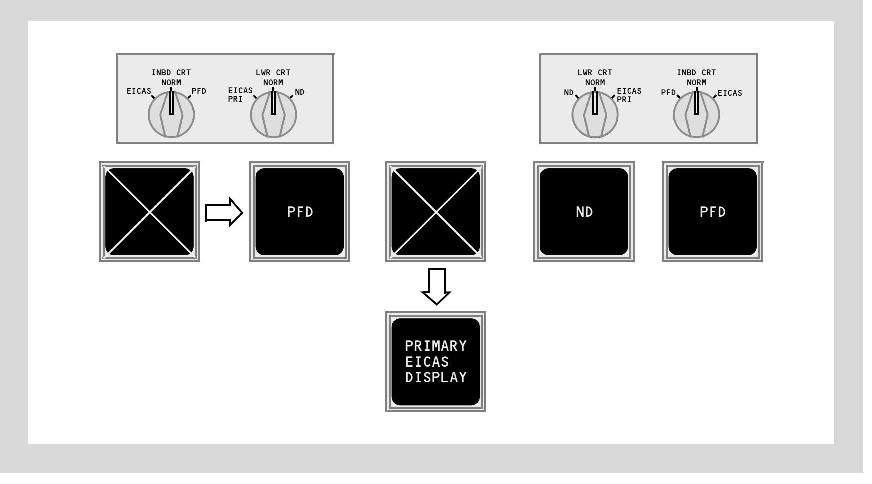
Display Selection and Control Examples

The following examples depict display selections.

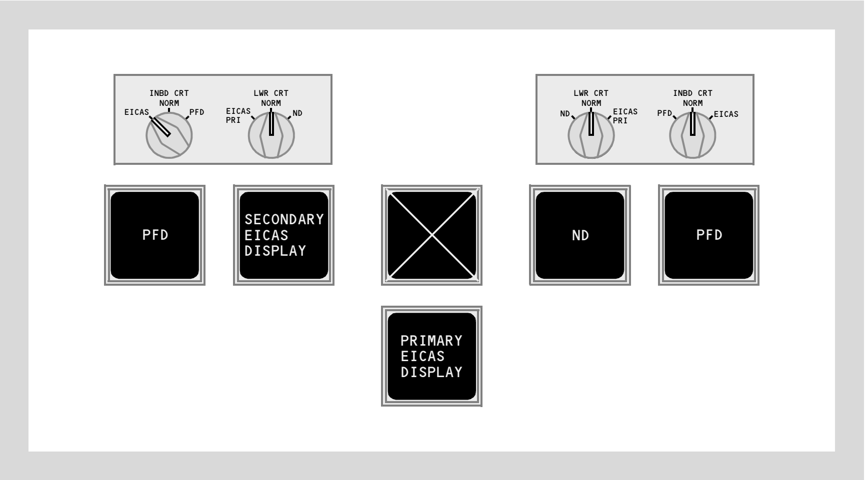
Normal Display Configuration



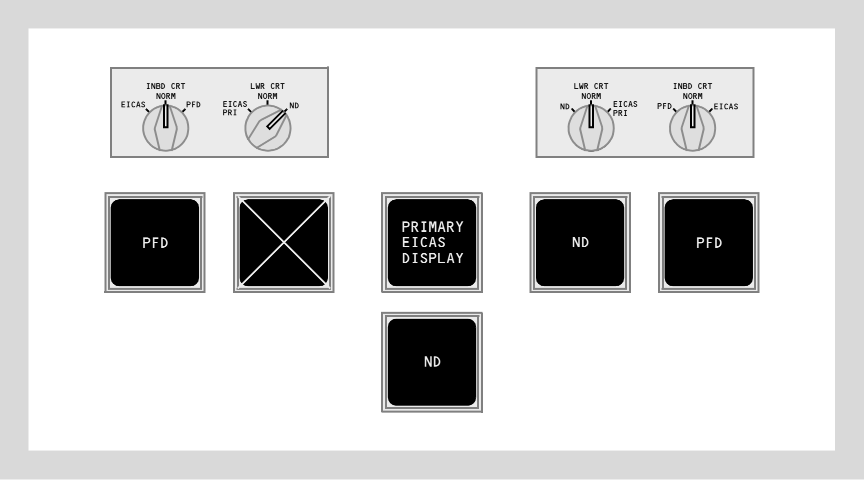
Display Failure Automatic Switching



Inboard Display Switching



Lower Display Switching



Standby Flight Instruments

The standby flight instruments include:

- standby magnetic compass
- standby attitude indicator
- standby airspeed indicator
- standby altimeter
- radio magnetic indicator

Standby Magnetic Compass

A standard liquid-damped magnetic standby compass is located on the center post above the glareshield. A card located near the compass provides heading correction factors.

Standby Attitude Indicator

The standby attitude indicator on the center instrument panel incorporates an (APP) display, a bank indicator, and a pitch scale display. The main battery powers the standby attitude indicator. The left ILS receiver provides approach information.

Standby Airspeed Indicator

The standby airspeed indicator on the center instrument panel receives pitot pressure from auxiliary pitot source 1 and static pressure from the alternate static source.

Standby Altimeter

The standby altimeter on the center instrument panel receives static pressure from the alternate static source. The pointer completes one revolution every 1,000 feet.

Radio Magnetic Indicator

The radio magnetic indicator displays selected VOR and ADF bearings. The right IRU provides heading information when the F/O's IRS source selector is in RIGHT. The center IRU provides heading information when center or left is selected.

- When the Heading Reference switch is in NORM, a heading flag is in view north of 82° latitude (or north of 70°N between 80°W and 130°W) or south of 82° latitude (or south of 60°S between 120°E and 160°E). When the switch is in TRUE, true heading displays and selecting a VOR displays the VOR failure flag.

Clocks

VP-BKJ, VP-BVR
The Captain's clock provides time and date to the FMCs. If the Captain's clock fails, the F/O's clock provides this information. In addition to time, the clocks provide alternating day and month-year, elapsed time, and chronograph functions. Chronograph switches on the glareshield control the clock chronograph function.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

The Captain's clock provides time and date to the FMCs if GPS is not available. If the Captain's clock fails, the F/O's clock provides this information. In addition to time, the clocks provide alternating day and month-year, elapsed time, and chronograph functions. Chronograph switches on the glareshield control the clock chronograph function.

Time and date no longer display if APU battery bus power is removed. However, all internal clock functions continue to operate and the correct time and date display when power is restored. All display and internal clock functions fail if the main hot battery bus power is removed. The clock must be reset when battery power is restored.

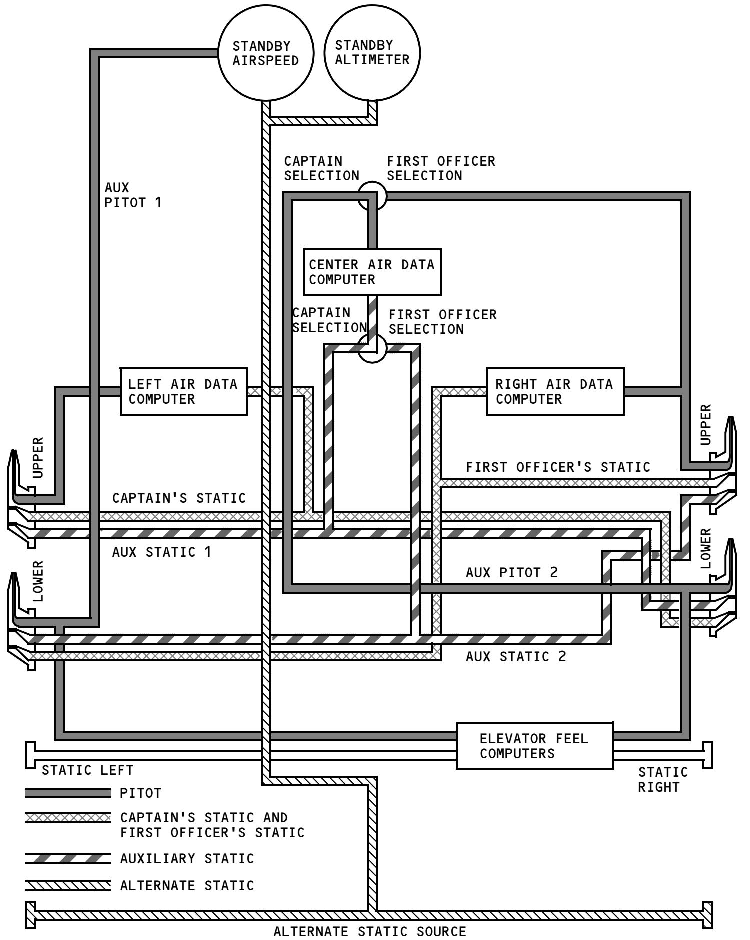
Display System Information Sources

Pitot Static System

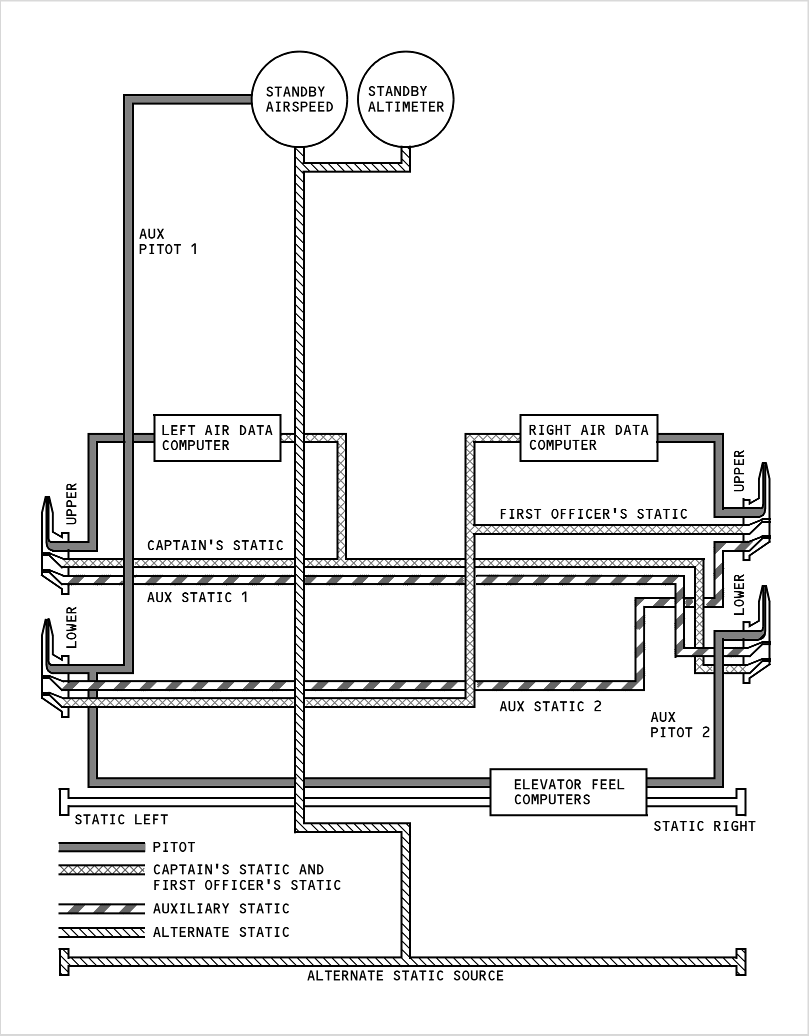
The pitot static system provides pitot pressure and static pressure to the air data computers, standby airspeed indicator, standby altimeter, and elevator feel computer.

Pitot Static Diagram

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX



Air Data Computer (ADC) System

The ADC system supplies air data information to various airplane systems. Air data information enables the EIUs to display altitude, airspeed, Mach, and air temperature.

VQ-BHW, VQ-BHX

There are two ADCs, left and right. Each ADC receives inputs from AOA sensors, TAT probes, pitot static system, and barometric settings from the EFIS control panels sent through the respective CDUs. Either ADC can provide flight information to the Captain’s and F/O’s flight instruments, depending on the position of the Air Data Source selectors. Normally, each ADC provides flight information to the PFD and ND on its respective side.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

There are two primary ADCs and one standby ADC. Each ADC receives inputs from AOA sensors, TAT probes, pitot static system, and barometric settings from the EFIS control panels sent through the respective CDUs. The left and right primary ADCs provide flight information to the Captain’s and F/O’s flight instruments. The center ADC is a backup for the left and right ADCs and is selected with the Air Data Source selectors. AOA sensor inputs to ADCs are required for displaying airspeed, Mach, and altitude information. When selecting the center ADC, vertical speed indications may lag actual conditions.

Angle-of-Attack (AOA)

There are two angle-of-attack vanes, one located on each side of the forward fuselage. The vanes measure airplane angle-of-attack relative to the air mass.

Total Air Temperature (TAT)

Left and right dual total air temperature probes sense outside air temperature (OAT) and heat of compression. TAT displays on primary EICAS. TAT indication on the ground approximates OAT. The TAT probe must be aspirated by bleed air to provide accurate information.

Static Air Temperature (SAT)

SAT displays on Progress page 2.

Introduction

PFDs present a dynamic color display of parameters necessary for flight path control. PFDs provide the following information:

- flight mode annunciation
- airspeed
- altitude
- vertical speed
- attitude
- steering information
- radio altitude
- instrument landing system display
- approach minimums
- heading/track indications
- time critical warnings

Failure flags display for airplane system failures. Displayed information is removed or replaced by dashes if no valid information is available to the display system (because of out-of-range or malfunctioning navigation aids). Displays are removed when a source fails or when no system source information is available.

Flight mode annunciations are described in Chapter 4, Automatic Flight.

TCAS resolution advisories are described in Chapter 15, Warning Systems.

Alerts on the PFD display in capital letters between the attitude display and the compass rose. Refer to Chapter 15, Warning Systems.

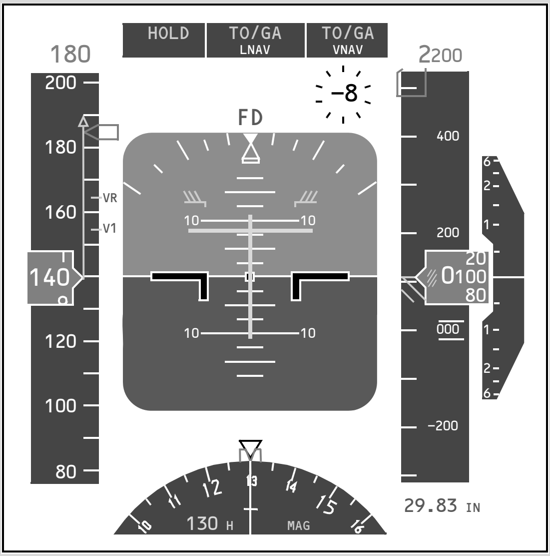
Typical PFD Displays

Typical PFD configurations for six phases of flight follow. The autopilot, LNAV, and VNAV are active for climb, cruise, descent, approach, and landing. The AFDS approach mode is used for approach and landing.

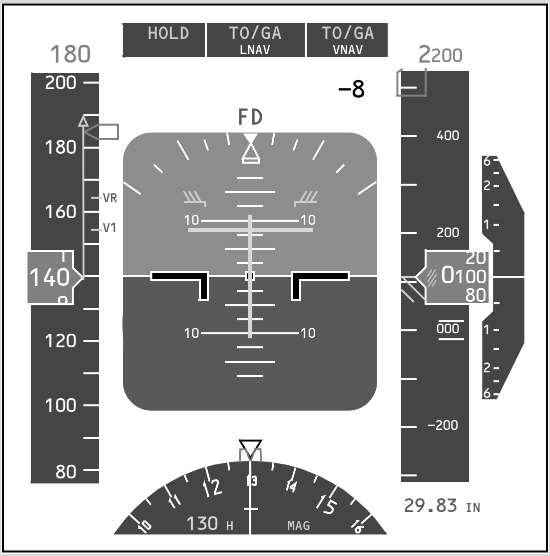
PFD Takeoff Display

Liquid Crystal Display

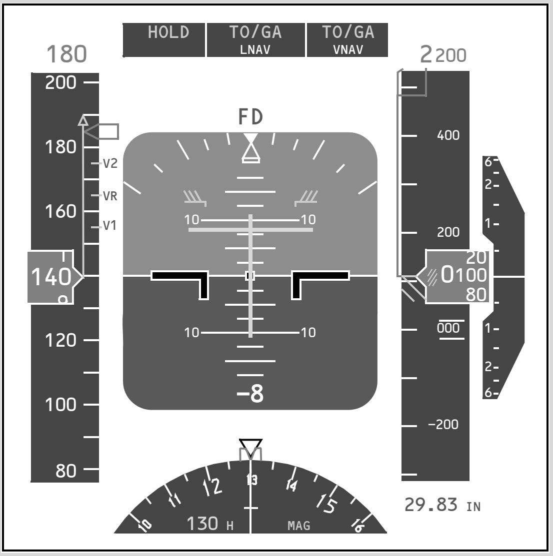
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

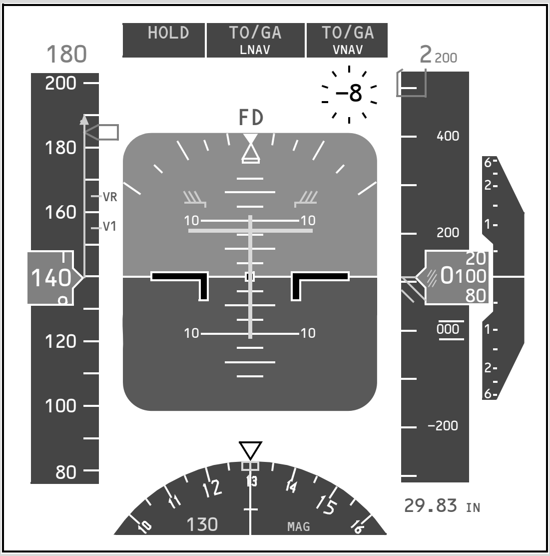


EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

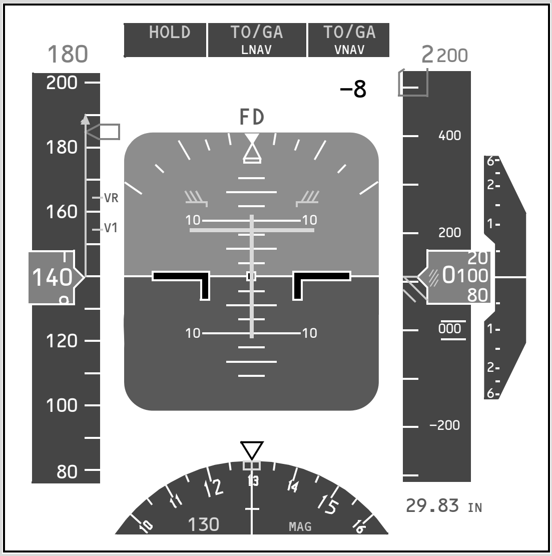


Cathode Ray Tube

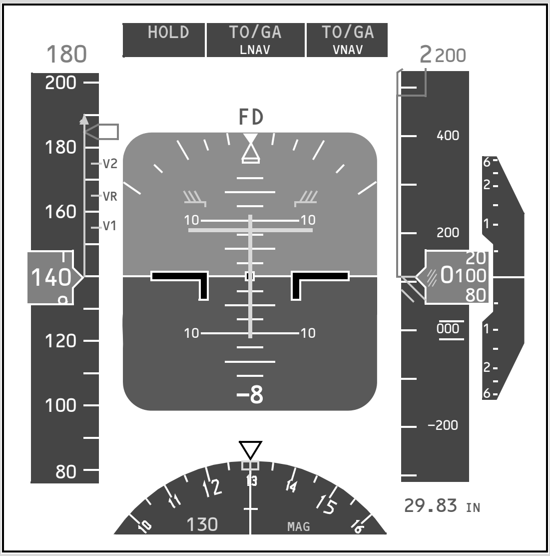
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

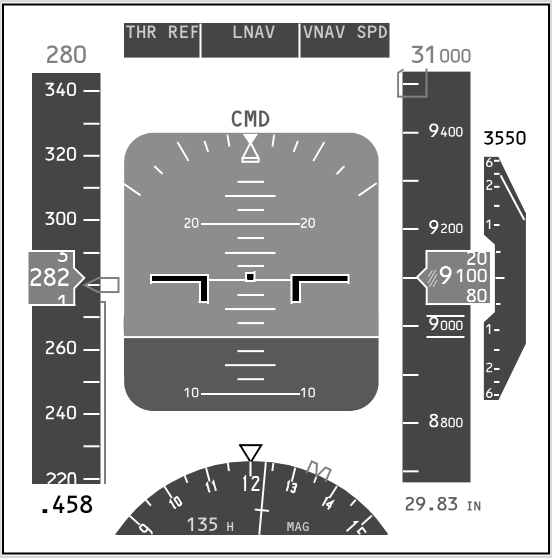


EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

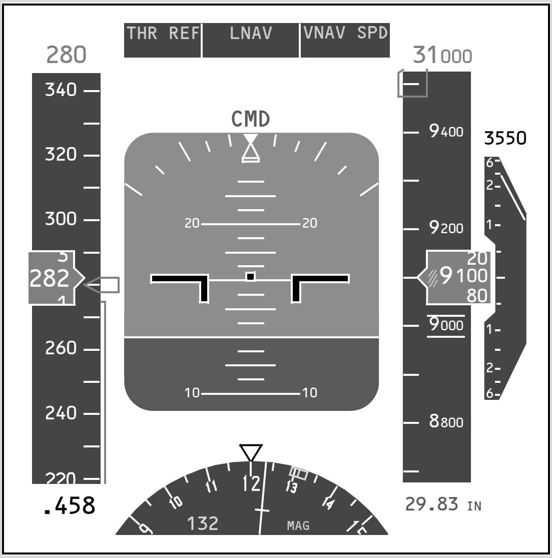


PFD Climb Display

Liquid Crystal Display

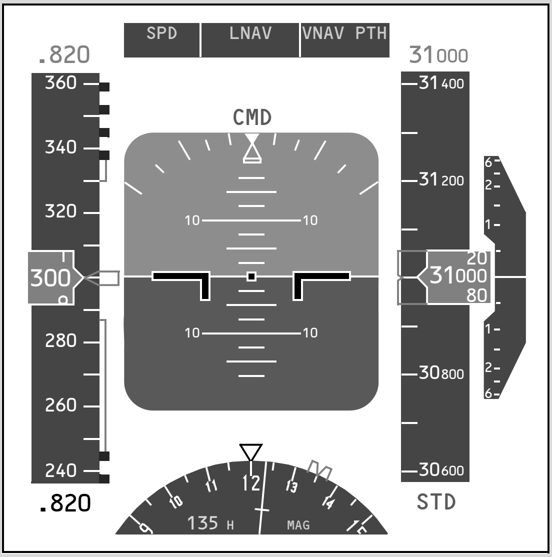


Cathode Ray Tube

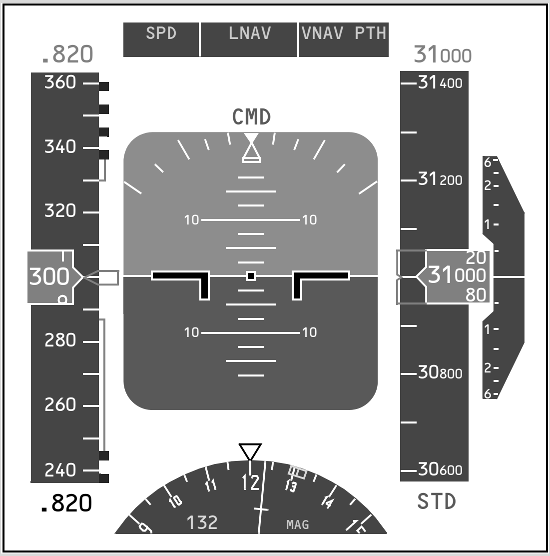


PFD Cruise Display

Liquid Crystal Display

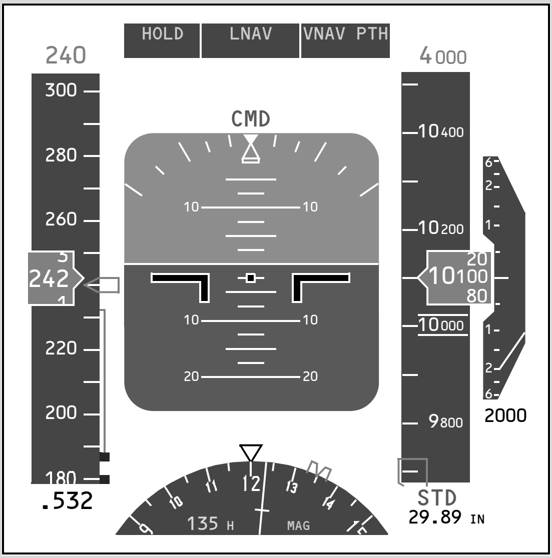


Cathode Ray Tube

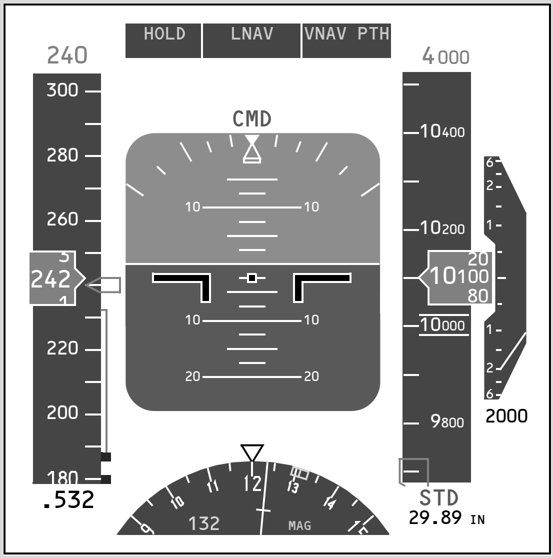


PFD Descent Display

Liquid Crystal Display



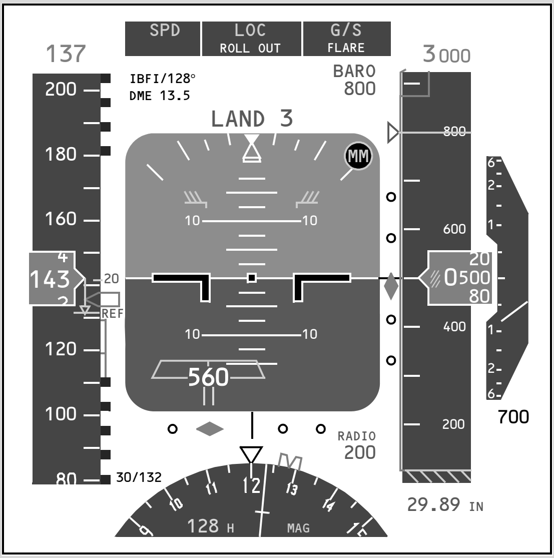
Cathode Ray Tube



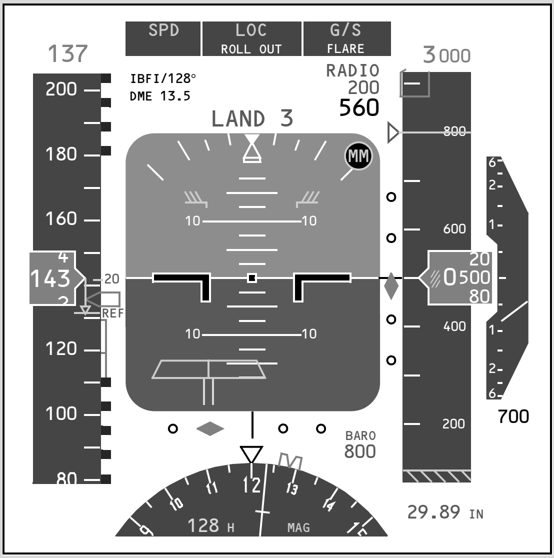
PFD Approach Display

Liquid Crystal Display

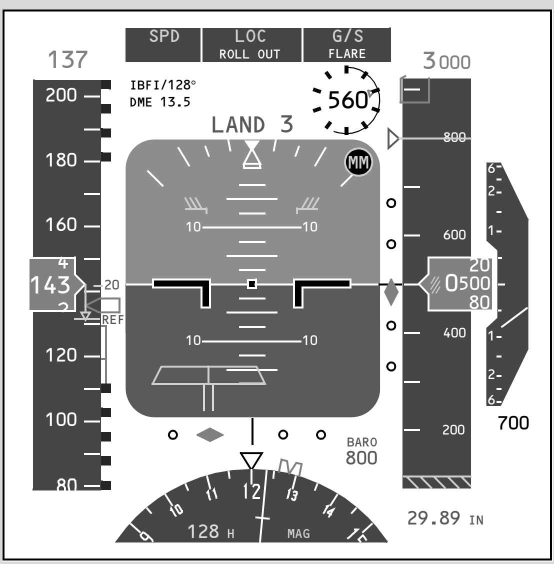
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



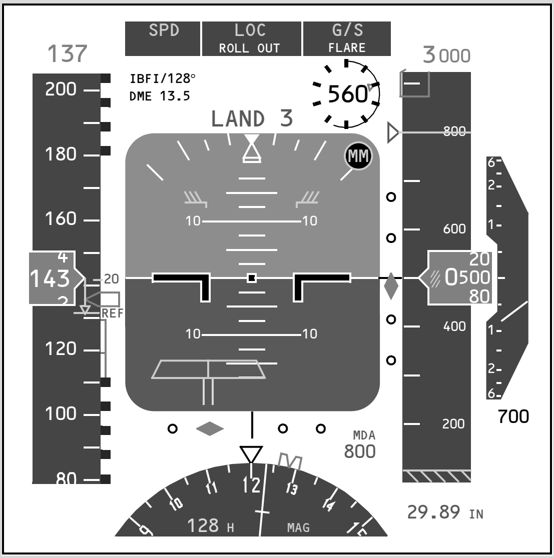
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



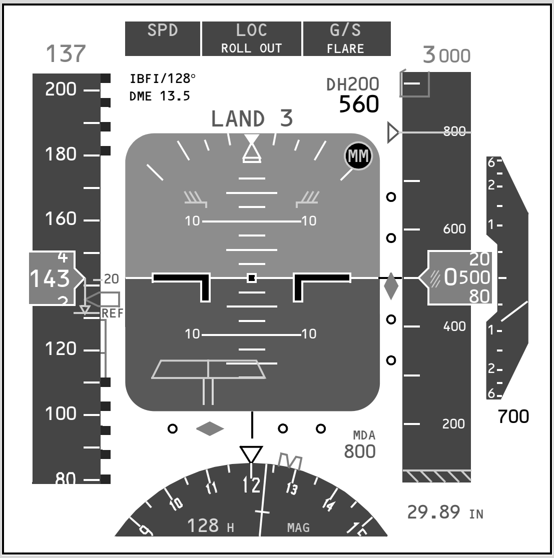
EI-XLZ



VP-BKJ, VP-BKL, VP-BVR

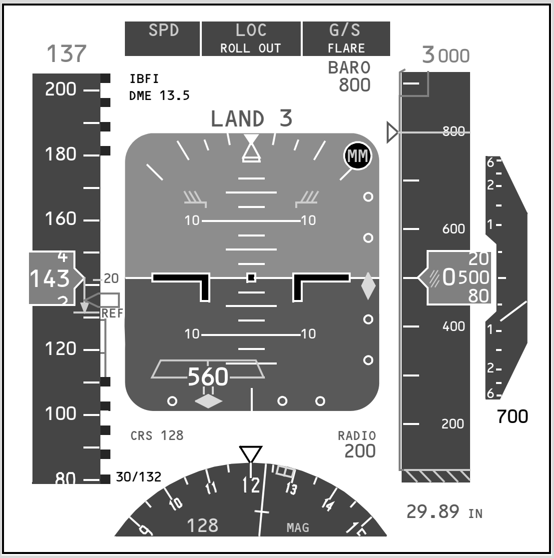


VQ-BHW, VQ-BHX

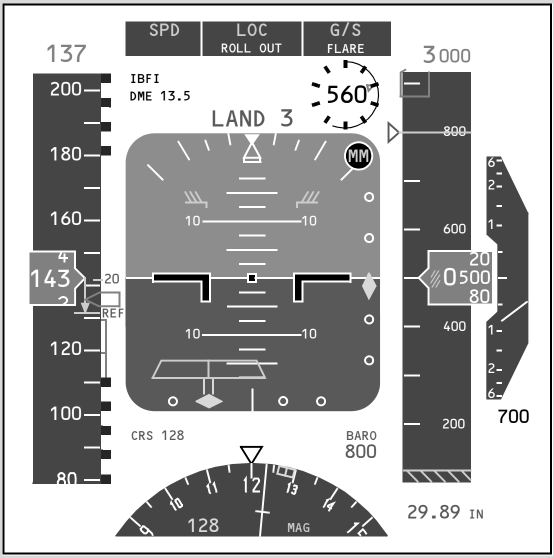

SPD
LOC
ROLL OUT
G/S
FLARE
137
3000
IBFI/128°
DME 13.5
DH200
560
LAND 3
MM
200
180
160
143
20
REF
120
100
80
10
10
10
10
800
600
0500
20
80
400
200
700
MDA
800
12
128 H
MAG
29.89 IN

Cathode Ray Tube

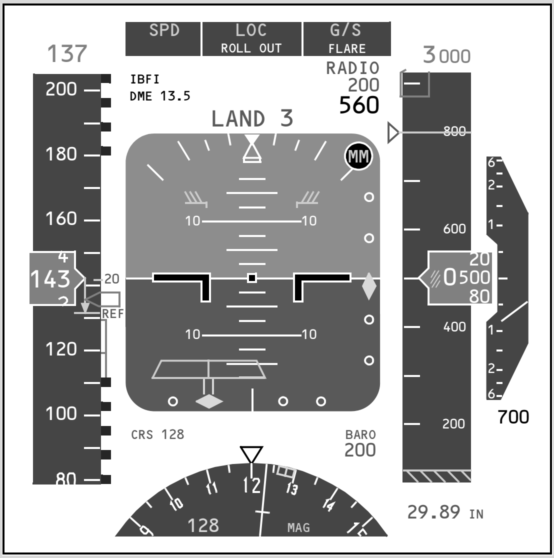
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



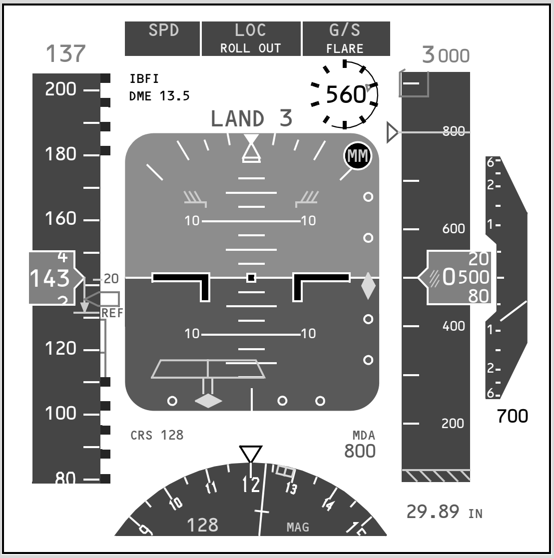
EI-XLZ



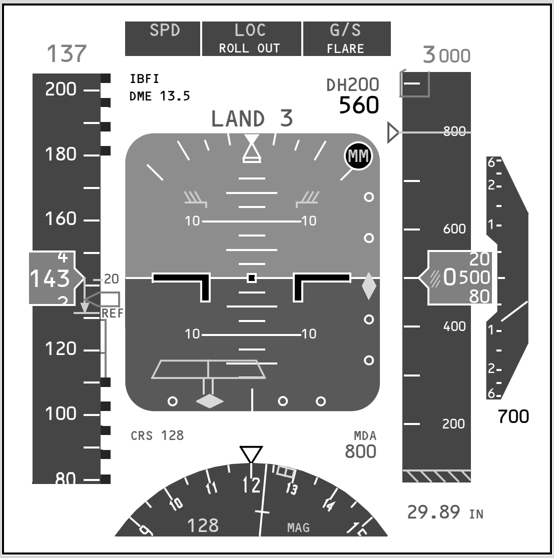
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



VP-BKJ, VP-BKL, VP-BVR



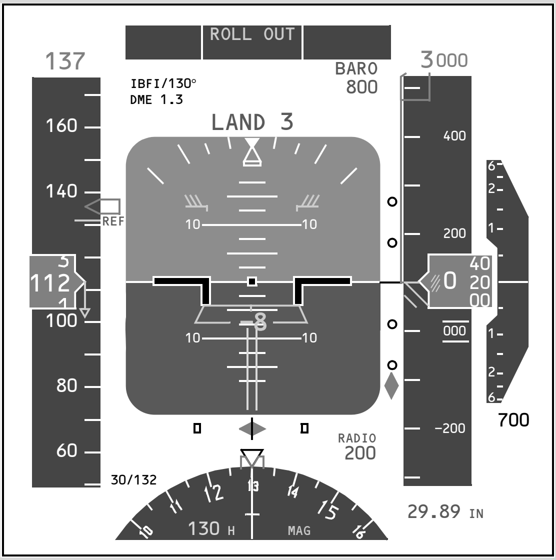
VQ-BHW, VQ-BHX


SPD
LOC
ROLL OUT
G/S
FLARE
137
3000
IBFI
DME 13.5
DH200
560
LAND 3
MM
200
180
160
143
20
REF
120
100
80
800
600
20
0500
80
400
200
700
CRS 128
MDA
800
128
MAG
29.89 IN

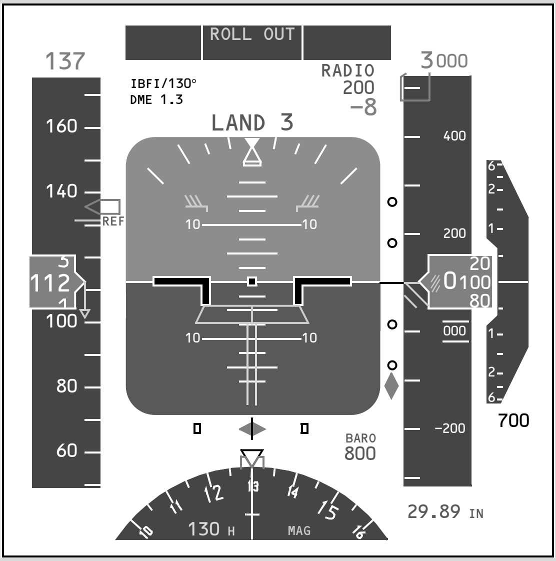
PFD Landing Display

Liquid Crystal Display

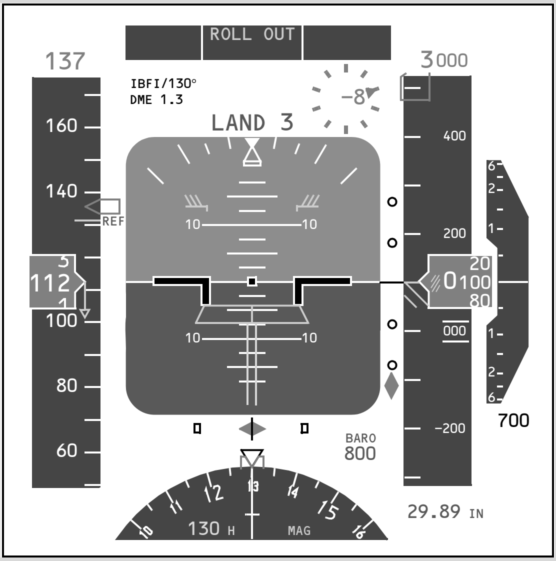
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



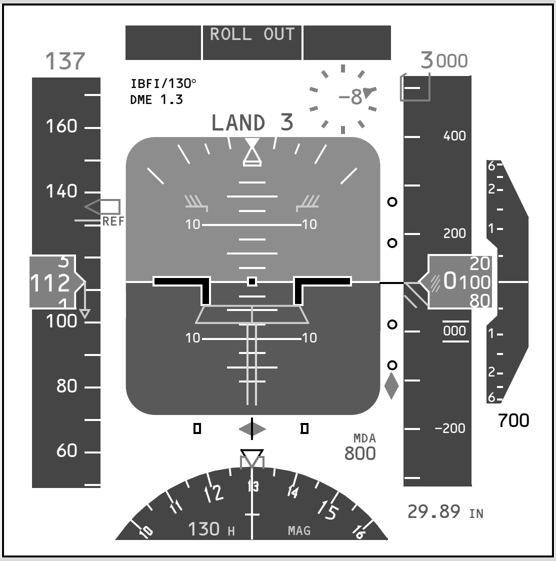
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



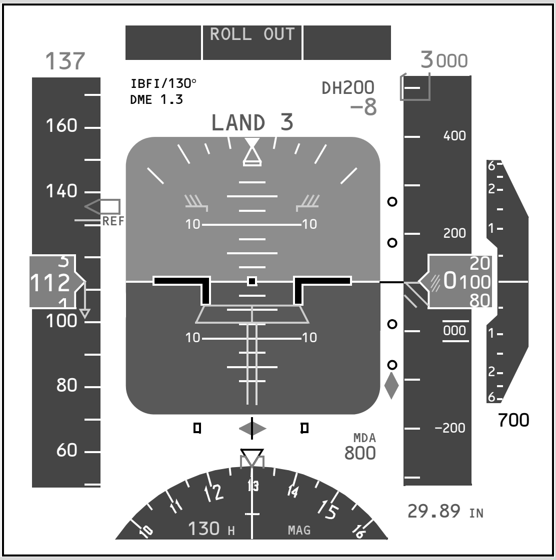
EI-XLZ



VP-BKJ, VP-BKL, VP-BVR

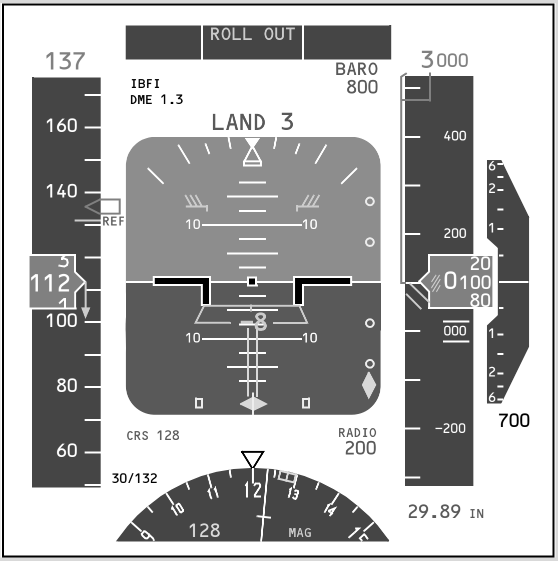


VQ-BHW, VQ-BHX

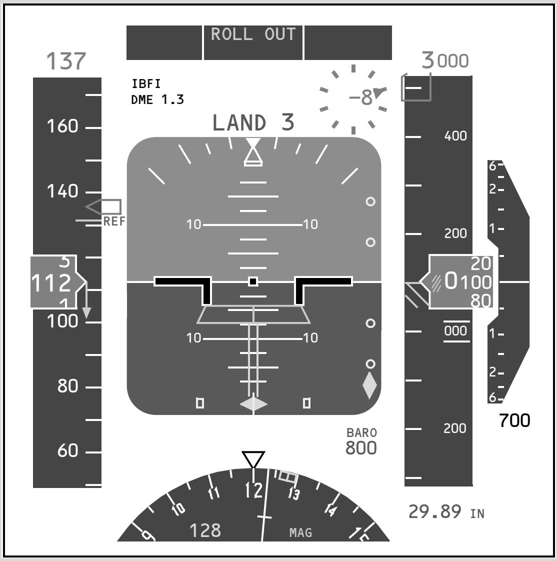

ROLL OUT
137
3000
IBFI/130°
DME 1.3
DH200
-8
LAND 3
160
140
REF
400
200
112
0100
20
80
100
000
80
60
10
10
10
10
MDA
800
-200
700
130 H
MAG
29.89 IN

Cathode Ray Tube

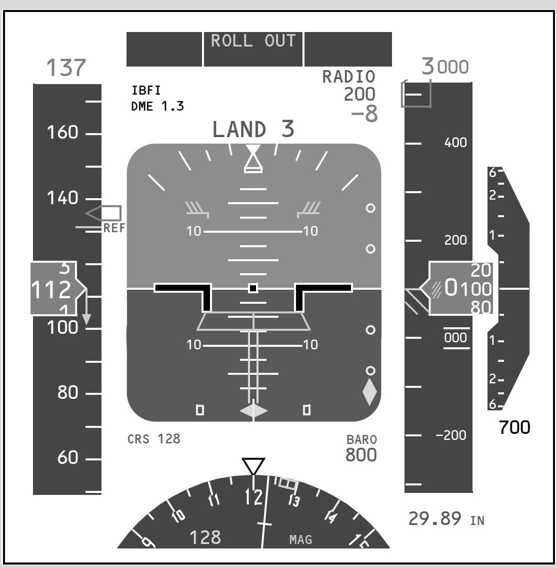
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



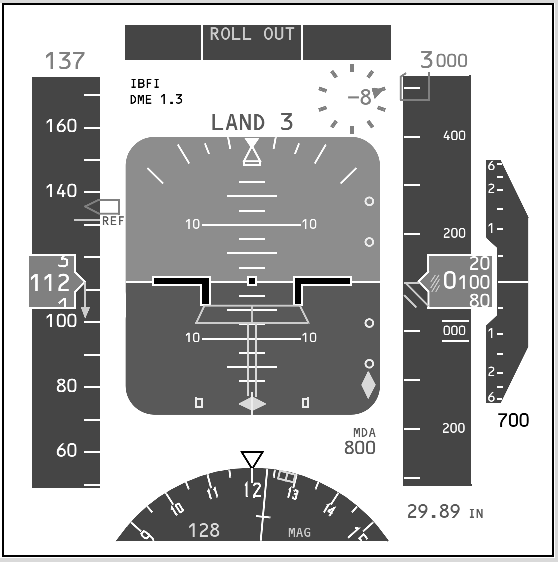
EI-XLZ



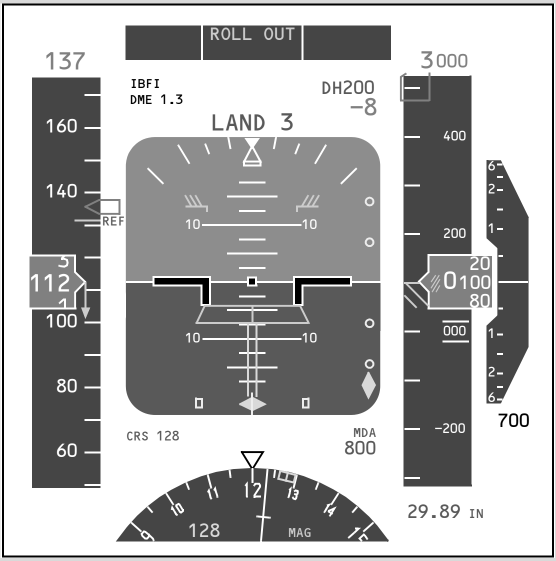
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX


ROLL OUT
137
3000
IBFI
DME 1.3
DH200
-8
LAND 3
160
140
REF
400
200
112
0100
20
80
100
80
60
000
-200
700
10
10
CRS 128
MDA
800
12
128
MAG
29.89 IN

Intentionally
Blank

Introduction

The NDs provide a mode-selectable color flight progress display. The modes are:

- MAP
- VOR
- APP (approach)
- PLN (plan)

MAP, VOR, and APP modes can be switched between an expanded mode with a partial compass rose and a centered mode with a full compass rose.

Map Mode

MAP mode is recommended for most phases of flight.

Presented track up, this mode shows airplane position relative to the route of flight against a moving map background.

Displayed information can include:

- track
- heading
- route
- position trend vector
- range to selected altitude
- map range scale
- ground speed
- true airspeed
- wind direction and speed
- next waypoint distance
- waypoint estimated time of arrival
- selected navigation data points
- TCAS Traffic Display

Navigation Data Points

Additional navigation facility (STA), waypoint (WPT), airport (ARPT), route progress (DATA), and position (POS) data may be displayed on the ND in both the expanded and center map modes.

VOR and Approach Modes

VOR and APP modes display heading up. VOR and APP modes display track, heading, and wind speed and direction with VOR navigation or ILS approach information.

Plan Mode

PLN mode displays true north up. The active route may be viewed using the STEP prompt on Legs pages. Position DATA is available for display in plan mode

ND Information
Heading

Heading is supplied by the selected IRU. The ND compass rose can be referenced to magnetic north or true north. The Heading Reference switch is used to manually select magnetic or true reference. The compass display references true north when the airplane is north of 82° N latitude (or north of 70°N between 80° W and 130° W) or south of 82° S latitude (or south of 60°S between 120° E and 160°E).

If the ND is referenced to true north and the airplane descends 2,000 feet at more than 800 feet per minute, the heading reference box changes color to amber and flashes for 10 seconds. The box returns to white when the airplane climbs 2,000 feet at more than 500 feet per minute.

Track

Track is supplied by the FMC during normal operation and by the IRU in alternate navigation.

Traffic

Traffic information from the TCAS can be displayed on the ND. TCAS is described in Chapter 15, Warning Systems.

Weather Radar

Weather radar information displays on the ND. The weather radar system is described in Chapter 11, Flight Management, Navigation.

Failure Flags and Messages

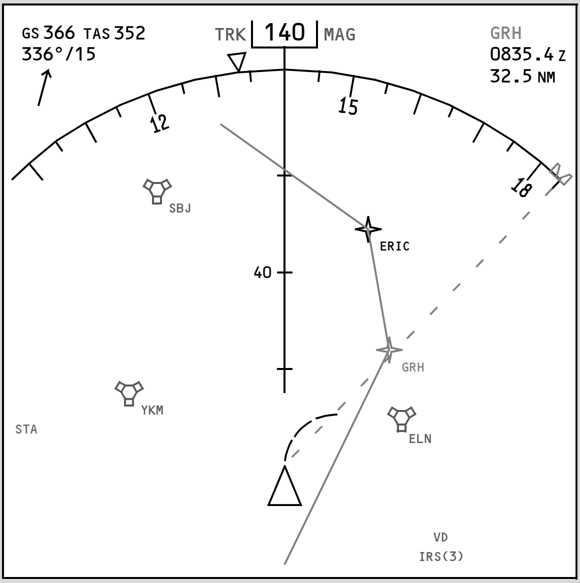
Failure flags display for system failures or invalid information. Indications are removed or replaced by dashes when source system information is not available.

The message EXCESS DATA displays on the ND if the amount of information sent to the ND exceeds the display capability. The message can be removed by deselecting one or more of the EFIS control panel map switches (STA, WPT, ARPT, DATA).

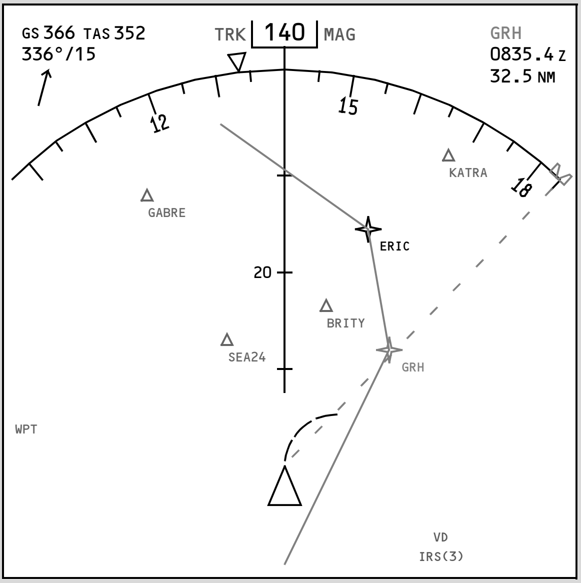
Typical ND Map Displays

Typical ND map displays are shown on the following pages. Examples of other ND displays (centered map, approach, VOR, and plan modes) are shown in Section 10 of this chapter.

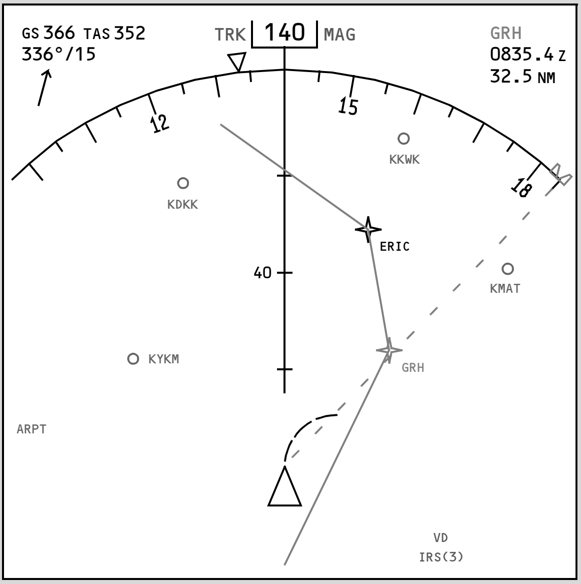
Liquid Crystal Display



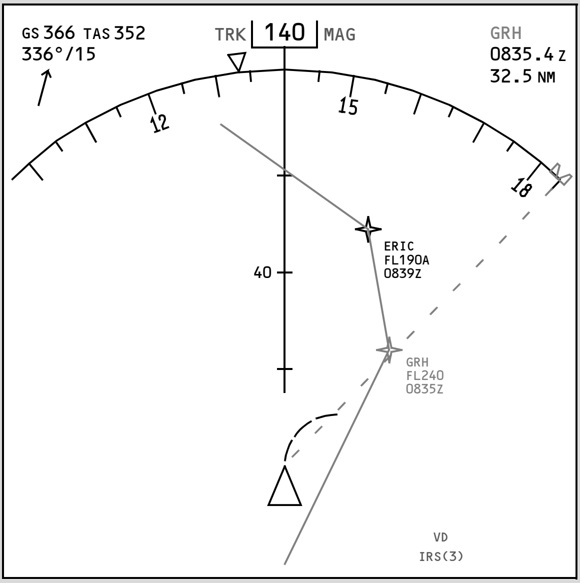
STA (STATION) SELECTED



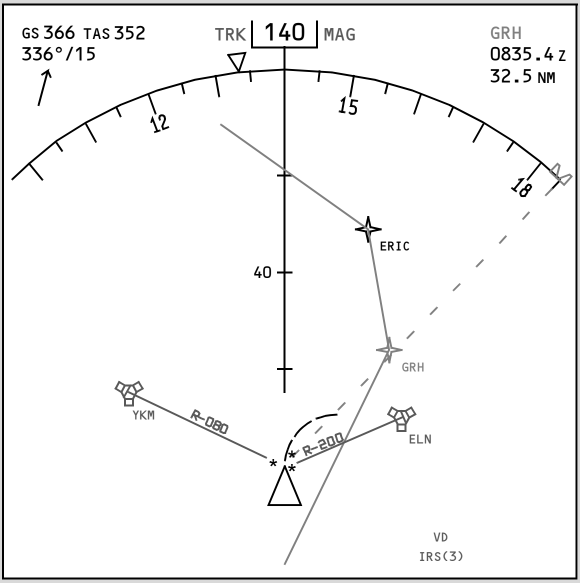
WPT (WAYPOINT) SELECTED



ARPT (AIRPORT) SELECTED

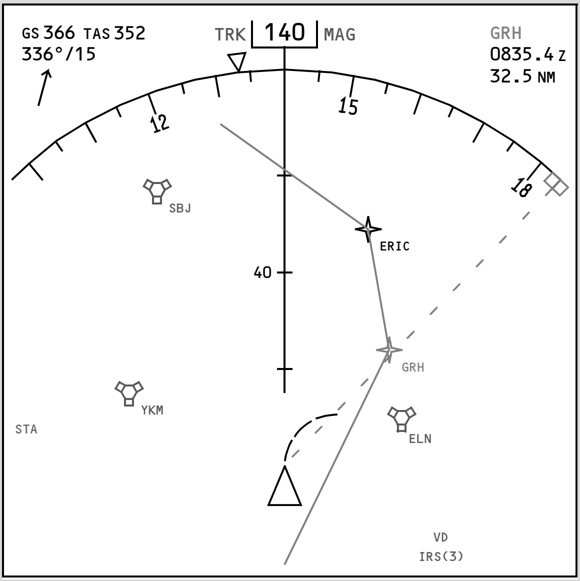


DATA SELECTED

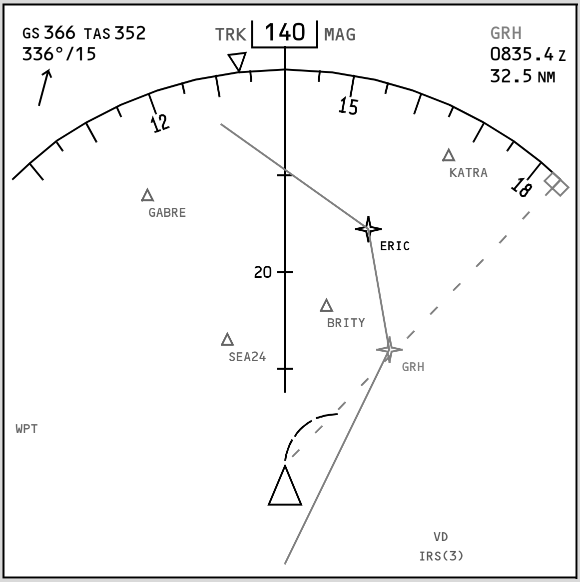


POS (POSITION) SELECTED

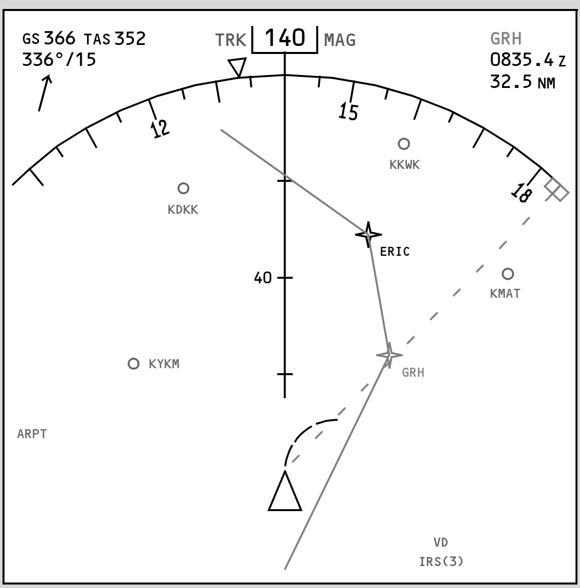
Cathode Ray Tube



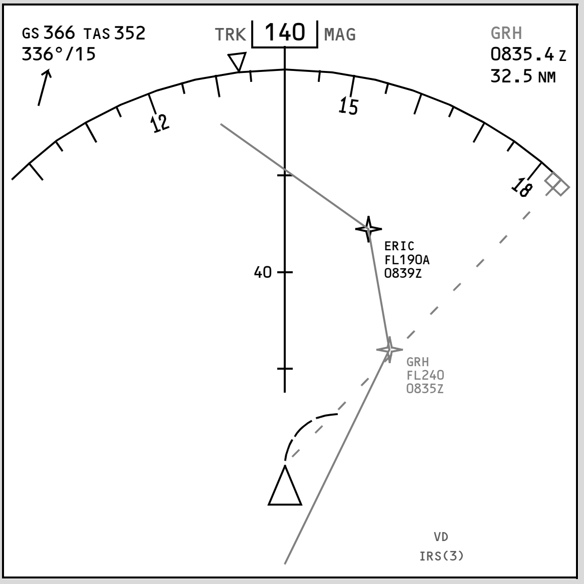
STA (STATION) SELECTED



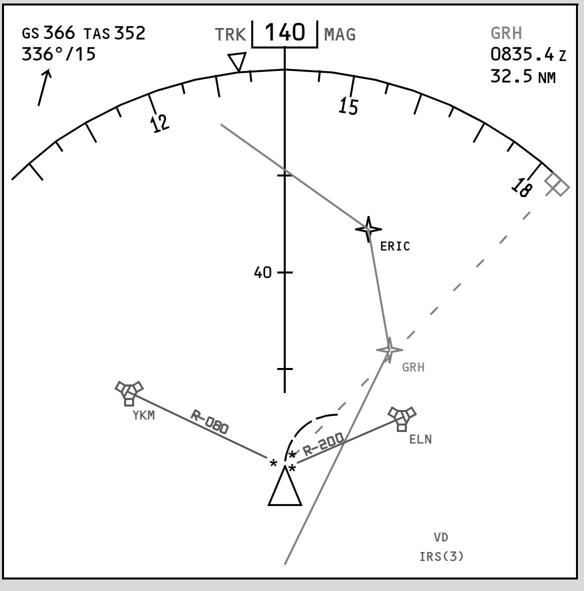
WPT (WAYPOINT) SELECTED



ARPT (AIRPORT) SELECTED



DATA SELECTED



POS (POSITION) SELECTED

ND Symbology

The following symbols display on each ND, depending on EFIS control panel switch selections. Colors indicate the following:

- W (white) - present or modified status, range scales, armed flight mode annunciations
- G (green) - dynamic conditions, active flight mode annunciations
- M (magenta) - active waypoint and route, command information, pointers, symbols, fly-to condition
- B (blue) - inactive or background information, ADF symbols
- A (amber) - cautions, faults, flags
- R (red) - warnings

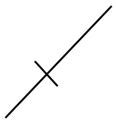
Heading, Track, and Speed

Symbol	Name	ND Mode	Remarks
▽	Current heading pointer (W)	MAP, MAP CTR, PLAN	Points to current heading on the compass rose.
	Expanded compass (W)	MAP, APP, VOR, PLAN	Displays 90 degrees of compass rose.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

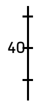
GRID 237	Grid heading (W)	MAP, MAP CTR, PLAN	Displays grid heading when Heading Reference switch NORM and IRU magnetic information not available due to airplane latitude.

GS310	Groundspeed (W)	All	Displays ground speed in large font below 30 knots; small font at 30 knots and above.
MAG OR TRU	Heading/track reference (G) box (W) in TRU, box (A) if TRU displayed in descent	All except PLAN	Indicates heading/track is referenced to magnetic north or true north. Switching from TRU to MAG displays a box around MAG for 10 seconds.

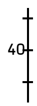
Symbol	Name	ND Mode	Remarks
TRK 062 MAG	Track orientation (G), current heading (W), heading reference (G), and heading pointer (W)	MAP, MAP CTR, PLAN	Displays TRK as display orientation, current heading, MAG or TRU as heading reference, and points to the heading on the compass rose.
HDG 263 MAG ▽	Heading orientation (G), current heading (W), heading reference (G), and heading pointer (W)	VOR, VOR CTR, APP, APP CTR	Displays HDG as display orientation, current heading, MAG or TRU as heading reference, and points to the heading on the compass rose.
	Track indicator (W)	VOR, VOR CTR, APP, APP CTR	Indicates airplane track when selected mode has heading orientation.
TIME TO ALIGN L 4 MIN C 7+ MIN R 5 MIN	IRU time to align (W)	All	Indicates time remaining for IRU alignment. Replaces wind direction/speed and wind arrow, on the ground, during alignment.
 (LCD)  (CRT)	Selected heading (M)	All except PLAN	Displays MCP-selected heading. A dashed line (M) may extend from the marker to the airplane symbol. In MAP mode with LNAV, LOC, or ROLLOUT engaged, dashed line is removed 10 seconds after the selected heading is moved.
TAS312	True airspeed (W)	All	Displays true airspeed above 100 knots.

Symbol	Name	ND Mode	Remarks

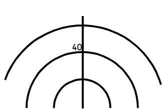
VP-BKJ, VP-BKL, VP-BVR

	Track line and range scale (W)	MAP, MAP CTR, VOR, APP	Line indicates track. Number indicates range. Displays in VOR or APP mode when WXR or TFC on.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

	Track line and range scale (W)	MAP, MAP CTR, VOR, APP	Line indicates track. Number indicates range. Displays in VOR or APP mode when WXR, TERR, or TFC on.

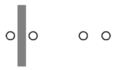
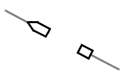
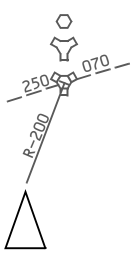
VQ-BHW, VQ-BHX

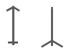
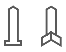
	Track line and range scale (W)	MAP, MAP CTR, VOR, APP	Line indicates track. Number indicates range. Displays in MAP and MAP CTR when WXR not on. Displays in VOR and APP when TFC on.
	Track line and range arcs (W)	MAP, VOR, APP	Line indicates current track. Number indicates range. Displays in VOR and APP when WXR on.

Symbol	Name	ND Mode	Remarks
350°/15 	Wind direction/ speed and wind arrow (W)	All	Indicates wind bearing, speed, and direction, with respect to display orientation and heading/track reference. Arrow not displayed in PLAN map mode (LCD).

Radio Navigation

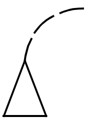
Symbol	Name	ND Mode	Remarks
DME 24.6	DME distance (W)	VOR, VOR CTR, APP, APP CTR	Displays DME distance to the reference navaid. Located in the upper right corner.
116.80 OR SEA	ILS/VOR (W) Reference receiver frequency or identifier display	VOR, VOR CTR, APP, APP CTR	Displays frequency before the identifier is decoded. The decoded identifier replaces the frequency. Medium size characters for VOR, small size characters for DME only. Located in the upper right corner.
VOR L, R ILS L, C, R	Reference receiver (G)	VOR, VOR CTR, APP, APP CTR	Displays selected receiver as display reference.
	Glide slope pointer (M) and scale (W)	APP, APP CTR	Displays glideslope position and deviation. Deviation indicator fills (M) when less than 2 1/2 dots from center.

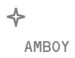
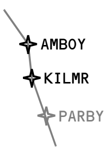
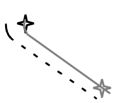
Symbol	Name	ND Mode	Remarks
	ILS localizer or VOR course deviation indication (M) and scale (W)	VOR, VOR CTR, APP, APP CTR	Displays LOC or VOR course deviation. Deviation indicator points in direction of VOR or ILS selected course. For ILS deviation, indicator fills (M) when less than 2 1/2 dots from center.
	Selected course pointer (W) and line (M)	VOR, VOR CTR, APP, APP CTR	Indicates CDU-selected course.
	To/from indication (W)	VOR CTR	Located near airplane symbol. Displays VOR TO/FROM indication.
TO FROM	To/from indication (W)	VOR, VOR CTR	Displays VOR to/from indication.
	VOR (B, G), DME/TACAN (B, G), VORTAC (B, G)	MAP, MAP CTR	Displays appropriate navaids (B) when EFIS control panel STA switch selected on. Tuned VHF navaids display in green, regardless of switch selection. When a navaid is manually tuned, the selected course and reciprocal display.
	VOR/DME raw data radial and distance (G)		Extends the station radial from the airplane to the CDU-tuned VOR when POS selected on. If co-located DME data received, tick mark displays at DME distance from airplane; extends to edge of display if no valid DME data displayed.

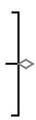
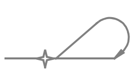
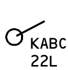
Symbol	Name	ND Mode	Remarks
	Left VOR (G) or ADF (B) pointer head and tail	MAP, MAP CTR, VOR, VOR CTR, PLAN	Indicates bearing to (head) or from (tail) the tuned station, if selected on related EFIS control panel.
	Right VOR (G) or ADF (B) pointer head and tail		
VOR L, R ADF L, R	VOR (G) or ADF (B) selection	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Represents positions of VOR/ADF switches. Located in the lower left or right corner.
116.80 OR SEA OR 520 OR BF	VOR frequency or identifier (G), ADF frequency or identifier (B)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Displays frequency before identifier is decoded. Decoded identifier replaces the frequency. For VORs, small size characters indicate only DME information is being received. Located in the lower left or right corner.
DME 24.6	DME distance (G)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Displays DME distance to the referenced navaid. Located in the lower left or right corner.
CRS 135	Reference ILS or VOR course (W)	VOR, VOR CTR, APP, APP CTR	Displays VOR course or FMC runway course.

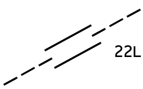
Map

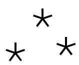
Symbol	Name	ND Mode	Remarks
	Airplane symbol (W)	MAP, MAP CTR, VOR, APP	Airplane position is at the apex of the triangle.

Symbol	Name	ND Mode	Remarks
	Airplane symbol (W)	VOR CTR, APP CTR	Airplane position is at the center of the symbol.
 (LCD)	Airplane symbol (W)	PLAN	Indicates actual position and track along the flight plan route in plan mode only (LCD).
	Position trend vector (W) (dashed line)	MAP, MAP CTR	Predicts position at the end of 30, 60, and 90 second intervals. Each segment represents 30 seconds. Based on bank angle and ground speed. Selected range determines the number of segments displayed. For range: • greater than 20 NM, 3 segments • = 20 NM, 2 segments • = 10 NM, 1 segment
ABCDE	Active waypoint identifier (M)	MAP, MAP CTR, PLAN	Displays active flight plan waypoint, the next waypoint on the route of flight.
124 NM	Active waypoint distance (W)	MAP, MAP CTR, PLAN	Distance to active waypoint.
0835.4z	Active waypoint ETA (W)	MAP, MAP CTR, PLAN	Displays FMS-calculated ETA at the active waypoint.

Symbol	Name	ND Mode	Remarks
	Waypoint: active (M), inactive (W)	MAP, MAP CTR, PLAN	Active - represents the waypoint the airplane is currently navigating to. Inactive - represents the waypoints on the active route.
	Off route waypoint (B)	MAP, MAP CTR	Displays waypoints not on selected route displayed in ND ranges of 10, 20, or 40 when WPT switch selected on.
	Flight plan route: active (M), modified (W), inactive (B)	MAP, MAP CTR, PLAN	Displays active route with a continuous line (M) between waypoints. Active route modifications display with short dashes (W) between waypoints. Inactive routes display with long dashes (B) between waypoints.
	Offset path and identifier: active route (M), modified route (W)	MAP, MAP CTR, PLAN	Presents a dashed line parallel to and offset from the active or modified route.
	Route data: active waypoint (M), inactive waypoint (W)	MAP, MAP CTR	Displays entered or procedural altitude and ETAs for applicable route waypoints when DATA switch selected on.
	Holding pattern: active route (M), modified route (W), inactive route (B)	MAP, MAP CTR, PLAN	Displays a holding pattern when in flight plan. Pattern increases to correct size when entering holding.

Symbol	Name	ND Mode	Remarks
	Altitude range arc (G)	MAP, MAP CTR	Displays position where MCP altitude will be reached based on vertical speed and groundspeed.
	Altitude profile point and identifier (G)	MAP, MAP CTR	Displays position of FMC-calculated T/C (top-of-climb), S/C (step climb), T/D (top-of-descent), and E/D (end of descent) points. Predicted altitude/ETA points entered on the FIX page display the altitude/ETA along with the profile point. Deceleration points have no identifier.
	VNAV path pointer (M) and deviation scale (W)	MAP, MAP CTR	Displays vertical deviation from selected VNAV PATH during descent only. Scale indicates ± 400 feet deviation. Digital display displays when the pointer indicates more than ± 400 feet.
	Procedure turn: active route (M), modified route (W), inactive route (B)	MAP, MAP CTR, PLAN	Displays procedure turn when in the flight plan. It increases in size upon entering the procedure turn.
	Airport and runway (W)	MAP, MAP CTR, PLAN	Display when selected as the origin or destination and ND range is 80, 160, 320, or 640 NM.

Symbol	Name	ND Mode	Remarks
	Airport (B)	MAP, MAP CTR	Displays when ARPT switch selected on. Origin and destination airports always display, regardless of map switch selection.
	Airport and runway (W)	MAP, MAP CTR, PLAN	Display when selected as the origin or destination and ND range is 10, 20, or 40 NM. Dashed runway centerlines extend 14.2 NM.
	Energy management circles (B, W)	MAP, MAP CTR	Displays clean (B) and drag (W) energy management circles as defined on CDU OFFPATH DES page.
	Selected reference point and bearing distance information (G)	MAP, MAP CTR, PLAN	Displays reference point selected on CDU FIX page. Bearing and/or distance from the fix are displayed with dashes (G).
IRS (3) IRS (L) IRS (C) IRS (R)	FMC-IRS position update status (G)	MAP, MAP CTR	Displays FMC-IRS status based on IRUs. Transition from IRS (3) to any other annunciation highlighted by a green box for 10 seconds.
DD VD LOC LOC DD LOC VD	FMC-radio position update status (G)	MAP, MAP CTR	Displays FMC-radio update mode. DD, DME DME; VD, VOR DME; LOC, localizer; LOC DD, localizer and DME DME; LOC VD, localizer and VOR DME.

Symbol	Name	ND Mode	Remarks
LOCGPS GPS	FMC-GPS position update status (G)	MAP, MAP CTR	Displays FMC-GPS update mode. LOCGPS, localizer and GPS; GPS, GPS only.
	GPS position (W)	MAP, MAP CTR	Displays GPS position relative to FMC position when POS switch selected on.
	IRU positions (W)	MAP, MAP CTR	Displays IRU positions relative to FMC position when POS switch selected on.
	Weather radar returns (R, A, G, M)	MAP, MAP CTR, VOR, APP	Displayed when WXR switch selected on. Most intense areas display in red, lesser intensity in amber, and lowest intensity green. Turbulence displays in magenta.
STA WPT ARPT WXR	Selected map options (B)	MAP, MAP CTR	Indicates STA, WPT, ARPT, and WXR switches selected on.
CDU L, C, R	Map source annunciation (G)	MAP, MAP CTR	Displays ND source if: • CDU is selected on respective Navigation Source Select switch • both FMCs fail, or • a manually selected FMC fails

Symbol	Name	ND Mode	Remarks
N↑	North up arrow (G)	PLAN	Indicates map background is oriented and referenced to true north.

TCAS

For more information, refer to Chapter 15, Warning Systems.

Symbol	Name	ND Mode

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

170	ABSOLUTE ALTITUDE (R, A, W)	MAP, MAP CTR, VOR, APP

■ ↑ −03	TCAS resolution advisory (RA), relative altitude (R)	MAP, MAP CTR, APP, VOR
+02 ● ↓	TCAS traffic advisory (TA), relative altitude (A)	MAP, MAP CTR, APP, VOR
◆ ↓ −05	TCAS proximate traffic, relative altitude (W)	MAP, MAP CTR, APP, VOR
+09 ◇ ↑	TCAS other traffic, relative altitude (W)	MAP, MAP CTR, APP, VOR
RA 5.3 +03 ↑ TA 8.9 −12 ↑	TCAS no bearing message (RA-R, TA-A)	MAP, MAP CTR, APP, VOR
TRAFFIC	TCAS traffic alert message (RA-R, TA-A)	All

Symbol	Name	ND Mode
OFFSCALE	TCAS off scale message (RA-R, TA-A)	MAP, MAP CTR, APP, VOR
TFC	TCAS mode (B)	MAP, MAP CTR, APP, VOR
TCAS TEST	TCAS mode (B)	All
TCAS FAIL	TCAS mode (A)	MAP, MAP CTR, APP, VOR
TA ONLY	TCAS mode (B)	All
TCAS OFF	TCAS mode (A)	MAP, MAP CTR, APP, VOR

Radar

For more information, refer to Chapter 11, Flight Management, Navigation.

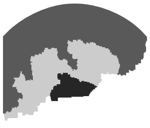
Symbol	Name	ND Mode
WEAK	Automatic gain control failure (A)	MAP, MAP CTR, APP, VOR
ATT	IRS stabilization signal failure (A)	MAP, MAP CTR, APP, VOR
MAP	Mode used with down-tilt, when ground mapping (B)	MAP, MAP CTR, APP, VOR
WX+T	WXR and turbulence mode (B)	MAP, MAP CTR, APP, VOR
WXR	WXR precipitation only mode (B)	MAP, MAP CTR, APP, VOR

Symbol	Name	ND Mode
TEST	Weather radar (WXR) test mode (A) (B)	MAP, MAP CTR, APP, VOR
+15 to −15	WXR antenna tilt (B)	MAP, MAP CTR, APP, VOR
CAL	WXR receiver gain (B)	MAP, MAP CTR, APP, VOR
CONT	WXR control panel failure (A)	MAP, MAP CTR, APP, VOR
RT	WXR receiver transmitter failure (A)	MAP, MAP CTR, APP, VOR
ANT	WXR antenna failure (A)	MAP, MAP CTR, APP, VOR
WXR FAIL	WXR system failure (A)	MAP, MAP CTR, APP, VOR

Look-Ahead Terrain

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

For more information, refer to Chapter 15, Warning Systems.

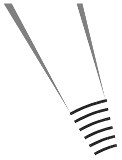
Symbol	Name	ND Mode
	Terrain display (R, A, G, M)	MAP, MAP CTR, APP, VOR
TERR	Terrain mode annunciation (B)	MAP, MAP CTR, APP, VOR
TERR TEST	Terrain test mode annunciation (B)	All
TERRAIN	Terrain annunciation (R, A)	All

Symbol	Name	ND Mode
TERR FAIL	Terrain status annunciations (A)	MAP, MAP CTR, APP, VOR
TERR POS	Terrain status annunciations (A)	MAP, MAP CTR, APP, VOR
TERR OVRD	Terrain status annunciations (A)	MAP, MAP CTR, APP, VOR
TERR RANGE DISAGREE	Terrain range status annunciations (A)	MAP, MAP CTR, APP, VOR
MAP/TERR RANGE DISAGREE	Terrain range status annunciations (A)	MAP, MAP CTR

Predictive Windshear

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

For more information, refer to Chapter 15, Warning Systems.

Symbol	Name	ND Mode
	Predictive windshear symbol (R, B, A)	MAP, MAP CTR, APP, VOR
WINDSHEAR	Windshear annunciation (R, A)	All

EICAS Alert Messages

Note: OVERSPEED warning and ALTITUDE ALERT caution messages are covered in Chapter 15, Warning Systems.

Message	Level	Aural	Message Logic
ALT DISAGREE	Caution	Beeper	Captain and First Officer uncorrected altitude indications disagree by more than 200 feet. Inhibited until disagreement lasts for more than five seconds.
>ATTITUDE	Caution	Beeper	Captain and First Officer selected IRS attitude output disagree by 3 degrees or more.
>BARO DISAGREE	Advisory		Captain and First Officer barometric reference settings disagree for more than one minute.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

>HEADING	Advisory		Captain and First Officer displayed headings disagree by 4 degrees or more.

IAS DISAGREE	Caution	Beeper	Captain and First Officer airspeed indicators disagree by five knots or more. Inhibited until disagreement lasts for more than five seconds.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

>AOA RIGHT	Advisory		Right AOA sensor has failed. AOA system redundancy lost.

Message	Level	Aural	Message Logic
>EFIS CONTROL L, R	Advisory		(CDU-152) EFIS control panel inoperative. (CDU-161) EFIS control panel inoperative or CDU control of the EFIS control panel active.
>EFIS/EICAS C/P	Advisory		(CDU-152) Both EFIS control panels and EICAS display select panel inoperative. (CDU-161) Both EFIS control panels and EICAS display select panel inoperative or CDU control of both EFIS control panels and EICAS display panel active.
>EIU LEFT	Advisory		Left EIU failed. Inhibited in flight.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

>PVD SYS CAPT, F/O	Advisory		PVD system failure.

>SNGL SOURCE RA	Advisory		Both pilots’ displays referenced to the same radio altimeter receiver.
>SOURCE SEL ADC	Advisory		Both pilots’ displays referenced to the same ADC.
>SOURCE SEL EIU	Advisory		Both pilots’ displays referenced to the same EIU.
>SOURCE SEL F/D	Advisory		Both pilots’ displays referenced to the same FCC.
>SOURCE SEL IRS	Advisory		Both pilots’ displays referenced to the same IRU.
>SOURCE SEL NAV	Advisory		Both pilots’ displays referenced to the same FMC.

Message	Level	Aural	Message Logic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

>TRACK	Advisory		Captain and First Officer selected track output disagree by 6 degrees or more.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

PVD BOTH, CAPT, F/O ON	Memo		PVD selected on.

Intentionally
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Flight Management, Navigation — Chapter 11

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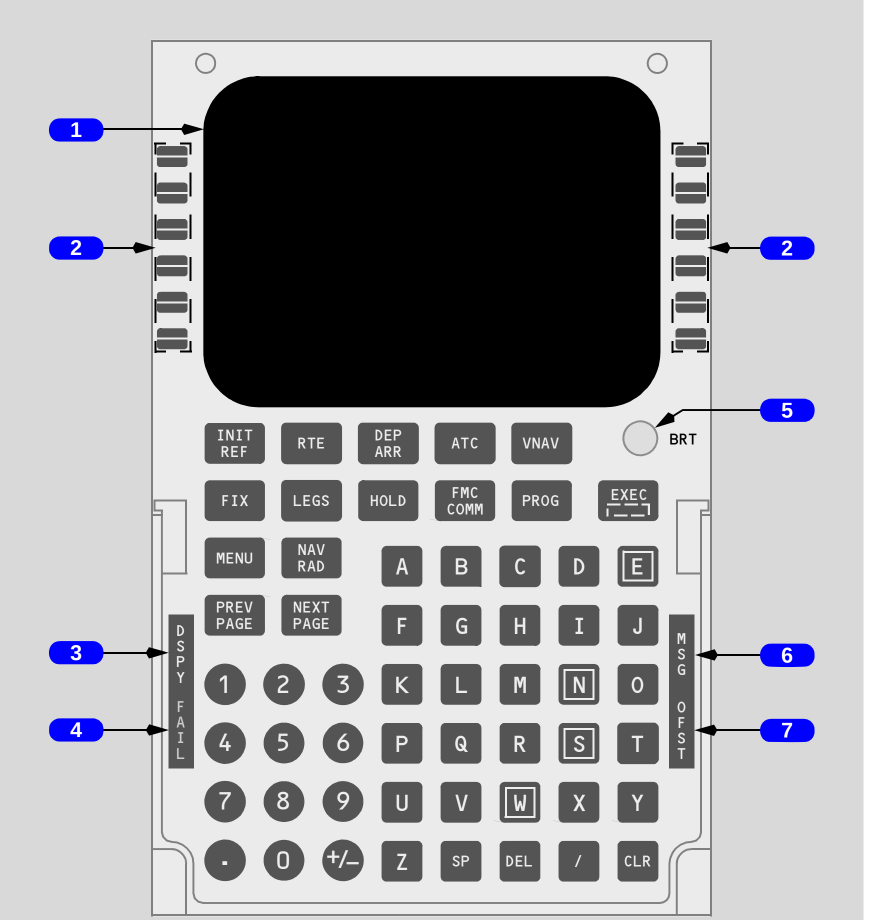
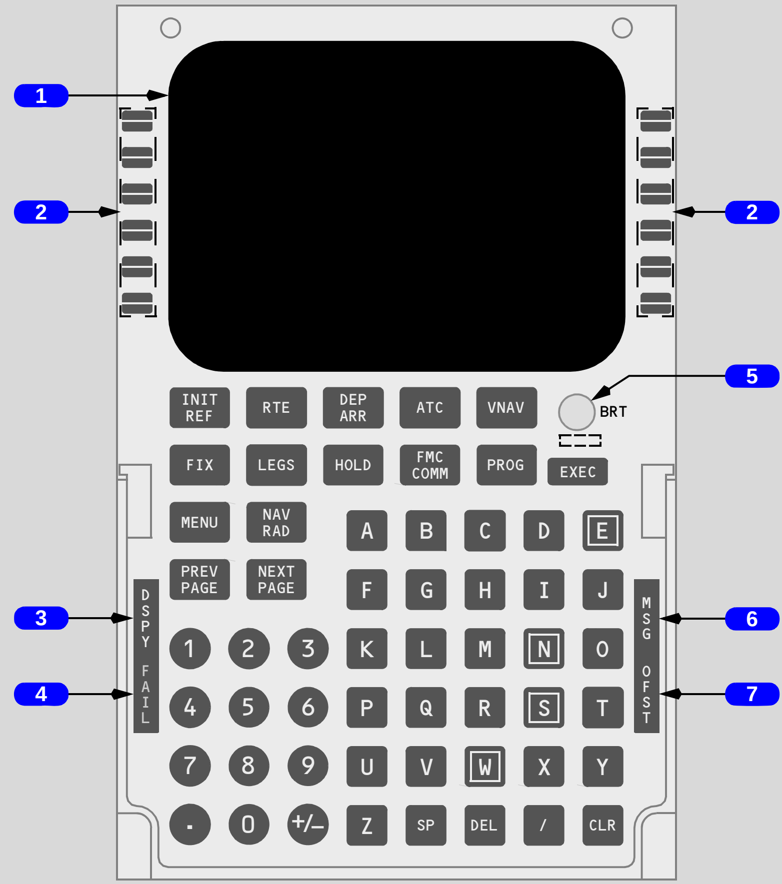
Flight Management System

The control display units shown in the Operations Manual have been labeled CDU-152 or CDU-161 where necessary to distinguish between Part Numbers S242T102-152 and S242T102-161. The CDU-161 panel has become the standard in production and as a replacement. Because the CDU-152 may be replaced with the CDU-161, both panels have been shown in the following pages.

Control Display Unit (CDU)



CDU-152
FORWARD AISLE STAND PANEL



CDU-161
FORWARD AISLE STAND PANEL

1 Control Display Unit (CDU) Display

Displays FMS data pages.

2 Line Select Keys

Push -

- moves data from scratchpad to selected line
- moves data from selected line to scratchpad

- selects page, procedure, or performance mode as applicable
- deletes data from selected line when DELETE is displayed in scratchpad

Conventions -

- scratch pad must be blank for line select transfer
- data cannot be transferred to a blank line
- a blank scratch pad cannot be transferred to a line
- not all data can be modified
- message displays if inappropriate entries attempted

3 Display (DSPY) Light

Illuminated (white) - indicates current display is not related to the active leg or current performance mode.

4 FAIL Light

Illuminated (amber) - indicates fault detected in FMC.

5 Brightness (BRT) Control

Rotate - controls display brightness.

Light sensors located near each CDU measure ambient light level and adjust CDU brightness to maintain desired illumination.

6 Message (MSG) Light

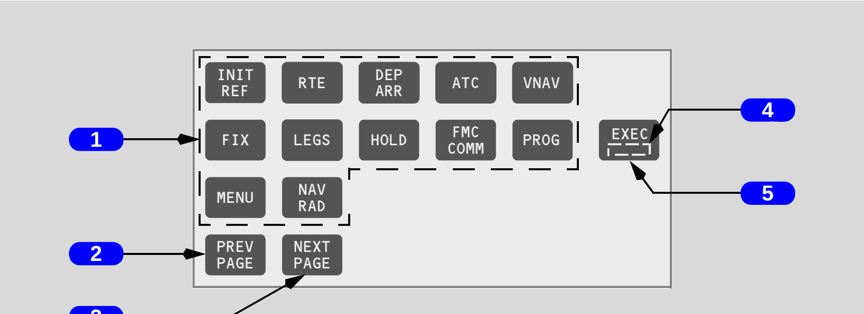
Illuminated (white) -

- scratchpad displays message
- pushing clear key extinguishes light and clears message

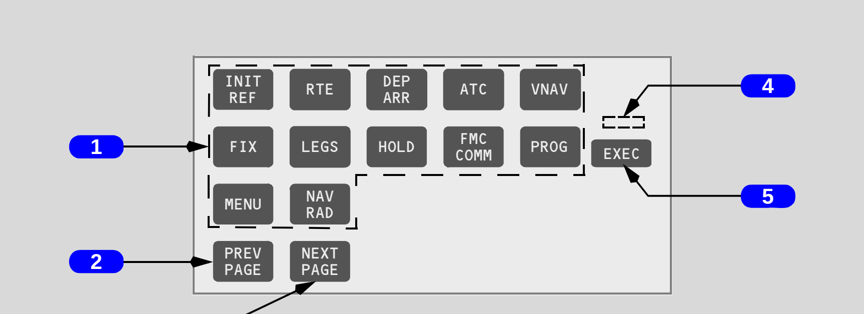
7 Offset (OFST) Light

Illuminated (white) - LNAV gives guidance for lateral route offset.

Function and Execute Keys



CDU-152



CDU-161

1 CDU Function Keys

Push -

- INIT REF - displays page for data initialization or for reference data
- RTE - displays page to input or change origin, destination, or route
- DEP ARR - displays page to input or change departure and arrival procedures

VP-BKJ, VP-BVR
(VQ-BHW, VQ-BHX ; before SB, ATS not active)
- ATC - displays CDU message KEY/FUNCTION INOP

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
(VQ-BHW, VQ-BHX ; SB activates ATS)
- ATC - displays ATC/ADS STATUS page
- VNAV - displays page to view or change vertical navigation path data
- FIX - displays page to create reference points on ND map

- LEGS -
  - displays page to evaluate or modify lateral and vertical route data
  - displays page to correlate route waypoints on ND
- HOLD - displays page to create holding patterns and holding pattern data, or to exit holding pattern

VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX
- FMC COMM - displays CDU message KEY/FUNCTION INOP

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
- FMC COMM - displays pages that access datalink, provides datalink status
- PROG - displays page to view dynamic flight and navigation data, including waypoint and destination ETAs, fuel remaining, and arrival estimates
- MENU -displays page to choose subsystems controlled by CDU
- NAV RAD - displays page to view or control navigation radio tuning

2 Previous (PREV) PAGE Key

Push - displays previous page in multiple page displays.

3 NEXT PAGE Key

Push - displays next page in multiple page displays.

4 Execute Light

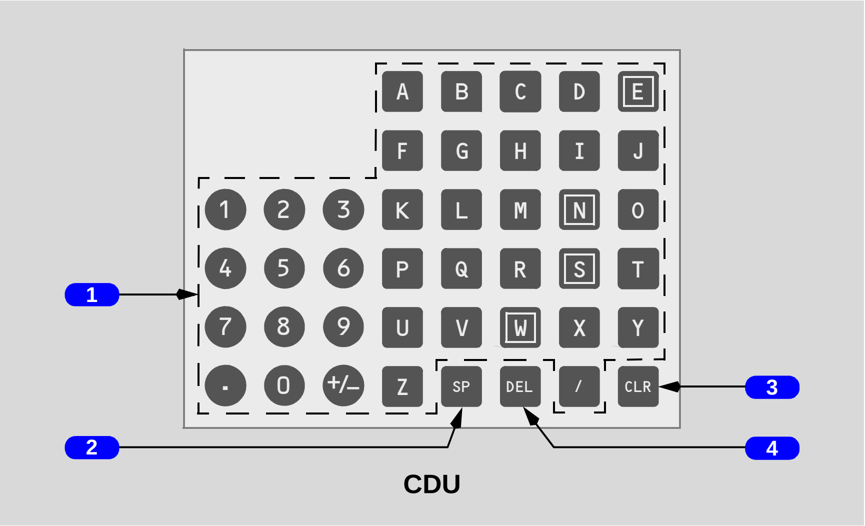
Illuminated (white) - active data modified but not executed.

5 Execute (EXEC) Key

Push -

- makes data modification(s) active
- extinguishes execute light

Alpha/Numeric and Miscellaneous Keys



1 Alpha/Numeric Keys

Push -

- enters selected character in scratchpad
- Slash (/) key - enters “/” in scratchpad
- Plus Minus (+/-) key - first push enters “-” in scratchpad. Subsequent pushes alternate between “+” and “-”

2 Space (SP) Key

Push - enters a space in scratchpad when using ACARS or SATCOM.

3 Clear (CLR) Key

Push -

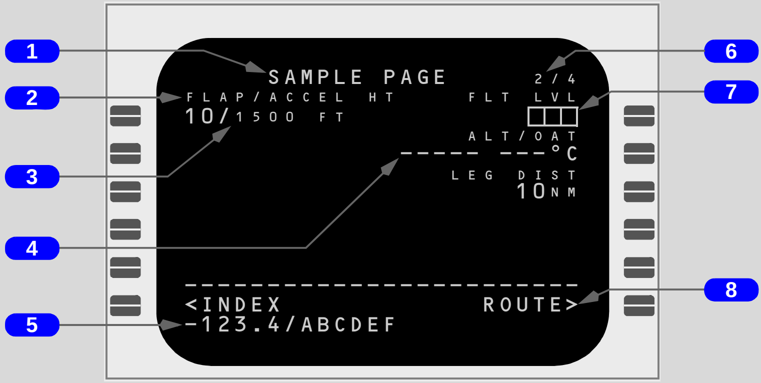
- clears last scratchpad character
- clears scratchpad message

Push and hold - clears all scratchpad data.

4 Delete (DEL) Key

Push - enters “DELETE” in scratchpad.

CDU Page Components



CDU

1 Page Title

Subject or name of data displays on page.

ACT (active) or MOD (modified) indicates whether page contains active or modified data.

2 Line Title

Title of data on line below.

3 Data Line

Displays -

- prompts
- data associated with line title

Large font indicates crew entered or verified data. Small font indicates FMC computed data.

4 Dashes

Data input is optional.

5 Scratchpad

Displays messages, alphanumeric entries, or line selected data.

6 Page Number

Left number is page number. Right number is total number of related pages. Page number is blank when only one page exists.

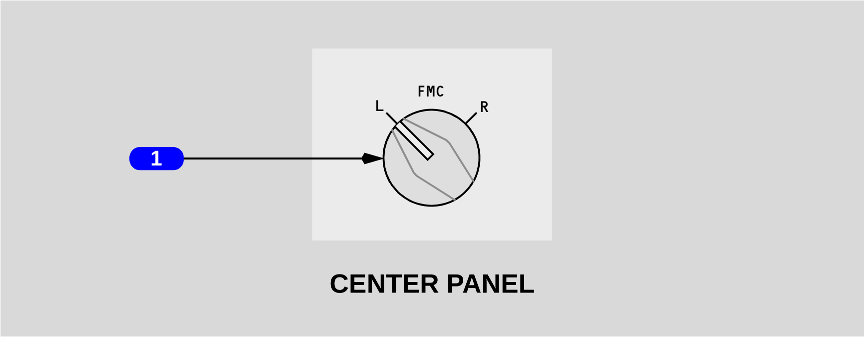
7 Boxes

Data input is mandatory.

8 Prompts

Display pages and control displays. Caret “<” or “>” is before or after prompt.

FMC Selector



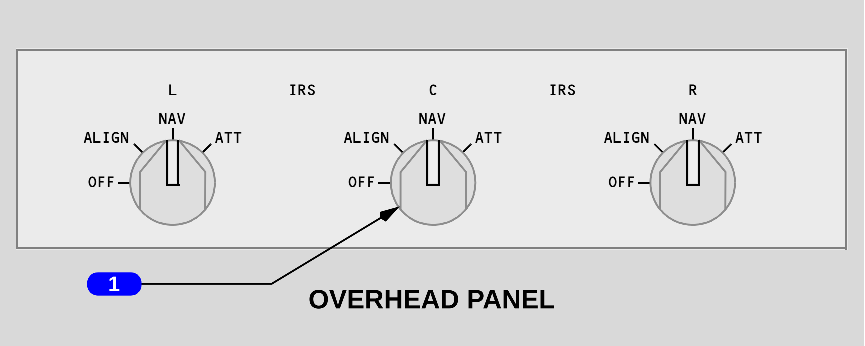
1 FMC Master Selector

L - selects left FMC to provide guidance commands

R - selects right FMC to provide guidance commands.

Note: Switching between FMCs with autothrottle active causes autothrottle to disconnect.

Inertial Reference System (IRS)
Inertial Reference Unit (IRU) Selectors



1 IRU Mode Selectors

IRU mode selector must be pulled out to move from NAV position.

OFF - alignment lost.

ALIGN (alignment)- when parked and momentarily selected:

- initiates alignment
- removes sensor errors when selected from navigation mode

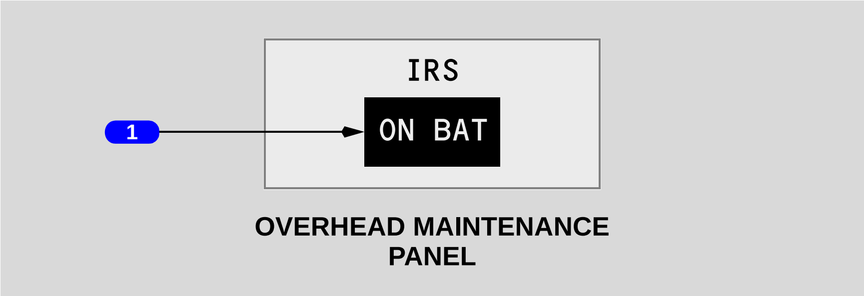
NAV (navigation) -

- system enters navigation mode after completing alignment
- provides IRS information to airplane systems for normal operations

ATT (attitude) -

- system enters attitude mode
- position and velocity information lost until system realigned on ground
- requires magnetic heading input from CDU

IRS On Battery Light

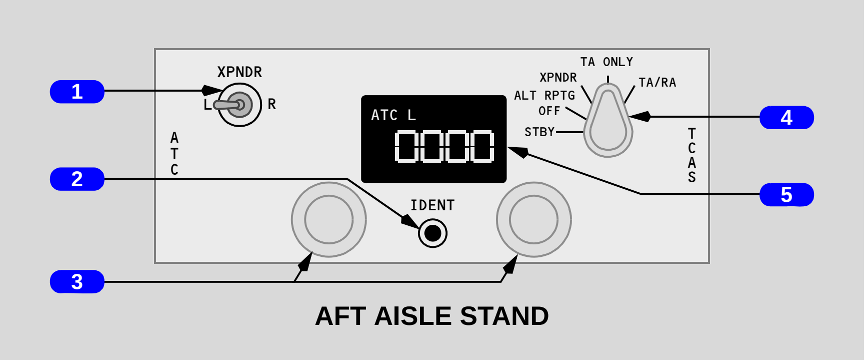


1 IRS ON Battery (BAT) Light

Illuminated (white) - IRS operating on backup electrical power (APU hot battery bus).

