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777

Flight Crew Operations Manual (FCOM)

TG Revision:	No. 14, dated 27 FEB 20
Boeing Revision:	No. 59, dated 15 DEC 19

Thai Airways International Public Company Limited

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Effective dates of FCOM bulletins

As each FCOM bulletin already includes its issue date, to avoid confusion please disregard the effective dates listed in the List of Effective Sections for all bulletins (Chapter 0, Section 6). A list of all effective bulletins may be found in the Bulletin Record page (Chapter 0, Section 7).

Graphic Enhancements on FCOM

Starting from FCOM revision 3, graphics in FCOM will be gradually replaced with improved ones. The improved graphics will contain no grey shade for better distinction from revision shade. The graphics will also be sharper and clearer in PDF format. In the meantime, non-improved and improved graphics will co-exist until all graphics are replaced.

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General

The table provides a list of airplanes in order of their delivery dates. Model designation, Line, Serial, and Fuselage numbers are supplied by the manufacturer of the airplanes.

No.	Model	Reg.	Name	Line No.	Serial/ Fuselage No.	Delivery Date
1.	2D7	HS-TJA	LAMPHUN	025	27726/WA086	31MAR96
2.	2D7	HS-TJB	UTHAI THANI	032	27727/WA087	13JUN96
3.	2D7	HS-TJC	NAKHON NAYOK	044	27728/WA088	25OCT96
4.	2D7	HS-TJD	MUKDAHAN	051	27729/WA089	19DEC96
5.	2D7	HS-TJG	PATTANI	100	27732/WA092	31OCT97
6.	2D7	HS-TJH	SUPHAN BURI	113	27733/WA093	09JAN98
7.	3D7	HS-TKA	SRIWANNA	156	29150/WB601	23DEC98
8.	3D7	HS-TKB	CHAINARAI	170	29151/WB602	30DEC98
9.	3D7	HS-TKC	KWANMUANG	250	29211/WB603	18OCT99
10.	3D7	HS-TKD	THEPALAI	260	29212/WB604	08DEC99
11.	3D7	HS-TKE	SUKHIRIN	304	29213/WB605	17OCT00
12.	3D7	HS-TKF	LAHAN SAI	310	29214/WB606	09DEC00
13.	2D7ER	HS-TJR	NAKHON SAWAN	588	34586/WC531	01NOV06
14.	2D7ER	HS-TJS	PHRA NAKHON	595	34587/WC532	09NOV06
15.	2D7ER	HS-TJT	PATHUM WAN	596	34588/WC533	17NOV06
16.	2D7ER	HS-TJU	PHICHIT	599	34589/WC534	08DEC06
17.	2D7ER	HS-TJV	NAKHON PATHOM	665	34590/WC535	24SEP07
18.	2D7ER	HS-TJW	PHETCHABUN	672	34591/WC536	29OCT07
19.	3ALER	HS-TKK	PHILAVAN	1030	41520/WE271	2AUG12
20.	3ALER	HS-TKL	SUNANDA	1049	41521/WE272	30OCT12
21.	3ALER	HS-TKM	PRABHASRI	1082	41522/WE273	07MAR13
22.	3ALER	HS-TKN	MEDININAT	1091	41523/WE274	09APR13
23.	3ALER	HS-TKO	VIMOLMASSIRI	1107	41524/WE275	11JUN13
24.	3ALER	HS-TKP	SRI-AMPHORN	1119	41525/WE276	19JUL13
25.	3ALER	HS-TKQ	KHEMARAT	1129	41526/WE277	26AUG13

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No.	Model	Reg.	Name	Line No.	Serial/ Fuselage No.	Delivery Date
26.	3ALER	HS-TKR	HAT YAI	1145	41527/WE278	22OCT13
27.	3D7ER	HS-TKU	ACHARASOBHIT	1166	42110/WE441	21JAN14
28.	3D7ER	HS-TKV	SUCHITRA	1215	42111/WE442	10JUL14
29.	3D7ER	HS-TKW	MUKDASAYAM	1228	42112/WE443	27AUG14
30.	3D7ER	HS-TKX	SUDHARMA	1267	42113/WE444	20JAN15
31.	3D7ER	HS-TKY	YUBHAPHAKA	1310	42114/WE445	22JUN15
32.	3D7ER	HS-TKZ	SULALIVAN	1338	42115/WE446	28SEP15

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General

The 777 Flight Crew Operating Manual is the property of Thai Airways International Public Company Limited. The manual contents are under the responsibility of THAI Flight Technical Engineering Department (BKKOU). Since the manual includes information regarding THAI policies and methods of operation, it is prohibited to reveal its contents to persons not associated with the Company. It is a responsibility of each manual holder to inform BKKOU of any discrepancy found in the manual at:

Tel (02) 545-2805
Fax (02) 545-3851
E-mail bkkouoffice@thaiairways.com
SITA BKKOUTG

The manual is also available at THAISphere and https://vpn.thaiairways.com.

Purpose and Scope

This manual specifically contains information and instructions for operation of the 777 and contains AFM information required for flight operations. The procedures in this manual cover the regulations issued by The Civil Aviation Authority of Thailand (CAAT) as applicable and specific to this type of aircraft. Although these procedures must be adhered to, nothing should limit personnel from acting on their own best judgement in an emergency.

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 sections/pages.
- Limitations and Normal Procedures chapters cover limitations and operational information 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 In-flight chapter contains performance information necessary for inflight use.

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Volume 1A—

- operating procedures
- emergency
- loading
- maintenance procedures.

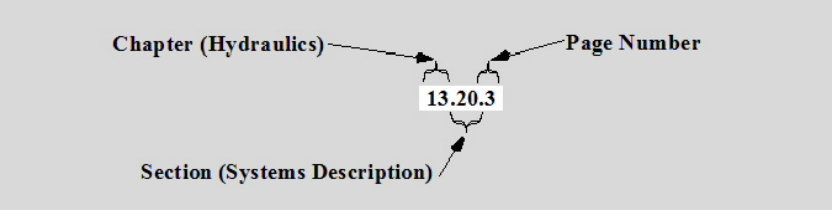
Volume 2—Chapters 1 through 15 contain general airplane and systems information. These chapters are generally subdivided into sections covering controls and indicators and systems descriptions.

Quick Reference Handbook (QRH)—The QRH contains 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



Warnings, Cautions, and Notes

The following levels of written advisories are used throughout the FCOM 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.

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Airplane Effectivities

Differences in airplane configuration are expressed through the use of airplane effectivities which lists airplane registration numbers applicable to particular contents.

Airplane registration numbers are listed in alpha-numeric order. A list of more than four consecutive registration numbers is presented as a range of airplanes. A comma is used in the list to indicate a break in the range, e.g. the list of “TKK to TKR, U” includes the alphabets K through R and U of the “TK” series.

An airplane list of an entire fleet may, in some cases, be expressed as the fleet itself, e.g. the list of “-200, -200ER” includes all airplanes in the -200 and -200ER fleets.

For PDF format of this document, airplane effectivities are shown adjacent to the applicable contents on the left for even pages and on the right for odd pages. In some rare cases where the effectivity includes several airplane registration numbers or models, the effectivity may extend below its content and slightly cover the area associated with the following content.

For HTML format of this document, airplane effectivities are distinguished by text colors and the airplane lists will be displayed in a pop-up note when the cursor moves over the respective contents.

Example:

Placing the mode select lever in the AUTOMATIC position:

- **arms the emergency power assist system**
- **engages the girt bar on entry doors**
- **arms the escape slide/rafts**
- **arms the overwing escape slides.**

TKA to TKF

Once armed, moving the interior door handle to the open position operates the emergency power assist system actuator. The pneumatic actuator drives the door open, and the slide automatically deploys and inflates.

In this example, the effectivity TJA to TJH, TJR to TJW, TKA to TKF applies only to the first paragraph (Placing the mode…) and all its subordinate bullets while the effectivity TKA to TKF applies only to the last bullet (arms the overwing…). The second paragraph applies to all airplanes in the 777 fleet.

The effectivity statements will be updated as the modifications are incorporated. When all affected airplanes have been modified, the effectivity statements are removed.

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Revisions

Revisions will be issued as necessary by the Flight Technical Engineering Department (BKKOU), and published & distributed by the Flight Documentation and Publication Services Department (BKKOR).

Rapid Content Revision

As a means to promptly provide operational information/instructions to flight crew when normal revisions cannot be published in time, a brief description together with necessary operational instructions will be published in the Operations Briefing Card (OBC). The OBC is located inside the front cover of the Technical Log on each aircraft. The content will later be incorporated into a future revision of FCOM as applicable.