Transponder Panel

VQ-BHW, VQ-BHX



1 Transponder (XPNDR) Switch

L - selects left transponder.

R - selects right transponder.

2 Identification (IDENT) Switch

Push - transmits ident signal.

3 Transponder Code Selectors

Rotate - sets transponder code.

4 Transponder Mode Selector

STBY (standby) - transponder disabled.

ALT RPTG OFF (altitude reporting) -

- transponder enabled
- altitude reporting disabled

XPNDR (transponder) -

- transponder enabled
- in flight, altitude reporting enabled

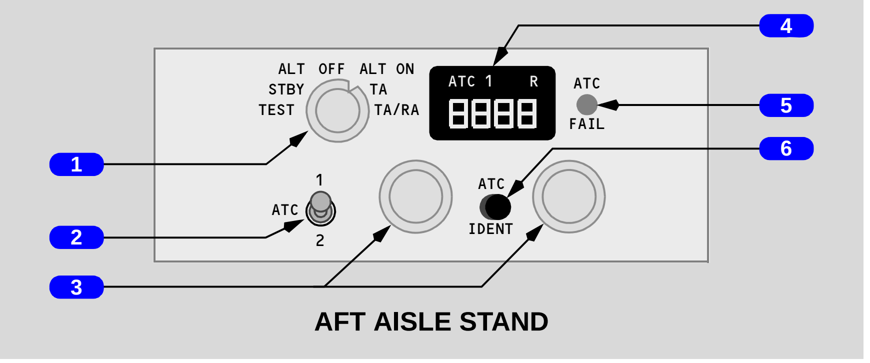
TA ONLY (traffic advisory) and TA/RA (traffic advisory/resolution advisory) - Refer to Chapter 15, Warning Systems.

5 Transponder Code Display

ATC L, ATC R - transponder selected.

Displays transponder code.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Transponder Mode Selector

TEST - initiates test.

STBY (standby) - transponder disabled.

ALT OFF (altitude) -

- transponder enabled
- altitude reporting disabled

ALT ON (altitude) -

- transponder enabled
- in flight, altitude reporting enabled

TA (traffic advisory) and TA/RA (traffic advisory/resolution advisory) - Refer to Chapter 15, Warning Systems.

2 ATC Switch

1 - selects left transponder.

2 - selects right transponder.

3 Transponder Code Selectors

Rotate - sets transponder code.

4 Transponder Code Display

ATC 1, ATC 2 - transponder selected.

R - reply indicator.

Displays transponder code.

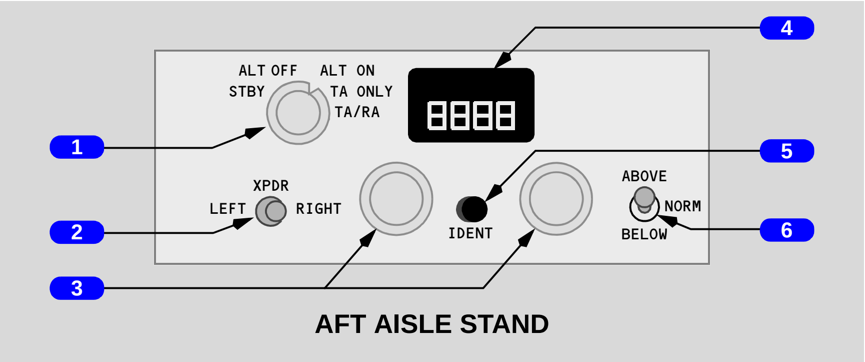
5 ATC FAIL Light

Illuminated (amber) - selected transponder has failed.

6 Identification (IDENT) Switch

Push - transmits ident signal.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



1 Transponder Mode Selector

STBY (standby) - transponder disabled.

ALT OFF (altitude) -

- transponder enabled
- altitude reporting disabled

ALT ON (altitude) -

- transponder enabled
- in flight, altitude reporting enabled

TA ONLY (traffic advisory) and TA/RA (traffic advisory/resolution advisory) - Refer to Chapter 15, Warning Systems.

2 Transponder (XPDR) Switch

LEFT - selects left transponder.

RIGHT - selects right transponder.

3 Transponder Code Selectors

Rotate - sets transponder code.

4 Transponder Code Display

Displays transponder code.

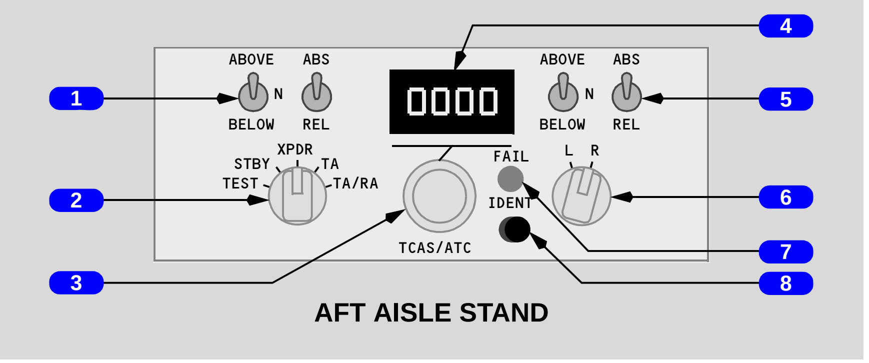
5 Identification (IDENT) Switch

Push - transmits ident signal.

6 TCAS Airspace Switch

Refer to Chapter 15, Warning Systems.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



1 TCAS Airspace Switches

Refer to Chapter 15, Warning Systems.

2 Transponder Mode Selector

TEST - initiates test.

STBY (standby) - transponder disabled.

XPDR (transponder) -

- transponder enabled
- in flight, altitude reporting enabled

TA (traffic advisory) and TA/RA (traffic advisory/resolution advisory) - Refer to Chapter 15, Warning Systems.

3 Transponder Code Selectors

Rotate - sets transponder code.

4 Transponder Code Display

Displays transponder code.

5 TCAS Absolute/Relative (ABS/REL) Altitude Switches

Refer to Chapter 15, Warning Systems.

6 Transponder Selector

L - selects left transponder.

R - selects right transponder.

7 Transponder FAIL Light

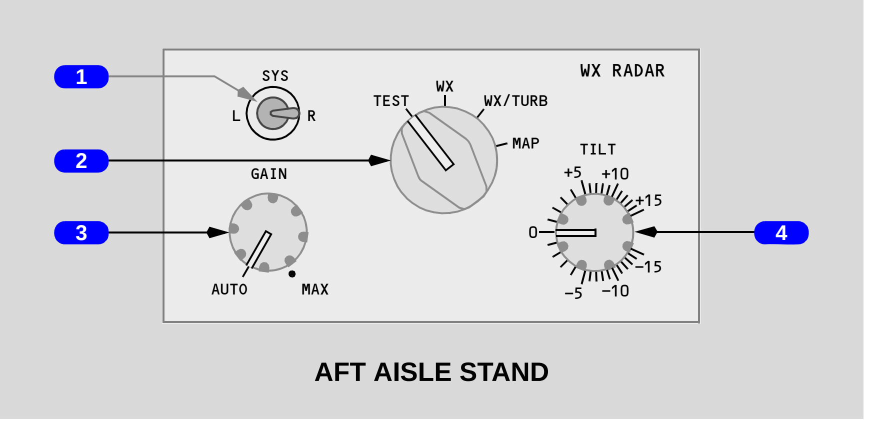
Illuminated (amber) - selected transponder has failed.

8 Identification (IDENT) Switch

Push - transmits ident signal.

Weather Radar Panel

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL



1 System (SYS) Switch

Selects receiver/transmitter (R/T) for operation.

L - radar antenna stabilized by left and center IRUs.

R - radar antenna stabilized by right and center IRUs.

2 Mode Selector

Controls display on NDs.

TEST -

- tests weather radar system operation without transmitting
- displays test pattern and any fault message on ND with WXR selected (except in PLAN, CTR VOR, and CTR APP modes)
- when on the ground, selecting WXR on the EFIS control panel and TEST on the weather radar control panel activates an 8 second test. Initially, the EICAS alert message WINDSHEAR SYS displays. Next, the amber WINDSHEAR annunciation displays and the aural MONITOR RADAR DISPLAY sounds. Finally, the red WINDSHEAR annunciation displays and the aural GO AROUND WINDSHEAR AHEAD, and then WINDSHEAR AHEAD, WINDSHEAR AHEAD sounds
- the test pattern remains displayed until WXR is selected off on the EFIS control panel, another mode is selected on the Mode Selector, or an actual PWS alert is detected. The source of any faults displays in the weather radar tilt field on the ND

WX (weather) - displays weather radar returns at selected gain level.

WX/TURB (weather/turbulence) - displays weather returns and turbulence. Turbulence display available with display ranges of 40 nm or less.

Note: Turbulence detection requires presence of detectable precipitation. Clear air turbulence cannot be detected by radar.

MAP - displays ground returns at selected gain level.

3 GAIN Control

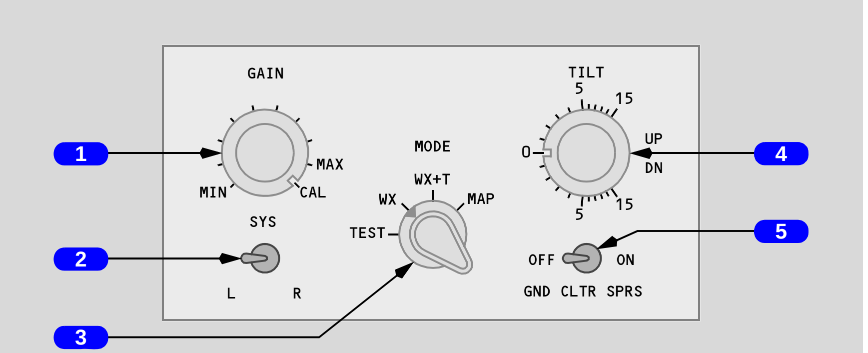
Rotate - sets receiver sensitivity in WX, WX/TURB, and MAP modes.

AUTO (automatic) - maintains optimum receiver sensitivity.

4 TILT Control

Controls antenna tilt angle with reference to horizon.

VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX



AFT AISLE STAND

1 GAIN Control

Rotate - sets receiver sensitivity from minimum to maximum.

CAL (calibrated) - maintains receiver sensitivity at a preset level.

2 System (SYS) Switch

Selects receiver/transmitter (R/T) for operation.

L - radar antenna stabilized by left and center IRUs.

R - radar antenna stabilized by right and center IRUs.

3 Mode Selector

Controls display on NDs.

TEST -

- tests weather radar system operation without transmitting
- displays test pattern and any fault message on ND with WXR selected (except in PLAN, CTR VOR, and CTR APP modes)

WX (weather) - displays weather returns at selected gain level.

WX + T (turbulence) - displays weather returns and turbulence within precipitation at selected gain level. Turbulence display available with display ranges of 40 nm or less.

Note: Turbulence detection requires presence of detectable precipitation. Clear air turbulence cannot be detected by radar.

MAP - displays ground returns at selected gain level.

4 TILT Control

Controls antenna tilt angle with reference to horizon.

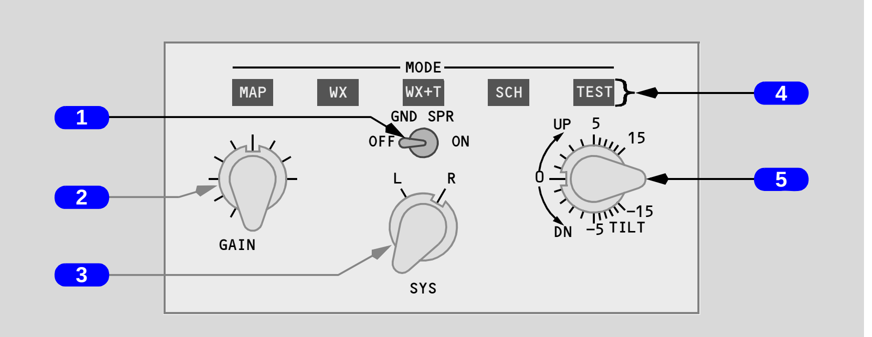
5 Ground Clutter Suppression (GND CLTR SPRS) Switch

ON - reduces amount of ground returns.

OFF - returns radar to normal operating mode.

Note: Continuous operation is not recommended; weather return intensity may be reduced.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



AFT AISLE STAND

1 Ground (GND) Clutter Suppression (SPR) Switch

ON - reduces amount of ground returns.

OFF - returns radar to normal operating mode.

Note: Continuous operation is not recommended; weather return intensity may be reduced.

2 GAIN Control

12 o'clock - maintains constant receiver sensitivity at a preset level in SCH (search) mode.

Full CW (clockwise) - maintains constant receiver sensitivity at a preset level in MAP mode.

Rotate - sets receiver sensitivity (minimum counter-clockwise to maximum clockwise) in MAP and SCH modes only.

3 System (SYS) Selector

Selects receiver/transmitter (R/T) for operation.

L - radar antenna stabilized by left and center IRUs.

R - radar antenna stabilized by right and center IRUs.

4 Mode Switches

Control display on NDs.

Push -

MAP - displays ground returns with gain control as selected.

WX (weather) - displays weather returns with gain controlled automatically.

WX + T (weather + turbulence) - displays weather returns and turbulence within precipitation with gain controlled automatically. Turbulence display is available with display ranges of 40 nm or less.

Note: Turbulence detection requires presence of detectable precipitation. Clear air turbulence cannot be detected by radar.

SCH (search) - displays weather returns and turbulence at selected gain level.

Note: Search mode operates identically to WX mode except it allows gain adjustment above or below the calibrated level. If gain is set below calibrated level, weather returns may be shown at reduced levels or even removed from the display.

TEST -

- tests weather radar system operation without transmitting

EI-XLB, EI-XLD, EI-XLE, EI-XLG
- displays test pattern and any fault message on ND with WXR selected (except in PLAN, CTR VOR, and CTR APP modes)

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ
- displays test pattern and PWS symbol at the end of the test and any fault message on ND with WXR selected (except in PLAN, CTR VOR, and CTR APP modes)

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ
- when on the ground, selecting WXR on the EFIS control panel and TEST on the weather radar control panel activates a 12 second test. To activate the aural messages, TEST must be selected after WXR is selected on the EFIS control panel. Initially, the amber WINDSHEAR annunciation displays and the aural MONITOR RADAR DISPLAY sounds. Next, Master Warning Light illuminates and the EICAS alert message WINDSHEAR SYS displays. Finally, the red WINDSHEAR annunciation displays and the aural GO AROUND WINDSHEAR AHEAD, and then WINDSHEAR AHEAD, WINDSHEAR AHEAD sounds

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ
- the test pattern and PWS symbol remain displayed until WXR is selected off on the EFIS control panel, another mode is selected on the Mode Selector, or an actual PWS alert is detected. The source of any faults displays in the weather radar tilt field on the ND

5 TILT Control

Controls antenna tilt angle with reference to horizon.

Introduction

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

Navigation systems include global positioning system (GPS), inertial reference system (IRS), VOR, DME, ILS, ADF, ATC transponder, weather radar, and the flight management system (FMS). The FMS is described in the Flight Management System Description section of this chapter.

VP-BKJ, VP-BVR

Navigation systems include inertial reference system (IRS), VOR, DME, ILS, ADF, ATC transponder, weather radar, and the flight management system (FMS). The FMS is described in the Flight Management System Description section of this chapter.

Navigation Systems Flight Instrument Displays

Refer to Chapter 10, Flight Instruments, Displays for flight instrument display system operations and typical instrument displays.

Global Positioning System (GPS)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

Left and right GPS receivers are independent and supply very accurate position data to the FMC. GPS tuning is automatic.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

The GPS also provides data to the GPWS.

GPS Displays

POS REF 3/3 page displays the left and right GPS position. The ND annunciates GPS when the FMC uses GPS position updates.

Pushing the POS (position) switch on the EFIS control panel displays left and right GPS positions on the ND. The GPS symbols are identical and display as a single symbol when the GPS receivers calculate the same position.

GPS Data

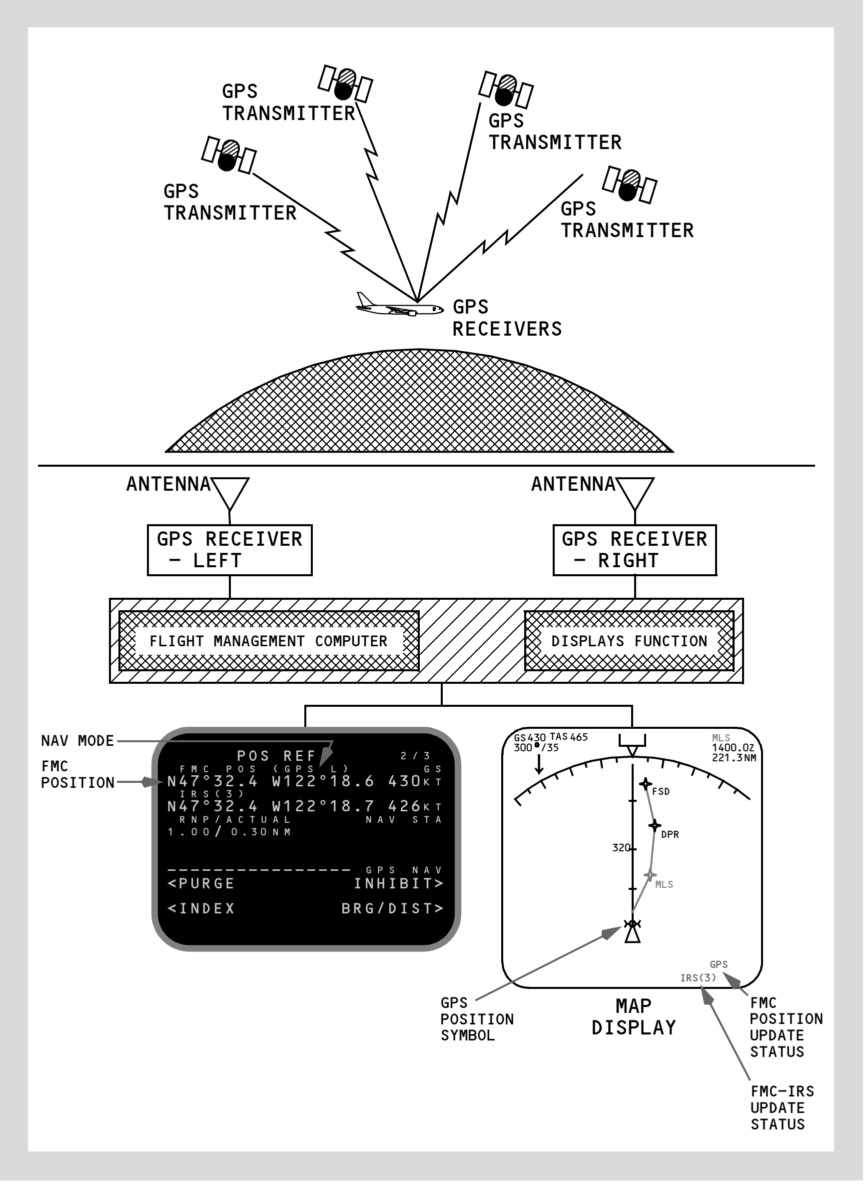
The FMC uses GPS position and velocity data to estimate errors in the inertial reference system (IRS) position and velocity. The IRS position and velocity are corrected to form the FMC position and velocity.

The flight crew can manually inhibit GPS updating. This is accomplished on the CDU POS REF 2/3 page.

GPS position updates should be used during all approaches in which the FMC database and approach procedures are referenced to the WGS-84 reference datum. GPS updates should be inhibited for other approach operations not based on WGS-84 unless other appropriate procedures are used.

GPS position updates should be used for all operations unless a specific state requires the use of other update provisions within their airspace (eg, to accomodate a non-WGS reference datum or other reason).

GPS System Schematic



Inertial Reference System

The inertial reference system (IRS) calculates airplane position, acceleration, track, vertical speed, ground speed, true and magnetic heading, wind speed and direction, and attitude data for the displays, flight management system, flight controls, engine controls, and other systems. The IRS consists of three inertial reference units (IRUs) and the IRS mode selector panel.

IRS Alignment

Full Alignment

Rotating the IRS mode selector from OFF to NAV begins IRS alignment. Alignment requires approximately ten minutes. Present position (latitude and longitude) must be entered on the CDU position initialization page to complete alignment. Alignment can be accomplished only when the airplane is parked. Alignment stops if an IRU detects motion during alignment. Alignment continues and completes in approximately ten minutes after motion stops. The IRS is aligned when all IRUs enter the navigation mode. Latitude and longitude entries then blank on the SET IRS POS line on the CDU position initialization page. Alignment is lost if the selector is moved out of the NAV position.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

A full alignment, accomplished by rotating the IRS mode selector to OFF and back to NAV, must be accomplished when the time from the last full alignment to the next expected arrival time exceeds 18 hours.

VQ-BHW, VQ-BHX

A full alignment, accomplished by rotating the IRS mode selector to OFF and back to NAV, must be accomplished when the time from the last full alignment to the next expected arrival time exceeds 15 hours (origin airport between 76° 32.0’ N or S latitude) or 10 hours (origin airport between 76° 32.0’ N or S latitude and 81° 36.0’ N or S latitude).

Fast Realignment

Following operation in the navigation mode and with the airplane parked, performing a realignment removes accumulated track, ground speed, and attitude errors, relevels the system, and updates present position. This is accomplished by positioning selectors to ALIGN, entering present position, and repositioning selectors to NAV. Fast realignment completes in approximately 30 seconds.

Fast realignment can be accomplished without entering present position. However, greater navigational accuracy is attained by entering present position.

IRS Attitude

If alignment is lost in flight, the navigation mode is inoperative for the remainder of the flight. Attitude information can be obtained by moving the selector to ATT. The IRU enters align mode for 30 seconds. This aligns the system. For best accuracy, the airplane must be in straight and level flight. Some attitude errors may occur during acceleration. After acceleration, errors are slowly removed.

The attitude mode can also provide heading information. A magnetic heading input is required to initialize the IRU while in attitude mode. This heading is available for backup if all three IRUs fail. Heading information displayed on the PFD and ND is from an IRU operating in the navigation mode. This information is independent of the IRS source selector position if an operating FMC is selected by the navigation source selector.

IRS Power

The IRS can operate on AC or DC power. The center IRU operates on DC power for five minutes, then shuts down. If an IRU loses both AC and DC power, alignment is lost.

Radio Navigation Systems

Automatic Direction Finding (ADF)

ADF Tuning

Two ADF receivers can be manually tuned from the left or right CDU on the NAV RADIO page.

ADF Displays

Left and right ADF bearings display on the ND when the VOR/ADF switch is in the ADF position. ADF data is cyan.

If both FMCs fail, left and right ADF radios can be tuned on the respective left and right ALTN NAV RADIO page.

Distance Measuring Equipment (DME)

The FMC usually tunes the two, five channel DME transceivers. Channels 3 and 4 can be tuned manually.

DME Tuning

Entering the VOR portion of a VOR/DME pair on the NAV RADIO page manually tunes the DME. Manual DME tuning does not inhibit FMC DME tuning.

The FMC tunes DME channels 1-4 for radio position updates. DME/DME position updates are usually more accurate than VOR/DME updates. The FMC cannot tune DMEs inhibited on the REF NAV DATA page. Channel 5 is reserved for tuning the selected ILS frequency.

If both FMCs fail, left and right DME transceivers can be tuned by entering the VOR portion of a VOR/DME pair on the related left and right ALTN NAV page. Each DME channel 1 is tuned to the VOR shown on the CDU unless the respective EFIS control panel ND mode selector is set to APP. In APP mode, DME channel 1 is tuned to the ILS.

DME Displays

DME distance displays at the top of the ND with the VOR mode selected. DME distance displays on the PFD when ILS receivers are tuned to a collocated DME and localizer facility. DME distances also display at the bottom of the ND when either or both VOR L or VOR R switches are selected.

POS REF page 2 displays the identifiers of the DME stations used for FMC position updates.

Instrument Landing System (ILS)

The FMC usually tunes the three ILS receivers. The receivers can be tuned manually on the NAV RADIO page.

ILS Tuning

Receivers tune and frequency/course display after selecting an ILS, LOC, back course, VOR, runway, or a VFR approach to an ILS/LOC equipped runway and the airplane is within 150 nm of the destination airport, 50 nm of T/D, or in FMC descent.

With a non-ILS approach selected to an ILS/LOC-equipped runway, the ILS autotunes and pointers and deviation scales display for positional awareness.

On initial takeoff, ILS autotuning is inhibited for 10 minutes to prevent clutter on the PFD. Selection and execution of a new approach in the active flight plan causes the ILS to autotune the new approach frequency, even if this is accomplished during the 10 minute takeoff inhibit period. ILS autotune inhibit does not apply to subsequent takeoffs on the same flight (for example, touch-and-go or stop-and-go landings).

All three ILS receivers can be manually tuned from the NAV RADIO page unless ILS approach tuning inhibit is active.

ILS approach tuning inhibit is active when:

- the autopilot is engaged and either the localizer or glideslope is captured
- the flight director is engaged, and either the localizer or the glideslope is captured, and the airplane is below 500 feet radio altitude, or
- on the ground, the localizer is alive, airplane heading is within 45 degrees of the localizer front course, and ground speed is greater than 40 knots

ILS tuning is enabled by disengaging the autopilot and turning OFF both flight director switches.

If both FMCs fail, ILS receivers can be tuned on the ALTN NAV RADIO page. The left ILS receiver is tuned with the left CDU, the center receiver is tuned with the center CDU, and the right receiver is tuned with the right CDU.

ILS Displays

The tuned ILS frequency displays on the PFD; and, on the ND in the approach mode. When receiving the identification signal, the decoded identifier displays.

Localizer and glideslope deviation display on the PFD. Localizer and glideslope deviation, and selected course display on the ND when the respective ND is in the approach mode.

VOR

The FMC usually tunes the two VOR receivers. The receivers can be tuned manually on the NAV RADIO page.

VOR Tuning

The FMC tunes a VOR and a collocated DME for position updating when more accurate sources are not available. Specific VOR/DME pairs can be inhibited on the REF NAV DATA page. If the crew enters two VOR identifiers/frequencies on the NAV RADIO page, the FMC cannot tune any other VOR/DME station for updating.

If both FMCs fail, left and right VOR receivers can be tuned on the respective ALTN NAV RADIO page.

VOR Displays

Left and right VOR bearings display on the ND when the VOR/ADF switch is in VOR position. VOR data is green. With the VOR mode selected, the VOR frequency and selected course display at the top of the ND and course deviation displays.

The NAV RADIO page displays FMC-tuned or manually-tuned VOR data. POS REF page 2 displays identifiers of the VOR stations used for FMC position updating.

Navaid Identifier Decoding

The Morse code identifier of a tuned VOR, ILS, or ADF can be converted to alpha characters. The decoded identifier displays on the PFD and ND. Monitoring this identifier ensures correct navigation radio reception. The identifier name is not compared with the FMC data base.

Due to the large variation in ground station identifier quality, the decode feature may incorrectly convert the intended identifier name. Examples: the Hong Kong localizer “KL” may show as “KAI”, or the Boeing Field ILS may show as “QBFI” or “TTTT” instead of “IBFI.”

It is essential to verify the identity of the tuned navigation station from the audio Morse code if the tuned frequency remains displayed or an incorrect identifier displays.

Transponder

The transponder panel controls two ATC transponders and the traffic alert and collision avoidance system (TCAS). Mode S operates continuously when the transponder mode selector is out of standby.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
In flight, traffic displays if the transponder mode selector is in TA ONLY or TA/RA.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
In flight, traffic displays if the transponder mode selector is in TA or TA/RA.

VQ-BHW, VQ-BHX
In flight, the selected transponder activates beacon and altitude reporting when the transponder mode selector is in XPNDR, TA ONLY, or TA/RA.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
In flight, the selected transponder activates beacon and altitude reporting when the transponder mode selector is in XPDR, TA, or TA/RA.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
In flight, the selected transponder activates beacon and altitude reporting when the transponder mode selector is in ALT ON, TA ONLY, or TA/RA.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
In flight, the selected transponder activates beacon and altitude reporting when the transponder mode selector is in ALT ON, TA, or TA/RA.

Refer to Chapter 15, Warning Systems, for a description of TCAS.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; SB activates enhanced Mode S transponder capability)
Transponders provide selective interrogation and downlink information, such as flight number, airspeed or groundspeed, magnetic heading, altitude, GPS position, etc., depending on the level of enhancement. Some airports use transponder information to monitor airplane position on the ground when the transponder is active (mode selector not in STANDBY or OFF). Transponder enhancements also enable air traffic controllers in some areas of the world to use Automatic Dependent Surveillance-Broadcast (ADS-B). TCAS modes should not be used on the ground for ground tracking.

Weather Radar

The weather radar system consists of two receiver-transmitter units, an antenna, and a control panel.

Radar returns display on the navigation display (ND) in all modes except:

- plan
- VOR center
- approach center

The EFIS control panel weather radar (WXR) map switch controls power to the transmitter/receiver and controls the weather radar display on the ND. The radar display range adjusts to the ND range selected on the EFIS control panel. Weather radar operating modes and fault conditions display on the ND.

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
The weather radar system performs various levels of self test on power up, during each sweep, and when descending through 2,300 feet AGL.

If the EFIS control panel fails, the CDU can control the EFIS control panel functions, including the WXR.

Turbulence can be sensed by the weather radar only when there is sufficient precipitation. Clear air turbulence can not be sensed by radar.

Intentionally
Blank

Introduction

The flight management system (FMS) aids the flight crew with navigation, in-flight performance optimization, fuel monitoring, and flight deck displays using Flight Management Computers (FMCs). Automatic flight functions manage the airplane lateral flight path (LNAV) and vertical flight path (VNAV). The displays include a map for airplane orientation and command markers on the airspeed, altitude, and thrust indicators to help fly efficient profiles.

The flight crew enters the applicable route and flight data into the CDUs. The FMS then uses the navigation database, airplane position, and supporting system data to calculate commands for manual and automatic flight path control.

The FMS tunes the navigation radios and sets courses. The FMS navigation database supplies the necessary data to fly routes, SIDs, STARs, holding patterns, approaches, and procedure turns. Cruise altitudes and crossing altitude restrictions are used to calculate VNAV commands. Lateral offsets from the programmed route can be calculated and commanded.

Flight Management Computer

Under normal conditions, the left FMC is designated the primary for CDU operations. The left FMC determines which key pushes should be executed and in what order. It then transmits the key-push messages to the right FMC. Each FMC processes the key-push message and updates its own CDU.

The FMC uses flight crew-entered flight plan data, airplane systems data, and data from the FMC navigation database to calculate airplane present position and pitch, roll, and thrust commands necessary to fly an optimum flight profile. The FMC sends these commands to the autothrottle, autopilot, and flight director. The FMC also sends landing altitude data to the cabin altitude controller. Map and route data are sent to the NDs. The EFIS control panels select the necessary data for the ND. The mode control panel selects the autothrottle, autopilot, and flight director operating modes. Refer to the following chapters for operation of these other systems:

- Chapter 4, Automatic Flight
- Chapter 10, Flight Instruments, Displays

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

The FMC is certified for area navigation when used with navigation radio and/or GPS updating. The FMC and CDU are used for enroute and terminal area navigation, RNAV approaches, and to supplement primary navigation during all types of instrument approaches.

VP-BKJ, VP-BVR

The FMC is certified for area navigation when used with navigation radio updating. The FMC and CDU are used for enroute and terminal area navigation, RNAV approaches, and to supplement primary navigation means when conducting other types of nonprecision approaches.

Two IRUs in conjunction with one FMC and two FMS-CDUs meet the requirements as the sole means of navigation for flights up to 18 hours duration.

Control Display Units (CDUs)

The flight crew controls the FMC using three CDUs. The CDUs give alternate display and navigation capability if both FMCs fail (refer to the Alternate Navigation section of this chapter). Refer to Chapter 10, Flight Instruments, Displays for a description of alternate display control.

Introduction

When first powered, the FMS is in preflight phase. When completing a phase, the FMS changes to the next phase in this order:

- preflight
- takeoff
- climb
- cruise
- descent
- approach
- flight complete

Preflight

During preflight, the flight crew enters flight plan and load sheet data into the CDU. The flight plan defines the route of flight from the origin to the destination and initializes LNAV. Flight plan and load sheet data provide performance data to initialize VNAV.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS)
Some ATC information can be entered into the CDU by datalink.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
Some company information can be entered into the CDU by datalink.

Required preflight data consists of:

- initial position
- route of flight
- performance data
- takeoff data

Optional preflight data includes:

- navigation database selection
- route 2
- alternate airport
- standard instrument departure (SID)
- standard terminal arrival route (STAR)
- thrust limits
- wind

Preflight starts with the IDENT page. If the IDENT page is not displayed, it can be selected with the IDENT prompt on the INIT/REF INDEX page. Visual prompts help the flight crew select CDU preflight pages. Preflight pages can be manually selected in any order.

After the data on each preflight page is entered and checked, pushing the lower right line select key selects the next preflight page. After selecting ACTIVATE on the ROUTE page, the execute (EXEC) light illuminates. Pushing the EXEC key activates the route.

The departure/arrival (DEP/ARR) page can be used to select a SID. Selection of the SID may cause a route discontinuity. Resolution of the discontinuity and execution of the modification should be accomplished on the LEGS page.

When all required preflight entries are complete, the PRE-FLT line title on the TAKEOFF REF page is replaced by dashes and the THRUST LIM prompt displays at the next page select line location.

Takeoff

Takeoff phase starts with selection of TO/GA and terminates with thrust reduction for climb. LNAV and VNAV can be armed before takeoff to activate at the applicable altitude (refer to Chapter 4, Automatic Flight).

Climb

Climb phase starts at thrust reduction for climb and terminates at the top of climb (T/C) point. The T/C point is where the airplane reaches the cruise altitude entered on the PERF INIT page.

Cruise

Cruise phase starts at the T/C point and terminates at top of descent (T/D) point. Cruise can include step climbs and en route descents.

Descent

Descent phase starts at the T/D point or when the VNAV descent page becomes active and terminates at the start of approach phase.

Approach

Approach phase starts when the first waypoint of the procedure sequences or when the runway is the active waypoint and the distance to go is less than 25 nm.

Flight Complete

Thirty seconds after engine shutdown, flight complete phase clears the active flight plan and load data. Some preflight data fields initialize to default values in preparation for the next flight.

Operational Notes

When operating in LNAV and VNAV modes, observe system operation for unwanted pitch, roll, or thrust commands. If unwanted operation is observed, select heading select and flight level change modes.

The system must be carefully observed for errors following:

- activation of a new data base
- power interruption
- IRU failure

The FMC will not sequence the active waypoint when: more than 21 nm off the active route and not on an offset route. Return to the active route can be accomplished using the DIRECT TO or INTERCEPT COURSE TO procedures.

When a waypoint entry is made on the LEGS page with a duplicate identification, the SELECT DESIRED WPT page displays and the correct navaid can be selected and entered into the active route.

Some SIDs or STARS contain a heading vectors leg. VECTORS waypoints display on the ND as a magenta line without an end point leading away from the airplane symbol. If LNAV is active, the DIRECT TO or INTERCEPT COURSE TO procedures can be used to start waypoint sequencing beyond the vectors leg.

When entering airways on a route page, the start and end waypoints must be in the data base. Otherwise, the route segment must be entered as a DIRECT leg.

If the engines remain operating between flights, entering a new cruise altitude before the next flight recalculates the proper vertical profile.

If a climb to cruise altitude is necessary after completing a descent, a new cruise altitude entry must be made. Cruise altitude can be entered on the CLB page.

DIRECT TO courses are segments of a great circle route. When entering a DIRECT TO waypoint on the Legs page, the course above the waypoint before execution is the arrival course at the waypoint. However, after execution, the course is the current course to fly to the waypoint. These courses may not be the same.

Terminology

The following paragraphs describe FMC and CDU terminology.

Active - flight plan data used to calculate LNAV or VNAV guidance commands.

Activate - changing a route from inactive to active for navigation by:

- selecting ACTIVATE prompt
- pushing execute (EXEC) key

Altitude constraint - a crossing restriction at a waypoint.

Delete - using DELETE key removes FMC data and reverts to default values, dash or box prompts, or a blank entry.

Econ - a speed schedule calculated to minimize operating cost. Economy speed is based on the cost index. A low cost index causes a lower cruise speed. Maximum range cruise or the minimum fuel speed schedule may be obtained by entering a cost index of zero. This speed schedule ignores the cost of time. A minimum time speed schedule may be obtained by entering a cost index of 9999. This speed schedule calls for maximum flight envelope speeds. A low cost index may be used when fuel costs are high compared to operating costs.

Enter - putting data in the CDU scratchpad and line selecting the data to the applicable location. New characters can be typed or existing data can be line selected to the scratchpad for entry.

Erase - removing entered data, which has resulted in a modification, by selecting the ERASE prompt.

Execute - pushing the illuminated EXEC key to make modified data active.

Inactive - data not being used to calculate LNAV or VNAV commands.

Initialize - entering data required to make the system operational.

Message - FMC information displayed in the scratchpad.

Modify - changing active data. When a modification is made to the active route or performance mode, MOD displays in the page title, ERASE displays next to line select key 6 left, and the execute key illuminates.

Prompt - CDU symbols that aid the flight crew in accomplishing a task. Prompts can be boxes, dashes, or a careted (< or >) line to remind the flight crew to enter or validate data.

Resynchronization - one FMC loading data into the other when a significant difference between the two FMCs is detected.

Select - pushing a key to obtain necessary data or action, or to copy selected data to the scratchpad.

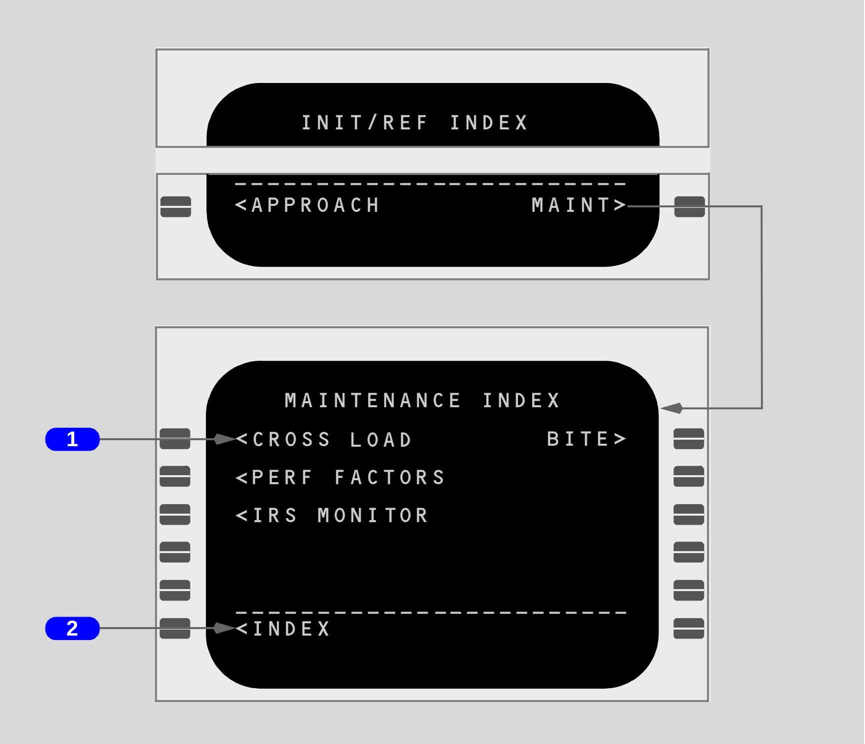
Speed restriction - an airspeed limit.

Speed transition - an airspeed limit associated with a specified altitude entered by the FMC.

Waypoint - a point on the route or in the navigation data base. It can be a fixed point such as a latitude and longitude, VOR or ADF station, or an airway intersection. A conditional waypoint is not associated with a land reference; it is based on a time or altitude requirement. An example of a conditional waypoint is “when reaching 4,000 feet”.

Maintenance Index

MAINTENANCE INDEX page prompts are only used on the ground.



1 Maintenance Prompts

All prompts on this page are maintenance functions.

2 INDEX

Push - displays the INIT/REF INDEX page.

Navigation Position (GPS equipped airplanes)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

The FMC determines present position from these navigation systems: GPS, navigation radios, and IRS. When receiving reliable GPS data, the primary mode of navigation is from a GPS updated FMC position. If GPS data is not available, cannot be validated, or is inhibited, the FMC position is updated using navigation radios. When navigation radios are not available or reliable, the FMC position comes from the IRS. In the case of IRS-only navigation, at least one IRU is required. The FMC requires position data from the IRS. All other position sources are validated against the IRS position.

FMC Position Update

The FMC position may be manually updated to the mixed IRS position. This update is accomplished using the PURGE prompt on the POS REF page 2.

On the ground, the FMC calculates present position based on IRS and/or GPS data.

When GPS is not active, pushing a TO/GA switch updates the FMC position to the runway threshold or to the position shift position when entered. When making an intersection takeoff, the intersection displacement distance from the runway threshold must be entered on the TAKEOFF REF page. With GPS active, the TO/GA update is inhibited.

In flight, the FMC position is the IRS position updated by GPS or navigation radio source data to compensate for inertial reference errors. Updating priority is based on the availability of valid data from these sources.

During an ILS/LOC approach, localizer signals (LOC, LOC DD, LOC VD, or LOC GPS) update the FMC.

The navigation radios update the FMC position using two DME stations (DD) or one VOR and its colocated DME(VD).

FMC selected stations display on the POS REF page 2. Position error can be detected by selecting the EFIS POS switch and observing calculated VOR (Chapter 10, VOR navigation display symbology) positions relative to VOR/DME RAW DATA radial and distance information.

The FMC automatically tunes VOR, DME, and ILS radios and displays them on the ND and CDU NAV RADIO page. Selection is related to the active route and any procedure (SID, STAR, etc.) in the active route. Manually selecting VOR frequencies precludes the FMC from autotuning other VOR/DME frequencies for position updating; however, the FMC continues to tune DME-DME pairs for position updating.

IRS position updating occurs in the following priority order:

- LOC and GPS
- LOC and DME-DME
- LOC and collocated VOR/DME
- LOC
- GPS
- DME-DME
- collocated VOR/DME

The station identifiers in use by the FMC for navigation radio updating display on the POS REF page 2.

Primary FMC Position Update Source	**POS REF page 2/3**	**ND Annunciation**
LOC, GPS valid*	LOC-GPS	LOC GPS
LOC, DME DME valid; GPS invalid*	LOC-RADIO	LOC DD
LOC, VOR DME valid; GPS invalid*	LOC-RADIO	LOC VD
LOC valid; GPS, DME, VOR invalid*	LOC	LOC
GPS valid, LOC invalid	GPS L, GPS R	GPS
DME valid; GPS invalid	RADIO	DD
VOR DME valid; GPS invalid	RADIO	VD
GPS, VOR, DME invalid	INERTIAL	IRS(X)

* The FMC changes to LOC updating when:

- the tuned localizer is associated with the destination runway
- the airplane is less than 6,000 feet above the localizer navaid elevation
- the airplane is less than 20 nm from the localizer navaid for a front course approach or less than 12 nm for a back course approach
- the airplane is within a 25° sector of the inbound localizer course
- the difference between airplane track and the localizer course is less than a 45° intercept angle

Navigation Position (non-GPS equipped airplanes)

VP-BKJ, VP-BVR

The FMC determines present position from the navigation radios and the IRS. When navigation radios are not available or reliable, the FMC position comes from the IRS. In the case of IRS-only navigation, at least one IRU is required. The FMC requires position data from the IRS. Other position sources are validated against the IRS position.

FMC Position Update

The FMC position may be manually updated to the mixed IRS position. This update is accomplished using the PURGE prompt on the POS REF page 2.

On the ground, the FMC calculates present position based on IRS data.

Pushing a TO/GA switch updates the FMC position to the landing threshold or to the position shift position when entered. When making an intersection takeoff, the intersection displacement distance from the runway threshold must be entered on the TAKEOFF REF page.

In flight, the FMC position is the IRS position updated from navigation radio source data to compensate for inertial reference errors. Updating priority is based on the availability of valid data from these sources.

During an ILS/LOC approach, localizer signals (LOC, LOC DD, or LOC VD) update the FMC.

The navigation radios update the FMC position using two DME stations (DD) or one VOR and its colocated DME(VD).

FMC selected stations display on the POS REF page 2. Position error can be detected by selecting the EFIS POS switch and observing calculated VOR (Chapter 10, VOR navigation display symbology) positions relative to VOR/DME RAW DATA radial and distance information.

The FMC automatically tunes VOR, DME, and ILS radios and displays them on the ND and CDU NAV RADIO page. Selection is related to the active route and any procedure (SID, STAR, etc.) in the active route. Manually selecting VOR frequencies precludes the FMC from autotuning other VOR/DME frequencies for position updating; however, the FMC continues to tune DME-DME pairs for position updating.

IRS position updating occurs in the following priority order:

- LOC and DME-DME
- LOC and collocated VOR/DME
- LOC
- DME-DME
- collocated VOR/DME

Primary FMC Position Update Source	POS REF page 2/2	ND Annunciation
LOC, DME DME valid*	LOC-RADIO	LOC DD
LOC, VOR DME valid*	LOC-RADIO	LOC VD
LOC valid; DME, VOR invalid*	LOC	LOC
DME valid	RADIO	DD
VOR DME valid	RADIO	VD
VOR, DME invalid	INERTIAL	IRS(X)

* The FMC changes to LOC updating when:
- the tuned localizer is associated with the destination runway
- the airplane is less than 6,000 feet above the localizer navaid elevation
- the airplane is less than 20 nm from the localizer navaid for a front course approach or less than 12 nm for a back course approach
- the airplane is within a 25° sector of the inbound localizer course
- the difference between airplane track and the localizer course is less than a 45° intercept angle

FMC Polar Operations

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

Polar operation begins when the FMC calculated airplane position passes north of 84°N or south of 84°S. FMCs revert to split IRS operation, the CDU message SPLIT IRS OPERATION displays, and each FMC connects to a different IRU. Radio update corrections are lost and FMCs incrementally remove the difference between FMC and IRU positions.

VP-BKJ, VP-BVR

Polar operation begins when the FMC calculated airplane position passes north of 84°N or south of 84°S. FMCs revert to split IRS operation, the CDU message SPLIT IRS OPERATION displays, the EICAS alert message UNABLE RNP is inhibited, and each FMC connects to a different IRU. Radio update corrections are lost and FMCs incrementally remove the difference between FMC and IRU positions.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

Split IRS operation may result in differences between Captain’s and F/O’s NDs if GPS updating is not available.

VP-BKJ, VP-BVR
Split IRS operation may result in differences between Captain's and F/O's NDs.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
When GPS is available, GPS updating continues until the FMC position passes north of 88.5°N or south of 88.5°S. At this point, GPS update corrections are inhibited and the FMC position becomes a single IRU position. The EICAS alert message UNABLE RNP is inhibited. When the FMC position passes south of 88.0°N or north of 88.0°S, GPS updating resumes.

When both FMC positions pass south of 83.5°N or north of 83.5°S latitude, FMCs return to normal operation using the triple mixed IRU position.

High Latitude Operations

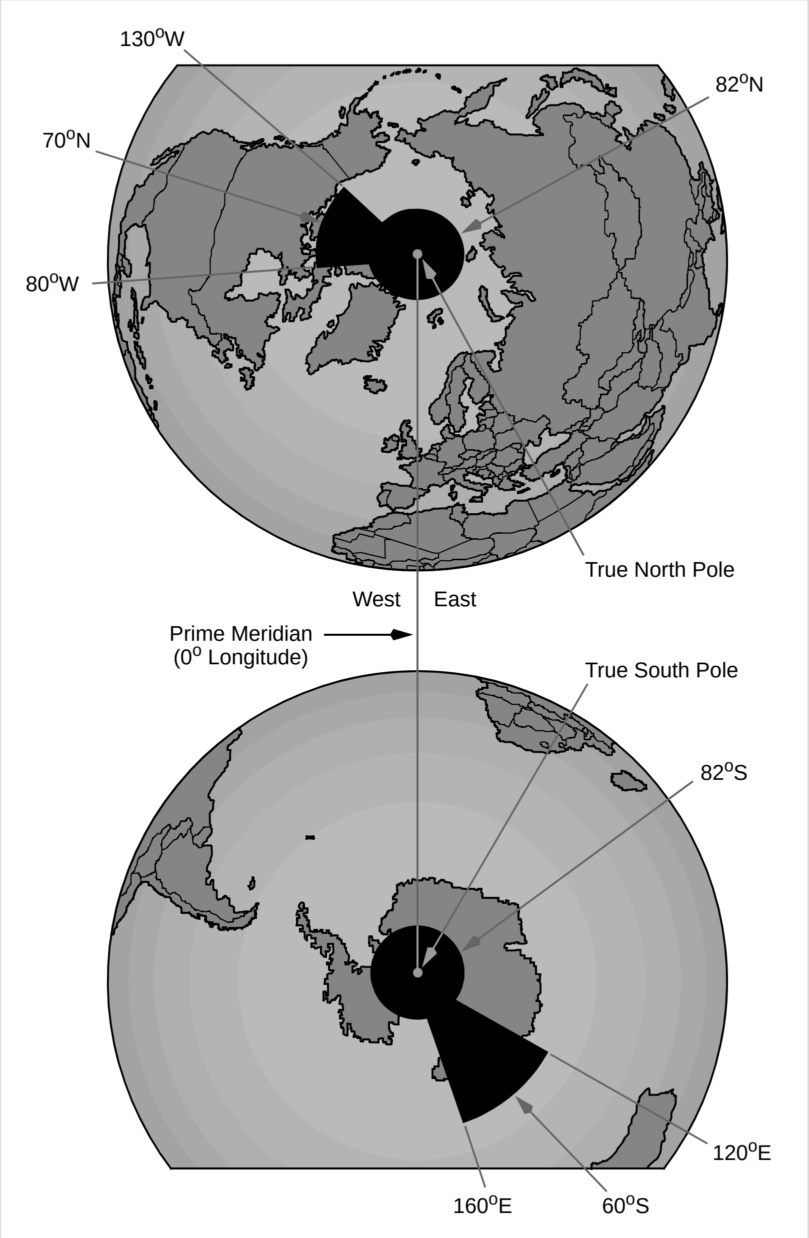
The heading reference for PFDs, NDs, and RMI changes to true north at 82°N (or north of 70°N between 80°W and 130°W) or at 82°S (or south of 60°S between 120°E and 160°E).

At latitudes between 82°N (or south of 70°N between 80°W and 130°W) and 82°S (or north of 60°S between 120°E and 160°E), the FMC and IRU reference is determined by Heading Reference switch position. Outside this region, the FMC and IRUs reference true north regardless of Heading Reference switch position.

Automatic switching to a true north reference annunciates by a flashing white box around the word TRU on the ND. A TRUE heading reference can be selected with the Heading Reference switch inside or outside high latitudes. The ND displays a green box around the word MAG to annunciate the change back to magnetic reference. If the heading reference is TRU in the descent phase, the ND displays an amber box around the word TRU.

Note: For autopilot operation in high latitudes using a roll mode other than LNAV, the TRUE position on the Heading Reference switch should be selected.

Areas of High Latitude Operations (with expanded MAGVAR)

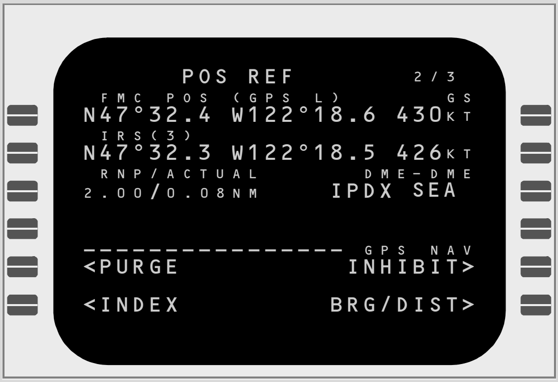


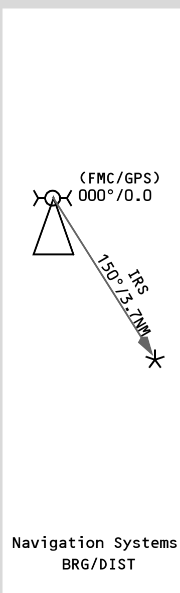
Navigation Performance

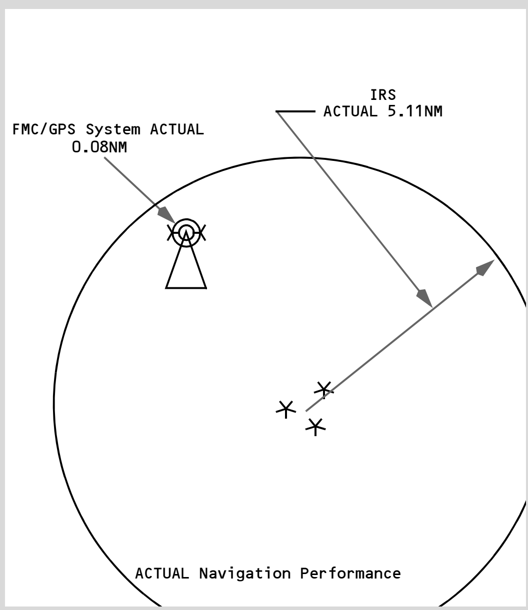
The FMC uses data from navigation systems to accurately calculate the position of the airplane. The current FMC position is on line 1 of the POS REF page 2. The primary source of update is in parentheses above the FMC position. The inertial reference system position is on line 2. The FMC position displays on the ND at the tip of the triangle. The IRS position displays relative to the FMC position. The ACTUAL navigation performance circles shown below do not display on the ND.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW,

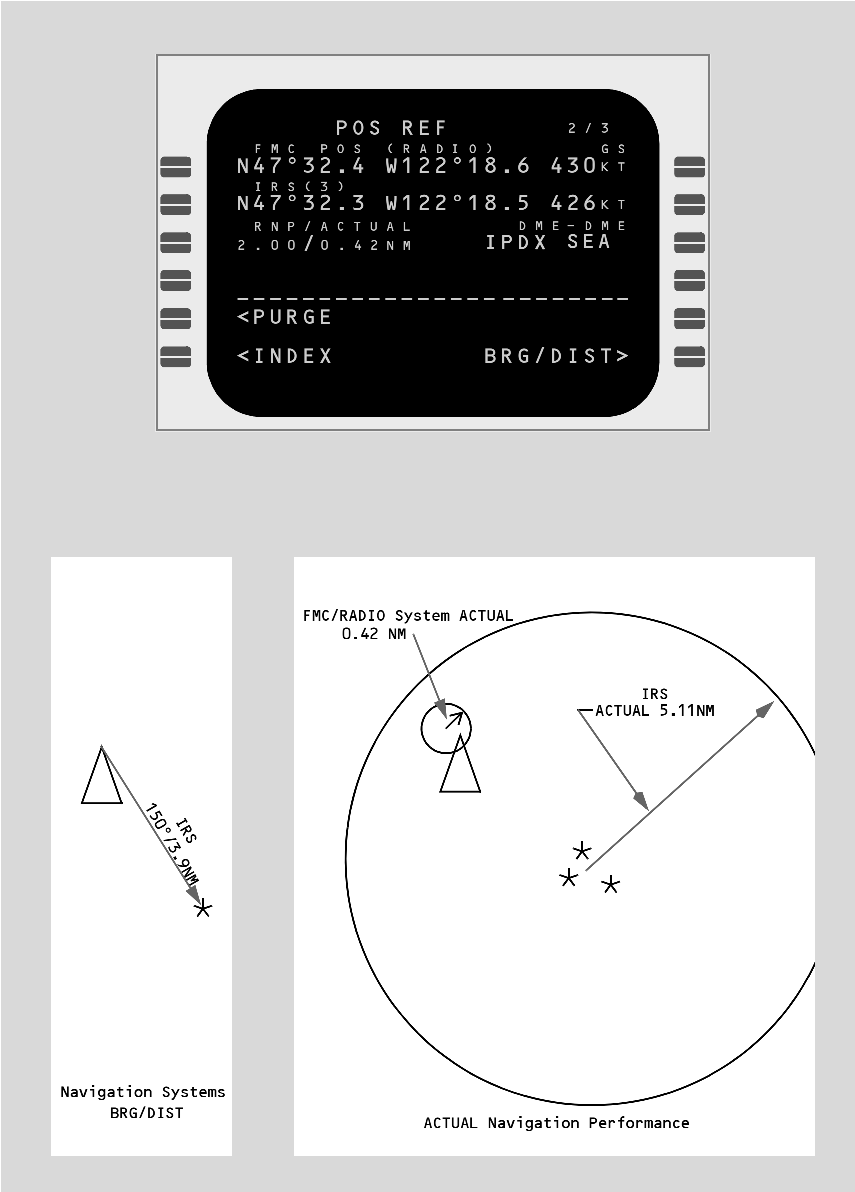
VQ-BHX


POS REF 2 / 3
FMC POS (GPS L) GS
N47°32.4 W122°18.6 430KT
IRS(3)
N47°32.3 W122°18.5 426KT
RNP/ACTUAL DME-DME
2.00/0.08NM IPDX SEA
---------------- GPS NAV
<PURGE INHIBIT>
<INDEX BRG/DIST>


(FMC/GPS)
000°/0.0
IRS
150°/3.7NM
Navigation Systems
BRG/DIST


IRS
ACTUAL 5.11NM
FMC/GPS System ACTUAL
0.08NM
ACTUAL Navigation Performance

VP-BKJ, VP-BVR


POS REF 2 / 3
FMC POS (RADIO) GS
N47°32.4 W122°18.6 430KT
IRS(3)
N47°32.3 W122°18.5 426KT
RNP/ACTUAL DME-DME
2.00/0.42NM IPDX SEA

<PURGE
<INDEX BRG/DIST>
IRS
150°/3.9NM
Navigation Systems
BRG/DIST
FMC/RADIO System ACTUAL
0.42 NM
IRS
ACTUAL 5.11NM
ACTUAL Navigation Performance

Actual Navigation Performance

Actual navigation performance (ANP) is the FMC current computed position accuracy. It is titled ACTUAL and displays on the POS REF page 2 for the navigation system displayed in title line 1. ACTUAL navigation performance is a circular prediction centered at the FMC position. Airplane position is estimated to be within this ACTUAL navigation performance circle 95 percent of the time.

Required Navigation Performance

Required Navigation Performance (RNP) is the navigation accuracy required for operation within a defined airspace. It is expressed in nautical miles. RNP values have been published for areas of operation around the world. Operations in these areas require on-board navigation systems to alert the flight crew if ANP exceeds RNP. The FMC supplies a default RNP value for takeoff, en route, oceanic/remote, terminal, and approach phases of flight. The flight crew may enter an RNP value, when required. RNP is on POS REF page 2.

Lateral Navigation (LNAV)

LNAV normally provides great circle courses between waypoints making up the active route. When an FMC database procedure is entered in the active route, the FMC commands a heading, a track, or a DME arc to comply with the procedure.

Waypoints

Waypoint identifiers display on the CDU and navigation display.

The CDU message NOT IN DATABASE displays if a manually entered waypoint identifier is not in the database. Waypoints can be entered as latitude/longitude, place/bearing/distance, or place bearing/place bearing.

FMC-generated waypoints contain a maximum of five characters assigned according to the following rules.

Navaid Waypoints

VHF - waypoints located at VHF navaids (VOR/DME/LOC) are identified by one, two, three, or four character facility identifier. Example: Los Angeles VORTAC - LAX.

NDB - waypoints located at NDBs are identified by use of the station identifier. Example: FORT NELSON, CAN - YE.

Fix Waypoints

Waypoints located at fixes with names containing five or fewer characters are identified by the name. Example: ALPHA.

Long Waypoints

Waypoints with more than five characters are abbreviated using the following rules sequentially until five characters remain:

- for double letters, one letter is deleted. Example: KIMMEL becomes KIMEL.
- keep the first letter, first vowel, and last letter. Delete other vowels starting from right to left. Example: BAILEY becomes BAILY
- the next rule abbreviates names even further. Apply the previous rule, then delete consonants from right to left. Example: BRIDGEPORT becomes BRIDGPRT then BRIDT
- fixes with multiword names use the first letter of the first word and abbreviate the last word, using the above rules sequentially until a total of five characters remain. Example: ROUGH ROAD becomes RROAD

Unnamed Waypoints

When an unnamed turn point, intersection, or fix is collocated with a named waypoint or navaid on a different route structure (such as low altitude routes or an approach), the name or identifier of the collocated waypoint is used. Example: Unnamed turn point on J2 between Lake Charles (LCH) and New Orleans (MSY) VORTACs is coincidental with the Lafayette (LFT) low altitude VORTAC. LFT is used as the identifier for the turn point.

Identifier codes for unnamed turn points not coincidental with named waypoints are constructed from the identifier of a navaid serving the point and the distance from the navaid to the point. If the distance is 99 nautical miles or less, the navaid identifier is placed first, followed by the distance. If the distance is 100 nautical miles or more, the last two digits are used and placed ahead of the navaid identifier. Examples (NAVAID - DISTANCE - IDENT):

- INW - 18 - INW18
- CSN - 106 - 06CSN

Waypoints located at unnamed flight information region (FIR), upper flight information region (UIR), and controlled airspace reporting points are identified by the three-letter airspace type identification followed by a two-digit sequence number. Example: FRA01.

Unnamed oceanic control area reporting points in the northern hemisphere use the letters N and E, while points in the southern hemisphere use the letters S and W. Latitude always precedes longitude. For longitude, only the last two digits of the three digit value are used.

Placement of the designator in the five character set indicates whether the first longitude digit is 0 or 1. The letter is the last character if the longitude is less than 100° and is the third character if the longitude is 100° or greater.

N is used for north latitude, west longitude. E is used for north latitude, east longitude. S is used for south latitude, east longitude. W is used for south latitude, west longitude. Examples:

- N50° W040° becomes 5040N
- N75° W170° becomes 75N70
- N50° E020° becomes 5020E
- N06° E110° becomes 06E10
- S52° W075° becomes 5275W
- S07° W120° becomes 07W20
- S50° E020° becomes 5020S
- S06° E110° becomes 06S10

Procedure Arc Fix Waypoints

Unnamed terminal area fixes along a DME arc procedure are identified with the first character D. Characters 2 through 4 indicate the radial on which the fix lies. The last character indicates the arc radius. The radius is expressed by a letter of the alphabet where A = 1 mile, B = 2 miles, C = 3 miles and so forth. Example: EPH252°/24 = D252X.

An unnamed waypoint along a DME arc with a radius greater than 26 miles is identified by the station identifier and the DME radius. Example: CPR338°/29 = CPR29.

When there are multiple unnamed waypoints along a DME arc with a radius greater than 26 miles, the station identifier is reduced to two characters, followed by the radius, and then a sequence character. Examples:

- CPR134°/29 = CP29A
- CPR190° /29 = CP29B

Procedure Fix Waypoints

Marker beacons are identified by the marker type identifier followed by the runway number. Examples: Outer Marker 13R = OM13R.

Runway-related fixes - waypoints located at unnamed runway-related fixes are identified by adding a two-letter prefix to the runway number:

- RX - runway extension fix
- FA - VFR final approach fix
- CF - final approach course fix
- FF - final approach fix
- IF - initial approach fix
- OM - outer marker
- MM - middle marker
- IM - inner marker
- BM - back course marker
- MD - minimum descent altitude
- A - (+ an alpha) step down fix
- RW - runway threshold
- MA - missed approach point other than RW
- TD - touchdown point inboard of RW

Examples: OM25L, MM09, IM23, RW04, RW18L.

For airports with more than one approach to the same runway, the two letter prefix may change to allow different identifiers for the same waypoint. The first letter identifies the type of fix and the second letter identifies the type approach:

- C( ) - final approach course fix
- F( ) - final approach fix
- P( ) - missed approach point
- I( ) - initial approach fix
- D( ) - minimum descent altitude
- T( ) - touch down point
- R( ) - runway centerline intercept.
- ( )I - ILS
- ( )L - localizer only
- ( )B - backcourse ILS
- ( )D - VOR/DME
- ( )V - VOR only
- ( )S - VOR with DME points
- ( )N - NDB
- ( )Q - NDB with DME points
- ( )M - MLS
- ( )T - Tacan
- ( )R - RNAV

Examples: CI32R, PV15, FN24L.

Unnamed turn points that are part of a procedure are identified as a latitude and longitude waypoint. These include waypoints (except conditional waypoints) defined by flying a course or track from a waypoint (except conditional waypoints) to a radial or DME distance. These waypoints are automatically entered in a route by selection of a procedure using these waypoints, from the departures or arrivals page.

Airport reference points are identified by the ICAO identifier.

DME step down fixes are identified by the distance and a “D”. Examples: 138D, 106D, 56D, 3D

Duplicate Waypoints

Application of the abbreviation rules may create identical identifiers for different waypoints. When a duplicate waypoint identifier is entered, the page changes to the SELECT DESIRED WPT page. The page lists the latitude and longitude of waypoints with the same identifier and the type of facility or waypoint. Selecting the latitude/longitude of the correct waypoint enters the correct waypoint on the original page.

When a waypoint which has a duplicate identifier in the active route is entered in the scratchpad and line selected, the SELECT DESIRED WPT page does not display. A direct-to the downtrack waypoint displays on the ND. Entering the local waypoint (the duplicate) using latitude/longitude, place/bearing/distance, or place bearing/place bearing enables the modification.

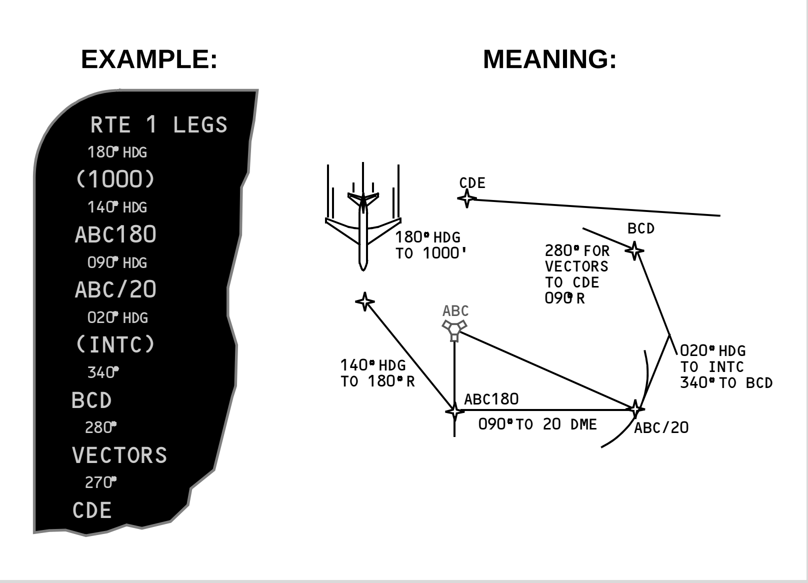
Conditional Waypoints

Conditional waypoints may display in the route when selecting a DEPARTURES or ARRIVALS page procedure. Usually, conditional waypoints cannot be manually entered on a route or legs page. These waypoints indicate when an event occurs and are not at a geographically-fixed position. The types of conditions are:

- climb/descent through an altitude
- flying a heading to a radial or DME distance
- intercepting a course
- heading vectors to a course or fix

Altitude and course intercept conditional waypoints display on the CDU inside (parenthesis) marks. The diagram below shows conditional waypoints.

(1000) is a conditional waypoint. LNAV guidance is to hold a 180° heading until above 1,000 feet; then, turn to a heading of 140°.



NOTE: ALL WAYPOINTS EXCEPT BCD AND CDE ARE EXAMPLES OF CONDITIONAL WAYPOINTS.

Manually Entered Latitude/Longitude Waypoints

Pilot defined waypoints entered as a latitude and longitude display in a seven-character format. Latitude and longitude waypoints are entered with no space or slash between the latitude and longitude entries. Leading zeroes must be entered. All digits and decimal points (to 1/10 minute) must be entered unless the latitude or longitude are full degrees. Examples:

- N47° W008° is entered as N47W008 and displayed as N47W008
- N47° 15.4’ W008° 3.4’ is entered as N4715.4W00803.4 and displayed as N47W008

Manually Entered Place/Bearing/Distance or Place Bearing/Place Bearing Waypoints

Waypoints entered as a place/bearing/distance or place bearing/place bearing are identified by the first three characters of the entry followed by a two-digit sequence number. Examples:

- SEA330/10 becomes SEA01
- SEA240/OLM320 becomes SEA02

The two digit sequence numbers reserved for RTE1 are 01 through 49. The two digit sequence numbers reserved for RTE2 are 51 through 99.

Manually Entered Airway Crossing Waypoints

Airway crossing fixes are entered as a five character waypoint name or by entering consecutive airways on the ROUTE page. In the latter case, the display is an X followed by the second airway name. Example: entering J70 on the VIA line of the ROUTE page causes box prompts to display opposite on the same line. Leaving the box prompts empty and entering J52 on the next VIA line, directly below J70, causes the FMC to calculate the intersection of the two airways and replace the boxes with the waypoint identifier XJ52.

If the number of waypoints in the existing route plus the new waypoints added to reach the new intersection (XJ52) exceeds 120, the FMC rejects the second entry. Repeated attempts to enter the second airway result in an FMC resynchronization. Delaying modification of the route until the number of waypoints to reach the new intersection does not exceed 120 prevents resynchronization.

Manually Entered Latitude or Longitude Reporting Point Waypoints

Latitude or longitude reporting waypoints are entered as the latitude or longitude followed by a dash, then the increment chosen for the following waypoints. Example:

- W060-10 adds waypoints starting at W060 in ten degree increments from that point to the destination
- the entry must be made on a LEGS page on any line before the first reporting point
- usually, this entry is made on the active waypoint line and proper sequencing is performed by the FMC

Manually Entered Along-Track Waypoints

Along-track waypoints are created on the active route and do not cause route discontinuities where they are created.

Along-track waypoints are created using the waypoint name (the place), followed by a slash and minus sign, for points before the waypoint, or no sign for points after the waypoint, followed by the mileage offset for the newly defined waypoint. The created waypoint is then inserted over the original waypoint. The distance offset must be less than the distance between the originating waypoint and next (positive value) or preceding (negative value) waypoint. Latitude and longitude waypoints cannot be used to create along-track waypoints. Examples:

- VAMPS/25 is 25 miles after VAMPS on the present route, and displays as VAM01
- ELN/-30 is 30 miles before ELN on the present route, and displays as ELN01

ND Map Displays

The route displays on the ND in map, map center, and plan modes. The display color and format represent the following status:

- an inactive route displays as a cyan dashed line
- a pending active route displays as a dashed white line
- the active route displays in magenta
- modifications to an active route display as dashed white lines
- modified waypoints display in white
- executed route offsets display as a dashed magenta line

The ND displays the FMC position at the apex of the airplane symbol. All ND map data displays relative to this apex.

When adequate radio (or GPS) updating is not available, the ND map may display a shift error. This error results in the displayed position of the airplane, route, waypoints, and navigation aids being shifted from their actual position. An undetected, across track map shift may result in the airplane flying a ground track offset from the desired track. An undetected, along track map shift may result in the flight crew initiating altitude changes earlier or later than desired. In either case, an undetected map shift may compromise terrain or traffic separation.

Map shift errors can be detected by comparing the position of the airplane on the ND map with data from the ILS, VOR, DME, and ADF systems.

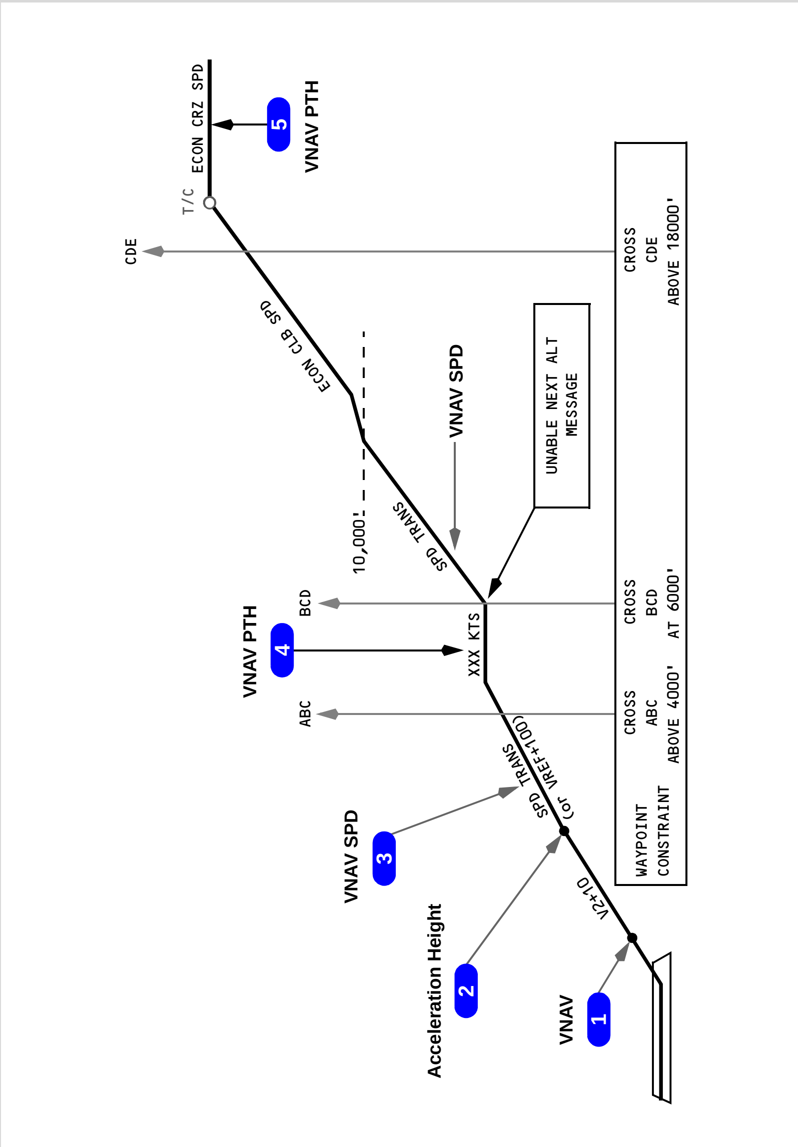
Vertical Navigation (VNAV)

VNAV provides vertical profile guidance through the climb, cruise, and descent phases of flight.

Speed/Altitude Constraints

VNAV controls the path and speed to comply with waypoint crossing constraints. Waypoint crossing constraints are entered on the LEGS page waypoint line by pushing the applicable key on the right side of the CDU. Barometric altitude constraints must be below the cruise altitude to be valid. Values entered as part of a procedure and manually entered constraints display in large font. FMC predicted values do not act as constraints, and display in small font.

Takeoff and Climb



1 Takeoff

When armed for takeoff, VNAV activates at 400 feet and pitch guidance continues to maintain the target airspeed.

During takeoff, the FMC updates the target airspeed to the current airspeed until VNAV activates. The target airspeed is between V2 + 10 and V2 + 25.

2 Acceleration Height

At acceleration height or altitude capture below acceleration height, VNAV commands an airspeed increase to a speed 5 knots below the flap placard speed for the existing flap setting. When flaps are retracted or at an AFDS capture altitude, VNAV commands the greater of VREF + 100 knots or the speed transition associated with the origin airport, limited by configuration.

The FMC changes the reference thrust limit to the armed climb thrust at the thrust reduction point.

3 VNAV Climb

VNAV climb profile uses VNAV SPD or VNAV PTH as the default climb speed or pilot selected climb speed to remain within all airspeed and altitude constraints of an active route Standard Instrument Departure. Autothrottle uses the armed climb thrust limit.

If the climb speed profile cannot achieve an altitude constraint, the UNABLE NEXT ALT scratchpad message displays.

4 Climb Constraints

VNAV enters the VNAV PTH mode to remain within departure or waypoint constraints. Speed maintained during this time can be:

- procedure based speed restriction
- waypoint speed restriction
- default VNAV climb speed
- manually entered climb speed

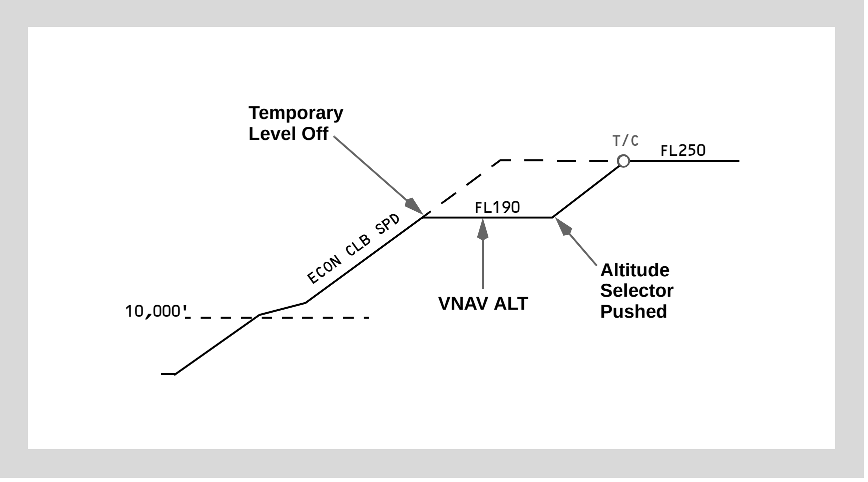
If the FMC predicts the airplane will not reach an altitude constraint, the FMS-CDU message UNABLE NEXT ALTITUDE displays. Speed intervention can be used by pushing the IAS/MACH selector and manually setting a lower airspeed to provide a steeper climb; or, climb derates can be deleted on the Thrust Limit page.

5 Top Of Climb (T/C)

The point where climb phase meets the cruise altitude is called the top of climb. Approaching this point, the FMC changes from climb phase to cruise phase. The T/C displays any time the FMC calculates a change from climb phase to cruise phase, such as step climb.

The T/C point displays on the map as a green circle with the label T/C.

MCP Altitude Intervention



Whenever the airplane levels at an MCP altitude not in the FMC, VNAV ALT annunciates. For example, FMC cruise altitude is FL250 and the clearance altitude, FL190, is set in the MCP. Pitch maintains altitude and thrust maintains FMC target speed. In the example, the speed after the temporary level off would be ECON CLB SPEED.

Setting the clearance altitude in the MCP altitude window and pushing the altitude selector continues the climb. VNAV SPD activates. Pitch maintains FMC speed and thrust increases to the armed reference thrust limit. In the example, the airplane climbs to FMC CRZ ALT and levels at FL250 in cruise.

Cruise

During cruise, the FMC commands economy cruise speed until reaching the top-of-descent (T/D) point. Other cruise speed options are:

- long range (LRC)
- engine out (ENG OUT), or
- flight crew entered speed

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- required time of arrival (RTA)

The FMC commands maximum range cruise speed with the cost index set to zero. Cost index modifications are allowed until within ten miles of the top of descent.

Cruise Climb

Setting an altitude above the current cruise altitude in the MCP altitude window and pushing the altitude selector causes the cruise altitude to be set to the MCP altitude and the airplane to climb to the new cruise altitude. The CRZ page displays ACT ECON CRZ CLB.

Step Climb

Fuel and ETA predictions assume the airplane climbs at each predicted step climb point as airplane weight decreases. FMC predicted step climb increments are based on the step size shown on the CRZ page. Entering a step size of zero causes the FMC to assume a constant altitude cruise.

Flight crew entry of a step altitude on the CRZ or RTE LEGS page overrides the FMC step climb predictions. Entry of a step altitude on the RTE LEGS page overrides a “Step To” entry made on the CRZ page.

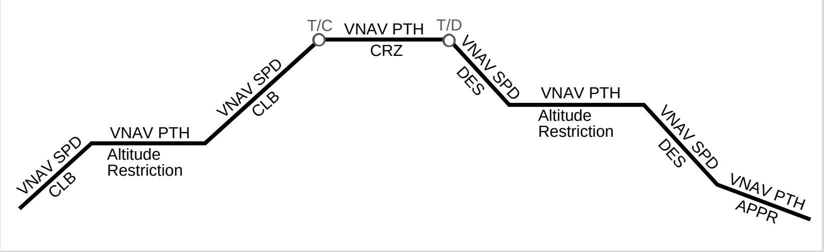
Predicted step altitudes display on the RTE LEGS page. The distance and ETA to the next step point (predicted or flight crew entered) display on the CDU CRZ and PROG pages. They also display on the ND map display with a green circle and S/C label.

The FMC calculates step climb points as a function of lateral flight plan, speed mode, present and step to altitude, and gross weight. The gross weight for a step from present CRZ ALT to STEP TO altitude is the gross weight at which the optimum altitude is halfway between the two altitudes.

Cruise Descent

Setting an altitude below the current cruise altitude in the MCP altitude window and pushing the altitude selector (more than 50 nm from a T/D) causes the cruise altitude to be set to the MCP altitude and the airplane to descend to the new cruise altitude. The CRZ page displays ACT ECON CRZ DES. If the altitude set in the altitude window is below the speed transition (SPD TRANS) or restriction (SPD RESTR) altitude displayed on the DES page, those altitudes and speeds are deleted. Transition or speed restrictions must be maintained by flight crew action.

MCP Speed Intervention



SPEED INTERVENTION PITCH MODES

With VNAV active, pushing the IAS MACH selector enables speed intervention. Speed intervention allows the flight crew to change airplane speed with the IAS/MACH selector.

The above illustration shows the VNAV pitch flight mode annunciation for each phase of flight when using speed intervention.

During a VNAV, non-ILS approach while using speed intervention, the pitch mode is VNAV PTH. The vertical path is maintained regardless of IAS MACH selector changes.

If a “direct to” is executed to a waypoint in the approach, VNAV transitions to the approach phase when the airplane passes the “direct to” waypoint. If a waypoint located after the first waypoint of an FMC database approach is added and executed, VNAV does not transition to approach phase when passing the first waypoint of the approach.

Descent

The FMC calculates a descent path based on cruise airspeed and altitude and the end of descent (E/D); and, when applicable, waypoint airspeed and altitude constraints. Dashes display on the LEGS page for speed and altitude descent waypoints. When an arrival or approach procedure is selected on the ARRIVALS page and incorporated into the flight plan, the FMC creates an E/D. The E/D is located 50 feet above the runway threshold (RW waypoint) for all approaches except VOR approaches. The E/D for VOR approaches is the missed approach point; which may be the VOR, runway waypoint (RWXXX), or a named waypoint. During cruise, an E/D is also created when an altitude constraint is entered on the LEGS page on a downstream waypoint.

The top of descent (T/D) is the point where the cruise phase changes to the descent phase. It displays on the ND as a green circle with the label T/D. The descent path starts at the T/D and includes waypoint altitude constraints. The path to the first constraint is based on:

- idle thrust
- speedbrakes retracted
- FMC cruise wind
- wind entries on the DESCENT FORECAST page
- predicted use of anti-ice
- applicable target speed

The descent may be planned at economy Mach/CAS (based on Cost Index) or a manually entered Mach/CAS. VNAV will not command an economy target speed greater than 349 knots (VMO/MMO minus 16 knots) or a pilot entered speed greater than 354 knots (VMO/MMO minus 11 knots).

The FMC creates the descent path with a deceleration at the speed transition altitude (typically 250 knots below 10,000 feet). VNAV plans a speed target 10 knots below the transition speed to allow for unknown tailwinds.

Descent path segments after the first altitude constraint waypoint are constructed as straight line point-to-point segments. If the VNAV path segment is too shallow to be flown satisfactorily at IDLE thrust, the FMC commands speed on thrust levers (SPD). Elevators control the shallow descent path.

If flight plan modifications or unknown winds occur when above the first speed constraint, VNAV varies speed to maintain the path up to the following limits:

- with greater than 15 knots below the target speed, the autothrottle changes from IDLE/HOLD to SPD to provide thrust to accelerate to the target speed. If the autothrottle is not active, the scratchpad message THRUST REQUIRED displays. The airspeed may decrease to minimum maneuvering speed. Subsequently, VNAV commands the airplane to fly below the path to stop the deceleration. If VNAV can no longer maintain the airplane within 150 feet of the path without further deceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV resets the target speed to 5 knots above the greater of best holding speed or minimum maneuvering speed, and the scratchpad message THRUST REQUIRED displays again
- with greater than 349 knots (VMO/MMO minus 16 knots), the scratchpad message DRAG REQUIRED displays. The airplane may accelerate up to 354 knots (VMO/MMO minus 11 knots) to maintain the path. If further correction is required, VNAV may allow the airplane to rise up to 150 feet above the path. If VNAV can no longer maintain the airplane within 150 feet of the path without further acceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV resets the target speed to 349 knots (VMO/MMO minus 16 knots), and the scratchpad message DRAG REQUIRED displays again

If flight plan modifications or unknown winds occur when below the first speed constraint, VNAV varies speed to maintain the path up to the following limits:

- with greater than 10 knots below the target speed, the autothrottle changes from IDLE/HOLD to SPD to provide thrust to accelerate to the target speed. If the autothrottle is not active, the scratchpad message THRUST REQUIRED displays. The airspeed may decrease to minimum maneuvering speed. Subsequently, VNAV commands the airplane to fly below the path to stop the deceleration. If VNAV can no longer maintain the airplane within 150 feet of the path without further deceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV commands a speed 10 knots less than the transition speed for the destination airport (not less than minimum maneuvering speed), and the scratchpad message THRUST REQUIRED displays again
- with greater than 10 knots above target speed, the scratchpad message DRAG REQUIRED displays. The airplane may accelerate up to 15 knots above target speed to maintain the path. The maximum speed excursion allowed is 5 knots above the transition speed after the airplane is below transition altitude for the destination airport or 5 knots below the flaps placard speed if flaps are extended. If further correction is required, VNAV may allow the airplane to rise up to 150 feet above the path to stop the acceleration. If VNAV can no longer maintain the airplane within 150 feet of the path without further acceleration, speed reversion occurs, the pitch mode annunciation changes from VNAV PTH to VNAV SPD, VNAV commands a speed 10 knots less than the transition speed for the destination airport, and the scratchpad message DRAG REQUIRED displays again

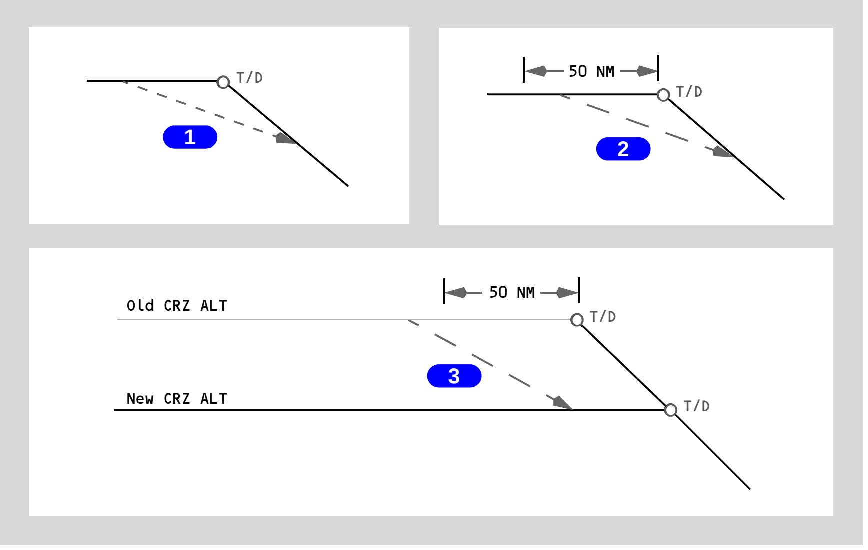
Reversion to VNAV SPD and departure below the path for a condition of speed decrease is inhibited when VNAV is in the "on approach" mode.

The DRAG REQUIRED and THRUST REQUIRED messages are inhibited when VNAV pitch control is speed-on-elevator.

Early Descent

When a descent is started before the T/D, VNAV commands a descent at a reduced descent rate until the idle descent path is intercepted.

Start an early descent by selecting the DES NOW prompt on the DES page or by dialing the altitude down and pushing the MCP altitude selector. In an early descent, the autothrottle mode annunciation is initially THR, followed by HOLD, allowing the pilot to adjust the rate of descent. The pitch mode is VNAV SPD.



1 DES NOW

Use the DES NOW prompt on the VNAV DES page. VNAV starts an early descent and captures the idle descent path.

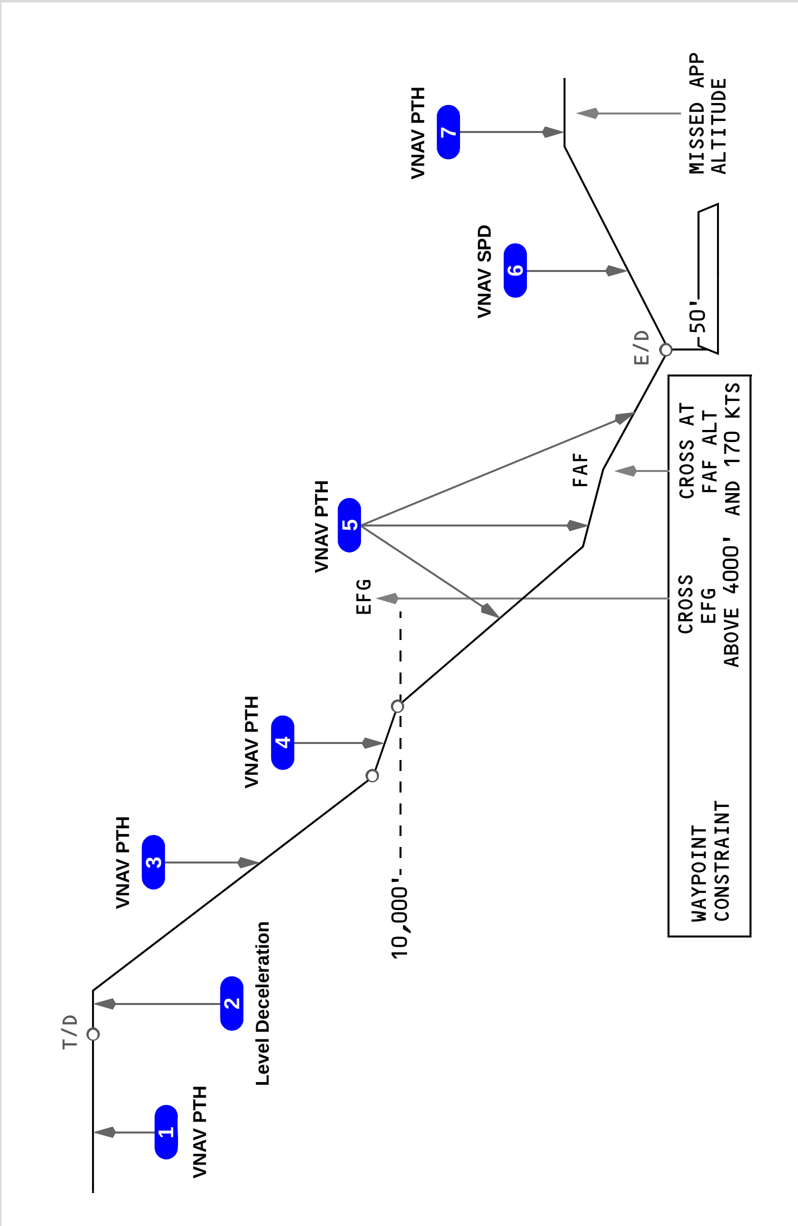
2 Within 50 NM of Top of Descent Point

Use the MCP altitude selector to start an early descent. Within 50 NM of the top of descent point, VNAV starts an early descent and captures the idle descent path.

3 More than 50 NM from Top of Descent Point

Use the MCP altitude selector to start a cruise descent. If the distance from the top of descent is more than 50 NM, VNAV begins a cruise descent to the new cruise altitude. VNAV may not capture the idle descent path since the target airspeed is economy cruise and the descent path is based on idle thrust and economy descent airspeed. In the example, VNAV levels at the new cruise altitude.

Cruise and Descent Profile (Instrument Approach using VNAV)



1 Cruise

Before top of descent, FMC is in cruise and commands VNAV PATH and ECON cruise speed.

2 Level deceleration phase

At top of descent, FMC transitions to descent and commands the airspeed to ECON descent speed and maintains altitude in VNAV PATH.

3 Descent

Nearing descent speed, VNAV commands a descent in VNAV PATH at ECON descent speed.

4 Descent deceleration phase

Before the speed restriction altitude, FMC commands the target descent airspeed. The pitch mode remains VNAV PTH and the descent rate approximates 500 feet per minute.

5 Descent and Approach

When at target speed, VNAV commands a descent and starts approach in VNAV PATH at commanded speed.

6 Missed Approach

When selected during missed approach, VNAV activates in VNAV SPD.

7 Missed Approach Level Off

At missed approach altitude, VNAV SPD changes to VNAV PATH.

Approach

The FMC transitions to "on approach" under the following conditions:

- a VFR approach is created and,
  - the airplane has sequenced the FAXXX, or
  - the airplane is enroute to a direct-to or intercept-to the RWYYY waypoint and the airplane is within 25 nm of the runway threshold
- a published instrument approach has been selected and incorporated in the active flight plan and the airplane has sequenced the first waypoint on the published approach

The FMC transitions out of "on approach" under the following conditions:

- selecting TOGA
- the airplane lands
- the airplane flies beyond the last waypoint in the approach (missed approach waypoint or runway) and the VNAV page title changes from "ACT xxxxxx DES" to "ACT END OF DES"

When the FMC is “on approach”, the following features are available:

- the IAS/MACH window can be opened and the command speed can be set while VNAV remains in VNAV PTH descent; VNAV commands the set speed
- the MCP altitude can be set above the airplane altitude for the missed approach. When the MCP altitude setting is at least 300 feet above the current airplane altitude, VNAV continues to command a descent
- VNAV remains in VNAV PTH and follows the descent path unless the airplane accelerates to within 5 knots of the current flap placard and the airplane rises more than 150 feet above the path. In this case, VNAV PTH changes to VNAV SPD
- When a glide path angle is specified for one or more legs on the approach, it displays on the LEGS page and VNAV provides VNAV PTH guidance at the displayed angle. When sequencing a waypoint prior to a descent leg specified by a glide path angle, VNAV commands level flight until the airplane intercepts the descent path

Note: Display of a specified glide path angle is not limited to approaches. A glide path angle may be defined for a leg in a STAR and displays on the LEGS page for the procedure.

Selection of another approach can be accomplished on the ARRIVALS page. An along-course intercept to an approach waypoint in the new approach can be selected on the “INTC CRS TO” line on the LEGS page or by selecting the "XXXXX INTC>" prompt on the ARRIVALS page.

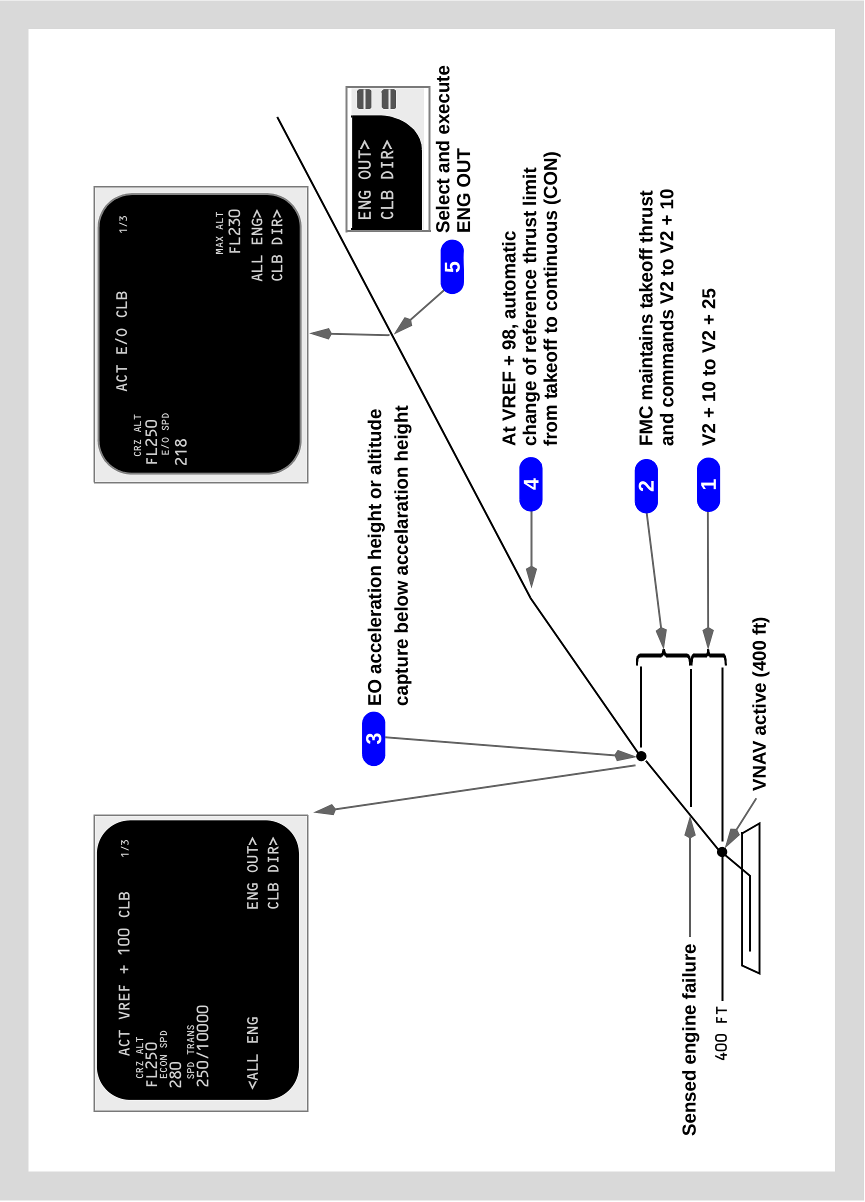
Missed Approach

A missed approach is accomplished by selection of either TOGA switch. The following features are available:

- VNAV (and LNAV) can only be activated when the airplane climbs above 400 feet radio altitude
- all descent altitude constraints below the current airplane altitude are deleted; the waypoints are retained in the active flight plan
- the highest altitude in the missed approach procedure becomes the new cruise altitude
- the FMC transitions from active descent to active climb

- AFDS guidance to fly the published missed approach procedure to the new cruise altitude is active when VNAV (and LNAV) are selected
- when cruise phase is active, the speed target is the most restrictive of speed transition, best hold speed, or ECON cruise (above speed transition altitude)

Takeoff and Climb (Engine Out)



1 Takeoff

Condition: before a sensed engine failure and above VNAV activation altitude.

Result: VNAV SPD commands a climb at V2+10 to V2+25 knots. Autothrottle mode is THR REF and the reference thrust limit is takeoff.

2 Sensed Engine Failure

Condition: after VNAV active, engine failure sensed, airplane below engine out acceleration height, and below the thrust reduction point entered on the TAKEOFF REF page.

Result: VNAV remains in VNAV SPD and commands a speed of V2 to V2 + 10 knots. Autothrottle remains in THR REF at the selected reference thrust limit for takeoff.

3 Acceleration Height

Condition: at acceleration height or altitude capture below acceleration height.

Result: VNAV commands an acceleration to VREF + 100 knots, limited by airplane configuration (flap placard). The VNAV climb page shows the ACT VREF + 100 CLB page.

4 Thrust Reduction

Condition: airplane has accelerated to VREF + 98 knots

Result: thrust is automatically reduced from selected takeoff to continuous (CON) thrust. If the engine failure occurs above the thrust reduction point, the current climb thrust is maintained.

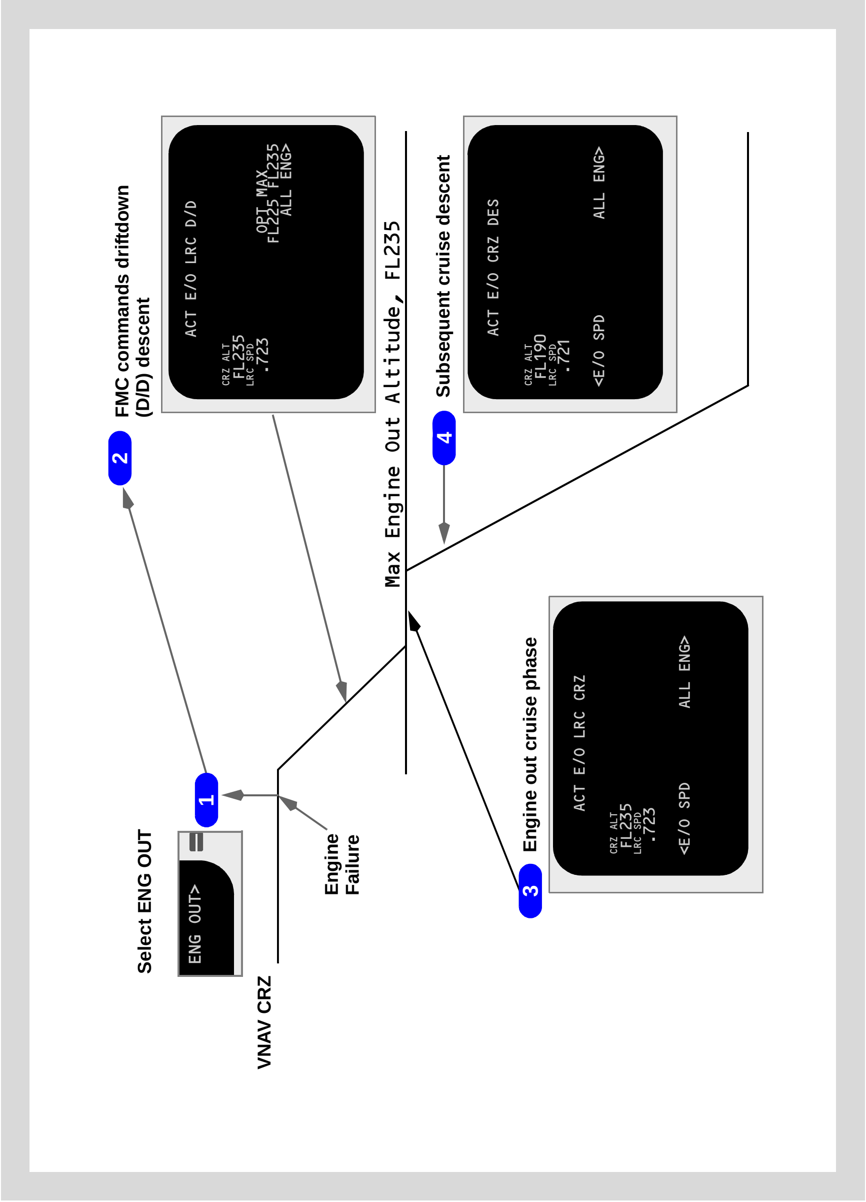
5 VNAV Climb (Engine Out)

Condition: Selecting the ENG OUT> prompt on the VNAV CLB page displays applicable engine out performance data. Execution activates engine out performance data and terminates the VNAV engine out takeoff phase.

Result: the FMC engine out climb function is active, the pitch mode is VNAV SPD, the command speed is E/O SPD, and the reference thrust limit is CON. The use of VNAV for descent and approach is enabled.

VNAV Cruise (Engine Out above EO Max Alt)

When the airplane is above the engine out maximum altitude, selection of the ENG OUT> prompt creates a modification and displays applicable engine out driftdown (D/D) performance data. Setting the altitude window lower and executing the modification activates engine out driftdown.



1 Engine Out Modification

Condition: Select the ENG OUT> prompt on the VNAV CRZ page.

Result: The FMC creates a modification and displays applicable engine out driftdown (D/D) performance data.

2 Drift Down Execution

Condition 1: Set the MCP altitude at or below E/O MAX altitude and execute the FMC modification. This Condition assumes clearance is approved to descend slowly to an non-standard altitude; for example, FL235.

Result: The autothrottle advances operating engines to CON thrust. VNAV commands the driftdown and E/O LRC SPD. The E/O MAX altitude becomes the cruise altitude displayed in 1L. VNAV captures the E/O MAX altitude and commands engine out LRC cruise. The descent rate is controlled to a minimum of 300 feet per minute (fpm). Time and distance for the D/D to E/O MAX altitude display at 2R.

Two other ways to activate EO D/D (to the clearance altitude) are discussed below.

Condition 2: Execute the ENG OUT modification. Then, set the clearance altitude (lower than E/O MAX) in the MCP and push the MCP altitude selector.

Result: Initially, the airplane remains at the MCP altitude, the pitch mode changes to VNAV ALT, the reference thrust limit is CON, and FMC speed is E/O LRC SPD. After setting the MCP altitude window and pushing the altitude selector, the airplane descends in a VNAV driftdown to the clearance altitude in 1L. Initial descent rate may be greater than Condition 1, depending how much airspeed is lost before pushing the altitude selector. If the airspeed has decreased below E/O LRC SPD, the descent rate increases to regain the airspeed.

Condition 3: Set the clearance altitude (lower than E/O MAX) in the MCP, push the altitude selector; then, after the descent is established, execute the FMC modification (ENG OUT).

Result: After pushing the altitude selector, the airplane descends in a normal VNAV cruise descent at four-engine economy cruise speed. The thrust limit is CLB/CRZ and the autothrottle maintains cruise airspeed. Executing the FMC modification while still above E/O MAX altitude sets the driftdown descent airspeed to E/O LRC SPD. The reference thrust limit becomes CON. The airplane initially descends at economy cruise airspeed and approximately 1,250 fpm. After executing the ENG OUT modification, the commanded airspeed is E/O LRC SPD. The rate of descent decreases to a minimum of 300 fpm.

3 Engine Out Cruise

Engine out cruise operates like normal cruise with engine out cruise speeds. Thrust limit remains in CON. VNAV PTH displays as the pitch mode.

4 **Subsequent Cruise Descent**

Condition: FMC in engine out mode, setting a lower MCP altitude, and pushing the altitude selector.

Result: VNAV cruise descent at approximately 1,250 feet per minute at E/O LRC airspeed. The thrust limit remains CON and the autothrottle adjusts to maintain the E/O LRC airspeed. The altitude set on the MCP becomes the CRZ ALT on the EO CRZ page.

Required Time of Arrival (RTA)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

VNAV controls cruise speed to arrive at a specified waypoint within ± 30 seconds of a specified time. The FMC displays the scratchpad message, UNABLE RTA, if the RTA is not achievable. RTA is not available with engine out.

Data Entry Rules

Altitude Entry

Altitudes can be entered into the FMC as three digit (XXX), four digit (XXXX), five digit (XXXXX), or flight level (FLXXX) numbers. The FMC displays altitude or flight level entries in the proper form based on the transition altitude. Some data lines further restrict the valid entry forms.

Three digit entries represent altitude or flight levels in increments of 100 feet. Leading zeros are required.

Examples of three digit (XXX, FLXXX) entries with transition altitude = 10,000 feet:

- 800 feet is entered as 008 or FL008; displays as 800
- 1,500 feet is entered as 015 or FL015; displays as 1500
- 11,500 feet is entered as 115 or FL115; displays as FL115
- 25,000 feet is entered as 250 or FL250; displays as FL250

Four digit entries represent feet, rounded to the nearest ten feet. Leading zeros are required. This form is used when the altitude does not exceed 9,994 feet.

Examples of four digit (XXXX) entries with transition altitude = 18,000 feet:

- 50 feet is entered as 0050; displays as 50
- 835 feet is entered as 0835; displays as 840
- 1,500 feet is entered as 1500; displays as 1500
- 8,500 feet is entered as 8500; displays as 8500
- 9,994 feet is entered as 9994; displays as 9990

Five digit entries represent feet, rounded to the nearest ten feet. This form is used when the altitude exceeds 9,994 feet

Examples of five (XXXXX) digit entries with transition altitude = 4,000 feet:

- 50 feet is entered as 00050; displays as 50
- 835 feet is entered as 00835; displays as 840
- 1,500 feet is entered as 01500; displays as 1500
- 8,500 feet is entered as 08500; displays as FL085
- 9,995 feet is entered as 09995; displays as FL100
- 11,500 feet is entered as 11500; displays as FL115
- 25,000 feet is entered as 25000; displays as FL250

Negative altitude entries are allowed to -1000 feet.

Airspeed Entry

Airspeeds can be entered into the FMC as calibrated airspeed, CAS, or Mach number, M. Calibrated airspeeds are entered as three digits (XXX) in knots. Mach numbers are entered as one, two, or three digits following a decimal point.

Data Pairs

Many CDU pages display data in pairs separated by a slash “/.” Examples of these pairs include wind direction/speed and waypoint airspeed/altitude constraints. When entering both values in a pair, the slash is inserted between the values. When it is possible to enter only one value of the pair, the slash may not be required. When entering only the outboard value of a pair, the trailing or leading slash may be entered, but is not required before transferring to the data line. When entering the inboard value of a pair, the trailing or leading slash must be entered before transferring to the data line. Omission of the required slash normally results in an INVALID ENTRY message.

FMC Databases

The FMC contains four databases:

- navigation
- operational program configuration (OPC)
- aero engine database (AEDB)
- MAGVAR tables

The navigation database includes most data found on navigation charts. This data can be displayed on the CDU or ND. The database contains:

- location of VHF navigation aids
- airports
- runways
- other airline selected data, such as SIDs, STARs, approaches, and company routes
- transition altitudes

The operational program configuration (OPC) database contains configurable features controlled by the airplane manufacturer.

The aeronautical engine database provides performance data for calculation and optimization of the vertical path, flight plan predictions, and flight optimization. Examples of database parameters are:

- airplane drag and engine characteristics
- maximum and optimum altitudes
- maximum and minimum speeds

The flight plan is stored in the FMC and is accessible to other FMC functions requiring information for further flight plan developments.

The FMC contains two sets of navigation data, each valid for 28 days. Each set corresponds to the navigation chart revision cycle. The FMC uses the active data for navigation calculations. The contents of the navigation database are periodically updated and transferred to the FMC before the expiration date of the active data.

Thrust Management

The thrust management function operates the autothrottle in response to flight crew mode control panel inputs or to FMC commands. Reference thrust limits can be selected on the THRUST LIM page. FMC autothrottle commands are made while VNAV is engaged. Thrust management:

- calculates reference thrust limits and thrust settings, or follows FMC thrust settings
- commands thrust levers
- senses and transmits autothrottle failures
- commands thrust equalization through the engine electronic controls

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX
Thrust limits are expressed as N1 limits. Thrust equalization references N1.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Thrust limits are expressed as EPR limits. Thrust equalization references EPR.

Thrust management calculates a reference thrust for the following thrust settings:

- TO - takeoff
- TO 1 - takeoff one
- TO 2 - takeoff two
- D-TO - assumed temperature takeoff
- D-TO 1 - derate one assumed temperature takeoff
- D-TO 2 - derate two assumed temperature takeoff
- CLB - climb
- CLB 1 - climb one
- CLB 2 - climb two
- CRZ - cruise
- CON - continuous
- GA - go-around

With VNAV active, the reference thrust limit changes for the phase of flight. Thrust settings can be selected on the THRUST LIM page. The reference thrust limit displays at the top of the EICAS display.

With VNAV active, an engine failure, and flaps fully retracted, the reference thrust limit changes to CON at VREF + 98. The planned thrust reduction point is inhibited.

The flight crew can specify the thrust reduction height where the change from takeoff to climb thrust takes place by making an entry on the CDU TAKEOFF REF page. This can be an altitude from 400 feet to 9,999 feet or an entry of 5 for flaps 5.

Reduced Thrust Takeoff

Reduced thrust takeoffs lower EGT and extend engine life.

Derate/Variable Takeoff Rating

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Two fixed derates, TO1 and TO2, can be selected on the THRUST LIM page.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Two fixed derates, TO1 and TO2, can be selected on the THRUST LIM page. TO1 and TO2 reduce takeoff thrust by percentages specified by the operator [Airline Selectable Option]. The derate percentages can be set between maximum takeoff thrust and the maximum certified derate in one percent increments. The Airplane Flight Manual (AFM) provides performance data for these derates.

With both TO1 and TO2, the thrust setting parameter is considered a limitation for takeoff; therefore, thrust levers should not be advanced further except in an emergency. A further thrust increase following an engine failure could result in a loss of directional control. Use the takeoff speeds calculated by the FMC for the selected derate or variable takeoff rating condition.

Assumed Temperature Thrust Reduction Takeoff

Entering an assumed temperature higher than the actual temperature reduces takeoff thrust.

The maximum thrust reduction authorized is 25 percent below any certified rating.

The assumed temperature thrust setting is not considered a limitation. The assumed temperature reduction can be removed. If conditions are encountered where more thrust is necessary, the crew can manually apply full thrust.

Derated Thrust Climb

During climb, CLB 1 and CLB 2 derates are gradually removed. In cruise, the thrust reference defaults to CLB or CRZ as set by maintenance.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Two fixed climb thrust derates can be selected on the THRUST LIM page. CLB 1 uses a 10% derate of CLB thrust to 10,000 feet, then increases thrust linearly with altitude to CLB thrust at 15,000 feet. CLB 2 uses a 20% derate of CLB thrust to 10,000 feet, then increases thrust linearly with altitude to CLB thrust at 15,000 feet.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
Two fixed climb thrust derates can be selected on the THRUST LIM page. CLB 1 uses a 10% derate of CLB thrust to 10,000 feet, then increases thrust linearly with altitude to CLB thrust at 30,000 feet. CLB 2 uses a 20% derate of CLB thrust to 10,000 feet, then increases thrust linearly with altitude to CLB thrust at 35,000 feet.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Two fixed climb thrust derates can be selected on the THRUST LIM page. CLB 1 uses a 10% derate of CLB thrust to 25,000 feet, then increases thrust linearly with altitude to CLB thrust at 35,000 feet. CLB 2 uses a 20% derate of CLB thrust to 25,000 feet, then increases thrust linearly with altitude to 5.5% derate at 35,000 feet.

Use of an assumed temperature reduced thrust takeoff or takeoff derate affects automatic selection of climb derate. For a thrust reduction less than 5 percent, maximum climb thrust is selected by the FMC. For takeoff thrust reductions or derates from 5 percent to less than 15 percent, CLB 1 is selected. CLB 2 is selected for all takeoff thrust reductions or derates equal to or greater than 15 percent. On the ground, the pilots may override the automatic climb derate selection after the takeoff selection is complete.

Fuel Monitoring

The FMC receives fuel data from the fuel quantity indicating system (FQIS) or from manual entries. Fuel quantity values display on the PERF INIT page as calculated (CALC), MANUAL, or SENSED. They also display on the PROGRESS page as totalizer and calculated.

The FMC usually uses the calculated value for performance computations. Before engine start, the calculated value is automatically set to agree with the FQIS value. When the FMC receives a positive fuel flow signal at engine start, the calculated value disconnects from the FQIS and decreases at the fuel flow rate.

During fuel jettison, the calculated value is set equal to the FQIS value. When fuel jettison is completed, the calculated value disconnects from the FQIS and decreases at the fuel flow rate. This fuel quantity value displays as CALC on the PERF INIT page and as CALCULATED on the PROGRESS page.

If the flight crew inputs a fuel quantity, the line title changes to MANUAL. The manual value replaces the FQIS value and is updated by the FMC using fuel flow rate, the same as for the calculated value.

If fuel flow data becomes invalid after engine start, the calculated value is considered invalid and the FMC uses FQIS quantity for performance computations. In this case, fuel quantity displays as SENSED on the PERF INIT page and as TOTALIZER on the PROGRESS page.

Fuel flow signals are also used to calculate fuel used by the engines. FUEL USED displays on the PROGRESS page. FUEL USED values are retained through flight completion and are subsequently cleared at engine start or following a long-term power interrupt on the ground. If the fuel flow signal is invalid for greater than two minutes after engine start or is invalid while on the ground, the display blanks.

The scratchpad message FUEL DISAGREE-PROG 2 displays if the FMC calculates a large difference between the total sensed fuel quantity and calculated value. The flight crew should select PROGRESS page 2, and select the fuel value for the FMC to use for the remainder of flight.

The FMC continually estimates the fuel at the destination airport if the active route is flown. FMC calculated fuel predictions are based on landing gear and flaps up during climb, cruise, and descent. Any prolonged flight with landing gear and/or flaps extended increases fuel required. The increased fuel consumption will not be correctly displayed on the FMC fuel predictions pages. The CDU message INSUFFICIENT FUEL displays if the estimate is less than the fuel reserve value entered on the PERF INIT page.

Loss of FMC Electrical Power

The FMC must have continuous electrical power to operate. When the electrical power is interrupted and returns, the FMC restarts.

After restart, performance data displayed on the PERF INIT page must be reentered. The route previously in use may be available. If so, it must be activated. If the route is not available, the route must be reentered.

Before activating LNAV, the FMC must be given guidance to the route. Selecting the appropriate waypoint and performing a direct to or course intercept to the waypoint enables LNAV activation.

FMC Failure

Single FMC Failure

After loss of a single FMC, a resynchronization may occur. The active route may become inactive, the performance data may be lost, and LNAV and VNAV modes may fail. To regain FMC operation, activate and execute the flight plan, enter the necessary performance data, and select LNAV and VNAV.

Note: If the MENU page and the scratchpad message TIMEOUT - RESELECT display, the FMC is no longer connected to the CDU. Use the <FMC prompt on the MENU page to connect the CDU to the FMC.

On the ground, the scratchpad message SINGLE FMC OPERATION displays after loss of either FMC.

In flight, the scratchpad message SINGLE FMC OPERATION displays on only one CDU after loss of the FMC not selected on the FMC selector. The scratchpad message TIMEOUT - RESELECT displays on the CDU with the inoperative FMC.

In flight, the scratchpad message TIMEOUT - RESELECT displays on both CDUs after loss of the selected FMC. The FAIL light illuminates in all three CDUs. The navigation display with the NAV source selector selected to the failed FMC is lost. There is a time delay before the FMC message FMC LEFT, RIGHT displays. When the FMC selector is rotated to the operative FMC, the FMC is available through the CDU. Once an FMC page is accessed, the scratchpad message SINGLE FMC OPERATION displays on the CDU with the operative FMC.

Dual FMC Failure

If both FMCs fail, LNAV, VNAV, and autothrottle are not useable. The CDUs supply route data to their respective ND. Alternate navigation using CDUs is discussed in Section 50 of this chapter.

Note: If the MENU page displays and the <FMC prompt is not displayed in line 1, pushing the LEGS function key displays the ALTN NAV LEGS page, the PROG key displays the ALTN NAV PROGRESS page, and the NAV RAD key displays the ALTN NAV RADIO page.

Introduction

Completion of the FMC preflight requires data entry in all minimum required data locations. Entry of all required and optional preflight data optimizes FMC accuracy.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
Datalink can load preflight data from airline ground stations. Using datalink reduces the number of required flight crew actions. Manual flight crew entries replace existing data. Datalink can also load takeoff data onto the TAKEOFF REF pages.

FMS-CDU Operation

Work in a slow, deliberate manner while operating the CDU. Avoid pushing more than one key at a time. Avoid entering information in both CDUs at the same time. Do not push keys when the system is resynchronizing. Resynchronizations complete in approximately 15 seconds. During this time, the respective CDU displays a failed condition, while the other CDU displays the message RESYNCHING OTHER FMC.

Uncareted, small font, or default values are not required to be line-selected to be valid. For example, acceleration heights and the thrust reduction point on the Takeoff Ref page are valid in small font.

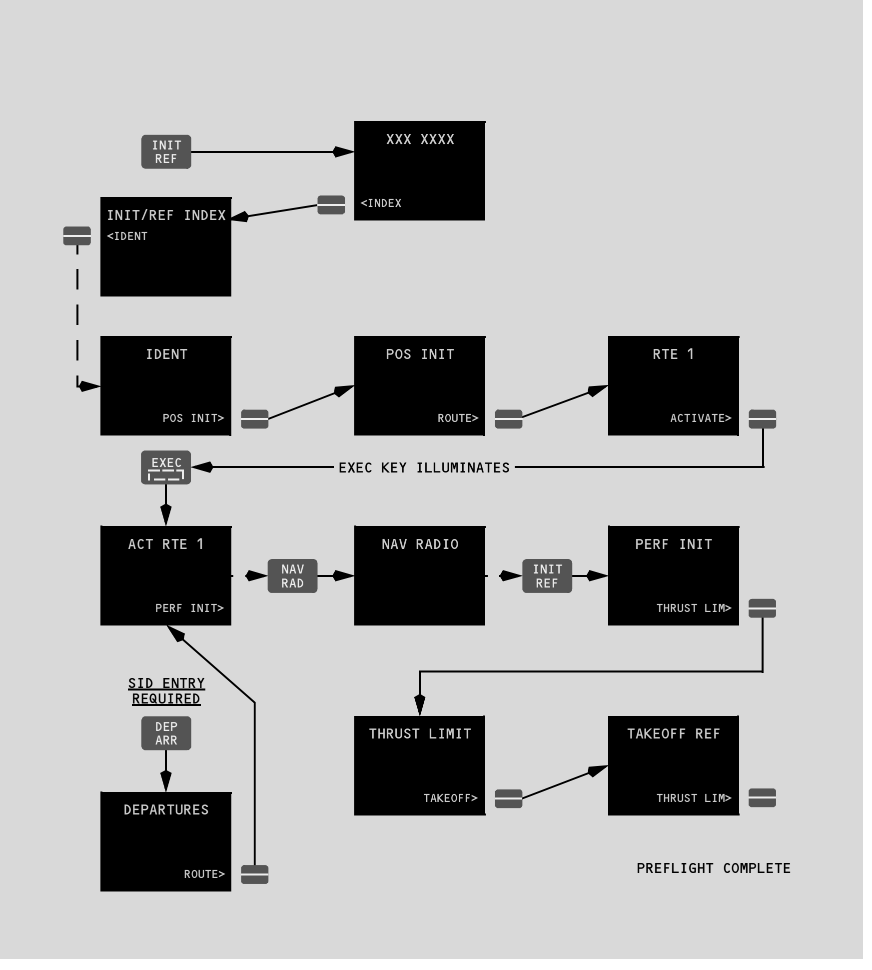
Preflight Page Sequence

The usual FMC power-up page is the identification page. Preflight flow continues in this sequence:

- identification (IDENT) page
- position initialization (POS INIT) page
- route (RTE) page
- DEPARTURES page (no prompt)
- navigation radios (NAV RAD) page (no prompt)
- performance initialization (PERF INIT) page
- thrust limit (THRUST LIM) page
- takeoff reference (TAKEOFF REF) page

Some of these pages are also used in flight.

Minimum Preflight Sequence



During preflight, a prompt in the lower right directs the flight crew through the minimum requirements for preflight completion. Selecting the prompt key displays the next page in the flow. If a required entry is missed, a prompt on TAKEOFF page leads the flight crew to the preflight page missing data.

FMC position is required for FMC preflight and flight instrument operation.

A route must be entered and activated. The minimum route data is origin and destination airports, and a route leg.

Performance data requires entry of airplane weights, fuel reserves, cost index, and cruise altitude.

Takeoff data requires a flap setting and center of gravity.

Supplementary Pages

Supplementary pages are sometimes required. These pages have no prompts and interrupt the usual sequence. Discussion of each page includes a method to display the page.

When the route includes SIDs and STARs, they can be entered using the DEPARTURES or ARRIVALS pages.

Route discontinuities are removed and the route is modified on the ROUTE and RTE LEGS pages. Speed/altitude restrictions are entered and removed on the RTE LEGS page. RTE LEGS page is described in the FMC Takeoff and Climb section of this chapter.

Waypoint, navigation, airport, and runway data is referenced on REF NAV DATA page. REF NAV DATA page is described in the FMC Cruise section of this chapter.

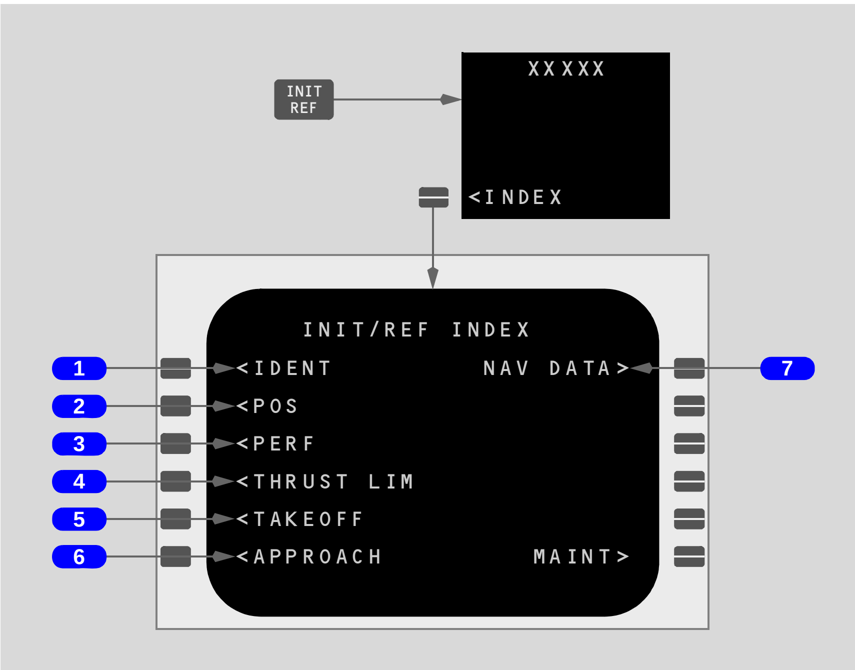
VNAV performance is improved if forecast winds and temperatures are entered during the preflight. Wind and temperature data for specific waypoints is entered on the the WIND page. WIND page is described in the FMC Cruise section of this chapter.

Preflight Pages - Part 1A

Preflight pages are presented in the sequence used during a typical preflight.

Initialization/Reference Index Page

Initialization/reference index page allows manual selection of FMC pages. It gives access to pages used during preflight and not usually used in flight.



1 Identification (IDENT)

IDENT page is used to verify basic airplane data and currency of the navigation database.

2 Position (POS)

POS INIT page is used for IRU initialization.

3 Performance (PERF)

PERF INIT page is used for initialization of data required for VNAV operations and performance predictions.

4 Thrust Limit (THRUST LIM)

THRUST LIM page is used to select thrust limits and derates.

5 TAKEOFF

TAKEOFF REF page is used to enter takeoff reference data and V speeds.

6 APPROACH

APPROACH REF page displays approach planning data and is used to enter the approach VREF speed.

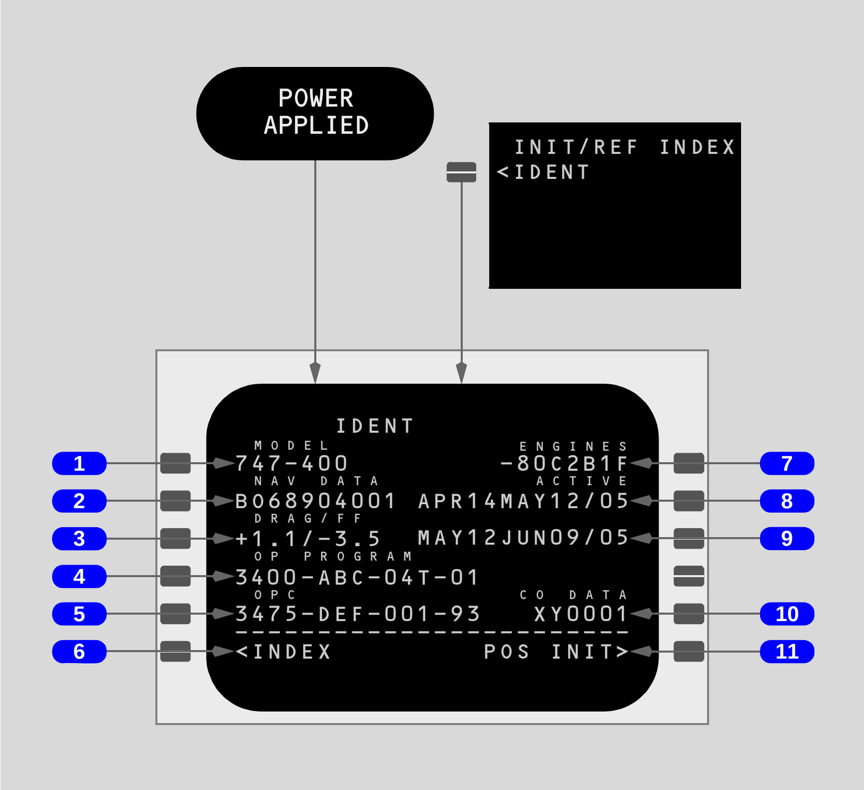
7 Navigation Data (NAV DATA)

REF NAV DATA page is used for data on waypoints, navaids, airports, and runways. The REF NAV DATA page is accessible only from this page.

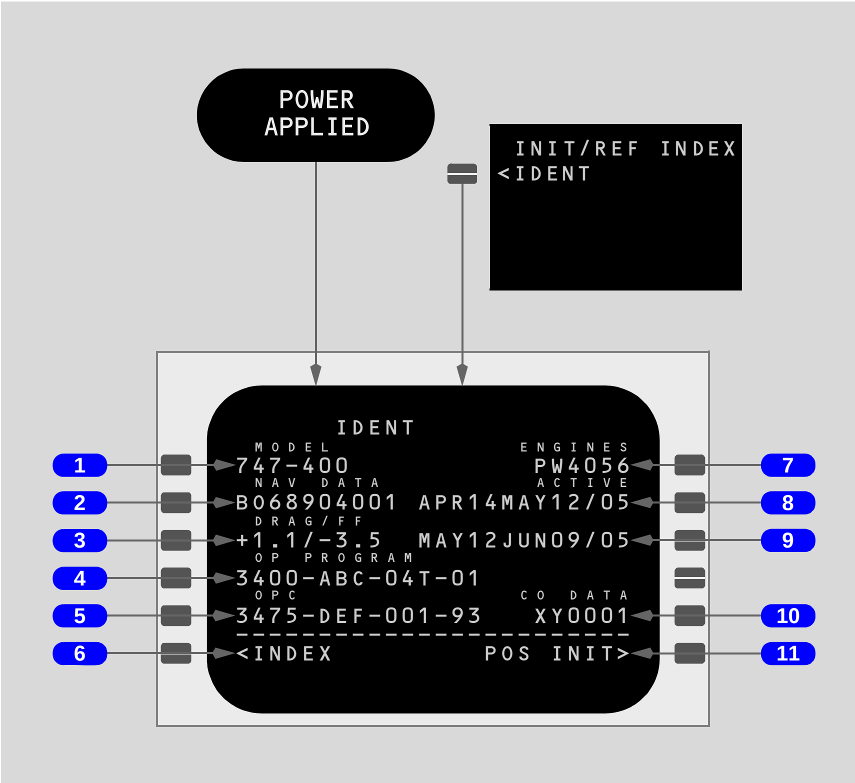
Identification Page

Most data on this page is for flight crew verification. The active navigation database can be selected.

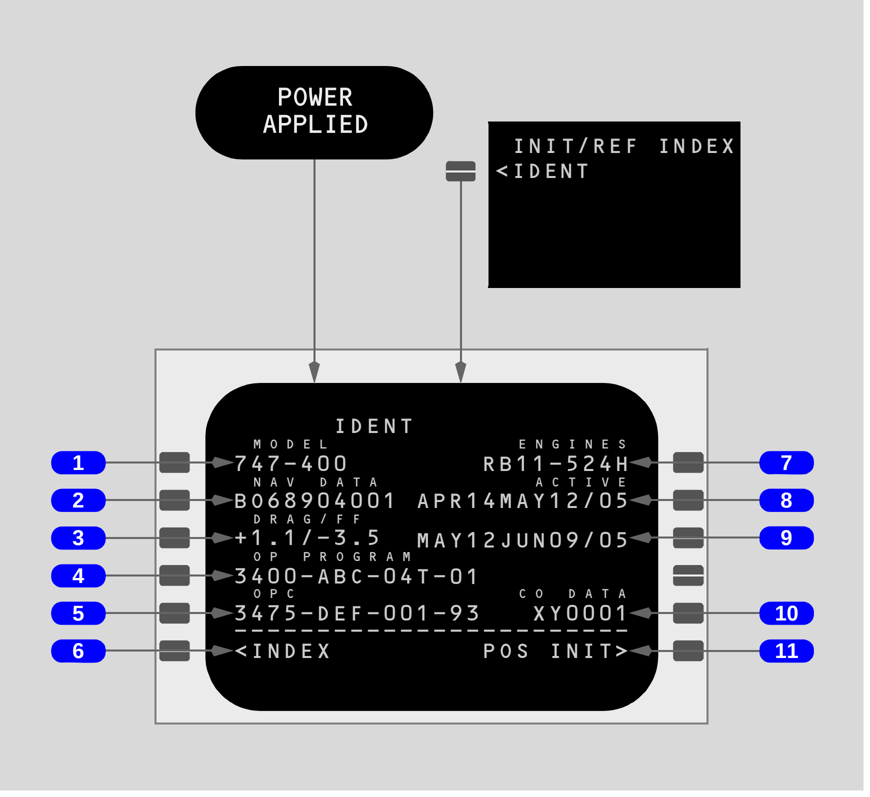
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 MODEL

Displays airplane model from FMC performance database.

2 Navigation Data (NAV DATA)

Displays navigation database identifier.

3 DRAG/Fuel Flow (FF)

Displays airplane drag and fuel flow correction factors.

4 Operating (OP) PROGRAM

Displays systems operating program identifier (FMC software load).

5 Operational Program Configuration (OPC) Number

Displays the operational program configuration (OPC) part number.

6 **INDEX**

Push - displays INIT/REF INDEX page.

7 **ENGINES**

Displays engine model from the FMC performance database.

8 **ACTIVE**

Displays the effectivity date range for the active navigation database.

The active navigation database may be out of date. It can be changed to the inactive navigation database. Pushing the date range prompt of the inactive navigation database copies that date into the scratchpad. Pushing the date range prompt of the active navigation database transfers the scratchpad date to the ACTIVE database line. The previous active date moves to the inactive date line.

The line title ACTIVE is above the active navigation database date. No line title is above the inactive navigation database date. The navigation database date can only be changed on the ground. Changing the navigation database removes all previously entered route data.

When an active database expires in flight, the expired database is used until the active date is changed after landing.

9 **Inactive Date Range**

Displays the effectivity date range for the inactive navigation database. The inactive database becomes effective at 0901Z on the respective day.

10 **Company (CO) DATA**

Displays airline policy file identifier.

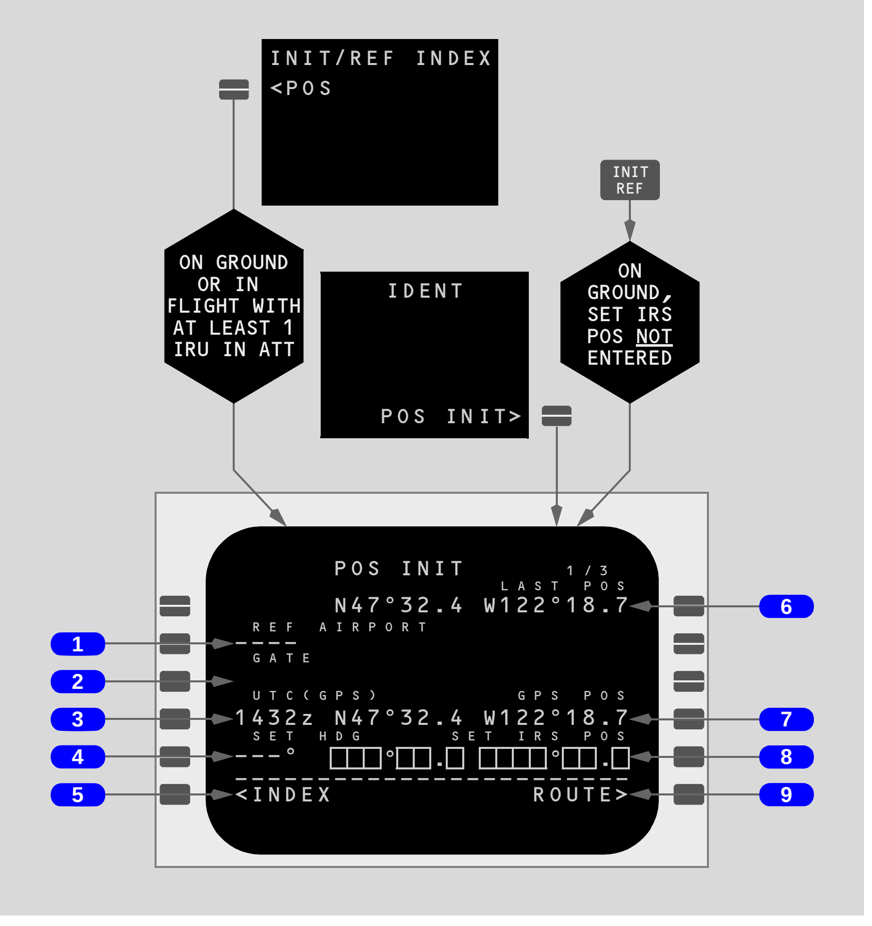
11 **Position Initialization (POS INIT)**

Push - displays POS INIT page.

Position Initialization Page 1/3

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

Position initialization page allows entry of airplane present position for IRU alignment. The same page is used to enter the heading for IRUs in attitude mode.



1 Reference (REF) AIRPORT

Entry of the reference airport displays airport latitude/longitude.

Valid entries are ICAO four letter airport identifiers.

Entry blanks at lift-off.

2 GATE

Gate entry allows further refinement of the latitude/longitude position.

Valid entry is a gate number at the reference airport.

Displays latitude and longitude of the reference airport gate.

Changes to dashes when a new reference airport entered.

Entry blanks at lift-off.

3 UTC

UTC (GPS) - displays time from a GPS sensor.

UTC (MAN) -

- displays time from Captain’s clock when operative; otherwise, displays time from F/O’s clock
- time set by resetting appropriate pilot’s clock

4 SET Heading (HDG)

Dashes display if an IRU is in attitude mode.

Entering heading updates IRS magnetic heading signal for all IRUs in attitude mode.

Valid entry is 0 to 360 (0 or 360 is shown as 360°). Dashes display two seconds after entry to allow another entry.

5 INDEX

Push - displays INIT/REF INDEX page.

6 LAST Position (POS)

Displays the last FMC calculated position.

7 GPS Position (POS)

Displays GPS position. During preflight, GPS POS may not display due to satellite availability, performance, or unfavorable geometry.

8 SET IRS Position (POS)

IRS position entry is required to initialize the IRUs.

Enter airplane position latitude and longitude. Select the most accurate latitude/longitude from LAST POS, REF AIRPORT, GATE, GPS POS, or make a manual entry.

If an entry is not made before the IRUs finish initial alignment, the scratchpad message ENTER IRS POSITION displays. If an entry has been made and the message displays, check the accuracy of the entered position for each IRU on the POS REF page and enter again even if positions are correct.

Boxes display when any IRU in align mode and present position not entered.

Blank except when an IRU in align mode.

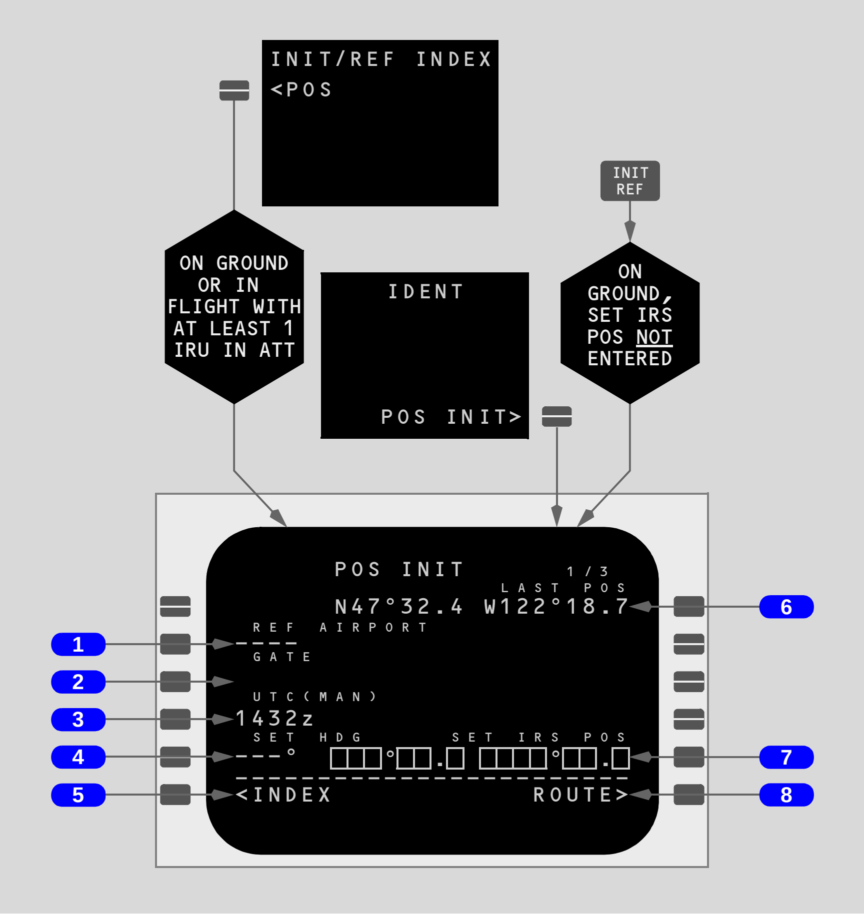
9 ROUTE

Push - displays the ROUTE page.

Position Initialization Page 1/3

VP-BKJ, VP-BVR

Position initialization page allows entry of airplane present position for IRU alignment. The same page is used to enter the heading for IRUs in attitude mode.



1 Reference (REF) AIRPORT

Entry of the reference airport displays the airport latitude/longitude.

Valid entries are ICAO four letter airport identifiers.

Entry blanks at lift-off.

2 GATE

Gate entry allows further refinement of the latitude/longitude position.

Valid entry is a gate number at the reference airport.

Displays the latitude and longitude of the reference airport gate.

Changes to dashes when a new reference airport entered.

Entry blanks at lift-off.

3 UTC

UTC (MAN) -

- displays time from Captain's clock when operative; otherwise, displays time from F/O's clock
- time set by resetting appropriate pilot's clock

4 SET Heading (HDG)

Dashes display if an IRU is in attitude mode.

Entering heading updates IRS magnetic heading signal for all IRUs in attitude mode.

Valid entry is 0 to 360 (0 or 360 is shown as 360°). Dashes display two seconds after entry to allow another entry.

5 INDEX

Push - displays INIT/REF INDEX page.

6 LAST Position (POS)

Displays the last FMC calculated position.

7 Set IRS Position (POS)

IRS position entry is required to initialize the IRUs.

Enter airplane position latitude and longitude. Select the most accurate latitude/longitude from LAST POS, REF AIRPORT, GATE, or a manual entry.

If an entry is not made before the IRUs finish initial alignment, the scratchpad message ENTER IRS POSITION displays.

Boxes display when any IRU in align mode and present position not entered.

Blank except when an IRU in align mode.

8 ROUTE

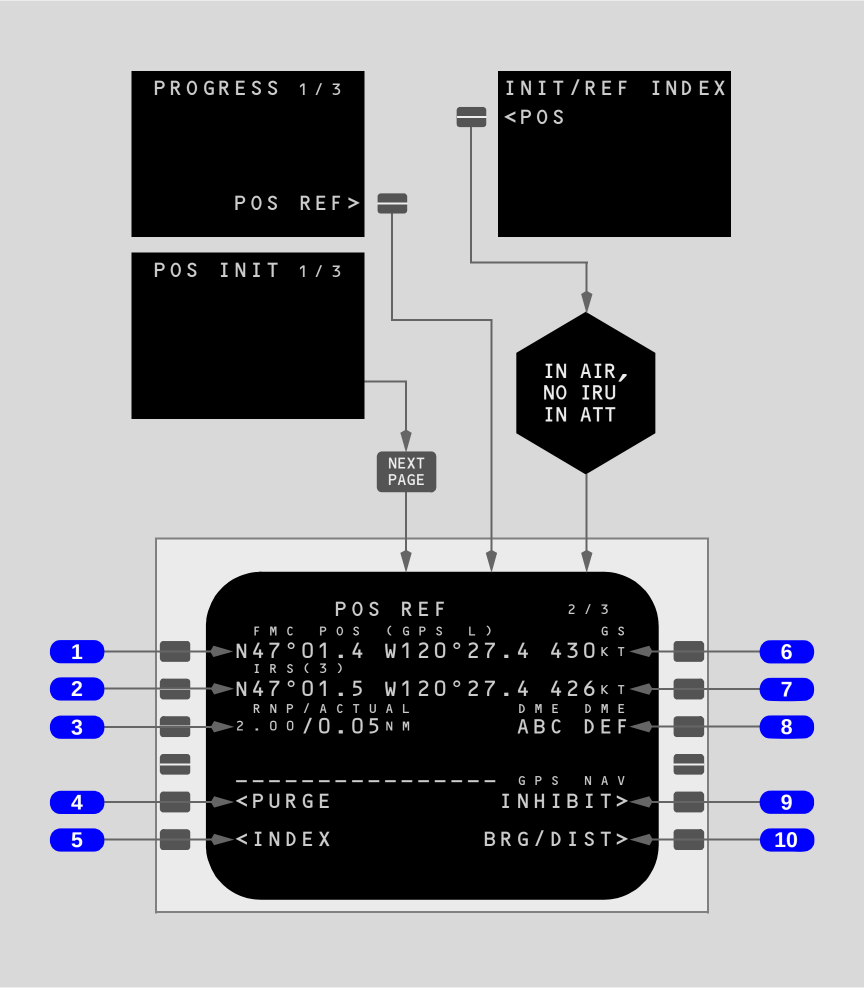
Push - displays the ROUTE page.

Position Reference Page 2/3

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

Position reference page 2 displays the position and ground speed calculated by the FMC and IRS.

GPS position updating can be enabled and inhibited and radio and GPS updates to the FMC position can be purged on this page. The IRS position can be changed to bearing/distance.



1 FMC Position (POS)

Displays the FMC calculated latitude/longitude position.

Line title identifies the source for calculating the FMC position:

- GPS L, GPS R - FMC calculates position using GPS data
- RADIO - FMC calculates position using navigation radio data
- LOC-GPSL, LOC-GPSR - FMC calculates position using localizer and GPS data
- LOC-DD - FMC calculates position using localizer and DME data
- LOC-VD - FMC calculates position using localizer, VOR, and DME data
- LOC - FMC calculates position using localizer data

Displays IRS (X) position when CONFIRM displayed in purge line; becomes active FMC position if purge is confirmed.

2 IRS

Displays the IRS latitude/longitude position.

Following selection of BRG/DIST, displays bearing/distance of IRS position from FMC position.

Blank when FMC receiving no valid IRU data.

3 Required Navigation Performance and Actual Navigation Performance (RNP /ACTUAL)

Displays the RNP and actual navigational performance (ACTUAL) of the FMC. Displays IRS (X) position accuracy when CONFIRM displayed in purge line.

Default RNP is in small font. Manual RNP entry displays in large font; entries clear at flight completion. Deletion of manual entry returns display to default RNP.

Valid RNP entries are in the range 0.01 to 99.9. ACTUAL entry not allowed.

Note: The FMC stops GPS updates if the GPS ACTUAL is twice the RNP. This occurs if the GPS ACTUAL has increased or the flight crew inputs a small RNP value. Subsequently, the FMC changes updates to another system.

4 PURGE

Push -

- displays mixed IRS position on the FMC POS line. Line title displays PURGE ARMED and data line displays CONFIRM
- selection of CONFIRM replaces FMC position with mixed IRS position. FMC resumes radio updating when valid stations available. Line title blanks and PURGE prompt displays

Leaving this page on both CDUs with CONFIRM displayed returns the initial display.

5 INDEX

Push - displays INIT/REF INDEX page.

6 GPS Ground Speed (GS)

Displays GPS ground speed.

7 IRS Ground Speed (GS)

Displays IRS ground speed.

Blank if ground speed from IRUs is not valid.

IRU values frozen at engine shutdown; frozen values display until power cycled off to both FMCs or until ground speed exceeds 40 knots.

8 Navigation Station

Displays indentifiers of navigation stations in use by FMC for radio position computation.

Line title displays type of radio station, DME-DME or VOR-DME.

Line title displays NAV STA and data line blanks when no radio position computation occurring.

9 GPS Navigation (NAV)

Initially displays INHIBIT. GPS data enabled for FMC position updating.

Push -

- inhibits GPS data for FMC position updating and displays ENABLE. Inhibiting retained through power interruption
- selection when ENABLE displayed enables GPS data for FMC position updating and displays INHIBIT. Defaults to INHIBIT following flight completion

10 Bearing/Distance (BRG/DIST) or Latitude/Longitude (LAT/LON)

Initially displays BRG/DIST.

Push -

- displays bearing/distance in IRS (X) line relative to FMC position and displays LAT/LON
- if distance is zero, bearing displays 000
- selection when LAT/LON displayed or leaving the POS REF pages on both CDUs returns displays to latitude/longitude and BRG/DIST

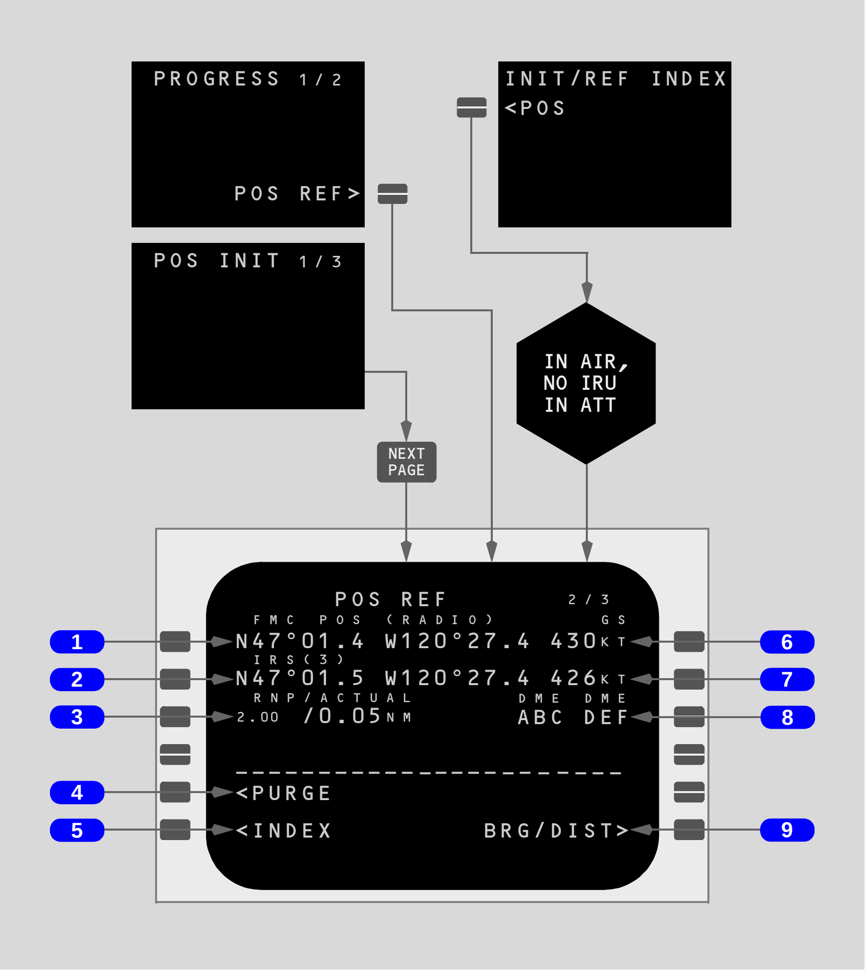
The page illustration is shown in the latitude/longitude display format.

Position Reference Page 2/3

VP-BKJ, VP-BVR

Position reference page 2 displays the position and ground speed calculated by the FMC and IRS.

Radio updates to the FMC position can be purged on this page. The IRS position can be changed to bearing/distance.



1 FMC Position (POS)

Displays the FMC calculated latitude/longitude position.

Line title identifies the source for calculating the FMC position:

- RADIO - FMC calculates position using navigation radio data
- LOC-DD - FMC calculates position using localizer and DME data
- LOC-VD - FMC calculates position using localizer, VOR, and DME data
- LOC - FMC calculates position using localizer data

Displays IRS (X) position when CONFIRM displayed in purge line; becomes active FMC position if purge is confirmed.

2 IRS

Displays the IRS latitude/longitude position.

Following selection of BRG/DIST, displays bearing/distance of IRS position from FMC position.

Blank when FMC receiving no valid IRU data.

3 Required Navigation Performance and Actual Navigation Performance (RNP /ACTUAL)

Displays the RNP and actual navigational performance (ACTUAL) of the FMC. Displays IRS (X) position accuracy when CONFIRM displayed in purge line.

Default RNP is in small font. Manual RNP entry displays in large font. Deletion of manual entry returns display to default RNP.

Valid RNP entries are in the range 0.01 to 99.9. ACTUAL entry not allowed.

4 PURGE

Push -

- displays mixed IRS position on the FMC POS line. Line title displays PURGE and data line displays CONFIRM
- selection of CONFIRM replaces FMC position with mixed IRS position. FMC resumes radio updating when valid stations available. Line title blanks and PURGE prompt displays

Leaving this page on both CDUs with CONFIRM displayed returns the initial display.

5 INDEX

Push - displays INIT/REF INDEX page.

6 FMC (Radio) Ground Speed (GS)

Displays FMC (radio) ground speed.

7 IRS Ground Speed (GS)

Displays IRS ground speed.

Blank if ground speed from IRUs is not valid.

IRU values frozen at engine shutdown; frozen values display until power cycled off to both FMCs or until ground speed exceeds 40 knots.

8 Navigation Station

Displays indentifiers of navigation stations in use by FMC for radio position computation.

Title line displays type of radio station, DME-DME or VOR-DME.

Title line displays NAV STA and data line blanks when no radio position computation occurring.

9 Bearing/Distance (BRG/DIST) or Latitude/Longitude (LAT/LON)

Initially displays BRG/DIST.

Push -

- displays bearing/distance in IRS (X) line relative to FMC position and displays LAT/LON
- if distance is zero, bearing displays 000
- selection when LAT/LON displayed or leaving the POS REF pages on both CDUs returns displays to latitude/longitude and BRG/DIST

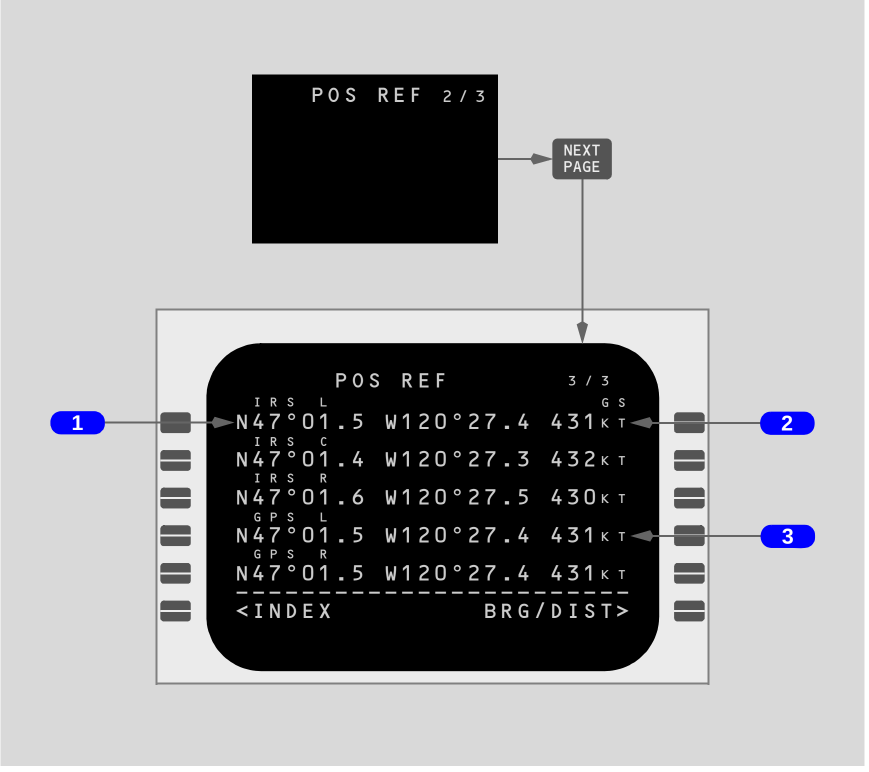
The page illustration is shown in the latitude/longitude display format.

Position Reference Page 3/3

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

On position reference page 3, the flight crew can observe the positions and ground speed from the GPS receivers and the IRUs.

This page can be displayed in the bearing/distance or latitude/longitude format. The bearing/distance format displays the bearing and distance of the position sources relative to the active FMC position on POS REF 2/3 page.



1 IRU, GPS Position

Displays position computed by related system.

GPS data blanks if GPS unavailable or inhibited.

2 IRS Ground Speed (GS)

Displays IRS ground speed.

Blank if ground speed from IRUs is not valid.

IRU values frozen at engine shutdown; frozen values display until power cycled off to both FMCs or until ground speed exceeds 40 knots.

3 GPS Ground Speed (GS)

Displays GPS ground speed.

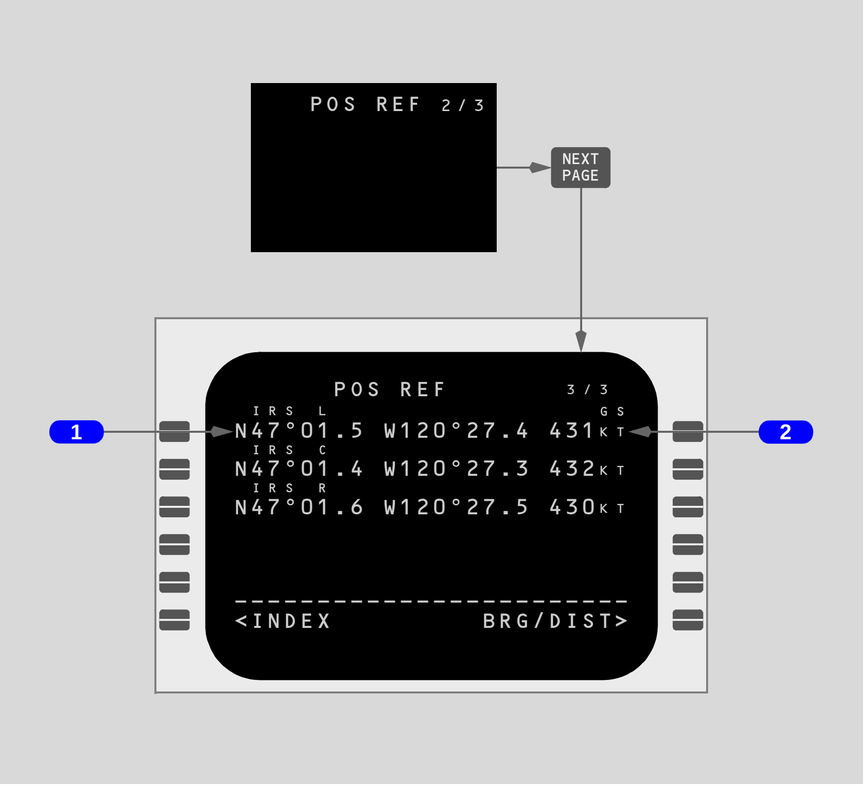
GPS data blanks if GPS unavailable or inhibited.

Position Reference Page 3/3

VP-BKJ, VP-BVR

On position reference page 3, the flight crew can observe positions and ground speed from the IRUs.

This page can be displayed in the latitude/longitude or bearing/distance format. The bearing/distance format displays the bearing and distance of the position sources relative to the active FMC position on POS REF 2/3 page.



1 IRU Position Lines

Displays current position computed by indicated system.

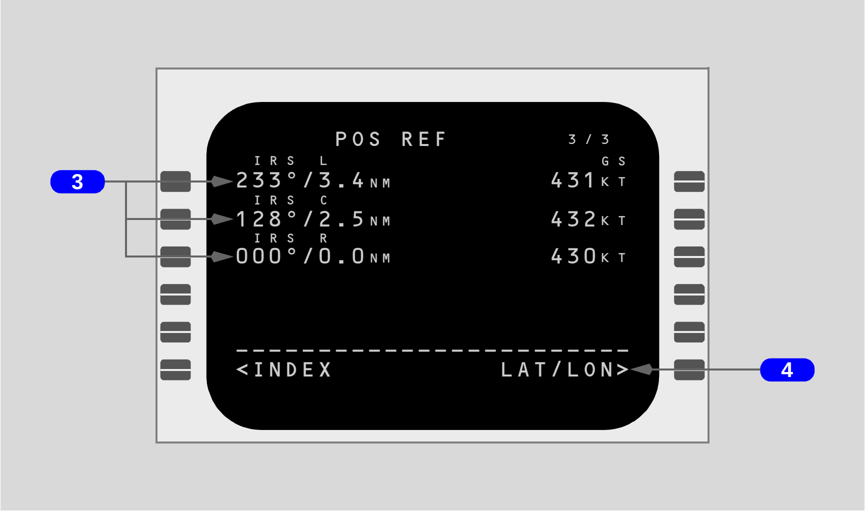
Positions may be selected to scratch pad.

2 IRS Ground Speed Lines

Displays IRS ground speed.

Blank if ground speed from IRUs is not valid.

IRU values frozen at engine shutdown; frozen values display until power cycled off to both FMCs or until ground speed exceeds 40 knots.



3 IRU Relative Positions

Displays current position relative to FMC position.

If distance is zero, bearing displays 000.

4 Latitude/Longitude (LAT/LON)

Displays after BRG/DIST line select key pushed.

Selection changes prompt to BRG/DIST for return to bearing distance display format.

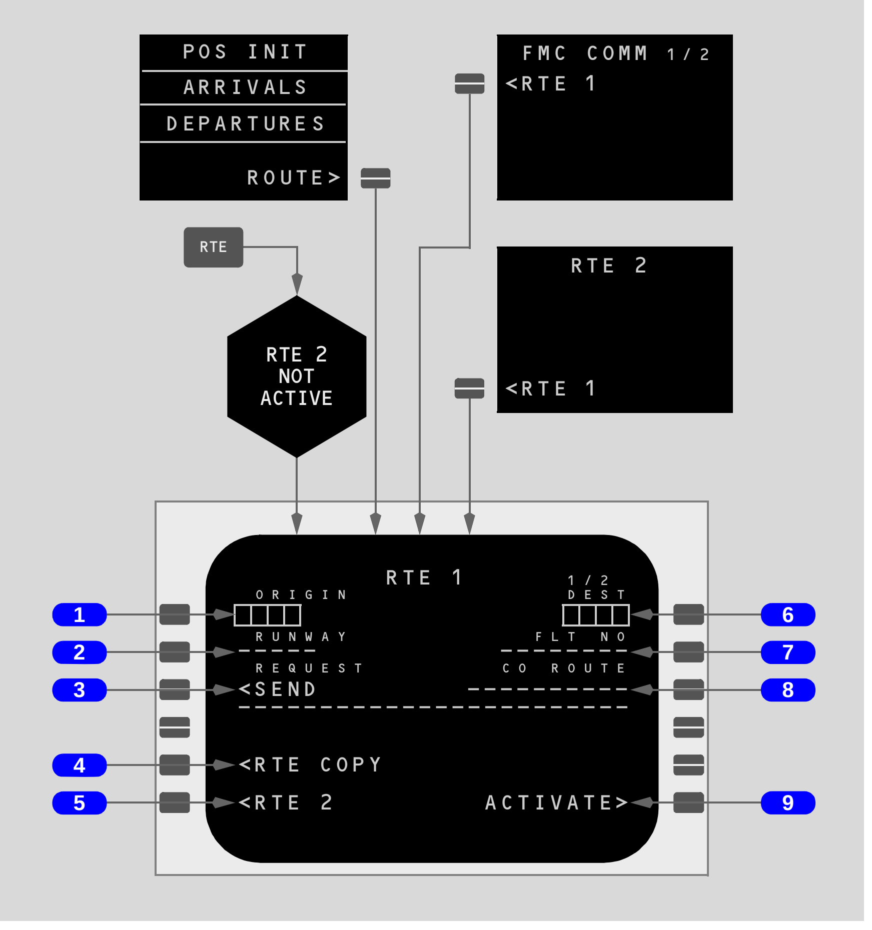
Preflight Pages - Part 1B
Route Page 1/X

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS and AOC)

Two routes (RTE 1 and RTE 2) can be displayed in air traffic control format. Routes can be entered by the flight crew or uplinked through datalink. All routes have two or more pages. The first route page displays origin and destination data. Subsequent route pages display the route segments between waypoints or fixes. ROUTE 1 and ROUTE 2 allow management of alternate or future routes while leaving the active route unmodified. ROUTE 2 has an identical page structure as ROUTE 1. The minimum number of route pages is 2.

When RTE 2 is active, page display logic is the same as RTE 1.

Active Route With Uplink Pending



1 ORIGIN

Valid entries are ICAO airport identifiers in the navigation database.

On the ground, entry of a new origin erases the previous route. In flight, entries are valid on the inactive route.

Enables selection of departure and arrival procedures for the origin airport.

Automatically entered as part of a company route.

2 RUNWAY

Valid entries are origin airport runways in the navigation database.

Automatically entered when part of a company route.

Can be selected on DEPARTURES page.

FMC deletes runway after sequencing the first waypoint.

3 Route REQUEST

Line title displays REQUEST. Line title blank if flight plan load pending.

Flight crew can fill in origin, destination, runway, flight number, company route name, or route definition to qualify request.

Push -

- transmits datalink request for a flight plan route uplink
- data line displays SENDING
- upon acknowledgement receipt, data line displays SENDsent

If data link fault occurs, title line displays DATA LINK, data line displays NO COMM, VOICE, or FAIL.

4 Route Copy (RTE COPY)

Push-

- displays when a route is active or is modified
- copies active route into the inactive route
- displays COMPLETE after the route is copied

5 RTE 2

Push -

- displays RTE 2 page 1/x
- data line displays RTE 1

6 Destination (DEST)

Valid entries are ICAO airport identifiers in the navigation database.

Enables selection of arrival procedures for the destination airport.

Automatically entered as part of a company route.

7 Flight Number (FLT NO)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLG, EI-XLH, EI-XLI, EI-XLK, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
Valid entry is any flight crew entered or uplinked company flight number.

EI-XLF, EI-XLJ, EI-XLL, EI-XLM, EI-XLN, EI-XLO
Valid entry is any flight crew entered or uplinked company flight number. FMC sends flight number to each ATC transponder for flight ID function.

Flight crew entered or uplinked.

Flight number displays in PROGRESS page title.

Data line blanks at flight completion.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
(EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX ; SB installs enhanced Mode S transponder capability)
Transponder transmits flight number to ATC when Eurocontrol-compliant transponder installed.

8 Company (CO) ROUTE

A company route can be called from the navigation database by entering the route identifier. The data supplied with a company route can include origin and destination airports, departure runway, SID and STAR, and route of flight. All company route data is entered when the route identifier is entered.

Valid entry is any flight crew entered or uplinked company route name. If the name is not contained in the NAV database, entry is allowed and the scratchpad message NOT IN DATABASE displays.

On the ground, entry of a new company route replaces the previous route.

In flight, entry of a new company route manually, or as a result of a route request downlink, may only be accomplished into the inactive route.

9 ACTIVATE

Displays on inactive route pages.

Activation of a route is required for completion of the preflight.

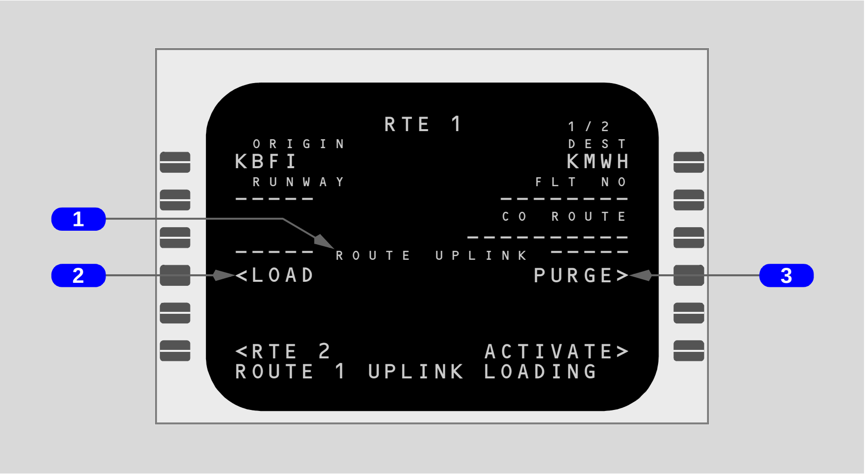
Push - arms the selected route for execution as the active route.

When the EXECUTE key is pushed, the route becomes the active route and the ACTIVATE prompt is replaced with the next required preflight page prompt.

After route activation, the ACTIVATE prompt is replaced by:

- PERF INIT, when the required performance data is incomplete, or
- TAKEOFF when the required performance data is complete

Active Route After Ground Station Uplink



1 **ROUTE UPLINK**

Displays ROUTE UPLINK when flight plan uplink received; otherwise, dashes.

2 **LOAD**

Displays LOAD when uplink received and passes error check.

PUSH -

- loads uplinked flight plan
- in flight, when uplinked flight plan applies to active route, EXECUTE light illuminates and ERASE displays at 6L
- when route inactive, blanks PURGE at 4R
- displays scratchpad message ROUTE 1 UPLINK LOADING

3 **PURGE**

Displays PURGE when an uplink has been received, passes an error check, and applies to an inactive route.

Push - rejects uplinked flight plan data.

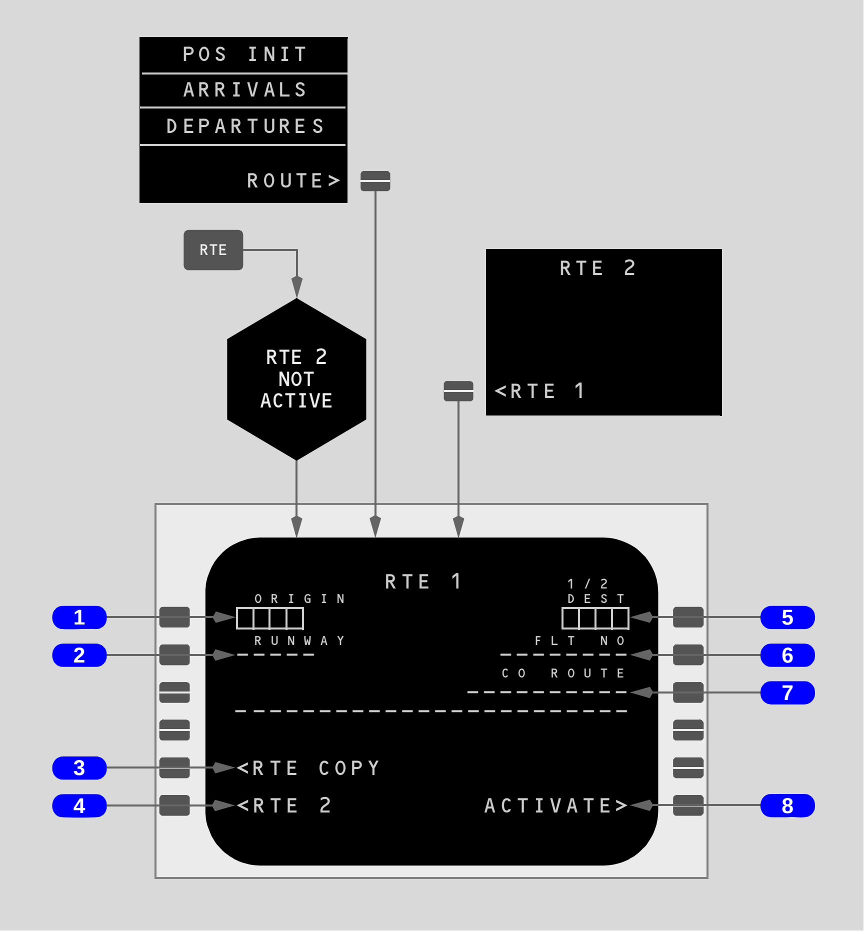
Route Page 1/X

VP-BKJ, VP-BVR
(VQ-BHW, VQ-BHX ; before SB, ATS and AOC not active)

Two routes (RTE 1 and RTE 2) can be displayed in air traffic control format. All routes have two or more pages. The first route page displays origin and destination data. Subsequent route pages display the route segments between waypoints or fixes. ROUTE 1 and ROUTE 2 allow management of alternate or future routes while leaving the active route unmodified. ROUTE 2 has an identical page structure as ROUTE 1. The minimum number of route pages is 2.

When RTE 2 is active, page display logic is the same as RTE 1.

Active Route Ready For Entry



1 ORIGIN

Valid entries are ICAO airport identifiers in the navigation database.

On the ground, entry of a new origin erases the previous route. In flight, entries are valid on the inactive route.

Enables selection of departure and arrival procedures for the origin airport.

Automatically entered as part of a company route.

2 RUNWAY

Valid entries are origin airport runways in the navigation data base.

Automatically entered when part of a company route.

Can be selected on DEPARTURES page.

FMC deletes runway after sequencing the first waypoint.

3 Route Copy (RTE COPY)

Push-

- displays when a route is active or is modified
- copies active route into the inactive route
- displays COMPLETE after the route is copied

4 RTE 2

Push -

- displays RTE 2 page 1/x
- data line displays RTE 1

5 Destination (DEST)

Valid entries are ICAO airport identifiers in the navigation database.

Enables selection of arrival procedures for the destination airport.

Automatically entered as part of a company route.

6 Flight Number (FLT NO)

Valid entry is any flight crew entered flight number.

Flight crew entered or uplinked.

Flight number displays in PROGRESS page title.

Data line blanks at flight completion.

(VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX ; SB installs enhanced Mode S transponder capability)
Transponder transmits flight number to ATC when Eurocontrol-compliant transponder installed.

7 Company (CO) ROUTE

A company route can be called from the navigation database by entering the route identifier. The data supplied with a company route can include origin and destination airports, departure runway, SID and STAR, and route of flight. All company route data is entered when the route identifier is entered.

Valid entry is any flight crew entered company route name. If the name is not contained in the NAV database, the entry is allowed and the scratchpad message NOT IN DATABASE displays.

On the ground, entry of a new company route replaces the previous route.

In flight, entry of a new company route manually may only be accomplished into the inactive route.

8 ACTIVATE

Displays on inactive route pages.

Activation of a route is required for completion of the preflight.

Push - arms the selected route for execution as the active route.

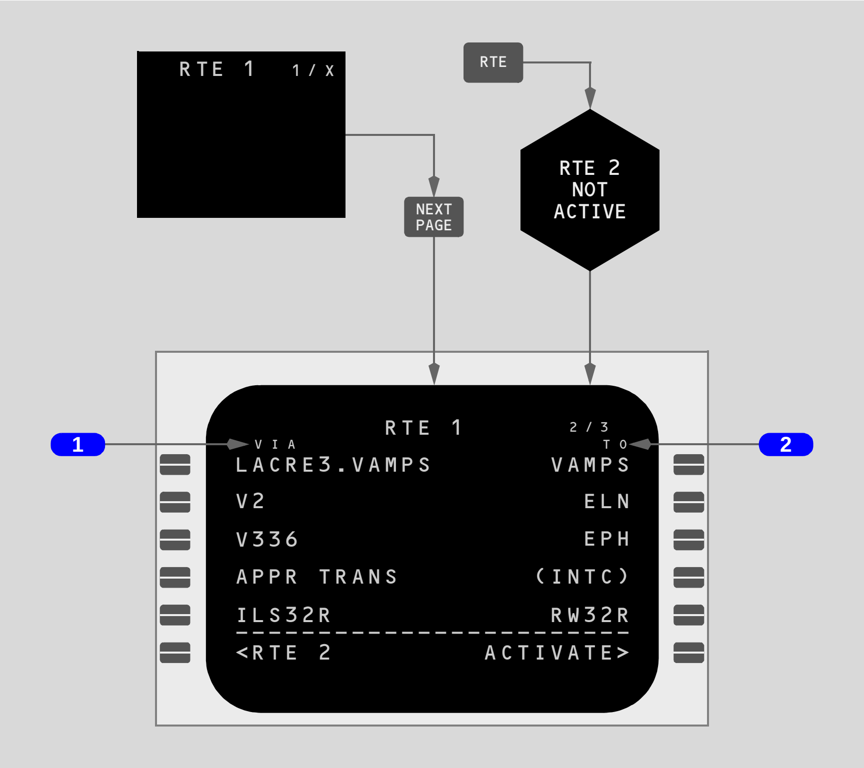
When the EXECUTE key is pushed, the route becomes the active route and the ACTIVATE prompt is replaced with the next required preflight page prompt.

After route activation, the ACTIVATE prompt is replaced by:

- PERF INIT, when the required performance data is incomplete, or
- TAKEOFF when the required performance data is complete

Route Page 2/X

Subsequent route pages 2/X through X/X show the route segments in air traffic control format. Route segments are defined as direct routing, airways, or procedures with start and end points such as waypoints, fixes, navaids, airports, or runways. More waypoints for each route segment display on the RTE LEGS page.



1 VIA

VIA column displays the route segment to the waypoint or termination in the TO column.

Entry of an airway in the VIA column displays boxes in the TO column.

Valid entries can also include procedures or DIRECT. Procedures are usually entered through selections on DEPARTURES and ARRIVALS pages. DIRECT usually results from entering a TO waypoint first.

Valid airways must:

- contain the fix entered in the TO waypoint, and
- contain the previous TO waypoint, or
- intersect the previous VIA route segment

Dashes change to DIRECT if entering the TO waypoint first.

Dashes display for the first VIA beyond the end of the route.

Invalid VIA entries display the scratchpad message INVALID ENTRY.

Invalid VIA entries are:

- airways and company routes which do not contain the TO waypoint of the previous line
- airways not intersecting the previous airway
- airways or company routes not in the navigation database

Entry of a SID or transition enters the VIA and TO data for the route segments of the SID. A SID links to the next route segment when the final SID waypoint is part of the route segment.

When no SID is used, entering an airway on the first line of page 2 initiates an airway intercept and displays boxes in the first line TO waypoint. Entering a waypoint in the boxes:

- replaces the airway with dashes in the first VIA line
- enters the fix preceding the nearest abeam location on the airway in the TO waypoint
- moves the airway to line 2

A route can contain segments formed by the intersection of two airways. Entering two intersecting airways in successive VIA lines without a TO waypoint causes the FMC to create an airway intersection waypoint. The FMC created waypoint intersection (INTC) displays as the first airway segment TO waypoint.

LACRE3.VAMPS is an example of a SID selection made on the DEPARTURES page.

V2 and V336 are examples of airway entries.

APP TRANS is an example of a transition selection made on the APPROACH page.

ILS32R is an example of an approach selection made on the APPROACH page.

2 TO

TO column displays the selected end waypoint or termination of the route segment in the VIA columnn.

During preflight when entering a runway on RTE page 1 and entering a waypoint in the TO column without first entering a VIA airway displays a DIRECT segment on the first VIA line from the runway threshold. When a runway has not been entered on RTE page 1, dashes display on the first VIA line.

Valid waypoint entries for a DIRECT route segment are any valid waypoint, fix, navaid, airport, or runway.

Valid waypoint entries for airways are waypoints or fixes on the airway.

Dashes display on the first TO waypoint after the end of the route.

Route Offset

Select route offsets on RTE page 1. The OFFSET prompt displays when the airplane is in flight and not on a SID, STAR, or transition. The offset route displays as a white dashed line on the ND until the offset modification is executed or erased. After execution, the offset route displays as a dashed magenta line. The original route continues to display as a solid magenta line. When executing the offset modification with LNAV active, the airplane turns to capture the offset course.

When on the route offset, active route waypoints sequence normally. However, during transition to or from an offset route greater than 21 nm, the crosstrack limit is extended to 200 nm.

1 Route Offset

Valid entry is L (left) or R (right) XX (XX is any number between 1 and 99).

Offset propagates along the route to a Standard Terminal Arrival Route (STAR), approach or approach transition, discontinuity, end of route, track change greater than 135 degrees, or holding pattern.

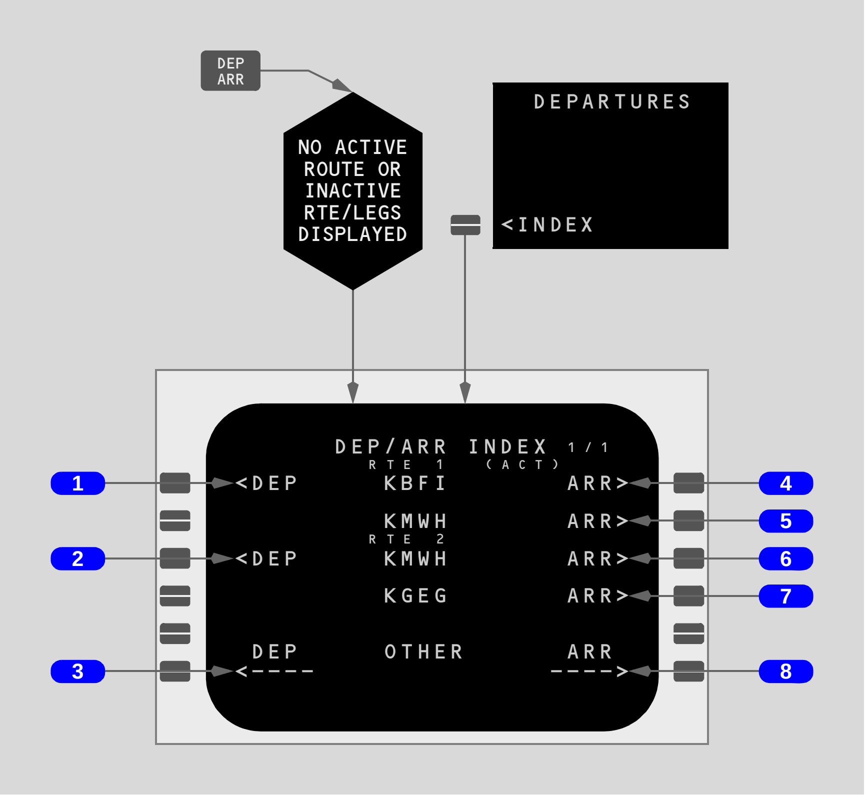
Offset removed by deleting, entering zero, or proceeding direct to a waypoint.

Preflight Pages - Part 1C

Departure/Arrival Index Page

Departure and arrival index page is used to select the departure or arrival page for the origin and destination airports for each route. The index page allows reference to departure or arrival data for any other airport in the navigation database.

Departure and arrival prompts are available for the origin airport. Destination airports have only arrival prompts.



1 Departure (DEP) - Route 1

Push - displays departure page for route 1 origin airport.

2 Departure (DEP) - Route 2

Push - displays departure page for route 2 origin airport.

3 Departure (DEP) -- Other

Displays departure page for the entered airport. Data can be viewed, but not selected because the airport is not in the route. Valid entry is four character ICAO airport identifier in the database.

4 Arrival (ARR) - Route 1 Origin

Push - displays arrival page for route 1 origin airport. Origin airport arrivals selection may be used during an air turnback.

5 Arrival (ARR) - Route 1 Destination

Push - displays arrival page for route 1 destination airport.

6 Arrival (ARR) - Route 2 Origin

Push - displays arrival page for route 2 origin airport. Origin airport arrivals selection may be used during an air turnback.

7 Arrival (ARR) - Route 2 Destination

Push - displays arrival page for route 2 destination airport.

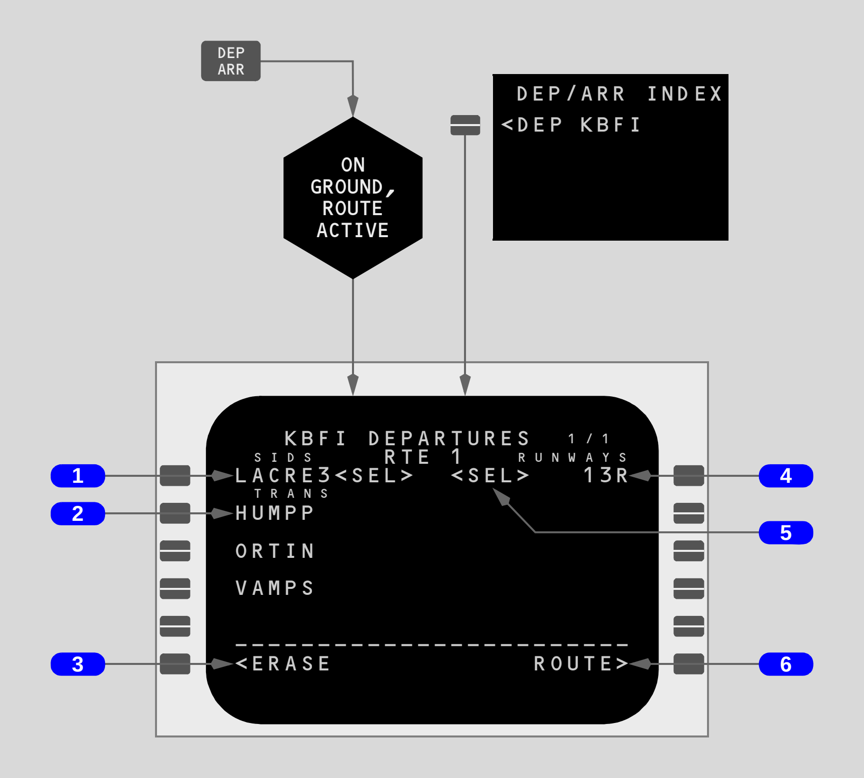
8 Arrival (ARR) - Other

Displays arrival page for the entered airport. Data can be viewed, but not selected because the airport is not on the route. Valid entry is four character ICAO airport identifier in the database.

Departures Page

The departures page is used to select the departure runway, SID, and transition for the route origin airport.

Pushing the DEP ARR function key displays the departures page for the inactive route when an inactive RTE or RTE LEGS page is displayed.



1 Standard Instrument Departures (SIDs)

Displays a list of SIDs for the airport.

Push -

- selects SID for use in the route
- other SIDs no longer display and transitions for the selected SID display
- runways for selected SID remain and others no longer display

2 Transitions (TRANS)

Displays transitions compatible with the selected SID.

Push -

- selects transition for entry into the route
- other transitions no longer display

3 ERASE, INDEX

ERASE displays when a route modification is pending. INDEX displays when no route modification pending.

ERASE -

Push - removes route modifications not executed and displays the original route.

INDEX -

Push - displays DEP/ARR INDEX page.

4 RUNWAYS

Displays a list of runways for the selected airport.

A runway selected on the RTE 1/X page displays as <SEL> or <ACT>.

Push -

- selects runway for use in the route. All other runways no longer display
- SIDs associated with selected runway remain, all others no longer display
- subsequent change of a runway deletes departure procedures previously selected

5 <SEL>, <ACT>

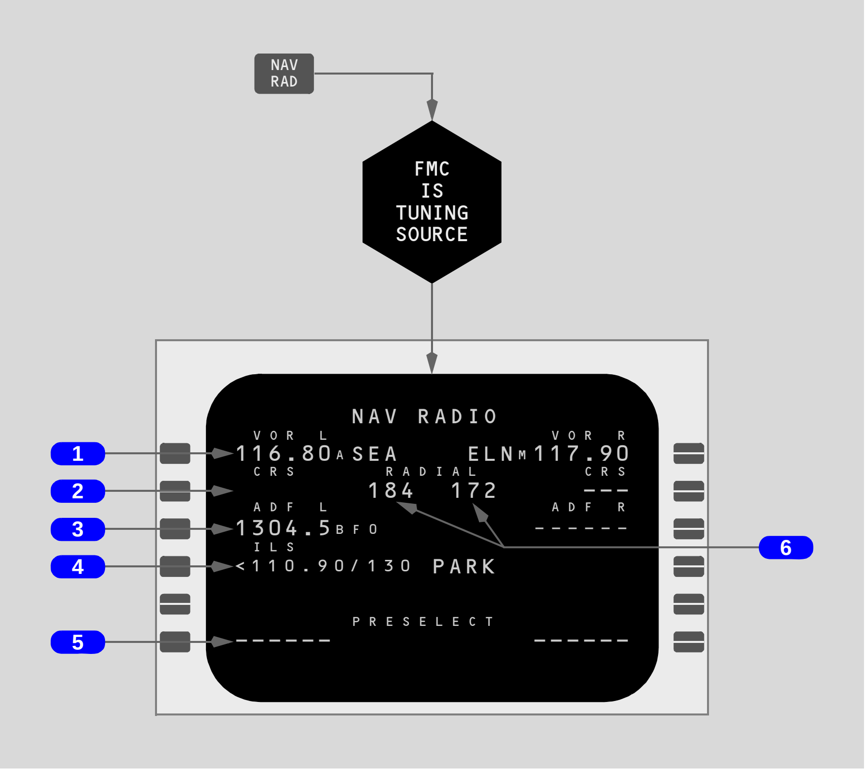
Selecting an option displays <SEL> inboard of the option and creates a route modification. After executing the modification, <SEL> becomes <ACT>. Executing a modification or leaving the page and returning displays all options and <SEL> or <ACT> prompts.

6 ROUTE

Push - displays the respective RTE page.

Navigation Radio Page

VOR and ILS navigation radios are normally autotuned by the FMC. ADF radios are manually tuned. NAV RADIO page displays the VOR, ILS, and ADF radio status and allows manual control of these radios. Entering data on this page tunes the selected navigation radio. VOR courses can also be entered.



1 VOR Frequency and Tune Status

Tuning status displays adjacent to left and right VOR frequencies. Entry of a frequency or identifier manual-tunes a VOR. FMC autotunes VORs for procedure flying and route operations. Tuning status displays are:

- P (procedure autotuning) - FMC selects navaids for approach or departure procedure guidance
- R (route autotuning) - FMC selects navaids on the active route. The navaid is the previous VOR or a downpath VOR within 250 nm of aircraft position
- A(autotuning) - FMC selects a navaid for best position orientation
- M (manual) - VOR is manual-tuned

Manual-tuning takes priority over FMC autotuning. Deletion of a manual-tuned frequency returns system to autotuning.

Valid entries:

- VOR or non-ILS DME identifier or VOR frequency (XXX.X or XXX.XX)
- VOR identifier or frequency/course; the course displays on the CRS line

Tunes respective DME.

Note: When magnetic variation at the airplane and VOR locations are significantly different, the ND VOR radial and ND POS green radial do not point directly to the VOR. This difference decreases as the airplane approaches the VOR.

2 Course (CRS)

Blank when in autotune.

Valid entry is a three-digit course. Data can be entered when dashes or a course display.

With a VOR approach selected, sequencing an IAF/FAF causes the FMC to procedure autotune the VOR frequency. When the approach has a runway waypoint, the FMC selects the inbound course.

3 ADF Frequency and Tune Status

Tuning status displays adjacent to left and right ADF frequencies. Tuning status displays are:

- ANT (antenna) - mode optimizes audio reception and removes ADF bearing data
- BFO (beat frequency oscillator) - mode for audio identification of stations transmitting unmodulated (CW) signals
- none - default tuning mode gives both bearing data and audio

Valid entries are XXX.X or XXXX.X

Entry can be followed by A (ANT), B (BFO), or none, which defaults to the ADF mode. A or B can be entered with a frequency already displayed.

4 ILS Frequency and Course

Tuning status displays adjacent to ILS frequency and course. The ILS receivers operate in FMC autotune or manual-tuning modes. The FMC autotunes ILS frequency and course. When the ILS is not necessary, the FMC sets the ILS to PARK. This removes the displays from the PFD.

ILS autotuning is inhibited for ten minutes after takeoff and during manual-tuning. The ten minute inhibit is canceled when making a change to the active flight plan destination runway. Autotuning and manual-tuning are inhibited when:

- the autopilot is engaged and either the localizer or glideslope is captured
- only the flight director is ON and either the localizer or glideslope is captured and the airplane is below 500 feet radio altitude
- on the ground with the localizer alive, airplane heading within 45 degrees of the localizer front course, and ground speed greater than 40 knots

Manual ILS tuning is enabled when:

- pushing either TOGA switch
- disengaging the autopilot and switching off both flight directors.

Valid entries:

- ILS frequency and front course (XXX.XX/YYY)
- front course, with a frequency and course already entered (/YYY)

5 PRESELECT

Any valid page data may be entered.

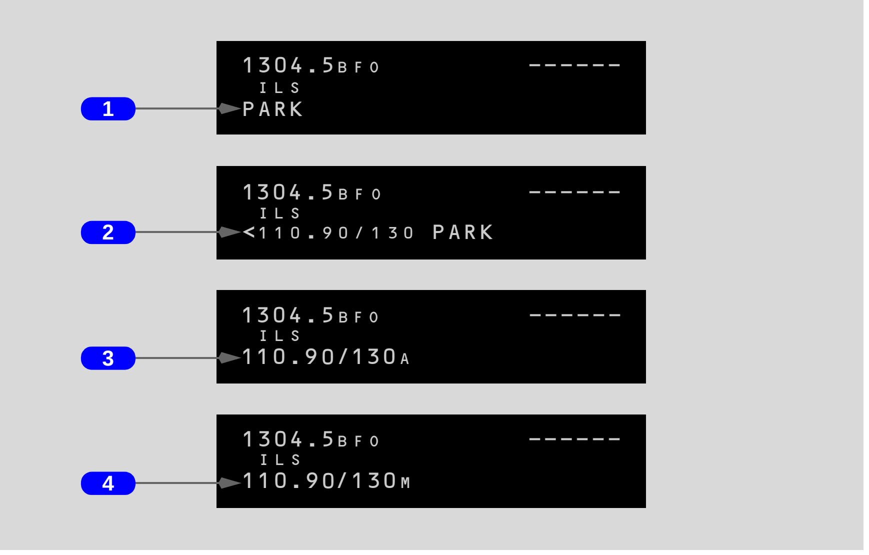
6 RADIAL

Displays radial from left and right VOR stations to the airplane.