Bangkok, 06 February 2020
THAI AIRWAYS INTERNATIONAL PUBLIC COMPANY LIMITED

Operations Department (DO)

DELETION

Capt. Soradej Namruangsri
Executive Vice President

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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	
ABS	Absolute
ABV	Above
A/C	Air Conditioning
AC	Alternating Current
ACARS	Aircraft Communications Addressing and Reporting System
ACE	Actuator Control Electronics
ACP	Audio Control Panel
ACPT	Accept
ACT	Active
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADIRS	Air Data Inertial Reference System
ADIRU	Air Data Inertial Reference Unit
ADJ	Adjust
ADRS	Air Data Reference System
AFDS	Autopilot Flight Director System
AFE	Above Field Elevation
AFM	Airplane Flight Manual (FAA approved)
A/G	Air/Ground
AGL	Above Ground Level
AHRU	Attitude Heading Reference Unit
AIL	Aileron
AIMS	Airplane Information Management System
ALT	Altitude

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A	
ALTN	Alternate
AM	Amplitude Modulation
AMI	Airline Modifiable Information
ANP	Actual Navigational Performance
ANT	Antenna
AOA	Angle of Attack
AOIP	ACARS over IP
A/P	Autopilot
APL	Airplane
APP	Approach
APU	Auxiliary Power Unit
AR	Authorization Required
ARINC	Aeronautical Radio, Incorporated
ARPT	Airport
ARR	Arrival
ASA	Autoland Status Annunciator
ASYM	Asymmetry
A/T	Autothrottle
ATA	Actual Time of Arrival
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATN	Aeronautical Telecommunication Network
ATP	Alerting and Transponder Control Panel
ATSP	Air Traffic Service Provider
ATT	Attitude
AUTO	Automatic
AUTO–THROT	Autothrottle
AUX	Auxiliary
AVAIL	Available
B	
BARO	Barometric
BAT	Battery

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B	
B/CRS	Back Course
BFO	Beat Frequency Oscillator
BKR	Breaker
BLD	Bleed
BLW	Below
BRG	Bearing
BRT	Bright
BTL	Bottle
C	
C	Captain Celsius Center Cool
CAAT	The Civil Aviation Authority of Thailand
CAB	Cabin
CAC	Cabin Air Compressor
CACTCS	Cabin Air Conditioning and Temperature Control System
CAM	Camera
CANC	Cancel
CAP	Capture
CAPT	Captain
CB	Circuit Breaker
CCD	Cursor Control Device
CDU	Control Display Unit
CG	Center of Gravity
CHKL	Checklist
CHR	Chronograph
CKT	Circuit
CL	Close
CLB	Climb
CLR	Clear
CMD	Command

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C	
CMF	Communication Management Function
CO	Company
COMM	Communication
COMP	Comparator
COMPT	Compartment
CON	Continuous
CONFIG	Configuration
CONT	Control
COOL	Cooling
CPDLC	Controller-Pilot Data Link Communications
CRS	Course
CRT	Cathode Ray Tube
CRZ	Cruise
CTL	Control
CTR	Center
CVR	Cockpit Voice Recorder
CWS	Control Wheel Steering
D	
DA(H)	Decision Altitude (Height)
DC	Direct Current
DDG	Dispatch Deviations Guide
DEL	Delete
DEM	Demand
DEP	Departure
DEPR	Depressurize
DES	Descent
DEST	Destination
DH	Decision Height
DIFF	Differential
DISC	Disconnect
DISCH	Discharge
DK	Deck

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D	
DME	Distance Measuring Equipment
DN	Down
DR	Door
DSP	Display Select Panel
DSPL	Display
DTG	Distance To Go
DU	Display Unit
E	
E	East
EAI	Engine Anti-Ice
ECL	Electronic Checklist
E/D	End of Descent
E/E	Electrical/Electronic
EEC	Electronic Engine Control
EFB	Electronic Flight Bag
EFI	Electronic Flight Instruments
EFIS	Electronic Flight Instrument System
EGT	Exhaust Gas Temperature
EICAS	Engine Indication and Crew Alerting System
ELEC	Electrical
ELEV	Elevator
ELMS	Electrical Load Management System
ELT	Emergency Locator Transmitter
EMER	Emergency
ENG	Engine
ENT	Entry
EO	Engine Out
EPR	Engine Pressure Ratio
EQPT or EQUIP	Equipment
EST	Estimate
ET	Elapsed Time
ETA	Estimated Time of Arrival

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E	
ETOPS	Extended Operations
EVAC	Evacuation
EXEC	Execute
EXT	Extend Extension Exterior External
F	
F	Fahrenheit
FADEC	Full Authority Digital Engine Control
FANS	Future Air Navigation System
FCC	Flight Control Computer
FCOM	Flight Crew Operations Manual
FCTL	Flight Control System
F/D	Flight Deck
FDEVSS	Flight Deck Entry Video Surveillance System
FD, F/D or FLT DIR	Flight Director
FF	Fuel Flow
FILT	Filter
FL CH or FLCH	Flight Level Change
FLT	Flight
FMA	Flight Mode Annunciations
FMC	Flight Management Computer
FMS	Flight Management System
F/O	First Officer
FPA	Flight Path Angle
FPM	Feet Per Minute
FPV	Flight Path Vector
FREQ	Frequency
F/S	Fast/Slow
FT	Feet
FWD	Forward

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F	
FWSOV	Fire Wall Shut Off Valve
G	
GA	Go–Around
GEN	Generator
GMT	Greenwich Mean Time
GND	Ground
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
G/S	Glide Slope
GS	Ground Speed
H	
HDG	Heading
HF	High Frequency
HFDL	High Frequency Datalink
HI	High
HLD	Hold
HPSOV	High Pressure Shut Off Valve
HSI	Horizontal Situation Indicator
HYD	Hydraulic
I	
IAF	Initial Approach Fix
IAN	Integrated Approach Navigation
IAS	Indicated Airspeed
ICA	Ice Crystal Anti-Ice
ICI	Ice Crystal Icing
IDENT	Identification
IDG	Integrated Drive Generator
IFE	Inflight Entertainment
IGN	Ignition
IGS	Instrument Guidance System
ILS	Instrument Landing System

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I	
INBD	Inboard
IND	Indicator
IND LTS	Indicator Lights
INIT	Initialization
INOP	Inoperative
INSTR	Instrument
INT	Interior Intermittent
INTC	Intercept
INT or INTPH	Interphone
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere
ISFD	Integrated Standby Flight Display
ISLN	Isolation
ITP	In-Trail Procedures
K	
KGS	Kilograms
KT or KTS	Knots
L	
L	Left
LAV	Lavatory
LBS	Pounds
LD	Load
LDA	Localizer-type Directional Aid
LDG	Landing
LE	Leading Edge
LIM	Limit
LKD	Locked
L NAV or LNAV	Lateral Navigation
LO	Low
LOC	Localizer

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L	
LOM	Locator Outer Marker
LPV	Localizer Performance with Vertical Guidance
LRC	Long Range Cruise
LT	Light
M	
M	Mach Meters
MAG	Magnetic
MAN	Manual
MAX	Maximum
MCP	Mode Control Panel
MDA(H)	Minimum Descent Altitude (Height)
MEL	Minimum Equipment List
MFD	Multifunction Display
MIC	Microphone
MIN	Minimum
MISC	Miscellaneous
MKR	Marker
MLG	Main Landing Gear
MLS	Microwave Landing System
MLW	Maximum Landing Weight
MMO	Maximum Mach Operating Speed
MOD	Modify
MSG	Message
N	
N	Normal
N1	Low Pressure Rotor Speed
N2	High Pressure Rotor Speed (Pratt & Whitney engines) Intermediate Pressure Rotor Speed (Rolls–Royce engines)
N3	High Pressure Rotor Speed (Rolls–Royce engines)
NAV	Navigation
ND	Navigation Display

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N	
	Nose Down
NDB	Navigation Data Base Non-Directional Beacon
NM	Nautical Miles
NORM	Normal
NPS	Navigation Performance Scales
NU	Nose Up
O	
OAT	Outside Air Temperature
OFST	Offset
OM-A	Operations Manual Part A
OP	Open
OUTBD	Outboard
OVHD	Overhead
OVHT	Overheat
OVRD	Override
OVSPD	Overspeed
OXY or O2	Oxygen
P	
PA	Passenger Address
PASS	Passenger
PCP	Pilot Call Panel
PED	Personal Electronic Device
PERF	Performance
PES	Pitch Enhancement System
PF	Pilot Flying
PFD	Primary Flight Display
PM	Pilot Monitoring
PNL	Panel
POS	Position
PPOS	Present Position
PRES or PRESS	Pressure