ILS Tuning Status

Display initializes to PARK. Tuning status displays are:

- XXX.XX/YYY PARK - ILS autotuned for selected approach but not being used
- A (autotune) - ILS autotuned for approach guidance
- M (manual) - ILS manual-tuned



1 Park

PARK displays when:

- electrical power is first applied
- more than 200 NM from the T/D, or
- less than halfway to the destination

2 Tuning Status - Frequency, Course, and Park

ILS frequency, front course, and PARK display when an ILS, LOC, Back Course; or a VOR, runway, or VFR approach to an ILS/LOC equipped runway is selected, and:

- less than 200 NM from the T/D, or
- more than halfway to the destination, whichever represents the lesser distance to destination

Line selection manually tunes ILS.

3 Tuning Status - Autotune

ILS frequency, front course, and A display when an ILS, LOC, Back Course; or a VOR, runway, or VFR approach to an ILS/LOC equipped runway is selected, and:

- less than 50 NM from the T/D, or
- less than 150 NM from the runway threshold, or
- FMC is in descent mode

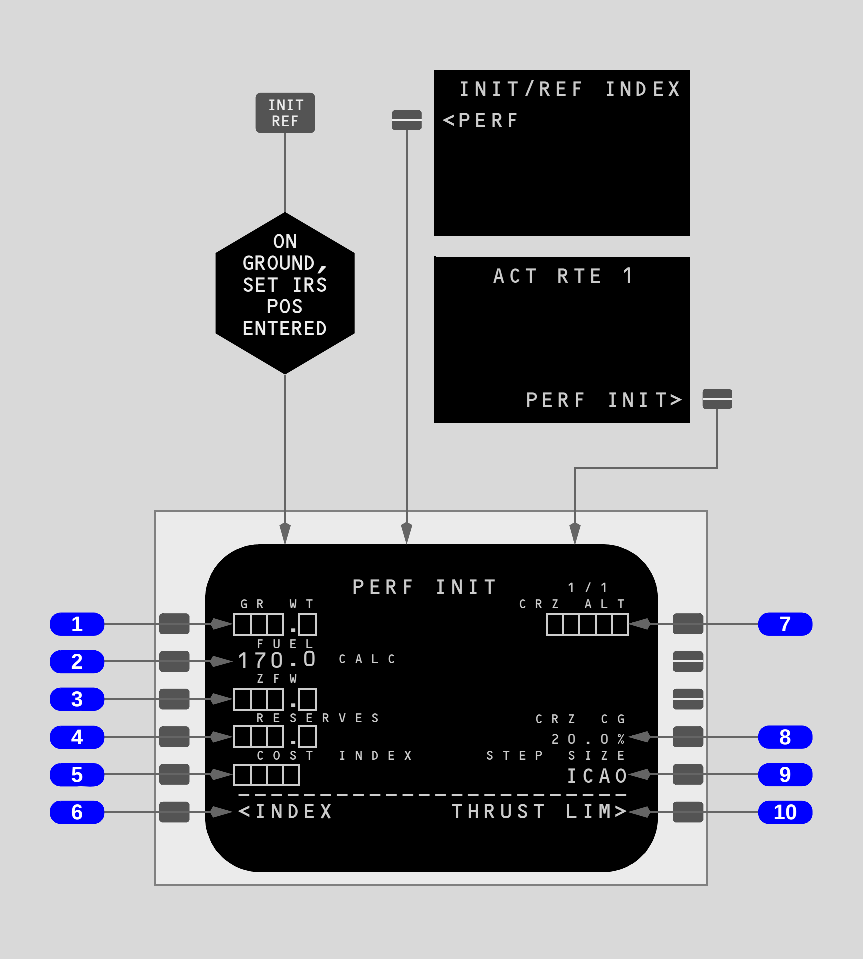
4 Tuning Status- Manual

Receiver tuned manually and valid frequency/course display.

Preflight Pages - Part 2A
Performance Initialization Page

The performance initialization page allows entry of airplane and route data to initialize performance calculations. This data is required for VNAV calculations.

Entered values clear with loss of electrical power or at engine shutdown after flight.



1 Gross Weight (GR WT)

Airplane gross weight can be entered by the flight crew or calculated by the FMC after entry of zero fuel weight.

Valid entries are XXX or XXX.X.

Entry of a value after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

2 FUEL

Fuel on board displays when fuel totalizer calculations are valid. The source for the display is included in the line:

- SENSED - fuel quantity is from the totalizer. Manual entry is not possible
- CALC (calculated) - fuel quantity is from FMC calculations. Manual entry is possible
- MANUAL - fuel quantity has been manually entered. A manual entry blanks totalizer and displays under CALCULATED on PROGRESS page 2/3

Definitions of SENSED and CALC are found on PROGRESS page 2/3 in Section 42, FMC Cruise.

Valid entry is XXX or XXX.X.

Only manual entries can be deleted.

3 Zero Fuel Weight (ZFW)

Normally, ZFW is entered from the airplane dispatch papers and the FMC calculates the airplane gross weight.

Valid entry is XXX or XXX.X.

Calculated zero fuel weight displays when airplane gross weight is entered first and fuel on board is valid.

Entry of a value after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
ZFW can be manually entered or uplinked. When a performance uplink is pending, uplinked values (small font) display beside the entered values (large font).

4 RESERVES

Valid entry is XXX or XXX.X.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
Can be manually entered or uplinked. When a performance uplink is pending, uplinked values (small font) display beside the entered values (large font).

5 COST INDEX

Cost index is used to calculate ECON climb, cruise, and descent speeds. Larger values increase ECON speeds. Entering zero results in maximum range airspeed and minimum trip fuel. Cost index can be entered by the flight crew or from a company route.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
Cost index can also be entered by uplink.

Valid entries are 0 to 9999.

6 INDEX

Push - displays the INIT/REF INDEX page.

7 Cruise Altitude (CRZ ALT)

Cruise altitude can be entered by the flight crew or from a company route.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
Cruise altitude can also be entered by uplink.

Valid entry is XXX, XXXX, XXXXX, or FLXXX.

Altitude displays in feet or flight level depending on transition altitude.

Entry displays this cruise altitude on the CLB and CRZ pages.

8 Cruise Center of Gravity (CRZ CG)

Displays default or pilot entered cruise CG value.

Used by FMC to calculate maximum altitude and maneuver margin to buffet.

Default value, 20.0, displays in small font.

A pilot entered value displays in large font. Deletion of a pilot entered value displays the default cruise CG value.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
An uplinked value displays in large font.

Valid entry is X.X or XX.X in the range 8.5 to 33.0.

9 STEP SIZE

Displays climb altitude increment used for planning the optimum climb profile.

Default display is ICAO.

Valid entries are 0 to 9000 in 1000 foot increments.

For a non-zero entry or ICAO, performance predictions are based on step climbs at calculated step climb points. For a zero entry, performance predictions are based on a constant CRZ ALT.

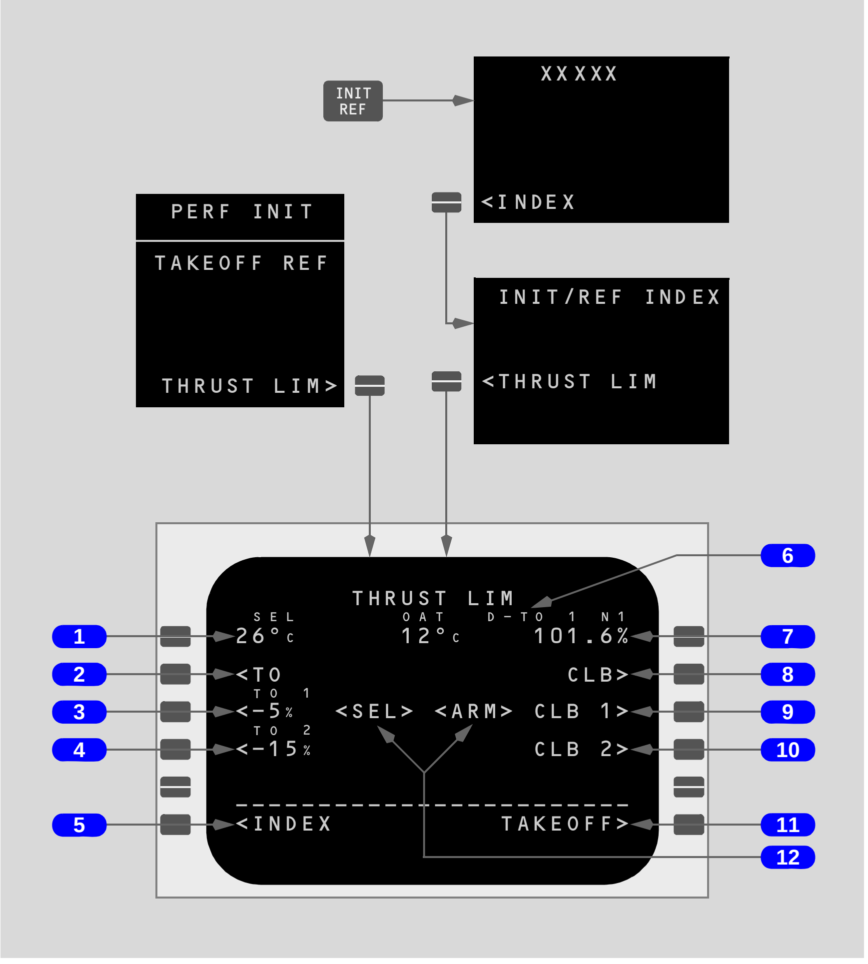
10 Thrust Limit (THRUST LIM)

Push - displays THRUST LIM page.

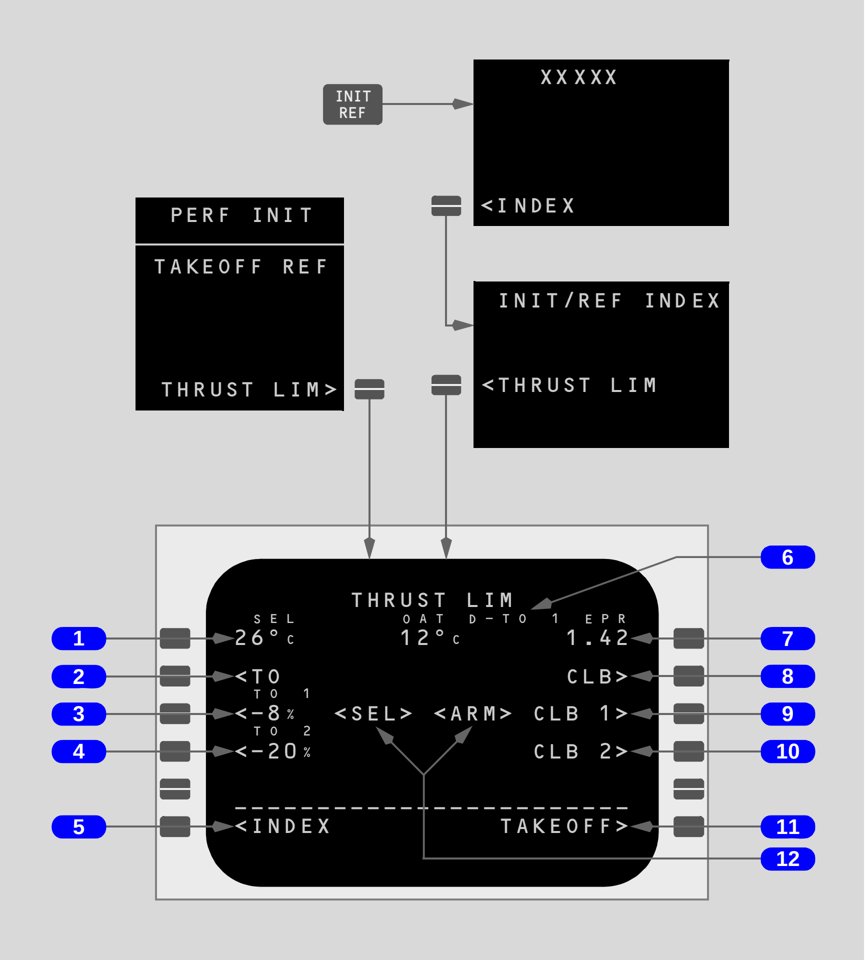
Preflight Pages - Part 2B
Thrust Limit Page

The thrust limit page allows selection and display of reference thrust for takeoff. Derating takeoff thrust by use of assumed temperature is also accomplished on this page.

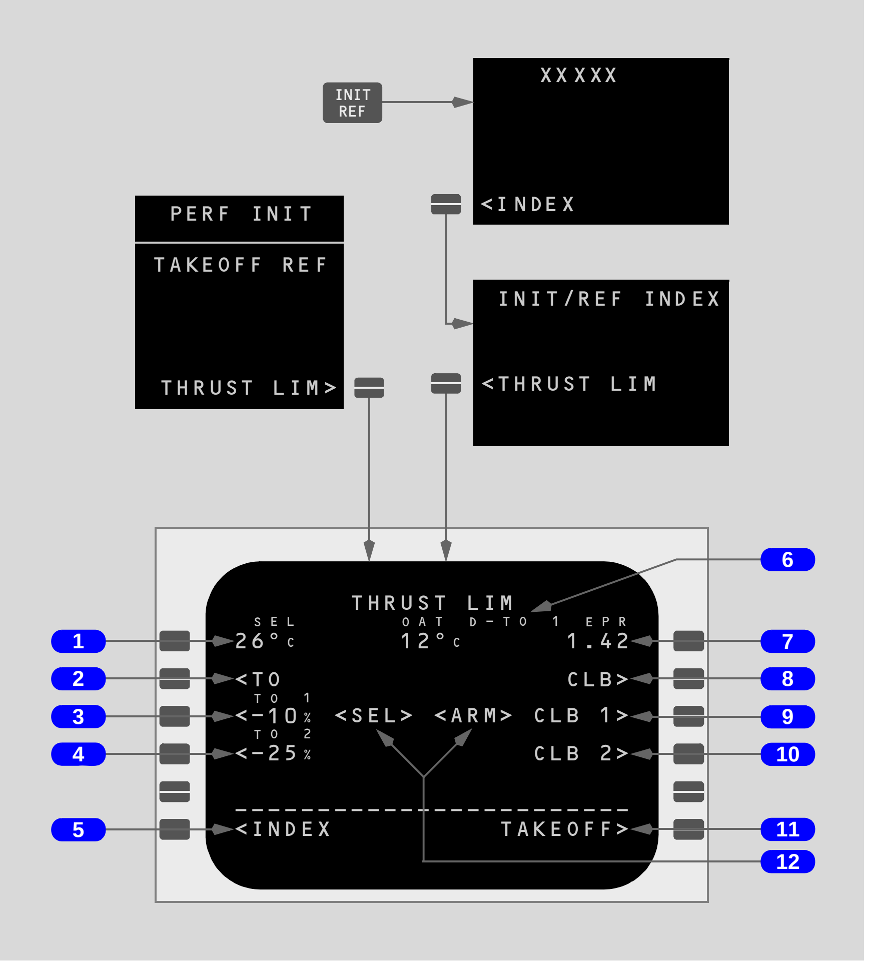
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Assumed Temperature (SEL), Outside Air Temperature (OAT)

Initially blank. Entry of an assumed temperature up to the maximum thrust reduction limit of 25% reduces takeoff thrust and displays D in the thrust reference mode line title. When selecting a temperature higher than the maximum assumed temperature limit, the FMC changes the entered temperature to the maximum temperature which gives a 25% thrust derate.

Valid entries are 0 to 99 degrees Celsius (C) or 32 to 210 degrees F.

Entry in degrees Fahrenheit (F) causes OAT to display degrees F.

Entry of a value after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

OAT displays outside air temperature in degrees C. When SEL temperature is in degrees F, the OAT converts to degrees F.

2 Takeoff (TO)

Push - selects full rated (TO) takeoff thrust limit.

Selection of a new rating after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

3 Takeoff 1 (TO 1)

Push - selects percentage derate (TO 1) takeoff thrust limit.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
Takeoff thrust derate can be entered by uplink.

Selecting TO 1 arms CLB 1.

4 Takeoff 2 (TO 2)

Push - selects percentage derate (TO 2) takeoff thrust limit.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
Takeoff thrust derate can be entered by uplink.

Selecting TO 2 arms CLB 2.

5 INDEX

Push - displays INIT/REF INDEX page.

6 Thrust Reference Mode

Displays selected takeoff thrust mode.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

7 Takeoff N1 Limit

Displays takeoff N1 calculated by the thrust management system.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

7 Takeoff EPR Limit

Displays takeoff EPR calculated by the thrust management system. Displays N1 when engines are operated in the alternate mode.

8 Climb (CLB)

Push - selects the full rated (CLB) climb thrust limit.

Pushing any climb line select key overrides an automatic selection.

9 **Climb 1 (CLB 1)**

Push - selects a percentage derate (CLB 1) climb thrust limit.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
Climb thrust derate can be entered by uplink.

10 **Climb 2 (CLB 2)**

Push - selects a percentage derate (CLB 2) climb thrust limit.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
Climb thrust derate can be entered by uplink.

11 **TAKEOFF**

Push - displays TAKEOFF REF page.

12 **<SEL>, <ACT>**

<SEL> - identifies selected takeoff thrust reference mode.

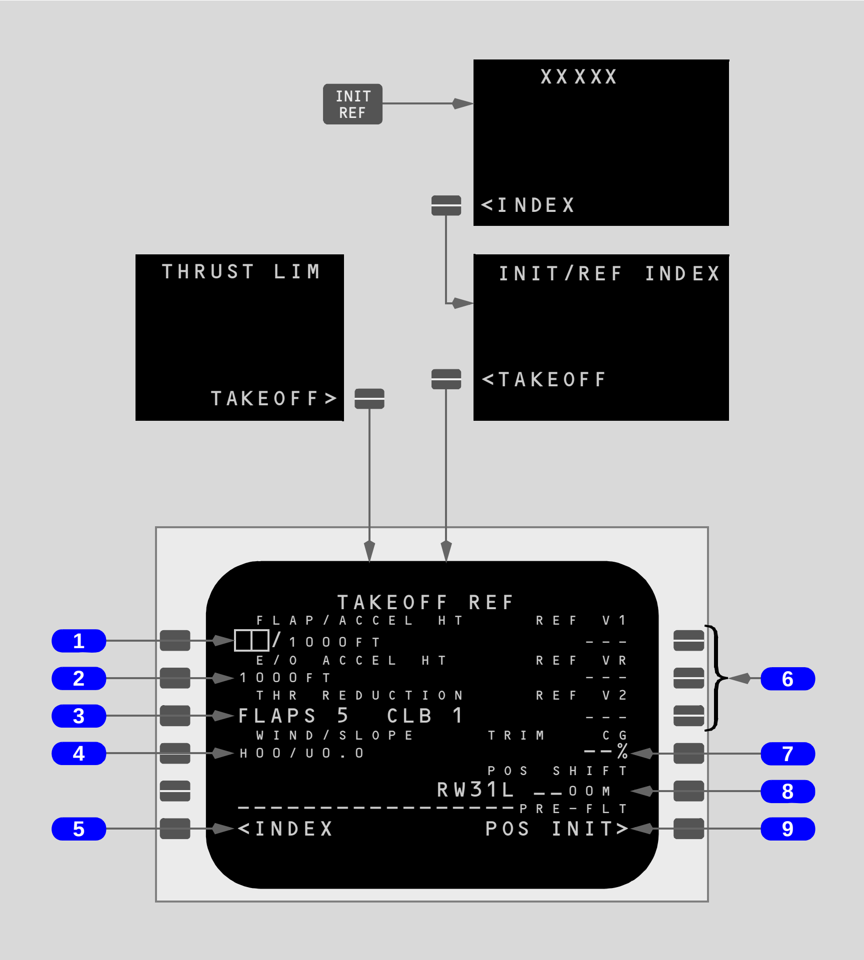
<ARM> - identifies armed climb thrust reference mode. <ARM> changes to <SEL> when armed climb mode becomes active.

Takeoff Reference Page

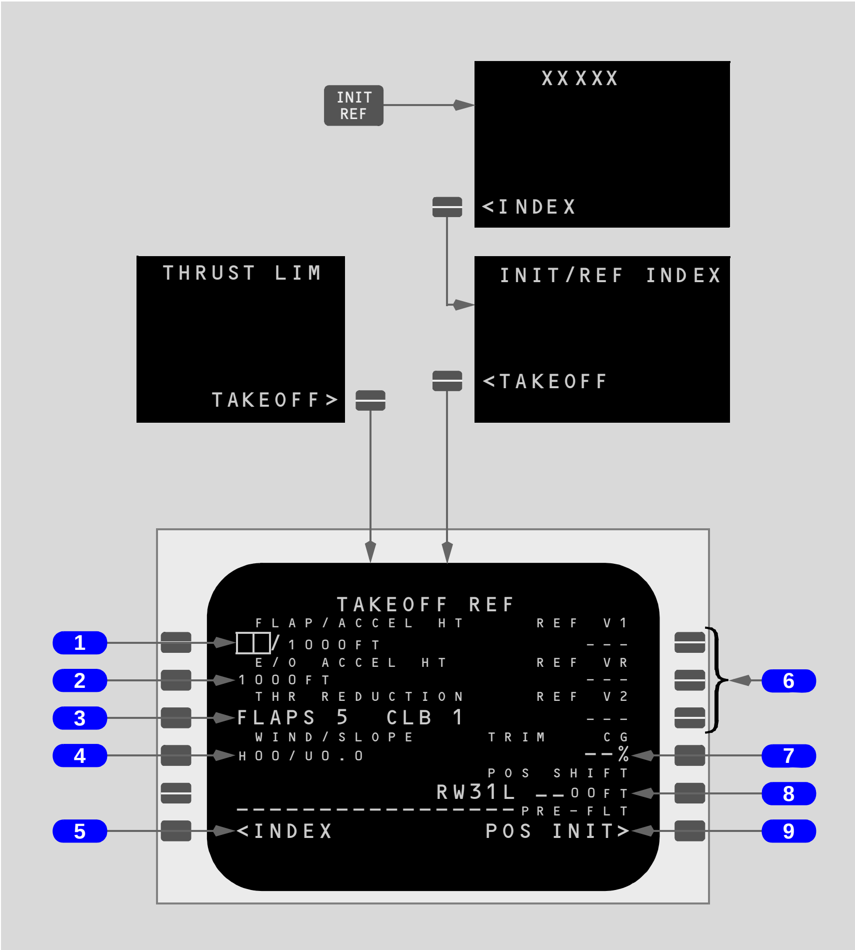
The takeoff reference page displays takeoff data and preflight status. Takeoff flap setting and V speeds are entered and verified. “PRE-FLT” displays in the line title at 6R if other preflight pages are not complete, such as POS INIT, ROUTE, or PERF INIT. When preflight is complete, THRUST LIM> displays allowing selection of other takeoff thrust limits.

Takeoff reference page entries complete the normal preflight.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



1 FLAP/Acceleration Height (ACCEL HT)

Initially displays boxes for takeoff flap setting; valid entries are 10 or 20.

Flap position is required for takeoff V speed calculations.

Displays default acceleration height in Height Above Airport (HAA) for flap retraction.

Valid entry is an HAA height from 400 to 9999 feet. The FMC adds airport elevation to entered HAA acceleration height causing acceleration at an MSL altitude. For example, for a airport elevation of 980 feet, an entry of 2020 acceleration height causes acceleration at 3,000 feet MSL.

Entry of a new flap setting after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

2 **Engine Out Acceleration Height (E/O ACCEL HT)**

Displays acceleration height in HAA for flap retraction with an engine out.

Valid entry is an HAA height from 400 to 9999 feet.

3 **Thrust (THR) REDUCTION**

Displays flap setting or height in HAA for reduction from selected takeoff thrust to armed climb thrust.

Displays armed climb thrust rating.

Valid entries are:

- 5 for flaps 5, or
- an HAA height from 400 to 9999 feet. The FMC adds airport elevation to entered HAA thrust reduction height causing thrust reduction at an MSL altitude. For example, for a airport elevation of 980 feet, an entry of 1020 thrust reduction height causes thrust reduction at 2,000 feet MSL.

4 **WIND/SLOPE**

Displays wind and runway slope after crew entry.

Valid entries are:

- WIND - HXX, XX for headwind, TXX for tailwind
- SLOPE - UX.X, X.X for upslope, DX.X for downslope

5 **INDEX**

Push - displays INIT/REF INDEX page.

6 **V Speeds (V1, VR, V2)**

Displays dashes when:

- required information not entered
- performance calculations inhibited
- IRUs not aligned

Displays FMC calculated speeds when required information entered.

Flight crew entered or selected speeds display in large font and replace calculated speeds. A manually entered V1 speed less than V1MIN is indicated by display of "V1MIN" in the header line and the value of V1MIN in the data line.

Calculated speeds display in small font.

FMC calculated speeds provide VMCA and VMCG protection.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

Uplinked speeds replace calculated speeds. An accepted uplinked V1 speed less than V1MIN is indicated by display of "V1MIN" in the header line and the value of V1MIN in the data line.

Push -

- selects V1, VR, and V2 to be sent to using systems, or
- crew entered V speeds replace calculated speeds
- display changes to large font; REF and caret no longer display

If performance data changes:

- FMC replaces existing speeds with FMC calculated speeds in small font
- V speeds are deleted from the PFD
- PFD speed tape message NO V SPD displays
- scratchpad message TAKEOFF SPEEDS DELETED displays

Note: After the third engine is started, any combination of gross weight, OAT, or pressure altitude resulting in a change in any computed speed of more than one knot from the previously calculated speed, causes the FMC to calculate and display revised takeoff speeds.

7 TRIM, Center of Gravity (CG)

Initially displays dashes.

Valid entries are whole numbers of CG expressed as a percentage of MAC within the range 0 to 40.

After CG entered, the FMC:

- calculates and displays stabilizer takeoff setting to the left of the CG entry (trim display is in 0.1 unit increments)
- updates the takeoff green band displayed on stabilizer position indicators

8 Position (POS) SHIFT

Displays the selected takeoff runway and TO/GA “push” distance from the runway threshold.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Valid entries are X, XX in + or - hundreds of meters(3 or 03 is 300 meters beyond the runway threshold; -3 or -03 is 300 meters prior to runway threshold).

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

Valid entries are X, XX in + or - hundreds of feet (3 or 03 is 300 feet beyond the runway threshold; -3 or -03 is 300 feet prior to runway threshold)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
Entered value updates FMC position to the TO/GA push point when GPS updating not active.

VP-BKJ, VP-BVR
Entered value updates FMC position to the TO/GA push point.

9 PRE-FLIGHT

Displays PRE-FLIGHT in the line title and the title (XXXXX) of the incomplete page on the dataline when preflight is not complete.

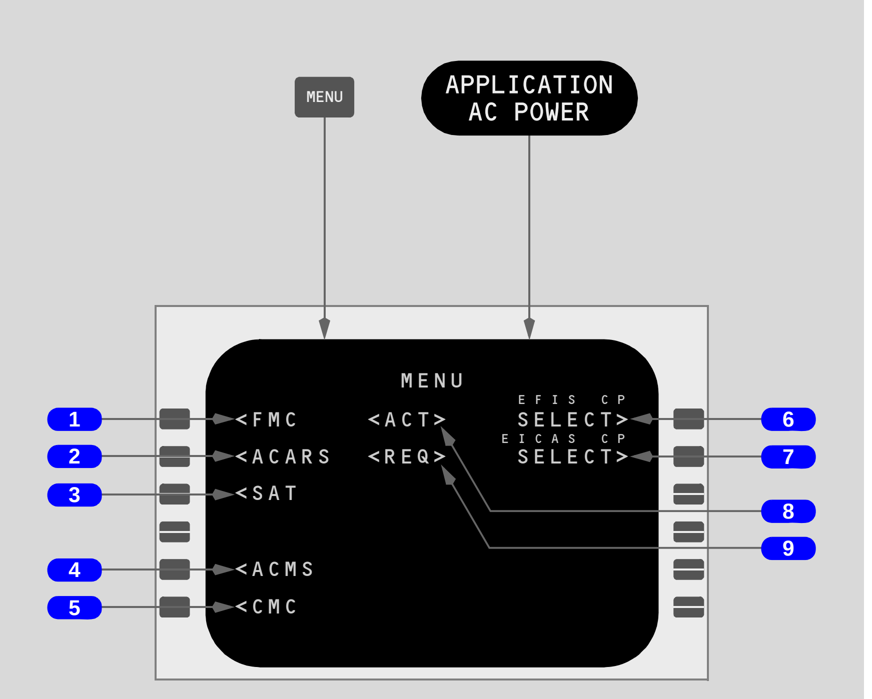
Displays dashes in the line title and THRUST LIM on the dataline when preflight is complete.

Push -

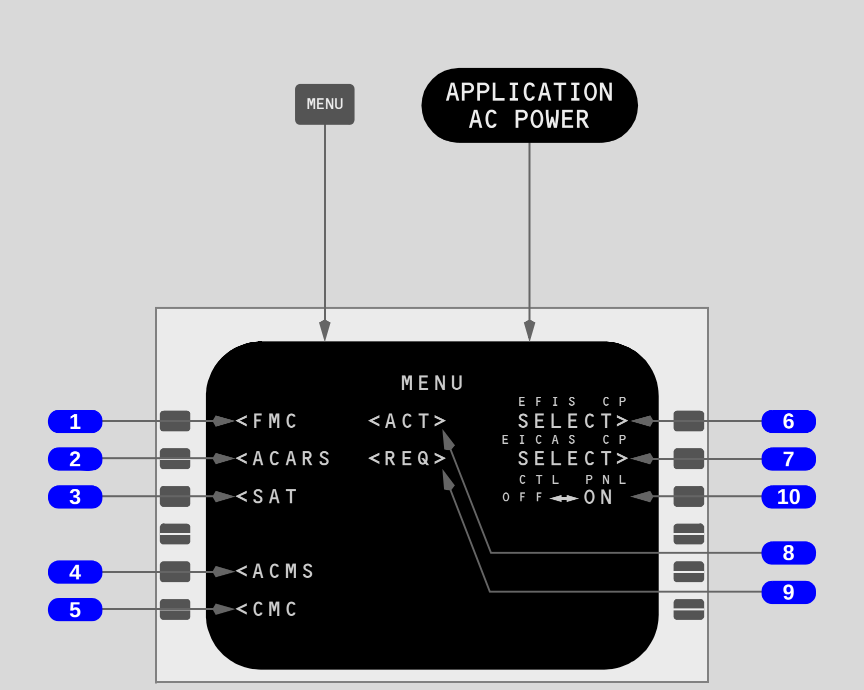
- displays THRUST LIM page when THRUST LIM displayed
- displays incomplete page (XXXXX) when PRE-FLIGHT displayed

Menu Page

Provides access to other systems that use CDU.



CDU-152



CDU-161

1 FMC

Push -

- connects FMC to the CDU
- displays last page used
- displays INITIALIZATION page on initial application of AC power

2 Aircraft Communication Addressing and Reporting System (ACARS)

See Chapter 5, Communications.

3 Satellite Communication System (SATCOM)

See Chapter 5, Communications.

4 Airplane Condition Monitoring System (ACMS)

Only displays on the center CDU.

Push -

- displays ACMS page
- activates ACMS control of CDU for maintenance use

5 Central Maintenance Computer (CMC)

Operational on ground and in flight above 10,000 feet.

Push -

- displays CMC menu page
- activates CMC control of the CDU for maintenance use

6 Alternate EFIS Control (CP)

See Chapter 10, Flight Instruments, Displays

7 Alternate EICAS Control (CP)

See Chapter 10, Flight Instruments, Displays

8 Active (ACT)

Indicates active CDU controller.

9 Requesting (REQ)

Indicates non-active CDU controller requires pilot action.

10 Control Panel Switch

See Chapter 10, Flight Instruments, Displays.

Introduction

FMC takeoff phase starts with selection of takeoff/go-around (TO/GA). Preparation for this phase starts in preflight phase and includes entry of TAKEOFF REF page data.

Takeoff phase changes to climb phase when the FMC commands climb thrust. Climb phase ends at the top of climb, where the cruise phase starts.

Prior to takeoff and during climb, the pages listed below are used to:

- TAKEOFF REF page - make changes to the departure runway
- DEPARTURES page - make SID selections
- CLIMB page - modify climb parameters and monitor airplane climb performance
- RTE X LEGS page - modify the route and monitor route progress
- PROGRESS page - monitor the overall progress of the flight
- THRUST LIM page - select fixed thrust climb derate limits
- DEP/ARR INDEX page - select an approach during a turn-back

Takeoff Phase

When changes are made to the departure runway and SID, TAKEOFF REF and DEPARTURES pages must be modified to comply with the revised clearance. The modified data are entered the same as during preflight.

With correct takeoff parameters, the FMC commands the selected takeoff thrust when the TO/GA switch is pushed. During takeoff roll, autothrottle commands thrust and the FMC commands a speed between V2+10 and V2+25 knots, based on rate of rotation.

Usually, LNAV and VNAV are armed before takeoff. When armed before takeoff, LNAV activates at 50 feet above the barometric altitude recorded by the FMC when accelerating through 100 knots and commands roll to fly the active route leg. VNAV activates at 400 feet above the recorded altitude and commands pitch to fly the climb profile.

Climb Phase

At acceleration height or altitude capture below acceleration height, VNAV commands acceleration to a speed 5 knots below the flap placard speed for the existing flap setting. When flaps are retracted, VNAV commands the speed displayed on the SPD TRANS line.

At the climb thrust reduction point, the FMC commands a reduction to the armed climb thrust. Passing the transition altitude displayed on the SPD TRANS line, VNAV commands an acceleration to economy climb speed, which is maintained until entering the cruise phase. Waypoint speed constraints take priority, provided they are greater than VREF+100 or the transition speed.

During climb, VNAV complies with LEGS page waypoint altitude and speed constraints. A temporary level-off for a crossing altitude restriction is accomplished at the commanded speed.

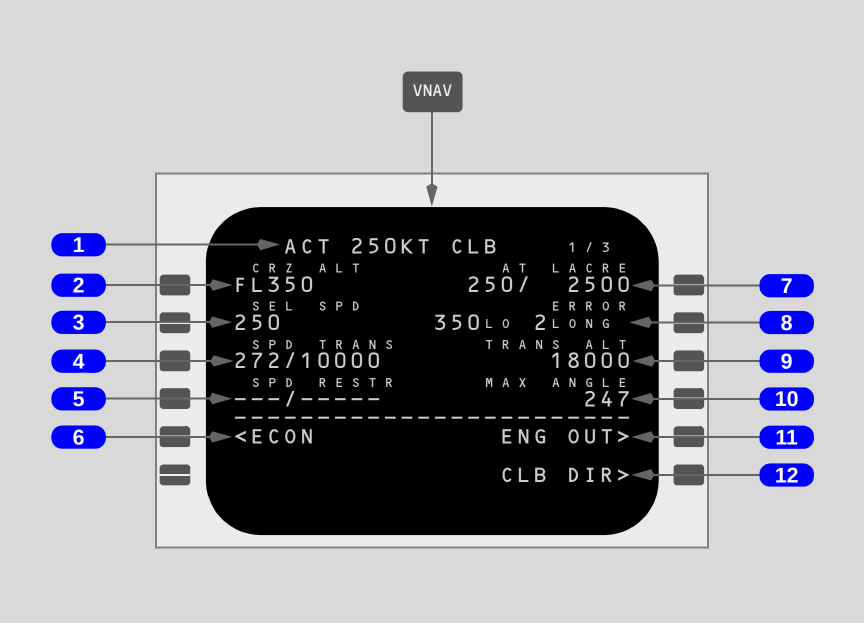
When the climb profile fails to reach a waypoint altitude constraint, the FMC displays the CDU scratchpad message UNABLE NEXT ALTITUDE. Deleting climb derates or selecting a reduced climb speed thus giving a steeper climb angle, may enable the airplane to reach the altitude constraint.

Climb Page

The climb page is used to evaluate, monitor, and modify the climb profile. Data on climb page comes from preflight entries made on the route and performance pages.

The climb page is the first of the three pages selected with the VNAV function key.

FMC climb can be economy, fixed speed, or engine out.



1 Page Title

The page title displays active (ACT) or modified (MOD) climb. Usually, the title contains ECON for economy climb. Fixed speed and engine out modify the title.

- ACT ECON CLB - speed based on a cost index
- ACT MCP SPD CLB - MCP speed intervention selected
- ACT XXXKT CLB - fixed CAS climb speed profile
- ACT M.XXX CLB - fixed Mach climb speed selected
- ACT LIM SPD CLB - speed based on an envelope limiting speed

Fixed climb speeds are for:

- takeoff/climb acceleration segment constraints
- a flight crew selected speed (SEL SPD)
- a speed transition

- a speed restriction associated with an altitude
- waypoint speed constraints

2 Cruise Altitude (CRZ ALT)

Displays cruise altitude entered on PERF INIT page.

Valid entries are: XXX, XXXX, XXXXX, or FLXXX. Altitude displays in feet or flight level depending on transition altitude.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

ECON SPD -

- speed based on cost index in CAS or Mach
- used by the FMC at altitudes above all waypoint speed constraints, speed restrictions, and speed transition altitudes

Valid entries are CAS or Mach.

SEL SPD - displays when flight crew enters speed.

4 Speed Transition (SPD TRANS)

Speed transition line displays the transition speed/altitude from one of these sources:

- the navigation database value for the origin airport
- the greater of the transition speed associated with the origin airport or VREF+100 knots (example 272/10000)

Not displayed above transition.

Can be deleted.

5 Speed Restriction (SPD RESTR)

Speed restrictions at an altitude less than the cruise altitude and not associated with a waypoint are manually entered on this line.

Displays dashes before entry by flight crew.

Valid entry is a CAS and altitude (example 240/8000).

6 Economy (ECON)

Displays when the climb speed is not ECON.

Push - changes climb speed to ECON.

7 Waypoint Constraint (AT XXXXX)

Displays next airspeed and/or altitude constraint at waypoint XXXXX.

Can also display HOLD AT XXXXX followed by a speed/altitude constraint.

FMC commands the slower of constraint speed or performance speed.

Constraints entered on RTE LEGS page.

Delete here or on RTE LEGS page.

Blank if no constraint exists.

8 ERROR at Waypoint

Displays altitude discrepancy and distance past waypoint where altitude will be reached.

Blank if no error exists.

9 Transition Altitude (TRANS ALT)

Transition altitude for origin airport contained in navigation database. FMC default value is 18,000 feet.

Enter transition altitude here or on the DESCENT FORECAST page.

Valid entries are: XXX, XXXX, XXXXX, or FLXXX.

CDU altitude data changes from altitudes to flight levels above the transition altitude.

10 Maximum Angle (MAX ANGLE)

Displays maximum angle climb speed.

Entry not allowed.

11 Engine Out (ENG OUT)

Push - displays E/O CLB page; deletes climb speed transition and restriction data.

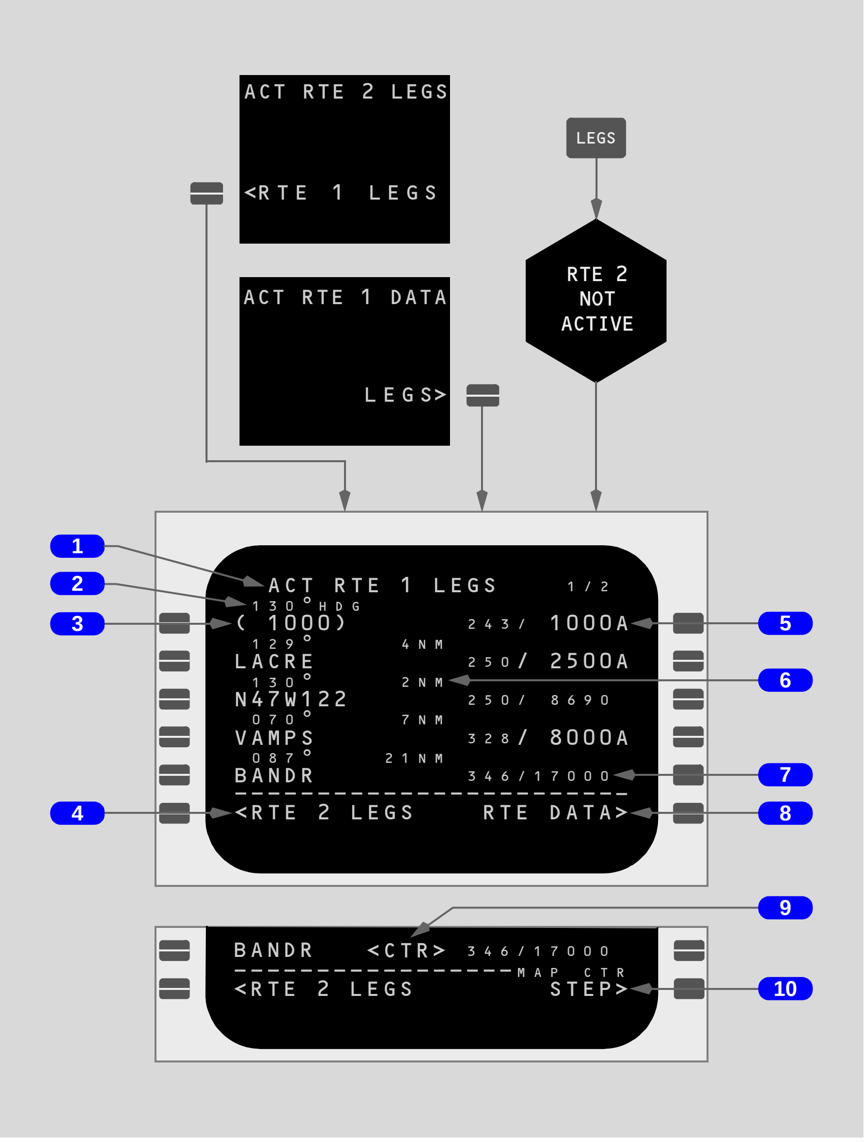
12 Climb Direct (CLB DIR)

Displays when climb altitude constraint exists between current altitude and FMC cruise altitude.

Push - deletes all waypoint altitude constraints between the airplane altitude and the MCP altitude or FMC cruise altitude, whichever is lower. FMC cruise altitude is not affected.

RTE X LEGS Page

Route legs page provides means of entering and displaying details of each leg of the route. Valid entries same as on route pages TO line.



1 Page Title

Title format displays route status:

- RTE X LEGS - inactive route
- ACT RTE X LEGS - active route
- MOD RTE X LEGS - modified active route

2 Leg Direction

Leg segment data in line title:

- computed course to waypoint - XXX°
- specified procedural course/track from database - XXX°
- arcs - arc radius in miles, ARC, turn direction (example: 24 ARC L)
- heading leg segments - XXX° HDG
- track leg segments - XXX° TRK
- special procedural instructions from database - HOLD AT, PROC TURN, or PROC HOLD

Directions are magnetic unless followed by T (131° T).

Calculated great circle route leg directions may be different than chart values.

Dashes display for an undefined course.

3 Waypoint Identifier

Active leg is the first line of the first active RTE X LEGS page.

Active waypoint is on active leg.

All route waypoints display in flight sequence. Airway waypoints display on the route legs page.

Waypoints can be modified. Examples:

- add waypoints
- delete waypoints
- change waypoint sequence
- connect route discontinuities

Displays the waypoint by name or condition.

Boxes display for route discontinuities.

Dashes display after the end of the route.

4 Route 2 Legs (RTE 2 LEGS)

Push -

- displays RTE 2 LEGS page
- when RTE 2 LEGS page displayed, changes to RTE 1 LEGS

5 Waypoint Speed/Altitude Constraints

Waypoint speed or altitude constraints display in large font.

Constraints can be entered manually. Entered by FMC when constraints are part of a procedure.

Valid entries are:

- speed only - XXX/. Enter CAS in the range of 100 to 400
- altitude only, less than cruise altitude - XXX, XXXA, XXXB, XXXAXXXB, XXXBXXXA or may include an optional leading "/". Enter FL190 or 19,000 feet as 190. Enter FL090 or 9,000 feet as 090
- speed/altitude - XXX/XXXX

Altitude constraint suffixes:

- blank - cross at altitude
- A - cross at or above altitude
- B - cross at or below altitude
- both - altitude block. If constraint is to cross between two altitudes when climbing, enter lower altitude followed by “A”; then, enter higher altitude followed by “B”. Example: 220A240B. Reverse the order for descent
- S - planned step climb (refer to Flight Management, Navigation, Cruise)

6 Distance to Waypoint

Distance (decreasing) from airplane to active waypoint or distance from waypoint to waypoint. Blank for some leg types (e.g. HDG or VECTORS).

7 Waypoint Speed/Altitude Predictions

Waypoint speed and altitude predictions display in small font.

Dashes display in predicted descent region prior to descent path calculation. Descent path calculation requires altitude constraint below cruise altitude.

Manual entry allowed in climb or descent phase.

8 ACTIVATE, Route (RTE) DATA

Push -

- ACTIVATE - prepares inactive flight plan for activation; illuminates the EXEC key. Other pages may be accessed and modifications performed before execution.With an active route, ACTIVATE replaced with RTE DATA. In flight, LEGS page displays
- RTE DATA - displays route data page

ACTIVATE displays when RTE and RTE LEGS flight plan is inactive.

9 Center (<CTR>)

Displays when PLAN mode selected.

Displays adjacent to the waypoint around which ND plan mode is centered.

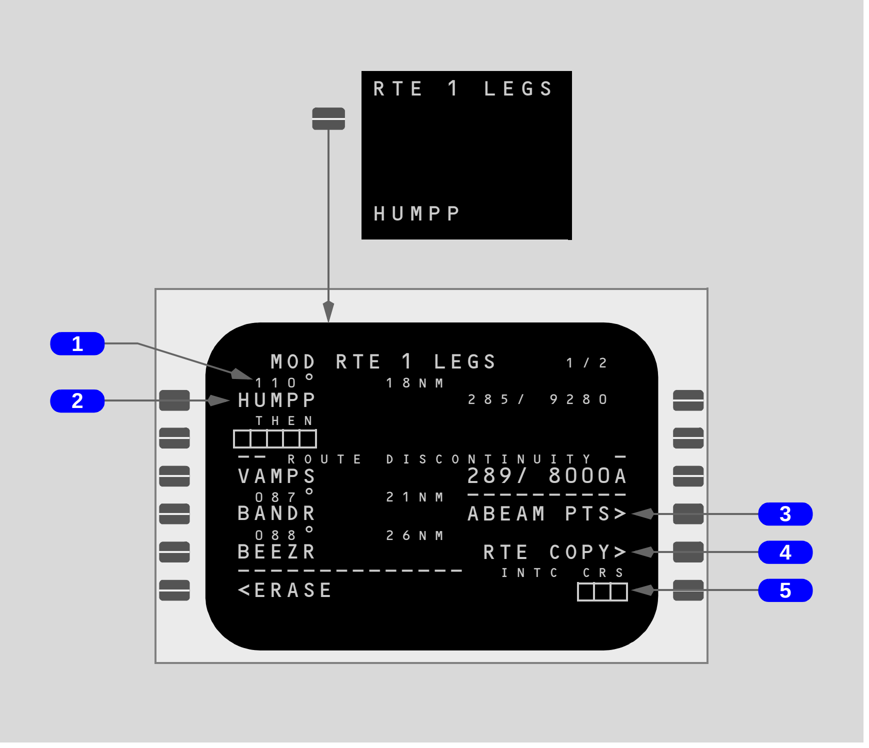
10 **MAP Center (CTR) STEP**

Replaces ACTIVATE or RTE DATA when PLAN mode selected.

Push - steps <CTR> to next waypoint. ND plan mode recenters.

Direct/Intercept Course

Used to fly direct to or intercept a course to a waypoint. Entering a waypoint over the active waypoint displays direct/intercept prompts.



1 Course to Active Waypoint

Prior to execution, displays direct-to inbound course at waypoint; changed by entry in INTC CRS line or by selecting intercept course.

After execution, displays current required track to fly inbound course to waypoint.

2 Active Waypoint

Displays crew entered direct/intercept waypoint.

3 ABEAM Points (PTS)

Push -

- line title displays ABEAM PTS, data line displays SELECTED
- creates abeam points on new route to indicate waypoints bypassed by direct to function

- abeam points are perpendicular to the waypoints bypassed
- subsequent route modifications remove ABEAM PTS prompt

4 Route (RTE) COPY

Push -

- copies active unmodified route into inactive route
- erases previous inactive route
- line title displays RTE COPY, data line displays COMPLETE
- subsequent route modifications remove RTE COPY prompt

5 Intercept (INTC) Course (CRS)

Displays boxes if entered waypoint not in the active route; valid entry is intercept course from 000° to 360°.

Displays current route course and prompt caret if entered waypoint in the active route.

Push -

- when current route course displayed, selects it as intercept course to active waypoint
- displays entry or current route course as course to active waypoint
- removes ABEAM PTS and RTE COPY prompts

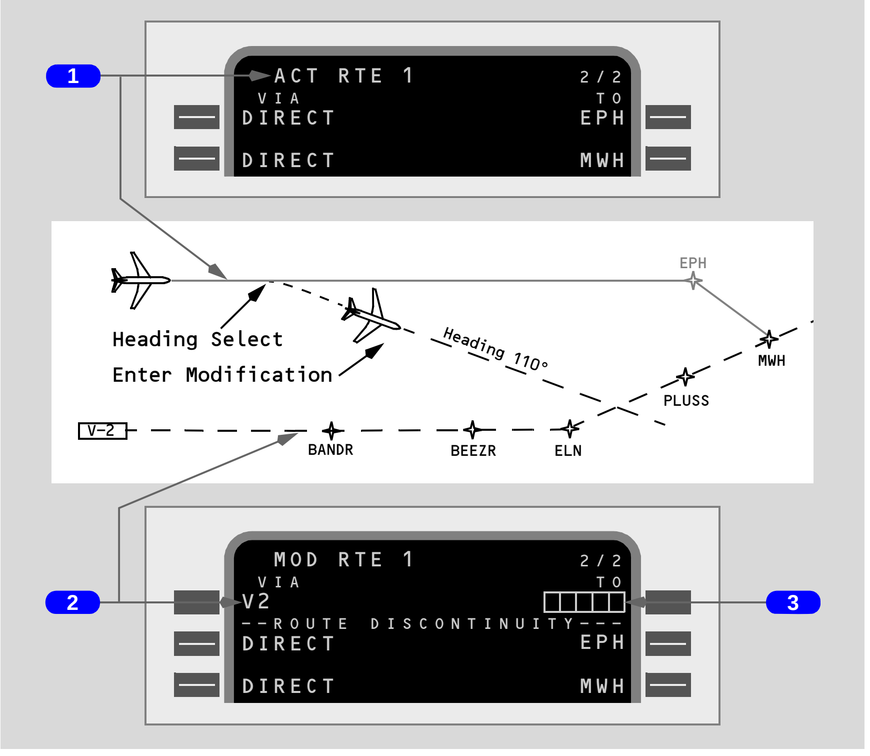
Airway Intercept

LNAV can be used to intercept an airway. An airway intercept changes the active waypoint on the RTE and LEGS pages.

Example

The active route is direct EPH, then direct MWH. ATC clears the airplane to:

- turn right heading 110°
- intercept V2 to MWH



1 Active RTE 1 Page

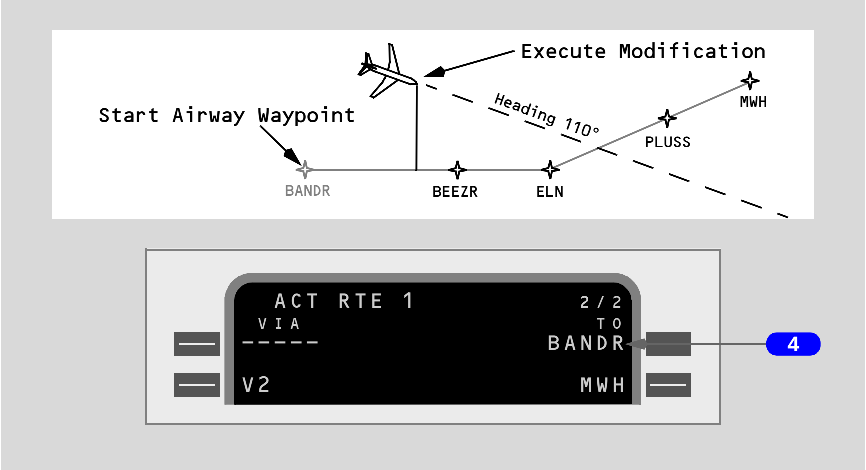
The route page before the ATC clearance.

2 Enter Airway

Enter the airway in the first VIA position on the RTE page. Boxes display in the TO position. A route discontinuity follows on the next line.

3 Airway Exit

Enter desired airway exit point (MWH) in the boxes.



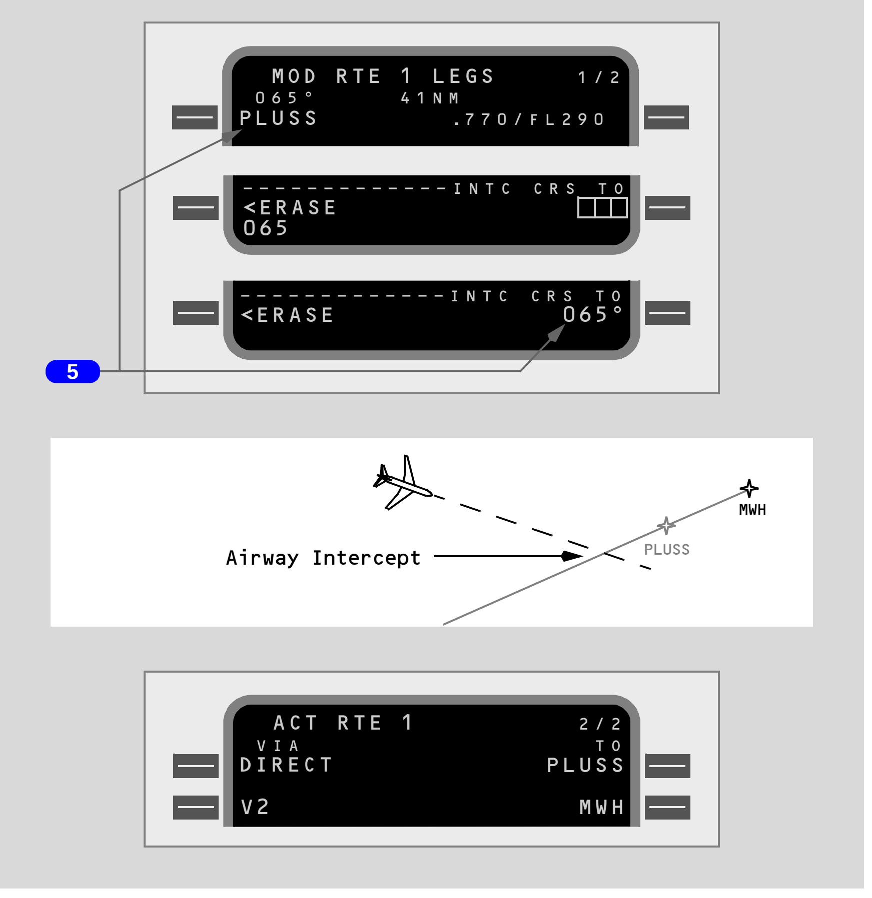
4 Start Airway Waypoint

After entering MWH in the boxes, the FMC selects the waypoint preceding the closest abeam location as the starting waypoint of the new airway. This waypoint displays under TO on line 1R. The entered airway and the selected exit point display on line 2. Executing the modification makes the FMC selected first waypoint the active waypoint; BANDR in this example. If the clearance heading intercepts the new route before the next downtrack waypoint (BEEZR), LNAV can be armed and will capture the new route. The active waypoint will sequence to next downtrack waypoint (BEEZR). Since the clearance heading will not intercept V2 prior to the next downtrack waypoint (BEEZR), use the intercept course procedure to make the inbound course to the next waypoint after the V2 crossing point the active leg segment.

The LEGS page displays this waypoint sequence:

- BANDR - the active waypoint
- BEEZR
- ELN
- PLUSS
- MWH - the V2 exit waypoint

The intercept heading crosses the V2 between ELN and PLUSS. Modify the LEGS page using a course intercept to the waypoint after the airway crossing, PLUSS, making PLUSS the active waypoint on the V2 airway. If the clearance heading does not intercept the new active leg segment, the NOT ON INTERCEPT HEADING scratchpad message displays.



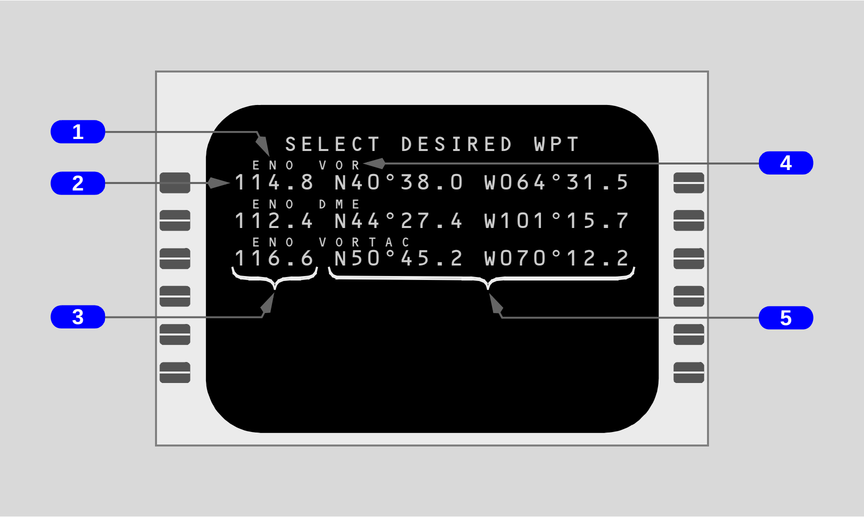
5 Airway Exit

On the LEGS page, move PLUSS to the scratchpad, then to 1L. The INTC CRS TO displays boxes. Enter the V2 inbound course to PLUSS.

Following the course intercept to PLUSS modification and execution, the LEGS page displays PLUSS as the active waypoint. LNAV can be armed and the airway intercept can be completed.

Select Desired Waypoint Page

The SELECT DESIRED WPT page displays after a waypoint entry when the FMC encounters more than one location for the same waypoint name. Selection of a waypoint returns the display to the previous page.



1 Identifier

Displays the identifier for the duplicate named waypoints.

2 Waypoint Lines

Display a sorted list of waypoints with identifier, navaid type, frequency, and coordinates;

- when page is accessed as a result of a flight plan modification, sort is based on proximity to the waypoint preceding the entered waypoint
- when page is accessed as a result of a DIR/INTC or REF NAV DATA entry, sort is based on proximity to current aircraft position

Push - selects waypoint location for use and returns display to page previously in use.

Pushing any CDU function key exits page without selecting a waypoint.

3 Frequency

Displays the frequency of the navaid.

Blank if the waypoint is not a navaid.

4 Type

Displays the type of navaid for each duplicate name.

Blank if the waypoint is not a navaid.

5 Latitude/Longitude

Displays the latitude/longitude for each duplicate name.

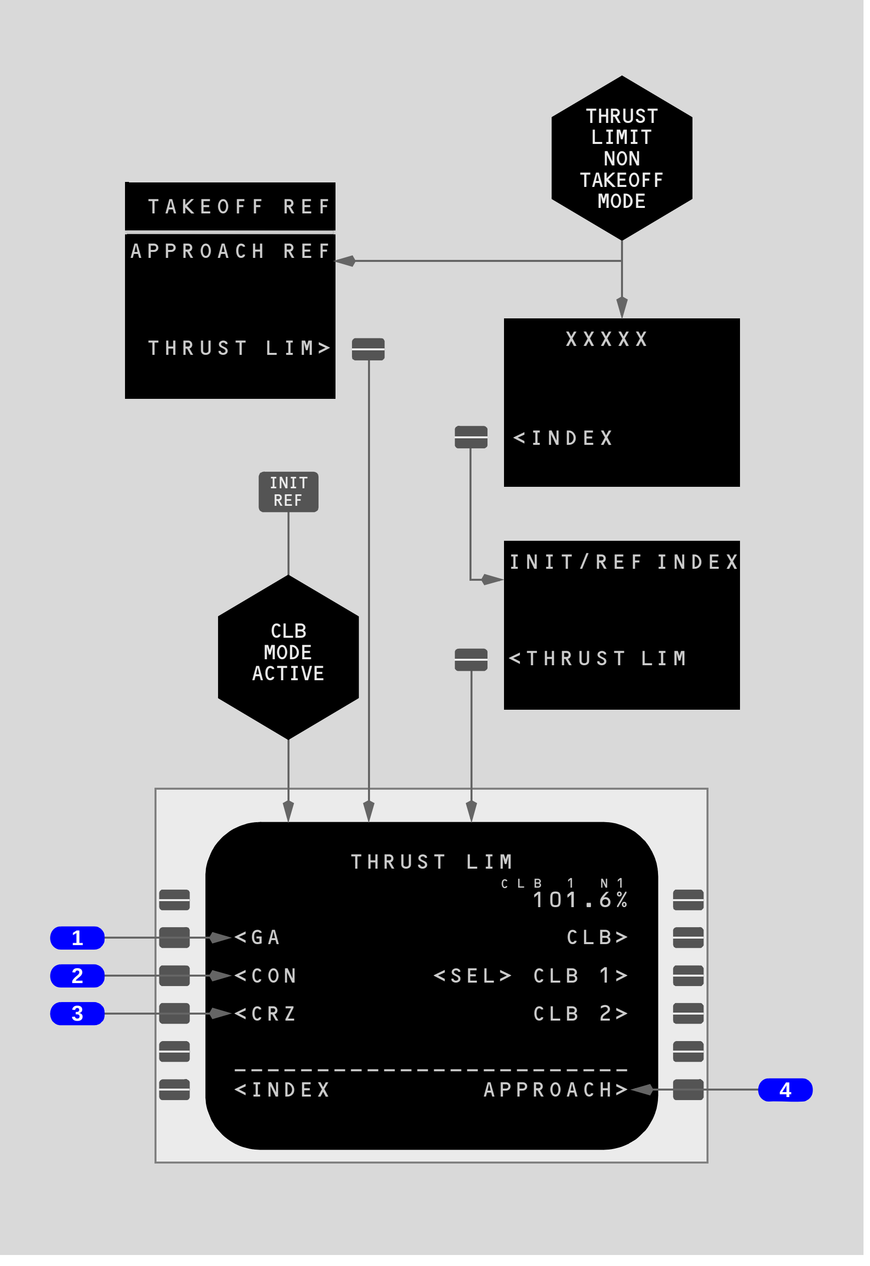
Thrust Limit Page

Thrust limits are selected on the thrust limit page. In flight, this display replaces the takeoff thrust limits with applicable thrust limits for climb. The selected limits display here and on the EICAS Display.

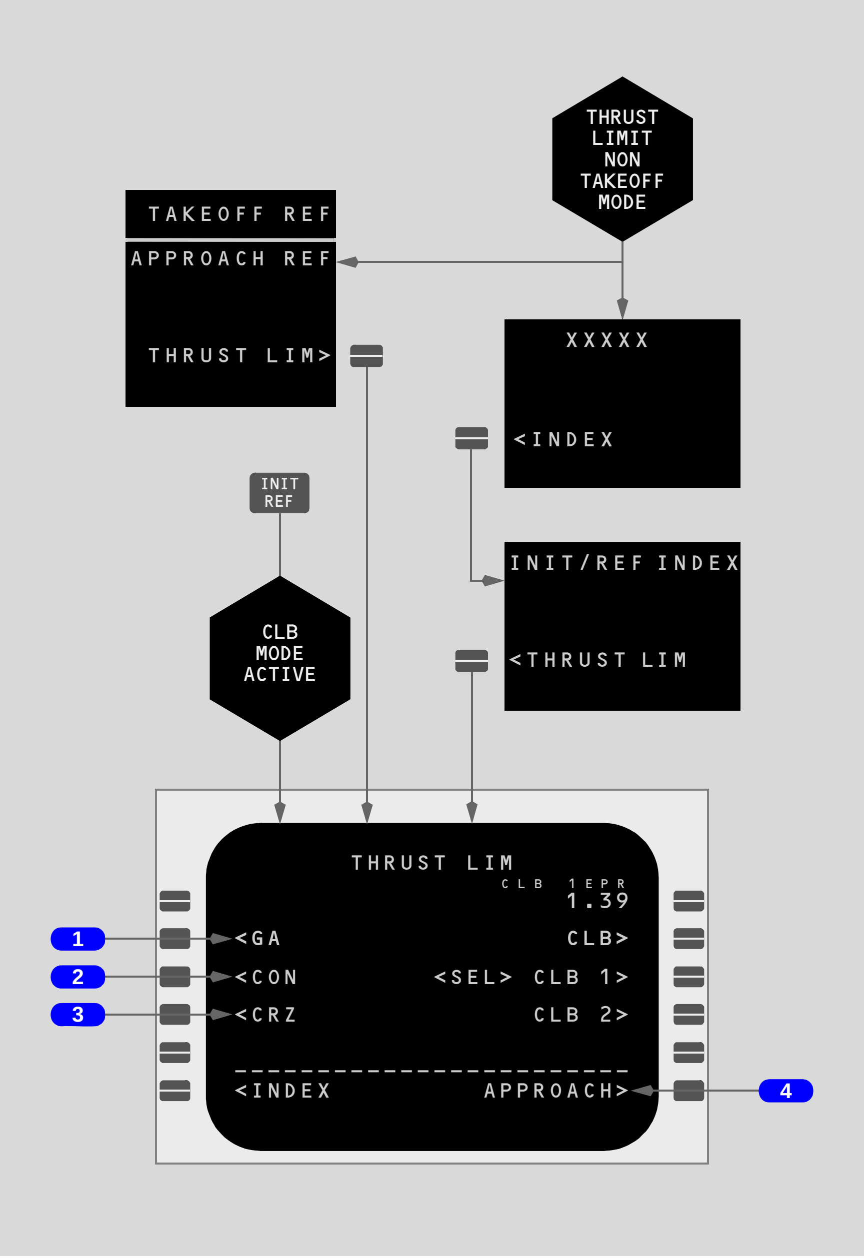
Fixed thrust derates can be selected for climb. Go-around, continuous, and cruise thrust limits are available also.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ,

VQ-BHW, VQ-BHX


THRUST LIMIT NON TAKEOFF MODE
TAKEOFF REF
APPROACH REF
THRUST LIM>
XXXXX
<INDEX
INIT REF
INIT/REF INDEX
<THRUST LIM
CLB MODE ACTIVE
THRUST LIM
CLB 1 N1
101.6%
<GA
CLB>
<CON
<SEL> CLB 1>
<CRZ
CLB 2>
<INDEX
APPROACH>
1
2
3
4

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 **Go-Around (GA)**

Push - selects go-around thrust limit.

2 **Continuous (CON)**

Push - selects maximum continuous thrust limit.

3 **Cruise (CRZ)**

Push - selects cruise thrust limit.

4 **APPROACH**

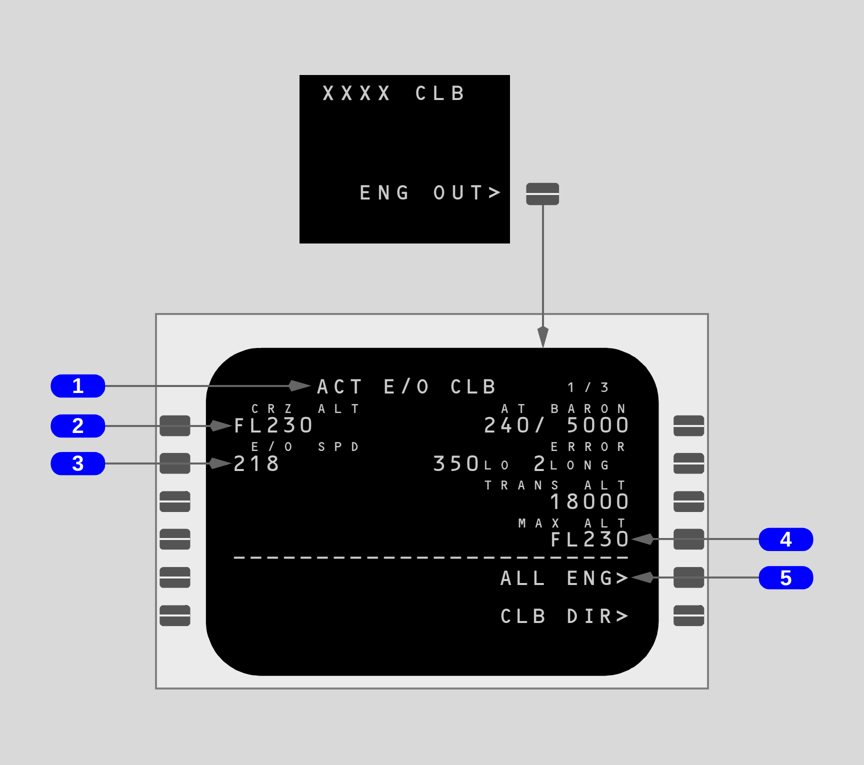
Push - displays APPROACH REF page.

Engine Out Climb

Engine out (E/O) VNAV climb guidance displays on the E/O CLB page. The E/O CLB page must be selected and executed by the flight crew. Engine out data is available with all engines operating. Engine out climb changes to engine out cruise at the top of climb.

E/O CLB Page

The modified page displays engine out performance data based on one engine out. Manual entries are allowed. After execution, VNAV gives E/O guidance in the climb; reference thrust limit changes to CON.



1 Page Title

Page title displays active (ACT) or modified (MOD) climb. Usually, the title contains ECON for economy climb.

Page titles include:

- ACT E/O CLB - engine out selected with minimum drag climb speed
- ACT E/O MCP CLB - MCP speed intervention selected

- ACT E/O XXXKT CLB - fixed CAS climb speed selected
- ACT E/O M.XXX CLB - fixed Mach climb speed selected

2 Cruise Altitude (CRZ ALT)

Displays cruise altitude if less than E/O MAX ALT.

Displays EO MAX ALT if less than cruise altitude.

Manual entry is allowed.

3 Engine Out Speed (E/O SPD)

Displays engine out climb speed.

Valid entry is XXX for CAS.

Valid entry is 0.XXX for Mach. Trailing zeros can be omitted.

A manual entry may cause MAX ALT to change.

4 Maximum Altitude (MAX ALT)

Displays lower of maximum altitude at engine out climb speed or cruise speed.

Entry not allowed.

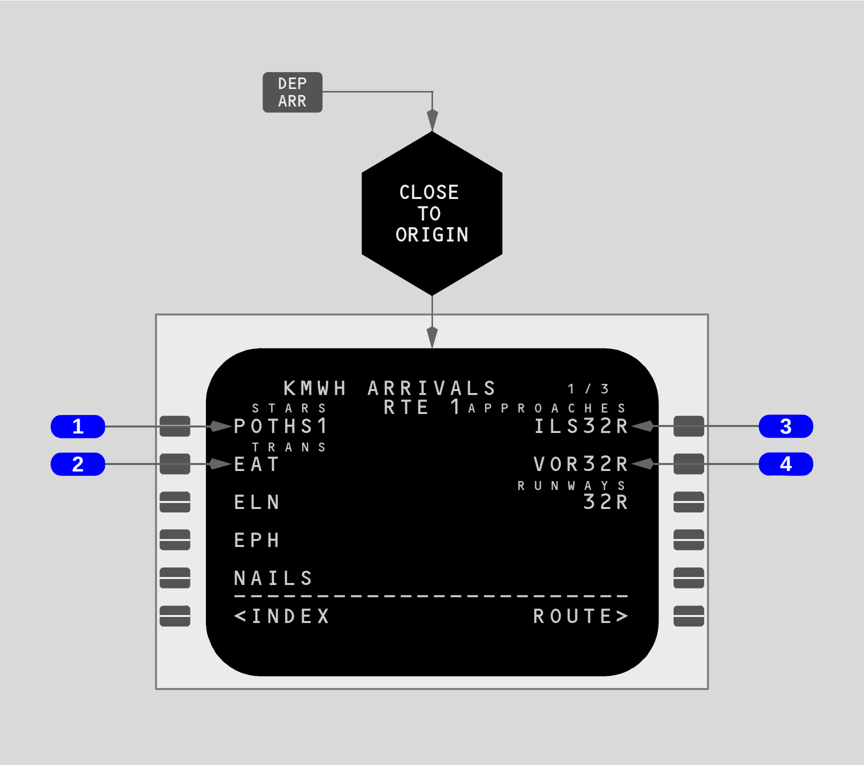
5 ALL ENG

Push - modifies page to display all engine (ALL ENG) performance data.

Air Turnback
Arrivals Page

During a turn-back situation, the flight crew requires quick access to the arrivals data for the origin airport. The arrivals page allows access without changing the destination on the route page.

During climb, less than 400 miles from the origin, and while nearer to the origin than the destination, pushing the DEP ARR function key displays the ARRIVALS page for the origin airport.



1 Standard Terminal Arrival Routes/Profile Descents (STARS)

Displays STARS for origin airport.

2 Transitions (TRANS)

Displays transitions for the selected arrival procedure.

3 APPROACHES

Displays approaches for origin airport.

4 **RUNWAYS**

Displays runways for origin airport.

Introduction

Cruise phase starts at top of climb.

During cruise, the primary FMC pages are:

- RTE X LEGS
- CRZ
- PROGRESS

RTE LEGS pages are described in section 11.41. CRZ pages display VNAV related data. PROGRESS pages display flight progress data. During cruise, the specific page listed below is used to:

- POS REF page - verify the FMC position
- RTE DATA page - display progress data for each waypoint on the RTE LEGS page
- WINDS page - enter forecast wind and temperature
- REF NAV DATA page - display data about waypoints, navaids, airports, or runways, and can be used to inhibit navaids
- FIX INFO page - display data about waypoints. Page data can be transferred to other pages to create new waypoints and fixes

VP-BKJ, VP-BVR
(VQ-BHW, VQ-BHX ; before SB, AOC and ATS not active)

- POS REPORT page -display data for a position report

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
(VQ-BHW, VQ-BHX ; SB activates ATS or AOC)

- POS REPORT page -display data for a position report; described in Chapter 5.33

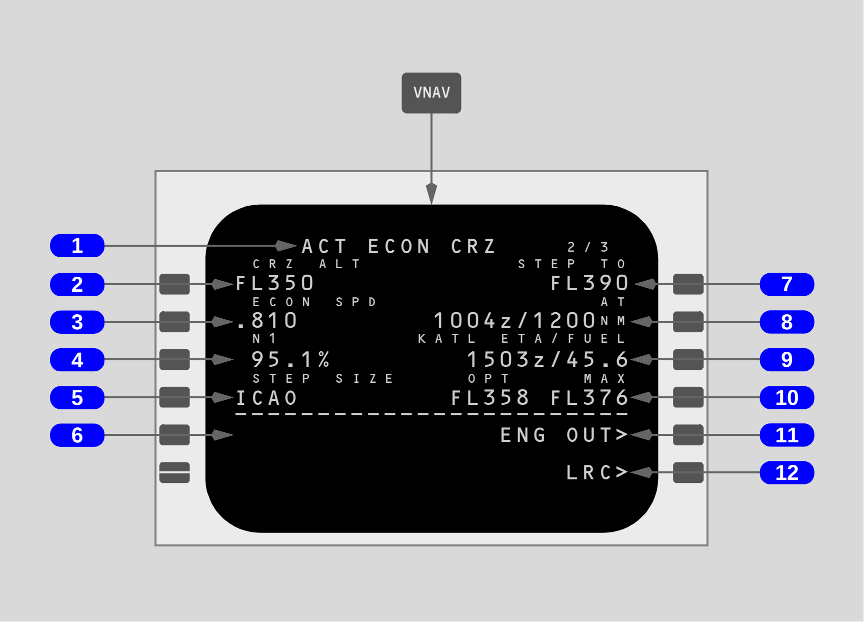
CLB page changes to CRZ at top of climb. CRZ CLB and CRZ DES pages change to CRZ at the new cruise altitude. CRZ page changes to DES at top of descent.

Cruise Page
All Engine Cruise

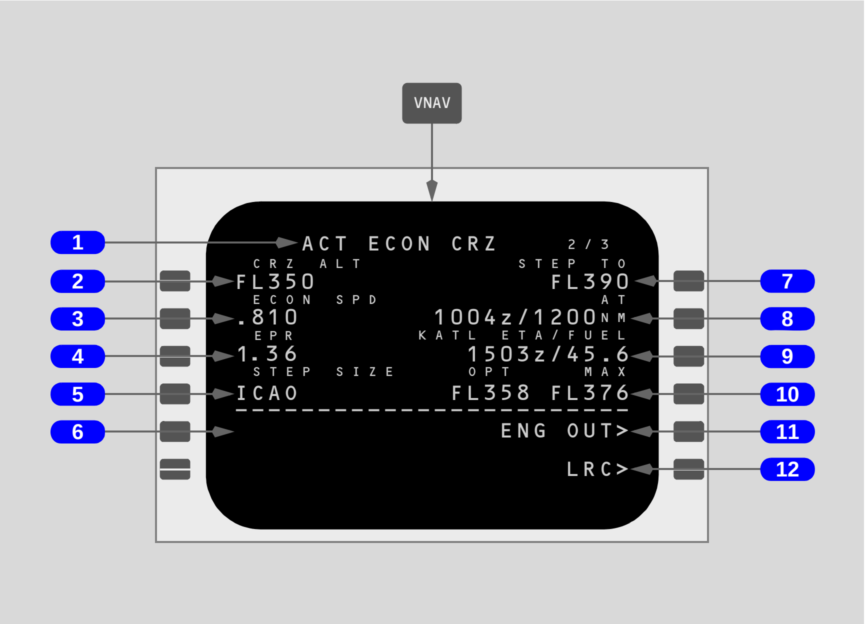
The cruise page is used to change cruise altitude and speed and to evaluate fuel burn and time to destination. Speed changes can be manually entered or selected using speed intervention. Cruise climbs and descents, and step climbs can be accomplished from the cruise page. Step size can be changed from the default value.

When using VNAV in economy mode, page data is based on operating at ECON SPD. Economy cruise speed is based on cost index. When the flight crew enters a selected speed, page data changes. When the FMC is in engine out mode, the data reflects airplane capabilities with one engine inoperative. The long range cruise (LRC) mode calculates speeds to maximize airplane range.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Page Title

Page title displays active (ACT) or modified (MOD) cruise. Usually, the title contains ECON for economy cruise. Fixed speed, engine out, and long range cruise modify the title.

Page titles include:

- ACT ECON CRZ - speed based on cost index
- ACT ECON CRZ CLB or CRZ DES - cruise climb or descent with ECON speed
- ACT LRC CRZ - long range cruise speed selected
- ACT LRC CRZ CLB or DES - cruise climb or descent with LRC selected
- ACT MCP SPD CRZ - MCP speed intervention selected
- ACT XXXKT CRZ - fixed CAS cruise speed selected
- ACT M.XXX CRZ - fixed Mach cruise speed selected
- ACT LIM SPD CRZ - speed based on an envelope limiting speed

Fixed cruise speeds are for:

- a flight crew selected speed (SEL SPD)
- a speed restriction associated with an altitude
- waypoint speed constraints

2 Cruise Altitude (CRZ ALT)

Displays cruise altitude entered on the PERF INIT page.

Valid entries are: XXX, XXXX, XXXXX, or FLXXX. Altitude displays in feet or flight level depending on the transition altitude.

A new entry changes the page title to CRZ CLB or CRZ DES when climb or descent initiated.

Changing the MCP altitude and pushing the Altitude selector enters the MCP altitude as the active cruise altitude, without creating a modification.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

Displays the command speed or Mach.

Valid entries are CAS or Mach.

SEL SPD - displays when flight crew enters speed.

LRC - displays when LRC selected.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX

4 N1

Displays N1 to maintain level flight at command airspeed.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

4 EPR

Displays EPR to maintain level flight at command airspeed.

5 STEP SIZE

Displays climb altitude increment used by FMC to calculate optimum step climb.

Defaults to ICAO.

Valid entries are 0 to 9000 feet in increments of 1000 feet.

6 Economy (ECON)

Push - selects economy cruise speed.

Displays when speed or Mach entered manually; or, when LRC selected.

7 STEP TO Altitude

Line title displays STEP TO when all of the following are true:

- an active route exists and there is no pending activation or flight plan modification
- the airplane is more than 200 nm from the T/D
- the airplane is more than 500 nm from the destination

Displays calculated step climb altitude based on STEP SIZE. May be overwritten with manual entry above CRZ ALT.

Valid entry is FLXXX or XXX (flight level), or XXXXX (feet).

Displays STEP TO altitudes entered on LEGS page. These altitudes may be greater or less than CRZ ALT and cannot be overwritten on the CRZ page.

Note: Calculated STEP TO altitude is always higher than OPT altitude.

When using ICAO STEP SIZE, the STEP TO altitude is the next higher altitude above OPT altitude corresponding to the direction of flight determined by the CRZ ALT entered before takeoff. For example: with an ICAO STEP SIZE, a CRZ ALT of FL280 entered before takeoff, and an OPT altitude of FL337; the STEP TO altitude will be FL350. In-flight changes to CRZ ALT will not affect the calculation of STEP TO altitudes when using ICAO step size. However, if an alternate route (for example, Route 2) is activated in flight, the hemispheric altitude will be calculated based on the current CRZ ALT.

When using an altitude increment STEP SIZE, the STEP TO altitude is the next higher altitude above OPT altitude calculated by adding the STEP SIZE increment to the current CRZ ALT.

8 AT

Displays ETA and distance to go to the optimum step point where a climb to the STEP TO altitude minimizes either trip cost (ECON CRZ) or fuel (other CRZ speeds).

Displays NOW passing the optimum step climb point.

Line title changes to AVAIL AT when STEP TO altitude entered at a waypoint on the LEGS page and MAX altitude at the waypoint is less than the STEP TO altitude. AVAIL AT indicates where MAX altitude will be equal to the STEP TO altitude.

Line title changes to TO T/D within 200 miles of T/D. ETA and distance are to T/D.

9 Destination ETA/FUEL

Line title is ETA/FUEL W/MOD when a modified active route is displayed.

Estimated time of arrival and calculated fuel remaining at the destination assume step climbs are made at optimum points to the STEP TO altitude.

Calculations are based on optimum and planned step climbs and cruise altitudes.

10 Optimum Altitude and Maximum Altitude (OPT, MAX)

OPT -

- displays altitude which minimizes trip cost when ECON speed selected
- displays altitude which minimizes trip fuel when LRC or SEL speed selected

MAX - displays the maximum cruise altitude based on:

- current gross weight
- number of engines operating
- selected speed option
- disregarding any altitude or speed constraints
- residual rate of climb set by airline (range: 0 to 500 feet per minute; default is 100)

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
For RTA CRZ mode active, OPT and MAX altitude are not computed. OPT and MAX headers are blank.

11 Engine Out (ENG OUT)

Push -

- displays MOD XXX CRZ page title; XXX is the active all engine CRZ speed mode before ENG OUT is selected
- changes command speed line title to LRC SPD
- below engine-out maximum altitude; upon execution, thrust reference limit changes to CON and page title becomes ACT E/O LRC CRZ
- above engine-out maximum altitude; sets CRZ ALT to engine-out long range cruise maximum altitude; and upon execution, thrust reference limit changes to CON and page title becomes ACT E/O LRC D/D

12 Long Range Cruise (LRC)

Push - displays LRC CRZ page; also displays LRC CRZ when E/O or SEL SPD is the active mode.

Engine Out Cruise

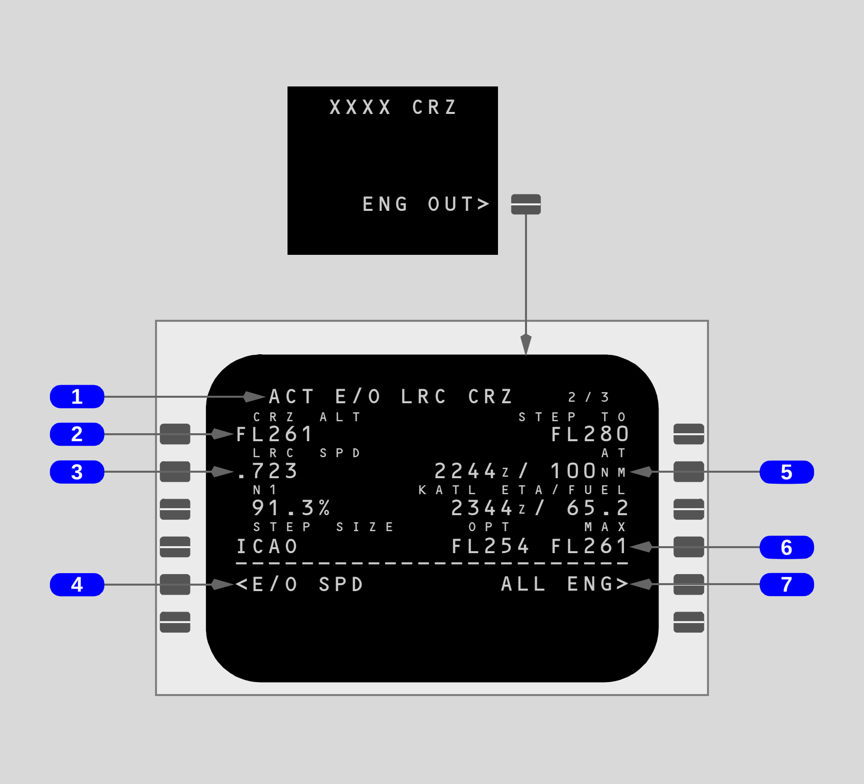
Engine out (E/O) VNAV cruise guidance displays on E/O CRZ page. E/O CRZ page must be selected and executed by the flight crew. Engine out data is also available with all engines operating.

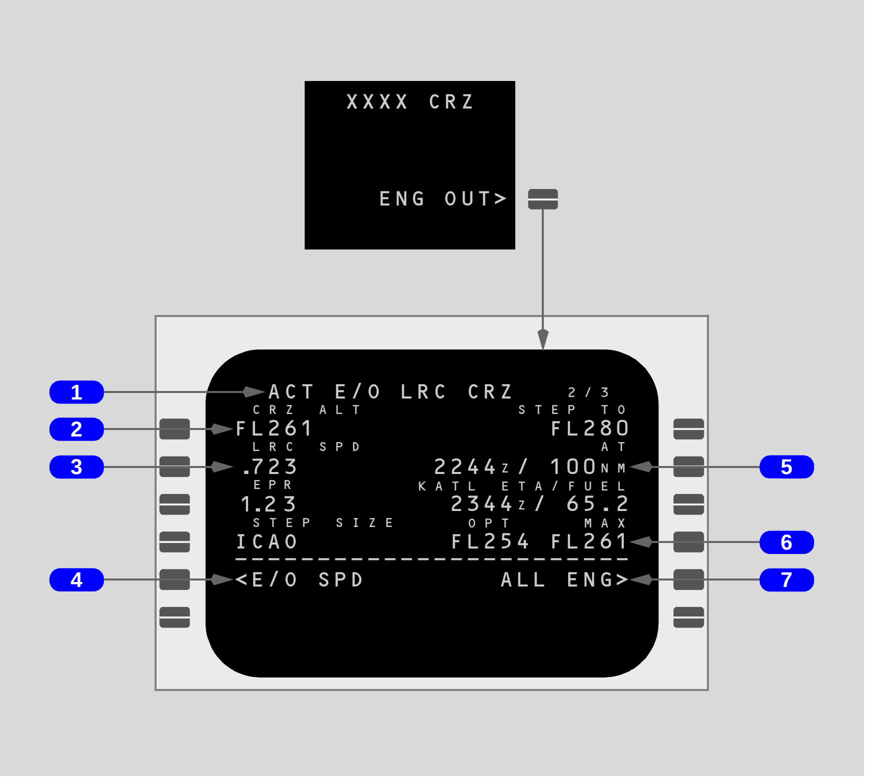
E/O Cruise Page

Following selection of the ENG OUT prompt on the ECON CRZ page, the modified page displays engine out performance information based on one engine out. Manual entries are allowed. When above the maximum engine out cruise altitude, VNAV calculates engine out guidance for drift down (D/D). This graphic is shown under VNAV Cruise (Engine Out above EO Max Alt), 11.31. The E/O LRC (long range cruise) D/D page changes to the E/O LRC CRZ page when reaching the engine out cruise altitude (shown below).

As the airplane gross weight decreases, maximum altitude increases. A step climb may be possible under these conditions.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, VQ-BHW, VQ-BHX





1 Page Title

The page title displays active (ACT) and modified (MOD) cruise.

Page titles include:

- ACT E/O CRZ - engine out selected with minimum drag cruise speed
- ACT E/O MCP SPD - MCP speed intervention selected
- ACT E/O XXXKT CRZ - fixed CAS cruise speed selected
- ACT E/O M.XXX CRZ - fixed Mach cruise speed selected
- ACT LRC D/D - engine out driftdown with LRC speed
- ACT E/O LRC CRZ - engine out cruise with LRC speed
- ACT E/O CRZ CLB/DES - cruise climb or descent with E/O SPD selected

2 Cruise Altitude (CRZ ALT)

Displays altitude from MAX ALT line when current CRZ ALT above MAX ALT.

Displays CRZ ALT from all engine cruise page if ENG OUT executed prior to engine shutdown.

Valid entries are the same as all engine cruise page.

3 Long Range Cruise Speed (LRC SPD)

Displays computed engine out LRC speed.

Valid entries are the same as all engine cruise page.

SEL SPD - displays when flight crew enters speed.

E/O SPD - displays when E/O SPD prompt selected.

Manual entries may change MAX altitude.

4 Engine Out (EO SPD)

Push - enables execution of engine out minimum drag speed profile.

Displays when LRC or SEL SPD is the active speed mode.

5 AT

Same as all engine display.

Displays time and distance to reach cruise altitude during driftdown.

6 Optimum Altitude and Maximum Altitude (OPT, MAX)

OPT - displays optimum altitude at speed displayed on speed line.

MAX - displays the maximum cruise altitude based on the same parameters as MAX for all engines.

7 ALL Engine (ENG)

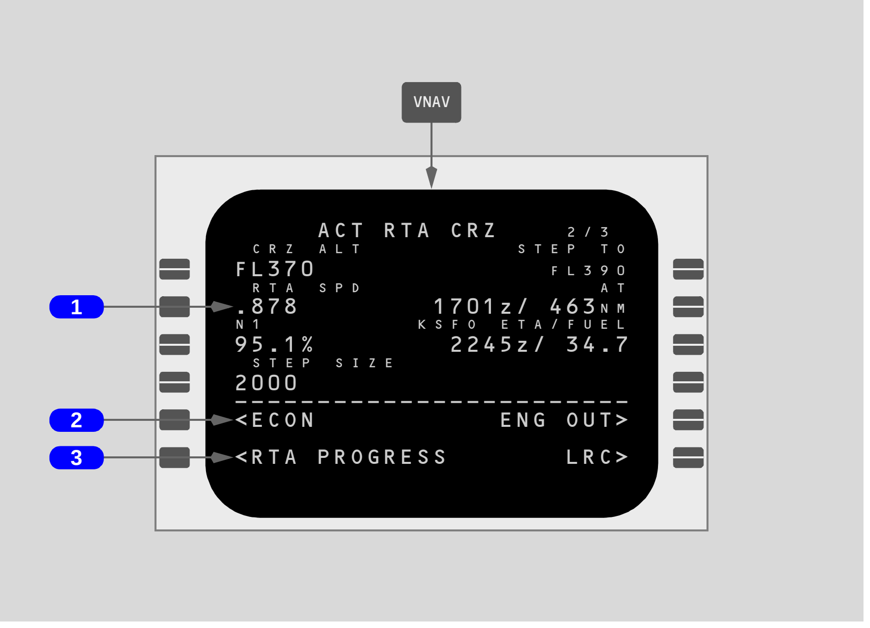
Push - displays and enables execution of MOD XXX CRZ page with performance based on all engines operating.

Required Time of Arrival (RTA) Cruise

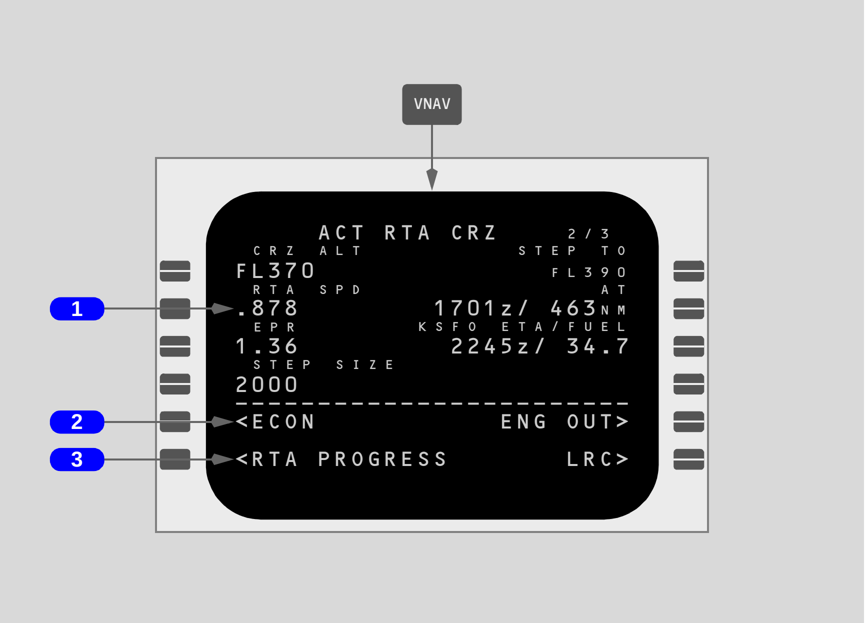
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

The required time of arrival cruise page is available after entry of Fix and Time on RTA PROG page. This page provides cruise speed required to accomplish RTA.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Required Time of Arrival Speed (RTA SPD)

Displays FMC computed cruise speed to accomplish RTA.

2 Economy Speed (ECON)

Displays when LRC, SPD SEL, or RTA SPD displayed in 2L.

Push -

- selects ECON CRZ page
- execution activates ECON CRZ and terminates RTA function

3 RTA PROGRESS, ERASE

RTA PROGRESS (displays when no modification pending).

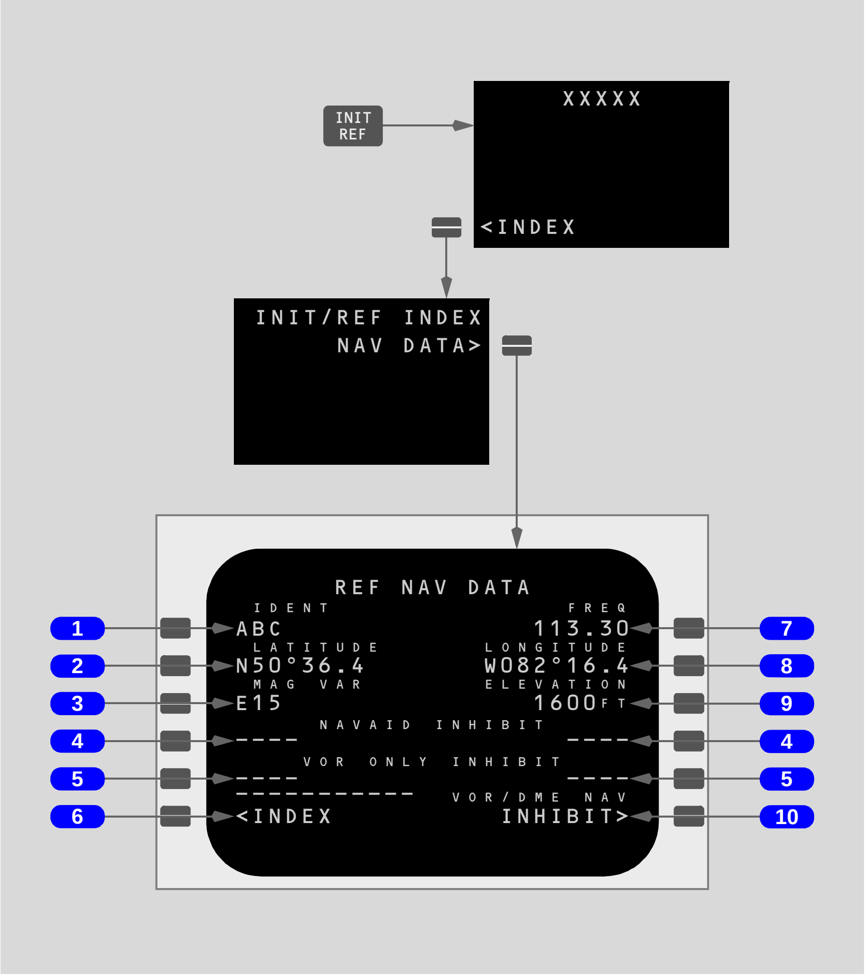
Push - displays RTA PROGRESS page.

ERASE (displays when modification pending).

Push - erases pending modification.

Navigation Data
Reference Navigation Data Page

Reference navigation data page displays data about waypoints, navaids, airports, and runways. This page is used to inhibit FMC position updates from radio navaids. The navaids are available for manual, route, and procedure tuning.



1 Identification (IDENT)

Valid entries are any waypoint, navaid, airport, or destination runway from the navigation database. Pilot defined waypoints such as latitude/longitude are also valid entries when in the active route.

Entry changes to dashes when page is exited and then reselected.

2 **LATITUDE**

Displays latitude of entered identifier.

3 **Magnetic Variation (MAG VAR), LENGTH**

MAG VAR - displays magnetic variation when entered identifier is a navaid.

LENGTH - displays runway length when entered identifier is a runway.

4 **NAVAID INHIBIT**

Valid entries are: VOR, VOR/DME, VORTAC, or DME identifiers from the navigation data base.

Inhibits use of entered navaids for updating by both FMCs.

Entries blank at flight completion.

Deleting or overwriting removes a previous inhibit.

5 **VOR ONLY INHIBIT**

Valid entries are VOR identifiers from the navigation database.

Inhibits use of only the VOR portion of entered navaid for updating by both FMCs.

Entries blank at flight completion.

Deleting or overwriting removes a previous inhibit.

6 **INDEX**

Push - displays INIT/REF INDEX page.

7 **Frequency (FREQ)**

Displays frequency of entered identifier when it is a navaid.

8 **LONGITUDE**

Displays longitude of entered identifier.

9 **ELEVATION**

Displays elevation of entered identifier when it is a navaid, airport, or runway.

10 **VOR/DME NAV INHIBIT, ENABLE**

INHIBIT -

Push -

- inhibits both FMCs from using VOR/DME radio position updating
- displays ENABLE

- does not affect DME/DME radio position updating
- overwrites VOR ONLY INHIBIT entries and displays ALL
- entries clear at flight completion and INHIBIT displays

ENABLE -

Push -

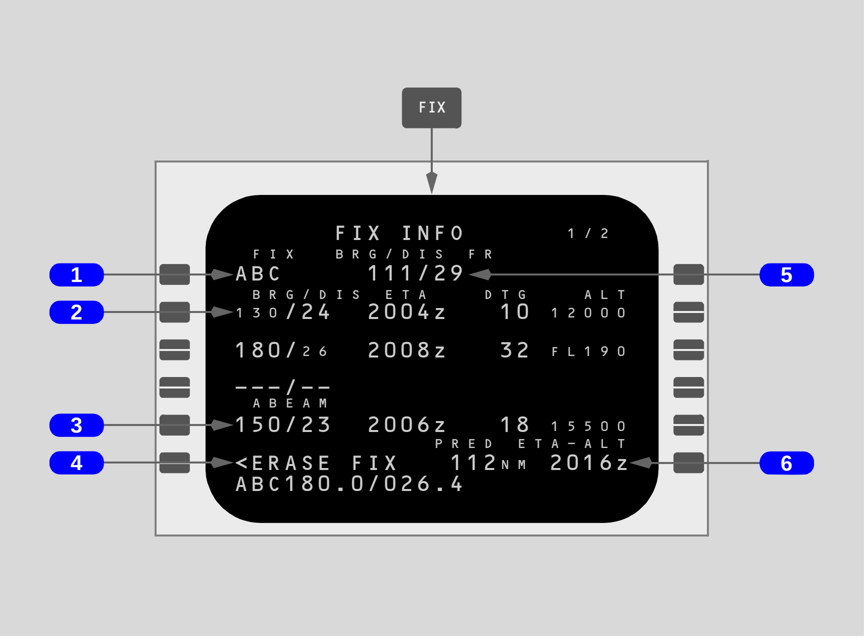
- allows VOR/DME radio position updating
- displays INHIBIT

Fix Information Page

Two identical fix information pages are used to create waypoint fixes and waypoints for the ND. Some of the created waypoints can be copied into the route.

Magnetic/True Bearing

Magnetic or true fix bearings depend on airplane location. Refer to FMC Polar Operations, Flight Management Navigation, section 31.



1 FIX

Valid entries are airports, navaids, and waypoints from the navigation database.

Selected fix displays on the ND.

2 Bearing/Distance (BRG/DIS), ETA, DTG, ALT

Valid entries are:

- a bearing followed by an optional slash, XXX/
- a distance preceded by a slash, /YYYY; leading zeros can be omitted
- a bearing/distance, XXX/YYYY

Distances from the fix display on the ND as a circle around the fix.

When the distance intersects the active route, the ETA, DTG, and altitude at the closest intersection display.

Bearing Entry:

- valid entry is a bearing from the fix, XXX
- slash (/) not required

Bearings from the fix display on the ND as radial lines from the fix.

When the bearing intersects the active route, the ETA, DTG, and altitude at the closest intersection display.

ETA - displays the estimated time of arrival to the intersection point.

DTG - displays the distance to go to the intersection point.

ALT - displays the predicted altitude at the intersection point.

Bearing/distance entries do not display ETA, DTG, or predicted altitude.

Line selection copies the fix in place/bearing/distance format into the scratchpad. Distance displays to the nearest tenth of a nautical mile. This fix can be placed in the route on a LEGS or RTE page as a waypoint.

3 ABEAM

Displays ABEAM prompt.

Push - displays bearing and distance from the fix perpendicular to the nearest segment of the flight plan path, and ETA, DTG, and altitude at the intersection point.

Second push - copies the fix place/bearing/distance definition into the scratchpad. This fix can be placed in the route on a LEGS or RTE page as a waypoint.

4 ERASE FIX

Push - removes all fix data from the page and the ND.

5 Bearing/Distance From (BRG/DIS FR)

Displays the bearing and distance of the airplane from the fix.

6 Predicted Distance to ETA or Altitude (PRED ETA-ALT)

Valid entry is altitude, flight level, or time. Time entry must be followed by “Z”.

Entering an altitude or flight level displays the predicted along track distance and altitude or flight level on this line. The predicted airplane position displays on the ND route line as a green circle with the entered altitude/flight level.

Entering a time displays the predicted along track distance and the time on this line. The predicted airplane position displays on the ND route line as a green circle with the entered ETA.

Route and Waypoint Data

Route Data Page

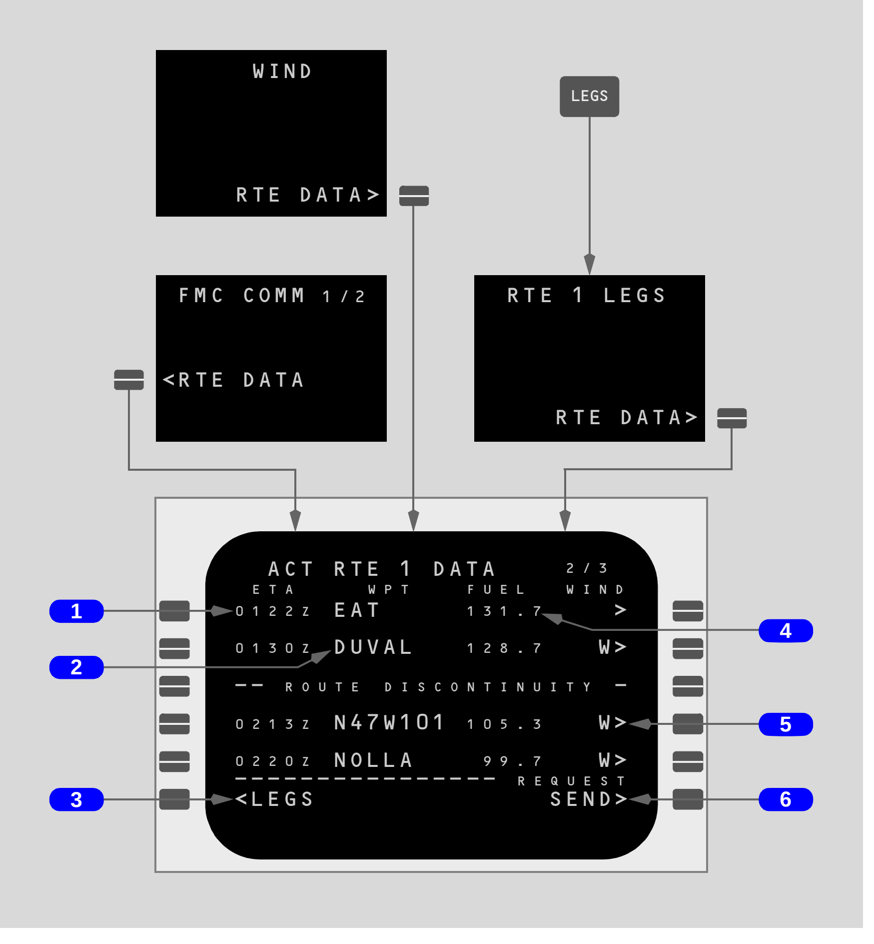
The route data page displays data for each waypoint on ACT RTE X LEGS page. This page also allows access to the WIND page. This page is available only for the active route.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

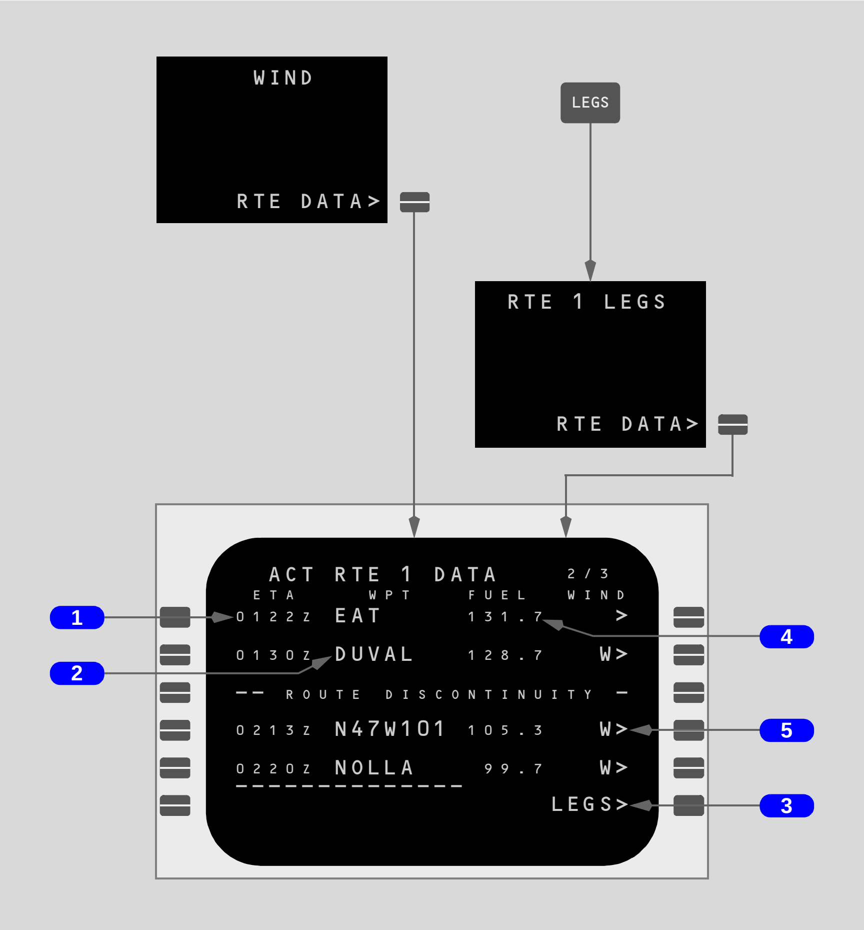
This page allows a downlink request for enroute wind information and allows review of uplinked enroute wind information.

The ETA and calculated fuel remaining display for each waypoint. Manual entry is not possible.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL



VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX



1 **ETA**

Displays ETA for waypoint.

2 **Waypoint (WPT)**

Displays identifier for waypoint.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

3 **LEGS, ERASE**

LEGS -

Push - displays RTE LEGS page.

Displays ERASE prompt when an uplink containing enroute wind data is loaded.

ERASE -

Push -

- rejects uplinked enroute wind data
- displays LEGS prompt

VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX

3 LEGS

LEGS -

Push - displays RTE LEGS page.

4 FUEL

Displays the FMC calculated fuel remaining at the waypoint.

Note: ETA and estimated fuel calculations assume a direct flight across route discontinuities.

5 WIND (W>/>)

W> - indicates waypoint winds have been entered.

> - winds not entered.

Push - displays WIND page for the selected waypoint.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

6 REQUEST SEND, WIND DATA LOAD

Blank when airplane is active on descent or approach.

Displays SEND prompt when datalink ready and airplane is not active on descent or approach.

Displays LOAD prompt when uplink containing enroute wind data received and error checks passed.

SEND -

Push -

- transmits a datalink request for wind and descent forecast data
- displays LOAD prompt and scratchpad message WIND DATA UPLINK READY when an uplink containing enroute wind data received and error checks passed
- displays scratchpad message DES FORECST UPLINK READY and displays LOAD and PURGE prompts on the DESCENT FORECAST page when an uplink containing descent forecast uplink data received and error checks passed

LOAD -

Push -

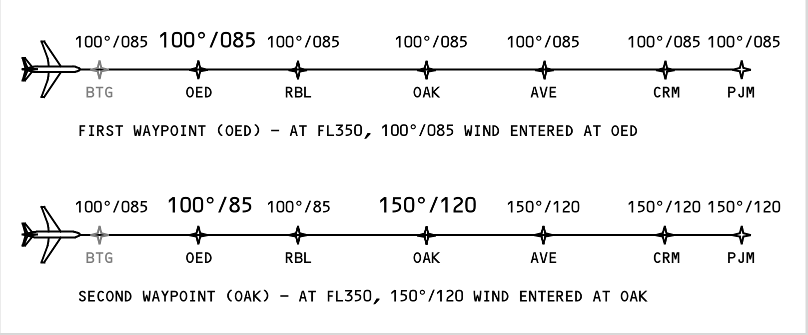
- applies enroute wind data to route and results in a modification
- displays ERASE and SEND prompts

Wind Data

The FMC uses temperature, altitude, and wind direction/speed to improve performance prediction accuracy.

The FMC applies the first entered wind data to all waypoints in the flight plan. Wind data entered at another waypoint (at the same altitude) changes wind data downtrack from the second entered waypoint either to the end of the track or to the next entered wind. The wind data before the second entered waypoint does not change. Therefore, wind data for waypoints closest to the airplane should be entered first, then wind data for downtrack waypoints can be entered.

For example: at FL 350, 100°/085 is entered at waypoint OED. All waypoints in the route have the OED wind data. Then, additional wind data entered at OAK changes the wind data at OAK through the end of the route.



Entered wind data are mixed with sensed wind data for performance predictions. The FMC uses entered winds for predictions far ahead of the airplane and sensed winds close to the airplane. At 200 nm in front of the airplane, the FMC uses 50% predicted winds and 50% sensed winds. Sensed winds display on the PROGRESS page 2.

Inaccurate forecast wind and temperature information degrades the accuracy of the recommended altitude displayed on the cruise page.

The FMC adjusts ECON climb speed and top of climb using entered and/or sensed wind data. FMC calculated ECON climb speed may fluctuate if top of climb is near a waypoint with approximately a 45 degree or larger track change and if a significant wind velocity has been entered or is predicted for that waypoint. This fluctuation does not occur when using a manually entered climb speed or speed intervention.

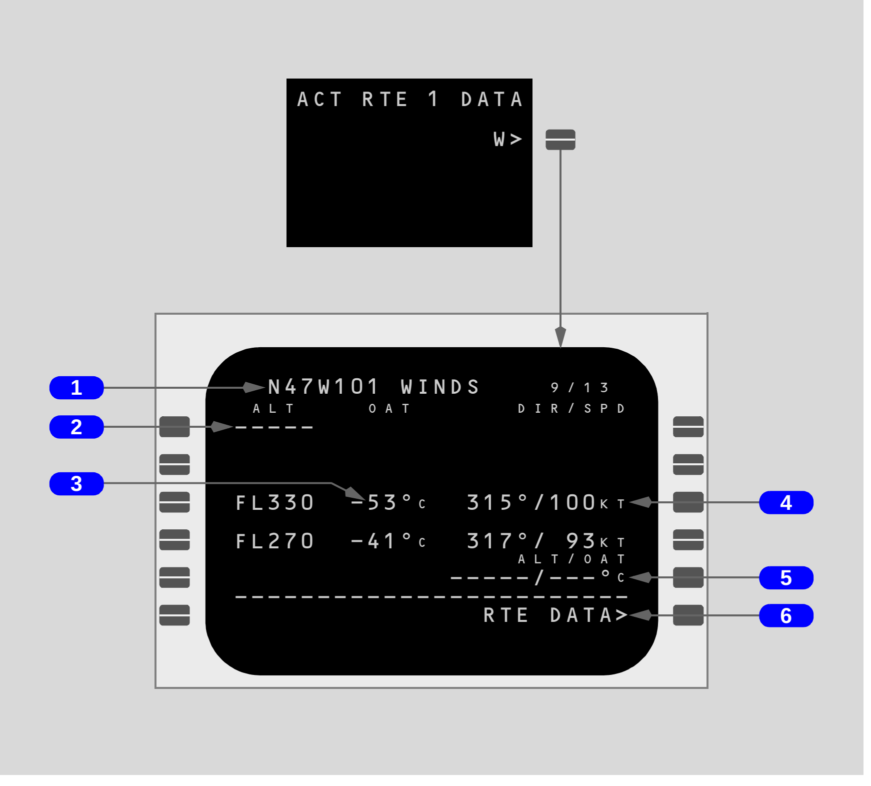
Wind Page

The wind page is used to enter forecast winds and temperatures at waypoints for up to four altitudes to enhance VNAV performance.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
This data can be uplinked or manually entered.

Wind speed and direction are entered for the specific altitudes.

OAT can be entered for any altitude. The FMC calculates the temperature for the entered altitudes using the standard lapse rate.



1 Page Title

Displays XXXXX, where XXXXX is the waypoint for which winds display.

2 Altitude (ALT)

Valid entry is altitude or flight level on line 1L.

After entry, data are sorted by altitude and display in lines 1 through 4. Dashes display on right side of line for wind direction and speed entry.

When all four lines have data, one must be deleted before new altitude can be entered.

3 OAT

Data entry not possible.

OAT displays the outside air temperature. Entries made using the ALT/OAT line display in large font. Calculated OAT based on standard lapse rate display in small font.

4 Direction and Speed (DIR/SPD)

Displays dashes after altitude/flight level entered in the ALT line.

Valid entries are wind direction and speed.

Displays wind direction and speed for related altitude.

Manual entries display in large font.

Values propagate in both directions for the first wind entered and downtrack for other entered winds. Propagated values display in small font.

5 Altitude/Outside Air Temperature (ALT/OAT)

Valid entries are altitude or flight level/and OAT. OAT is a one-to-three digit entry, including the sigh; plus or minus signs are optional. Valid range is -99 to 60.

OATs display in OAT column.

The altitude for OAT does not have to be one of the wind altitudes. The FMC uses standard lapse rate to calculate and display the temperature at the other altitudes.

6 Route Data (RTE DATA)

Push - displays RTE DATA page.

Progress Pages

Progress Page 1/3

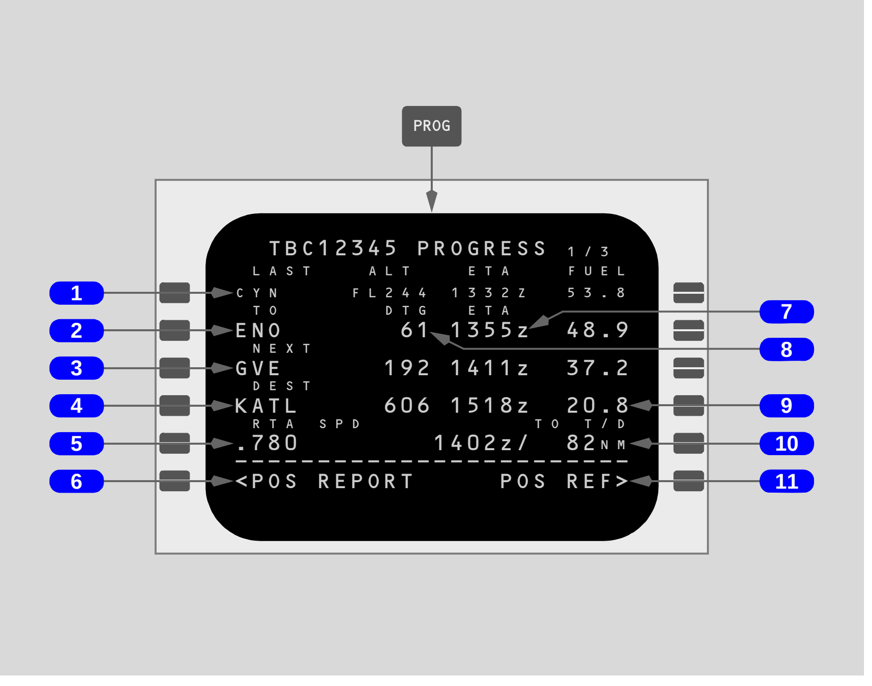
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Progress page displays general flight progress data. The FMC Communication section of Chapter 05, Communications describes CDU position reports.

The page title displays the company flight number entered on the RTE page.

Page one of the progress pages displays general data about:

- waypoints (last, active, and next)
- destination data
- FMC speed
- T/C, T/D, etc.



1 LAST

Displays last waypoint identifer and altitude (ALT), actual time of arrival (ATA), and lesser of calculated or totalizer fuel remaining at LAST waypoint.

2 TO

Displays active waypoint identifier.

3 NEXT

Displays waypoint identifier of waypoint after the active waypoint.

4 Destination (DEST)

Displays destination identifier.

Valid entry is any airport or waypoint in navigation database or waypoint in the flight plan. The line titles are:

- DEST - performance predictions to destination. Default display
- DIR TO ALTERNATE - performance predictions to alternate. Line data based on flying direct to the alternate
- EN ROUTE WPT - when entered waypoint is in flight plan. Line data based on flying the flight plan route to the waypoint
- MOD - a modification has been made on another page. Performance predictions include modification

Remove entries with DELETE key or change all CDUs to a different page.

5 Selected Speed (SEL SPD)

Displays active command speed and mode.

The active speed mode is the same as displayed on the active VNAV page, unless changed by the MCP or a limit. Speed modes are:

- ECON SPD - economy speed
- LRC SPD - long range cruise speed
- SEL SPD - selected speed manually entered on the CDU
- EO SPD - engine out speed
- LIM SPD - speed is limited by VMO, MMO, flap limit, or alpha limit
- MCP SPD - MCP speed entered on the MCP IAS/MACH indicator
- VREF +100 - engine out during takeoff, engine out not selected, and speed not restricted by limit speed (e.g., flap placard)
- RTA SPD - RTA SPD when RTA mode active

6 Position Report (POS REPORT)

Push - displays the POS REPORT page.

7 ETA

Displays estimated time of arrival at waypoint or destination.

8 Distance To Go (DTG)

Displays distance to go to waypoint or destination.

9 **FUEL**

Displays estimated fuel remaining at waypoint or destination.

10 **TO T/D**

Data line displays ETA and DTG to line title point.

Line titles are:

- T/C - top of climb data
- STEP CLB - step climb data
- T/D - top of descent data
- E/D - end of descent data
- LEVEL AT - time and distance to level off when drift down active

11 **Position Reference (POS REF)**

Push - displays position reference page 2/3.

Progress Page 1/2

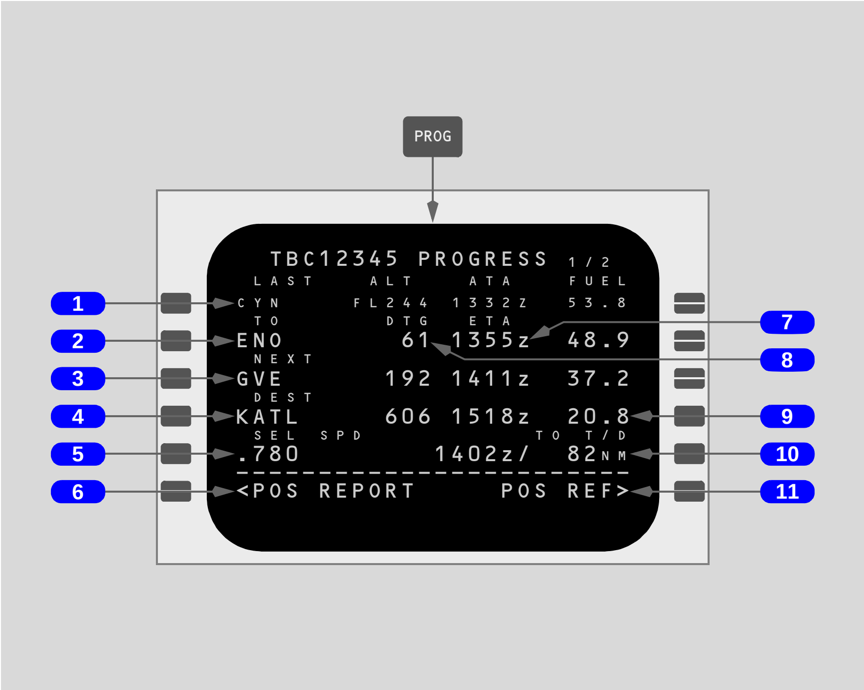
VQ-BHW, VQ-BHX

Progress page displays general flight progress data. The FMC Communication section of Chapter 05, Communications describes CDU position reports.

The page title displays the company flight number entered on the RTE page.

Page one of the progress pages displays general data about:

- waypoints (last, active, and next)
- destination data
- T/C, T/D, etc.



1 LAST

Displays last waypoint identifer and altitude (ALT), actual time of arrival (ATA), and lesser of calculated or totalizer fuel remaining at LAST waypoint.

2 TO

Displays active waypoint identifier.

3 NEXT

Displays waypoint identifier of waypoint after the active waypoint.

4 Destination (DEST)

Displays destination identifier.

Valid entry is any airport in navigation database or waypoint in the flight plan. The line titles are:

- DEST - performance predictions to destination. Default display
- DIR TO ALTERNATE - performance predictions to alternate. Line data based on flying direct to the alternate

- EN ROUTE WPT - when entered waypoint is in flight plan. Line data based on flying the flight plan route to the waypoint
- MOD - a modification has been made on another page. Performance predictions include modification

Remove entries with DELETE key or change all CDUs to a different page.

5 Selected Speed (SEL SPD)

Displays active command speed and mode.

The active speed mode is the same as displayed on the performance page, unless changed by the MCP or a limit. The speed modes are:

- ECON SPD - economy speed
- LRC SPD - long range cruise speed
- SEL SPD - selected speed manually entered on the CDU
- EO SPD - engine out speed
- LIM SPD - speed is limited by VMO, MMO, flap limit, or alpha limit
- MCP SPD - MCP speed entered on the MCP IAS/MACH indicator
- VREF +100 - engine out during takeoff, engine out not selected, and speed not restricted by limit speed (e.g., flap placard)

6 Position Report (POS REPORT)

Push - displays the POS REPORT page.

7 ETA

Displays estimated time of arrival at waypoint or destination.

8 Distance To Go (DTG)

Displays distance to go to waypoint or destination.

9 FUEL

Displays estimated fuel remaining at waypoint or destination.

10 TO T/D

Data line displays ETA and DTG to line title point.

Line titles are:

- T/C - top of climb data
- STEP CLB - step climb data
- T/D - top of descent data
- E/D - end of descent data
- LEVEL AT - time and distance to level off when drift down active

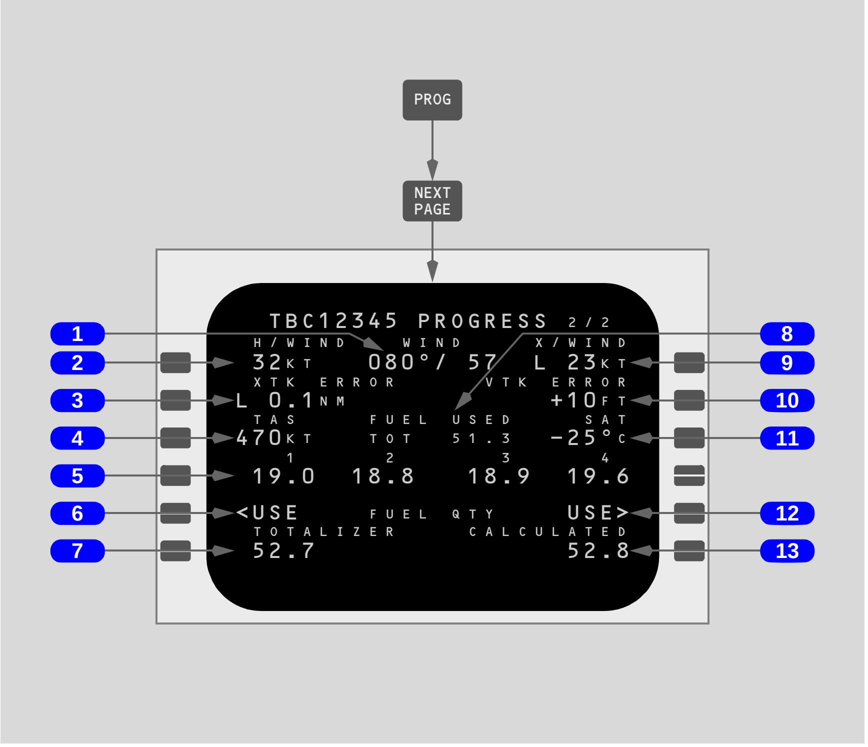
11 Position Reference (POS REF)

Push - displays position reference page 2/3.

Progress Page 2/2
VQ-BHW, VQ-BHX

Progress page two contains:

- wind data
- fuel data
- static air temperature
- true airspeed
- track error data



1 WIND

Displays current wind direction and speed referenced to true north.

2 Headwind (H/WIND), Tailwind (T/WIND)

Displays headwind (H/WIND) or tailwind (T/WIND) component.

Wind component data is relative to airplane heading.

3 Crosstrack Error (XTK ERROR)

Displays crosstrack (XTK) error in nautical miles left or right of the active route.

4 **TAS**

Displays airplane true airspeed.

5 **FUEL USED 1, 2, 3, 4**

Displays fuel used by engines 1, 2, 3, 4 sensed by fuel flow meters.

6 **USE TOTALIZER**

Displays USE prompt and scratchpad message FUEL DISAGREE - PROG 2 if a difference of 4,080 kilograms or more exists between TOTALIZER and CALCULATED fuel quantity for 5 minutes.

Push -

- FMC uses fuel quantity processor computations to determine fuel quantity
- blanks CALCULATED and FUEL USED displays
- PERF INIT page fuel quantity retitled SENSED

7 **FUEL Quantity (QTY) TOTALIZER**

Displays fuel quantity calculated by fuel quantity processor.

Blank if fuel value manually entered on PERF INIT page.

8 **FUEL USED Total (TOT)**

Displays total fuel used as calculated from fuel flow.

9 **Crosswind (X/WIND)**

Displays left (L) or right (R) crosswind component relative to airplane heading.

10 **Vertical Track Error (VTK ERROR)**

Displays vertical path (VTK) error above (+) or below (-) vertical path.

Blank when vertical-track error is invalid or both routes are inactive.

11 **Static Air Temperature (SAT)**

Displays outside static air temperature.

12 **USE CALCULATED**

Displays USE prompt and scratchpad message FUEL DISAGREE - PROG 2 if a difference of 4,080 kilograms or more exists between TOTALIZER and CALCULATED fuel quantity.

Push -

- FMC uses calculated fuel quantity values
- blanks TOTALIZER display

13 FUEL Quantity (QTY) CALCULATED

Fuel remaining as calculated by the FMC:

- before engine start, displays fuel quantity calculated by fuel quantity system totalizer
- after engine start, displays fuel quantity at engine start decreased by total fuel flow (FUEL USED)
- after fuel jettison or after all engines are shut down, CALCULATED resets to fuel quantity system totalizer

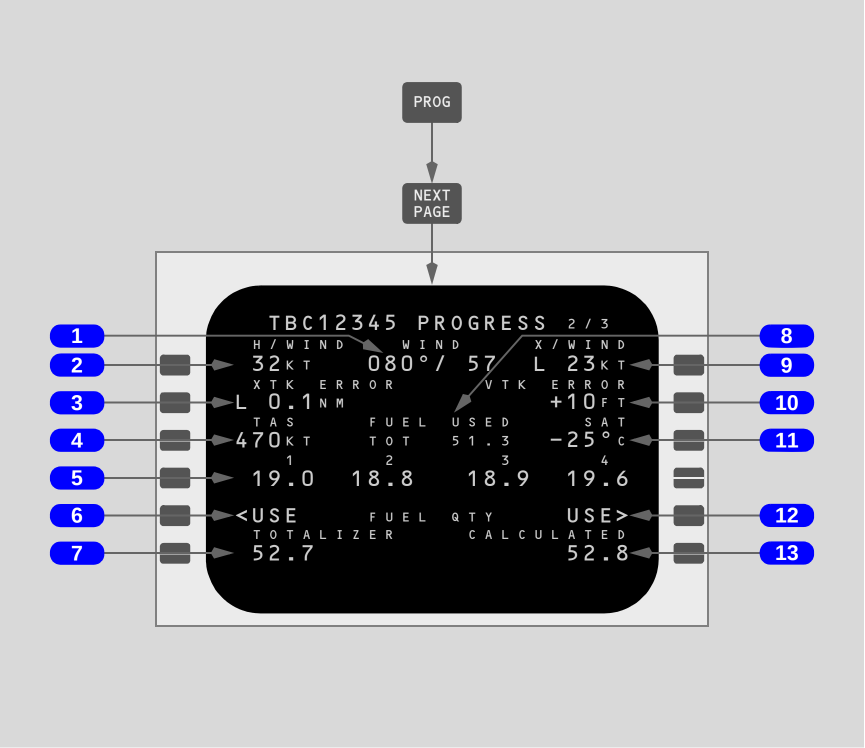
The fuel remaining line displays two independent fuel remaining values, TOTALIZER and CALCULATED. They can be compared to validate FMC calculations. Fuel flow rate sensing tolerances may allow the CALCULATED and the TOTALIZER fuel quantities to be different by as much as 25 to 40 kilograms per hour.

Progress Page 2/3

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Progress page two contains:

- wind data
- fuel data
- static air temperature
- true airspeed
- track error data



1 WIND

Displays current wind direction and speed referenced to true north.

2 Headwind (H/WIND), Tailwind (T/WIND)

Displays headwind (H/WIND) or tailwind (T/WIND) component.

Wind component data is relative to airplane heading.

3 Crosstrack Error (XTK ERROR)

Displays crosstrack (XTK) error in nautical miles left or right of the active route.

4 **TAS**

Displays airplane true airspeed.

5 **FUEL USED 1, 2, 3, 4**

Displays fuel used by engines 1, 2, 3, 4 sensed by fuel flow meters.

6 **USE TOTALIZER**

Displays USE prompt and scratchpad message FUEL DISAGREE - PROG 2 if a difference of 4,080 kilograms or more exists between TOTALIZER and CALCULATED fuel quantity.

Push -

- FMC uses fuel quantity processor computations to determine fuel quantity
- blanks CALCULATED and FUEL USED displays
- PERF INIT page fuel quantity retitled SENSED

7 **FUEL Quantity (QTY) TOTALIZER**

Displays fuel quantity calculated by fuel quantity processor.

Blank if fuel value manually entered on PERF INIT page.

8 **FUEL USED Total (TOT)**

Displays total fuel used as calculated from fuel flow.

9 **Crosswind (X/WIND)**

Displays left (L) or right (R) crosswind component relative to airplane heading.

10 **Vertical Track Error (VTK ERROR)**

Displays vertical path (VTK) error above (+) or below (-) vertical path.

Blank when descent not active.

11 **Static Air Temperature (SAT)**

Displays outside static air temperature.

12 **USE CALCULATED**

Displays USE prompt and scratchpad message FUEL DISAGREE - PROG 2 if a difference of 4,080 kilograms or more exists between TOTALIZER and CALCULATED fuel quantity.

Push -

- FMC uses calculated fuel quantity values
- blanks TOTALIZER display

13 FUEL Quantity (QTY) CALCULATED

Fuel remaining as calculated by the FMC:

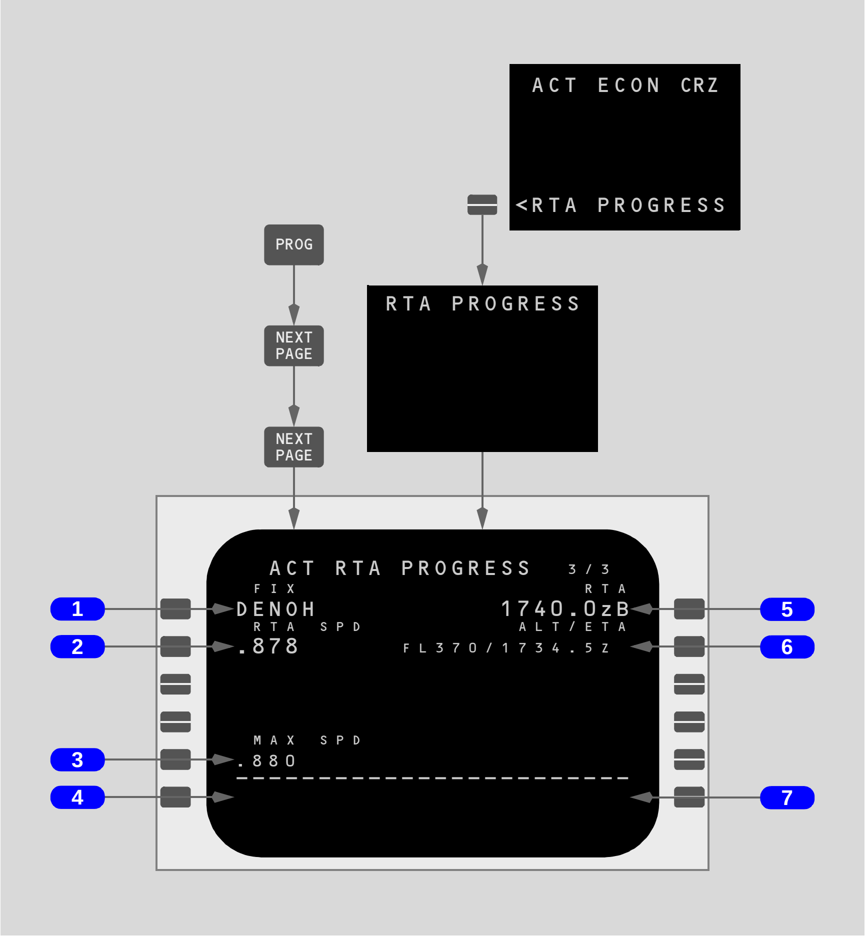
- before engine start, displays fuel quantity calculated by fuel quantity system totalizer
- after engine start, displays fuel quantity at engine start decreased by total fuel flow (FUEL USED)
- after fuel jettison or after all engines are shut down, CALCULATED resets to fuel quantity system totalizer

The fuel remaining line displays two independent fuel remaining values, TOTALIZER and CALCULATED. They can be compared to validate FMC calculations. Fuel flow rate sensing tolerances may allow the CALCULATED and the TOTALIZER fuel quantities to be different by as much as 25 to 40 kilograms per hour.

RTA Progress Page 3/3

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Progress page three is used to enter data for required time of arrival (RTA). RTA can be entered or changed during preflight or in flight. Creating an RTA changes PROGRESS and CRZ page titles to include RTA. RTA operates only in cruise.



1 FIX

Displays boxes when an active or modified route exists.

Entry by flight crew or datalink.

Valid entry is a waypoint in the active or pending active route prior to the missed approach. Waypoints defined by coordinates must be down selected to the scratchpad, then selected to the FIX line.

Entry displays boxes in 1R and the ALT/ETA line title at 2R.

When RTA active, deletion of FIX terminates RTA mode and resumes ECON. Display returns to boxes.

When RTA not active, deletion of FIX erases a pending RTA MOD. Display returns to boxes.

Displays blank if engine out has been selected.

2 Required Time Of Arrival Speed (RTA SPD)

Displays FMC computed cruise speed to accomplish RTA.

Blank if no RTA fix or time entered.

3 Maximum Speed (MAX SPD)

Valid entry is Mach .100 to .99; displays in large font.

Deletion of entered value displays default Mach .880 in small font.

4 ERASE

Displays ERASE when modification pending.

Push - displays previous unmodified page, or if no previous active values, deletes RTA in 1R.

5 Required Time Of Arrival (RTA)

Boxes display after entry of FIX in 1L.

Valid entry is time from 0000.0 to 2359.9. Decimal entry of .0 is optional.

Suffix to RTA indicates:

- no suffix - arrive at entered time
- A - arrive at or after entered time
- B - arrive at or before entered time

Deletion terminates RTA and returns ECON as cruise mode.

6 Altitude/ETA (ALT/ETA)

Displays predicted altitude and ETA at RTA fix after entry of FIX in 1L.

Blank until performance data is entered.

7 PRIOR RTA

Displays when prior RTA fix and time exists.

Push -

- displays previous RTA fix and time
- initiates RTA flight plan modification

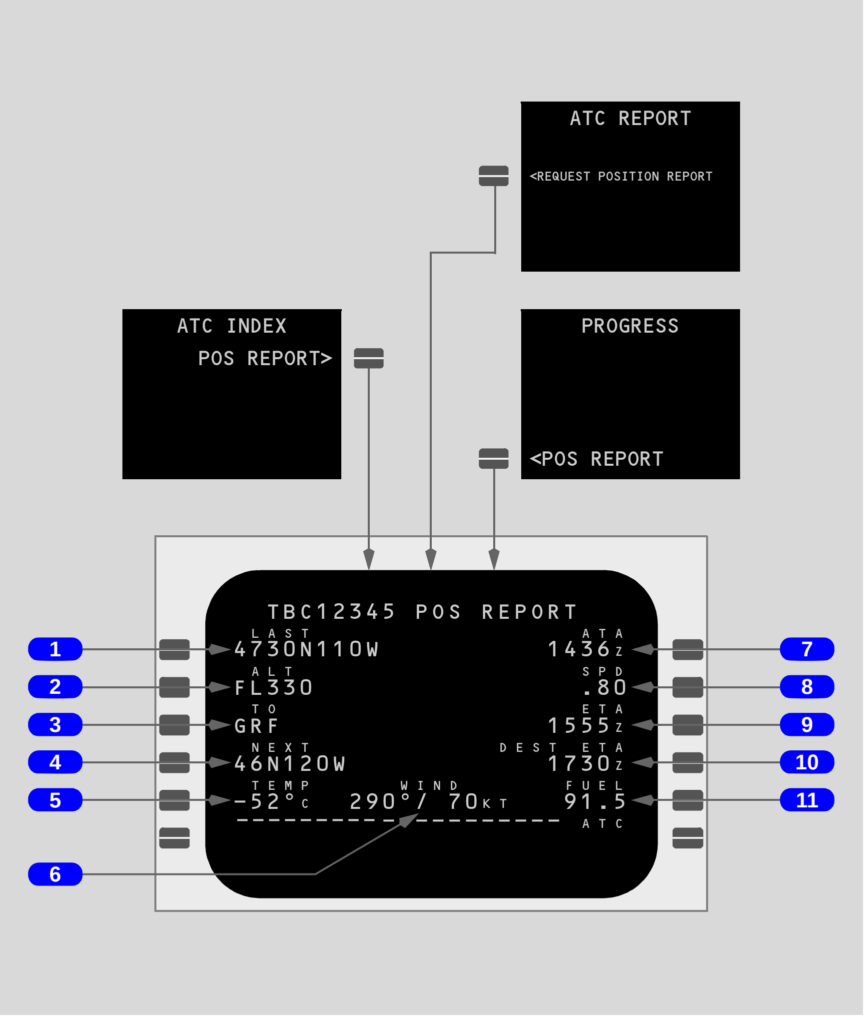
Execution activates RTA function.

Position Report

VP-BKJ, VP-BVR
(VQ-BHW, VQ-BHX ; before SB, ATS not active)

XXXX Position Report Page

The XXXX POS REPORT page allows review of the position report before transmitting to ATC. XXXX is the flight number.



1 LAST Waypoint

Displays waypoint identifier for last sequenced leg.

2 **Altitude (ALT)**

Displays current altitude.

3 **TO Waypoint**

Displays waypoint identifier of current leg.

4 **NEXT Waypoint**

Displays waypoint identifier of leg following the TO leg.

5 **Temperature (TEMP)**

Displays current static air temperature.

6 **WIND**

Displays current wind direction and magnitude.

7 **Actual Time of Arrival (ATA)**

Displays ATA at last sequenced waypoint.

8 **Speed (SPD)**

Displays current airspeed/Mach.

9 **Estimated Time of Arrival (ETA)**

Displays ETA at TO waypoint.

10 **Destination Estimated Time of Arrival (DEST ETA)**

Displays ETA at destination.

11 **FUEL**

Displays lesser of calculated or totalizer fuel remaining at LAST waypoint.

Introduction

The descent phase starts at the top of descent point and continues to the end of descent point. Planning for descent phase starts during cruise.

The approach phase starts at the end of descent point and continues to touchdown or missed approach. If a go-around is accomplished, the FMC climb mode activates.

Early Descent

An early descent is a descent started prior to the T/D. The VNAV descent page becomes active.

During cruise, setting an altitude below the current cruise altitude in the MCP altitude window and pushing the altitude selector activates the DES NOW function when the aircraft is within 50 nm of the T/D or if the MCP altitude is set below the highest descent altitude constraint in the VNAV descent profile.

Descent

During descent, the RTE LEGS and PROGRESS pages are used to control the lateral route. The DES page is used to control the vertical descent profile.

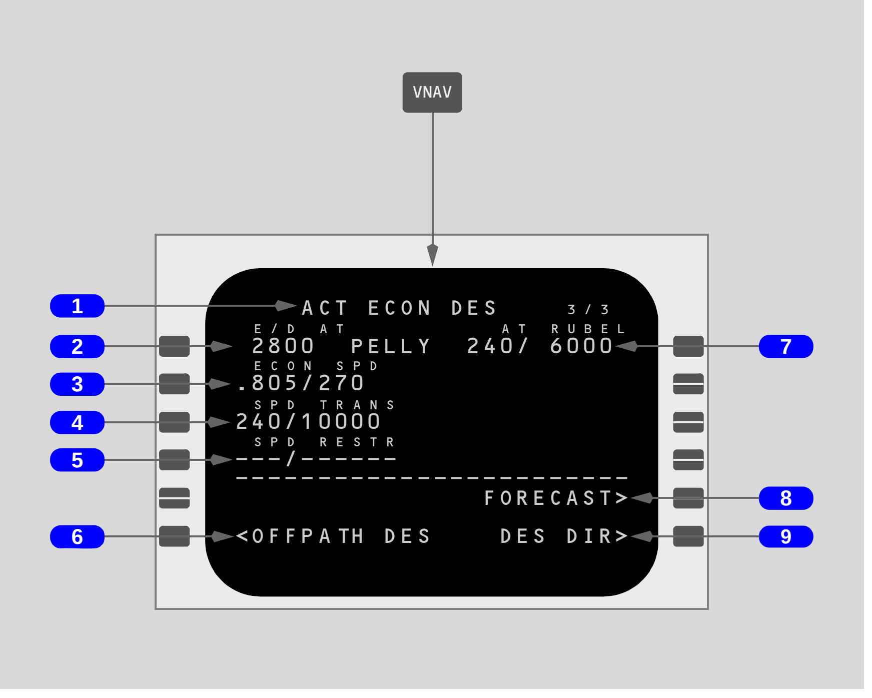
The additional descent pages listed below are used to:

- DESCENT FORECAST page - enter forecast wind data to aid descent planning
- OFFPATH DES page - analyze descent performance with and without the use of speedbrakes

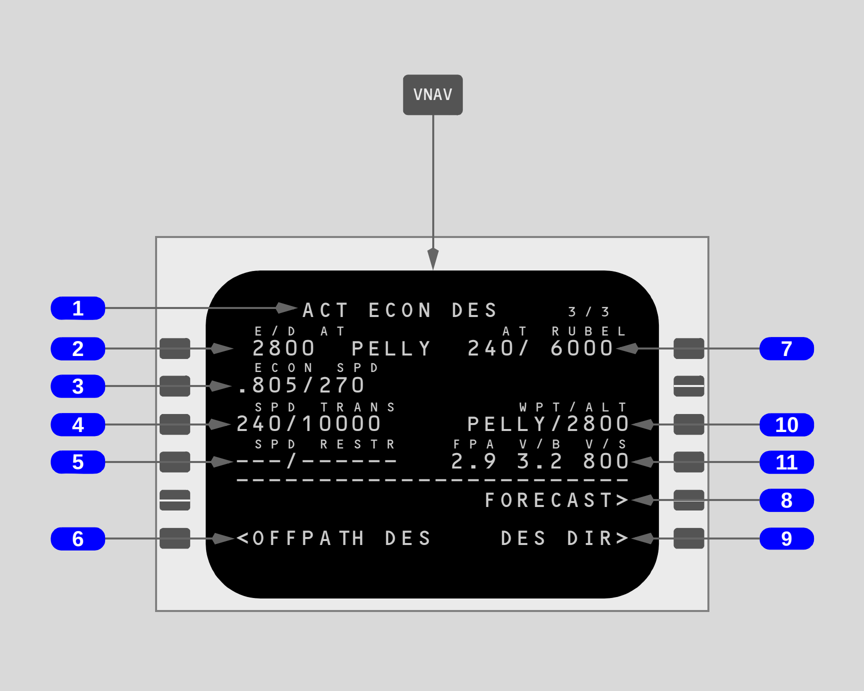
Descent Page

The DES page is used to monitor and revise the descent path. Descent speeds are economy (ECON) and selected speed (SEL). The default VNAV descent speed is ECON. A selected speed descent is flown when speed intervention is used or a speed is entered on the DES page. The DES page is blank with DES as the title until an altitude constraint below the cruise altitude is entered.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



1 Page Title

The page title displays active (ACT) or modified (MOD) descent. Usually, the title contains ECON for economy descent. Other fixed or selected speeds modify the title.

The page title displays the type of descent:

- ACT ECON DES - speed based on a cost index
- ACT MCP SPD DES - MCP speed intervention selected
- ACT XXXKT DES - fixed CAS descent speed profile
- ACT M.XXX DES - fixed Mach descent speed segment selected
- ACT LIM SPD DES - speed based on an envelope limiting speed
- ACT END OF DES - airplane has sequenced E/D constraint

Fixed or selected descent speeds are for:

- a flight crew selected speed (SEL SPD)
- a speed transition
- a speed restriction associated with an altitude constraint
- waypoint speed constraints

2 End Of Descent At (E/D AT)

Displays end of descent altitude and waypoint.

End of descent point is a point in descent phase with the lowest altitude constraint.

Page is blank if no E/D point exists.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

Both CAS and Mach values display.

ECON SPD -

- economy speed based on cost index
- displays CAS and Mach values

SEL SPD -

- displays when transitioning from ECON speed into a selected speed segment (waypoint speed constraint, SPD RESTR, or SPD TRANS)
- displays when flight crew enters speed
- valid entries are CAS or Mach value

4 Speed Transition (SPD TRANS)

Transition speed is usually 10 knots less than the destination airport limiting speed from the navigation database. When no airport limit speed exists, the default speed of 240 knots displays. Transition altitude is the point transition speed is active for the destination airport. When no altitude exists in the navigation database, the default of 10,000 feet displays.

Blanks below SPD TRANS altitude.

Deleting causes the airplane to fly economy or selected speed if not limited by a waypoint constraint or speed restriction.

5 Speed Restriction (SPD RESTR)

Speed restrictions at an altitude higher than E/D altitude and not associated with specific waypoints are manually entered on this line.

Displays dashes before entry by flight crew.

Valid entry is a CAS and altitude (example: 240/8000).

6 Off Path Descent (OFFPATH DES)

Push - displays OFFPATH DES page.

7 AT XXXXX

Displays the next waypoint constraint from RTE LEGS page.

Line title is:

- AT XXXXX, or
- HOLD AT XXXXX, where XXXXX is the constrained waypoint or holding fix, or
- AT VECTORS, or
- AT (INTC), or
- AAAA/DD or AAA RRR, where AAAA is a navaid name; DD is distance in nm and RRR is the radial

The constraint is an altitude or a speed/altitude; blank when no constraint exists; can be deleted on this page.

VNAV commands the lesser of constraint speed or present performance speed.

8 FORECAST

Push - displays DESCENT FORECAST page.

9 Descend Direct (DES DIR), Descend Now (DES NOW)

DES DIR -

Displays in descent phase with altitude constraint between airplane and E/D.

Push - deletes all waypoint altitude constraints between the airplane altitude and the MCP altitude. FMC cruise altitude is not affected.

DES NOW -

Displays when T/D created and the descent phase is not active.

Push -

- provides guidance to descend at approximately 1,250 feet per minute using the active descent speed schedule. Thrust levers may be manually repositioned to adjust vertical speed. Upon intercepting the planned descent path, the airplane transitions to the planned descent path
- activates FMC descent phase

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

10 Waypoint/Altitude (WPT/ALT)

Line title appears even though the descent page is blank. Defaults to the same waypoint/altitude restriction displayed on the AT line (1R); may be overwritten by pilot entry. Valid entry is any navigation database waypoint, latitude/longitude, or waypoint from the flight plan.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

11 Flight Path Angle, Vertical Bearing, and Vertical Speed (FPA, V/B, V/S)

Initially displays dashes. Following entry of waypoint/altitude:

- FPA - displays the current airplane flight path angle
- V/B - displays vertical bearing from current position to the entered waypoint and altitude
- V/S - displays required vertical speed to maintain the vertical bearing

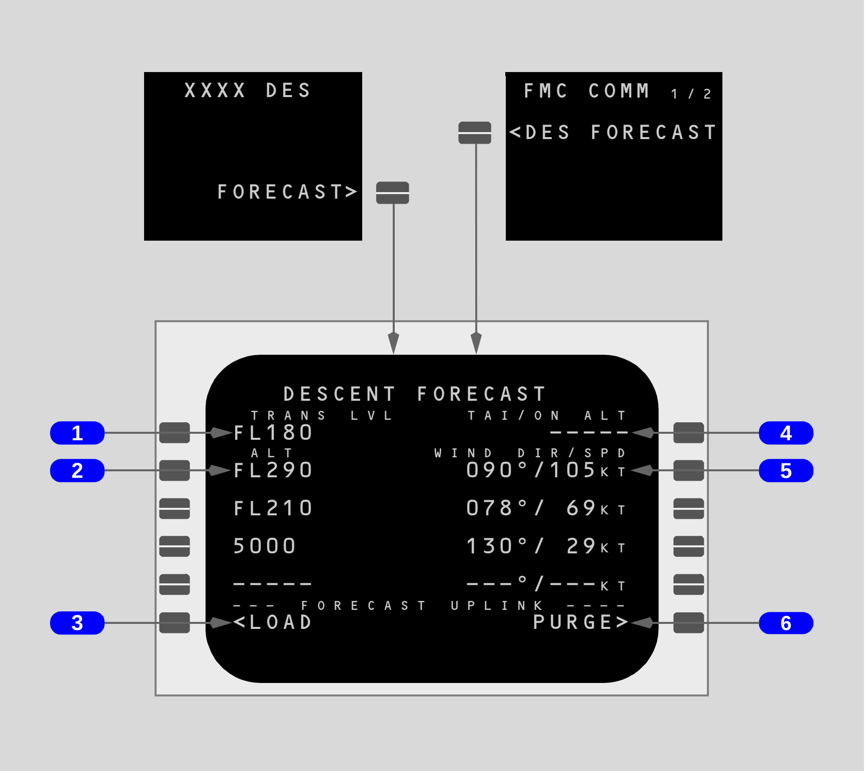
Data blanks if airplane climbs or descends below the entered altitude.

Descent Forecast Page

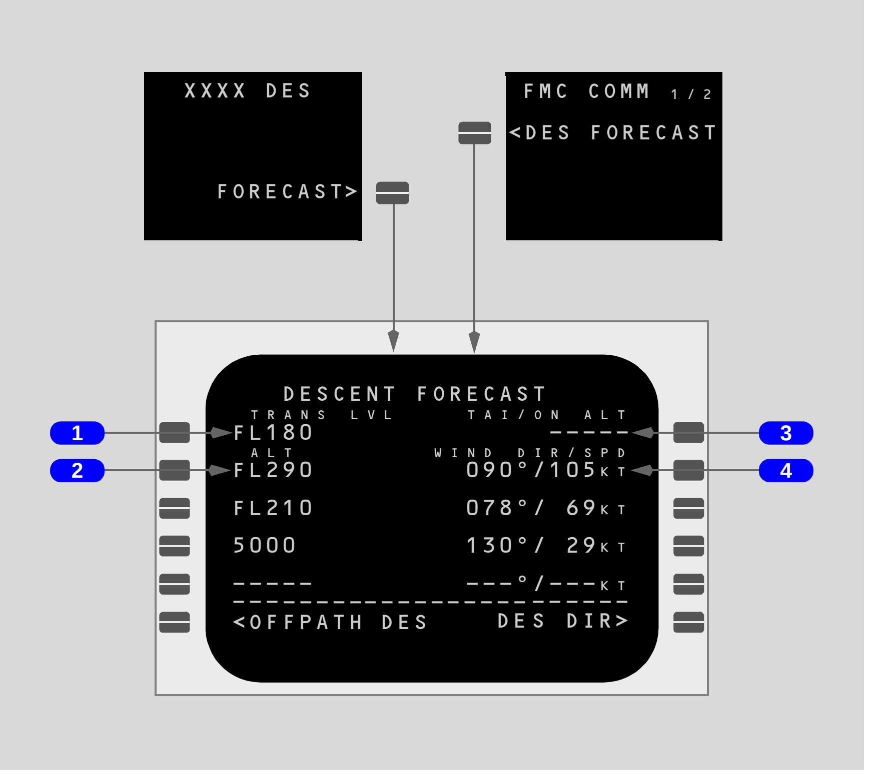
Descent forecast page is used to enter wind data for descent, and the altitude at which anti-ice use is anticipated for more accurate descent path calculation.

Primary entries are wind direction and speed for up to four descent altitudes, and the altitude anti-ice is to be turned on. Entries can be manual or uplinked.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL



VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX



1 **Transition Level (TRANS LVL)**

Transition level can be specified by the arrival procedure. The default transition level is FL180.

Valid entry is an altitude or flight level.

The FMC uses transition level to change displays between FL and feet.

2 **Altitude (ALT)**

Valid entries are altitudes and flight levels.

Altitudes and flight levels can be entered in any order. Entries are not sorted.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

3 **REQUEST SEND, FORECAST UPLINK LOAD, DATALINK**

Displays SEND prompt when datalink READY and no uplink pending.

SEND -

Push -

- transmits datalink request for descent wind data
- displays scratchpad message DESCENT FORECAST UPLINK READY and displays LOAD and PURGE prompts when an uplink containing descent forecast uplink data received and error checks passed

LOAD -

Push -

- accepts and displays request for descent wind data
- displays SEND prompt
- changes PURGE prompt to DES prompt

Displays DATA LINK and data line NO COMM, VOICE, or FAIL if datalink is not READY.

VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX

3 Thermal Anti-Ice On Altitude (TAI/ON ALT)

Valid entry is altitude or flight level where anti-ice is to be first turned on during the descent.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

4 Thermal Anti-Ice On Altitude (TAI/ON ALT)

Valid entry is altitude or flight level where anti-ice is to be first turned on during the descent.

VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX

4 Wind Direction/Speed (WIND DIR/SPD)

Valid entry is wind direction/speed for the specified altitude. Initial entry must have wind direction and speed, subsequent entries may have one or the other.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

5 Wind Direction/Speed (WIND DIR/SPD)

Valid entry is wind direction/speed for the specified altitude. Initial entry must have wind direction and speed, subsequent entries may have one or the other.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

6 FORECAST UPLINK PURGE, Descent (DES)

Displays PURGE prompt when an uplink containing descent forecast uplink data received and error checks passed.

PURGE -

Push - rejects uplinked descent forecast data.

DES -

Push - displays the DES page.

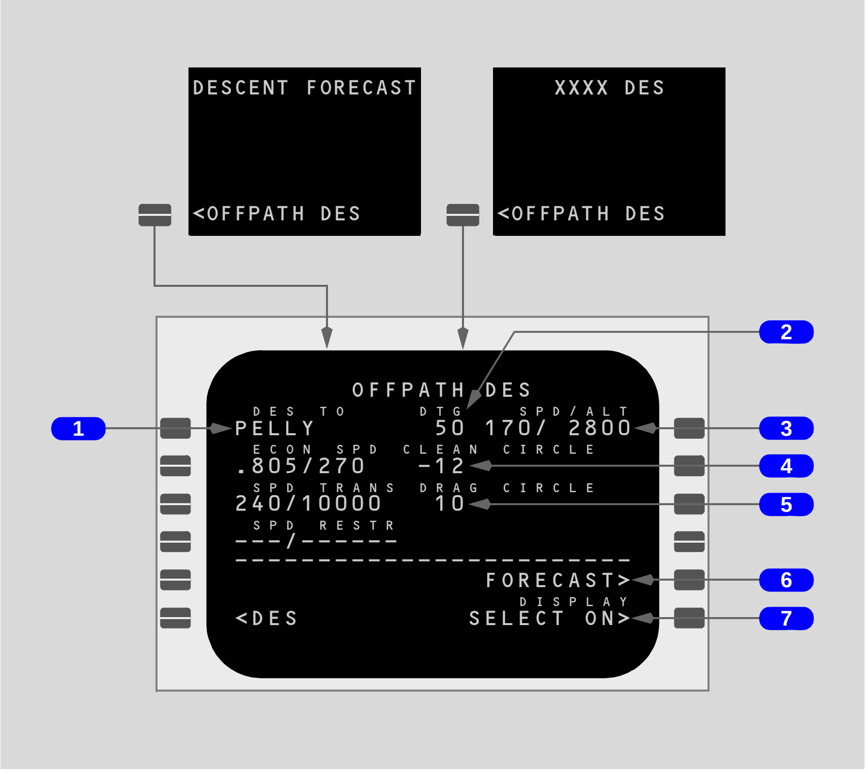
Offpath Descent Page

Offpath descent page allows the analysis of descent performance direct to a selected waypoint. Data entered displays clean and drag descent ranges on the page and on the ND. Ranges are based on an entered waypoint and altitude constraint. Range can be used to determine if the altitude constraint can be met in a direct descent to the waypoint.

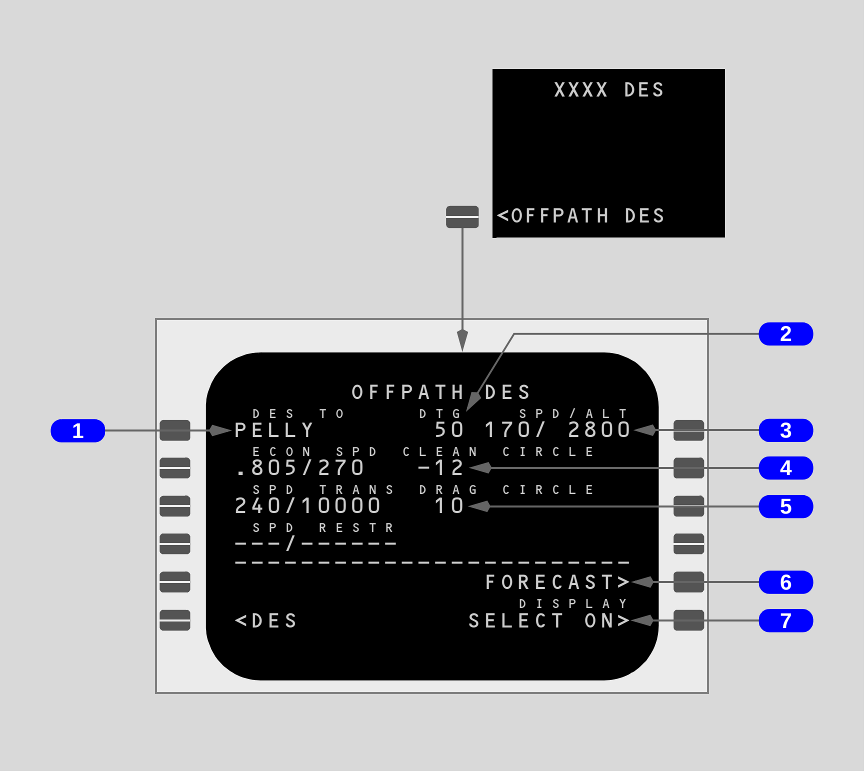
The FMC displays the last descent waypoint with an altitude constraint in DES TO.

The ECON SPD, SPD TRANS, SPD RESTR, and DES data are the same as the DES page.

VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL



1 Descend To (DES TO)

The waypoint for a direct-to descent. Usually, this is the E/D waypoint from the DES page. DTG calculations are for a descent direct to the DES TO waypoint.

Valid entry is any navigation data base waypoint.

When within 150 feet of the DES TO waypoint altitude for a waypoint other than the E/D waypoint, the display changes from DES TO waypoint to the E/D waypoint from DES page.

2 Distance To Go (DTG)

Displays straight line distance to the entered waypoint.

3 Speed/Altitude (SPD/ALT)

Displays the speed/altitude constraint from the E/D waypoint on the DES page or from an entered active waypoint which has a speed/altitude constraint. Other entries cause prompt boxes to display.

4 CLEAN CIRCLE

Displays distance to the clean descent circle. Distance is negative when a clean descent is no longer possible.

A clean circle assumes no drag devices are used for descent.

A direct descent to the DES TO waypoint at a SPD/ALT constraint is possible when the airplane is outside the clean circle.

5 DRAG CIRCLE

Displays distance to the drag descent circle. Distance is negative when a drag descent is no longer possible.

A drag circle assumes speedbrakes are UP for descent.

A direct descent to the DES TO waypoint at a SPD/ALT constraint is possible when the airplane is outside the drag circle.

6 FORECAST

PUSH - displays DESCENT FORECAST page.

7 DISPLAY SELECT ON, SELECT OFF

SELECT ON -

Push -

- displays CLEAN CIRCLE on ND
- displays DRAG CIRCLE on ND after aircraft inside CLEAN CIRCLE

SELECT OFF -

Push - removes clean and drag circles from the ND.

Engine Out Descent

There are no specific engine out pages for descent. Use the all-engine descent planning features and pages.

Approach

During an ILS or LOC approach, roll and pitch modes change to approach guidance supplied by navigation radios. The FMC continues to calculate and display present position and can supply LNAV and VNAV approach guidance for certain types of approaches when radio navigation is not used.

RTE LEGS and PROGRESS pages are used to manage the airplane until other approach guidance becomes active.

During approach, the specific page listed below is used to:

- APPROACH REF page - specify approach flap settings and set the approach VREF
- ARRIVALS page - select arrival and approach procedures
- HOLD page - manage holding patterns

Accessing the arrivals page more than 400 NM from the departure airport, more than halfway along the active route, beyond the top of climb and within two minutes of top of descent, or beyond the top of descent, displays arrivals for the destination airport. Prior to sequencing any of these points, accessing the arrivals page displays arrivals for the departure airport.

Sequencing any of the above points also causes the FMC to send landing altitude data to the cabin altitude controller. Until an arrival approach has been selected into the active flight plan, the destination airport altitude is used by the cabin altitude controller.

Arrivals Page - IFR Approaches

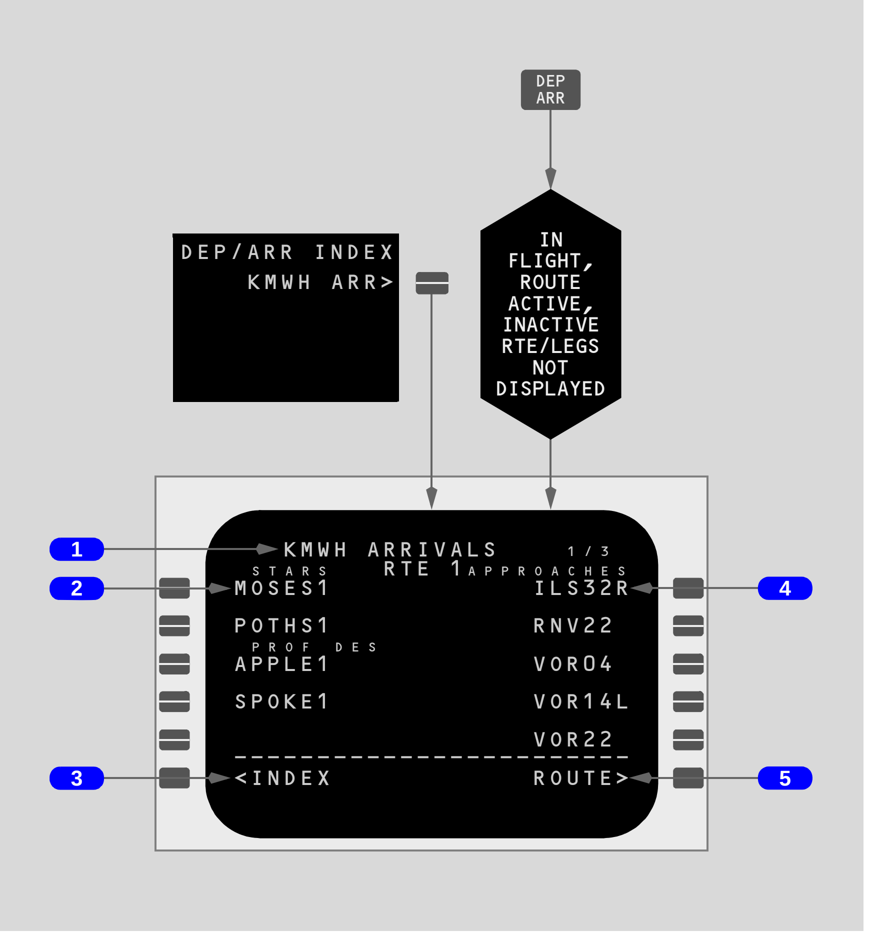
The arrivals page allows selection of an approach, standard terminal arrival route (STAR), and an arrival transition to the destination airport. This page can also be used to view data about a selected airport that is not the destination. Route 1 and route 2 have separate arrival pages.

The approaches, STARS/profile descents, and transitions are displayed and selected on this page.

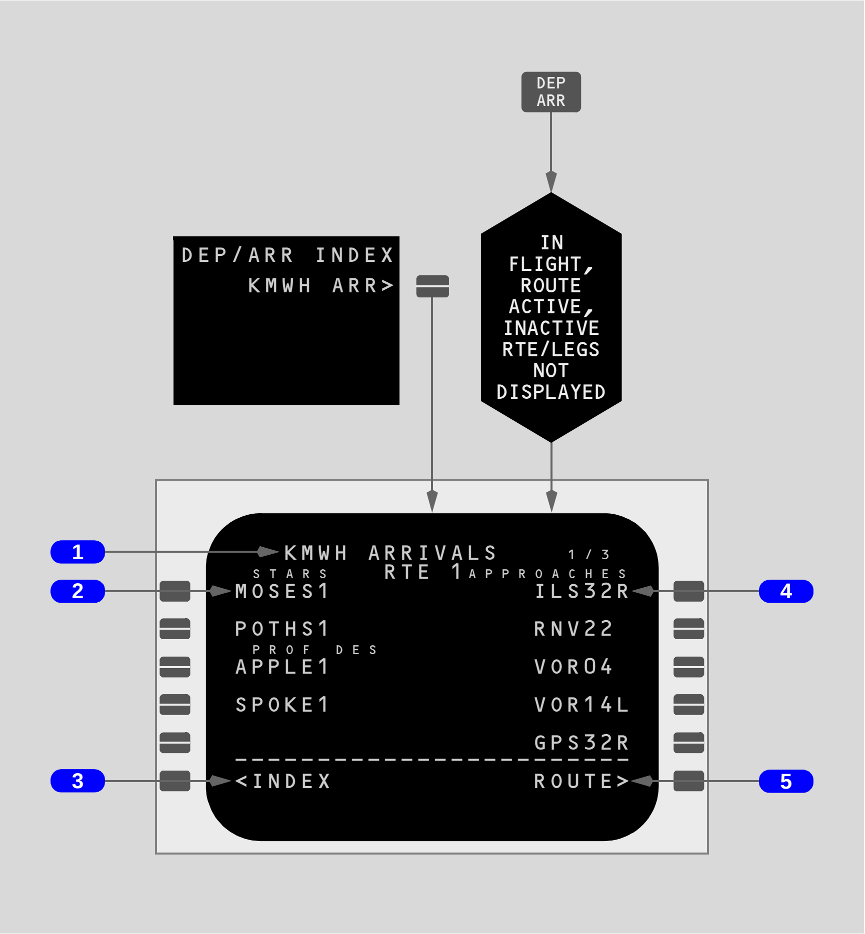
Selecting Options

Selecting a runway, approach, approach transition, STAR/profile descent, or descent transition option shows <SEL> inboard of the selection, and makes a route modification. The other options within the same category are removed from the list. When executing the modification, <SEL> changes to <ACT>. Selecting another page and returning to ARRIVALS displays all options; the applicable <SEL> or <ACT> prompts are displayed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



1 Page Title

The destination airport identifier displays in the title.

Second line displays route number.

Airports with more than 5 runways or STARs produce multiple arrivals pages.

2 Standard Terminal Arrivals (STARS), Profile Descents (PROF DES)

STARS display in a list under the STAR line title. Profile descents display below STARS under the PROF DES line title.

NONE displays when no STARS in the database.

Push -

- selects STAR or PROF DES for entry into the route, <SEL> displays
- all other arrival procedures no longer display and transitions for the selected procedure display
- deletes a previously selected procedure
- displays ERASE prompt

3 INDEX

Push - displays the DEP/ARR INDEX page.

4 APPROACHES

Displays the destination airport approaches.

Push -

- selects approach for entry into the route, <SEL> displays
- all other approaches and runways no longer display; transitions and profile descents for the selected approach display
- displays INTC prompt for selected approach
- displays ERASE prompt

5 ROUTE

Push -

- displays route page for related route
- displayed only on ground or for inactive route

Arrivals Page With STAR Selected

1 STAR Transitions (TRANS)

Displays list of transitions for the selected arrival procedure.

Push -

- selects transition for entry into the route
- all other transitions no longer display

2 ERASE

Displayed when STAR, PROF DES, or APPROACH selected.

Push -

- deletes selections made to active route
- displays lists of STARS, PROF DES, APPOACHES, and RUNWAYS
- displays INDEX prompt

Arrivals Page With STAR, STAR Transition, and Approach Selected

1 Approach Transitions (TRANS)

Displays list of transitions for the selected approach procedure.

Approach transitions include IAFs, feeder fixes, and fixes providing routing to the FAF.

When transition not selected, approach will be a straight-in approach starting at a waypoint 4 to 8 miles outside the FAF. Waypoint may be a charted fix or CFXXX (XXX is the runway number).

Push -

- selects transition for entry into the route
- all other transitions no longer display
- displays INTC prompt for selected transition

2 Approach Intercept

Selecting an arrival runway or approach displays an approach intercept waypoint on the approach course for selected approach or runway.

Following selection of a transition, the charted fix or CFXXX is replaced with the final approach fix (FAF) intercept (example: PELLY INTC).

Push -

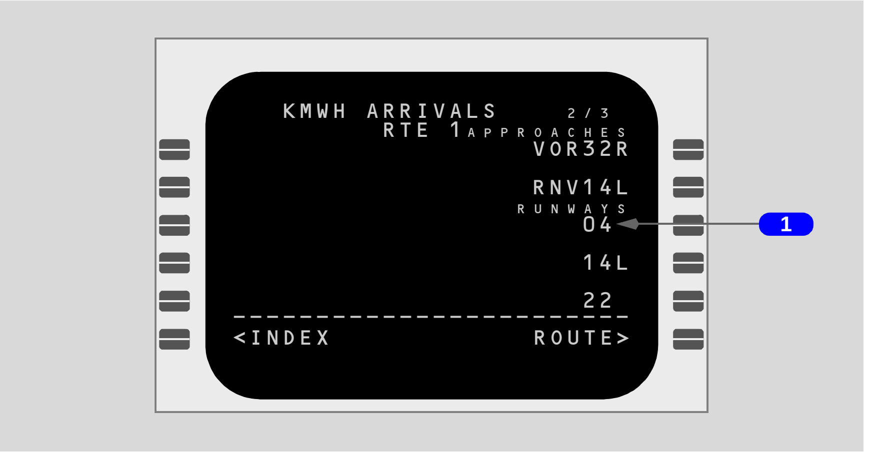
- displays RTE LEGS page and modifies route with approach intercept fix as the active waypoint
- selects approach course for selected approach as inbound course to approach intercept fix on LEGS page

Active Route Legs Page With Glide Path (GP) Angle

1 GP Display

Displays the navigation database GP angle for ILS, B/C, GPS, LOC, RNV, NDB, and VOR approaches. When AFDS pitch mode VNAV PTH is active, vertical path guidance is provided at the displayed GP angle.

Arrivals Page - VFR Approaches



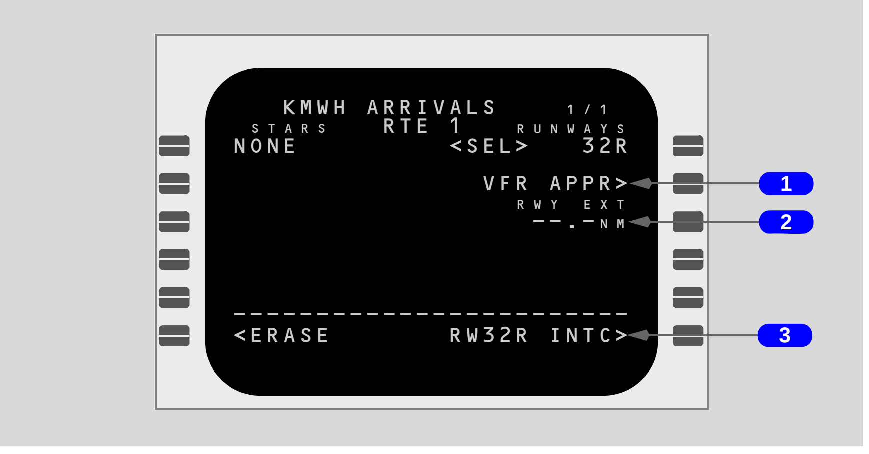
1 RUNWAYS

Displays list of runways for destination airport.

Push -

- selects runway for entry into the route; <SEL> displays
- deletes previously selected approach
- displays VFR APPR and runway extension when enabled in the navigation database
- no longer displays other runways and approaches
- displays approach intercept fix for selected runway

Arrivals Page With Runway Selected



1 VFR Approach (VFR APPR)

Displays when a VFR approach is in the navigation database for selected runway.

Push - following a discontinuity, creates a straight-in VFR approach beginning with a transition waypoint, FAXXX at 8 NM from the runway threshold with an airspeed/altitude constraint of 170 kts/2,000 feet above runway altitude.

The VFR approach ends with a runway altitude constraint of 50 feet.

Displays RWY EXT 8.0 NM and FPA of 3.0 degrees.

2 Runway Extension (RWY EXT)

Allows entry of end of descent target for VNAV guidance.

Creates a runway extension fix along runway centerline for LNAV guidance.

Deletes VFR APPR prompt.

3 Approach Intercept

Selecting an arrival runway displays an approach intercept waypoint on the approach course for the selected runway.

Push - modifies the flight plan, displays the RTE LEGS page, and activates the intercept course to function.

Arrivals Page With VFR Approach Selected

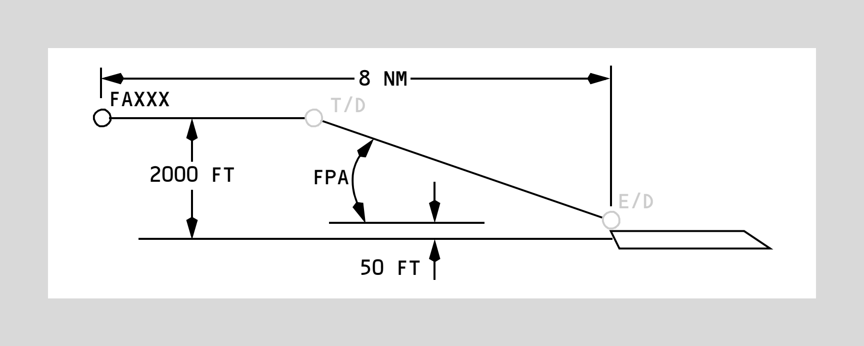
1 Runway Extension (RWY EXT)

Following selection of a runway, the RWY EXT 8.0 waypoint, FAXXX, displays as part of VFR APPR. Distance cannot be changed.

2 **Flight Path Angle (FPA)**

Displays descent flight path angle to 50 foot runway waypoint. Default is 3.0°. Valid entry is 2.4° to 3.7°.

VFR Approach Path



The VFR approach is a level path until the VNAV descent path is intercepted. The descent path begins at the FAXXX waypoint altitude and terminates at the runway threshold at 50 feet. Default values display in RWY EXT and FPA.

Arrivals Page With Manually Entered Runway Extension

1 **Runway Extension (RWY EXT)**

Valid entries are from 1.0 to 25.0 nm from the runway threshold.

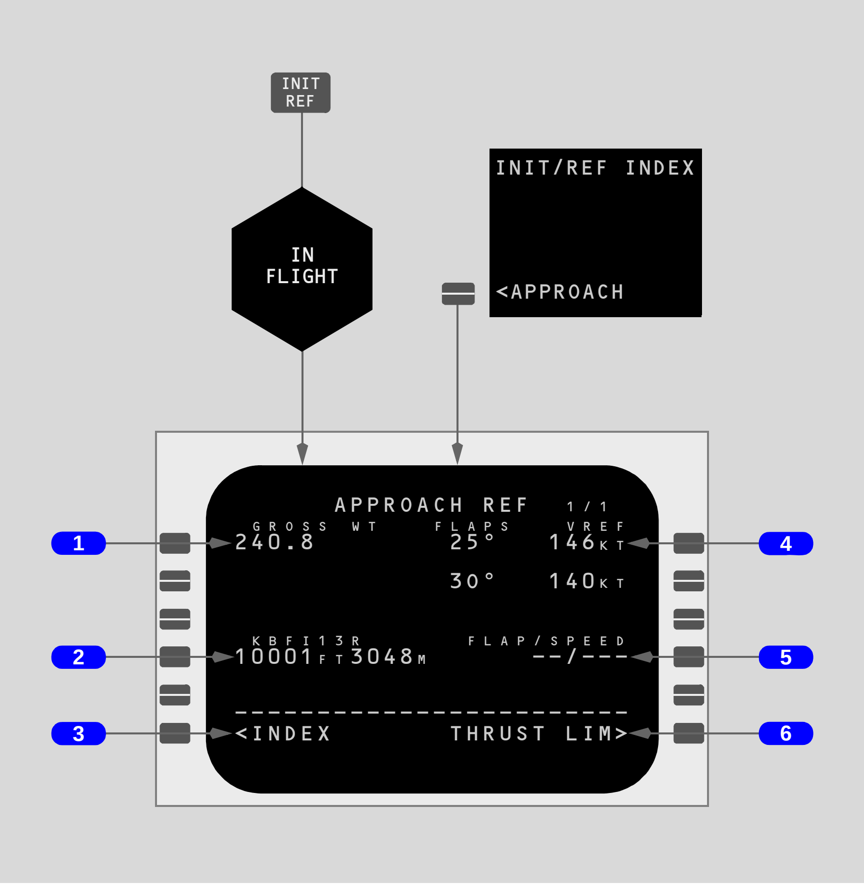
Entry allowed if VFR APPR is not selected. Entry removes VFR APPR prompt. Example shows 6 nm entered.

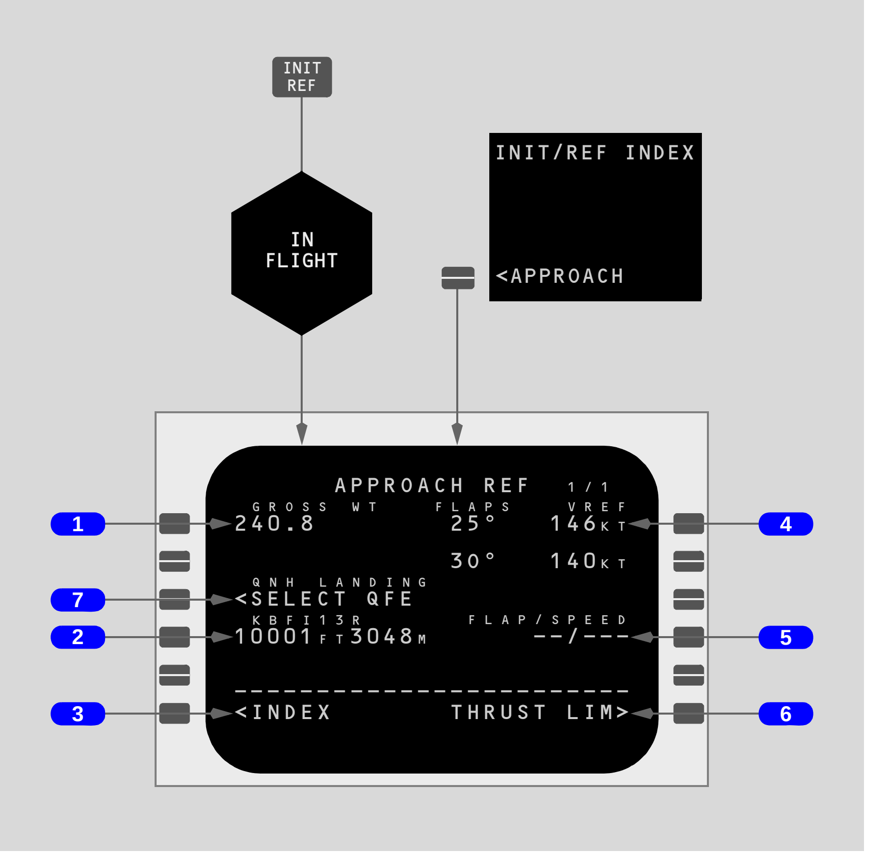
Makes waypoint RXYYY, where YYY is the runway; example: RX32R. Makes a route discontinuity before and after waypoint.

Approach Reference Page

The approach reference page displays approach planning data and the approach reference speed (VREF) selection.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX





1 Gross Weight (GROSS WT)

Displays FMC calculated airplane gross weight.

Displays boxes when gross weight is not available from FMC.

Valid entry is XXX.X. Leaving this page and returning displays the FMC calculated gross weight.

2 Runway Length

Displays length of departure runway until destination runway or approach entered into active route and airplane is 50 NM from departure airport or halfway to destination.

Displays runway length in feet and meters.

Display clears at flight completion.

3 INDEX

Push - displays INT/REF INDEX page.

4 FLAPS VREF

Displays computed VREF for the indicated landing flap settings at displayed gross weight. Blank until gross weight entered.

Push - displays flaps/VREF in scratchpad for entry in 4R.

5 FLAP/SPEED

Valid entries are: XX/YYY, /YYY, or YYY. XX is flap setting, YYY is airspeed.

Entry displays VREF speed on PFD. Entry of an airspeed greater than VREF increases the entire flap speed schedule by the increased amount. If no VREF is selected or an entry is not made, displayed flap speeds are based on flap position increments above VREF 30 for the current gross weight.

Deletion of data removes VREF from PFD.

6 Thrust Limit (THRUST LIM)

Push - displays THRUST LIM page.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

7 QFE/QNH

Defaults to QNH: after pushing barometric standard switch to STD, after flight completion, or after a long term power interruption.

Line title displays current status as QNH LANDING or QFE LANDING.

Push -

- selects QFE or QNH landing elevation
- when QFE selected, sets Landing Altitude and Touchdown Zone Indicator to zero

Holding

The FMC computes holding patterns with constant radius turns based on current wind and FMC commanded airspeed. The pattern size is limited to FAA or ICAO protected airspace. In LNAV, the AFDS tracks the holding pattern using up to a 30 degree bank angle. Strong winds or airspeed in excess of FAA or ICAO entry speeds may result in the airplane flying outside the protected airspace.

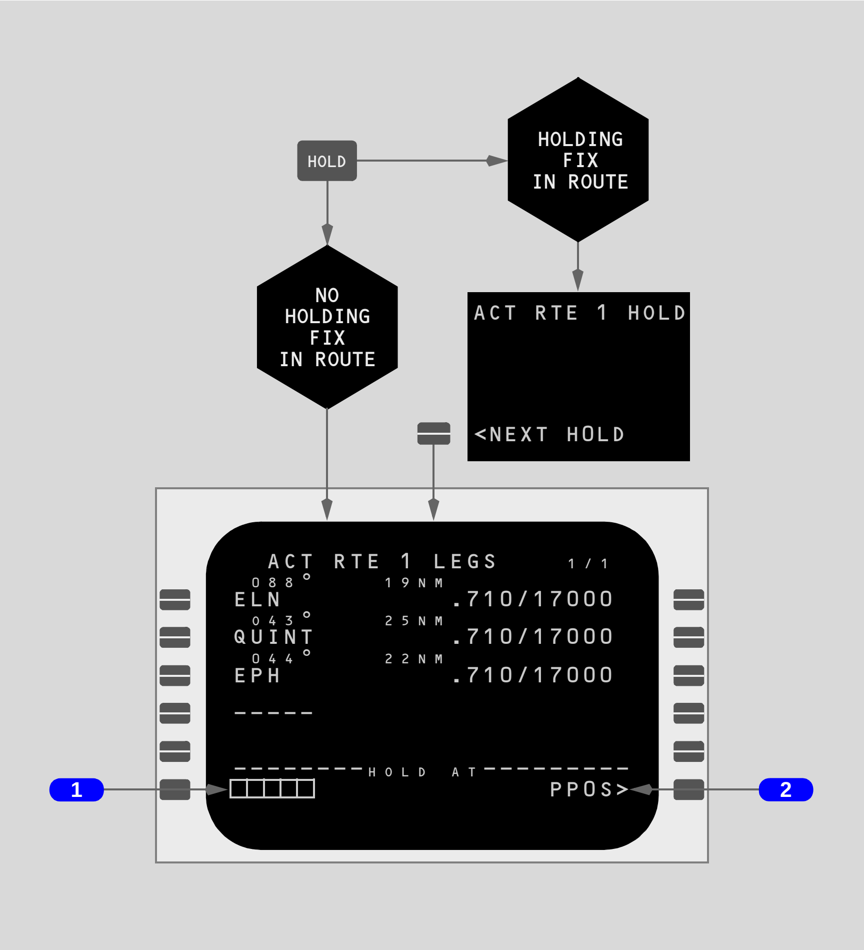
With LNAV active before sequencing the holding fix, holding pattern entries are determined by the following:

- airplane track, not heading or direction from which the active route approaches the holding pattern, determines the entry method used (parallel, teardrop, or direct entry)
- the airplane flies the initial outbound leg a computed distance from the holding fix, rather than a specific time. The computed distance is a function of the command airspeed and computed wind at the time the holding pattern becomes active
- teardrop entries use a 40 degree offset angle
- the initial entry into holding treats the holding fix as a "fly-by" waypoint. Subsequently, the entry path displays and all entry maneuvering is within the displayed holding pattern

The route hold page is used to enter holding information in the route or to view or modify an existing holding pattern. Modifications made to a holding pattern while active in the hold become effective on the next crossing of the holding fix.

Route Hold Page With No Holding Fix in Route

When no hold exists in route, pushing the HOLD key displays RTE LEGS page. RTE LEGS page displays prompts to enter the holding fix as a route waypoint or at present position.



1 HOLD AT Boxes

Boxes can be displayed on any RTE LEGS page.

Valid entry is any RTE LEGS waypoint, database waypoint, or pilot-defined waypoint.

Along-track waypoints must be entered over the original waypoint, then in the boxes.

If holding fix not in active route, waypoint is entered in scratch pad, then selected to HOLD AT boxes. HOLD AT XXXXX displays in scratch pad. Selecting HOLD AT XXXX to desired line displays RTE HOLD page; cannot be selected as the active waypoint.

2 HOLD AT Present Position (PPOS)

Push -

- creates holding pattern at present position
- execution establishes the holding fix at the position when EXEC is pushed and displays RTE HOLD page

Route Hold Page After Pushing PPOS And Executing

Route Hold Page With Holding Fix in Route

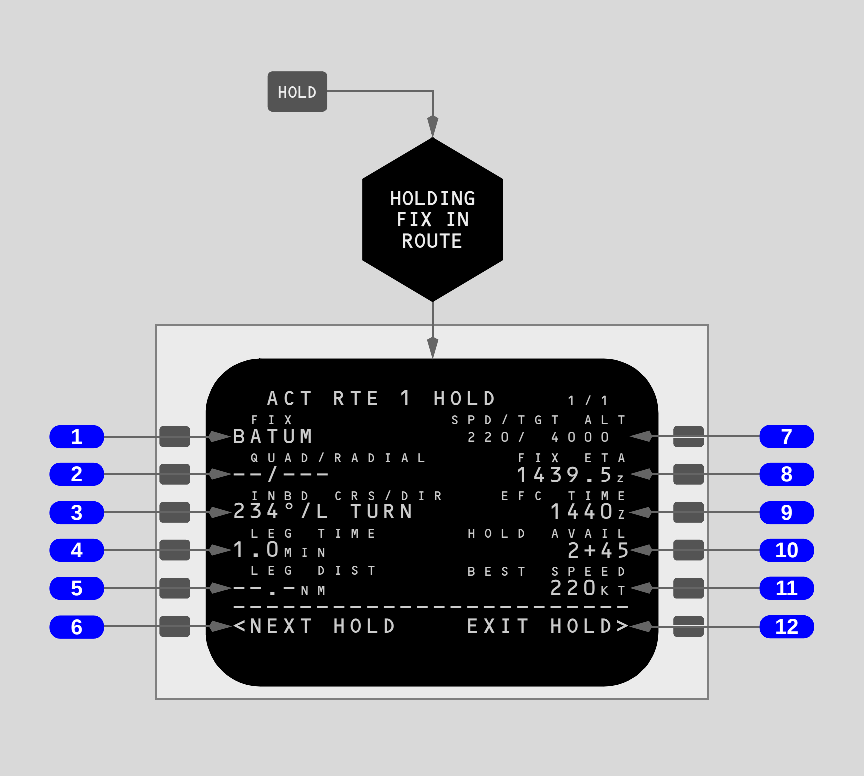
When a hold(s) exists in the route, hold page 1/X displays first existing hold. When more than one hold exists, pushing NEXT PAGE displays succeeding holds.

Most holding patterns are part of a procedure or airway and remain active until the flight crew executes an exit from holding. This may be accomplished in one of two ways:

- on the ACT RTE LEGS page, deleting or bypassing the HOLD AT waypoint causes LNAV to command a direct to the next waypoint
- on the ACT RTE HOLD page, selecting and executing EXIT HOLD> causes LNAV to command the airplane to continue in the holding pattern until arriving at the holding fix, at which time the airplane exits the holding pattern

The FMC automatically commands an exit from some holding patterns in procedures under the following conditions:

- for instrument approach holding patterns designed as a course reversal in lieu of a procedure turn, the airplane exits holding upon arrival at the holding fix inbound. Header at 1L displays PROC HOLD
- for some holding patterns in SIDs, the airplane exits holding when arriving at an altitude. Header at 1L displays HOLD AT



1 Holding FIX

Displays the holding fix.

2 Quadrant/Radial (QUAD/RADIAL)

Normally displays dashes.

Valid entry is X/XXX OR XX/XXX, or /XXX. Example: NW/330.

Entry changes INBD CRS/DIR to agree.

3 Inbound Course/Direction (INBD CRS/DIR)

Displays inbound course and direction of turn.

Valid entry is XXX (course), XXX/X, /X, or X (turn direction).

Entry changes QUAD/RADIAL to agree.

4 LEG TIME

Displays 1.0 MIN (minute) at or below 14,000 feet.

Displays 1.5 MIN above 14,000 feet.

Displays dashes when entry made on LEG DIST line.

Valid entry is XXX.X.

Entry displays dashes on LEG DIST line.

When climbing/descending through 14,000 feet with VNAV active and the SPD/TGT ALT at 1R displays in large font, the FMC adjusts the leg time (1.0 MIN at or below 14,000 feet; 1.5 MIN above 14,000 feet).

5 LEG Distance (DIST)

Normally displays dashes. Allows entry of leg distance for hold.

Valid entry is XX.X or X.X.

Entry displays dashes on LEG TIME line.