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P	
PREV	Previous
PROG	Progress
PROX	Proximity
P/RST	Push To Reset
PRV	Pressure Regulating Valve
PSI	Pounds Per Square Inch
PTH	Path
PTT	Push To Talk
PTU	Power Transfer Unit
PWR	Power
PWS	Predictive Windshear System
Q	
Q	Quantity
QFE	Local Station Pressure
QNH	Local Station Pressure corrected to MSL
QTY	Quantity
R	
R	Right
RA	Radio Altimeter Radio Altitude Resolution Advisory
RAAS	Runway Awareness and Advisory System
RAD	Radio
RAT	Ram Air Turbine
RDMI	Radio Distance Magnetic Indicator
REC	Recorder
RECIR or RECIRC	Recirculation
REF	Reference
REV	Reverse
RF	Refill
RMI	Radio Magnetic Indicator
RNAV	Area Navigation (RNAV)

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R	
RNP	Required Navigational Performance
RNV	Area Navigation (RNAV)
RPM	Revolutions Per Minute
RST	Reset
RSVR	Reservoir
R/T	Radio Transmit
RTA	Required Time of Arrival
RTE	Route
RTO	Rejected Takeoff
RUD	Rudder
RVSM	Reduced Vertical Separation Minimum
S	
S	South
SAT	Satellite Communication Static Air Temperature
SATCOM	Satellite Communication
SB	Service Bulletin
S/C	Step Climb
SDF	Simplified Directional Facility
SEL	Select
SELCAL	Selective Calling
SENS	Sensitivity
SERV	Service
SPD	Speed
SPDBRK	Speedbrake
STAB	Stabilizer
STAT	Status
STBY	Standby
SUPR or SUPRNMRY	Supernumerary
SYS	System
T	
TA	Traffic Advisory

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T	
TAI	Thermal Anti–Ice
TAT	Total Air Temperature
T/C	Top of Climb
TCAS	Traffic Alert and Collision Avoidance System
T/D	Top of Descent
TE	Trailing Edge
TEMP	Temperature
TERR	Terrain
TFC	Traffic
TFR	Transfer
TGT	Target
THR	Throttle Thrust
TK or TRK	Track
TO/GA	Takeoff/Go–Around
TO or T/O	Takeoff
TRU	Transformer Rectifier Unit True
TURB	Turbine Turbulence
U	
UNLK or UNLKD	Unlocked
UNSCHD or UNSCHED	Unscheduled
USB	Universal Serial Bus Upper Side Band
UTC	Universal Time Coordinated
UTIL	Utility
V	
V1	Takeoff Decision Speed
V2	Takeoff Safety Speed
VA	Design maneuvering Speed
VAL	Valve

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V	
VERT	Vertical
VHF	Very High Frequency
VIB	Vibration
VLV	Valve
VMO	Maximum Operating Speed
V NAV or VNAV	Vertical Navigation
VOC	Volatile Orgainic Compounds
VOR	VHF Omnidirectional Range
VR	Rotation Speed
VREF	Reference Speed
V/S	Vertical Speed
VSD	Vertical Situation Display
VSI	Vertical Speed Indicator
VTK	Vertical Track
W	
W	Warm West
WAI	Wing Anti-Ice
WHL	Wheel
WPT	Waypoint
WT	Weight
WXR	Weather Radar
X	
X–FEED	Crossfeed
XFER	Transfer
XMIT	Transmit
XPDR or XPNDR	Transponder
XTK	Cross Track

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Revision Record

No.	Revision date	Date filed & Signature
1	22 OCT 13	Incorporated
3	11 APR 14	Incorporated
5	05 JUN 15	Incorporated
7	29 AUG 16	Incorporated
9	23 AUG 17	Incorporated
11	12 SEP 18	Incorporated
13	16 SEP 19	Incorporated
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2	15 NOV 13	Incorporated
4	04 NOV 14	Incorporated
6	11 MAY 16	Incorporated
8	01 FEB 17	Incorporated
10	20 MAR 18	Incorporated
12	04 MAR 19	Incorporated
14	27 FEB 20	
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General

FCOM revisions are issued to provide new or revised procedures and information. Formal revisions also incorporate appropriate information from previously issued flight crew operations manual bulletins.

FCOM revisions, include the FCOM Revision Status, FCOM Revision Highlights, and the current FCOM List of Effective Sections.

oOo indicates the end of sections.

Revision Status

TG Revision:	No. 14, dated 27 FEB 20
Boeing Revision:	No. 59, dated 15 DEC 19

Revision Highlights

Revision marks indicate changes to contents. These marks are removed in the digital format of the subsequent revision. Revision marks include:

- Shading (gray for PDF, yellow for HTML) on texts or illustrations indicates changes to or addition of the content for the current revision
- “DELETION” mark appears when a text or illustration from previous revision has been deleted
- Asterisk (*) symbol appearing adjacent to airplane registration numbers indicates changes to airplane effectivity of that content.

Revision highlights provide brief reasons for changes to individual contents. Technical changes are always provided with revision highlights. There are cases where non-technical changes are not accompanied by revision highlights. These include but not limited to:

- Minor grammatical corrections
- Changes to publishing system database configuration; revision marks may appear on contents that appear unchanged.

0 Preface

0.2 Introduction

0.2.1—Revised purpose and scope.

0.7 Bulletin Record

0.7.2—Removed bulletin TII-97.

0.7.2—Re-added bulletin TII-87 to reflect fleet configuration.

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0.7.3—Revised to reflect current bulletin status.

0.7.3—Revised to reflect current bulletin status.

NP Normal Procedures

NP.21 Amplified Procedures

NP.21.5—Changed the Nose Gear Towing Lever's exterior inspection to "as needed" to allow for the possibility of a pushback situation.

NP.21.25—Revised the Before Taxi transponder setting to "as needed" to let the flight crew determine the correct setting per ATC instructions.

SP Supplementary Procedures

SP.7 Engines, APU

SP.7.2—Grammatical correction.

PD Performance Dispatch

PD.41 Enroute

PD.41.9—Corrected crew oxygen requirements tables for airplanes installed with gasseous passenger oxygen systems.

2 Air Systems

2.40 Bleed Air System Description

2.40.3—Added a caution to the Bleed Air Systems Description.

4 Automatic Flight

4.10 Controls and Indicators

4.10.1—Changed the grammar.

4.10.3—Changed autothrottle ARM switches description from "controls" to "arms or disarms" for clarity.

4.10.6—Editorial correction.

4.10.7—Added information on disarming LNAV.

4.10.7—Editorial correction.

4.10.7—Editorial correction.

4.10.8—Added VNAV deactivation "by disengaging the autopilot and turning both flight directors off".

4.10.8—Editorial correction.

4.10.8—Editorial correction.

4.10.8—Changed the grammar.

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4.10.15—Changed the grammar.

4.20 System Description

4.20.1—Added autopilot information.

4.20.3—Changed the punctuation.

4.20.7—Changed the punctuation.

5 Communications

5.40 MFD Communications Functions

5.40.29—Clarified description of "WEATHER DEVIATION UP TO" entry box.

5.40.37—Updated graphic according to Boeing.

5.40.38—Added illustration to reflect AIMS BP V17 or later software is installed.

5.40.39—Updated graphic according to Boeing.

5.40.39—Editorial correction.

5.40.40—Added description to reflect AIMS V17 or later software is installed with ATN data link option not activated.

5.40.43—Added illustration to reflect AIMS V17 or later software is installed.

5.40.73—Deleted graphic of manager menu page that reflected AIMS V17 or later software is not installed and added graphic to reflect AIMS V17 or later software is installed.

5.40.75—Removed inapplicable illustration.

5.40.75—Removed inapplicable descriptions.

5.40.80—Added illustration to reflect AIMS V17 or later software is installed with ATN option not installed.

5.40.85—Added table to reflect SATCOM, HF datalink, and AIMS V17 or later software are installed with ATN option not installed.

6 Electrical

6.20 System Description

6.20.15—Deleted "and supplemental galley night".

6.30 EICAS Messages

6.30.1—Deleted flight crew non-normal procedure Note for battery operation from EICAS message list. The procedure Note is included in the QRH Main Battery Discharge non-normal procedure.

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7 Engines, APU

7.10 Controls and Indicators

7.10.11—Added an additional condition for X-BLD display.

7.10.11—Removed comma and work "and".

7.10.16—Modified the vertical position of the oil pressure line will vary with N2 RPM.

7.20 Engine System Description

7.20.2—Reworded bullet to improve clarity.

7.20.5—Editorial correction.

7.20.6—Modified the note made more clarification for EEC.

7.20.11—Added "the in-flight start envelope is displayed, and the respective engine fire switch is in."

7.20.22—Corrected conditions for the display of ENG THRUST L, R EICAS messages.

11 Flight Management, Navigation

11.32 Flight Management Computer

11.32.4—Added missing information on the display of FUEL USED value.

14 Landing Gear

14.20 System Description

14.20.3—Added Main Gear aft axle steering system description.

15 Warning Systems

15.20 System Description

15.20.11—Revised RA prediction to 15 to 35 seconds to reflect system operation.