6 NEXT HOLD, ERASE

NEXT HOLD -

Push - displays prompts for entering another hold in route.

ERASE -

Displayed when hold modified.

Push -

- erases modification to hold
- displays NEXT HOLD prompt

7 Speed/Target Altitude (SPD/TGT ALT)

Displays dashes or fix target speed/altitude from RTE LEGS page.

Display is small font for FMC predictions, large font for constraints or manual entries.

Valid entry is XXX/ (speed); YYY, YYYY, or YYYYY (target altitude), or a combination of speed/target altitude.

- speed entry requires altitude constraint
- altitude entry must be below cruise altitude

Entry displays on HOLD AT waypoint on RTE LEGS page.

During cruise, entry of a target altitude lower than CRZ ALT modifies DESCENT page and displays a T/D. After T/D, the DESCENT page remains active unless a new cruise altitude is entered.

8 FIX ETA

With no EFC TIME entry, displays time the airplane will next pass the holding fix.

With EFC TIME entry, displays time the airplane will pass the holding fix after the EFC time. The FMC uses this time to calculate downtrack ETAs and fuel values based on departing the holding fix at the new FIX ETA.

9 Expect Further Clearance Time (EFC TIME)

Normally displays dashes.

Valid entry is XXXX (time).

Entry changes ETA and fuel predictions for the route after holding.

10 HOLD Available (HOLD)

Displays holding time available before requiring reserve fuel to reach the destination.

11 BEST SPEED

Displays best holding speed for airplane gross weight, altitude, and flap setting.

Note: BEST SPEED may exceed regulatory maximum holding speeds.

12 EXIT HOLD, EXIT ARMED

EXIT HOLD -

Push -

- arms a holding pattern exit
- displays EXIT ARMED prompt

EXIT ARMED -

When executed, airplane returns to the fix via the inbound course and exits holding pattern.

Introduction

The CDUs can be used as an alternate navigation system if both FMCs fail. The CDUs perform lateral navigation computations; however, LNAV, VNAV, and autothrottle are not available. The CDU can be used to tune navigation radios.

During normal FMC operation, all system capabilities are contained within the FMCs. During alternate navigation operation, the CDUs use their own internal memory and computing capability.

Each CDU performs its calculations based on inputs from its respective IRU. Usually, the left CDU provides information to the left ND map and the right CDU provides information to the right ND map. The center CDU can be selected as an alternate to the left or right CDU.

Alternate Navigation Waypoints

The CDUs do not have a performance or navigation database. The CDUs continuously copy the active route from the FMC. If both FMCs fail, the CDUs retain flight plan waypoints except for conditional waypoints, offsets, and holding patterns. Waypoints on the copied route can be referenced by either their identifier, or latitude and longitude.

New waypoints can only be entered in latitude and longitude. This includes waypoints the flight crew has deleted from the copied route.

Waypoint Operations

Waypoint operations include:

- add new waypoints (latitude/longitude entry only)
- remove existing waypoints
- change the sequence of existing waypoints
- connect discontinuities.

Alternate Lateral Navigation

All CDU calculations are based on a great-circle course between waypoints.

Route Changes

Route changes are made on the ALTERNATE NAVIGATION LEGS page in similar manner to normal FMC operations. All courses between waypoints are direct routes. When the active waypoint is modified, the only navigational choice is present position direct to the modified active waypoint.

A route change to any one CDU does not change the other two. The Captain may view the route entered in either the left or center CDU on the ND using the NAV source select switch. The First Officer may view the route entered in either the right or center CDU on the ND using the NAV source select switch.

When displaying center CDU data on the First Officer’s ND, the ND range selector must agree with the range selected on the Captain’s selector. If different, the message MAP RANGE DISAGREE displays on the First Officer’s ND.

Course Reference

The IRU supplies magnetic variation for present position. Only the active waypoint course can be referenced to magnetic north. All subsequent waypoint courses are true courses.

Alternate Navigation Radio Tuning

The radios must be manually tuned on each CDU in alternate navigation. The left CDU tunes the left VOR, DME, ADF, and left ILS. The right CDU tunes the right VOR, DME, ADF, and right ILS. The center CDU tunes the center ILS. Manual tuning is accomplished on the ALTERNATE NAVIGATION RADIO page.

Alternate Navigation CDU Pages

Alternate navigation is accomplished from three CDU pages:

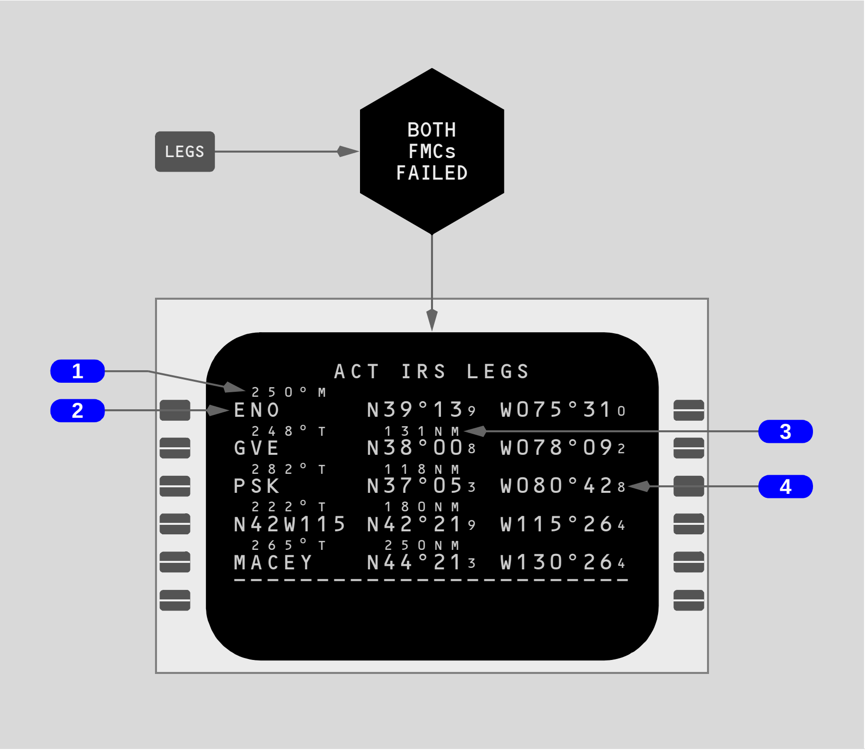
- ALTERNATE NAVIGATION LEGS
- ALTERNATE NAVIGATION PROGRESS
- ALTERNATE NAVIGATION RADIO

Failure of the primary FMC causes both CDUs to display the MENU page and display of the scratchpad message TIME OUT - RESELECT. Failure of the secondary FMC displays the respective CDU MENU page and the scratchpad message TIME OUT - RESELECT. Rotating the respective Navigation Source Selector to the operable FMC restores the CDU display and NDs to normal.

If both FMCs fail, the IRS LEGS, IRS PROGRESS, and ALTN NAV RADIO pages are available on all CDUs. Rotating Navigation Souce Selectors to a CDU position restores NDs and the alternate navigation pages.

Alternate Navigation Legs Page

This page displays data about each leg of the route. The route can be modified. Waypoint speed and altitude restrictions are not displayed because performance data is not available.



1 Leg Direction

Displays course to the waypoint.

Course reference is M for magnetic, T for true.

Active waypoint leg direction can be magnetic or true. Subsequent waypoint leg directions are true.

2 Waypoint Identifier

Displays the waypoint by name or latitude/longitude.

Valid entries are waypoints currently in the route or latitude/longitude for new waypoints.

3 Distance to Waypoint

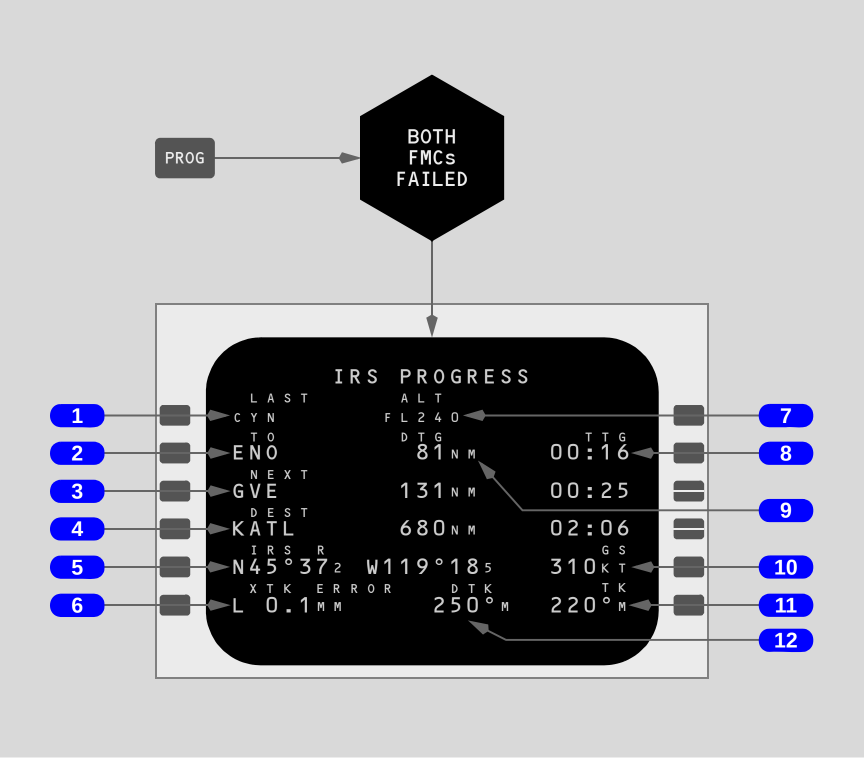
Displays the great circle distance between waypoints.

4 Waypoint Coordinates

Displays the waypoint coordinates.

Alternate Navigation Progress Page

This page displays general data about flight progress.



1 LAST

Displays the identifier of the last waypoint.

2 TO

Displays the active waypoint on the route.

3 NEXT

Displays the waypoint after the TO waypoint.

4 Destination (DEST)

Displays identifier for route destination waypoint or airport. Any waypoint on or off the route can be entered. Time and distance data temporarily displays for that waypoint.

Display options:

- destination airport identifier; distance and time to go along track to the destination airport
- entry of an existing flight plan waypoint (identifier or latitude/longitude) causes the line title to change to ENROUTE WPT. Time and distance to go are from the present position direct to the new waypoint
- entry of a waypoint not in the flight plan causes the line title to change to DIR TO ALTERNATE. Time and distance to go are from the present position direct to the new waypoint

5 Inertial Position (IRS L, C, R)

Displays IRU present position.

Line title displays IRU source for position.

6 Cross Track Error (XTK ERROR)

Displays airplane left or right cross-track error in nautical miles from the active route track.

7 Altitude (ALT)

Displays airplane altitude when the LAST waypoint was crossed.

8 Time to Go (TTG)

Displays time to go to waypoint or destination.

9 Distance to Go (DTG)

Displays distance to go to waypoint or destination.

10 Ground Speed (GS)

Displays IRU groundspeed.

11 Track (TK)

Displays airplane track angle relative to the true or magnetic reference selected on the HEADING REFERENCE switch.

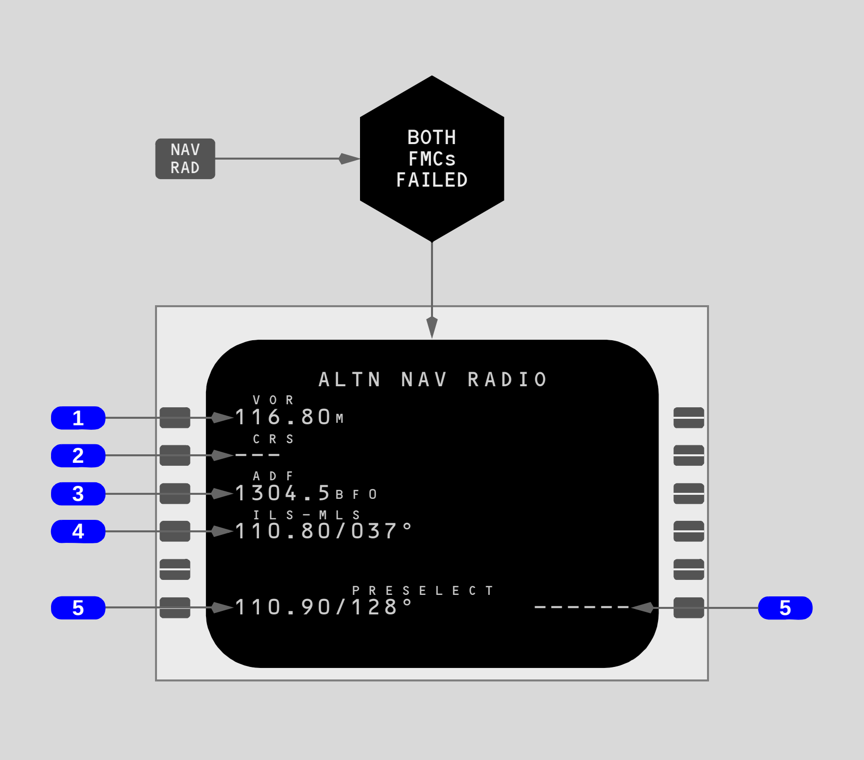
12 Desired Track (DTK)

Displays desired track angle relative to the true or magnetic reference selected on the HEADING REFERENCE switch.

Alternate Navigation Radio Page

Navigation radios are tuned on this page and related parameters display. Autotune is not available. The CDUs operate independently for navigation radio tuning:

- the left CDU tunes the left radios
- the right CDU tunes the right radios
- the center CDU tunes the center ILS



1 VOR

Displays last selected VOR frequency. Tuning status displays as manual (M).

Display is blank on center CDU.

Valid entry is VOR frequency or VOR frequency/course.

Entry tunes related DME frequency.

2 Course (CRS)

Displays selected VOR course.

Display is blank on center CDU.

Valid entry is VOR course or VOR frequency/course.

3 ADF

Displays ADF frequency. Tuning status displays as ANT or BFO.

Displays dashes if no ADF frequency entered on NAV RAD or ALTN NAV RAD pages after initial power up.

Valid entry is ADF frequency or ADF frequency suffixed with A or B. Suffix may be changed after entry.

4 ILS

Displays last selected ILS frequency, ILS frequency and course, or PARK.

Valid entries are:

- ILS frequency
- ILS frequency/front course
- front course only (a frequency must already be displayed)

Front course defaults to runway course if runway on active route and only frequency entered. Otherwise, front course defaults to 000 or the last entered front course.

Note: If ILS was in autotune at the time of the FMC failure, the frequency and course are copied to the ALTN NAV RADIO page.

Note: The ILS frequency displays PARK when no frequency is tuned. Deleting the ILS frequency parks a tuned ILS.

Note: ILS course and frequency must be entered on the left, center, and right ALTN NAV RADIO page.

5 PRESELECT

Allows entry of two separate preselected frequencies and/or frequencies/courses.

Valid entries are any of the entries that can be made on the other lines.

EICAS Alert Messages

Message	Level	Aural	Message Logic
FMC LEFT, RIGHT	Advisory		Affected FMC has failed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; before SB, IDS 508 software not installed; message has a ">")

>FMC MESSAGE	Advisory		High priority FMC message exists.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs IDS 508 software; deletes ">")

FMC MESSAGE	Advisory		High priority FMC message exists.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

>FMC RUNWAY DIS	Caution	Beeper	Airplane position or heading not within specified limits of active FMC departure runway and takeoff thrust applied.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX

>GPS	Advisory		Dual GPS failure.
>GPS LEFT, RIGHT	Advisory		Left or Right GPS system failure.

Message	Level	Aural	Message Logic
ILS ANTENNA	Caution	Beeper	Glideslope or localizer antenna fails to switch.
>IRS AC CENTER, LEFT, RIGHT	Advisory		Center, Left, or Right IRU AC power failure.
IRS CENTER, LEFT, RIGHT	Advisory		Center, Left, or Right IRU system fault.
>IRS DC CENTER, LEFT, RIGHT	Advisory		Center, Left, or Right IRU backup DC power failure.
IRS MOTION	Advisory		Excessive airplane motion detected during alignment.
>SNGL SOURCE ILS	Caution	Beeper	Both pilots' displays referenced to the same localizer or glideslope receiver.
>TRANSPONDER L, R	Advisory		Affected ATC transponder has failed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; before SB, IDS 508 software not installed; message is two level)

UNABLE RNP	Advisory		Actual navigation performance does not meet required accuracy during navigation phases other than approach. Inhibited in polar region.
UNABLE RNP	Caution	Beeper	Actual navigation performance does not meet required accuracy during navigation approach phase. Inhibited in polar region.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs IDS 508 software; UNABLE RNP message is one level)

UNABLE RNP	Caution	Beeper	Actual navigation performance does not meet required accuracy during navigation phases. Inhibited in polar region.

EICAS Memo Messages

Message	Message Logic
IRS ALIGN MODE C, L, R	IRS in align mode. Message no longer displayed when all IRUs enter navigation mode.

FMC Messages

FMC messages indicate degraded system operation or data input errors. The messages are categorized as alert messages and advisory messages.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS or AOC)
FMC messages also indicate data link status.

The scratchpad messages display according to their level of importance. A less important message replaces another message in the scratchpad when the CLEAR key is pushed or the condition is corrected.

FMC alert messages display the EICAS message FMC MESSAGE. All FMC messages illuminate the CDU message (MSG) light. Pushing the CLEAR key or correcting the condition cancels the message.

FMC Alert Messages

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS)
ATC COMM ESTABLISHED - ATC COMM available or control passed to a new ATC center.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS)
ATC COMM TERMINATED - ATC datalink is terminated.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS)
ATC MSG NOT ACKNOWLEDGED - ATC message has been transmitted and no network acknowledgment is received.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS)
ATC REPORT LIST FULL - nine reports have been generated and are awaiting transmission and a tenth report request has been received.

CHECK ALT TGT - VNAV activates when airplane between MCP and FMC target altitudes. VNAV maintains level flight.

CYCLE IRS OFF-NAV - IRS align problem requires cycling IRS mode switch OFF, then back to NAV.

DESCENT PATH DELETED - VNAV active and all waypoint altitude constraints defining descent path deleted.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
DESCENT FORECAST UPLINK READY - receipt of an uplink message containing descent forecast data which passes error checks and is ready to be loaded on the DESCENT FORECAST page.

DISCONTINUITY - LNAV active and airplane enters route discontinuity. AFDS maintains last heading.

DRAG REQUIRED - VNAV active and additional drag required or autothrottle off and less thrust required to maintain descent path.

END OF OFFSET - LNAV active and 5 NM prior to end of active route offset. AFDS maintains last heading if active route offset overflown.

END OF ROUTE - LNAV active and end of active route overflown. AFDS maintains last heading.

ENTER IRS POSITION - the flight crew-entered present position did not pass an IRS comparison check or the IRS is ready to enter the navigation mode and a present position has not been entered.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS or AOC)
FLT NUMBER UPLINK - receipt of an uplink message containing flight number data which passes error checks and is inserted in the flight plan.

FMC L/R OUTPUT LOSS - some information used by systems other than the FMS is not available.

FUEL DISAGREE - PROG 2 - fuel totalizer and calculated values disagree by 4,080 Kg or more continuously for 5 minutes. This may indicate an engine fuel leak.

ILS TUNE INHIBITED - MCP - flight control computers inhibiting changes in ILS tuning, and either a manual operation in the ILS tuning field attempted or a new arrival ILS approach activated.

INSUFFICIENT FUEL - estimated fuel at destination less than entered RESERVES value. This may indicate an engine fuel leak.

VP-BKJ, VP-BVR
IRS ONLY - FMC in IRS only mode for navigation.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
(VQ-BHW, VQ-BHX ; SB activates ATS; adds INVALID ATC UPLINK message)
INVALID ATC UPLINK - ATC uplink message received by FMC contains format or other errors. FMC rejects the uplink and sends a downlink response to ATC center.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
(VQ-BHW, VQ-BHX ; SB activates ATS or AOC; adds INVALID FLT NO UPLINK message)
INVALID FLT NO UPLINK - receipt of an uplink message containing route data, which is at least partially loaded, and flight number data which fails error checks and is rejected or upon receipt of an uplink message containing only flight number data which fails error checks and is rejected. FMC sends a downlink response rejecting the message and explaining why.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
INVALID FORECAST UPLINK - receipt of an uplink message containing only descent forecast data in which all data fails error checks and is rejected, or receipt of an uplink message containing waypoint wind data which is loaded into the flight plan and descent forecast data in which all data fails error check and is rejected. FMC sends a downlink response rejecting the message and explaining why.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
(VQ-BHW, VQ-BHX ; SB activates ATS or AOC; adds INVALID ROUTE UPLINK message)
INVALID ROUTE UPLINK - receipt of an uplink message containing route data which fails error checks and is rejected. FMC sends a downlink response rejecting the message and explaining why.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
INVALID WIND DATA UPLINK - receipt of an uplink message in which all waypoint wind data is invalid and cannot be loaded into the flight plan. FMC sends a downlink response rejecting the message and explaining why.

IRS POS/ORIGIN DISAGREE - valid IRS position differs from active origin airport.

LIMIT ALT FLXXX - VNAV active and cruise altitude greater than VNAV limit altitude.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
(VQ-BHW, VQ-BHX ; SB activates ATS; adds MESSAGE LIMIT EXCEEDED message)
MESSAGE LIMIT EXCEEDED - attempted selection of a sixth request of an ATC request.

NAV DATA OUT OF DATE - clock calendar date exceeds navigation data base valid (active) calendar cycle.

NAV INVALID-TUNE XXXX (XXXX = required navaid) - signals not received from navaid required for approach procedure.

NO ACTIVE ROUTE - LNAV selected, but no active route activated.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS or AOC; adds PARTIAL CLEARANCE LOADED message)

PARTIAL CLEARANCE LOADED - FMC was able to load only a portion of the loadable data in an uplink message. If pilot unable to determine which portion of the clearance did not load, REJECT the corresponding uplink message.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS or AOC; adds PARTIAL ROUTE X UPLINK message)

PARTIAL ROUTE X UPLINK - receipt of a flight plan uplink message containing route data errors which do not cause total rejection, and part of the route data has been loaded into RTE 1 or RTE 2, as appropriate. FMC sends a downlink response rejecting the message and explaining why.

PERF/VNAV UNAVAILABLE - VNAV selected without gross weight, cost index, or cruise altitude entered.

PURGE UPDATES - POS 2 - incorrect FMC position results in raw radio data being rejected due to DME reasonableness checks.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS; adds RE-LOGON TO ATC COMM message)

RE-LOGON TO ATC COMM - ATC LOGON message was sent from the airplane and ATC did not respond within the required time, or ATC sent a negative response or, an error occurs which causes ATC center in communication to be disconnected without ATC COMM transferring to another ATC center.

RESET MCP ALT - two minutes prior to T/D point with VNAV active and MCP not set to altitude below cruise altitude.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS; adds RESPOND TO ATC UPLINKS message)

RESPOND TO ATC UPLINKS - ATC uplink received and causes storage to be full or uplink received when storage is full.

RESYNC FAIL - SINGLE FMC - resynchronization is unsuccessful and one FMC has shutdown.

RESYNCING OTHER FMC - FMC synchronization in progress.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS or AOC; adds RTE X UPLINK LOADING message)
RTE X UPLINK LOADING - uplinked (company or ATC DL) route data being loaded into RTE 1 or RTE 2, as appropriate; or uplink message containing route data being loaded into RTE 1 or RTE 2, as appropriate, and a CDU button is pushed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VQ-BHW, VQ-BHX ; SB activates ATS or AOC; adds ROUTE X UPLINK READY message)
ROUTE X UPLINK READY - receipt of a flight plan uplink message that contains route data which has passed error checks and is ready to be loaded into RTE 1 or RTE 2, as appropriate.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
RTA FIX DELETED - RTA fix has been deleted from the modified flight plan.

RW/ ILS FREQ ERROR - selected ILS frequency does not match the frequency for destination runway in the active route.

RW/ILS CRS ERROR - selected ILS course does not match course for destination runway in the active route or valid course data not received.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
SET CLOCK TO UTC TIME - UTC from GPS is more than 12 seconds different from Captain's (or FO's if Captain's failed) flight deck clock.

SINGLE FMC OPERATION - one FMC data not available.

SPLIT IRS OPERATION - FMCs have selected single IRU position updating while operating in polar latitudes or with significant position or velocity differences.

THRUST REQUIRED - VNAV active, autothrottle disconnected, and additional thrust required to track descent path and maintain speed.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
UNABLE FLXXX AT RTA FIX - predicted crossing altitude at RTA fix less than FLXXX, but predicted ETA within tolerance.

UNABLE NEXT ALT - VNAV active and climb not sufficient to comply with waypoint altitude constraint.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
UNABLE RTA - RTA not achievable within applicable arrival time tolerance.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
(VQ-BHW, VQ-BHX ; SB activates ATS or AOC; adds UNABLE TO LOAD CLEARANCE message)
UNABLE TO LOAD CLEARANCE - FMC unable to load any of the loadable data in an uplink message.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
(VQ-BHW, VQ-BHX ; SB activates ATS or AOC; adds UNABLE TO SEND MESSAGE)
UNABLE TO SEND MESSAGE - transmission of a downlink message has been initiated and cannot be delivered to the ACARS MU.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
VERIFY POSITION - updating sensor, radio or GPS, and FMC positions; or left and right FMC positions differ.

VP-BKJ, VP-BVR
VERIFY POSITION - computed radio and FMC positions or left and right FMC positions differ.

VERIFY RNP - POS REF 2 - RNP option is selected in the APF, the default (based on phase of flight) RNP changes, and the manually entered RNP exceeds the new default RNP value.

VERIFY TAIL NUMBER - the entered tail number disagrees with the tail number contained in the FMC database.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
WIND DATA UPLINK READY - receipt of an uplink message containg waypoint wind data which passes error checks and is ready to be loaded into RTE DATA page.

FMC Advisory Messages

ARR N/A FOR RUNWAY - runway/approach selected not compatible with arrival selected.

CRS REVERSAL AT FA FIX - entered route contains a course reversal at final approach fix and does not contain a procedure turn.

DELETE - DELETE key pushed.

INVALID DELETE - deletion of data displayed in selected field not allowed.

INVALID ENTRY - entry format or range is incorrect for the selected field or, the entered airway or TO waypoint does not coincide with the nav data base.

KEY/FUNCTION INOP - function selected is not available in existing FMC data base.

MAX ALT FLNNN - entered cruise altitude greater than performance maximum altitude.

NOT IN DATA BASE - data not in system.

NOT ON INTERCEPT HEADING - LNAV selected and airplane outside active leg capture criteria and current heading will not intercept active leg.

ROUTE FULL - last route modification fills FMC beyond its capacity of 120 waypoints. Last selection not entered in route.

RUNWAY N/A FOR SID - runway not compatible with SID.

STANDBY ONE - FMC requires more than four seconds to display data.

TAKEOFF SPEEDS DELETED - selected V speeds are invalid.

TIME OUT - RESELECT - communications with selected system have failed. Menu page displayed. Systems with a caret symbol are available for selection. Selecting < FMC displays last page used.

UNABLE CRZ ALT - entered cruise altitude results in climb intersecting the descent path or the time in cruise prior to top of descent less than minimum allowable.

VERIFY RNP ENTRY - RNP option selected in the APF and the manually entered RNP exceeds the default RNP value or is less than the ANP.

Intentionally
Blank

Fuel — Chapter 12
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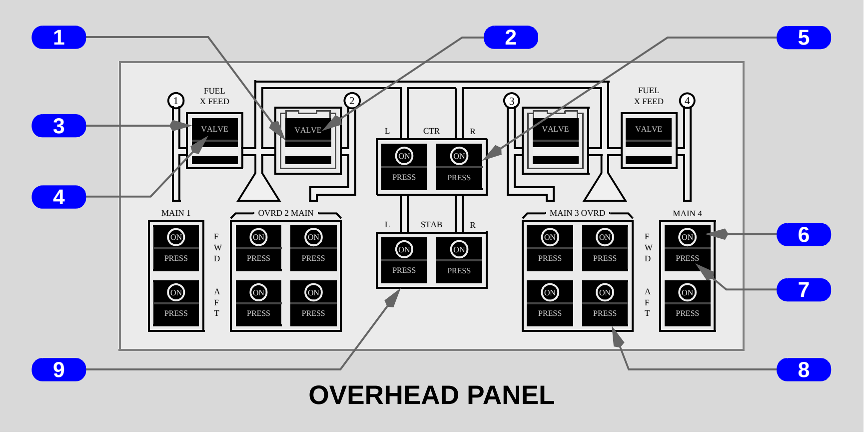
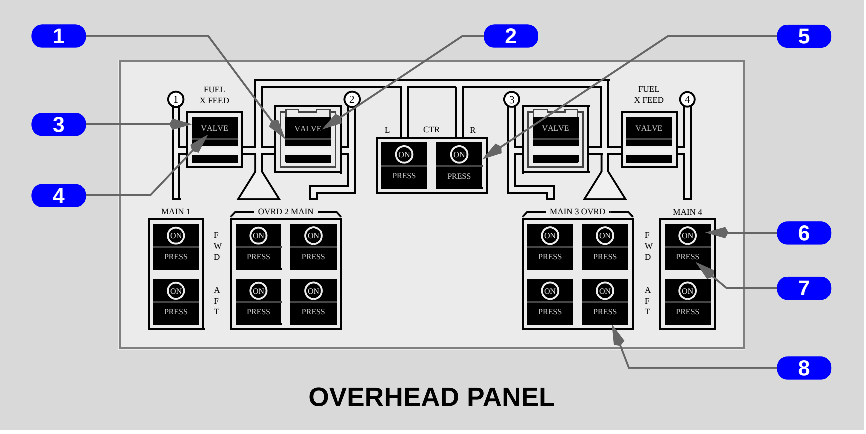
Fuel System

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



1 Crossfeed (X FEED) Valve Switches 2 and 3

ON (bar visible) - crossfeed valve opens when commanded by system logic.

2 Crossfeed VALVE Lights 2 and 3

Illuminated (amber) - crossfeed valve not in system logic commanded position.

3 Crossfeed (X FEED) Valve Switches 1 and 4

ON (bar visible) - crossfeed valve opens.

4 Crossfeed VALVE Lights 1 and 4

Illuminated (amber) - crossfeed valve position does not agree with switch position.

5 Center (CTR) Wing Tank Pump Switches

ON - fuel pump selected ON.

Off (ON not visible) - fuel pump selected OFF.

6 MAIN Pump Switches

ON - fuel pump selected ON.

Off (ON not visible) - fuel pump selected off.

7 Fuel Pressure (PRESS) Lights

Illuminated (amber) - fuel output pressure low.

8 Override (OVRD) Fuel Pump Switches

ON - fuel pump operates when commanded by system logic.

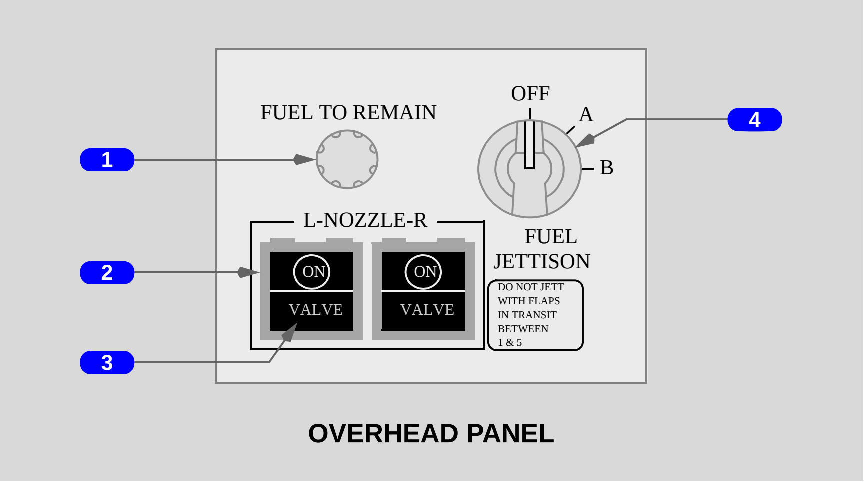
Off (ON not visible) - fuel pump selected off.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

9 Stabilizer (STAB) Tank Pump Switches

ON - fuel pump operates when commanded by system logic.

Fuel Jettison System



1 FUEL TO REMAIN Selector

Rotate -

- selects fuel to remain after jettison
- displays value on EICAS

2 Fuel Jettison NOZZLE Valve Switches

ON -

- jettison nozzle valve selected open

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
- when jettison system armed, activates override/jettison pumps in tanks containing fuel (pump switches must be ON)

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
- when jettison system armed, activates override/jettison and transfer/ jettison pumps in tanks containing fuel (pump switches must be ON)

Off - jettison nozzle valve selected closed.

3 Fuel Jettison Nozzle VALVE Lights

Illuminated (amber) - jettison nozzle valve not in selected position.

4 Fuel Jettison Selector

OFF -

- disarms jettison system
- removes EICAS fuel to remain indication

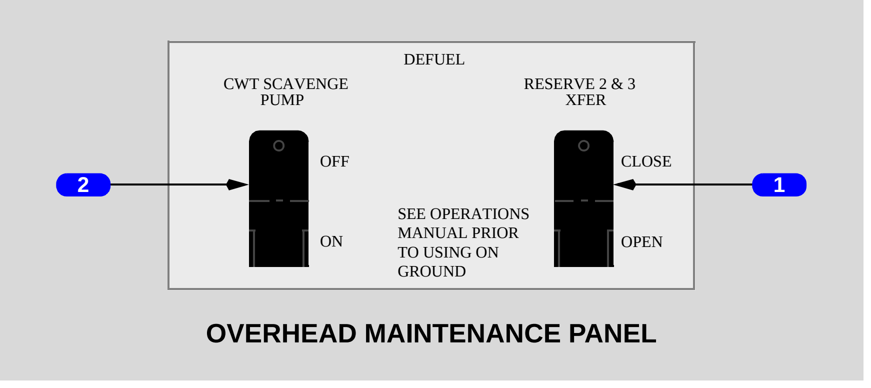
A or B -

- arms jettison system
- displays preselected fuel to remain on EICAS

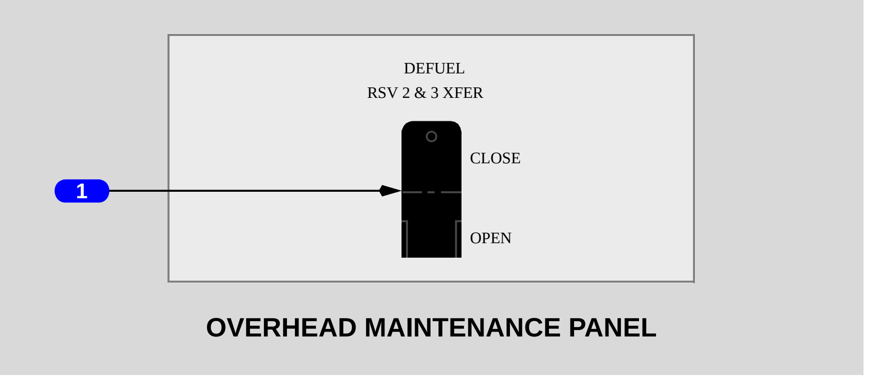
Miscellaneous Fuel Control

Defuel Panel

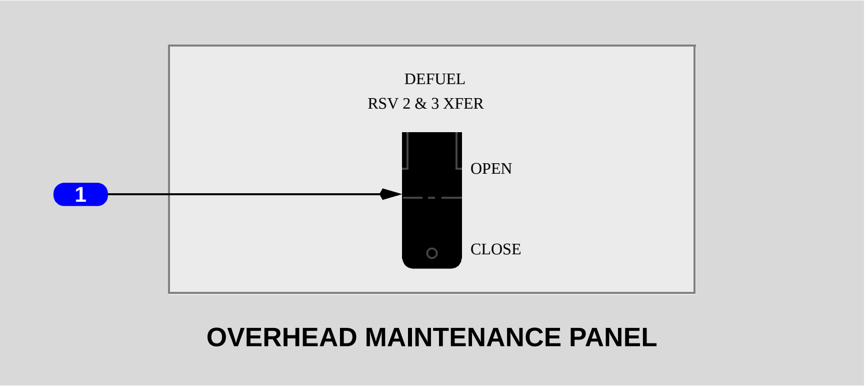
VP-BVR



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL



VQ-BHW, VQ-BHX



1 Reserve (RSV) 2 & 3 Transfer (XFER) Switch

CLOSE -

- reserve 2 and 3 transfer valves closed
- reserve 2 and 3 transfer valves open when commanded by system logic

OPEN - reserve 2 and 3 transfer valves open.

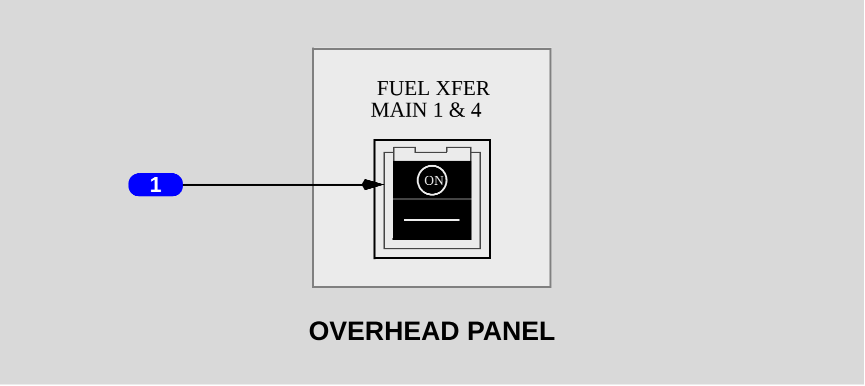
VP-BVR

2 Center Wing Tank (CWT) SCAVENGE PUMP

ON - pump operates.

OFF - pump operates when commanded by system logic.

Fuel Transfer Main 1 & 4 Switch



1 FUEL Transfer (XFER) MAIN 1 & 4 Switch

ON - main 1 and 4 transfer valves open.

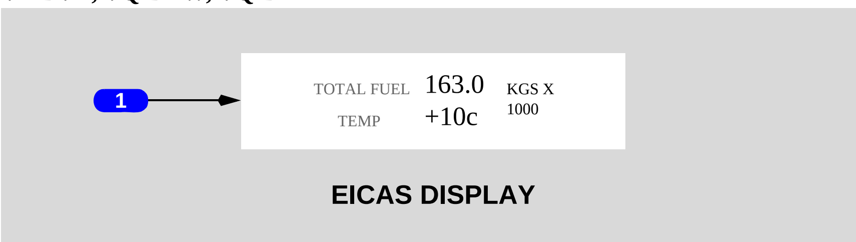
Off -

- main 1 and 4 transfer valves closed
- main 1 and 4 transfer valves open when commanded by system logic

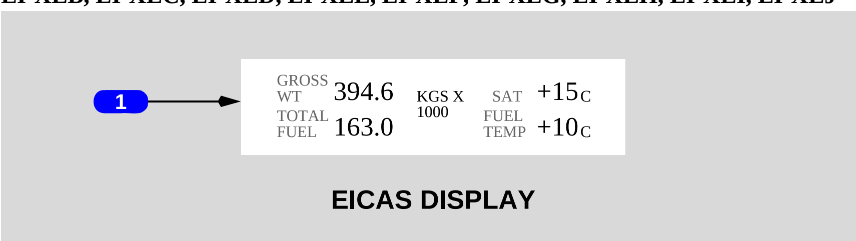
Fuel Indications and Displays

Normal Fuel Indications

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



1 Normal Fuel Indications

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
GROSS Weight (WT) (kilograms x 1000).

Total fuel quantity (kilograms x 1000).

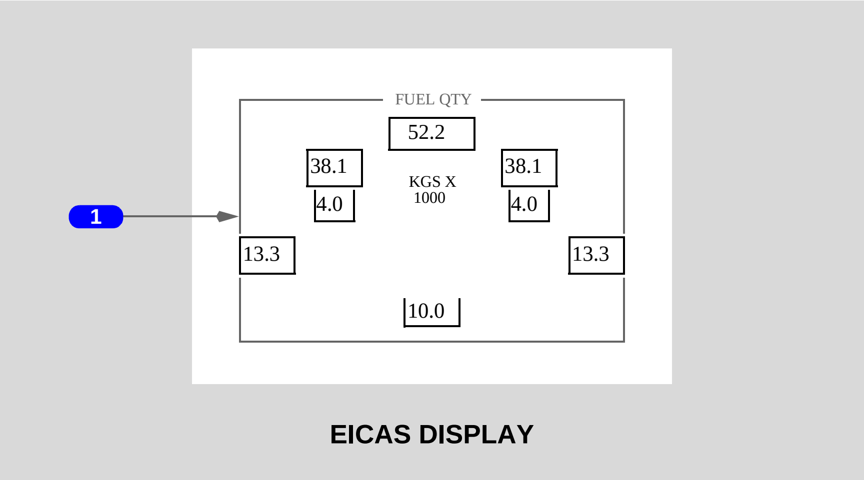
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
Static Air Temperature (SAT) (degrees Celsius).

Fuel temperature (degrees Celsius).

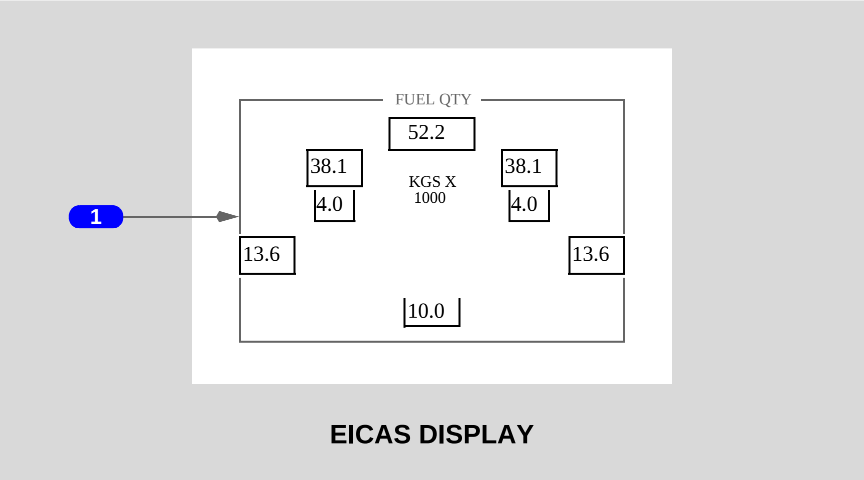
Amber - fuel temperature is -37°C and below.

Compacted Fuel Indications

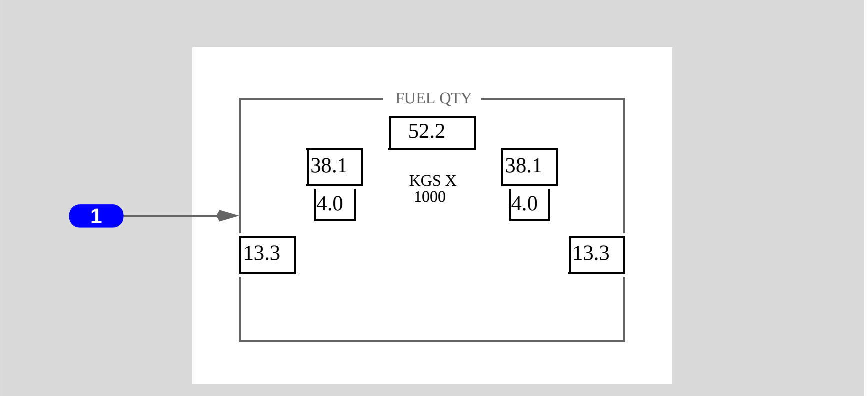
VQ-BHW, VQ-BHX



EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



EICAS DISPLAY

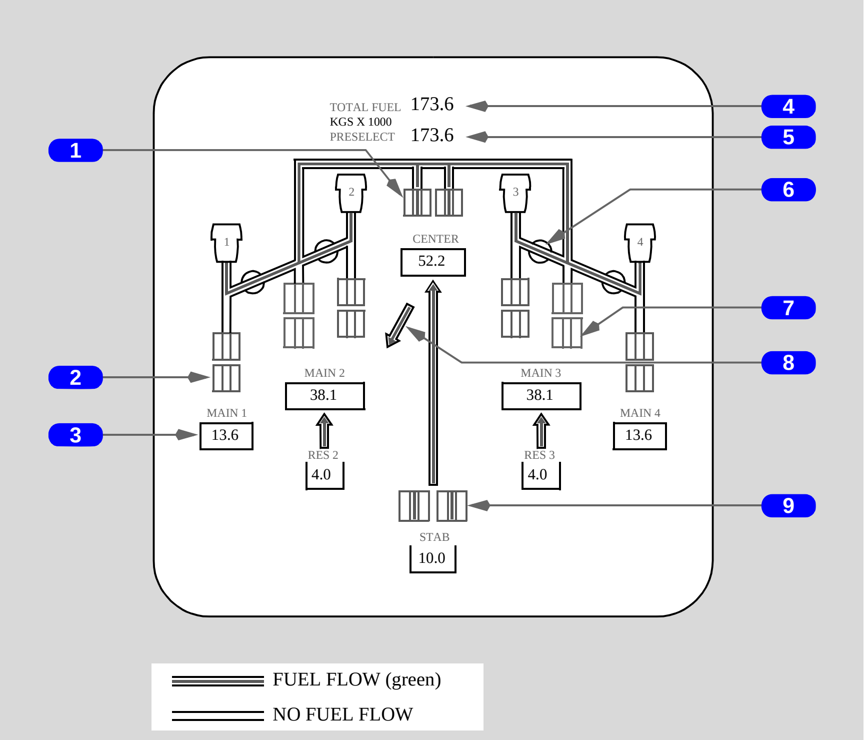
1 Compacted Fuel Indications

Compacted fuel quantity indications display on primary EICAS if only one display is available for EICAS.

Fuel Synoptic Display

The fuel synoptic is displayed by pushing the Fuel Synoptic Display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

The fuel flow displayed is generated by displayed valve positions and pump status. It does not display actual fuel flow, therefore the display may not represent actual system operation.



SECONDARY EICAS DISPLAY

1 **Center Wing Tank Pump**

White - pump switch off.

Green - pump on.

Amber - pump pressure low.

2 Main Pump

White - pump switch off.

Green - pump on.

Amber - pump pressure low.

3 Tank Quantity

White - indicates fuel quantity in tank.

Amber (main tank only) - imbalance condition or quantity less than 900 kg.

4 Total Fuel Quantity

White - indicates total fuel quantity.

5 Preselect Fuel Quantity

White - indicates selected total fuel quantity.

Displayed during fueling. No longer displayed when wing fueling panel door closed.

6 Crossfeed Valve

White - indicates open or closed position of crossfeed valve.

Green - indicates open or closed position of crossfeed valve with fuel.

Amber - valve position disagrees with commanded position.

7 Override Pump

White - pump switch off.

Cyan - armed for system logic operation.

Green - pump on.

Amber - pump pressure low.

VP-BVR

8 Scavenge Pump Transfer

White - pump on

Green - fuel pressure.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

9 Stabilizer Tank Pump

White - pump switch off.

Cyan - armed for system logic operation.

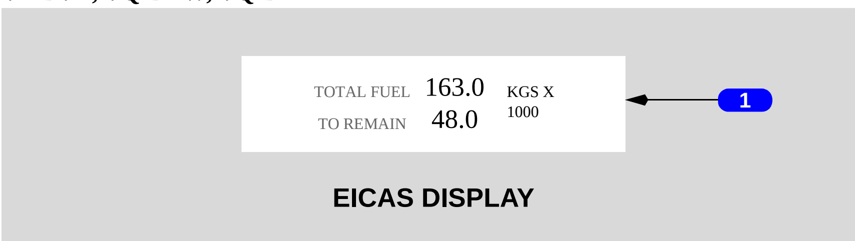
Green - pump on.

Amber - pump pressure low.

Fuel Jettison Indications

Fuel Jettison Indications, Primary EICAS

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

1 Fuel Jettison Indications

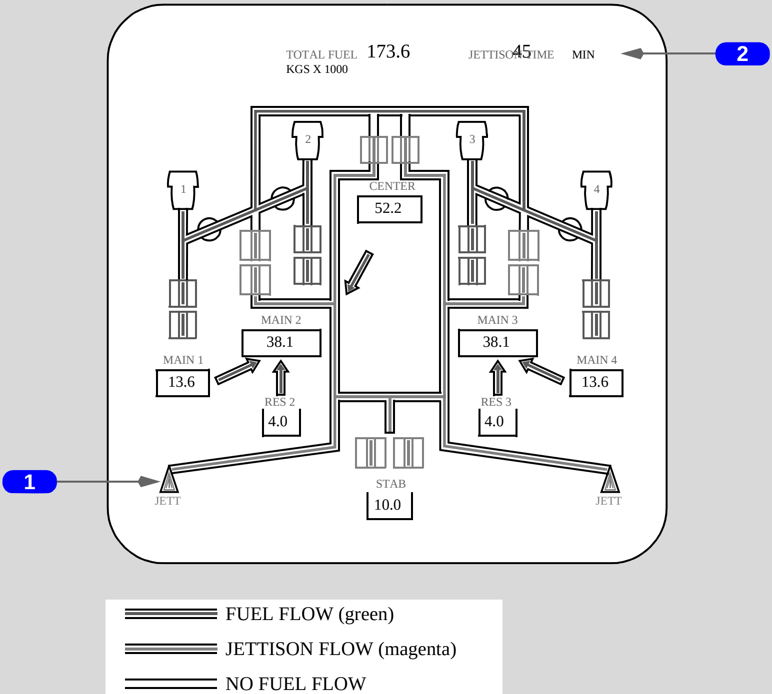
Fuel to remain replaces fuel temperature during jettison operation.

Magenta - indicates fuel to remain at completion of jettison.

White (flashes for five seconds) - indicates jettison has completed.

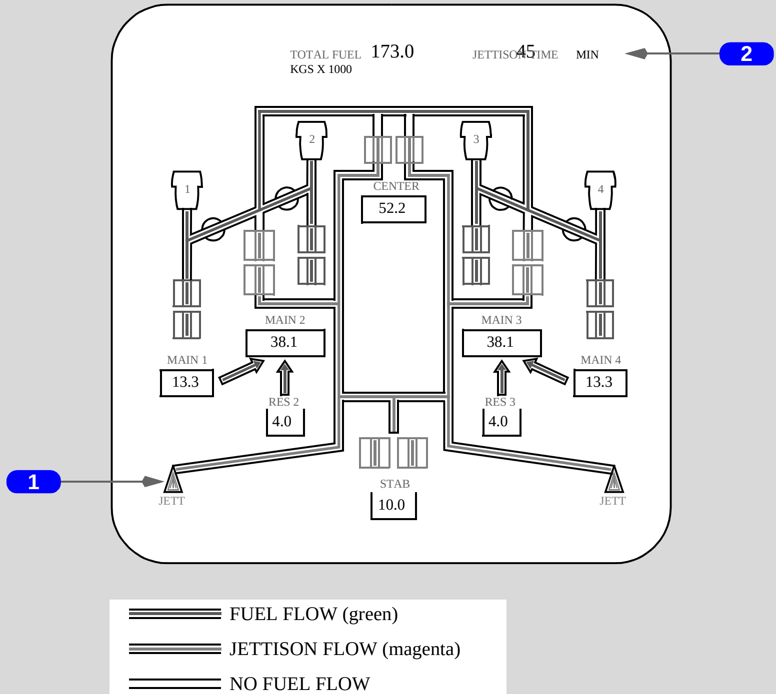
Fuel Jettison Indications, Fuel Synoptic

VP-BVR



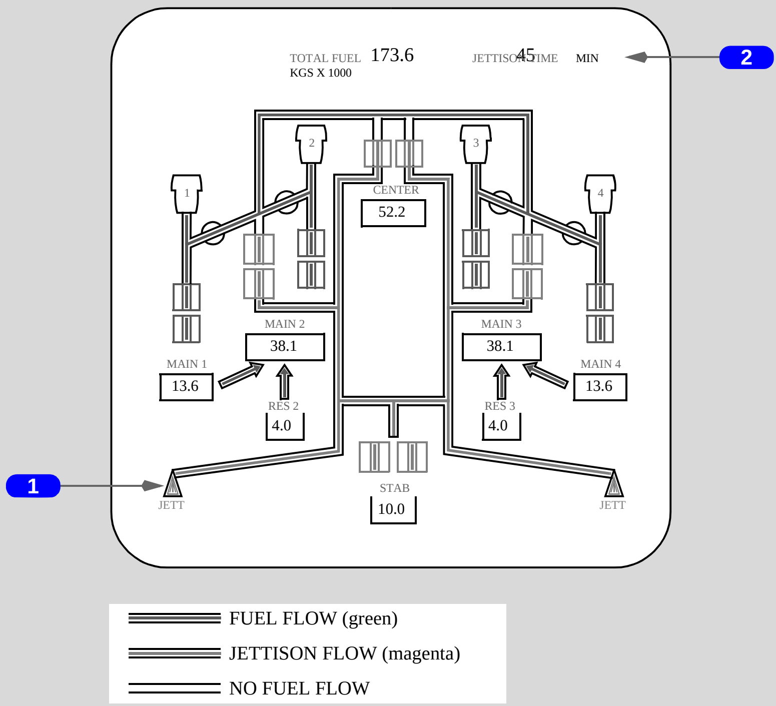
SECONDARY EICAS DISPLAY

VQ-BHW, VQ-BHX



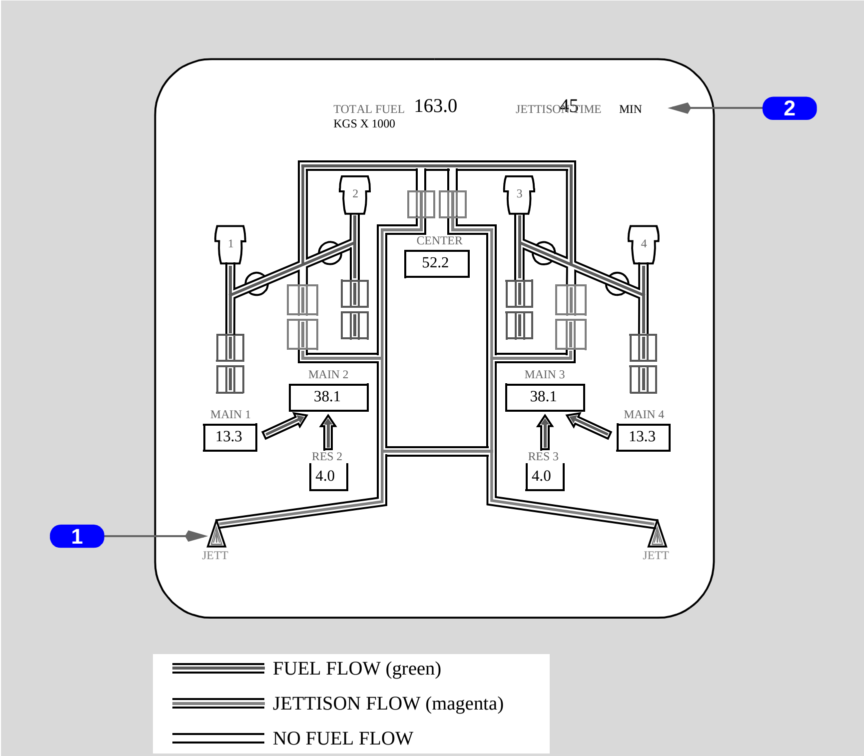
SECONDARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL



SECONDARY EICAS DISPLAY

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



SECONDARY EICAS DISPLAY

1 Jettison Nozzle

Magenta - fuel jettison system operating.

2 Time To Complete Jettison

White - time remaining to complete jettison.

Intentionally
Blank

Introduction

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The fuel system supplies fuel to the engines and the APU. The fuel is contained in a center wing tank, main tanks 1, 2, 3, 4, reserve tanks 2 and 3, and the horizontal stabilizer tank. Surge tanks are located in the outer portion of each wing and the outer portion of the right horizontal stabilizer.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

The fuel system supplies fuel to the engines and the APU. The fuel is contained in a center wing tank, main tanks 1, 2, 3, 4, and reserve tanks 2 and 3. Surge tanks are located in the outer portion of each wing.

Refer to Chapter 7, Engines, APU, for a description of the engine and APU fuel systems.

Fuel Quantity

Fuel quantity is measured by sensors in each tank. Total fuel quantity displays on primary EICAS. Tank quantities and total fuel quantity display on the fuel synoptic.

Compacted fuel quantity indications display on primary EICAS if only one display is available for EICAS.

Fuel Temperature

Fuel temperature is measured in main tank 1 and displays on primary EICAS. The temperature normally displays in white. It displays in amber when fuel temperature is at or below -37°C. During jettison, the TO REMAIN quantity replaces the EICAS display fuel temperature indication.

Fuel Pumps

Each main tank contains two AC-powered fuel pumps which run continuously when selected ON. A single pump supplies sufficient fuel to operate one engine at takeoff thrust conditions or two engines at cruise thrust. Main tank 2 and main tank 3 also contain two AC-powered override/jettison pumps which can operate to a standpipe level of approximately 3,200 kilograms remaining in the tank. Each override/jettison pump supplies sufficient fuel to operate two engines during takeoff and cruise conditions. The override/jettison pump’s higher output pressure overrides the main pumps’ output.

The two center wing tank (CWT) fuel pumps are also override/jettison pumps. Together, the CWT pumps inhibit 2 and 3 override/jettison pumps and override the main pumps so CWT fuel is used before wing tank fuel. However, one CWT pump alone does not inhibit 2 and 3 override/jettison pumps or override the outboard main pumps.

VP-BVR
CWT fuel is scavenged by an electric pump activated by system logic at either or both of two separate instances, one when a CWT override/jettison pump has low output pressure and the other when main tank 2 or 3 fuel quantity decreases to approximately 18,200 kilograms. After each activation, the pump will operate for approximately two hours or until the scavenge pump pressure is low, whichever occurs first. The scavenged fuel is pumped into main tank 2.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VQ-BHW, VQ-BHX
CWT fuel is scavenged by four jet pumps, two pumping into each main tank 2 and 3. Scavenge begins when main tank 2 or 3 fuel quantity decreases to approximately 27,200 kilograms.

VP-BKJ, VP-BKL, VP-BVR
(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; before SB, stab fuel auto-shutoff not installed)
The horizontal stabilizer tank contains two AC-powered transfer/jettison pumps. Each pump can transfer all fuel in the horizontal stabilizer tank to the CWT.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; SB installs stab fuel auto-shutoff)
The horizontal stabilizer tank contains two AC-powered transfer/jettison pumps. Each pump can transfer all fuel in the horizontal stabilizer tank to the CWT. If low output pressure is detected, the FUEL PRES STB L or R EICAS message is displayed. If after a brief delay the pump is not selected off, the pump shuts off to protect from overheating.

Suction Feed

When main tank fuel pump pressure is low, each engine can draw fuel from its corresponding main tank through a suction feed line that bypasses the pumps. As the airplane climbs, dissolved air is released from the fuel in the tank due to the decrease in air pressure. This air may collect in the suction feed line and restrict fuel flow. At high altitude, thrust deterioration or engine flameout may occur as a result of the fuel flow reduction.

The dissolved air in the fuel tank will eventually deplete after reaching cruise altitude. The depletion time is dependent upon airplane altitude, fuel temperature, and type of fuel. Once the dissolved air is depleted, the engine may be capable of suction feed operation at cruise power.

Fuel pressure can be provided from a main tank with operating pumps to another engine by opening the appropriate fuel crossfeed valves. Continued crossfeed use will result in a progressive fuel imbalance.

Fuel Crossfeed

A common fuel manifold connects all main tanks and the CWT. There are four crossfeed valves in the fuel manifold. In flight, the combination of active pumps and automatically or manually controlled crossfeed valves direct the flow of fuel from tanks to engines.

Fuel Imbalance

Excessive fuel imbalance adversely affects CG, aerodynamic drag, and fuel economy.

Fuel balancing is accomplished by opening or closing crossfeed valves and turning off and on fuel pump switches.

Fuel Tank Capacities

VQ-BHW, VQ-BHX

Tank	Liters	Kilograms *
1 and 4 Main	33,100	26,576
2 and 3 Main	94,984	76,263
Center	64,973	52,167
Reserves	10,009	8,036
Stabilizer	12,492	10,030
Total	215,558	173,072
* Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.		

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

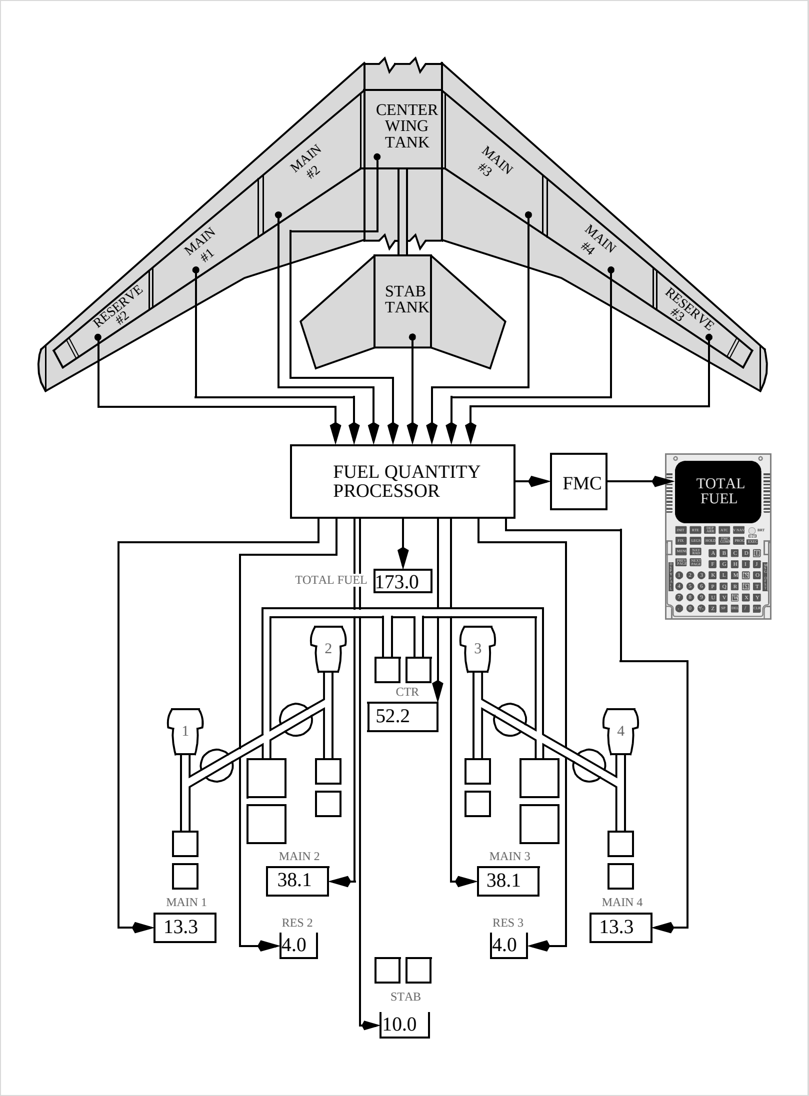
Tank	Liters	Kilograms *
1 and 4 Main	33,932	27,244
2 and 3 Main	94,984	76,263
Center	64,973	52,167
Reserves	10,009	8,036
Stabilizer	12,492	10,030
Total	216,390	173,740
* Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.		

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

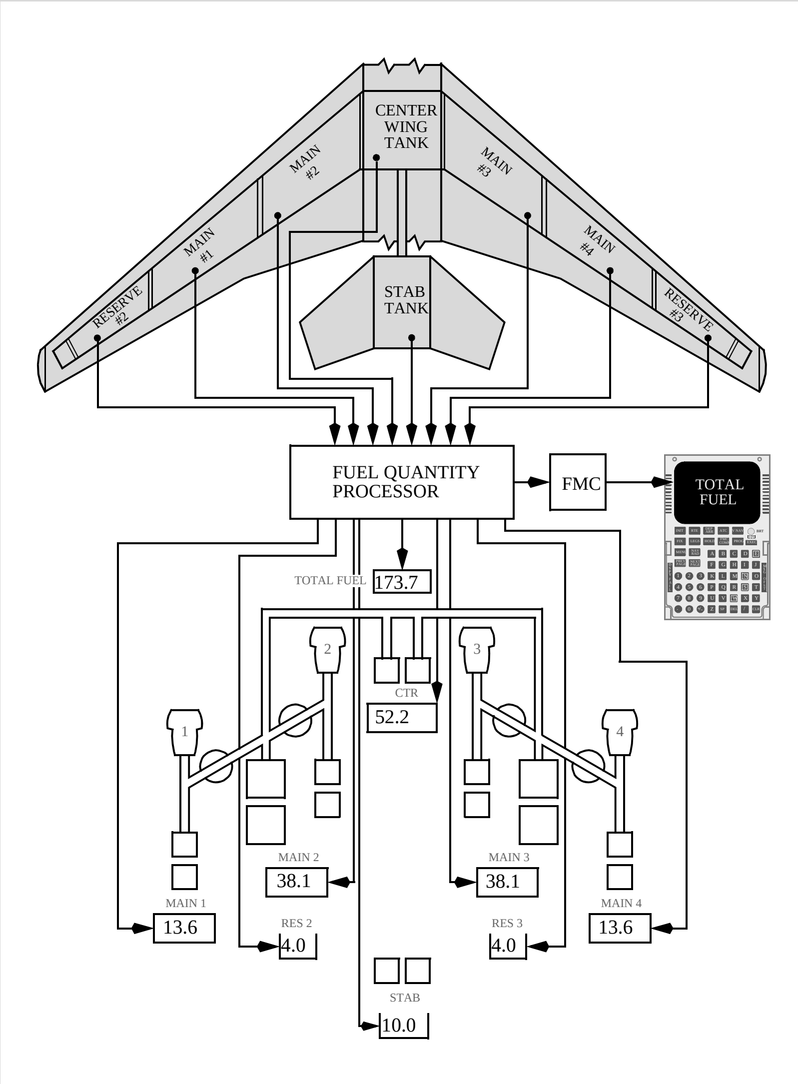
Tank	Liters	Kilograms *
1 and 4 Main	33,100	26,576
2 and 3 Main	94,984	76,263
Center	64,973	52,167
Reserves	10,009	8,036
Total	203,066	163,042
* Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.		

Fuel Quantity Indication

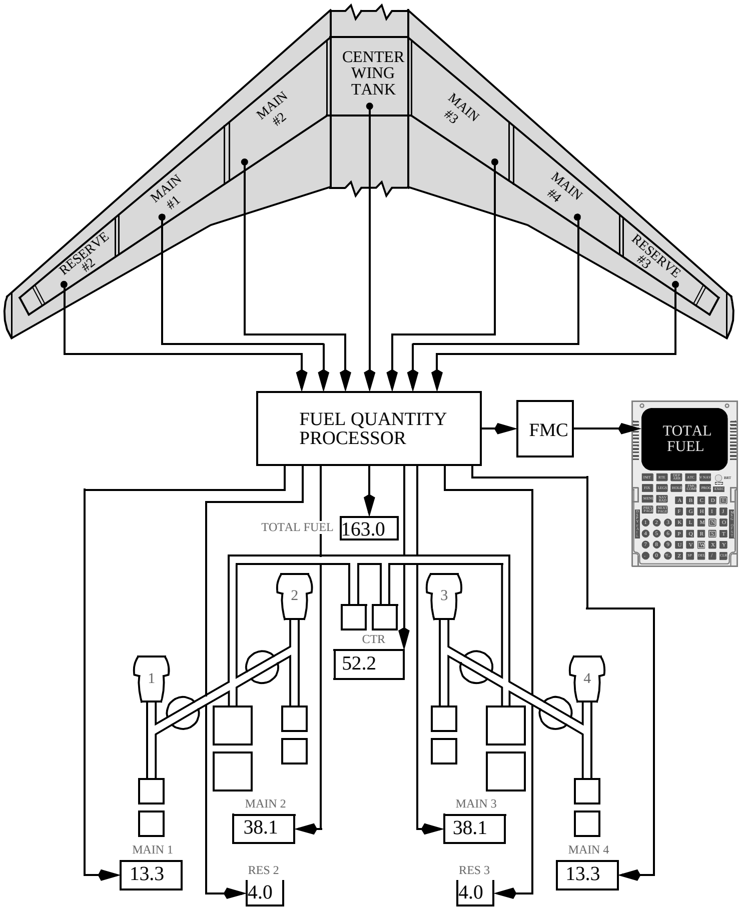
VQ-BHW, VQ-BHX



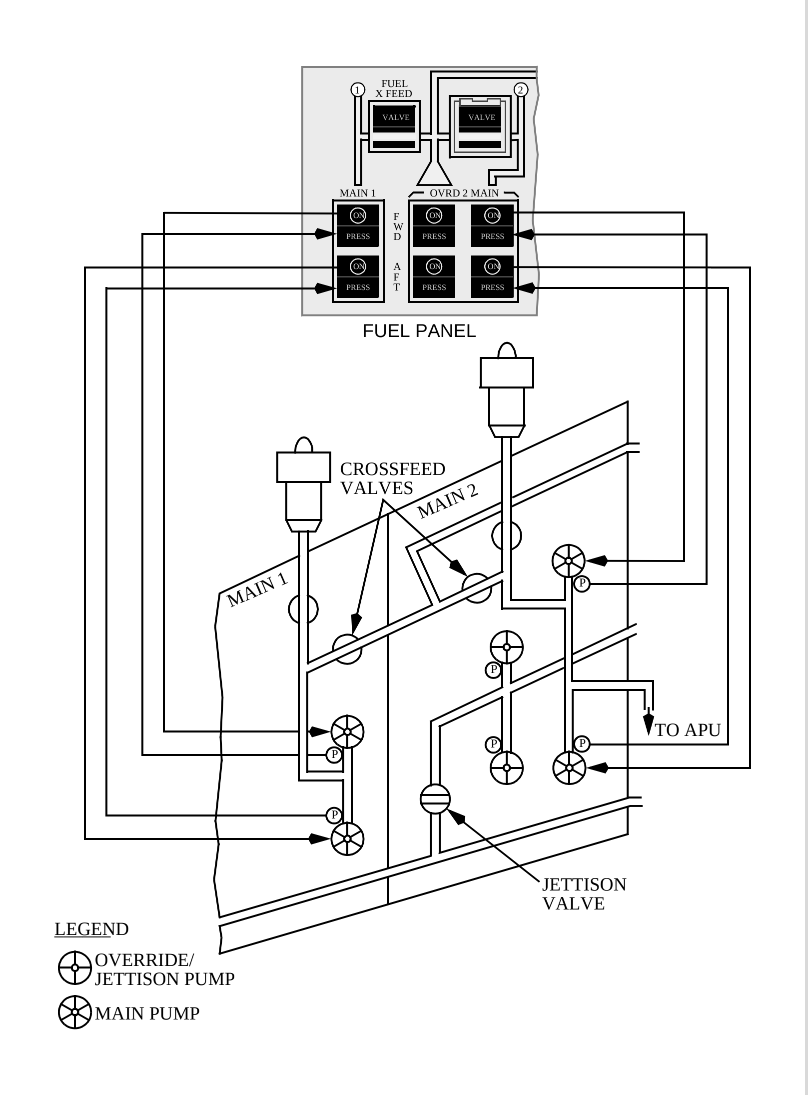
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



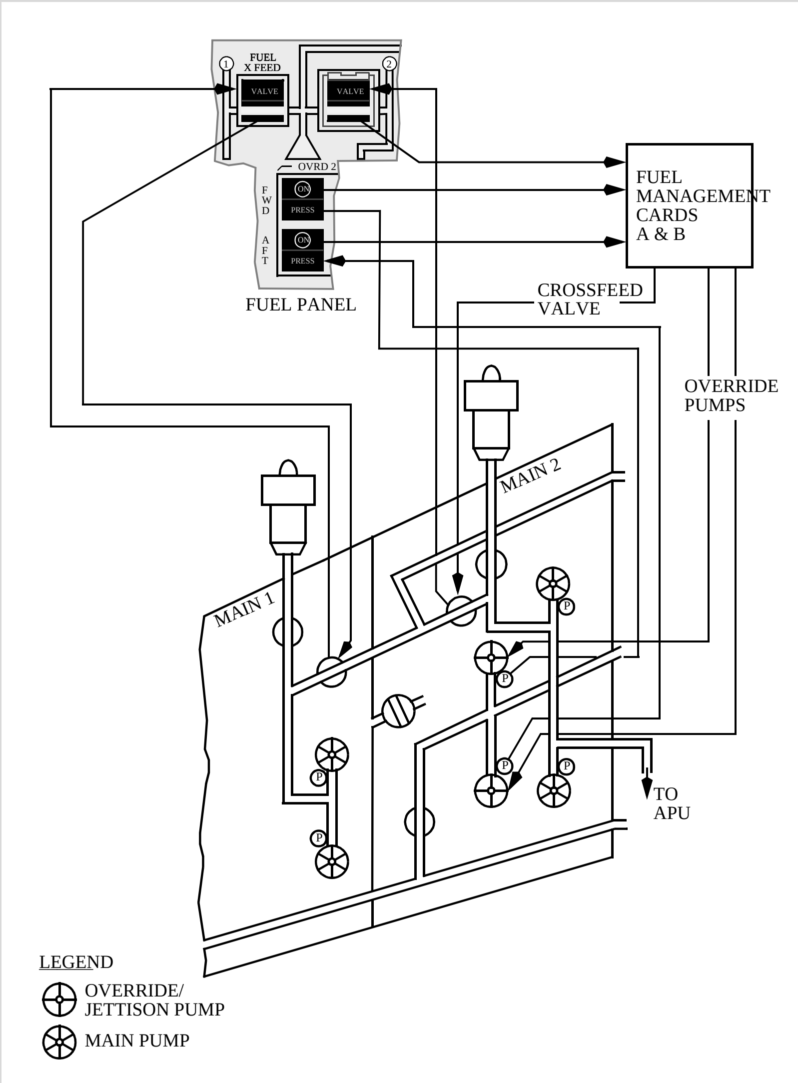
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



Fuel System Schematics
Main Tank Main Pump Schematic

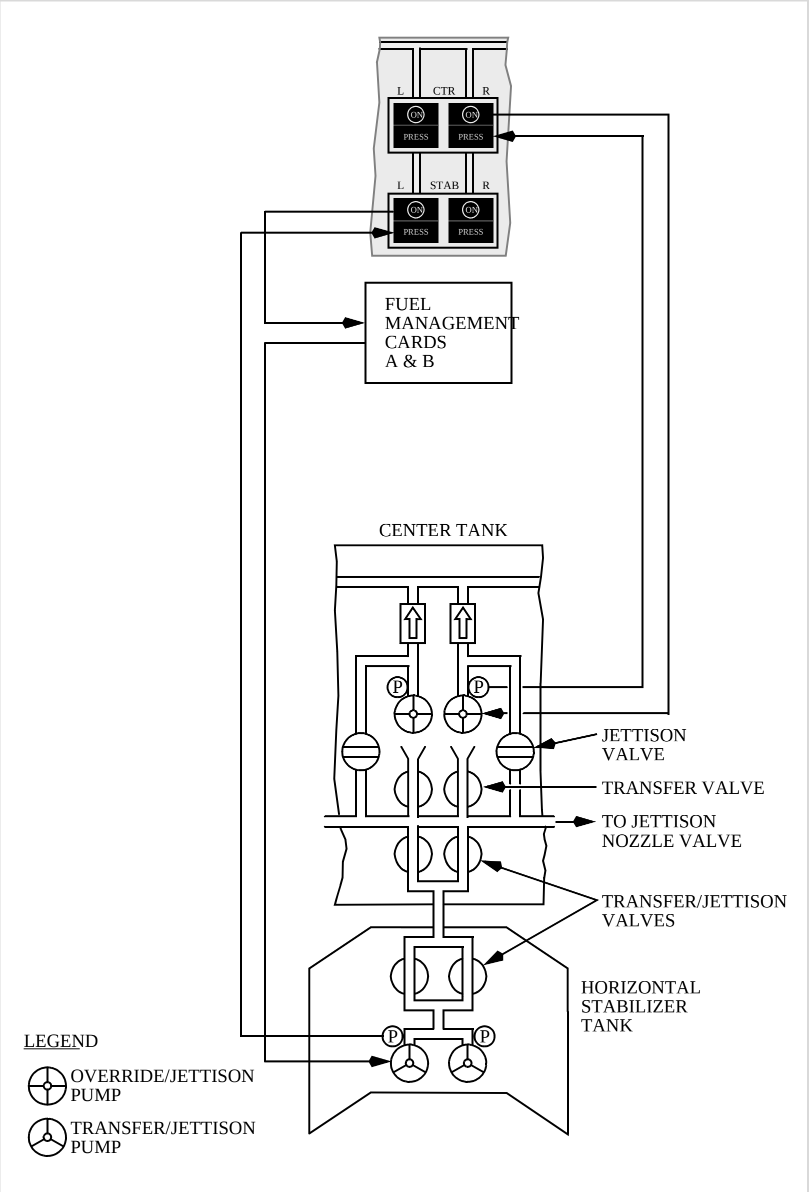


Main Tank Override/Jettison Pump and Fuel Crossfeed Schematic



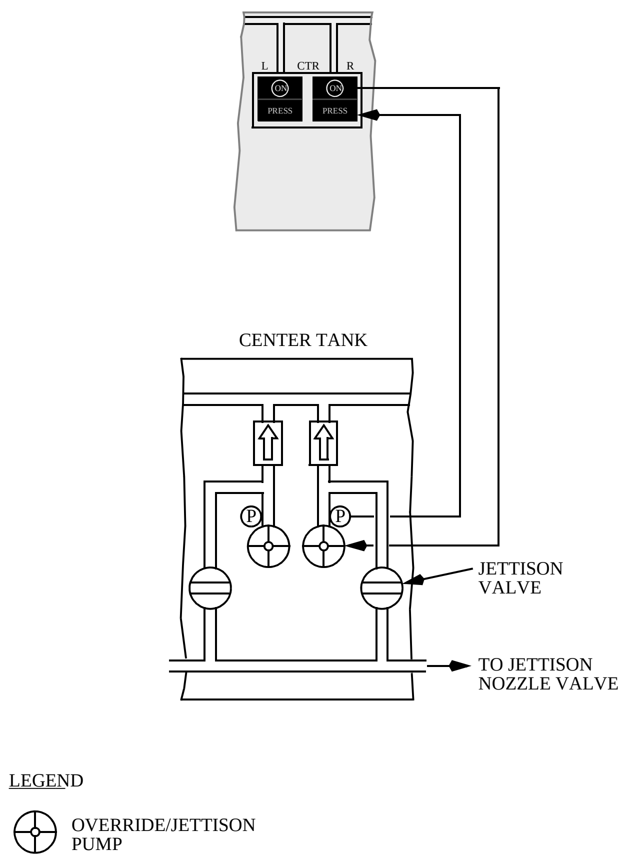
Center Wing and Horizontal Stabilizer Pump Schematic

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



Center Wing Tank Pump Schematic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



Reserve Tank 2 and 3 Transfer

Each reserve tank contains two transfer valves. The valves open and fuel gravity transfers to the inboard main tanks when main tank 2 or 3 fuel quantity decreases to approximately 18,200 kilograms.

Main Tank 1 and 4 Transfer

Main tank 1 and 4 each contain one transfer valve. When the valves open, fuel gravity transfers from the outboard main tanks to the inboard main tanks. Fuel transfers to approximately 3,200 kilograms remaining in each outboard main tank.

During fuel jettison, the valves open when either main tank 2 or 3 fuel quantity decreases to 9,072 kilograms. The valves may be opened manually using the Fuel Transfer Main 1 & 4 switch on the overhead panel.

APU Fuel Feed

VP-BVR
(VP-BKJ ; before SB, main pump 3 aft for APU fuel feed not installed)
APU fuel is normally supplied from main tank 2. When AC power is available, fuel is supplied by main pump 2 aft. If AC power is not available, a dedicated DC pump in main tank 2 supplies fuel to the APU.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL, VQ-BHW, VQ-BHX
(VP-BKJ ; SB installs main pump 3 aft for APU fuel feed)
APU fuel is normally supplied from main tank 2. When AC power is available, fuel is supplied by main pump 2 aft; main pump 3 aft operates to prevent tank-to-tank transfer and provides fuel if main pump 2 aft fails. If AC power is not available, a dedicated DC pump in main tank 2 supplies fuel to the APU.

Fuel System Operation

Fuel system management cards (FSMCs) command fuel valves open or closed and fuel pumps on or off according to fuel management logic.

Preflight

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
When fuel pump switches are off before engine start, low pressure lights are illuminated on the main pump switches and extinguished on the override, CWT, and stabilizer tank pump switches.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
When fuel pump switches are off before engine start, low pressure lights are illuminated on the main pump switches and extinguished on the override, and CWT pump switches.

Operation With Fuel in Center Wing Tank

With 7,700 kgs or more fuel in the CWT, both CWT pump switches should be ON. The FSMCs close crossfeed valves 2 and 3 when flaps extend to takeoff position on the ground. Override/jettison pumps 2 and 3 are inhibited from operating when pressure is detected from both CWT override/jettison pumps. The CWT override/jettison pumps provide fuel to engines 1 and 4 and main pumps 2 and 3 provide fuel to their related engine.

With less than 7,700 kgs of fuel in the CWT, both CWT pump switches should be off. The FSMCs close crossfeed valves 2 and 3 when flaps extend to takeoff position on the ground. Override/jettisons pumps 2 provide fuel to engine 1 and override/jettison pumps 3 provide fuel to engine 4. Main pumps 2 and 3 provide fuel to their related engine.

The FSMCs open crossfeed valves 2 and 3 when the flaps are out of the range of flaps 10 and flaps 20 settings. With the CWT pump switches ON, the CWT override/jettison pumps provide fuel to all engines. With the CWT pump switches OFF, the override/jettison pumps 2 provide fuel to engines 1 and 2 and override/jettison pumps 3 provide fuel to engines 3 and 4.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Stabilizer fuel transfer is enabled in flight when the flaps are retracted out of the range of flaps 10 and flaps 20 settings and the CWT fuel quantity is 36,470 kgs or less.

Note: When CWT quantity drops below approximately 2,300 kgs and total fuel consumption is greater than 6,800 kgs per hour, the CWT override/jettison pumps can no longer provide full override of the outboard main tank pumps. As a result, a shared flow situation between the CWT and outboard main tanks is established. During this shared flow situation, approximately 900 kilograms of fuel are consumed from each outboard main tank prior to display of the EICAS message FUEL LOW CTR.

The FSMCs activate override/jettison pumps 2 and 3 when low pressure is detected from either CWT override/jettison pump with the CWT pump switches ON or when both CWT pump switches are pushed off. Override/jettison pumps 2 provide fuel to engines 1 and 2 and override/jettison pumps 3 provide fuel to engines 3 and 4.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VQ-BHW, VQ-BHX

CWT fuel is scavenged by four jet pumps, two pumping into each main tank 2 and 3.

The FSMCs open the reserve transfer valves when main tank 2 or 3 fuel quantity decreases to approximately 18,200 kgs. Fuel transfers from reserve tanks 2 and 3 to the related main tank.

VP-BVR

The electrical CWT scavenge pump is automatically activated to pump CWT fuel into main tank 2. The pump is deactivated after 120 minutes, or no pressure, whichever occurs first.

In flight, the EICAS message FUEL TANK/ENG displays when one of the following occurs with the crossfeed valve 1 or 4 open: main tank 2 quantity is equal to or less than main tank 1 quantity or main tank 3 quantity is equal to or less than main tank 4 quantity. In the tank-to-engine configuration the main pumps provide fuel to their respective engine until engine shutdown.

Note: On the ground, the FUEL TANK/ENG message can display when the inboard tank quantity is less than or equal to the sum of the adjacent outboard tank plus 500 kgs in both wings.

Operation With No Fuel in Center Wing Tank

With no fuel in center wing tank, the FSMCs activate override/jettison pumps 2 and 3. The FSMCs close crossfeed valves 2 and 3 when the flaps extend to takeoff position on the ground. Override/jettison pumps 2 provide fuel to engine 1 and override/jettison pumps 3 provide fuel to engine 4. Main pumps 2 and 3 provide fuel to their related engine.

The FSMCs open crossfeed valves 2 and 3 when the flaps are out of the range of flaps 10 and flaps 20 settings. Override/jettison pumps 2 provide fuel to engines 1 and 2 and override/jettison pumps 3 provide fuel to engines 3 and 4. Reserve fuel transfer and tank-to-engine configuration are identical to operating with fuel in the CWT.

Note: On the ground, the FUEL TANK/ENG message can display with as much as 500 kilograms more fuel in an inboard main tank than the adjacent outboard main tank.

Fuel Jettison

The fuel jettison system allows jettison from all fuel tanks. Override/jettison pumps in main tanks 2 and 3 and the center wing tank pump fuel overboard through the jettison nozzle valves.

Fuel jettison is initiated by rotating the fuel jettison selector to A or B. When a jettison control system is selected, the fuel temperature indication on EICAS is replaced with the fuel to remain quantity indication. The jettison manifold and jettison time display on the fuel synoptic.

Rotating the Fuel To Remain selector decreases or increases the fuel to remain quantity.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Pushing either fuel jettison nozzle valve switch ON activates all override/jettison and transfer/jettison pumps in the tanks containing fuel (pump switches must be ON) and opens the required jettison and transfer/jettison valves. The related jettison nozzle valve also opens. The jettison time is initially estimated using preprogrammed rates. The system begins updating the estimate based on actual fuel quantity rate of change ninety seconds after jettison begins.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
Pushing either fuel jettison nozzle valve switch ON activates all override/jettison pumps in the tanks containing fuel (pump switches must be ON) and opens the required jettison valves. The related jettison nozzle valve also opens. The jettison time is initially estimated using preprogrammed rates. The system begins updating the estimate based on actual fuel quantity rate of change ninety seconds after jettison begins.

If override/jettison pumps 2 and 3 are providing fuel to the engines when jettison begins, the EICAS message FUEL OVRD may be displayed due to reduced pressure caused by the jettison nozzles valves opening. Jettison is verified by observing decreasing tank quantities.

The jettison control system controls fuel balancing between main tanks 2 and 3 as fuel is jettisoned. If fuel balancing is necessary, the override/jettison pumps in the low tank deactivate until the tanks are balanced.

The FSMCs open the reserve transfer valves when main tank 2 or 3 fuel quantity decreases to 18,140 kilograms. Fuel transfers from reserve tanks 2 and 3 to the related main tank.

When either main tank 2 or 3 fuel quantity decreases to 9,072 kilograms during jettison, both main tank 1 and 4 transfer valves open.

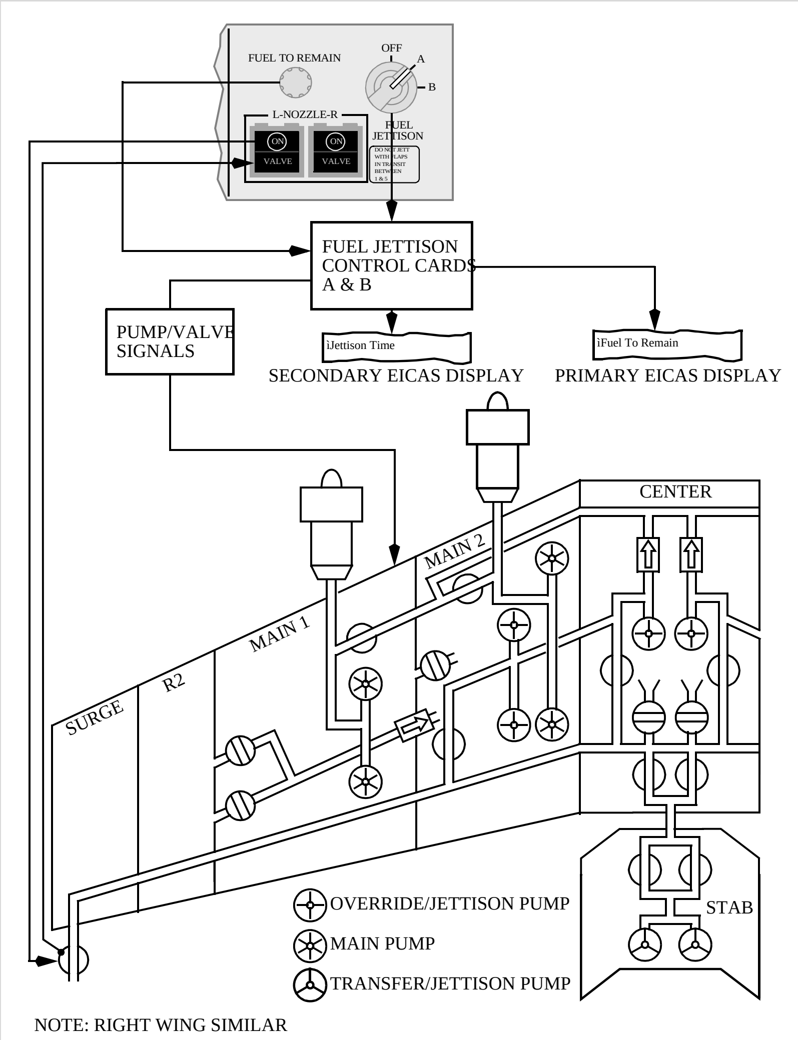
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
Jettison terminates when total fuel quantity decreases to the fuel to remain quantity. The fuel to remain quantity indication changes color from magenta to white and flashes for five seconds. The jettison control system deactivates all operating override/jettison and transfer/jettison pumps. The related FUEL OVRD pump EICAS messages display until the Fuel Jettison selector is OFF.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

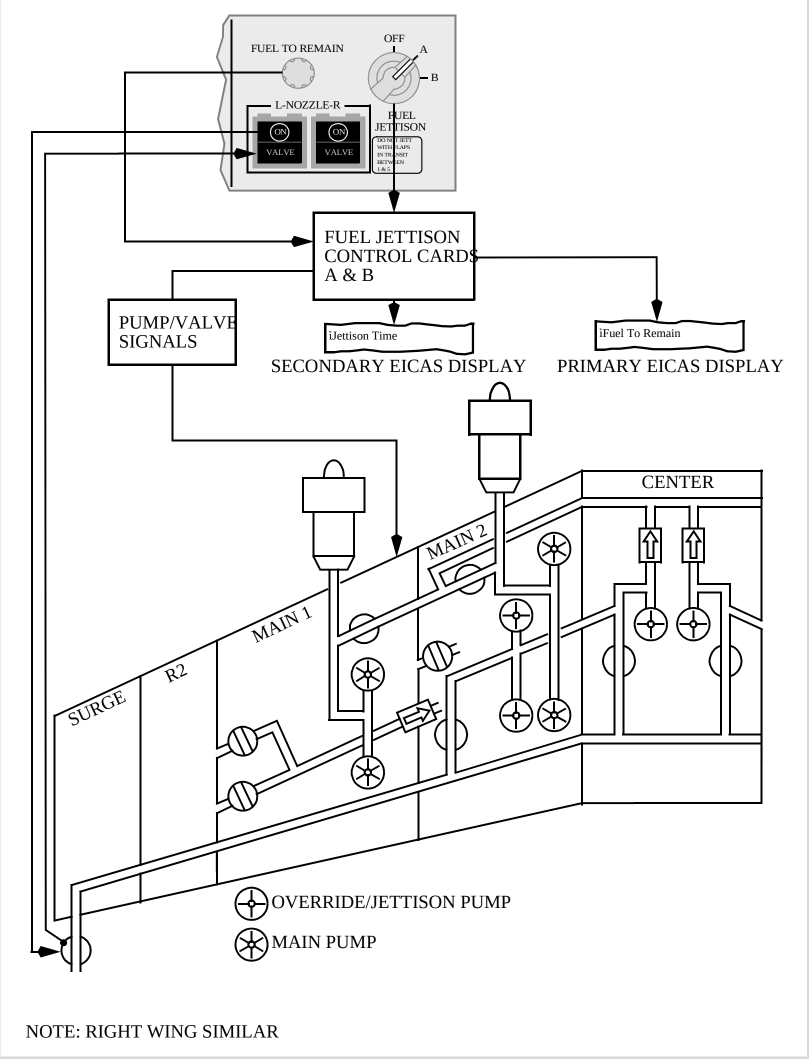
Jettison terminates when total fuel quantity decreases to the fuel to remain quantity. The fuel to remain quantity indication changes color from magenta to white and flashes for five seconds. The jettison control system deactivates all operating override/jettison pumps. The related FUEL OVRD pump EICAS messages display until the Fuel Jettison selector is OFF.

Fuel Jettison Schematic

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



EICAS Alert Messages

Message	Level	Aural	Message Logic
FUEL IMBAL 1-4	Advisory		Fuel difference of 1,360 kgs between main tanks 1 and 4. Message no longer displayed when difference less than 450 kgs.
FUEL IMBAL 2-3	Advisory		Fuel difference of 2,720 kgs between main tanks 2 and 3. Message no longer displayed when difference less than 450 kgs.
FUEL IMBALANCE	Advisory		Fuel difference of 2,720 kgs between inboard main tanks (2 and 3) and outboard main tanks (1 and 4) after reaching FUEL TANK/ENG condition. Message no longer displayed when difference less than 450 kgs.
>FUEL JETT A, B	Advisory		A fuel jettison system is failed. Message inhibited when FUEL JETT SYS message displayed.
FUEL JETT SYS	Caution	Beeper	Fuel total is less than fuel to remain and one jettison nozzle valve is open, or both fuel jettison systems are failed.

VP-BKJ, VP-BKL, VP-BVR
(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; before SB, stab fuel auto-shutoff not installed)

>FUEL LO STAB L	Advisory		Horizontal stabilizer tank quantity 3,600 kgs or less in climb with Left Stabilizer Tank Pump switch ON, or horizontal stabilizer tank quantity approximately 1,200 kgs in cruise with Left Stabilizer Tank Pump switch ON. Message inhibited during jettison.

Message	Level	Aural	Message Logic

VP-BKJ, VP-BKL, VP-BVR
(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; before SB, stab fuel auto-shutoff not installed)

Message	Level	Aural	Message Logic
>FUEL LO STAB R	Advisory		Horizontal stabilizer tank quantity 3,600 kgs or less in climb with Right Stabilizer Tank Pump switch ON, or horizontal stabilizer tank quantity approximately 600 kgs in cruise with Right Stabilizer Tank Pump switch ON. Message inhibited during jettison.
>FUEL LOW CTR L, R	Advisory		Center wing tank quantity less than 7,700 kgs before start with pump switches ON, or center wing tank quantity approximately 3,200 kgs in climb with pump switches ON, or center wing tank quantity approximately 1,300 kgs in cruise with pump switches ON. Message inhibited during jettison.
>FUEL OVD CTR L, R	Advisory		On the ground with center wing tank quantity of 7,700 kgs or more with center wing tank pump switch OFF, or in cruise, center wing tank quantity 1,800 kgs or more with center wing tank pump switch OFF.
FUEL OVRD 2, 3 AFT	Advisory		Low pump pressure detected when pump activated. Pump activates by system logic with Override Pump switch ON. Message displays with Override Pump switch OFF before tank-to-engine configuration.

Message	Level	Aural	Message Logic
FUEL OVRD 2, 3 FWD	Advisory		Low pump pressure detected when pump activated. Pump activates by system logic with Override Pump switch ON. Message displays with Override Pump switch OFF before tank-to-engine configuration.

VP-BKJ, VP-BKL, VP-BVR
(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; before SB, stab fuel auto-shutoff not installed)

>FUEL PMP STB L	Advisory		Left Stabilizer Tank Pump switch ON on the ground, or stabilizer tank quantity 1,600 kgs or more in cruise with Left Stabilizer Tank Pump switch OFF.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; SB installs stab fuel auto-shutoff)

>FUEL PMP STB L	Advisory		Left Stabilizer Tank Pump switch ON on the ground, or stabilizer tank quantity 500 kgs or more in cruise with Left Stabilizer Tank Pump switch OFF. Message inhibited when FUEL STAB XFR message displayed.

VP-BKJ, VP-BKL, VP-BVR
(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; before SB, stab fuel auto-shutoff not installed)

>FUEL PMP STB R	Advisory		Right Stabilizer Tank Pump switch ON on the ground, or stabilizer tank quantity 1,000 kgs or more in cruise with Right Stabilizer Tank Pump switch OFF.

Message	Level	Aural	Message Logic

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; SB installs stab fuel auto-shutoff)

Message	Level	Aural	Message Logic
>FUEL PMP STB R	Advisory		Right Stabilizer Tank Pump switch ON on the ground, or stabilizer tank quantity 500 kgs or more in cruise with Right Stabilizer Tank Pump switch OFF. Message inhibited when FUEL STAB XFR message displayed.

VP-BKJ, VP-BKL, VP-BVR
(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; before SB, stab fuel auto-shutoff not installed)

Message	Level	Aural	Message Logic
FUEL PRES STAB L, R	Caution	Beeper	FUEL LO STAB L, R message displayed for 30 seconds, or low pump pressure detected when pump activated.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VQ-BHW, VQ-BHX ; SB installs stab fuel auto-shutoff)

Message	Level	Aural	Message Logic
FUEL PRES STB L, R	Advisory		Low pump pressure detected when pump activated. Pump activates by system logic with Stabilizer Tank Pump switch ON.