15.20.12—Revised TA prediction to 20 to 48 seconds to reflect system operation.

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General

Bulletins are issued to provide important information to flight crews. Bulletins are dated and numbered sequentially.

Bulletin contains pertinent information not otherwise covered in the Flight Crew Operations Manuals. The bulletin remains active until the relevant information has been incorporated into the Flight Crew Operations Manual or appropriate actions or airplane modification have been performed to correct for the faults/ anomalites described in the bulletin. When appropriate, the next formal Flight Crew Operations Manual revision will include an updated bulletin record page to reflect current bulletin status. When the information in the bulletin is no longer applicable, the bulletin will be removed.

Each bulletin identifies airplanes affected by the bulletin. The airplane effectivity is defined as follows:

- Effectivity range—effectivities in parentheses indicate the corrective service bulletin is planned to be accomplished and some airplanes may be complete.
- All Airplanes—the bulletin applies to all airplanes in the fleet.
- Descriptive statement—the bulletin applies to airplanes with specific equipment.

Bulletins that are originated from Boeing are designated “TII-xx”.

Bulletins that are issued by the company are designated “TH-xx”.

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TH-1	Directional Control with One Engine Inoperative	June 23, 2008
TH-2 R1	Continued Flight After 777 Tail Contact During Takeoff When No EICAS TAIL STRIKE Message is Displayed	August 29, 2016
TH-3	Occurences of Un-powered Right Transfer Bus During Triple Channel Autoland Bus Isolation	February 14, 2010
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TII-76 R4	Uncommanded Turns When LNAV is in Use	July 11, 2017
TII-77 R1	777 Fuel Quantity Indicating System Fluctuations or Blanking Due to a Wiring Harness Problem	June 15, 2012
TII-78 R1	Nuisance EICAS Message: SMOKE BBAND UPR DR2	May 20, 2015
TII-82 R2	Conflict with Duplicate Waypoints with the Same Identifier in the Navigation Database	June 16, 2017
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TII-95 R2	Altimeter Setting While in VNAV	September 8, 2017
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TII-100 R2	Transient TRANSPONDER EICAS advisory message when arming APP on the MCP	February 19, 2018
TII-101 R2	Route Full Condition	June 16, 2017
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TII-108	Fuel Flow Blanking with GE90-100 Series Engines	June 15, 2018

DELETION

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Number	Subject	Date
TII-109	Setting STEP Size to Zero When No Further Step Climbs Are Planned	January 23, 2019
TII-110	Error in Airplane Fuel Quantity Indications	July 16, 2019
TII-112	Erroneous Autopilot Flight Director System (AFDS) Guidance when Instrument Landing System (ILS) Signal Interference Occurs	October 18, 2019

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THAI

777 Flight Crew Operations Manual Bulletin

Number: TH-1

Issue Date: June 23, 2008

Airplane Effectivity: All Airplanes

Subject: Directional Control With One Engine Inoperative

Reason: To inform flight crews about the possible directional control problem with one engine inoperative.

The growth of engine thrust levels has increased significantly since the original engine on the first 777 airplane. With this engine growth the vertical tail and rudder size has remained the same. This has resulted in reduced margins between the normal operating speeds and the in-air minimum control speed. Flight crew following published procedures and flying recommended speeds will maintain directional control authority. However, with an engine failed at light weights, loss of directional control authority (and potential loss of directional control) may occur for 777-200ER during a go-around if airspeed is lower than recommended.

Takeoff (Full Rated Thrust)

Full rated thrust takeoffs are NOT affected. Takeoff V-speeds account for full rated thrust in the minimum control speed (Vmc) calculations.

Takeoff (Assumed Temperature Method (ATM) Reduced Thrust)

ATM reduced thrust takeoffs are NOT affected. Takeoff V-speeds account for full rated thrust in the minimum control speed (Vmc) calculations.

Go-Around

Go-Arounds ARE affected. If an engine fails during a go-around, it is importantthat airspeed loss be recovered to prevent a high asymmetric thrust condition atlower than recommended airspeed. Airspeed recovery is accomplished byfollowing Flight Director (F/D) guidance and standard published procedures.

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777 Flight Crew Operations Manual Bulletin

Number: TH-2 R1

Issue Date: August 29, 2016

Airplane Effectivity: All Airplanes

Subject: Continued Flight After 777 Tail Contact During Takeoff When No EICAS TAIL STRIKE Message is Displayed

Background Information

Operators have reported 777-300 tail-skid contact events that did not result in the EICAS caution message TAIL STRIKE. In some events, the flight crew were notaware of the tail-skid contact until notified by ATC. In at least one event, the flight crew elected to return to the originating airport rather than continue the flight. In each case, subsequent inspection found that the tail-skid system functioned as designed and there was no damage to the fuselage. This bulletin describes the 777-200 and 777-300 tail strike detection system and provides guidance on when the crew would be expected to turn back and when it would be unnecessary.

The tail strike indication system detects ground contact which could damage the airplane pressure hull. The system consists of a blade target (2-inches tall for the777-200, 6-inches tall for the 777-300) and two proximity sensors, and is installed on the aft body of the airplane. If the blade target is sheared off, the EICAS caution message TAIL STRIKE is displayed and an aural beeper sounds in the flight deck.

The blade target will contact the runway prior to the fuselage, for both the 777-200 and 777-300, provided the main-gear tires are all on the runway. For the 777-200 with the main-gear front tires off the runway and at pitch attitudes above 12.3 degrees it is possible for the unpressurized aft fuselage to contact the ground without blade contact, and hence without the EICAS TAIL STRIKE message displayed in the flight deck. There has been at least one such 777-200 in-service event.

For the 777-300, it is extremely unlikely for any part of the fuselage to contact the ground without prior blade contact. To do so would require all tires to be 3 feet above ground and the airplane to be at a pitch attitude greater than 13.2 degrees and for the tail skid crushable cartridge to be fully compressed. At these extremely unlikely conditions, the unpressurized aft end of the lower fuselage could strike the ground without blade contact. For tire heights above 3 feet, even greater pitch attitudes are required for fuselage contact.

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Operating Instructions

For a tailstrike event resulting in the TAILSTRIKE EICAS message, follow the TAIL STRIKE procedure in the QRH.

The absence of the EICAS caution message TAIL STRIKE ensures that the pressure hull is not damaged. If the flight crew are made aware of a tail-contact event during takeoff, but there is no EICAS caution message TAIL STRIKE, the following actions are recommended:

- For the 777-200, crews should accomplish the TAIL STRIKE checklist and land at the nearest suitable airport. Any tail-contact event will result in damage. Damage to the non-pressurized aft fuselage without the EICAS caution message TAIL STRIKE is possible for pitch attitudes above 12.3 degrees with the airplane near the ground.
- For the 777-300, crews should continue the flight. The 777-300 tail skid protects the fuselage from damage during tail-contact events. Damage to the non-pressurized aft fuselage without the EICAS caution message TAIL STRIKE is extremely unlikely.

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777 Flight Crew Operations Manual Bulletin

Number: TH-3

Issue Date: February 14, 2010

Airplane Effectivity: HS-TJA - HS-TJH, HS-TKA - HS-TKF

Subject: Occurrences of Un-powered Right Transfer Bus during triple channel autoland bus isolation.

Background Information

There have been a number of reported cases of displays flickering and multiple flight deck effects during electrical bus isolation for triple channel autoland.

It is believed that this is the result of a momentary or extended loss of power to the right transfer bus during triple channel autoland bus isolation. In some cases, the transfer bus has become unpowered for the remainder of the flight.

The anomaly is believed to be caused by a defective Right Integrated Drive Generator (R IDG). Boeing has several released maintenance-related documents that discuss the specific causes of this problem.

When electrical bus isolation occurs, there is a very small interval of time where this anomaly may occur. Thirty occurrences of an unpowered transfer bus on 12 airplanes during the decent phase of flight have been reported to Boeing.

Boeing and the IDG supplier, Hamilton Sundstrand, are investigating this issue. Investigation status is provided by Fleet Team Digest article 777-FTD-24-03005.

Operating Instructions

The following EICAS messages or failure indications may appear with loss of power to Right Transfer bus:

Warning message:
AUTOPILOT DISC

Advisory messages:
ENG EEC MODE L (NOTE)
ENG EEC MODE R
HEAT PITOT C
NOLAND 3
TCAS
TCAS OFF
TRANSPONDER R

Note: This message is believed to be the result of flight crews following the checklist for ENG EEC MODE R message.

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Status messages:
ADF R
AFDC R
CABIN TEMP CTRL R
DME R
DOOR FLIGHT LOCK 2R
ENG EEC MODE R
HEAT PITOT C
ILS R
NO LAND 3
RADIO ALT R
TCAS
TRANSPONDER R
VOR R

Failure indications:
CAPT ADF R FLAG
CAPT DME R FLAG
CAPT TCAS FLAG
CAPT VOR R FLAG
ENG R EPR BLANKING
F/D BAR BIAS
F/O ADF R FLAG
F/O DME FLAG
F/O DME R FLAG
F/O TCAS FLAG
F/O VOR R FLAG

Recommended crew action:
When approach mode is selected, incorrect bus isolation may result in an un-powered transfer bus and associated messages and failure indications. If the airplane was above 1500 radio altitude when approach mode was selected, the flight crew may be able to restore normal operation by pushing the Approach Switch twice to deselect and reselect the approach mode.

This action will cancel and reinitiate bus isolation. A bus isolation fault is not likely to reoccur during the second attempt at approach mode selection. If the airplane was below 1500 feet radio altitude when approach mode was selected, it is necessary to disconnect the autopilot and cycle the flight director switches prior to re-selecting the approach mode.

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777 Flight Crew Operations Manual Bulletin

Number: TH-4

Issue Date: June 4, 2013

Airplane Effectivity: 777-300ER

Subject: Cruise CG Setting

Reason: To inform flight crews of the published CRZ CG values.

Background Information

The FMC uses cruise center of gravity (CRZ CG) to calculate maximum altitude and maneuver margin to buffet. For 777-200, 777-200ER and 777-300 the default CRZ CG is 30%. For 777-300ER, due to some characteristics encountered during Boeing's flight test program of the airplane, the 777-300ER default CRZ CG is set to 7.5%.

During the 777-300ER operations, flight crew have reported unusually restrictive maximum operating altitude as compared to other 777-200/200ER/300 fleets. Flight crew are sometimes unable to make desired altitude selections and have reported very tight speed margins near the maximum operating altitude in cruise.

In order to improve the maximum operating altitude capability, Weight & Balance department has determined more accurate values of cruise CG to use for flight. The instruction together with the cruise CG values are provided below (and also at the back of the Stabilizer Setting Chart).

Operating Instructions

To improve altitude capability, during cruise, when fuel quantity is below 100 tons the CRZ CG can be changed to a value which relates to LIZFW as shown in the table:

LIZFW	20.29.9	30.39.9	40.49.9	>50
CRUISE CG	18%	21%	25%	30%

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777 Flight Crew Operations Manual Bulletin

Number: TII-41 R5

Issue Date: July 31, 2013

Airplane Effectivity: HS-TJA - HS-TJH, HS-TKA - HS-TKF

Subject: STABILIZER GREENBAND Nuisance EICAS Message

Reason: Incorrect figure on 777-300 Gross Weight scale.

Background Information

Boeing has received reports of nuisance STAB GREENBAND advisory alerts on 777 airplanes. These nuisance alerts occur prior to departure (at the gate or during taxi for takeoff) after FMC gross weight (GW) and center of gravity (CG) data are entered which result in a nose down forward greenband stabilizer trim calculation. Dispatch delays have resulted.

Preliminary investigation indicates that STAB GREENBAND nuisance alerts occur in a small region of the GW and CG envelope where the greenband system has the least margin against nuisance alerts. Boeing has determined that the airplane would still be safe to takeoff in this region should the STAB GREENBAND alert be accurate and a real mistrim result. Should a worst case mistrim occur in this range, the column rotation force would be approximately 30-35 pounds. Normal column rotation force is approximately 20-25 pounds.

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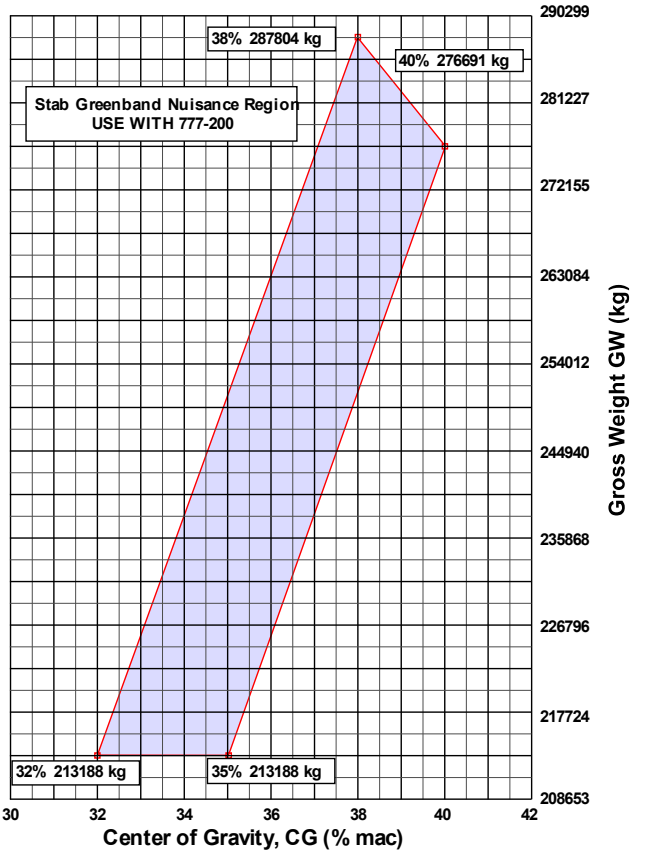
Operating Instructions

Boeing recommends continued use of the stabilizer greenband monitor and alert. When crews experience a STAB GREENBAND alert after loading is complete:

- verify the FMC takeoff data has been correctly entered (takeoff thrust, takeoff flaps, gross weight, and center of gravity)
- verify the stabilizer trim is properly set.

If the aircraft GW and CG fall within the Stab Greenband Known Nuisance Region on the following GW-CG charts, the STAB GREENBAND advisory alert may be considered a nuisance and takeoff may be safely conducted. Otherwise, or if in doubt, the alert should be considered valid and the actual loading of the airplane should be verified.

HS-TJA - HS-TJH



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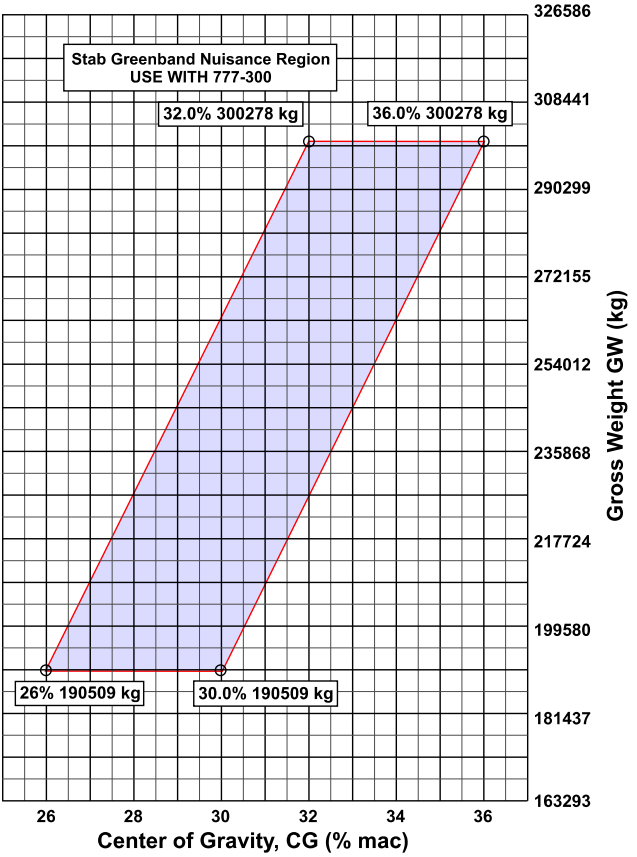
HS-TKA - HS-TKF



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777 Flight Crew Operations Manual Bulletin

Number: TII-44 R1

Issue Date: June 30, 2006

Airplane Effectivity: All Airplanes

Subject: Electronic Checklist (ECL) Line Items not Completing Correctly

Reason: To inform flight crews of a problem with ECL line items not completing correctly and appropriate crew response.

Background Information

Boeing has received reports from operators of ECL closed loop line items not completing correctly (not changing from white to green) when performing a normal checklist despite the respective switch being selected to the correct position and system operating normally. Boeing engineering has determined that the contacts within the switch which provide switch position to ECL may be intermittent. The affected contacts do not control the system component or function associated with the switch. Switch contact faults can cause ECL line item problems in both normal and non-normal checklists. However, they are most likely when several frequently-used switches must be correctly positioned for the line item to turn green. This occurs with the HYDRAULICS or FUEL items that some operators add to their customized normal checklists. The failure of a switch contact to close or open cannot complete an ECL closed loop line item.

Operating Instructions

If an ECL closed loop line item does not complete as expected, confirm that the switch is positioned correctly. If the system is functioning normally, or is otherwise operating as expected, override the line item and continue with the checklist. The failure of a line item to automatically complete is not indicative of an ECL fault. Therefore, the ECL should continue to be used for all checklists.