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; before SB, IDS-504 or later software not installed)

Message	Level	Aural	Message Logic
FUEL PRESS CTR L, R	Caution	Beeper	FUEL LOW CTR L, R message displayed for 60 seconds, or low pump pressure detected when pump switch ON. Message inhibited during jettison until fuel in Center Wing Tank is less than 220 kgs.

Message	Level	Aural	Message Logic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; SB installs IDS-504 or later software)

FUEL PRESS CTR L, R	Caution	Beeper	FUEL LOW CTR L, R message displayed for 60 seconds, or low pump pressure detected when pump switch ON. Message inhibited during jettison until fuel in Center Wing Tank is less than 900 kgs.
FUEL PRESS ENG 1, 2, 3, 4	Caution	Beeper	Engine on suction feed. Suction feed occurs if both main pumps in a tank fail with the respective crossfeed valve closed.
FUEL PUMP 1, 2, 3, 4 AFT	Advisory		Low pump pressure detected. Message inhibited when FUEL PRESS ENG message displayed.
FUEL PUMP 1, 2, 3, 4 FWD	Advisory		Low pump pressure detected. Message inhibited when FUEL PRESS ENG message displayed.
FUEL QTY LOW	Caution	Beeper	Fuel quantity 900 kgs or less in one or more main tanks.
FUEL RES XFR 2, 3	Advisory		Reserve transfer valves not in commanded position.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

FUEL STAB XFR	Caution	Beeper	Stabilizer tank fuel transfer function is failed.

Message	Level	Aural	Message Logic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX (EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; before SB, IDS-506 or earlier software installed with FQIS BLK B)

>FUEL TANK/ENG	Advisory		With crossfeed valve 1 or 4 open: on the ground after fueling, after initial electrical power established, or after CMC ground test; main tank 2 quantity less than or equal to main tank 1 quantity plus 500 kgs and main tank 3 quantity less than or equal to main tank 4 quantity plus 500 kgs, or in flight, main tank 2 quantity equal to or less than main tank 1 quantity, or main tank 3 quantity equal to or less than main tank 4 quantity. Message inhibited during jettison.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs IDS-508 software with FQIS BLK B)

>FUEL TANK/ENG	Advisory		With crossfeed valve 1 or 4 open: on the ground after fueling, after initial electrical power established, or after CMC ground test; main tank 2 quantity less than or equal to main tank 1 quantity plus 500 kgs and main tank 3 quantity less than or equal to main tank 4 quantity plus 500 kgs, or in flight, main tank 2 quantity equal to or less than main tank 1 quantity, or main tank 3 quantity equal to or less than main tank 4 quantity. Message inhibited during jettison. Message inhibited for ten seconds following takeoff power or until airplane is in flight.
FUEL TEMP LOW	Advisory		Fuel temperature -37°C or less.
FUEL TEMP SYS	Advisory		Fuel temperature sensing inoperative.

Message	Level	Aural	Message Logic
FUEL X FEED 1, 2, 3, 4	Advisory		Fuel crossfeed valve position disagrees with commanded position.
>FUEL XFER 1+4	Advisory		Fuel Transfer Main 1 & 4 switch ON with inboard main tank quantities greater than outboard main tank quantities in flight, or switch ON while airplane on the ground.
>JETT NOZ ON	Advisory		Both fuel jettison nozzle valves open.
>JETT NOZ ON L, R	Advisory		Fuel jettison nozzle valve open. Message inhibited when JETT NOZ ON message displayed.
>JETT NOZZLE L, R	Advisory		Jettison nozzle valve position disagrees with commanded position.

VP-BVR

>SCAV PUMP ON	Advisory		Center wing tank scavenge pump operating while airplane on the ground.
>X FEED CONFIG	Advisory		One or more fuel crossfeed valves incorrectly configured. Message displayed when crossfeed valve 1 or 4 closed and main tanks not equal, or crossfeed valve 2 or 3 closed and flaps not in takeoff position.

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Hydraulics — Chapter 13
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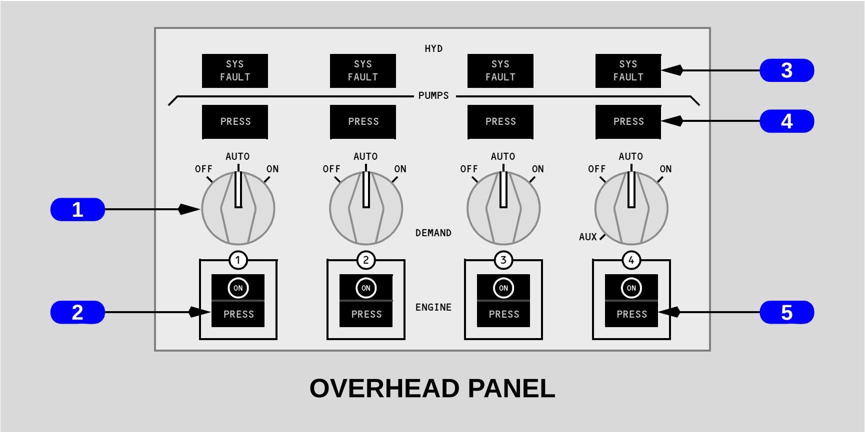
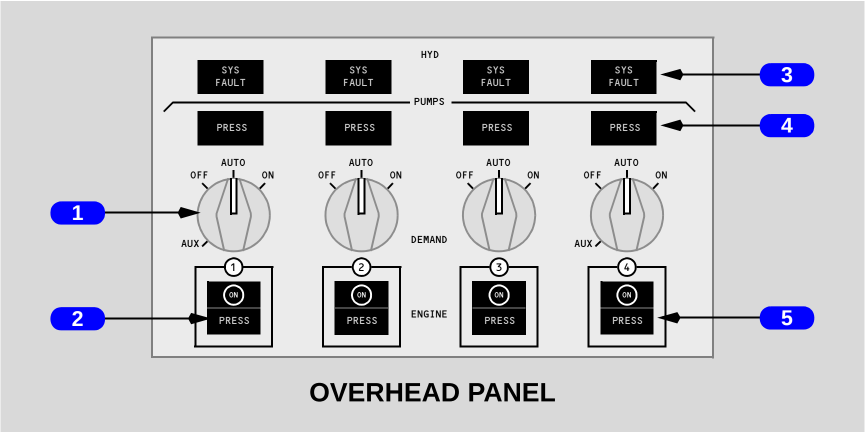
Hydraulic Panel

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



1 Hydraulic DEMAND Pump Selector

OFF - demand and auxiliary pumps off.

AUTO -

- demand pump operates when respective engine pump output pressure is low, or when respective fuel control switch is in CUTOFF

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

- demand pumps 1 & 4 also operate when trailing edge flaps are in transit, or flaps extended past 1

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

- and not OM/HYD_SYS::PUMP:DEM:FLAPS_EXTNDD
- demand pumps 1 & 4 also operate when trailing edge flaps are in transit

ON - demand pump operates

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
Auxiliary (AUX) (System 4) -

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
Auxiliary (AUX) (System 1 and 4) -

- auxiliary pump operates on ground until respective engine pump pressurizes
- related demand pump off

2 ENGINE Hydraulic Pump Switch

ON - engine hydraulic pump pressurizes system when engine rotates.

3 Hydraulic System (SYS) Light

Illuminated (amber) -

- low hydraulic system pressure
- low hydraulic reservoir quantity
- excessive hydraulic fluid temperature

4 Demand Pump Low PRESS Light

Illuminated (amber) -

- demand pump selector positioned to OFF or AUX
- demand pump commanded to operate and output pressure is low

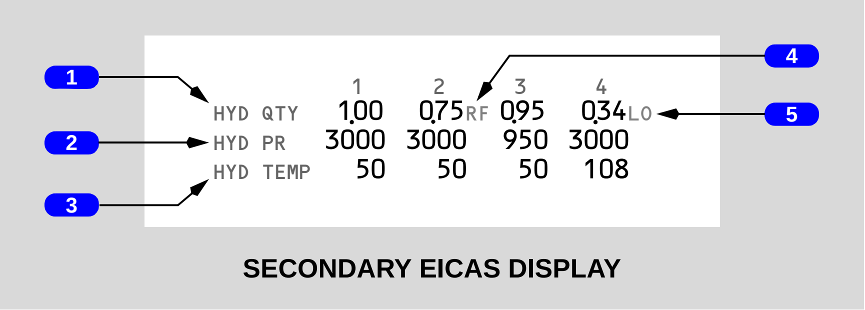
5 ENGINE Hydraulic Pump Low PRESS Light

Illuminated (amber) - low engine hydraulic pump pressure.

Hydraulic System Indications

To view the status display, push the STAT display switch on the display select panel. To view the hydraulic synoptic, push the HYD synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

Status Display



1 Hydraulic Fluid Quantity (HYD QTY)

Hydraulic reservoir quantity of each system displays as a percentage of the normal service level (1.00).

2 Hydraulic System Pressure (HYD PR)

Hydraulic pressure of each system displays in psi.

3 Hydraulic System Temperature (HYD TEMP)

Hydraulic fluid temperature of each system displays in degrees C.

4 Reservoir Refill

RF (Refill) (magenta) - displays on ground when reservoir requires refill.

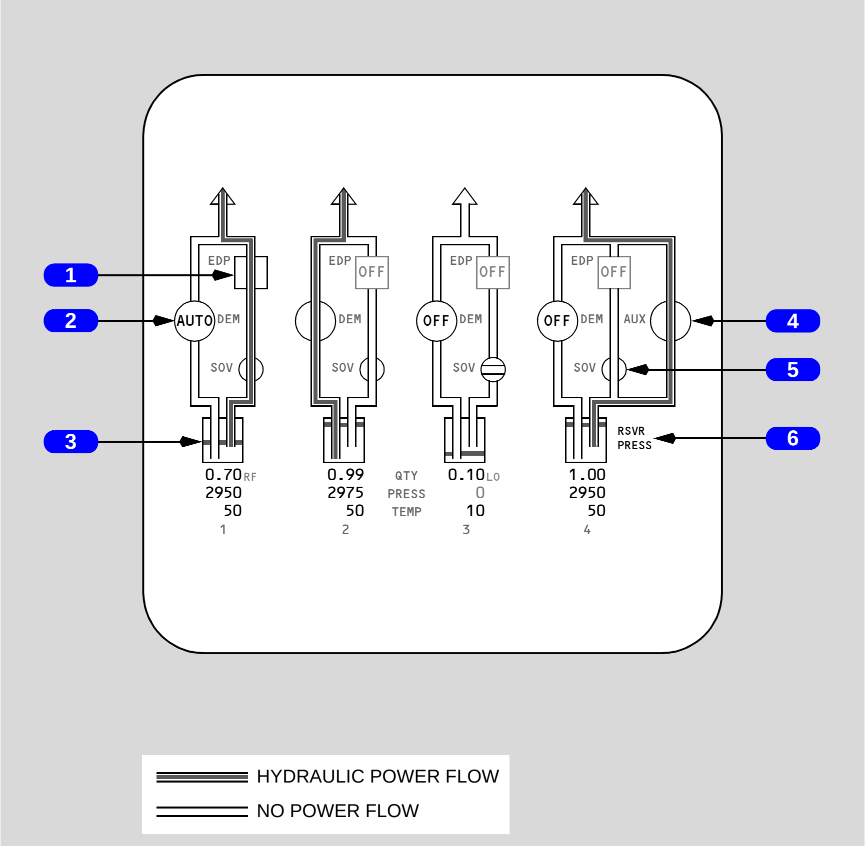
5 Low Reservoir Quantity

LO (magenta) - displays when a reservoir quantity is low.

Hydraulic Synoptic Display

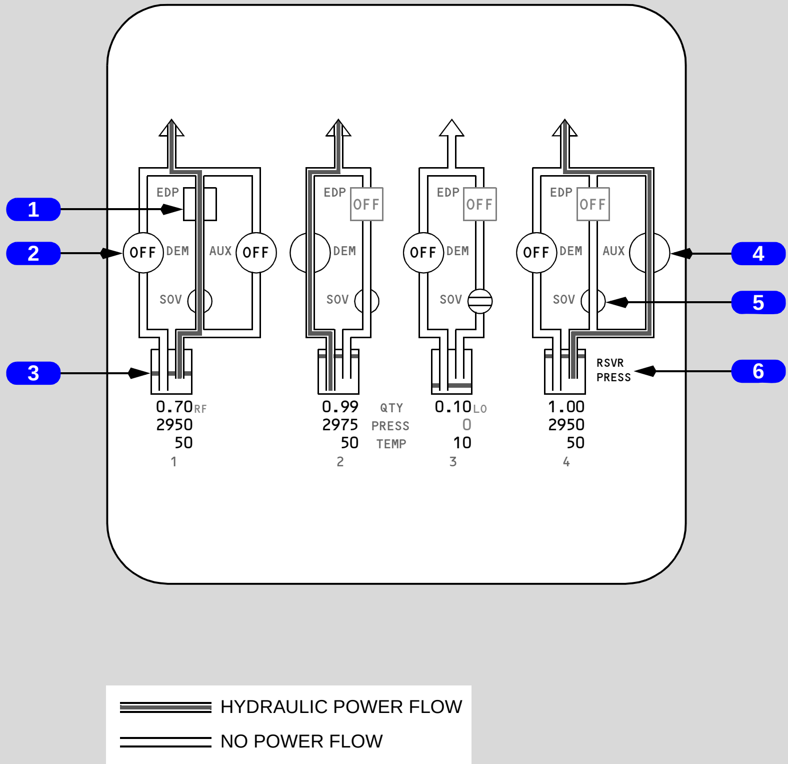
The hydraulic power flow displayed is generated by the displayed valve positions, pump status, and fluid levels. It does not display actual hydraulic power flow, therefore the display may not represent actual system operation.

VQ-BHW, VQ-BHX



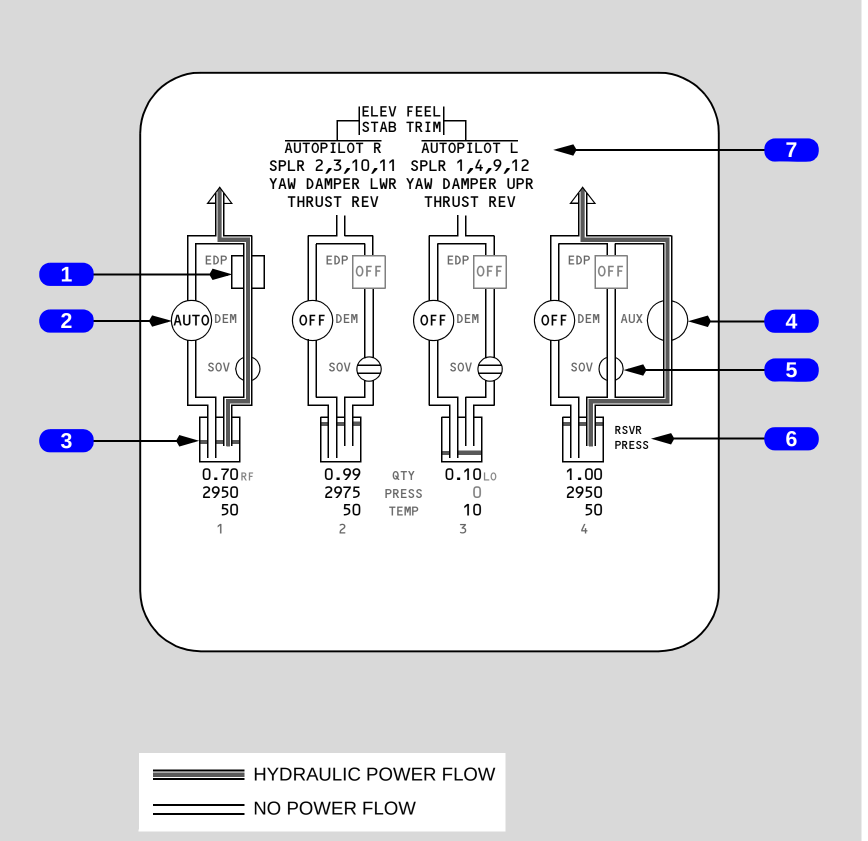
SECONDARY EICAS DISPLAY

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



SECONDARY EICAS DISPLAY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



SECONDARY EICAS DISPLAY

1 Engine Driven Pump

OFF - engine driven pump is not operating.

2 Demand Pump

OFF - demand pump is not operating.

3 Hydraulic Reservoir

Fluid Level - displays relative fluid level in the hydraulic reservoir.

4 **Auxiliary Pump**

OFF - auxiliary pump is not operating.

5 **Shutoff Valve**

Indicates open or closed position of shutoff valve.

6 **Reservoir Pressure**

RSVR PRESS - displays when reservoir bleed air pressure is low.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

7 **Inoperative Systems**

Lists inoperative systems due to hydraulic system failures.

Intentionally
Blank

Introduction

The airplane has four independent hydraulic systems, numbered by the engine which powers it. The hydraulic systems power the:

- primary flight controls
- autopilot servos
- spoilers
- stabilizer trim
- elevator feel
- landing gear
- flaps
- brakes
- steering

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- thrust reversers

Hydraulic Systems

Each system is powered by an engine driven pump and a demand pump installed in parallel.

Engine Driven Pumps

Each system has an engine driven pump (EDP). The EDP is pressurized when the engine is running and the engine pump switch is ON.

Demand Pumps

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
The demand pumps supply normal system demands if an engine or EDP fails. Systems 1 and 4 have air driven demand pumps. The bleed air manifold provides pneumatic power for the air driven pumps. Systems 2 and 3 have electric motor driven demand pumps. In the AUTO position, the demand pumps operate during periods of high system demands, such as flaps in transit or gear retraction.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
The demand pumps supply normal system demands if an engine or EDP fails. All four systems have air driven demand pumps. The bleed air manifold provides pneumatic power for the air driven pumps. In the AUTO position, the demand pumps operate during periods of high system demands, such as flaps in transit or gear retraction.

Auxiliary Pump
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

System 4 has an electric auxiliary pump for ground handling operations.

Auxiliary Pumps

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Systems 1 and 4 have electric auxiliary pumps for ground handling operations.

Fluid Supply

Independent reservoirs supply fluid to each hydraulic system. The bleed air system pressurizes the reservoirs to prevent pump cavitation and ensure positive flow during high demand conditions. RSVR PRESS displays next to the synoptic reservoir symbol when reservoir bleed air pressure is low.

Fluid pressure, fluid temperature and reservoir quantity are displayed on the EICAS status display and hydraulic synoptic display. The letters RF display next to the reservoir quantity indication when refill is required. RF is inhibited in flight and replaced with the letters LO when a system low quantity exists. Hydraulic quantity levels fluctuate with variations in temperature as well as with the activation of systems using hydraulic power.

Each hydraulic system has a dedicated hydraulic interface module (HYDIM) to process temperature and pressure inputs as well as perform some pump control. Should a HYDIM fail, the following indications may occur on that hydraulic system:

- blank hydraulic pressure and temperature indications on the EICAS status page, HYD synoptic page
- HYD CONTROL X advisory messages

A single hydraulic quantity interface module (HYQUIM) processes quantity inputs from each reservoir transmitter. Should the HYQUIM fail the following false indications may occur for all four hydraulic systems:

- hydraulic SYS FAULT lights flashing on and off
- >HYD QTY LOW X advisory messages appearing and disappearing
- EICAS hydraulic quantity indications decreasing and increasing

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

For a single hydraulic system failure, the inoperative items display on the hydraulics synoptic above the affected system graphic. If multiple hydraulic systems are inoperative, additional items common to those systems display above the single system items and are connected by lines to the failed systems.

A hydraulic fluid shutoff valve is installed in the fluid supply line to each EDP. If an engine fire switch is pulled, the respective hydraulic fluid shutoff valve closes, the EDP depressurizes, and the respective demand pump operates.

Load Assignments

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Systems 1 and 4 power the trailing edge flaps, landing gear, normal brakes (SYS 4), alternate brakes (SYS 1), and steering. Systems 1 and 4 also provide redundant power to the primary flight controls.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Systems 1 and 4 power the trailing edge flaps, landing gear, normal brakes (SYS 4), alternate brakes (SYS 1), steering, and their respective thrust reversers. Systems 1 and 4 also provide redundant power to the primary flight controls.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Systems 2 and 3 power the primary flight controls, stabilizer trim, and elevator feel. System 2 also powers the alternate brakes and lower yaw damper. System 3 powers the upper yaw damper.

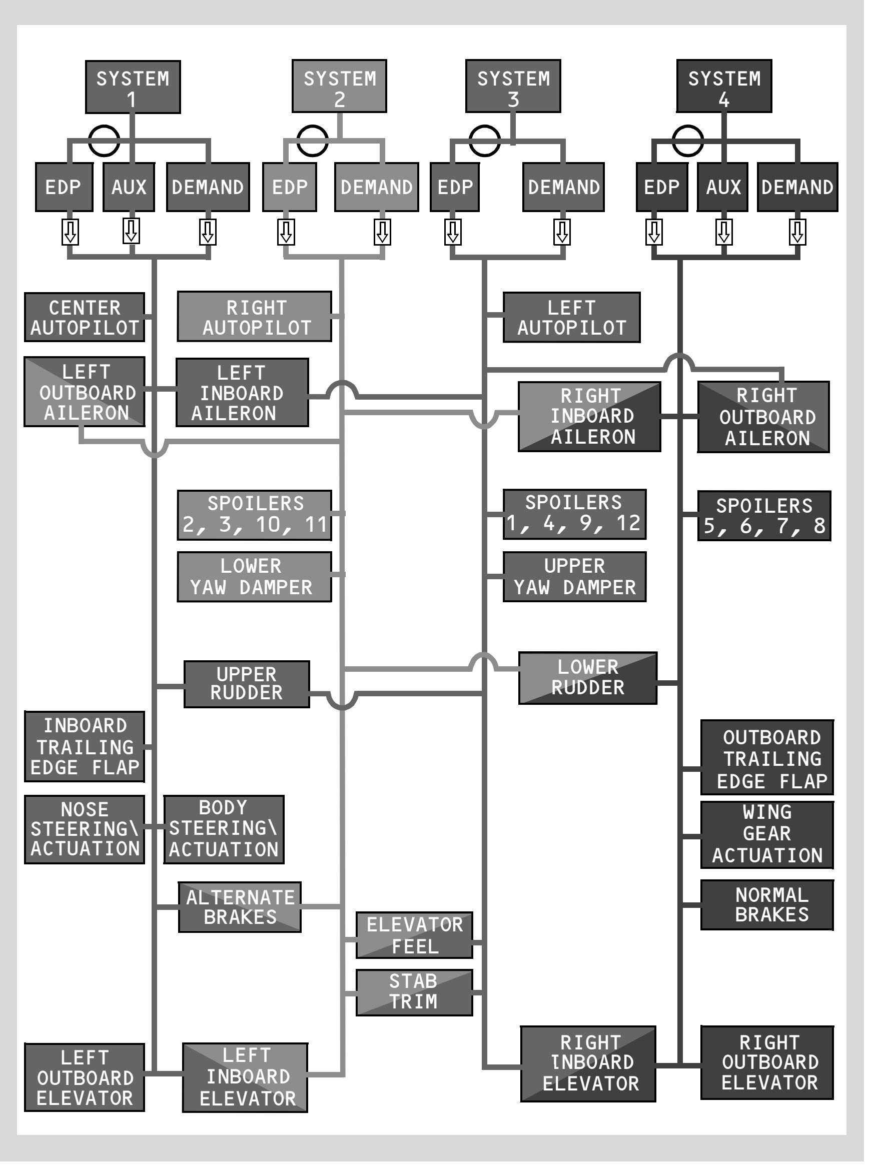
EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Systems 2 and 3 power the primary flight controls, stabilizer trim, elevator feel and their respective thrust reversers. System 2 also powers the alternate brakes and lower yaw damper. System 3 powers the upper yaw damper.

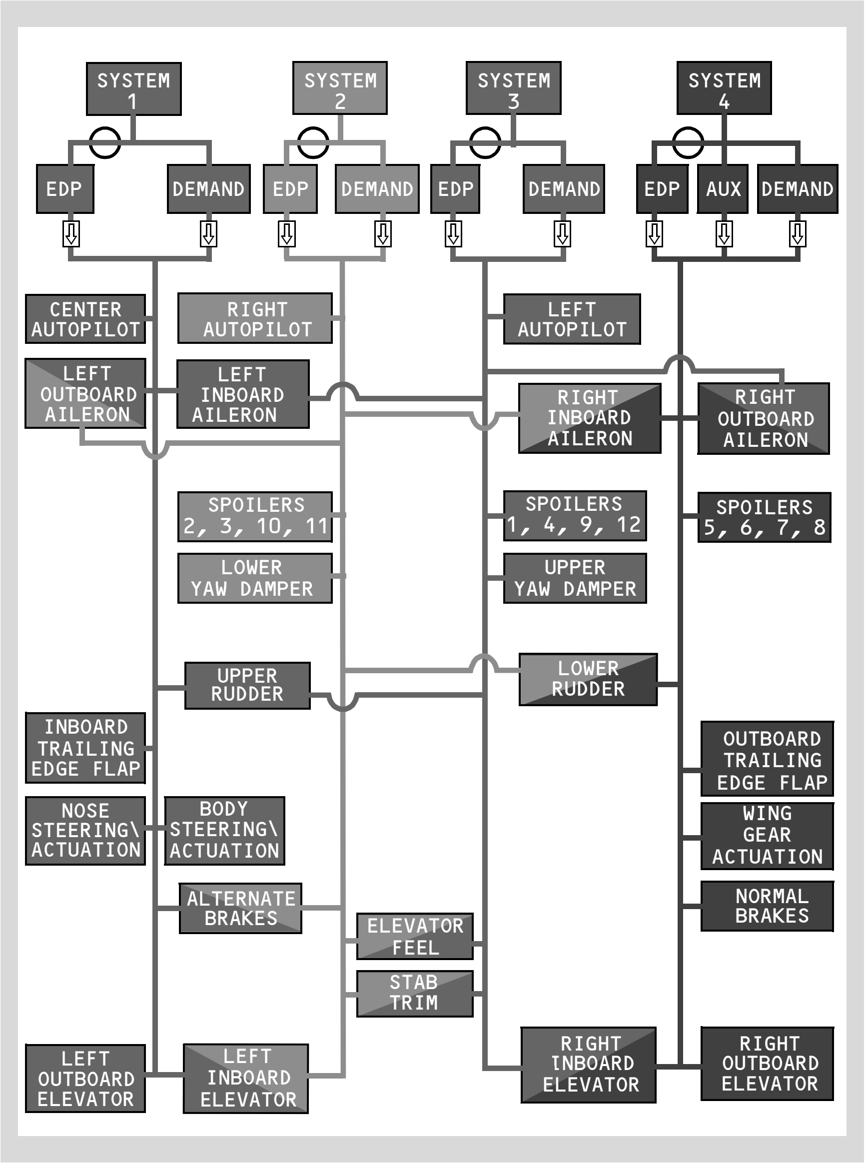
Systems 1, 2, and 3 power the respective center, right, and left autopilot servos. Systems 2, 3, and 4 power the spoilers.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ,

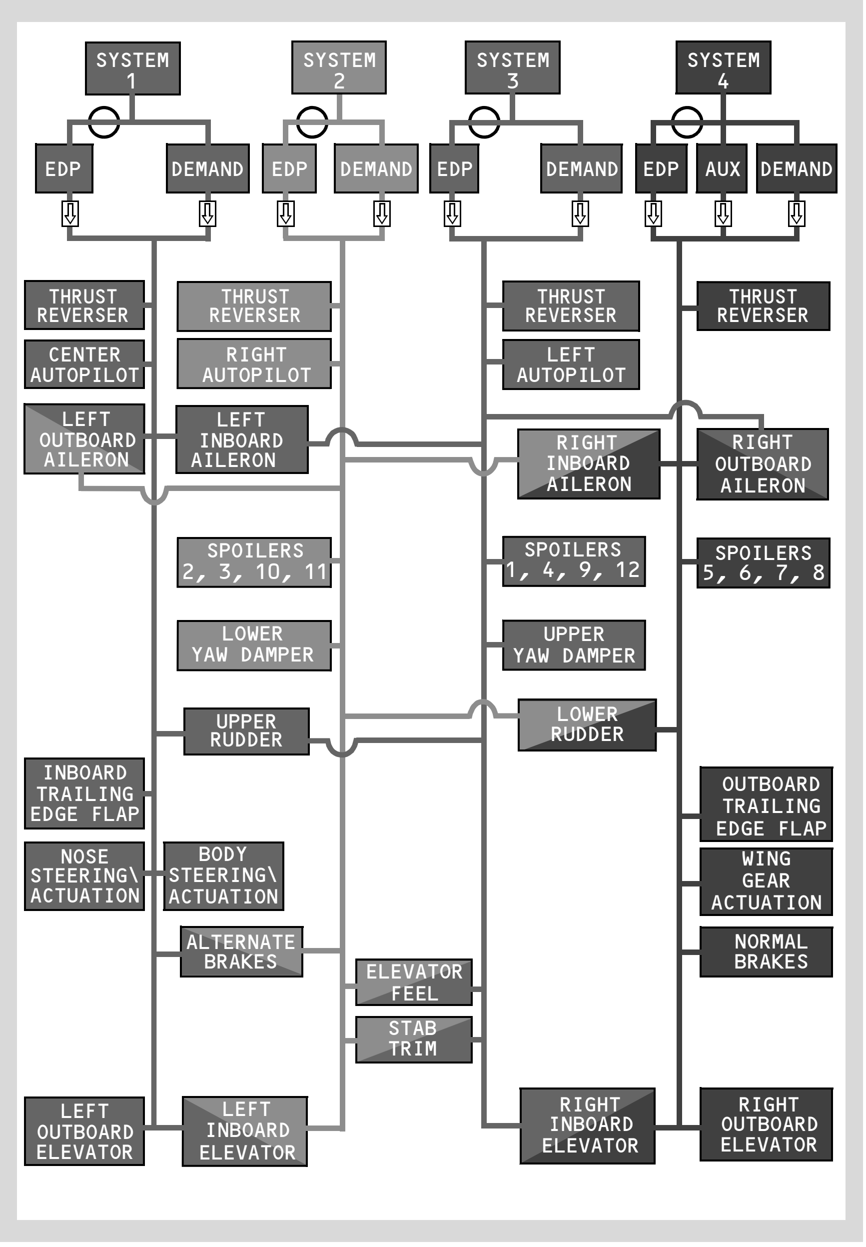
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



VQ-BHW, VQ-BHX

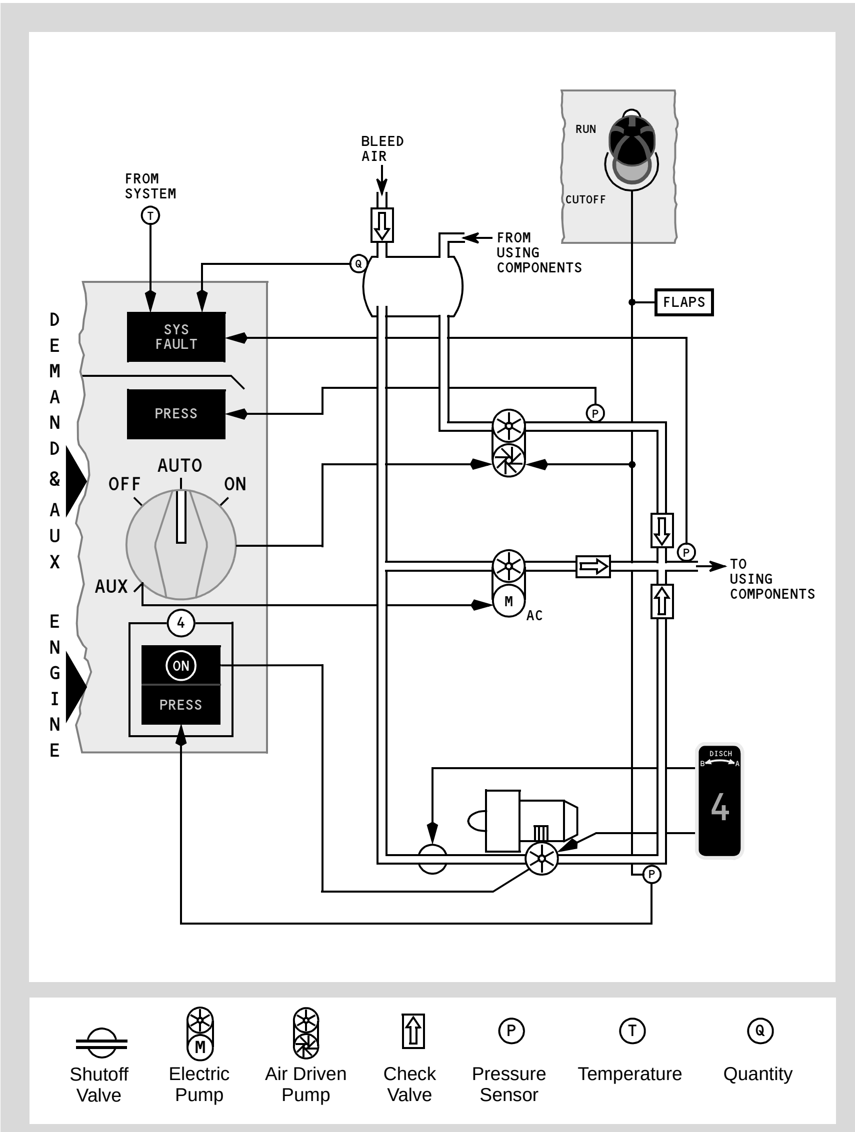

SYSTEM 1
SYSTEM 2
SYSTEM 3
SYSTEM 4
EDP
DEMAND
EDP
DEMAND
EDP
DEMAND
EDP
AUX
DEMAND
CENTER AUTOPILOT
RIGHT AUTOPILOT
LEFT AUTOPILOT
LEFT OUTBOARD AILERON
LEFT INBOARD AILERON
RIGHT INBOARD AILERON
RIGHT OUTBOARD AILERON
SPOILERS 2, 3, 10, 11
SPOILERS 1, 4, 9, 12
SPOILERS 5, 6, 7, 8
LOWER YAW DAMPER
UPPER YAW DAMPER
UPPER RUDDER
LOWER RUDDER
INBOARD TRAILING EDGE FLAP
OUTBOARD TRAILING EDGE FLAP
NOSE STEERING\ ACTUATION
BODY STEERING\ ACTUATION
WING GEAR ACTUATION
ALTERNATE BRAKES
NORMAL BRAKES
ELEVATOR FEEL
STAB TRIM
LEFT OUTBOARD ELEVATOR
LEFT INBOARD ELEVATOR
RIGHT INBOARD ELEVATOR
RIGHT OUTBOARD ELEVATOR

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

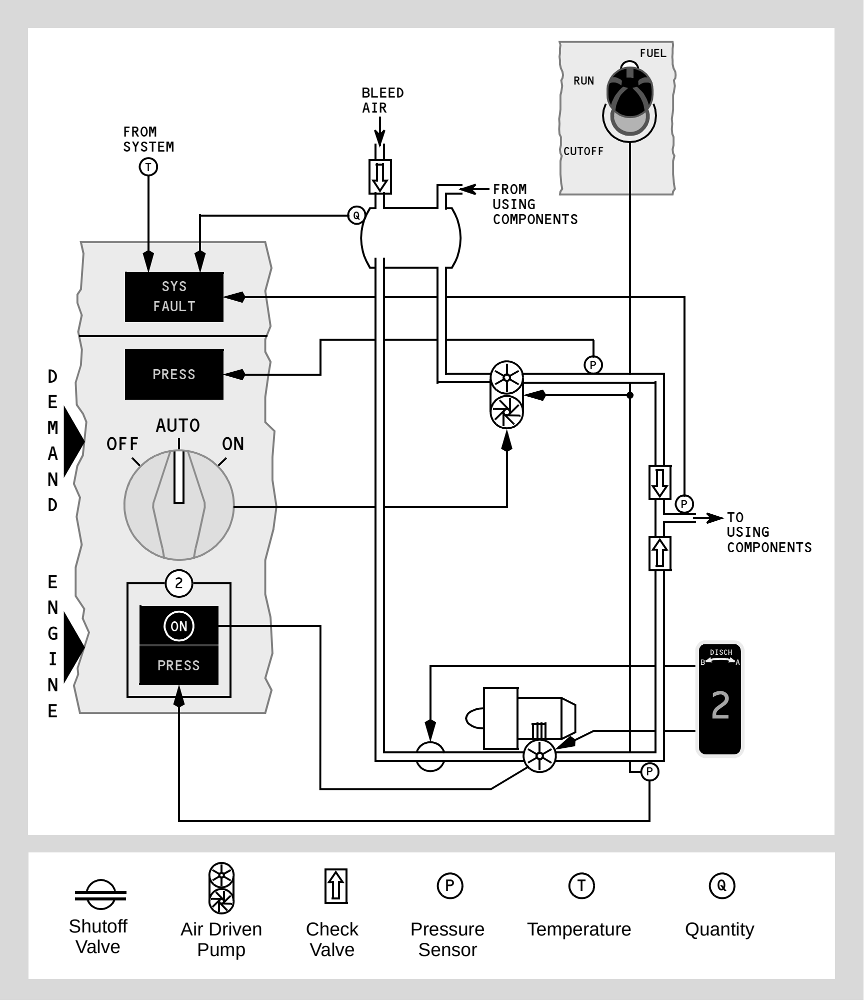


Hydraulic Systems 1 and 4 Diagram

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

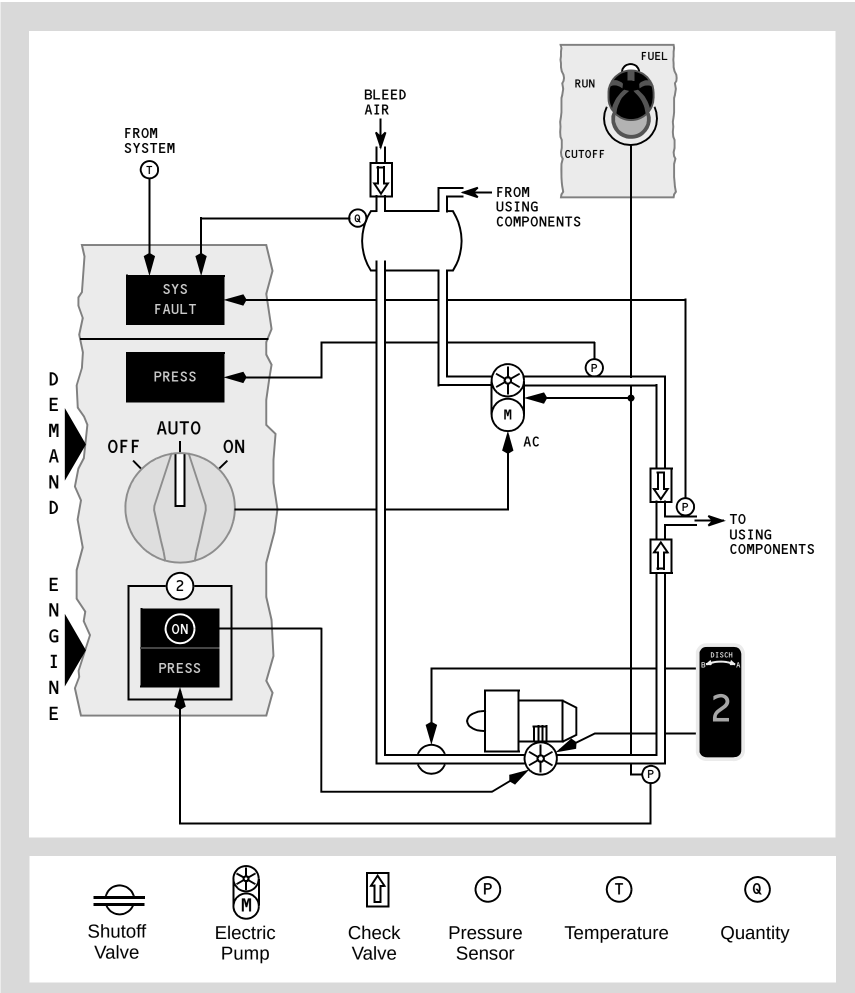


Hydraulic Systems 2 and 3 Diagram
EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



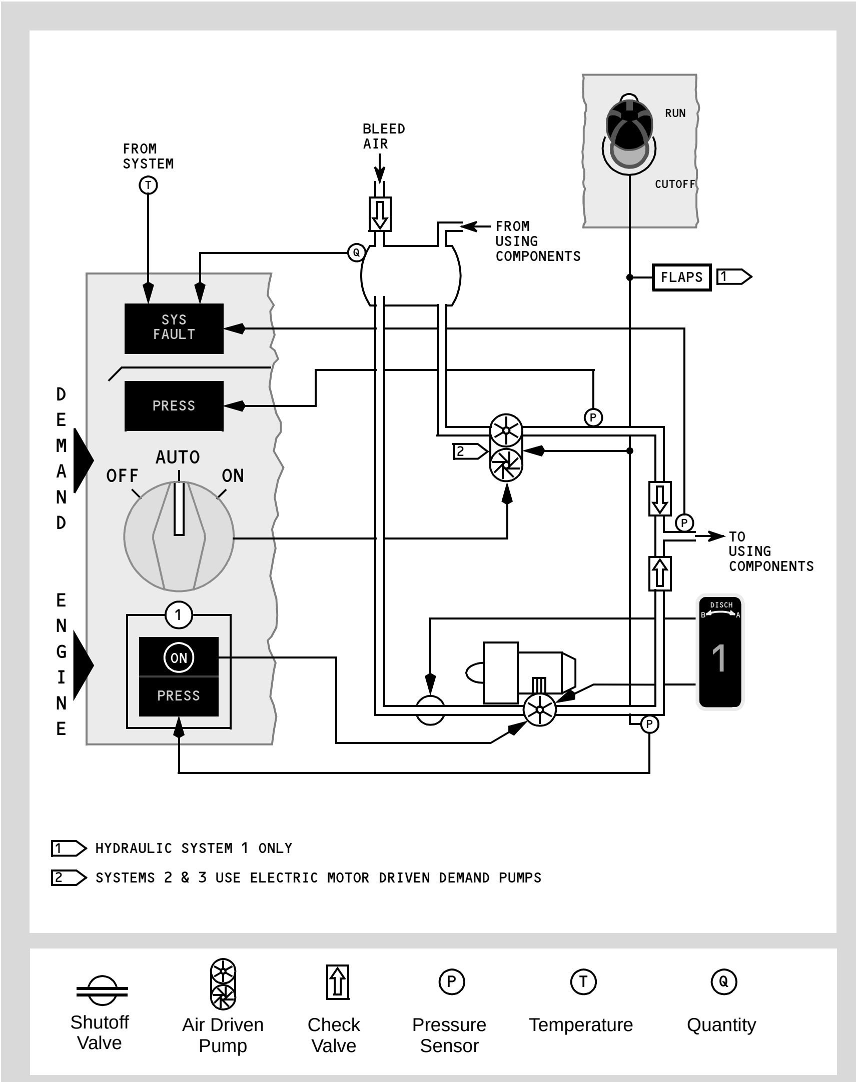
Hydraulic Systems 2 and 3 Diagram

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



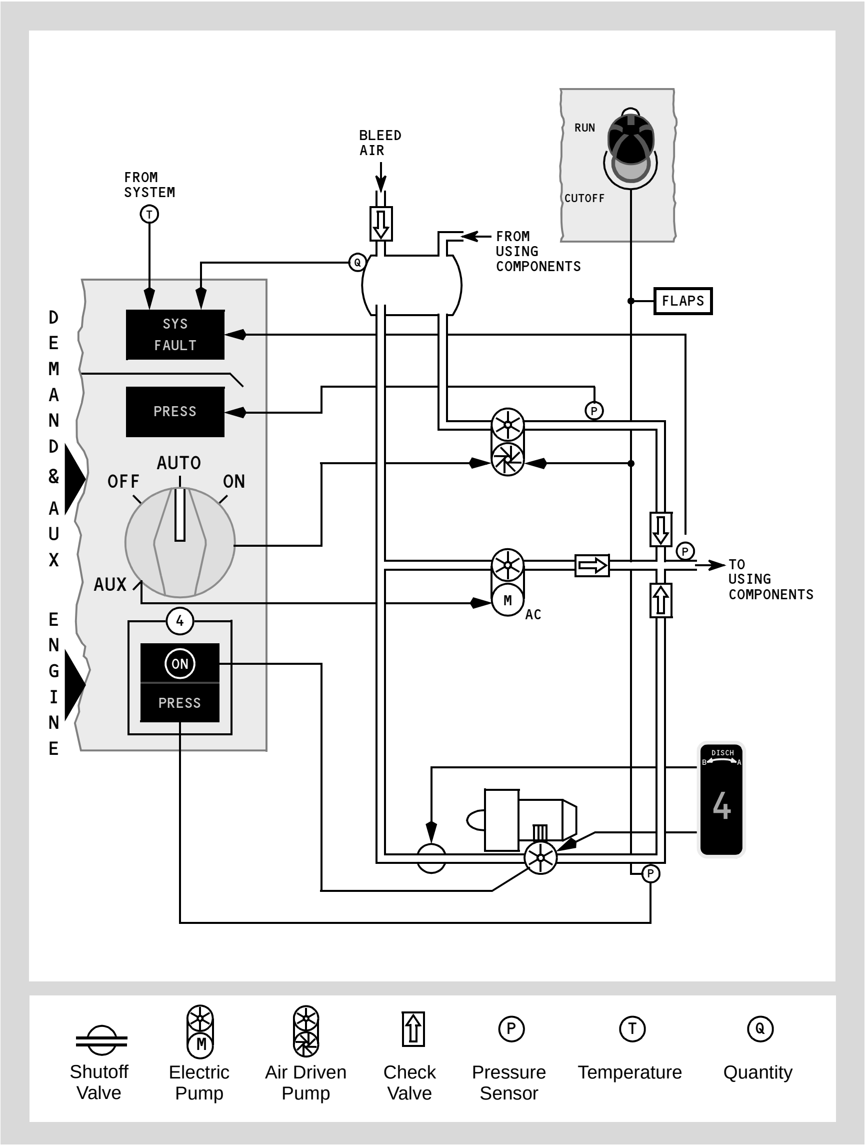
Hydraulic Systems 1, 2, and 3 Diagram

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



Hydraulic Systems Diagram 4

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX



EICAS Alert Messages

Message	Level	Aural	Message Logic
HYD CONTROL 1, 4	Advisory		Hydraulic control system is inoperative. Hydraulic system indications may be inoperative.
HYD OVHT SYS 1, 2, 3, 4	Advisory		Excessive hydraulic system temperature.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

HYD PRESS DEM 1, 2, 3, 4	Advisory		Demand pump pressure is low. Occurs when Demand Pump selector OFF, demand pump commanded to run and demand pump output pressure low, or system 4 Demand Pump selector is in AUX. Inhibited by HYD PRESS SYS message in a system low pressure condition.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

HYD PRESS DEM 1, 2, 3, 4	Advisory		Demand pump pressure is low. Occurs when Demand Pump selector OFF, demand pump commanded to run and demand pump output pressure low, or systems 1 or 4 Demand Pump selectors are in AUX. Inhibited by HYD PRESS SYS message in a system low pressure condition.

Message	Level	Aural	Message Logic
HYD PRESS ENG 1, 2, 3, 4	Advisory		Engine pump output pressure low. Inhibited by HYD PRESS SYS message in a system low pressure condition.
HYD PRESS SYS 1, 2, 3, 4	Caution	Beeper	Loss of hydraulic system pressure.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; before SB, IDS 508 software is not installed)

>HYD QTY LOW 1, 2, 3, 4	Advisory		Hydraulic quantity low.

(EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO ; SB installs IDS 508 software)

HYD QTY LOW 1, 4	Advisory		Hydraulic quantity low.
>HYD QTY LOW 2, 3	Advisory		Hydraulic quantity low.

Landing Gear — Chapter 14
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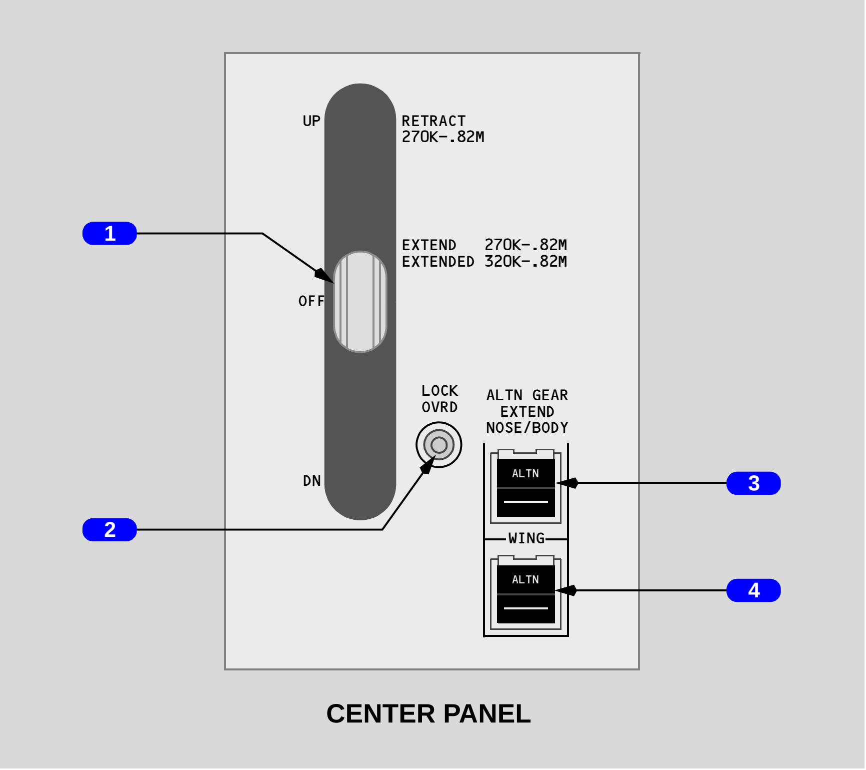
Landing Gear Panel



1 Landing Gear Lever

UP - landing gear retracts.

OFF - landing gear hydraulic system depressurized.

DN - landing gear extends.

2 Landing Gear Lever LOCK Override (OVRD) switch

Push - releases Landing Gear lever lock.

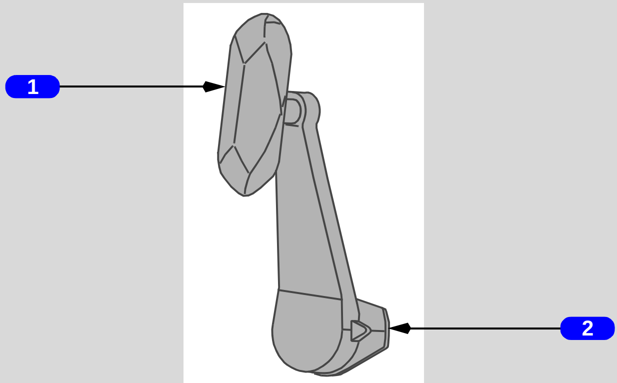
3 NOSE/BODY Alternate (ALTN) GEAR EXTEND switch

ALTN - nose/body landing gear extends by alternate extension system.

4 **WING Alternate (ALTN) GEAR EXTEND switch**

ALTN - wing landing gear extends by alternate extension system.

Nose Wheel Steering Tiller



LEFT AND RIGHT SIDEWALLS

1 **Nose Wheel Steering Tiller**

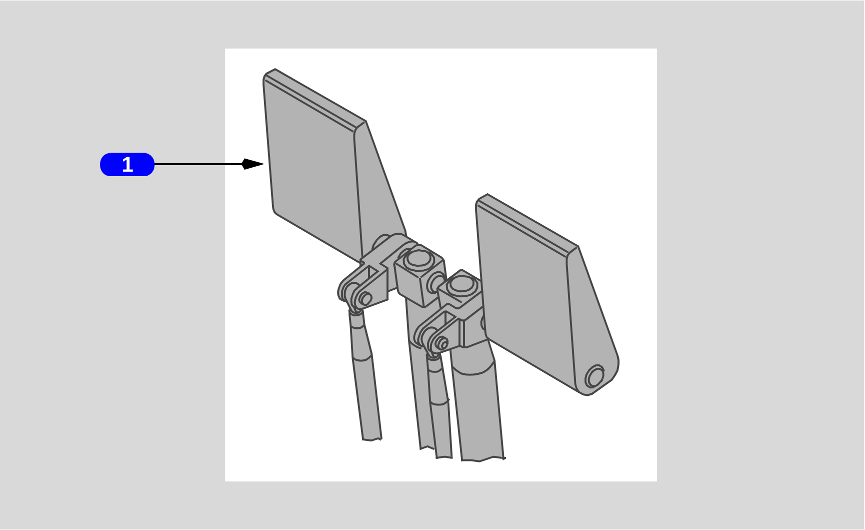
Rotate -

- turns nose wheels up to 70 degrees in either direction
- overrides rudder pedal steering

2 **Tiller Position Indicator**

Shows tiller displacement from straight-ahead, neutral position.

Brake System
Rudder/Brake Pedals



1 Rudder/Brake Pedals

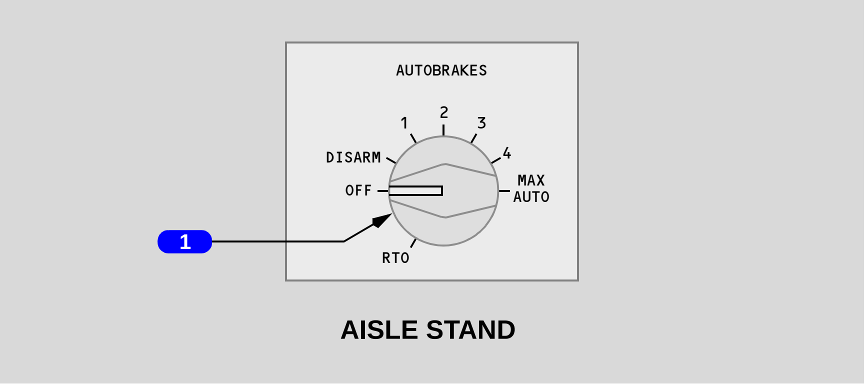
Push full pedal -

- turns nose wheel up to 7 degrees in either direction
- does not activate body gear steering

Push top of pedals - actuates wheel brakes.

Refer to Chapter 9, Flight Controls for the description of rudder operation.

Autobrakes Selector



1 AUTOBRAKES Selector

OFF - deactivates and resets system.

DISARM -

- disengages autobrake
- releases brake pressure

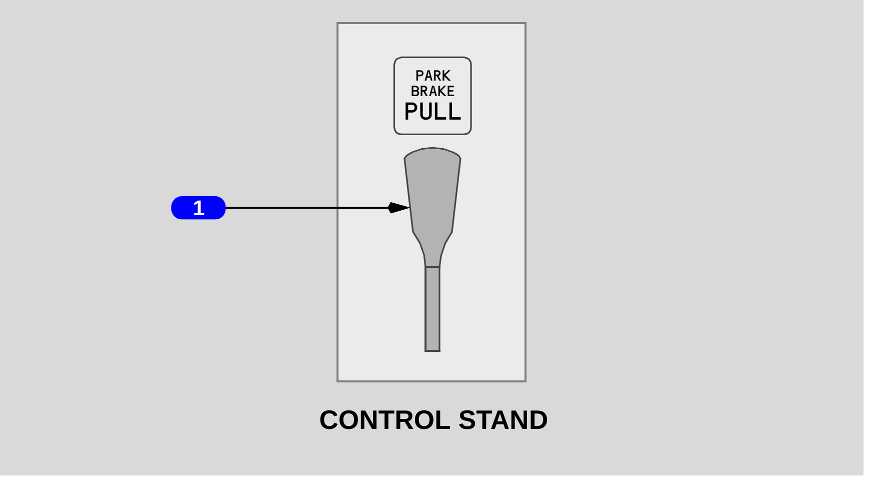
1, 2, 3, 4, MAX AUTO -

- increasing autobrake deceleration rates
- brakes apply at touchdown

RTO -

- rejected takeoff braking
- applies maximum brake pressure when thrust levers retarded to idle above 85 knots

Parking Brake Lever

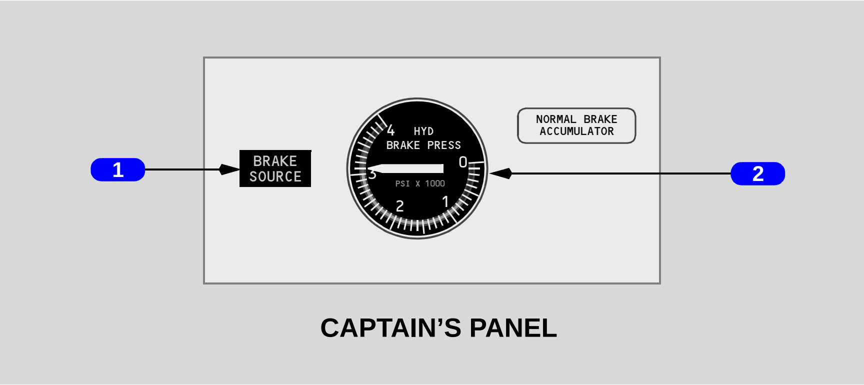


1 Parking Brake Lever

Pull - sets parking brake when both brake pedals simultaneously depressed.

Releases when both brake pedals simultaneously depressed.

Brake Accumulator Pressure Indicator



1 BRAKE SOURCE Light

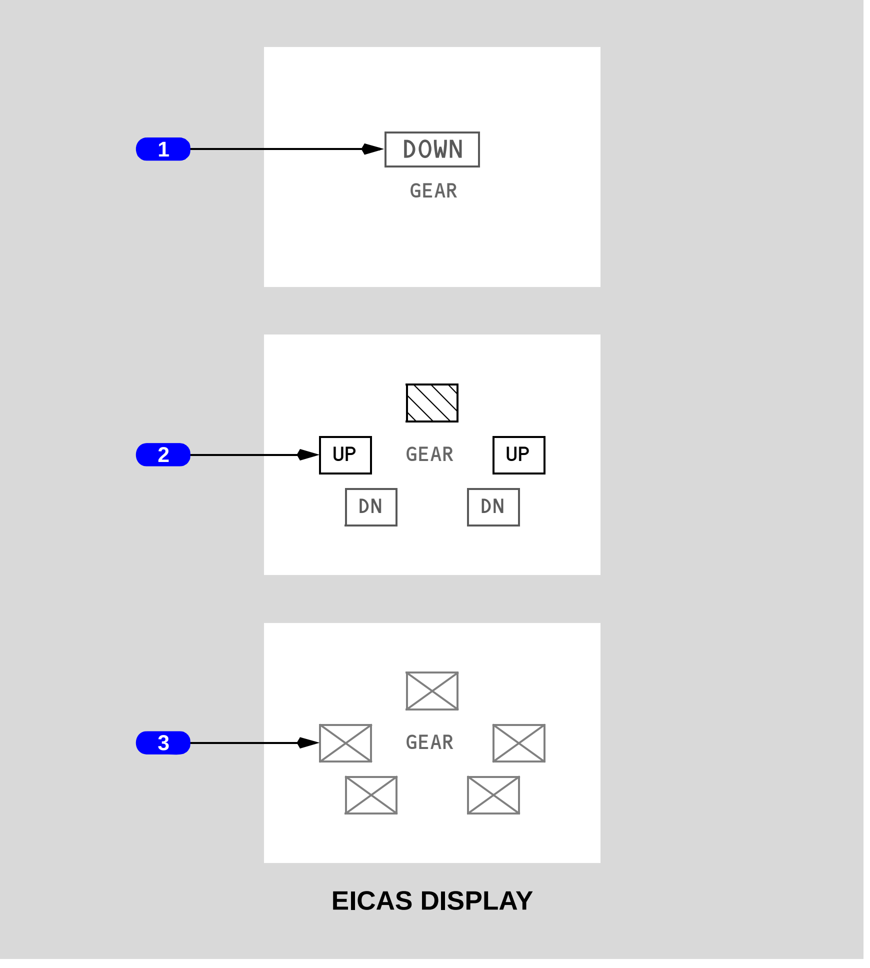
Illuminated (amber) - active brake hydraulic sources (hydraulic systems 4, 1, and 2) have low pressure.

2 BRAKE ACCUMULATOR PRESSURE Indicator

Indicates brake accumulator pressure.

Landing Gear System Indications

Landing Gear Position Indications



1 Gear Position Indication (Normal Display)

DOWN (green) - all landing gear down and locked.

Crosshatched (white) - one or more landing gear in transit.

UP (white) - all landing gear up and locked (blanks after 10 seconds).

Empty box (white) - all landing gear position indicators inoperative.

2 Expanded Gear Position Indication (Non-Normal Display)

DN (green) - respective landing gear down and locked.

Crosshatched (white) - respective landing gear in transit.

UP (white) - respective landing gear up and locked.

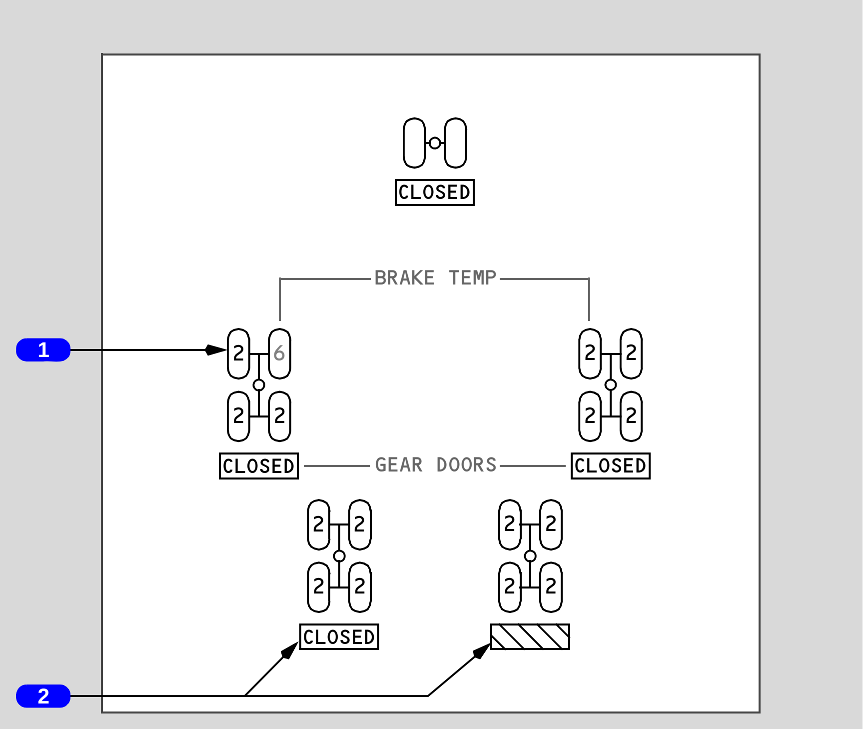
3 Expanded Gear Position Indication (Inoperative Display)

X (amber) - landing gear position indicators inoperative.

Gear Synoptic Display

The landing gear synoptic is displayed by pushing the GEAR synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

VQ-BHW, VQ-BHX



SECONDARY EICAS DISPLAY

1 Brake Temperature

Indicates a relative value of wheel brake temperature:

- values range from 0 to 9
- white - normal range
- amber - high range

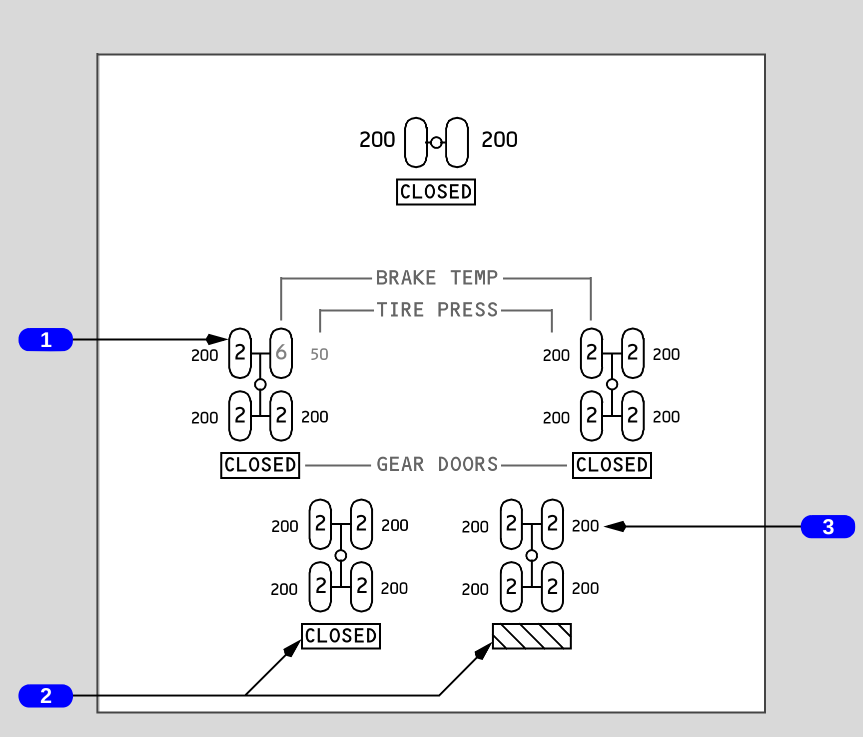
2 Gear Door Status

Crosshatched - door not closed.

CLOSED (white) - door closed.

Empty box(es) (white) - respective landing gear door position indicators inoperative.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



SECONDARY EICAS DISPLAY

1 Brake Temperature

Indicates a relative value of wheel brake temperature:

- values range from 0 to 9
- white - normal range
- amber - high range

2 Gear Door Status

Crosshatched - door not closed.

CLOSED (white) - door closed.

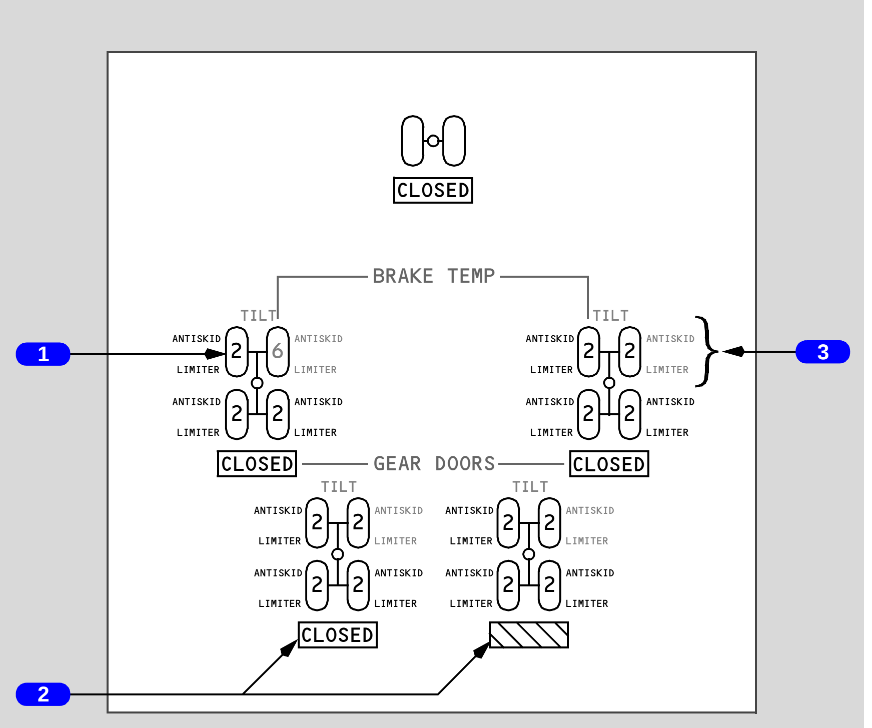
Empty box(es) (white) - respective landing gear door position indicators inoperative.

3 Tire Pressure Indication

Displays individual tire pressures:

- white - normal range
- amber - abnormal high or low range

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



SECONDARY EICAS DISPLAY

1 Brake Temperature

Indicates a relative value of wheel brake temperature:

- values range from 0 to 9
- white - normal range
- amber - high range

2 Gear Door Status

Crosshatched - door not closed.

CLOSED (white) - door closed.

Empty box(es) (white) - respective landing gear door position indicators inoperative.

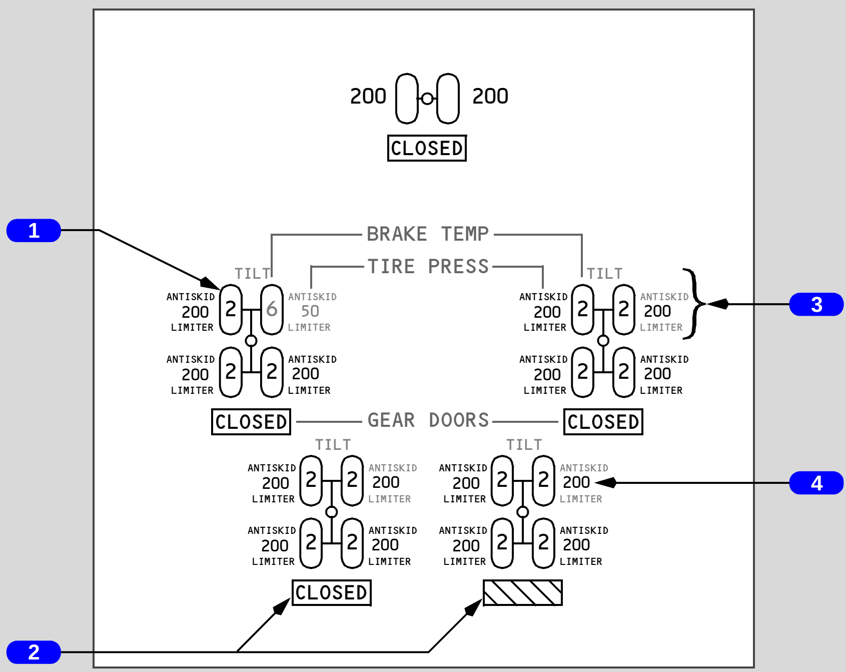
3 Disabled System Messages

TILT (amber) - main gear truck not in full tilt positions.

ANTISKID (white or amber) - loss of antiskid protection to respective wheels.

LIMITER (white or amber) - torque limiting control fault detected.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



SECONDARY EICAS DISPLAY

1 Brake Temperature

Indicates a relative value of wheel brake temperature:

- values range from 0 to 9
- white - normal range
- amber - high range

2 Gear Door Status

Crosshatched - door not closed.

CLOSED (white) - door closed.

Empty box(es) (white) - respective landing gear door position indicators inoperative.

3 Disabled System Messages

TILT (amber) - main gear truck not in full tilt positions.

ANTISKID (white or amber) - loss of antiskid protection to respective wheels.

LIMITER (white or amber) - torque limiting control fault detected.

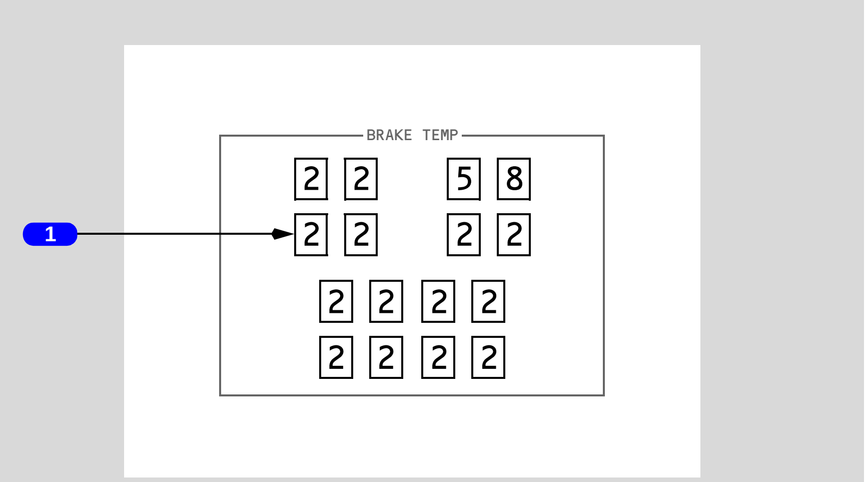
4 Tire Pressure Indication

Displays individual tire pressures:

- white - normal range
- amber - abnormal high or low range

Compacted Brake Temperature Indications

Compacted brake temperature indications display if only one display is available for EICAS.



PRIMARY EICAS DISPLAY

1 Brake Temperature

Indicates a relative value of wheel brake temperature:

- values range from 0 to 9
- white - normal range
- amber - high range

Intentionally
Blank

Introduction

The airplane has four main landing gear and a single nose gear. The nose gear is a conventional steerable two-wheel unit. The main gear consist of two steerable body gear and two non-steerable wing gear. Each main gear has four wheels per truck in tandem pairs. The main gear trucks must be tilted and centered to allow retraction into the wheel wells.

Hydraulic power for nose and body gear retraction, extension, and steering is supplied by hydraulic system 1. Power to retract and extend the wing gear is provided by hydraulic system 4. An alternate extension system is also provided.

The normal brake system is powered by hydraulic system 4. The alternate brake system is powered by hydraulic system 1 or 2. Pressure-operated selector valves provide automatic brake source selection. Antiskid protection is provided with both systems, but the autobrake system is available only through the normal system.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
A brake temperature monitor system and tire pressure indication system displays each brake temperature and tire pressure on the GEAR synoptic display.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
A brake temperature monitor system displays each brake temperature on the GEAR synoptic display.

Air/Ground Sensing System

In flight and ground operation of various airplane systems are controlled by the air/ground sensing system and a nose gear extension sensing system.

A combination of main gear tilt sensors indicate the gear are tilted (air mode) or not tilted (ground mode) to provide an air/ground signal to relays which control various system functions.

Nose gear extension sensing provides a signal to relays controlling functions in the stall warning and nose gear steering systems.

Landing Gear Operation

The Landing Gear lever normally controls the landing gear. On the ground, an automatic lever lock prevents movement of the lever from OFF to UP. The lever lock can be manually overridden by pushing and holding the Landing Gear Lever Lock Override switch. In flight, the lever lock is released when the main gear are tilted and the body gear is centered.

All four main gear hydraulically tilt as the airplane lifts off the runway. During landing, ground load brings the gear to a level position.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
If any main gear is not tilted in flight, the disabled system message TILT displays on the gear synoptic adjacent to the affected gear.

Each wing gear has one hydraulically actuated and one mechanically actuated gear door. Each body gear has one hydraulically actuated and two mechanically actuated gear doors. The nose gear has two hydraulically actuated and two mechanically actuated gear doors.

Landing Gear Retraction

When the Landing Gear lever is moved to UP, the landing gear doors open, automatic braking occurs, and the landing gear begin to retract. The EICAS landing gear position indication display changes from a green DOWN indication to a white crosshatch in-transit indication as the landing gear retract into the wheel wells.

After retraction, the main gear are held in the up position by uplocks. The nose gear is mechanically locked in the up position. The EICAS landing gear position indication changes to UP for 10 seconds and then blanks. Positioning the Landing Gear lever to OFF depressurizes the landing gear system.

If any gear is not up and locked up after the normal transit time, the EICAS gear position indication changes to the expanded non-normal format, with the affected gear displayed as in-transit, or down if the gear never unlocked from the down position.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
The disabled system message TILT displays on the gear synoptic adjacent to the affected gear.

Landing Gear Extension

When the Landing Gear lever is moved to DN, the landing gear doors open, the gear are unlocked, and the in-transit indication is displayed on the EICAS landing gear position indication.

The gear are hydraulically powered to the down and locked position. The downlocks are powered to the locked position, all hydraulically actuated gear doors close, and the main gear trucks hydraulically tilt to the flight position. When all gear are down and locked, the EICAS gear position indication displays DOWN.

If any gear position disagrees with lever position after the normal transit time the EICAS gear position indication changes to the expanded non-normal format, with the affected gear displayed as in transit (or UP if the gear never unlocked from the up position).

Landing Gear Alternate Extension

Alternate gear extension is activated by pushing the Alternate Gear Extend switches. The gear uplocks and gear door latches are electrically released, allowing the gear to free fall. Gravity and airloads extend the gear and springs pull the downlocks into the locked position. All gear doors remain open for the affected gear after alternate extension.

The EICAS landing gear position indication displays the expanded gear position indication when the alternate extension system is used.

Nose Wheel and Body Gear Steering

Nose wheel and body gear steering is powered by hydraulic system 1.

Primary low speed steering control is provided by a nose wheel steering tiller for each pilot. Limited steering control is available through the rudder pedals. The tillers can turn the nose wheels up to 70 degrees in either direction. A pointer on the tiller assembly shows tiller position relative to the neutral setting. The rudder pedals can be used to turn the nose wheels up to 7 degrees in either direction. Tiller inputs override rudder pedal inputs.

Body gear steering operates when the nose wheel steering angle exceeds 20 degrees. This reduces tire scrubbing and lets the airplane turn in a minimum radius. Body gear steering is activated when ground speed decreases through 15 knots. As speed increases through 20 knots, the body gear is hydraulically centered and body gear steering is deactivated.

Brake System

Each main gear wheel has a multiple disc carbon brake. The nose wheels have no brakes. The brake system includes:

- normal brake hydraulic system
- alternate brake hydraulic system
- brake accumulator
- antiskid protection
- autobrake system
- parking brake

Normal Brake Hydraulic System

The normal brake hydraulic system is powered by hydraulic system 4. The brake pedals provide independent control of the left and right brakes.

Alternate Brake Hydraulic System

If hydraulic system 4 pressure is low, hydraulic system 1 supplies pressure to the alternate brake hydraulic system. If hydraulic pressure in systems 4 and 1 are low, system 2 powers the alternate brake system.

Loss of hydraulic systems 4, 1, and 2 causes the brake source light to illuminate.

Brake Accumulator

The brake accumulator provides for parking brake application.

Antiskid Protection

Antiskid protection is provided in the normal and alternate brake hydraulic systems.

The normal brake hydraulic system provides each main gear wheel with individual antiskid protection. When a wheel speed sensor detects a skid, the associated antiskid valve reduces brake pressure until skidding stops.

The alternate brake hydraulic system provides antiskid protection to lateral wheel pairs (forward and/or aft pair on each truck) rather than to individual wheels.

Touchdown and hydroplaning protection is provided using airplane inertial ground speed. Locked wheel protection is provided using a comparison with other wheel speeds.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
If antiskid power is off on all wheels, or the parking brake valve is not fully open, or a brake system control unit power loss occurs, the disabled system message ANTISKID displays on the gear synoptic adjacent to the affected wheels.

Brake Torque Limiter

A brake torque sensor is provided at each wheel. The sensors detect excessive torque during braking to prevent damage to landing gear. When excessive torque is detected, a signal is sent to the antiskid valve to release brake pressure to that wheel. If the alternate brake system is used, brake torque is sensed on an individual wheel basis, however the signal is sent to the alternate antiskid valve and brake pressure is released on a laterally paired wheel basis.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
If a brake torque limiter failure occurs on more than one wheel per truck, or the parking brake lever is released and the parking brake valve is not fully open, or a brake system control unit power loss occurs, the disabled system message LIMITER displays on the gear synoptic adjacent to the affected wheels.

Autobrake System

The autobrake system provides braking at preselected deceleration rates for landing and full pressure for rejected takeoff. The system operates only when the normal brake and antiskid systems are functioning. Antiskid system protection is provided during autobrake operation.

Rejected Takeoff

Selecting RTO (rejected takeoff) prior to takeoff arms the autobrake system. The RTO mode can be selected only on the ground. The RTO autobrake setting commands maximum braking pressure if:

- the airplane is on the ground
- groundspeed is above 85 knots, and
- all thrust levers are closed

Maximum braking is obtained in this mode. If an RTO is initiated below 85 knots, the RTO autobrake function does not operate.

Landing

Five levels of deceleration can be selected for landing. However, on dry runways, the maximum autobrake deceleration rate in the landing mode is less than that produced by full pedal braking.

After landing, autobrake application begins when:

- all thrust levers are closed,
- ground mode is sensed, and
- the wheels have spun up

To maintain the selected airplane deceleration rate, autobrake pressure is reduced as other controls, such as thrust reversers and spoilers, contribute to total deceleration. The system provides braking to a complete stop or until it is disarmed.

Autobrake - Disarm

The system disarms immediately if any of the following occur:

- pedal braking applied
- any Thrust lever advanced after landing
- Speedbrake lever moved to DOWN detent after speedbrakes have deployed on the ground
- DISARM or OFF position selected on Autobrakes selector
- autobrake fault
- normal antiskid system fault
- loss of normal brake hydraulic pressure

When the autobrake system disarms after landing, the Autobrakes selector moves to DISARM position. Rotating the Autobrakes selector to OFF removes power from the autobrake system.

When the autobrake system disarms during takeoff, the Autobrakes selector remains in RTO position, but moves to OFF after takeoff.

Parking Brake

The parking brake can be set with the normal or alternate brake hydraulic system pressurized. If the normal and alternate brake systems are not pressurized, parking brake pressure is maintained by the brake accumulator. The brake accumulator is pressurized by hydraulic system 4. Accumulator pressure is shown on the brake accumulator pressure indicator.

Sufficient pressure is stored in the accumulator to set and hold the parking brake, but the accumulator is not designed to stop the aircraft.

The parking brake is set by fully depressing both brake pedals, pulling the Parking Brake lever up, then releasing the pedals. This mechanically latches the pedals in the depressed position and commands the parking brake valve to close.

When the parking brake is set, the first hydraulic system pressurized may supply a small amount of fluid to the brake lines. When brakes are released, that small amount of fluid returns to hydraulic system 4. Pressurizing hydraulic system 4 before pressurizing the other hydraulic systems precludes the transfer of hydraulic fluid from system 1 or 2 into system 4.

The parking brake is released by depressing the pedals until the Parking Brake lever releases.

Brake Temperature Indication

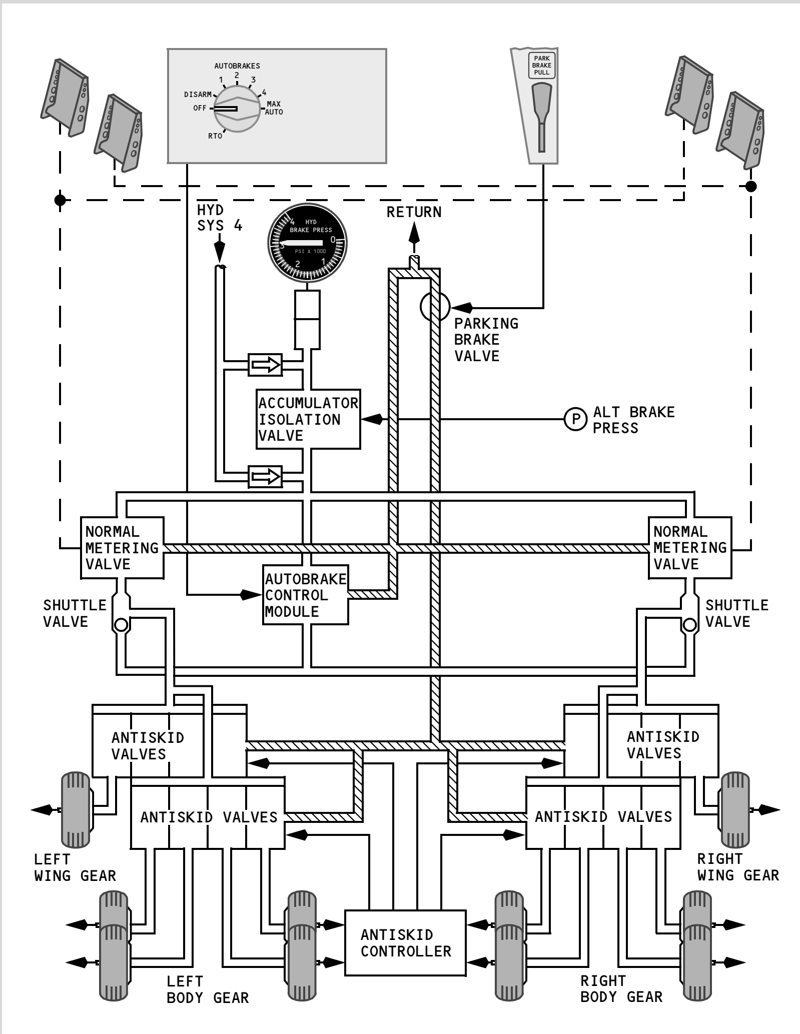
Wheel brake temperatures display on the GEAR synoptic display. Numerical values related to wheel brake temperature display inside each wheel/brake symbol.

Tire Pressure Indication

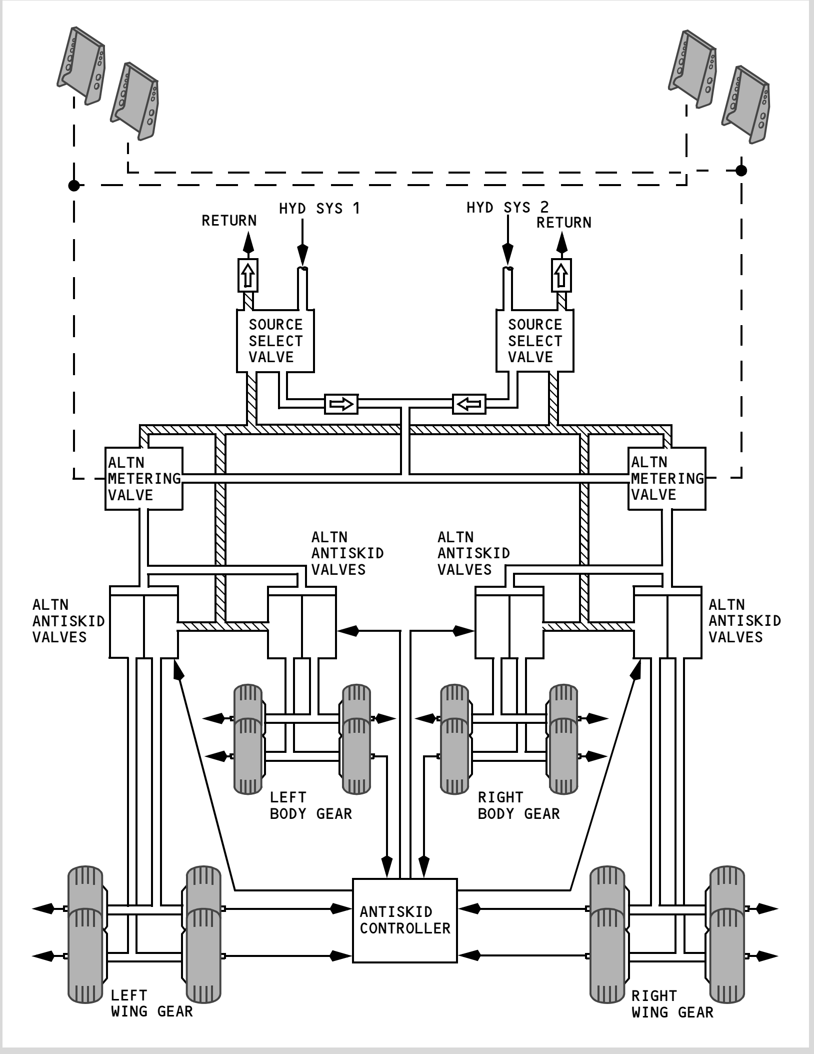
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

Tire pressures, from 0 to 400 PSI, display beside the individual wheel symbols on the GEAR synoptic display.

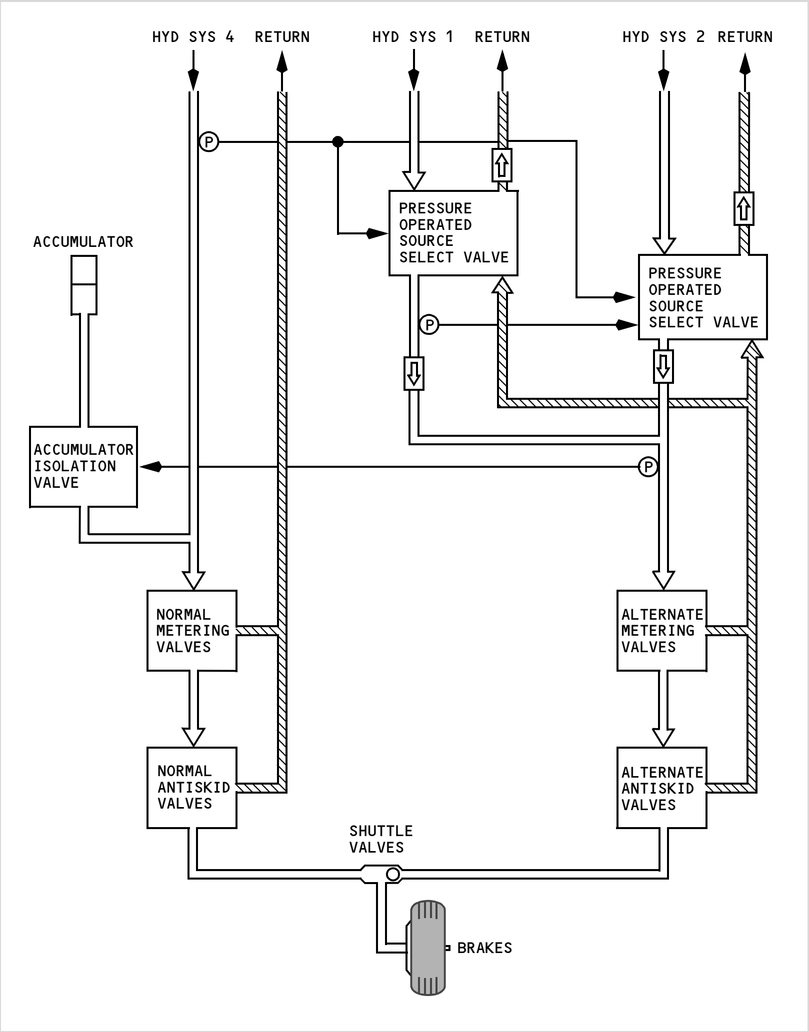
Normal Brake System Diagram



Alternate Brake System Diagram



Brake Source Selection Diagram



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EICAS Alert Messages

Note: Configuration (CONFIG) warning messages are described in Chapter 15, Warning Systems.

Message	Level	Aural	Message Logic
AIR/GND SYSTEM	Advisory		Air/ground sensing system failed to air position.
ANTISKID	Advisory		Fault detected in antiskid system. Fault in active antiskid system, either normal or alternate, results in loss of antiskid protection to one or more wheels.
ANTISKID OFF	Advisory		Antiskid power off on all wheels, or parking brake lever released and parking brake valve not fully open, or brake system control unit power loss occurs.
AUTOBRAKES	Advisory		Autobrake disarmed or inoperative, or autobrake armed with Autobrakes selector OFF, or RTO initiated above 85 knots and autobrake has not been applied.
>BODY GEAR STRG	Advisory		Body gear steering unlocked when commanded locked, or pressurized when not commanded.
BRAKE LIMITER	Advisory		Brake torque limiter failure on more than one wheel per truck, or parking brake lever released and parking brake valve not fully open, or brake unit control system power loss.
>BRAKE SOURCE	Caution	Beeper	Brake system pressures from hydraulic systems 1, 2, and 4 are low.

Message	Level	Aural	Message Logic
BRAKE TEMP	Advisory		Temperature of one or more brakes excessive. Brake temperature equal to or greater than 5 units.
GEAR DISAGREE	Caution	Beeper	Gear position disagrees with Landing Gear lever position after normal transit time.
GEAR DOOR	Advisory		One or more gear doors not closed after normal gear transit time. Inhibited if alternate gear extension selected.
GEAR TILT	Caution	Beeper	Main gear trucks not in full tilt position.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

>TIRE PRESSURE	Advisory		One or more tire pressures out of limits.

EICAS Memo Messages

Message	Level	Aural	Message Logic
AUTOBRAKES 1, 2, 3, 4	Memo		Autobrake level selected.
AUTOBRAKES MAX	Memo		Autobrake MAX selected.
AUTOBRAKES RTO	Memo		Autobrake RTO selected.
PARK BRAKE SET	Memo		Parking brake valve closed.

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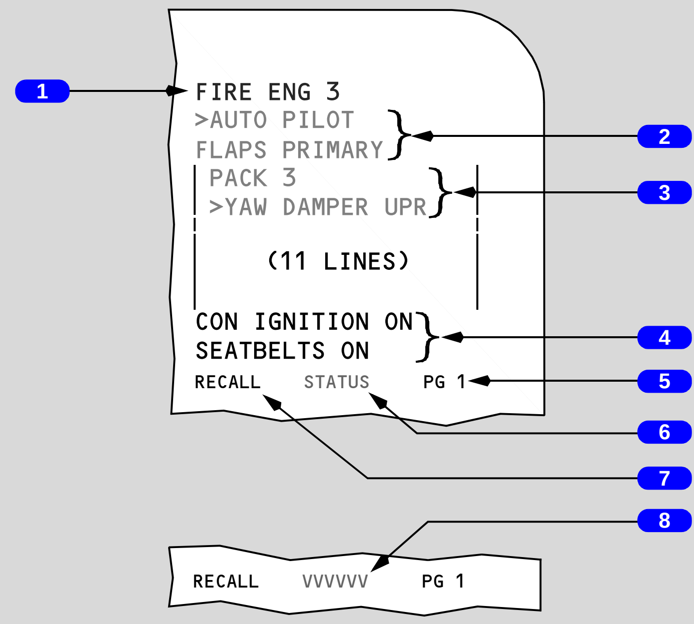
Engine Indication and Crew Alerting System (EICAS)

EICAS Messages



EICAS DISPLAY

1 Warning Messages

Displayed (red) -

- highest priority alert messages
- red alert messages remain displayed and cannot be canceled by pushing the Cancel switch.

2 Caution Messages

Displayed (amber) -

- next highest priority alert messages after warning messages
- amber alert messages can be canceled by pushing the Cancel switch or recalled by pushing the Recall switch

3 Advisory Messages

Displayed (amber) -

- lowest priority alert messages; indented one space
- amber alert messages can be canceled by pushing the Cancel switch or recalled by pushing the Recall switch

4 Memo Messages

Displayed (white) -

- reminder of selected state of controls or systems
- cannot be canceled by pushing the Cancell switch
- EICAS alert messages have display priority over memo messages; some or all memo messages not displayed on current EICAS message page if insufficient message lines are available below alert messages

5 Page (PG) Number

Displayed (white) -

- more than one page of alert or memo messages exists
- indicates the number of page selected

6 STATUS Cue

Displayed (cyan) -

- new status message exists
- no longer displayed when status display selected
- inhibited from after engine start until 30 minutes after lift-off
- inhibited if Secondary Engine Exceedance cue is displayed

7 RECALL Indication

Displayed (white) -

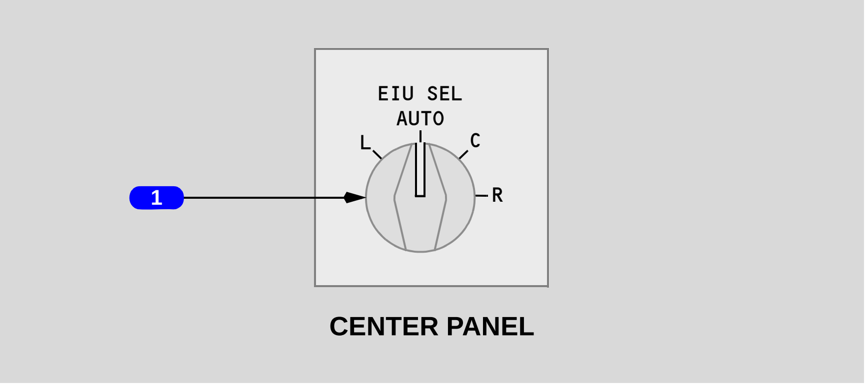
- when Recall switch pushed
- remains displayed for one second after switch released

8 **Secondary Engine Exceedance Cue**

Displayed (cyan) -

- engine parameter on Secondary Engine display is exceeded
- displayed until parameter exceeded returns to normal operating range
- inhibits display of Status cue

EFIS/EICAS Interface Unit (EIU) Selector



1 **EIU Selector**

L -

- left EIU provides data to EFIS and EICAS
- if left EIU fails, automatic switching to an operable EIU is inhibited; if airplane is on standby power and left EIU fails, all CRT displays fail

AUTO -

- selects an operable EIU to provide data to EFIS and EICAS
- Selects left, then center, then right

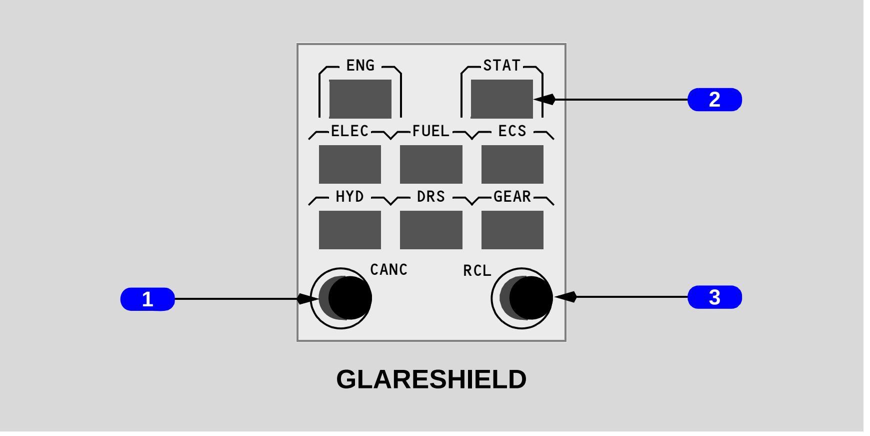
C -

- center EIU provides data to EFIS and EICAS
- if center EIU fails, automatic switching to an operable EIU is inhibited

R -

- right EIU provides data to EFIS and EICAS
- if right EIU fails, automatic switching to an operable EIU is inhibited

Display Select Panel



1 Cancel (CANC) Switch

Push -

- displays next page of caution and advisory messages when additional pages exist
- cancels caution and advisory messages when last page displayed; warning and memo messages remain displayed
- cancels red box for any engine parameter previously exceeded when displayed parameter no longer exceeds the limit

2 Status (STAT) Display Switch

Push - displays status display on secondary EICAS.