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777 Flight Crew Operations Manual Bulletin

Number: TII-53 R1

Issue Date: June 16, 2017

Airplane Effectivity: HS-TJA - HS-TJH, HS-TKA - HS-TKF

Subject: 777 FMC Calculation of Reduced Thrust Takeoff Anomaly

Reason: To inform flight crews of a thrust setting anomaly associated with derated thrust takeoff selection.

Background Information

Boeing has received reports of anomalous FMC calculation of derate takeoff (TO 1 or TO 2) thrust settings. The percent thrust reduction associated with TO 1 and TO 2 on the FMC THRUST LIM page can display zero (0). This anomaly seems to occur at power up, after a data load, or after FMC reset. When this occurs, selection of TO 1 or TO 2 does not result in derated thrust. The Takeoff EPR/N1 Limit displayed on line 1R of the FMC THRUST LIM page is full rated thrust (TO); however, FMC V speeds may be based on the selected derate. If an assumed temperature has been entered, the resulting thrust reduction is relative to full rated thrust, not the intended derate.

Operating Instructions

Takeoffs using full rated thrust are not affected by this anomaly. If intending to use derates TO 1 or TO 2, verify the appropriate percentage thrust reduction displays under TO 1 or TO 2 on the FMC THRUST LIM page. If the displayed percentage thrust reduction associated with TO 1 and TO 2 is zero (0), FMC selection of derates is not available. Flight crew action should be based on airline policy; however, the following thrust setting options are available:

- Use full rated thrust (TO) with appropriate V speeds, if conditions permit.
- Use the assumed temperature method with full rated thrust (TO) and appropriate V speeds, if conditions permit.
- Set EPR/N1 manually for the intended derate. Derate thrust settings and appropriate V speeds can be obtained from company airport analysis or from the Flight Planning and Performance Manual, Section 1.3.

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777 Flight Crew Operations Manual Bulletin

Number: TII-56 R3

Issue Date: August 31, 2006

Airplane Effectivity: HS-TJR - HS-TJW

Subject: Fuel temperature blanking indication.

Reason: To inform flight crews of a Fuel Quantity Processor Unit (FQPU) anomaly that may cause blanking of the fuel temperature indication.

Background Information

The fuel temperature indication may blank on certain 777 airplanes, accompanied by the EICAS status message FUEL TEMP INDICATION.

Operating Instructions

In the event of inflight blanking of the fuel temperature indication, use Total Air Temperature (TAT) as a conservative indication of fuel temperature.

The FUEL TEMP LOW EICAS advisory message will not display when the fuel temperature indication is blank. Therefore, maintain TAT greater than 3 degrees C above the fuel freeze point.

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777 Flight Crew Operations Manual Bulletin

Number: TII-73 R7

Issue Date: February 27, 2018

Airplane Effectivity: HS-TJA - HS-TJH, HS-TKA - HS-TKF

Subject: Uncommanded Autothrottle Movement During Cruise Flight

Reason: To inform flight crews of an autothrottle anomaly.

Revised airplane effectivity and removed unnecessary guidlines.

Background Information

Operators have reported several instances of uncommanded autothrottle movement during the cruise phase of flight.

In one case, the autothrottle advanced the thrust levers to full climb thrust even though the speed of the airplane was at the desired speed. While the thrust levers were moving forward, the EICAS message FUEL TEMP LOW appeared for approximately 2 seconds in most of the reported cases. On each event, the thrust levers returned to normal with no action by the flight crew. This condition was reported to happen multiple times during the same flight, each event lasting for approximately 3-10 seconds.

In another instance the autothrottles retarded during cruise flight while at the desired speed. The indications were similar to the thrust lever advance condition and after the event the thrust levers returned to normal with no action by the flight crew.

When investigating this condition, it was determined that a very short term data corruption between the two AIMS cabinets is the cause of the anomaly. Boeing and Honeywell plan to modify the AIMS OPS to resolve this condition and the condition of the display of the erroneous FUEL TEMP LOW advisory EICAS message.

Operating Instructions

To prevent the above described anomaly from occurring, prior to engine start, move the FMC selector switch to either L or R, then back to AUTO. Should cycling of the FMC selector switch be inadvertently overlooked prior to preflight, cycling of the switch inflight at any time will resolve or prevent the anomaly.

Note: After a company uplink is received, do not move the FMC selector switch until all pending company uplinks have been accepted or rejected.

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777 Flight Crew Operations Manual Bulletin

Number: TII-76 R4

Issue Date: July 11, 2017

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.

The Administrative Information section of this bulletin was revised to reflect that a future AIMS software update will correct the condition described in the OMB.

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 by the flight crews 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

Improper sequencing may occur when within 1 NM of the active waypoint for small route modifications, or within 4 NM of the active waypoint for modifications involving a large turn.

The following actions will limit incorrect waypoint sequencing:

- Avoid executing lateral OFFSET when approaching an active waypoint.
- Avoid entry of a vertical or lateral flight planning change when approaching an active waypoint.
- Avoid executing DIR-TO with ABEAM selected when approaching an active waypoint.

If a premature waypoint sequence in the flight plan is observed prior to Executing the flight plan mod, the mod can be Erased and the waypoint sequence and associated uncommanded turn will not occur.

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Should an uncommanded turn occur 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.

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777 Flight Crew Operations Manual Bulletin

Number: TII-77 R1

Issue Date: June 15, 2012

Airplane Effectivity: HS-TJA - HS-TKF

Subject: 777 Fuel Quantity Indicating System Fluctuations or Blanking Due to a Wiring Harness Problem

Reason: To inform flight crews of fuel quantity indicating system fluctuations.

Background Information

777 operators report FUEL IMBALANCE EICAS advisory messages and/or the fuel quantity display blanking in flight due to fluctuating main and center tank fuel quantity indications. Fluctuating indications will usually result in a sudden fuel quantity increase or decrease of one main tank relative to the other main tank, but have occurred in the center tank also.

Erroneous fuel indications have been observed to either suddenly increase or decrease and recover within several minutes. The events can be a single occurrence or multiple events throughout the flight. To date, these occurrences have occurred during cruise flight, and with different fuel loads.

The condition normally does not result in any fuel system status messages and postflight troubleshooting does not reveal any discrepancies. Boeing and GE Aviation are currently in the process of formulating a retrofit program to replace discrepant FQIS wiring harnesses.

Operating Instructions

If the FUEL IMBALANCE EICAS advisory message occurs in flight, check fuel quantity readings to determine if the fuel quantity is fluctuating, or if a true imbalance or fuel leak exists.

If the fuel quantity fluctuates or suddenly increases or decreases and remains at a low level, and an imbalance or fuel leak is not suspected, consider the indications erroneous.

A steady increase in fuel imbalance or steadily increasing difference between fuel totalizer and calculated fuel quantities of approximately 1000 lbs / 500 kgs or more in 30 minutes should be considered a fuel leak.

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To prevent unnecessary fuel balancing, do not accomplish the FUEL IMBALANCE checklist unless an actual fuel imbalance can be confirmed. An actual fuel imbalance can be confirmed by comparison of FMC calculated fuel used, comparison of respective engine fuel flows, or other evidence indicating a true imbalance exists.

Note: Should fuel jettison be required with erroneous fuel indications, the fuel jettison system will use the indicated totalizer fuel to determine when to cease jettisoning at the fuel TO REMAIN value set by the crew. Therefore, if the indicated fuel quantity indications are in error, the crew should use the FMC calculated fuel value and determine the jettison time using the jettison rates of 5400 lbs / 2500 kgs per minute with fuel in the center tank, or 3100 lbs / 1400 kgs per minute withcenter tank empty.

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777 Flight Crew Operations Manual Bulletin

Number: TII-78 R1

Issue Date: May 20, 2015

Airplane Effectivity: HS-TJA - HS-TJH, HS-TKA - HS-TKF

Subject: Nuisance EICAS Message: SMOKE BBAND UPR DR2

Reason: To inform flight crews of nuisance SMOKE BBAND UPR DR2 cautions.

Revised airplane effectivity.

Background Information

Boeing has received reports of nuisance SMOKE BBAND UPR DR2 caution messages on 777 airplanes. The original purpose of this EICAS message was to alert the flight crew that a smoke detector installed above the Connexion LRU's detected smoke in the area.

Operating Instructions

The EICAS message SMOKE BBAND UPR DR2 may display even when no Connexion LRU's are installed on the airplane. This is a nuisance message. No flight crew act ion is required.

Operations Manual Information

The SMOKE BBAND UPR DR2 message is not referenced in the Flight Crew Operations Manual.

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777 Flight Crew Operations Manual Bulletin

Number: TII-82 R2

Issue Date: June 16, 2017

Airplane Effectivity: HS-TJA - HS-TJH, HS-TKA - HS-TKF

Subject: Conflict with Duplicate Waypoints with the Same Identifier in the Navigation Database

Reason: To inform flight crews that two different waypoints with the same identifier cannot be entered into the flight plan at the same time.

Background Information

Airline operators have reported the FMC will not allow flight crews to enter two geographically different waypoints with the same identifier into the route. Once a waypoint identifier is in the route, the FMC recognizes a second entry of the same waypoint identifier as the same waypoint that was first entered and will not allow entry of the second waypoint. The following illustrates this issue:

The active route legs are: SEA - CTB - DIK - FAR - MSP. The flight crew would like to enter CTB (LAT/LON N 40 30.0 W 112 29.8) into the route after FAR waypoint. The CTB waypoint currently displayed on Line 2L is at LAT/LON N 48 33.6 W 122 20.6. If the crew manually enters CTB into the scratchpad and line selects it into Line 5L, the FMC recognize it as the same latitude and longitude as the CTB in 2L. This will result in the route: SEA - CTB - DIK - FAR - CTB - MSP, where the two CTB fixes are the same LAT/LON.

Operating Instructions

When entering two waypoints in the flight plan with the same identifier, enter the LAT/LON for the second waypoint in the flight plan instead of the waypoint identifier. After the first waypoint is sequenced, delete the LAT/LON entry and enter the duplicate identifier at the appropriate place in the flight plan by typing the name of the desired waypoint into the scratchpad and line selecting it into the desired location. Replacing the LAT/LON is not required; however, replacing the LAT/LON enables the use of the waypoint identifier for navaid updating.

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777 Flight Crew Operations Manual Bulletin

Number: TII-83 R3

Issue Date: June 16, 2017

Airplane Effectivity: HS-TJA - HS-TJH, HS-TKA - HS-TKF

Subject: FMC Distance to Waypoint Anomaly

Reason: To inform flight crews of erroneous distance to waypoint anomaly and subsequent fly-over vs. fly-by waypoint in the route.

Revised airplane effectivity.

Background Information

A customer reported an erroneous distance was shown for a flight plan waypoint after a departure procedure was added to the flight plan. This also results in LNAV overflying the waypoint in which the distance is incorrect. This anomaly occurs when moving a waypoint into the first line of the first LEGS page after the flight plan has been activated. Selecting a SID where the last waypoint of the SID is the first waypoint of the enroute flight plan results in an incorrect distance to the waypoint following the last waypoint of the SID.

Here is an example of the problem:

ZSSS is the origin. Enter the following fixes on the LEGS page:

JTN..NXD..TOL..ELNEX

Activate and execute the route. Select NXD to the scratchpad and place it into the first line.

Execute this mod.

The distance between NXD and TOL is shown correctly as 78 NM.

Select RW36 with the NXD02X SID. The last waypoint of the SID procedure is NXD. Now the distance between NXD and TOL is incorrectly shown as 121 NM.

Operating Instructions

If a flight plan leg appears to have an incorrect distance, push the line select key next to the waypoint with the incorrect distance twice and execute. Verify the distance is correct.

To prevent this anomaly from occurring, follow the Boeing Normal Procedures for entering Route, Runways and SIDs, included below for review.

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RTE page:

1. Enter the route
2. Enter the FLIGHT NUMBER
3. Activate and execute the route.

Note: Do not perform a DIRECT TO to the first waypoint.

Departures page:

1. Select the runway and departure routing
2. Execute the runway and departure routing

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

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777 Flight Crew Operations Manual Bulletin

Number: TII-87 R1

Issue Date: June 15, 2017

Airplane Effectivity: HS-TKC, HS-TKK - HS-TKQ, HS-TKU, HS-TKW

Subject: Control Panel (MCP) Altitude Window Changing Without Pilot Action

Reason: To inform flight crews that the altitude in the MCP altitude window may change indication without pilot action.

Revised to add Service Bulletin information.

Background Information

An operator has experienced multiple occurrences of the MCP altitude window indication changing by 1,000, 1,500, 2,000, and 4,000 foot increments during climb, cruise, and descent. These changes occurred without flight crew input to the MCP. In addition when operating in VNAV, the altitude indication has changed after the altitude selector was pushed. This may allow the airplane to climb or descend above or below the desired altitude. Boeing and the equipment supplier are investigating the causes of these events. Initial findings suggest that electrostatic discharge introduced when the pilots touch the MCP may be causing the value in the altitude window to change. Testing has shown that if the Altitude Increment selector is in the AUTO position, the maximum altitude change was 1,500 feet if a static discharge occurs.

Operating Instructions

The following may help minimize the effects and magnitude of uncommanded MCP altitude changes:

- Confirm all altitude changes on the MCP with both crew members
- Periodically check that the MCP altitude window and indication above the altitude display on the PFD remain at the desired value
- Use VNAV to the maximum extent possible
- Place Altitude increment selector in the AUTO position following use in the 1000s position.

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777 Flight Crew Operations Manual Bulletin

Number: TII-88 R1

Issue Date: June 16, 2017

Airplane Effectivity: All Airplanes

Subject: Engine Anti-Ice Valve Sticking Due to Debris

Reason: To inform flight crews of additional actions which may allow the engine anti-ice system to operate.

Background Information

Engine anti-ice valve malfunctions have occurred due to small particle debris in the valve.

The existing ANTI-ICE ENG L, R non-normal checklist directs the crew to cycle the engine anti-ice selector to OFF then ON one time.

Boeing Engineering has reported that additional cycling of the engine anti-ice valve may clear the debris causing the malfunction and allow continued engine anti-ice operation.

Operating Instructions

If the engine anti-ice system is not restored following completion of the ANTI-ICE ENG L, R NNC the following actions may restore the system:

Move the affected engine anti-ice selector to ON

If the ANTI-ICE ENG L, R message shows, wait 3 seconds and then cycle the engine anti-ice selector OFF then ON. This step may be repeated up to 5 times.

If these actions restore the system, move the engine anti-ice selector to the AUTO position after exiting icing conditions.

If these actions do not restore the system, the selector should be moved to OFF and icing conditions should be avoided.

After doing this procedure a maintenance log entry should be made.

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777 Flight Crew Operations Manual Bulletin

Number: TII-90 R1

Issue Date: February 26, 2013

Airplane Effectivity: HS-TJA - HS-TKR

Subject: Delayed Release of Landing Gear Lever Lock

Reason: To inform flight crews of the possibility the landing gear lever lock may not immediately release after takeoff.

Background Information

Several 777 operators have reported occurrences in which flight crews were unable to raise the landing gear lever after takeoff. After the initial retraction attempt, crews were able to retract the gear by raising the landing gear lever after a short delay or by accomplishing the Gear Lever Locked Down NNC.

The Weight-On-Wheels (WOW) system engages the landing gear lever lock while on the ground and releases the lock after transition to the air mode. Analysis has shown the 777 WOW system can delay the ground-to-air transition if the take-off weight is light (< 490K lbs/220K kg) and the 2 preceding landing weights were heavy (> 525K lbs/240K kg). This delay can be as long as 17 seconds.

A delay or failure of the 777 landing gear lever lock to release when the airplane is in the air does not indicate the landing gear is out of configuration for retraction. In this case, overriding the gear lever lock and raising the landing gear will not cause damage to the landing gear.

Operating Instructions

If this condition occurs the flight crew should accomplish the Gear Lever Locked Down NNC:

- Landing gear lever LOCK OVRD switch.....Push and hold
- Landing gear lever.....UP

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777 Flight Crew Operations Manual Bulletin

Number: TII-91 R1

Issue Date: June 16, 2017

Airplane Effectivity: All Airplanes

Subject: System anomalies to be corrected with a future FMC software revision.

Reason: To inform flight crews of existing anomalies and associated procedures.

Revised to include Service Bulletin information. Clarified that the AIMS upgrade version for operators of airplanes with AIMS-2 hardware is BP V17A.

Background Information

Several FMC system anomalies have been identified that will be corrected in a future AIMS revision. Appropriate flight crew procedures have been developed to deal with these issues.

Steep Descent Path

Background Information

An operator reported a VNAV descent below a waypoint constraint altitude prior to arriving at the fix. This occurred after the flight crew performed an INTC CRS TO when in proximity to the approach intercept waypoint and significantly above the constraint altitude. Under these conditions, although VNAV was not engaged, the FMC computed the descent path required from the point where the modification was executed to the intercept waypoint, resulting in a steep descent path. When VNAV was subsequently engaged the FMC used the earlier computed descent profile which resulted in an altitude deviation.

Operating Instructions:

If an INTC CRS TO was performed at an altitude significantly above the waypoint altitude constraint at the intercept waypoint, perform another INTC CRS TO just prior to engaging VNAV.