Subsequent pushes -

- display next page of status messages when additional pages exist
- secondary EICAS blanks when last status message page displayed

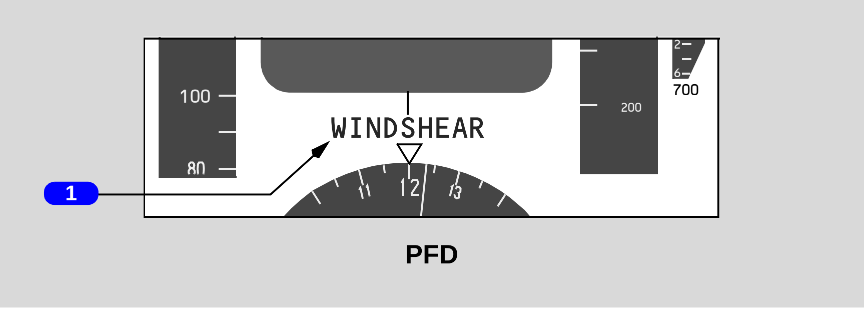
3 Recall (RCL) Switch

Push -

- redisplays all caution and advisory EICAS messages, when respective non-normal condition exists
- displays first page of messages when multiple pages exist
- redisplays red box for parameters previously exceeded
- displays RECALL indication for one second after switch released

GPWS and PWS Alerts on PFD

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL



1 Alert on PFD

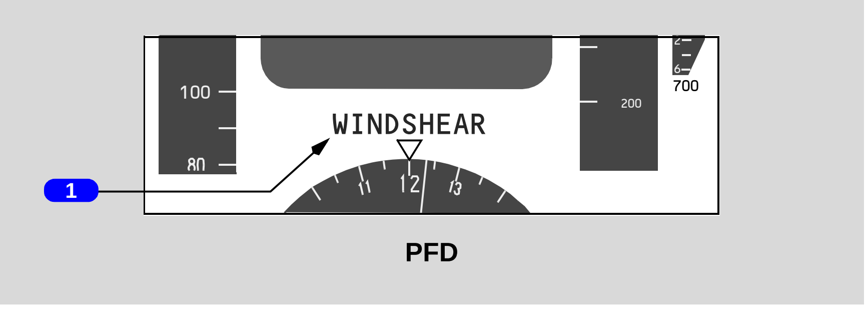
PULL UP (red) - PULL UP alert is occurring.

WINDSHEAR (red) -

- predictive WINDSHEAR AHEAD alert or immediate WINDSHEAR alert is occurring
- all other GPWS alerts inhibited

GPWS Alerts on PFD

EI-XLB, EI-XLD, EI-XLE, EI-XLG, VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX



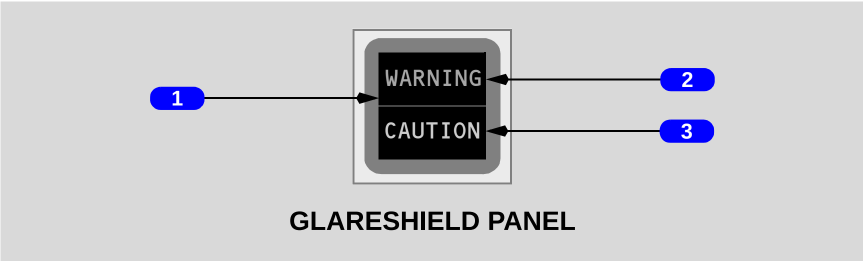
1 Alert on PFD

PULL UP (red) - PULL UP alert is occurring.

WINDSHEAR (red) -

- WINDSHEAR alert is occurring
- all other GPWS alerts inhibited

Master WARNING/CAUTION Reset Switches and Lights



1 Master WARNING/CAUTION Reset Switch

Push -

- extinguishes master WARNING lights
- extinguishes master CAUTION lights
- silences the aural alert that accompany the EICAS warning messages:
  - CABIN ALTITUDE
  - CONFIG GEAR, if displayed because landing gear not down and locked, any thrust lever at idle, and radio altitude less than 800 feet
  - FIRE

  EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO (EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; SB installs OVERSPEED aural resettable by Master Warning/Caution switch)
  - OVERSPEED

  EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
  - PILOT RESPONSE

2 Master WARNING Light

Illuminated (red) -

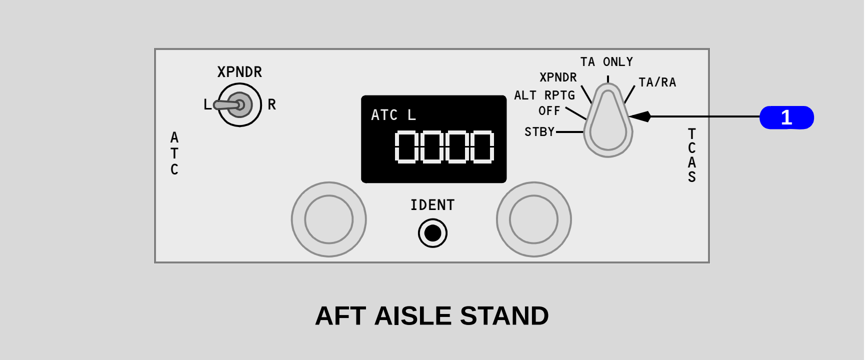
- new EICAS warning message displayed, or
- PULL UP or WINDSHEAR alert displayed on PFD

3 Master CAUTION Light

Illuminated (amber) - new EICAS caution message displayed

Traffic Alert and Collision Avoidance System (TCAS)
TCAS Controls (Transponder Panel)

VQ-BHW, VQ-BHX



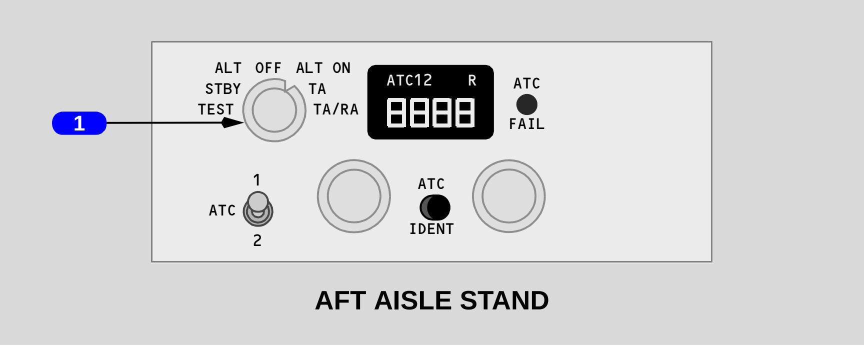
1 Transponder Mode Selector

TA ONLY (traffic advisory) -

- transponder and TCAS TA modes enabled
- all aircraft that would have been predicted as a RA are predicted as a TA

TA/RA (traffic advisory/resolution advisory) - transponder and TCAS TA and RA modes enabled.

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR



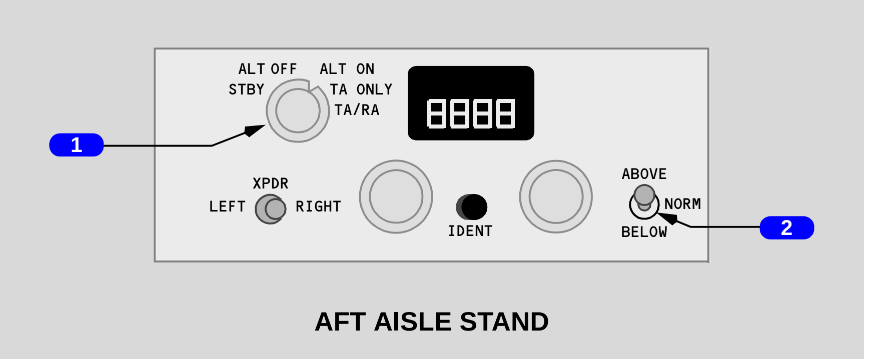
1 Transponder Mode Selector

Traffic Advisory (TA) -

- transponder and TCAS TA modes enabled
- all aircraft that would have been predicted as a RA are predicted as a TA

Traffic Advisory/Resolution Advisory (TA/RA) - transponder and TCAS TA and RA modes enabled.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



1 Transponder Mode Selector

Traffic Advisory (TA) ONLY -

- transponder and TCAS TA modes enabled
- all aircraft that would have been predicted as a RA are predicted as a TA

Traffic Advisory/Resolution Advisory (TA/RA) - transponder and TCAS TA and RA modes enabled.

2 TCAS Airspace Switch

ABOVE - displays altitude reporting traffic from 2,700 feet below to 9,000 feet above current altitude.

Normal (NORM) - displays altitude reporting traffic from 2,700 feet below to 2,700 feet above current altitude.

BELOW - displays altitude reporting traffic 9,000 feet below to 2,700 feet above current altitude.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

1 TCAS Airspace Switches

Left switch controls Captain TCAS display. Right switch controls First Officer TCAS display.

Above (ABV) - displays altitude reporting traffic from 2,700 feet below to 9.900 feet above current altitude.

Normal (N) - displays altitude reporting traffic from 2,700 feet below to 2,700 feet above current altitude.

Below (BLW) - displays altitude reporting traffic 9,900 feet below to 2,700 feet above current altitude.

2 Transponder Mode Selector

Traffic Advisory (TA) - .

- transponder and TCAS TA modes enabled
- all aircraft that would have been predicted as a RA are predicted as a TA

Traffic Advisory/Resolution Advisory (TA/RA) - transponder and TCAS TA and RA modes enabled.

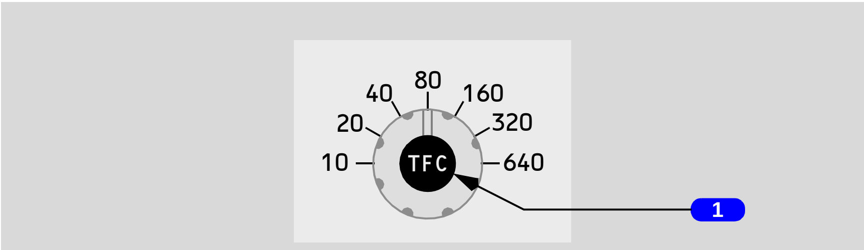
3 TCAS Absolute/Relative (ABS/REL) Altitude Switches

Left switch controls Captain TCAS display. Right switch controls First Officer TCAS display.

Absolute (ABS) - absolute altitude displayed in TCAS traffic symbol data tags.

Relative (REL) - relative altitude displayed in TCAS traffic symbol data tags.

TCAS Controls (EFIS Control Panel)



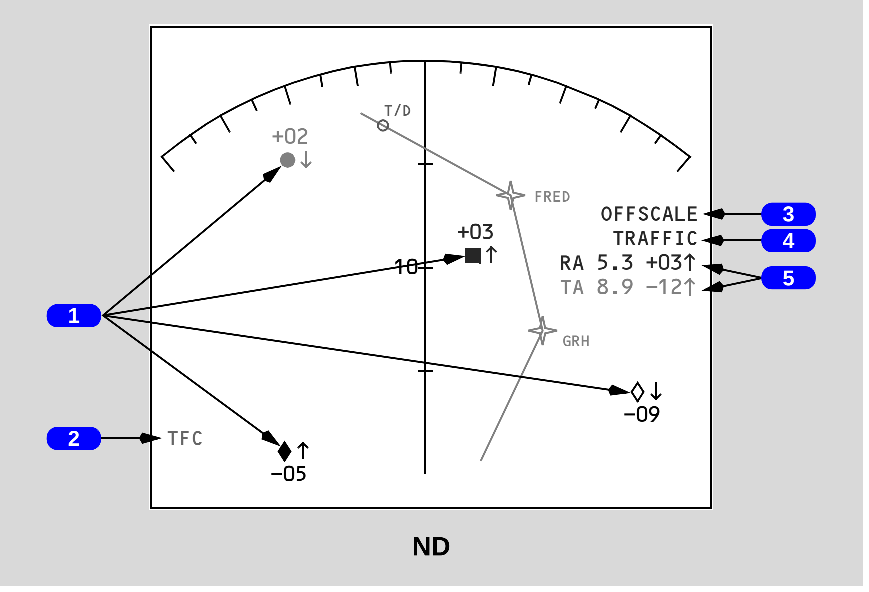
EFIS CONTROL PANEL

1 ND Traffic (TFC) Switch (inner)

Push – in VOR, APP, MAP, and MAP CTR modes:

- TCAS traffic dsiplayed on ND
- range information displayed when in the expanded APP or VOR modes
- with TCAS FAIL displayed on ND, cancels TCAS FAIL message

TCAS Traffic Displays



1 Traffic Display

Indicates relative position of traffic.

- filled red square indicates a resolution advisory (RA)
- filled amber circle indicates a traffic advisory (TA)
- filled white diamond indicates proximate traffic
- unfilled white diamond indicates other traffic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

- number is relative or absolute altitude of traffic in hundreds and thousands of feet; not displayed when altitude unknown

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

- number is relative altitude of traffic in hundreds of feet; not displayed when altitude unknown

- number is below the traffic symbol when traffic is below the airplame altitude and above the traffic symbol when traffic is above the airplane altitude
- vertical motion arrow indicates traffic climbing or descending at 500 feet per minute or greater; not displayed for vertical motion less than 500 feet per minute

Displayed automatically when:

- a RA or TA occurs, and
- TFC is not displayed on either ND, and
- respective ND is in MAP, MAP CTR, VOR, or APP mode

Displayed automatically when:

- EFIS control panel fails, and
- respective ND is in MAP, MAP CTR, VOR, or APP mode

2 TCAS Mode Annunciations

TFC (cyan) -

- TCAS traffic display enabled
- TCAS traffic displayed in MAP, MAP CTR, APP, and VOR modes

TA ONLY (cyan) -

- TCAS cannot provide RAs
- all traffic that would have been RAs are predicted as TAs

3 OFFSCALE Message

Displayed (red) -

- RA is beyond selected map range
- only when TCAS enabled

Displayed (amber) -

- TA is beyond selected map range
- only when TCAS enabled

4 TRAFFIC Alert Message

Displayed: (red) - RA is occurring.

Displayed: (amber) - TA is occurring, and RA is not occurring.

Displayed whether TCAS traffic is displayed or not.

Displayed in all ND modes and ranges.

5 TCAS No-Bearing Messages

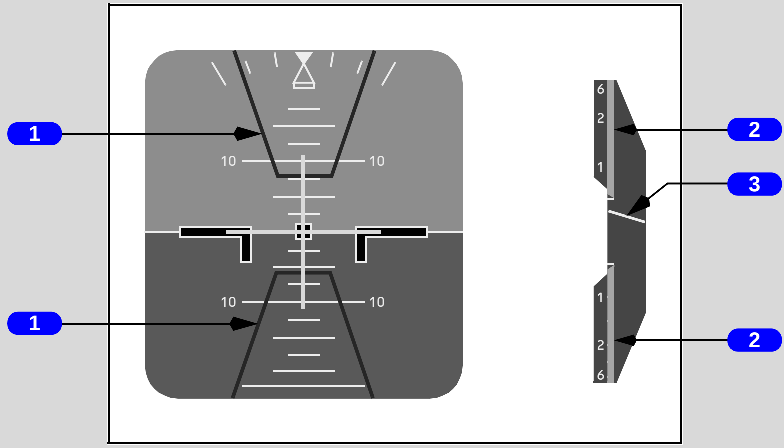
RA (red) - data tag displayed for no-bearing RA.

TA (amber) - data tag displayed for no-bearing TA.

Data tag contains distance, altitude, and vertical motion arrow.

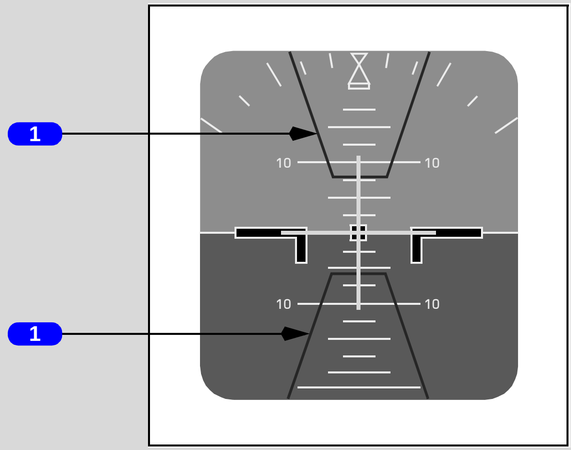
TCAS PFD Vertical Guidance

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ



PFD

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



PFD

1 RA Pitch Region To Avoid Traffic (red outlined)

Note: For a single RA, only one red outlined RA pitch region, either above or below, is displayed at a time. For two or more RAs, two red outlined RA pitch regions may be displayed.

To ensure vertical separation, the center of the airplane symbol must be outside the red outlined RA pitch regions to avoid traffic.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

2 RA Vertical Speed Region to Avoid Traffic (red)

To ensure vertical separation, vertical speed must be outside the red RA vertical speed region to avoid traffic.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

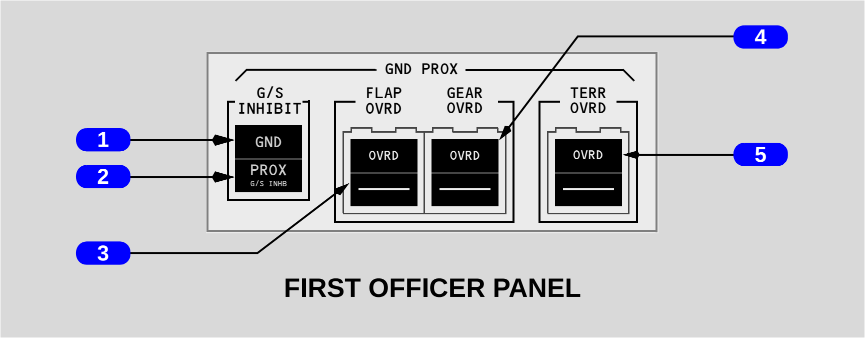
3 Vertical Speed Pointer

Red - present vertical speed does not ensure traffic is avoided.

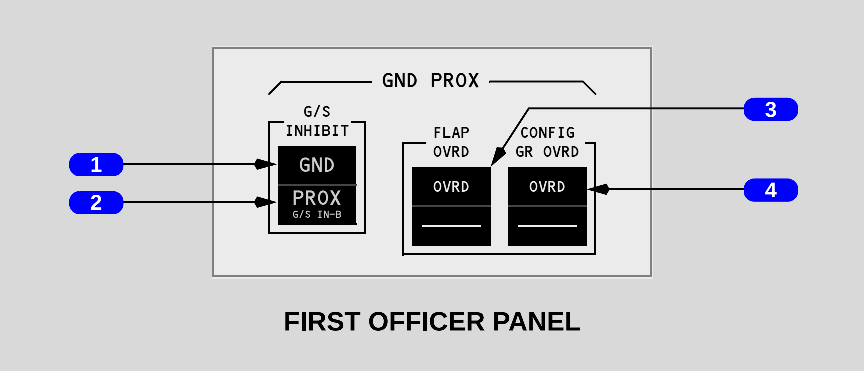
White - present vertical speed ensures traffic is avoided.

Ground Proximity Warning System (GPWS) Controls
Ground Proximity Panel

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ



VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX



1 Ground Proximity (GND PROX) Glideslope (G/S) Inhibit Switch

Push - inhibits GLIDESLOPE alert when pushed below 1,000 feet radio altitude.

2 Ground Proximity (GND PROX) Light

Illuminated (amber) -

- GPWS GLIDE SLOPE, SINKRATE, TERRAIN, TOO LOW FLAPS, TOO LOW GEAR, or TOO LOW TERRAIN immediate alert is occurring
- Inhibited for GLIDESLOPE, or TOO LOW FLAPS, or TOO LOW GEAR alerts when respective inhibit or override switch is pushed

3 Ground Proximity (GND PROX) Flap Override (OVRD) Switch

Push (OVRD illuminated) -

- inhibits TOO LOW FLAPS alert
- EICAS advisory message GND PROX SYS will be displayed when airspeed greater than 250 knots for more than 60 seconds

4 Ground Proximity (GND PROX) Configuration (CONFIG) Gear (GEAR) Override (OVRD) Switch

Push (OVRD illuminated) -

- inhibits TOO LOW GEAR alert
- inhibits CONFIG GEAR alert
- EICAS advisory message GND PROX SYS will be displayed when airspeed greater than 290 knots for more than 60 seconds

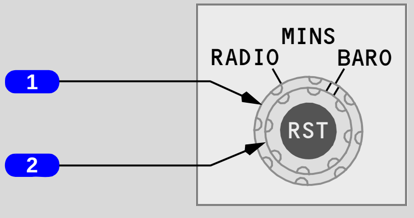
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

5 Ground Proximity (GND PROX) Terrain (TERR) Override (OVRD) Switch

Push (OVRD illuminated) - inhibits look-ahead terrain alerts and terrain display.

Radio Altitude/Barometric Altitude Control

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO



EFIS CONTROL PANEL

1 Minimums (MINS) Selector (outer)

RADIO - Radio Altimeter/Barometric Altitude control sets RADIO minimums display on PFD. The left Radio Altimeter/Barometric Altitude control sets radio altitude reference for GPWS minimums voice annunciation

BARO - Radio Altimeter/Barometric Altitude control sets barometric alitude minimums pointer and BARO minimums display on PFD. The left Radio Altimeter/Barometric Altitude control sets BARO reference for GPWS minimums voice annunciation.

2 RADIO Altitude/Barometric (BARO) Altitude Control (middle)

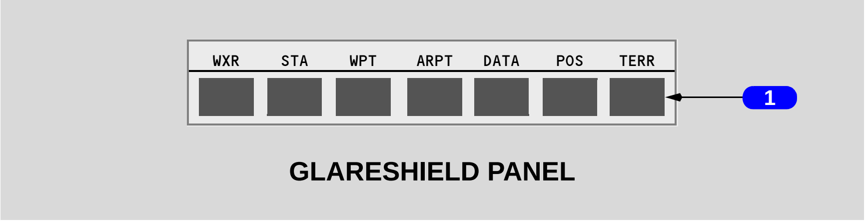
Rotate -

- when RADIO selected on Minimums selector, sets RADIO altitude minimums displayed on PFD
- when BARO selected on Minimums selector, sets BARO minimums pointer and BARO minimums display on PFD
- the left Radio Altitude/Barometric Altitude control sets RADIO or BARO reference for GPWS minimums voice annunciation

GPWS Look-Ahead Terrain Alerting Controls, Display, and Annunciations

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

Control Panel ND Controls

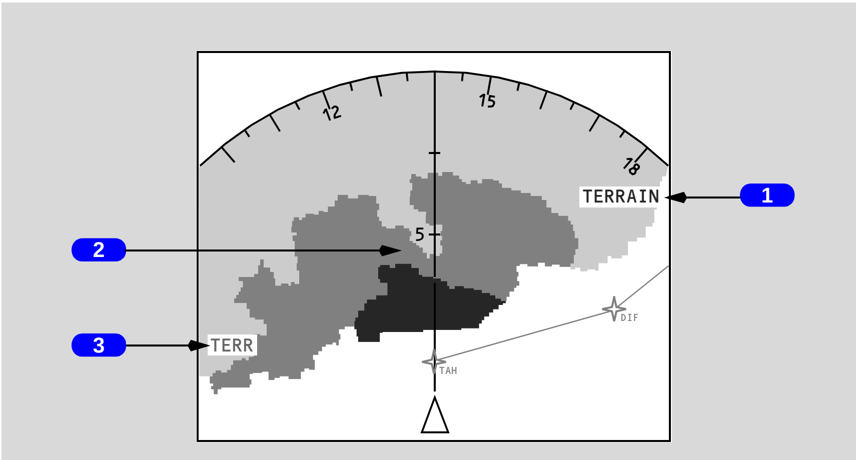


1 TERR Switch

Push -

- terrain data is displayed in MAP, MAP CTR, VOR, and APP modes
- weather radar data is not displayed

Terrain Display



NAVIGATION DISPLAY

1 TERRAIN Annunciation

TERRAIN (amber) – look–ahead terrain caution alert is occurring.

TERRAIN (red) – look–ahead terrain warning alert is occurring.

Displayed in all ND display modes.

2 Terrain Display

Color and density vary based on terrain height and airplane altitude:

- dotted green: terrain from 2,000 feet below to 500 feet (250 feet with gear down) below airplane altitude
- dotted amber: terrain 500 feet (250 feet with gear down) below to 2,000 feet above airplane altitude
- dotted red: terrain more than 2,000 feet above airplane altitude
- dotted magenta: no terrain data available
- solid amber: look–ahead terrain caution alert is occurring
- solid red: look–ahead terrain warning alert is occurring

Note: In areas without terrain data, look–ahead terrain alerting and display functions not available. GPWS immediate alerts function normally.

Note: Terrain more than 2,000 feet below airplane altitude or within 400 feet of the nearest airport runway elevation is not displayed.

Displayed automatically when:

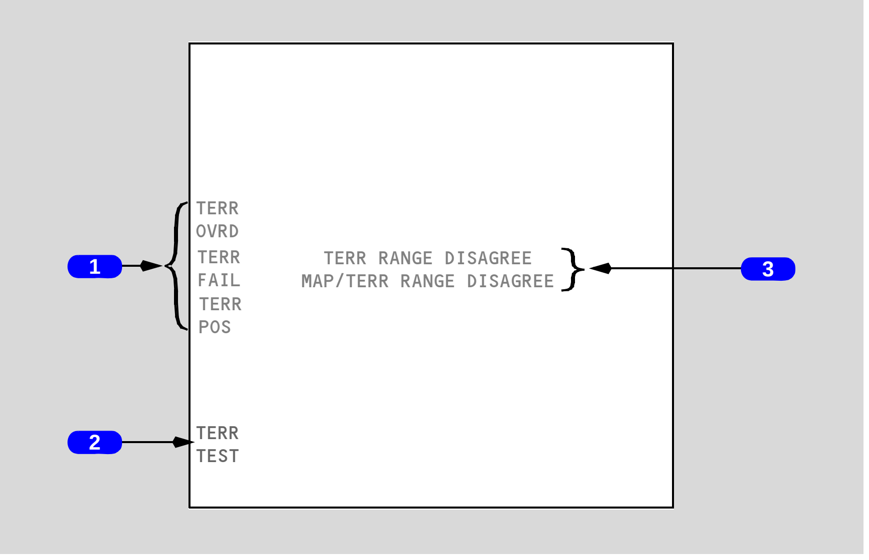
- a look–ahead terrain alert occurs, and
- TERR not selected on either ND, and
- respective ND is in MAP, MAP CTR, VOR, or APP mode

Display updates with a display sweep similar to weather radar display.

3 Terrain Mode Annunciation

TERR (cyan) – terrain display enabled.

Terrain Navigation Display Annunciations



1 Terrain Annunciations

TERR OVRD (amber) - TERR OVRD switch pushed.

TERR FAIL (amber) - look-ahead terrain alerting and display failed.

TERR POS (amber) - look-ahead terrain alerting and display unavailable because GPS has failed. During time between GPS failure and display of TERR POS message, IRS provides position for look-ahead alerting and display.

2 Terrain Test Annunciation

TERR TEST (cyan) - GPWS operating in self-test mode.

3 Terrain Range Annunciation

TERR RANGE DISAGREE (amber) -

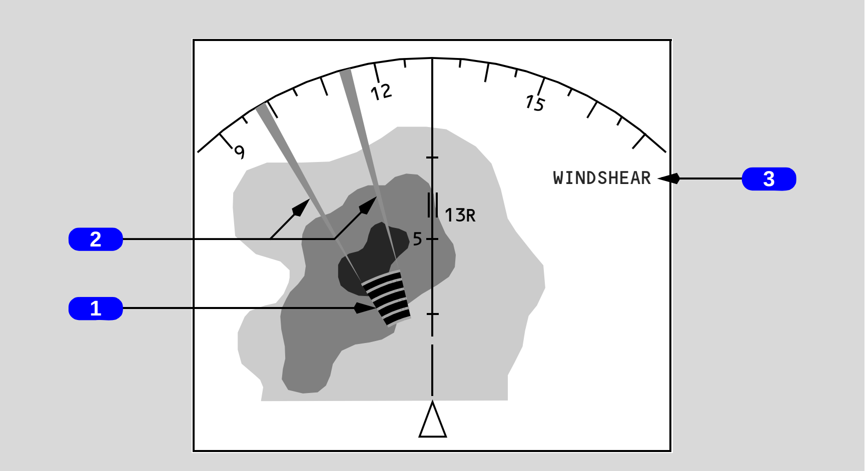
- terrain display enabled, and
- terrain output range disagrees with range selected by EFIS control panel

MAP/TERR RANGE DISAGREE (amber) -

- terrain display enabled, and
- terrain output range disagrees with range selected by EFIS control panel, and
- map display output range disagrees with range selected by EFIS control panel

Predictive Windshear (PWS) Display and Annunciations

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL



NAVIGATION DISPLAY

1 PWS Symbol

Displayed (red and black) -

- PWS alert is occurring
- displays windshear location and approximate geometric size (width and depth)

Symbol, radials, and weather radar returns displayed automatically when:

- PWS alert occurs, and
- WXR is not selected on either ND, and
- respective ND is in MAP, MAP CTR, VOR, or APP mode

When terrain display is selected and PWS alert occurs, weather radar display replaces terrain display.

2 PWS Radials

Displayed (amber) -

- PWS alert is occurring
- Extend from PWS symbol to help locate windshear event

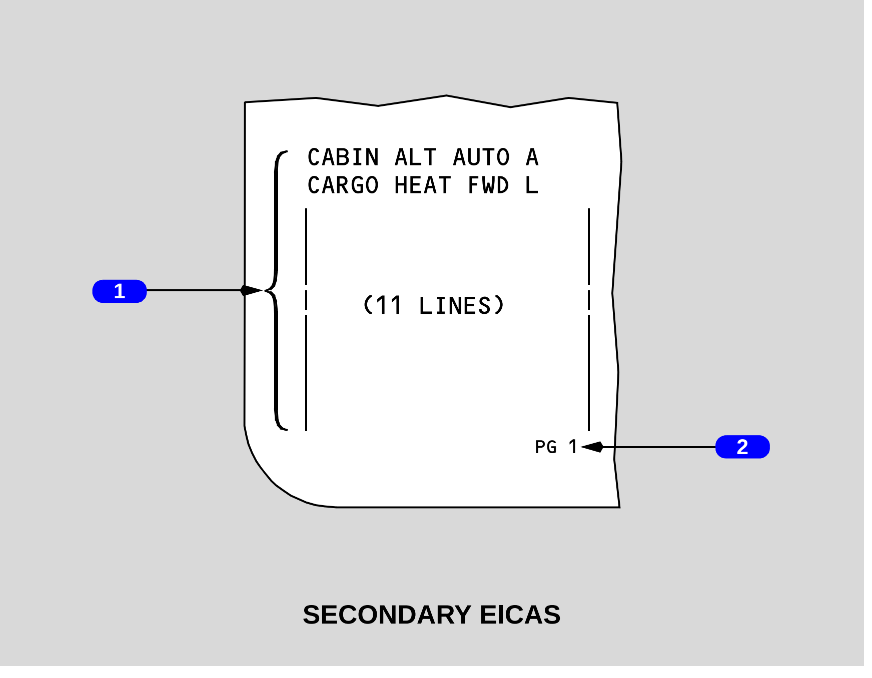
3 WINDSHEAR Annunciation

WINDSHEAR (amber) - PWS caution is occurring.

WINDSHEAR (red) - PWS warning is occurring.

Displayed in all navigation display modes.

Status Display



1 Status Messages

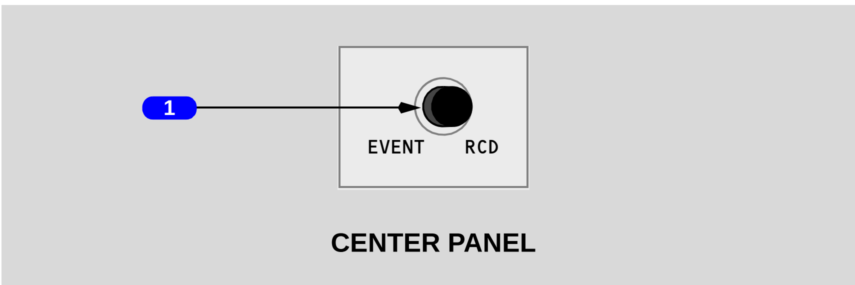
Status messages indicate equipment faults requiring MEL reference for dispatch.

2 Page (PG) Number

Displayed -

- additional pages of status messages exist
- displays number of page selected

EICAS Event Record Switch



1 EICAS Event Record (EVENT RCD) Switch

Push - records up to five EICAS events.

Intentionally
Blank

Warning Systems — Chapter 15
System Description — Section 20

Introduction

Warning systems consist of:

- engine indication and crew alerting system (EICAS)
- airspeed alerts
- takeoff and landing configuration warning system
- MCP selected altitude alerts

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

- crew alertness monitor
- traffic collision avoidance system (TCAS)
- windshear alerts
- ground proximity warning system (GPWS)
- maintenance event recording

Engine Indication and Crew Alerting System (EICAS)

EICAS consolidates engine and airplane system indications and is the primary means of displaying system indications and alerts to the flight crew. The most important indications are displayed on primary EICAS.

EFIS/EICAS Interface Unit (EIU)

The EIUs monitor all airplane systems continuously and control the information displayed on the EICAS displays. Data from airplane systems is provided to three EIUs and one of the three EIUs controls all EICAS displays. The EIU selector provides either automatic or manual selection of the controlling EIU.

EICAS Messages

Systems conditions and configuration information is provided to the crew by three types of EICAS messages:

- EICAS alert messages are the primary method to alert the crew to non-normal conditions
- EICAS memo messages are crew reminders of certain flight crew selected normal conditions
- EICAS status messages indicate equipment faults requiring MEL reference for dispatch

An EICAS alert or memo message is no longer displayed when the respective condition no longer exists.

EICAS Alert messages

From after engine start until engine shut down, EICAS alert messages are the primary means to alert the crew to non-normal conditions which may impact other operations during the flight.

There is a non-normal procedure for each EICAS alert message. The procedure for every EICAS alert message is included as a checklist in the QRH. Procedures for some EICAS alert messages have steps to reconfigure airplane systems. A caret symbol (>) prefaces an alert message that has no procedural steps.

EICAS alert messages are grouped into three priority levels: warning, caution, and advisory. Prioritization is an aid to flight crew decision making when more than one EICAS alert message is displayed.

EICAS warning messages are displayed red and EICAS caution and advisory messages are displayed amber. Red EICAS alert messages remain displayed and cannot be canceled by pushing the Cancel switch. Amber EICAS alert messages can be canceled by pushing the Cancel switch and recalled by pushing the Recall switch.

EICAS Memo Messages

EICAS memo messages are crew reminders of certain flight crew selected normal conditions. They display in white at the bottom of the last page of EICAS alert messages on the primary EICAS display.

Pushing the Cancel switch when the last page of EICAS alert messages is displayed ensures all current memo messages have been displayed.

EICAS Status Messages

All EICAS status messages are listed in the DDG or airline equivalent and provide a cross reference to the MEL for dispatch capability.

Display and Manipulation of EICAS Messages

If more than one EICAS alert message is displayed, the messages are displayed in a list which is grouped by priority level. EICAS warning messages are displayed in red at the top of the message list.

EICAS caution messages are displayed in amber below the lowest warning message. EICAS advisory messages are displayed in amber below the lowest caution message and are indented one character so they may be distinguished from EICAS caution messages.

The most recent EICAS alert message is displayed at the top of its priority group and all messages move down one display line. If a message is no longer displayed because the respective system non-normal condition no longer exists, all messages previously displayed move up one display line.

If there are more messages in the list than can be displayed on one page, multiple pages are created and numbered sequentially. The page number is normally displayed at the bottom of each list. Multiple pages of EICAS caution and advisory messages can be displayed one page at a time by pushing the Cancel switch. If there are more EICAS warning messages in the list than can be displayed on one page, no page number is displayed and it is not possible to display other pages. In all other cases, pushing the Cancel switch displays the next page of EICAS caution and advisory messages. EICAS warning messages are displayed at the top of each page.

Pushing the Cancel switch when the last page of the list is displayed causes all EICAS caution and advisory messages to be no longer displayed.

EICAS alert messages for new system non-normal conditions are displayed on the page being viewed.

For example, if page three is displayed and an EICAS caution message is displayed because a new system non-normal occurs, the message is displayed immediately below any EICAS warning messages. If the Recall switch is subsequently pushed to redisplay page one, the message is displayed as the first EICAS caution message on page one.

When no EICAS caution or advisory messages are displayed, pushing the Recall switch redisplays page one of the EICAS caution and advisory messages for all system non-normal conditions and the RECALL message is displayed briefly.

The most recent EICAS memo message is displayed at the bottom of the memo messages.

The Status cue is displayed on primary EICAS when a new EICAS status message is displayed. When the Status Display switch is pushed, the status display is displayed on the secondary EICAS display. The most recent status message is displayed at the top of the message list.

The Status Display switch controls the display of single and multiple pages of status messages in a manner similar to the way the Cancel and Recall switches control the display of EICAS alert messages.

Aurals, Master Warning/Caution Switches and Lights, and Ground Proximity Light

Aurals, two Master Warning/Caution lights, and the Ground Proximity light call attention to the following alerts:

- in the following table, parenthesis () describe crew action to silence the aural alert or extinguish the light while the alert is occurring.

Aural	Light	Calls Attention To:
Bell (Silence by pushing Master Warning/Caution Reset switch.)	Master Warning lights (Extinguish by pushing Master Warning/Caution Reset switch.)	EICAS warning message: APU FIRE FIRE CARGO AFT, FWD FIRE ENG FIRE WHEEL WELL

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

Wailer	Master Warning lights (Extinguish by pushing Master Warning/Caution Reset switch.)	EICAS warning message AUTO PILOT DISC

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
(VQ-BHW, VQ-BHX ; SB installs OVERSPEED aural resettable)

Siren	Master Warning lights (Extinguish by pushing Master Warning/Caution Reset switch.)	EICAS warning message: CONFIG FLAPS CONFIG GEAR CONFIG PARK BRK CONFIG SPOILERS CONFIG STAB

(VQ-BHW, VQ-BHX ; before SB, OVERSPEED aural resettable is not installed)

Siren	Master Warning lights (Extinguish by pushing Master Warning/Caution Reset switch.)	EICAS warning message: CONFIG FLAPS CONFIG GEAR CONFIG PARK BRK CONFIG SPOILERS CONFIG STAB OVERSPEED

Aural	Light	Calls Attention To:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ (EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; SB installs OVERSPEED aural resettable)

Siren	Master Warning lights (Extinguish by pushing Master Warning/Caution Reset switch.)	EICAS warning message: AUTOPILOT DISC CONFIG FLAPS CONFIG GEAR CONFIG PARK BRK CONFIG SPOILERS CONFIG STAB

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; before SB, OVERSPEED aural resettable is not installed)

Siren	Master Warning lights (Extinguish by pushing Master Warning/Caution Reset switch.)	EICAS warning message: AUTOPILOT DISC CONFIG FLAPS CONFIG GEAR CONFIG PARK BRK CONFIG SPOILERS CONFIG STAB OVERSPEED

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; before SB, OVERSPEED aural resettable is not installed)

Siren (Silence by pushing Master Warning/Caution Reset switch.)	Master Warning lights (Extinguish by pushing Master Warning/Caution Reset switch.)	EICAS warning message: CABIN ALTITUDE

Aural	Light	Calls Attention To:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Siren (Silence by pushing Master Warning/Caution Reset switch.)	Master Warning lights (Extinguish by pushing Master Warning/Caution Reset switch.)	EICAS warning message: CABIN ALTITUDE OVERSPEED PILOT RESPONSE

(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX ; SB installs OVERSPEED aural resettable)

Siren (Silence by pushing Master Warning/Caution Reset switch.)	Master Warning lights (Extinguish by pushing Master Warning/Caution Reset switch.)	EICAS warning message: CABIN ALTITUDE OVERSPEED

EI-XLL, EI-XLM, EI-XLN, EI-XLO

Voice annunciation VEE ONE	None	Airspeed at V1 during takeoff

Beeper	Master Caution lights (Extinguish by pushing Master Warning/Caution Reset switch.)	New EICAS caution message, except: ENG SHUTDOWN
Voice annunciation: DON’T SINK, DON’T SINK TOO LOW, TERRAIN	Ground Proximity (GND PROX) light	GPWS immediate alert.

VQ-BHW, VQ-BHX

C-chord	None	Approaching MCP selected altitude.

Aural	Light	Calls Attention To:
Voice annunciation TRAFFIC, TRAFFIC	None	Amber TRAFFIC message and TCAS TA traffic display on ND

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; SB installs TCAS Ver. 7.0)

Voice annunciation: ADJUST VERTICAL SPEED, ADJUST CLIMB, CLIMB CLIMB, CLIMB NOW, CLIMB, CLIMB NOW CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB DESCEND, DESCEND DESCEND, DESCEND NOW, DESCEND, DESCEND NOW DESCEND, CROSSING DESCEND, DESCEND, CROSSING DESCEND INCREASE CLIMB, INCREASE CLIMB INCREASE DESCENT, INCREASE DESCENT MAINTAIN VERTICAL SPEED, MAINTAIN MAINTAIN VERTICAL SPEED CROSSING, MAINTAIN MONITOR VERTICAL SPEED	None	Red regions to avoid on PFD Red TRAFFIC message and TCAS RA traffic display on ND

Aural	Light	Calls Attention To:

VQ-BHW, VQ-BHX
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; before SB, TCAS Ver. 6.04A is installed)

Voice annunciation: CLIMB, CLIMB, CLIMB CLIMB, CLIMB NOW, CLIMB, CLIMB NOW CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB DESCEND, DESCEND, DESCEND DESCEND, DESCEND NOW, DESCEND, DESCEND NOW DESCEND, CROSSING DESCEND, DESCEND, CROSSING DESCEND INCREASE CLIMB, INCREASE CLIMB INCREASE DESCENT, INCREASE DESCENT MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED REDUCE CLIMB, REDUCE CLIMB REDUCE DESCENT, REDUCE DESCENT	None	Red regions to avoid on PFD Red TRAFFIC message and TCAS RA traffic display on ND

Voice annunciation CLEAR OF CONFLICT	None	Red regions to avoid on PFD, Red TRAFFIC message, and TCAS RA traffic display on ND are no longer displayed.

Aural	Light	Calls Attention To:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

Voice annunciation TERRAIN, TERRAIN, PULL UP	Master Warning lights (Extinguish by pushing Master Warning/Caution switch.)	Red PULL UP on both PFDs Red TERRAIN message and terrain display on ND

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

Voice annunciation CAUTION TERRAIN	Ground Proximity GND PROX) light	Amber TERRAIN message and terrain display on ND

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

Voice annunciation: WINDSHEAR AHEAD GO AROUND, WINDSHEAR	Master Warning lights (Extinguish by pushing Master Warning/Caution switch)	Red WINDSHEAR on both PFDs Red WINDSHEAR message and PWS display on ND
Voice annunciation MONITOR RADAR DISPLAY	None	Amber WINDSHEAR message and PWS display on ND

Siren, followed by voice annunciation WINDSHEAR, WINDSHEAR, WINDSHEAR	Master Warning lights (Extinguish by pushing Master Warning/Caution switch)	Red WINDSHEAR on both PFDs
Voice annunciation PULL UP	Master Warning lights (Extinguish by pushing Master Warning/Caution switch)	Red PULL UP on both PFDs

Aural	Light	Calls Attention To:
Siren (If caused by Thrust lever at idle, silence by pushing Master Warning/Caution switch.)	Master Warning lights (If caused by Thrust lever at idle, extinguish by pushing Master Warning/Caution switch.)	EICAS warning message CONFIG GEAR for: • Thrust lever at idle, and • radio altitude less than 800 feet, and • gear not down and locked.
Voice annunciation: GLIDE SLOPE SINK RATE TERRAIN TOO LOW, FLAPS TOO LOW, GEAR TOO LOW, TERRAIN	Ground Proximity (GND PROX) light	GPWS immediate alert
Altitude voice annunciations	None	Altitude voice annunciations during approach

Flight Deck Panel Annunciator Lights

Flight deck panel annunciator lights are used with EICAS messages to:

- help locate and identify affected systems and controls
- reduce potential for error

Airspeed Alerts
Stall Warning

Warning of an impending stall is provided by left and right stick shakers, which independently vibrate the left and right control columns.

Airspeed Low

The EICAS caution message AIRSPEED LOW is displayed and the box around the current airspeed indication on the PFD is highlighted amber when airspeed is below minimum maneuvering speed.

Takeoff V1 Airspeed

EI-XLL, EI-XLM, EI-XLN, EI-XLO

The voice annunciation VEE ONE sounds when airspeed reaches V1 during takeoff.

Overspeed Warning

The EICAS alert message OVERSPEED is displayed if VMO/MMO is exceeded. The message remains displayed until airspeed is reduced below VMO/MMO.

The EICAS memo message VMO GEAR DOWN is displayed when gear down dispatch has been selected in the electronics bay. When gear down dispatch is selected, the VMO/MMO calculated by the ADC are based on maximum gear extended speed.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

The EICAS memo message VMO SPARE ENGINE is displayed when spare engine dispatch has been selected in the electronics bay. When spare engine dispatch is selected, the VMO/MMO calculated by the ADC is based on maximum spare engine carriage speed.

Takeoff And Landing Configuration Warning System

The takeoff and landing configuration warning system alerts the crew that the airplane is not configured for a normal takeoff or a normal landing.

Takeoff Configuration Warnings

The respective EICAS alert message CONFIG is displayed if:

- airplane is on the ground, and
- FUEL CONTROL switches are in RUN position, and
- engine two or three thrust is in takeoff range, and
- airspeed is less than V1, and
- any of the following configurations exist;
  - flaps not in a takeoff position, or
  - body gear not centered, or
  - parking brake set, or
  - Speedbrake lever not in DN detent, or
  - stabilizer trim not in takeoff range

The CONFIG message remains displayed until the airplane is configured for a normal takeoff or until engine 2 and 3 thrust is decreased below takeoff range and airspeed is less than V1.

Landing Configuration Warning

The landing configuration warning system alerts the crew the landing gear is not extended for landing. The EICAS warning message CONFIG GEAR is displayed if:

- the airplane is in flight, and
- any landing gear is not down and locked, and
- any of the following configurations exist;
  - any Thrust lever is closed and radio altitude is less than 800 ft., or
  - flaps in a landing position (flaps 25 or more)

If the message is displayed because a Thrust lever is closed at low radio altitudes, the message remains displayed until the Thrust levers are advanced or landing gear is down and locked.

If the message is displayed because the flaps are in a landing position, the message remains displayed until the landing gear is down and locked or the Ground Proximity Gear Override switch is pushed.

Speedbrake Lever Extended Beyond ARM During Climb

(EI-XLG, EI-XLH, EI-XLJ ; SB installs message in flight)

In flight, the EICAS warning message CONFIG SPOILERS is displayed if:

- the Speedbrake lever is extended beyond ARM, and
- climb or greater thrust is set for 3 seconds on any two thrust levers

The EICAS message remains displayed until:

- the Speedbrake lever is DN or at ARM, or
- at least three thrust levers are set below climb thrust

Configuration Warning System Non-normal Operation

If the takeoff warning system fails or if the takeoff warning system input to the EIU fails, the EICAS alert message CONFIG WARN SY will be displayed. If the takeoff and landing configuration system fails, CONFIG messages may or may not be displayed. If the messages are displayed with the CONFIG WARN SY message, the CONFIG messages may not be correct.

MCP Selected Altitude

Altitude alerting is provided when departing the altitude selected in the MCP altitude window.

Approaching MCP Selected Altitude

VQ-BHW, VQ-BHX
At 900 feet prior to reaching the selected altitude a c-chord sounds and a highlighted white box is displayed around the selected altitude and the current altitude on the PFD. The highlights are no longer displayed when within 300 feet of the selected altitude.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
At 900 feet prior to reaching the selected altitude a highlighted white box is displayed around the selected altitude and the current altitude on the PFD. The highlights are no longer displayed when within 300 feet of the selected altitude.

Departing MCP Selected Altitude

When departing the selected altitude by 300 feet, the EICAS alert message ALTITUDE ALERT is displayed, and a highlighted amber box is displayed around the current altitude. The message and amber highlights are no longer displayed when:

- subsequently reapproaching to within 300 feet of the selected altitude, or
- a new MCP altitude is selected, or
- departing more than 900 feet from the selected altitude

MCP Selected Altitude Alert Inhibits

Alerts when departing MCP selected altitude are inhibited when:

- glideslope captured, or
- landing flaps selected and landing gear down and locked

Crew Alertness Monitor

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

The FMC continuously monitors switch action on the MCP, EFIS control panel, EICAS control panel, CDUs, and radio transmitter switches. When a predefined time elapses after the last switch action was detected the EICAS alert message PILOT RESPONSE is displayed.

The PILOT RESPONSE message is no longer displayed after pushing any monitored switch.

The PILOT RESPONSE message is inhibited:

- below 20,000 feet, or
- during climb, or
- when flaps are not up

Traffic Alert and Collision Avoidance System (TCAS)

TCAS alerts the crew to possible conflicting traffic. TCAS interrogates operating transponders in other aircraft, tracks the other aircraft by analyzing the transponder replies, and predicts the flight paths and positions. TCAS provides advisory, flight path guidance, and traffic displays of the other aircraft to the flight crew. Neither ND messages, voice annunciations, PFD vertical guidance, nor traffic display is provided for other airplanes that do not have operating transponders. TCAS operation is independent of ground-based air traffic control.

To provide advisories, TCAS identifies a three-dimensional airspace around the airplane where a high likelihood of traffic conflict exists. The dimensions of this airspace are contingent upon the closure rate with conflicting traffic.

TCAS provides advisories and traffic displays:

- resolution advisory (RA) and display
- traffic advisory (TA) and display
- proximate traffic display
- other traffic display

TCAS messages and TCAS traffic symbols can be displayed on the ND in the map, map centered, VOR, and approach modes. TCAS messages and TCAS traffic symbols cannot be displayed on the ND in the VOR-centered, approach-centered, or plan modes.

TCAS messages TRAFFIC, TA ONLY, and TCAS TEST may be displayed in all ND modes.

TCAS processing priorities may reduce display of certain air traffic on the ND. Reduced display of air traffic does not affect system collision avoidance alerting capability.

Resolution Advisories (RA) and Display

A RA is a prediction another aircraft will enter TCAS conflict airspace within approximately 20 to 30 seconds. If altitude data from the other aircraft is not available, no RA can be provided.

When TCAS predicts an RA:

- a TCAS voice annunciation sounds
- TCAS PFD vertical guidance is displayed
- the TCAS red message TRAFFIC is displayed on the ND

When the TCAS cyan message TFC is displayed on the ND, and the RA is within the display range of the ND, the TCAS RA Traffic aircraft symbol and its accompanying data tag are displayed on the ND.

The TCAS RA Traffic aircraft symbol is a filled red square. The RA data tag contains the altitude and the vertical motion arrow.

For no-bearing RAs, the red RA label is displayed below the red message, TRAFFIC, and the RA data tag information is displayed to the right of the label. The RA data tag contains the distance, altitude, and the vertical motion arrow.

When the RA is further from the airplane than the ND range currently displayed, the TCAS red message OFFSCALE is displayed on the ND.

Traffic Advisories (TA) and Display

A TA is a prediction another aircraft will enter the conflict airspace in 25 to 45 seconds. TAs assist the flight crew in establishing visual contact with the other aircraft.

When TCAS predicts a TA:

- the TCAS voice annunciation TRAFFIC, TRAFFIC sounds once
- the TCAS amber message TRAFFIC is displayed on the ND

When the TCAS cyan message TFC is displayed on the ND and the TA is within the display range of the ND, the TCAS TA Traffic aircraft symbol and its accompanying data tag are displayed on the ND.

The TA Traffic aircraft symbol is a filled amber circle. The TA data tag contains the altitude and vertical motion arrow.

For no-bearing TAs, the amber TA label is displayed below the TRAFFIC message, and the TA data tag information is displayed to the right of the label. The TA labels are displayed below the RA labels. The TA data tag contains the distance, altitude, and vertical motion arrow.

When the TA is further from the airplane than the ND range currently displayed, the TCAS amber message OFFSCALE is displayed on the ND.

Proximate Traffic Display

Proximate traffic is another aircraft that is neither an RA or a TA but is within:

- six miles
- 1,200 feet vertically

When the TCAS cyan message TFC is displayed on the ND, and the Proximate Traffic aircraft is within the ND display range, the TCAS Proximate Traffic aircraft symbol is displayed on the ND.

The TCAS Proximate Traffic aircraft symbol is a filled white diamond. When TCAS is receiving and processing altitude data from the Proximate Traffic aircraft, the proximate traffic data tag is displayed on the ND. The proximate traffic data tag contains the altitude and vertical motion arrow.

Other Traffic Display

Other Traffic aircraft is an aircraft that is within the ND display limits but is neither a RA, a TA, or proximate traffic aircraft. When TCAS is not receiving and processing altitude data from the Other Traffic aircraft, the Other Traffic aircraft becomes Proximate Traffic aircraft automatically when within six miles.

When the TCAS cyan message TFC is displayed on the ND and the Other Traffic aircraft is within the ND display range, the TCAS Other Traffic symbol is displayed on the ND.

The TCAS Other Traffic symbol is a hollow white diamond. When TCAS is receiving and processing altitude data from the Other Traffic aircraft, a data tag like that described in Proximate Traffic Display is displayed.

TCAS PFD Vertical Guidance

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ
When TCAS predicts an RA, TCAS PFD vertical guidance is displayed for a traffic avoidance maneuver to ensure vertical separation. Traffic avoidance is ensured by adjusting or maintaining a pitch attitude and vertical speed outside the red RA regions.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
When TCAS predicts an RA, TCAS PFD vertical guidance is displayed for a traffic avoidance maneuver to ensure vertical separation. Traffic avoidance is ensured by adjusting or maintaining a pitch attitude outside the red outlined RA pitch region.

If the traffic aircraft also has TCAS and a mode S transponder, TCAS vertical guidance is coordinated with the traffic aircraft TCAS.

TCAS ND Messages

ND Message	Color	Description
TFC	Cyan	TCAS traffic display enabled. Inhibited if following TCAS messages are displayed: TCAS FAIL, TCAS OFF, TCAS TEST
TRAFFIC	Amber	TA is occurring.

ND Message	Color	Description
OFFSCALE	Amber	TA is occurring at range greater than current ND range. Replaced by red OFFSCALE when RA is also occurring at range greater than current ND range.
TRAFFIC	Red	RA is occurring.
OFFSCALE	Red	RA is occurring at range greater than current ND range.
TA ONLY	Cyan	TCAS can not provide RAs. All traffic that would have been RAs are predicted as TAs.
TCAS FAIL	Amber	TCAS failed, or TCAS information cannot be displayed on ND.
TCAS OFF	Amber	ND Traffic switch pushed to display traffic but TCAS not selected on transponder panel.
TCAS TEST	Cyan	TCAS in test mode. Message is displayed on all ND modes and ranges.

TCAS Voice Annunciations

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

Voice Annunciation	Condition	Response
TRAFFIC, TRAFFIC	New TA, initial voice annunciation.	Attempt to visually locate the traffic.
MONITOR VERTICAL SPEED	New RA, initial voice annunciation. Present pitch attitude and vertical speed are outside the red RA region.	Continue to keep pitch attitude and vertical speed outside the red RA region.
MAINTAIN VERTICAL SPEED, MAINTAIN	New RA, initial voice annunciation. Present pitch attitude and vertical speed are outside the red RA region.	
MAINTAIN VERTICAL SPEED CROSSING, MAINTAIN	New RA, initial voice annunciation. Present pitch attitude and vertical speed are outside the red RA region. Airplane will pass through the altitude of the traffic.	
CLIMB, CLIMB	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA region.	Increase pitch attitude and vertical speed to remain outside the red RA region.
CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA region. Airplane will climb through the altitude of the traffic.	

Voice Annunciation	Condition	Response
DESCEND, DESCEND	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA region.	Decrease pitch attitude and vertical speed to remain outside the red RA region.
DESCEND, CROSSING DESCEND DESCEND, CROSSING DESCEND	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA region. Airplane will descend through the altitude of the traffic.	
INCREASE CLIMB, INCREASE CLIMB	Existing RA, TCAS requires change in vertical rate. Present pitch attitude and vertical speed are within the red RA region.	Adjust pitch attitude and vertical speed to remain outside the red RA region.
INCREASE DESCENT, INCREASE DESCENT		
ADJUST VERTICAL SPEED, ADJUST	Existing RA, minimum vertical speed required to ensure separation has decreased, present pitch attitude and vertical speed are outside the red RA region, or, new RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA region.	Continue to keep pitch attitude and vertical speed outside the red RA region. Vertical speed may be decreased, or, change pitch attitude and vertical speed to remain outside the red RA region.

Voice Annunciation	Condition	Response
DESCEND, DESCEND NOW, DESCEND, DESCEND NOW	Existing RA, previous TCAS vertical guidance was to climb. Present pitch attitude and vertical speed are within the red RA region.	Decrease pitch attitude and vertical speed to remain outside the red RA region.
CLIMB, CLIMB NOW, CLIMB, CLIMB NOW	Existing RA, previous TCAS vertical guidance was to descend. Present pitch attitude and vertical speed are within the red RA region.	Increase pitch attitude and vertical speed to remain outside the red RA region.
CLEAR OF CONFLICT	TCAS PFD vertical guidance is no longer displayed and traffic changes to a TA symbol. Separation is increasing and the RA will not occur. However, the voice annunciation will not sound if TCAS can no longer predict the track of the RA aircraft.	Attempt to visually locate the traffic.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; SB installs TCAS Ver. 7.x.)

Voice Annunciation	Condition	Response
TRAFFIC, TRAFFIC	New TA, initial voice annunciation.	Attempt to visually locate the traffic.
MONITOR VERTICAL SPEED	New RA, initial voice annunciation. Present pitch attitude is outside the red RA region.	Continue to keep pitch attitude outside the red RA region.
MAINTAIN VERTICAL SPEED, MAINTAIN	New RA, initial voice annunciation. Present pitch attitude is outside the red RA region.	
MAINTAIN VERTICAL SPEED CROSSING, MAINTAIN	New RA, initial voice annunciation. Present pitch attitude is outside the red RA region. Airplane will pass through the altitude of the traffic.	
CLIMB, CLIMB	New RA, initial voice annunciation. Present pitch attitude is within the red RA region.	Increase pitch attitude to remain outside the red RA region.
CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB	New RA, initial voice annunciation. Present pitch attitude is within the red RA region. Airplane will climb through the altitude of the traffic.	

Voice Annunciation	Condition	Response
DESCEND, DESCEND	New RA, initial voice annunciation. Present pitch attitude is within the red R region	Decrease pitch attitude to remain outside the red RA region.
DESCEND, CROSSING DESCEND DESCEND, CROSSING DESCEND	New RA, initial voice annunciation. Present pitch attitude is within the red RA region. Airplane will descend through the altitude of the traffic.	
INCREASE CLIMB, INCREASE CLIMB	Existing RA, TCAS requires change in vertical rate. Present pitch attitude is within the red RA region.	Adjust pitch attitude to remain outside the red RA region.
INCREASE DESCENT, INCREASE DESCENT		
ADJUST VERTICAL SPEED, ADJUST	Existing RA, minimum rate required to ensure separation has decreased, present pitch attitude is outside the red RA region, or, new RA, initial voice annunciation. Present pitch attitude is within the red RA region.	Continue to keep pitch attitude outside the red RA region, or, change pitch attitude to remain outside the red RA region.
DESCEND, DESCEND NOW, DESCEND, DESCEND NOW	Existing RA, previous TCAS vertical guidance was to climb. Present pitch attitude is within the red RA region.	Decrease pitch attitude to remain outside the red RA region.

Voice Annunciation	Condition	Response
CLIMB, CLIMB NOW, CLIMB, CLIMB NOW	Existing RA, previous TCAS vertical guidance was to descend. Present pitch attitude is within the red RA region.	Increase pitch attitude to remain outside the red RA regions
CLEAR OF CONFLICT	TCAS PFD vertical guidance is no longer displayed and traffic changes to a TA symbol. Separation is increasing and the RA will not occur. However, the voice annunciation will not sound if TCAS can no longer predict the track of the RA aircraft.	Attempt to visually locate the traffic.

VQ-BHW, VQ-BHX
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; before SB, TCAS Ver. 6.04a is installed)

Voice Annunciation	Condition	Response
TRAFFIC, TRAFFIC	New TA, initial voice annunciation.	Attempt to visually locate the traffic.
MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED	New RA, initial voice annunciation. Present pitch attitude is outside the red RA region.	Continue to keep pitch attitude outside the red RA region.

Voice Annunciation	Condition	Response
CLIMB, CLIMB, CLIMB	New RA, initial voice annunciation. Present pitch attitude is within the red RA region.	Increase pitch attitude to remain outside the red RA region..
CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB	New RA, initial voice annunciation. Present pitch attitude is within the red RA regions. Airplane will climb through the altitude of the traffic.	
DESCEND, DESCEND, DESCEND	New RA, initial voice annunciation. Present pitch attitude is within the red RA region.	Decrease pitch attitude to remain outside the red RA region.
DESCEND, CROSSING DESCEND DESCEND, CROSSING DESCEND	New RA, initial voice annunciation. Present pitch attitude is within the red RA region. Airplane will descend through the altitude of the traffic.	
INCREASE CLIMB, INCREASE CLIMB	Existing RA, TCAS requires change in vertical rate. Present pitch attitude is within the red RA region.	Adjust pitch attitude to remain outside the red RA region.
REDUCE CLIMB, REDUCE CLIMB		
INCREASE DESCENT, INCREASE DESCENT		
REDUCE DESCENT, REDUCE DESCENT		

Voice Annunciation	Condition	Response
DESCEND, DESCEND NOW, DESCEND, DESCEND NOW	Existing RA, previous TCAS vertical guidance was to climb. Present pitch attitude is within the red RA region.	Decrease pitch attitude to remain outside the red RA region.
CLIMB, CLIMB NOW, CLIMB, CLIMB NOW	Existing RA, previous TCAS vertical guidance was to descend. Present pitch attitude is within the red RA region.	Increase pitch attitude to remain outside the red RA region.
CLEAR OF CONFLICT	TCAS PFD vertical guidance is no longer displayed and traffic changes to a TA symbol. Separation is increasing and the RA will not occur. However, the voice annunciation will not sound if TCAS can no longer predict the track of the RA aircraft.	Attempt to visually locate the traffic.

TCAS Normal Operation

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
The TCAS operating mode is controlled from the transponder panel. TA/RA is normally selected, however, it is sometimes necessary to select in TA to prevent nuisance RAs.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
The TCAS operating mode is controlled from the transponder panel. TA/RA is normally selected, however, it is sometimes necessary to select TA ONLY to prevent nuisance RAs.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR
TA is selected during engine out operations to prevent RAs when adequate thrust is not available to follow the RA commands. Also, TA can be selected when intentionally operating near other traffic that may cause RAs, such as during parallel approaches and VFR operations.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX
TA ONLY is selected during engine out operations to prevent RAs when adequate thrust is not available to follow the RA commands. Also, TA ONLY can be selected when intentionally operating near other traffic that may cause RAs, such as during parallel approaches and VFR operations.

TCAS Non-Normal Operation

The EICAS alert message TCAS OFF is displayed if TCAS is not operating. No TCAS RA guidance is displayed on the PFDs, no TCAS traffic symbols are displayed on the NDs, and no TCAS voice alerts sound. An amber TCAS OFF message is displayed on both NDs.

The EICAS alert message TCAS RA is displayed if TCAS cannot display RA guidance on the respective Captain or First Officer PFD. The ND traffic displays and voice alerts are unaffected.

The EICAS alert message TCAS SYSTEM is displayed if TCAS cannot display TCAS RA guidance on either PFD, and cannot display TCAS traffic symbols on either ND. An amber TCAS FAIL message is displayed on both NDs, and TCAS voice alerts will not occur.

Ground Proximity Warning System (GPWS)

Introduction

GPWS provides:

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ
- look-ahead terrain alerts for potentially hazardous flight conditions involving impact with the ground

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
- predictive windshear alerts
- immediate windshear alerts

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VP-BKJ, VP-BVR ; SB installs the voice alert BANK ANGLE)
- bank angle voice alerts
- immediate alerts for potentially hazardous flight conditions involving impact with the obstacles and the ground
- altitude voice annunciations during approach

Look-ahead Terrain Alerting System

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

Look-ahead terrain alerts are provided by monitoring terrain proximity using a world-wide terrain data base. The data base contains detailed terrain data near major airports, and data in lesser detail for areas between airports. Terrain within 2,000 feet of airplane altitude is displayed on the navigation display. Terrain data is not designed to be an independent navigation aid.

Proximate terrain data may be displayed on the ND. If there is a potential terrain hazard, GPWS look-ahead alerts are provided based on estimated time to impact.

Estimated time to impact is based on airplane position, altitude, present track, vertical path, and ground speed. FMC VNAV and LNAV is not considered in the estimated time to impact.

Altitudes used for look-ahead terrain mode alerts are a weighted combination of radio altitude, barometric altitude, GPS, and previous flight path. Weighting is reduced for an altitude source which becomes less reliable.

Note: Terrain ahead of the airplane may exceed available climb performance. A GPWS caution or warning alert does not guarantee terrain clearance.

When the GPWS Terrain switch is pushed on, the TERR symbol is displayed on the ND and terrain contours may be displayed.

When the airplane is higher than 2,000 feet above the terrain, terrain more than 2,000 feet below airplane altitude is not displayed.

When the airplane is lower than 2,000 feet above the terrain, all obstacles and terrain within 2,000 feet of airplane altitude is displayed on the navigation display.

Note: The GPWS terrain database, GPWS look-ahead terrain alerts, and terrain display do not account for man-made obstructions.

The terrain display is correlated to GPS position, or to IRU position if GPS position is intermittently unavailable.

Terrain and weather radar cannot be simultaneously displayed on an ND. When one pilot selects terrain and the other pilot selects weather radar, each display updates on alternating sweeps.

GPWS Look-Ahead Terrain Alerts

Voice Annunciation	PFD and ND Display and Light	Description
TERRAIN TERRAIN PULL UP	Red PULL UP on both PFDs Master WARNING lights Red TERRAIN message on both NDs Solid red terrain on ND	20 to 30 seconds from projected impact with terrain. Pushing the GND PROX TERR OVRD switch to OVRD inhibits the alert.
CAUTION TERRAIN	Amber TERRAIN message on both NDs Solid amber terrain on ND GND PROX light	40 to 60 seconds from projected impact with terrain. Pushing the GND PROX TERR OVRD switch to OVRD inhibits the alert.
TOO LOW, TERRAIN	GND PROX light	Descent below unsafe altitude while too far from any airport in the terrain database. Pushing the GND PROX TERR OVRD switch to OVRD inhibits the alert.

Predictive Wind Shear Alerting System (PWS)

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

PWS provides windshear alerts when an excessive windshear condition is detected ahead of the airplane during takeoff, approach, and landing.

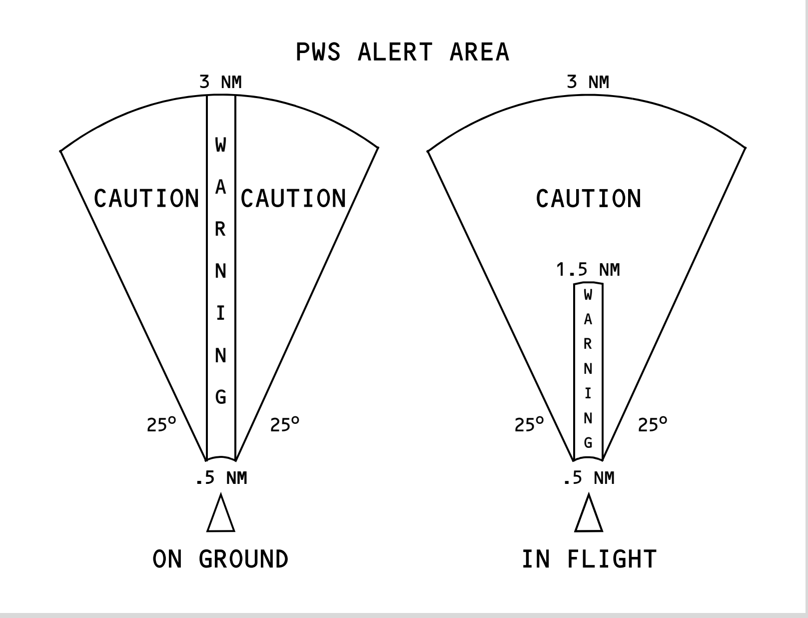
Weather radar uses radar imaging to detect disturbed air ahead of the airplane. PWS alerts are enabled approximately 12 seconds after weather radar begins scanning for windshear.

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ
When PWS is enabled, radar antenna scan sweep is reduced.

Prior to takeoff, PWS alerts can be enabled by pushing the Weather Radar switch on the EFIS control panel. On the ground with the Weather Radar switch pushed or not pushed, weather radar begins scanning for windshear when engine thrust lever 2 or 3 is in the takeoff range.

In flight with the Weather Radar switch pushed or not pushed, weather radar begins scanning for windshear below 2,300 feet radio altitude. and PWS alerts are enabled below 1,200 feet radio altitude.

When windshear is not predicted by PWS, weather radar returns are displayed only when the Weather Radar switch on the EFIS control panel is pushed.



PWS Alerts

Voice Annunciation	PFD and ND Display and Light	Description
WINDSHEAR AHEAD, WINDSHEAR AHEAD	Red WINDSHEAR on both PFDs Master WARNING lights Red WINDSHEAR message on both NDs RED windshear symbol on ND	Windshear predicted close to and directly ahead of airplane. Enabled during takeoff, below 1,200 feet radio altitude. Windshear position displayed by PWS symbol on the ND in MAP, MAP CTR, VOR, or APP modes only.

Voice Annunciation	PFD and ND Display and Light	Description
GO AROUND, WINDSHEAR AHEAD	Red WINDSHEAR on both PFDs Master WARNING lights Red WINDSHEAR message on both NDs RED windshear symbol on ND	Windshear predicted within 1.5 miles and directly ahead of the airplane. Enabled during approach, below 1,200 feet radio altitude. WIndshear position displayed by PWS symbol on the ND in MAP, MAP CTR, VOR, or APP modes only.
MONITOR RADAR DISPLAY	Amber WINDSHEAR message on both NDs RED windshear symbol on ND	Windshear predicted within 3 miles and ahead of the airplane. Enabled during takeoff and approach, below 1,200 feet radio altitude. Windshear position displayed on PWS on ND in MAP, MAP CTR, VOR, or APP modes only.

Note: Weather radar provides windshear alerts for windshear events containing some level of moisture or particulate matter.

Note: Weather radar detects microbursts and other windshears with similar characteristics. Weather radar does not provide alerting for all types of windshear. The flight crew must continue to rely on traditional windshear avoidance methods.

Immediate Windshear Alerting System

Immediate windshear alerts are provided when an excessive downdraft or tailwind is occurring during takeoff, approach, and landing.

Voice Annunciation	PFD and ND Display and Light	Description
(Siren) WINDSHEAR, WINDSHEAR, WINDSHEAR	Red WINDSHEAR on both PFDs Master WARNING lights	Excessive windshear detected by GPWS. Enabled below 1,500 feet radio altitude. GPWS windshear detection begins at rotation.

Bank Angle Alerting System

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL (VP-BKJ, VP-BVR ; SB installs the voice alert BANK ANGLE)

The voice alert BANK ANGLE sounds if bank angle exceeds 35°, 40°, and 45°.

Immediate Alerting System

Voice Annunciation	PFD and ND Display and Light	Description
DON’T SINK	Ground Proximity light	Altitude loss with flaps and/or gear up after takeoff or go-around.
GLIDE SLOPE	Ground Proximity light	Excessive deviation below glide slope. Volume and repetition rate increase as deviation increases. Pushing the Ground Proximity Glideslope Inhibit switch inhibits the alert when pushed below 1,000 feet radio altitude.
PULL UP	Red PULL UP on both PFDs Master Warning lights	Follows SINK RATE alert when descent rate becomes severe, or follows TERRAIN alert with flaps and/or gear not in landing configuration when excessive terrain closing rate continues.
SINK RATE	Ground Proximity light	Excessive descent rate.
TERRAIN	Ground Proximity light	Excessive terrain closing rate.

Voice Annunciation	PFD and ND Display and Light	Description
TOO LOW, FLAPS	Ground Proximity light	Unsafe terrain clearance with flaps not in landing configuration at low altitude and airspeed. Pushing the Ground Proximity Flap Override switch to OVRD inhibits the alert.
TOO LOW, GEAR	Ground Proximity light	Unsafe terrain clearance with gear not in landing configuration at low altitude and airspeed with gear not down. Pushing the Ground Proximity Gear Override switch to OVRD inhibits the alert.
TOO LOW, TERRAIN	Ground Proximity light	Follows DON’T SINK alert with gear and/or flaps up after takeoff or go-around for altitude loss at low altitude, or unsafe terrain clearance with gear and/or flaps not in landing configuration at low altitude and airspeed. Pushing the Ground Proximity Flap Override switch to OVRD inhibits the alert, when the alert is because flaps are not in landing position. Pushing the Ground Proximity Gear Override switch to OVRD inhibits the alert, when the alert is because gear is not down.

Altitude Voice Annunciations During Approach

GPWS provides the following altitude voice annunciations during approach:

EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
- 100 feet - ONE HUNDRED
- 50 feet - FIFTY
- 30 feet - THIRTY

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
- 2,500 feet - TWENTY-FIVE HUNDRED
- 500 feet - FIVE HUNDRED

- 100 feet - ONE HUNDRED
- 50 feet - FIFTY
- 40 feet - FORTY
- 30 feet - THIRTY
- 20 feet - TWENTY
- 10 feet - TEN

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ

- 100 feet - ONE HUNDRED
- 50 feet - FIFTY
- 30 feet - THIRTY
- 20 feet - TWENTY
- 10 feet - TEN

Minimums Voice Annunciation

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

GPWS provides the voice annunciation MINIMUMS at the altitude set by the captain RADIO/BARO Altitude control on the EFIS control panel.

GPWS Non-Normal Operation

Altitude Voice Annunciations During Approach Non-Normal Operation

If there is a fault in the Altitude Voice Annunciations During Approach system, the EICAS advisory message ALT CALLOUTS is displayed and Altitude Voice Annunciations During Approach are inhibited.

Look-Ahead Alert Non-Normal Operation

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

If there is a fault in look-ahead terrain alert, the respective terrain status annunciation TERR is displayed.

Windshear Alert Non-Normal Operation

If there is a fault in the immediate windshear system or in the PWS system, the EICAS advisory message WINDSHEAR SYS is displayed and the voice alert WINDSHEAR and the PFD alert WINDSHEAR are inhibited.

Immediate Alert Non-Normal Operation

If there is a fault in any immediate alert, the respective alert is inhibited. If a fault occurs in any immediate alert other than windshear, there is no indication to the flight crew of which alerts are inhibited. GPWS will continue to provide immediate alerts for which no fault has occurred.

Alert Inhibits

Alerts are inhibited when they are operationally unnecessary or inappropriate. Alerts are inhibited during normal system operation, and during part of the takeoff to prevent distracting the crew.

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
GPWS immediate windshear alert inhibits all PWS, TCAS, and other GPWS alerts.

EI-XLB, EI-XLD, EI-XLE, EI-XLG, VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX
GPWS immediate windshear alert inhibits all TCAS and other GPWS alerts.

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL
When TA/RA is selected on the transponder panel and a GPWS or PWS warning alert occurs, TCAS automatically inhibits RA mode and operates in TA ONLY mode. All aircraft that would have been predicted as a RA are predicted as a TA. When a subsequent GPWS or PWS warning alert occurs while a RA is occurring, the RA is discontinued and becomes a TA. When GPWS and PWS warning alerts are no longer occurring, TCAS returns to TA/RA mode and provides RAs for all appropriate TAs.

EI-XLB, EI-XLD, EI-XLE, EI-XLG, VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX
When TA/RA is selected on the transponder panel and a GPWS warning alert occurs, TCAS automatically inhibits RA mode and operates in TA ONLY mode. All aircraft that would have been predicted as a RA are predicted as a TA. When a subsequent GPWS warning alert occurs while a RA is occurring, the RA is discontinued and becomes a TA. When GPWS warning alerts are no longer occurring, TCAS returns to TA/RA mode and provides RAs for all appropriate TAs.

Alert Messages Inhibited By Other Alert Messages

Some EICAS alert messages are inhibited if another related alert message is displayed. For example, individual fuel or hydraulic pump pressure messages are inhibited if a hydraulic system pressure message is displayed.

Alert Messages Inhibited During Normal System Operation

Certain alert messages are time delayed, even though related flight deck panel annunciation lights are illuminated. Time delay inhibits prevent normal in-transit indications from being displayed as EICAS system alert messages. For example, valves are generally only sensed open and/or closed, not in-transit. When a valve is in-transit, the alert message indicating the valve has failed to open or close is inhibited to allow the valve time to move to the commanded position. If the valve is not in the commanded position at the end of the inhibit period, the respective EICAS alert message is displayed.

Voice Annunciation Inhibits

Voice annunciations for warning alerts inhibit new voice annunciations for caution alerts.

All voice annunciations are prioritized to aid flight crew decision making when more than one alert occurs.

ND Display Alert Inhibits and Automatic Display

Alert displays on the NDs are prioritized to aid flight crew decision making when more than one alert occurs. The displays are also prioritized when neither ND is in MAP, MAP CTR, VOR, or APP mode.

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ
Immediate windshear alert inhibits the automatic display of new TCAS, look-ahead terrain, or PWS alerts.

EI-XLB, EI-XLD, EI-XLE, EI-XLG
Immediate windshear alert inhibits the automatic display of new TCAS or look-ahead terrain alerts.

VP-BKL
Immediate windshear alert inhibits the automatic display of new TCAS or PWS alerts.

VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX
Immediate windshear alert inhibits the automatic display of new TCAS alerts.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ
TCAS traffic can be displayed concurrently with either TERR and WXR display.

VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX
TCAS traffic can be displayed concurrently with WXR display.

New TCAS alerts:

- When TFC is displayed on the first officer ND and both NDs are in MAP, MAP CTR, VOR, or APP mode and a new TCAS TA or RA alert occurs, TCAS traffic continue to be selected on the first officer ND while TCAS traffic display and TFC are inhibited on the captain ND. When the captain TFC switch is subsequently pushed, TCAS traffic and TFC are selected automatically on the captain ND.
- When TFC is displayed on the captain ND and both NDs are in MAP, MAP CTR, VOR, or APP mode and a new TCAS TA or RA alert occurs, TCAS traffic continues to be selected on the captain ND while TCAS traffic display and TFC are inhibited on the first officer ND. When the first officer TFC switch is subsequently pushed, TCAS traffic and TFC are selected automatically on the first officer ND.
- When TFC is displayed on neither ND and both NDs are in MAP, MAP CTR, VOR, or APP mode and a new TCAS TA or RA alert occurs, TCAS traffic and TFC are selected automatically on both NDs.
- When only one ND is in MAP, MAP CTR, VOR, or APP mode and a new TCAS TA or RA alert occurs, TCAS traffic and TFC are selected automatically on that ND. The ND not in MAP, MAP CTR, VOR, or APP mode is armed for TCAS display, and TCAS traffic and TFC will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected.
- When neither ND is in MAP, MAP CTR, VOR, or APP mode and a new TCAS TA or RA alert occurs, both NDs are armed for TCAS display. TCAS traffic and TFC will be selected automatically when the respective MAP, MAP CTR, VOR, or APP mode is selected.
- When TCAS traffic and TFC are selected automatically because a TCAS TA or RA had occurred, but TAs and RAs are no longer occurring, TCAS traffic and TFC continue to be selected until the respective TFC switch is pushed; TCAS traffic and TFC are not automatically de-selected.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

New look-ahead terrain alerts:

- When both NDs are in MAP, MAP CTR, VOR, or APP mode and a new look-ahead terrain alert occurs, TERR is selected automatically for both NDs.
- When only one ND is in MAP, MAP CTR, VOR, or APP mode and a new look-ahead terrain alert occurs, TERR is selected automatically for that ND. The ND not in MAP, MAP CTR, VOR, or APP mode is armed for TERR display and TERR will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected. TERR is disarmed by selecting WXR prior to selecting MAP, MAP CTR, VOR, or APP mode.
- When neither ND is in MAP, MAP CTR, VOR, or APP mode and a new look-ahead terrain alert occurs, both NDs are armed for TERR display and TERR will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected. TERR is disarmed for either ND by selecting WXR prior to selecting MAP, MAP CTR, VOR, or APP mode on the respective ND.

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

New PWS alerts:

- When both NDs are in MAP, MAP CTR, VOR, or APP mode and a new PWS alert occurs, WXR is selected automatically for both NDs.

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

- When only one ND is in MAP, MAP CTR, VOR, or APP mode and a new PWS alert occurs, WXR is selected automatically for that ND. The ND not in MAP, MAP CTR, VOR, or APP mode is armed for WXR display and WXR will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected. WXR is disarmed by selecting TERR prior to selecting MAP, MAP CTR, VOR, or APP mode.

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

- When neither ND is in MAP, MAP CTR, VOR, or APP mode and a new PWS alert occurs, both NDs are armed for WXR display and WXR will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected. WXR is disarmed by selecting TERR prior to selecting MAP, MAP CTR, VOR, or APP mode.

VP-BKL

- When only one ND is in MAP, MAP CTR, VOR, or APP mode and a new PWS alert occurs, WXR is selected automatically for that ND. The ND not in MAP, MAP CTR, VOR, or APP mode is armed for WXR display and WXR will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected.

VP-BKL

- When neither ND is in MAP, MAP CTR, VOR, or APP mode and a new PWS alert occurs, both NDs are armed for WXR display and WXR will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected.

Alerts Inhibited Before Engine Start and After Shutdown

Alert Inhibited	For Message	Inhibit Occurs
Master CAUTION lights Beeper	For all EICAS caution messages	On the ground, and all Fuel Control switches in CUTOFF.
Respective EICAS messages: ELEC GEN OFF ENG CONTROL, ENG EEC MODE ENG FAIL ENG OIL PRESS HYD PRESS ENG NAI VALVE	For EICAS caution messages: ENG SHUTDOWN	On the ground, and respective Fuel Control switch in CUTOFF or Engine Fire switch out.

Alerts Inhibited During Engine Start

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

Alert Inhibited	Inhibit Begins	Inhibit Ends
All new EICAS caution and advisory messages, except: BLEED ENG FUEL VALVE ENG SHUTDOWN ENG START VLV STARTER CUTOUT	Engine START switch pulled.	Engine reaches idle RPM, or start is aborted, or five minutes elapse.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

Alert Inhibited	Inhibit Begins	Inhibit Ends
All new EICAS caution and advisory messages, except: BLEED ENG AUTOSTART ENG FUEL VALVE ENG SHUTDOWN ENG START VLV STARTER CUTOUT	Engine START switch pulled.	Engine reaches idle RPM, or start is aborted, or five minutes elapse.

Alerts Inhibited During Takeoff

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO (EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; SB installs TCAS Ver. 7.x)			
EICAS caution message ENG FAIL	Message is inhibited	On ground	Lift-off
EICAS advisory message TCAS OFF	Message is inhibited		400 feet radio altitude
TCAS TA voice alerts	TCAS TAs		Approximately 500 feet radio altitude
All TCAS RAs	TCAS RAs are inhibited When RA selected on panel, TCAS switches to TA only mode and TCAS message TA ONLY is displayed on ND		Approximately 1,000 feet radio altitude
TCAS DESCEND RAs	Alerts are inhibited		Approximately 1,100 feet radio altitude

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends

VQ-BHW, VQ-BHX
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; before SB, TCAS Ver. 6.04a is installed)

EICAS caution message ENG FAIL	Message is inhibited	On ground	Lift-off
EICAS advisory message TCAS OFF	Message is inhibited		400 feet radio altitude
TCAS TA voice alerts All TCAS RAs	TCAS TAs TCAS RAs are inhibited When RA selected on panel, TCAS switches automatically to TA only mode. and TCAS message TA ONLY is displayed on ND		Approximately 1,000 feet radio altitude
TCAS DESCEND RAs	Alerts are inhibited		Approximately 1,100 feet radio altitude

STATUS cue	All EICAS new status messages	Engine start	30 minutes after lift-off
Hi Chime	Attendant call	Any engine in takeoff thrust range	400 feet radio altitude

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
EI-XLZ, VP-BKL			
Master Caution lights Beeper If the Master Caution lights illuminate before reaching 80 knots airspeed, they continue to be illuminated when 80 knots airspeed is exceeded and cannot be extinguished until the inhibit ends. If new EICAS caution messages are displayed during the inhibit, the beeper will sound when the inhibit ends.	New EICAS caution messages	80 knots airspeed	400 feet radio altitude or 20 seconds after rotation, whichever occurs first. If rejected takeoff initiated above 80 knots, inhibit continues until airspeed is less than 75 knots.
New PWS caution alerts EICAS advisory message WINDSHEAR SYS	Messages are inhibited		400 feet radio altitude

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO			
New PWS caution alerts EICAS advisory message WINDSHEAR SYS	Messages are inhibited	80 knots airspeed	400 feet radio altitude
Master Caution lights Beeper If the Master Caution lights illuminate before reaching 80 knots airspeed, they continue to be illuminated when 80 knots airspeed is exceeded and cannot be extinguished until the inhibit ends. If new EICAS caution messages are displayed during the inhibit, the beeper will sound when the inhibit ends.	New EICAS caution messages		800 feet radio altitude or 30 seconds after rotation, whichever occurs first. If rejected takeoff initiated above 80 knots, inhibit continues until airspeed is less than 75 knots

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX			
Master Caution lights Beeper If the Master Caution lights illuminate before reaching 80 knots airspeed, they continue to be illuminated when 80 knots airspeed is exceeded and cannot be extinguished until the inhibit ends. If new EICAS caution messages are displayed during the inhibit, the beeper will sound when the inhibit ends.	New EICAS caution messages	80 knots airspeed	400 feet radio altitude or 20 seconds after rotation, whichever occurs first. If rejected takeoff initiated above 80 knots, inhibit continues until airspeed is less than 75 knots.
EI-XLB, EI-XLD, EI-XLE, EI-XLG			
Master Caution lights Beeper If the Master Caution lights illuminate before reaching 80 knots airspeed, they continue to be illuminated when 80 knots airspeed is exceeded and cannot be extinguished until the inhibit ends. If new EICAS caution messages are displayed during the inhibit, the beeper will sound when the inhibit ends.	New EICAS caution messages	80 knots airspeed	800 feet radio altitude or 30 seconds after rotation, whichever occurs first. If rejected takeoff initiated above 80 knots, inhibit continues until airspeed is less than 75 knots.

<table>
<tr><th>Alert Inhibited</th><th>For Message</th><th>Inhibit Begins</th><th>Inhibit Ends</th></tr>
<tr><td colspan="4">EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL</td></tr>
<tr><td>New PWS warning alerts</td><td>Messages are inhibited</td><td>100 knots airspeed</td><td>50 feet radio altitude</td></tr>
<tr><td>Master Warning lights
Bell
If the Master Warning lights illuminate and fire bell sounds before reaching V1, they continue to be illuminated and sound when V1 is exceeded.
If new FIRE messages are displayed during the inhibit, the bell will sound when the inhibit ends.</td><td>New EICAS warning messages FIRE</td><td rowspan="2">V1</td><td rowspan="2">400 feet radio altitude or 25 seconds after V1, whichever occurs first.</td></tr>
<tr><td rowspan="2">Master Warning lights
Siren
If the Master Warning lights illuminate and siren sounds before reaching V1, they continue to be illuminated and sound when V1 is exceeded
If new EICAS warning messages are displayed during the inhibit, the siren will sound when the inhibit ends.</td><td>New EICAS warning messages except:
CONFIG GEAR
FIRE</td></tr>
<tr><td>EICAS warning message CONFIG GEAR</td><td rowspan="2">Lift-off</td><td>800 feet radio altitude or 140 seconds after nose gear strut lift-off, whichever occurs first</td></tr>
<tr><td>EICAS advisory message FUEL TANK/ENG if tank to engine condition occurs after lift-off.</td><td>Message is inhibited</td><td>Ten minutes after lift-off</td></tr>
</table>

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

All PWS alerts	Messages are inhibited	1,200 feet radio altitude	Approach

Alerts Inhibited During Landing

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends

EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL

All PWS alerts	Alerts are inhibited	2,300 feet radio altitude	1,200 feet radio altitude
TCAS INCREASE DESCENT RAs		Approximately 1,500 feet radio altitude	Go-around at approximately 1,500 feet radio altitude
TCAS DESCEND RAs		Approximately 1,100 feet radio altitude	Go-around at approximately 1,100 feet radio altitude

EI-XLB, EI-XLD, EI-XLE, EI-XLG, VP-BKJ, VP-BVR, VQ-BHW, VQ-BHX

TCAS INCREASE DESCENT RAs	Alerts are inhibited	Approximately 1,500 feet radio altitude	Go-around at approximately 1,500 feet radio altitude
TCAS DESCEND RAs		Approximately 1,100 feet radio altitude	Go-around at approximately 1,100 feet radio altitude

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; SB installs TCAS Ver. 7.x)

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
All TCAS RAs	Alerts are inhibited When RA selected on panel, TCAS switches to TA only mode and TCAS message TA ONLY is displayed on ND	Approximately 1,000 feet radio altitude	Go-around at approximately 1,000 feet radio altitude

VQ-BHW, VQ-BHX
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; before SB, TCAS Ver. 6.04a is installed)

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
All TCAS RAs TCAS voice alerts	Alerts are inhibited When RA selected on panel, TCAS switches to TA only mode and TCAS message TA ONLY is displayed on ND	Approximately 1,000 feet radio altitude	Go-around at approximately 1,000 feet radio altitude

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
STATUS cue Hi chime	All EICAS status messages	800 feet radio altitude	75 knots airspeed

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO
(EI-XLZ, VP-BKJ, VP-BKL, VP-BVR ; SB installs TCAS Ver. 7.x)

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
TCAS voice alerts	TCAS TAs	Approximately 500 feet radio altitude	Go-around at approximately 500 feet radio altitude

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
EICAS alert message WINDSHEAR SYS	Message is inhibited	400 feet radio altitude	80 knots airspeed
EICAS advisory message TCAS OFF			Go-around at 400 feet radio altitude

<table>
<tr><th>Alert Inhibited</th><th>For Message</th><th>Inhibit Begins</th><th>Inhibit Ends</th></tr>
<tr><td colspan="4">EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL</td></tr>
<tr><td>New PWS caution alerts</td><td>Alerts are inhibited</td><td rowspan="3">400 feet radio altitude</td><td rowspan="2">80 knots airspeed</td></tr>
<tr><td>EICAS alert message WINDSHEAR SYS</td><td rowspan="2">Message is inhibited</td></tr>
<tr><td>EICAS advisory message TCAS OFF</td><td>Go-around at 400 feet radio altitude</td></tr>
<tr><td colspan="4">EI-XLC, EI-XLF, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKL</td></tr>
<tr><td>New PWS warning alerts</td><td>Alerts are inhibited</td><td>50 feet radio altitude</td><td>100 knots airspeed</td></tr>
</table>

EICAS Event Record

Pushing the EICAS EVENT RCD switch records currently displayed engine indications and additional EICAS maintenance information. Up to five events may be recorded by the first five pushes. The system also records out of limit parameters and related conditions automatically when a system parameter is exceeded.

Intentionally
Blank

EICAS Alert Messages

Message	Level	Aural	Message Logic
>AIRSPEED LOW	Caution	Beeper	Airspeed less than minimum maneuvering speed.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

>ALT CALLOUTS	Advisory		Altitude and minimums voice annunciations during approach no longer provided.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

>ALT CALLOUTS	Advisory		Altitude voice annunciations during approach no longer provided.

>ALTITUDE ALERT	Caution	Beeper	Airplane has deviated more than 300 feet from MCP selected altitude.
>CONFIG FLAPS	Warning	Siren	Flaps not in takeoff position when airplane on the ground, airspeed less than V1, three or more Fuel Control switches in RUN, and engine 2 or 3 thrust in takeoff range.
>CONFIG GEAR	Warning	Siren	Any landing gear not down and locked when any Thrust lever closed below 800 feet radio altitude or when flaps are in a landing position.
>CONFIG GEAR CTR	Warning	Siren	Body gear steering unlocked when airplane on the ground, airspeed less than V1, three or more Fuel Control switches in RUN, and engine 2 or 3 thrust in takeoff range.

Message	Level	Aural	Message Logic
>CONFIG PARK BRK	Warning	Siren	Parking brake set when airplane on the ground, airspeed less than V1, three or more Fuel Control switches in RUN, and engine 2 or 3 thrust in takeoff range.

(EI-XLG, EI-XLH, EI-XLJ ; SB installs message in flight)

>CONFIG SPOILERS	Warning	Siren	Speedbrake lever not DOWN when airplane on the ground, airspeed less than V1, three or more Fuel Control switches in RUN, and engine 2 or 3 thrust in takeoff range; or, Speedbrake lever extended beyond ARM in flight, and climb thrust or greater set for 3 seconds on any two Thrust levers.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLI, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX (EI-XLG, EI-XLH, EI-XLJ ; before SB, message in flight is not installed)

>CONFIG SPOILERS	Warning	Siren	Speedbrake lever not DOWN when airplane on the ground, airspeed less than V1, three or more Fuel Control switches in RUN, and engine 2 or 3 thrust in takeoff range.

>CONFIG STAB	Warning	Siren	Stabilizer not within the greenband when airplane on the ground, airspeed less than V1, three or more Fuel Control switches in RUN, and engine 2 or 3 thrust in takeoff range.
>CONFIG WARN SY	Advisory		Fault detected in configuration warning system.
GND PROX SYS	Advisory		GPWS alerts may not be provided.
>OVERSPEED	Warning	Siren	Airspeed exceeds Vmo/Mmo.

Message	Level	Aural	Message Logic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

>PILOT RESPONSE	Warning	Siren	FMC does not detect crew activity in monitored area within a predefined time.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

>PILOT RESPONSE	Caution	Beeper	FMC does not detect crew activity in monitored area within a predefined time.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO

>PILOT RESPONSE	Advisory		FMC does not detect crew activity in monitored area within a predefined time.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR

>TCAS OFF	Advisory		TCAS mode TA or TA/RA not selected.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, VQ-BHW, VQ-BHX

>TCAS OFF	Advisory		TCAS mode TA ONLY or TA/RA not selected.

>TCAS RA CAPTAIN, F/O	Advisory		TCAS cannot display RA guidance on respective PFD.
>TCAS SYSTEM	Advisory		TCAS has failed.

Message	Level	Aural	Message Logic

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

>TERR OVRD	Advisory		Ground Proximity Override switch in OVRD. Look-ahead terrain alerts will not be provided.

EI-XLB, EI-XLC, EI-XLD, EI-XLE, EI-XLF, EI-XLG, EI-XLH, EI-XLI, EI-XLJ, EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ

TERR POS	Advisory		Terrain position data has been lost. Look-ahead terrain alerting and display unavailable because GPS has failed. During time between GPS failure and display of TERR POS message, IRS provides position for look-ahead alerting and display.

WINDSHEAR SYS	Advisory		Windshear alerts may not be provided.

EICAS Memo Messages

Message	Level	Aural	Message Logic
VMO GEAR DOWN	Memo		Gear down dispatch has been selected in the electronics bay.

EI-XLK, EI-XLL, EI-XLM, EI-XLN, EI-XLO, EI-XLZ, VP-BKJ, VP-BKL, VP-BVR, VQ-BHW, VQ-BHX

VMO SPARE ENGINE	Memo		Spare engine dispatch has been selected in the electronics bay.