Incorrect VNAV Sequencing

Background Information

Several reports have been received of VNAV leveling off inside the Final Approach Fix (FAF) and departing the descent profile. These incidents occurred after performing a direct-to the Initial Approach Fix (IAF) waypoint of an approach with a track change of approximately 130-135 degrees. Depending on conditions (weight, wind, temperature, etc), the large track change may result in a curved path extending past the next waypoint in the flight plan. In this state, when the

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curved path transition extends beyond the next waypoint in the flight plan, VNAV will command level flight and not continue to follow the VNAV path. Although leveling off, VNAV will stay in VNAV PTH and will not transition to VNAV ALT.

Operating Instructions:

If a direct-to a waypoint on an approach using VNAV is being flown and the track change will be more than 100 degrees to the final approach course, the flight crew should do an INTC CRS TO the next desired waypoint if the waypoints have not sequenced correctly. Proper waypoint sequencing should be monitored throughout the approach.

Autothrottle Advance When Engaging VNAV on Approach

Background Information

Operators have reported autothrottle advances while sequencing the IAF. If VNAV is engaged when the aircraft is above path, within 150 ft of the VNAV path capture band, and the prior VNAV speed target was a higher value, the autothrottle internal speed target may be initialized to a higher value than the displayed VNAV speed target. If this occurs the autothrottles will then target the prior higher internal speed target and advance. The autothrottle internal speed target will subsequently decrease to the displayed VNAV speed target over a period of a few seconds.

Operating Instructions:

If VNAV will be engaged when on an approach, do not select the VNAV button on the MCP while sequencing the IAF.

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777 Flight Crew Operations Manual Bulletin

Number: TII-93 R5

Issue Date: July 10, 2018

Airplane Effectivity: HS-TJR - HS-TJW, HS-TKK - HS-TKZ

Subject: Invalid Fuel Spar Valve Indication

Reason: To inform pilots of a fuel synoptic anomaly in AIMS BP V17.1.

Revise to reflect that this condition does not exist on BP V17A or later.

Background Information

During flight test, following a power interrupt to the Left AC Bus the EICAS Fuel Synoptic page displayed the fuel spar valve as invalid (white circle) and the green fuel flow bars were replaced with white background lines.

This power interrupt caused a momentary loss of data which resulted in an invalid fuel spar valve indication. When the spar valve indication is invalid it is displayed in the color white, and the fuel flow bars to the engine show as white lines. The invalid fuel spar valve indication remains latched until it can be reset on the ground.

An invalid fuel spar valve symbol on the Fuel Synoptic indicates the valve position signal has received invalid data and is not an indication of a valve failure.

Operating Instructions

Anytime there is a power interrupt to the left AC bus, the Fuel Synoptic can give invalid indications and should not be used for situational awareness. Depending on conditions, the fuel synoptic page on the Captain's inboard display, First Officer's inboard display, and lower MFD can display different fuel spar valve indications.

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777 Flight Crew Operations Manual Bulletin

Number: TII-95 R2

Issue Date: September 8, 2017

Airplane Effectivity: All Airplanes

Subject: Altimeter Setting While in VNAV

Reason: To inform the flight crew of possible aggressive pitch maneuvers when changing the barometric setting near transition altitude or transition level.

Revised to provide additional Operating Instructions.

Background Information

Boeing has been made aware that overly aggressive pitch behavior may occur during altitude capture in VNAV when large changes to the barometric pressure reference are made.

The event involved clearance to hold at an altitude near the transition level. During the altitude capture the crew made a large barometric setting change. The barometric setting change shifted the reference altitude, which resulted in an aggressive VNAV maneuver to climb to the shifted altitude value.

Operating Instructions

When in VNAV and capturing an altitude at or near the transition level or transition altitude, select FLCH, V/S or Altitude HOLD prior to making the barometric setting change. After the level off is complete VNAV may be reengaged if desired.

During a continuous climb or descent in VNAV and the aircraft is nearing the transition altitude or transition level, select FLCH or V/S prior to making a barometric setting change of more than .20 inches of mercury or 7 hectopascals. After making the barometric setting change, VNAV may be reengaged if desired.

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777 Flight Crew Operations Manual Bulletin

Number: TII-96 R1

Issue Date: June 16, 2017

Airplane Effectivity: HS-TJR - HS-TJW, HS-TKC - HS-TKZ

Subject: Multi-Mode Receiver (MMR) ILS Frequency Disagreement

Reason: To inform flight crew of approach procedures in the event of a single MMR ILS frequency disagreement.

Background Information

Boeing has received reports of single Multi Mode Receiver (MMR) failures which can result in the ILS frequency output of the faulty MMR to be in disagreement with the valid ILS frequencies of the other two MMRs.

If an ILS frequency disagreement occurs due to a single MMR failure, the following indications will be shown:

- NO LAND 3 EICAS Advisory message, and can show prior to selecting an approach
- Amber ILS frequency with an amber horizontal line on the PFD when an approach is selected.

The following indications may also show due to a single MMR failure:

- The LAND 2 AFDS annunciation can show below 1,500 feet when both PFDs show the amber ILS frequency with amber horizontal line
- If the failed MMR is the left or right, the approach reference information on the failed side PFD can initially be either blank or missing the ILS frequency. The display should eventually transition to the center MMR and show an amber ILS frequency with an amber horizontal line.

  Note: If the blank or missing approach information does not transition to the center MMR, the airplane is capable of a single channel ILS approach using the PFD to monitor the valid ILS frequency.

The localizer and glideslope pointers on the PFD are accurate when the ILS frequency is amber with an amber horizontal line. When in alternate navigation mode, the amber frequency and amber horizontal line indicate the ILS frequencies manually entered in both CDU's do not match and should be verified.

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Operating Instructions

After selecting an ILS approach and when in reception range, verify the ILS is correctly tuned and identified. Identify the ILS after the on side PFD displays the amber frequency.

- To verify the ILS frequency on the ND, select APP mode using the EFIS control panel. The ILS alpha identification is shown in the upper right corner.
- To verify the audio identification, select the approach receiver on the audio control panel corresponding to the ILS receiver shown on the ND (to the left of the ILS identification).

The ND mode may be changed after the ILS is verified.

If both PFD's show amber ILS frequencies with amber horizontal lines, the autoflight system may be capable of a LAND 2 autoland (fail passive) using the two valid MMRs. The LAND 2 annunciation shows on the PFD when below 1,500 feet.

When one PFD is missing the ILS frequency or the approach reference information is blank, an ILS can be flown to CAT I minimums using the localizer and glideslope pointers on the PFD with the amber ILS frequency and an amber horizontal line. The ILS indications on the PFD missing the ILS frequency or approach reference information is not usable. If suitable visual reference is established at DA(H), disengage the autopilot in accordance with regulatory requirements.

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777 Flight Crew Operations Manual Bulletin

Number: TII-99 R2

Issue Date: March 21, 2019

Airplane Effectivity: All Airplanes

Subject: Uncommanded Autothrottle Movement on the Ground

Reason: To inform flight crews of an autothrottle advancement during ground operations.

Revised to clarify that the condition in this OMB is still under investigation. Boeing Service Bulletin 777-22-0038 may not fully resolve this condition. Changed “TOGA” to “TO/GA” throughout.

Background Information

There have been reports of uncommanded authothrottle advancement during ground operations. The majority of reports have occurred during taxi. In one report, the autothrottles advanced after landing before speedbrakes were retracted.

During investigation, it was determined these events were most likely caused by a short between grounding wires to the TO/GA switches. When this occurs, the aircraft senses the TO/GA switches have been pushed, the autothrottles activate in THR REF mode, and the thrust levers advance to set takeoff thrust.

The system will be revised to rewire the TO/GA switches, preventing uncommanded autothrottle movement on the ground.

Operating Instructions

Boeing recommends the pilot flying keeps a hand on the thrust levers as much as possible during ground operations. This action will allow the pilot to monitor the movement of thrust levers and prevent thrust from advancing during an uncommanded autothrottle advancement.

If there is uncommanded autothrottle movement, retard the thrust levers and disconnect the autothrottle.

On takeoff, the autothrottles will advance normally when the TO/GA switches are pushed.

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777 Flight Crew Operations Manual Bulletin

Number: TII-100 R2

Issue Date: February 19, 2018

Airplane Effectivity: HS-TKY - HS-TKZ

Subject: Transient TRANSPONDER EICAS advisory message when arming APP on the MCP

Reason: To inform flight crews that when arming APP on the MCP, a transient TRANSPONDER L and TCAS OFF message may show.

Background Information

During Boeing flight testing, the EICAS messages TRANSPONDER L and TCAS OFF momentarily showed when the approach mode was armed. The messages were displayed for approximately 2 seconds and then blanked. Investigation into the root cause is in process at Boeing. Possible causes are being looked at including power transients during electrical isolation switching or software timing issues. Actual system failures continue to annunciate properly.

Operating Instructions

The subject condition is considered a transient. If actual system failures occur, the EICAS message stays shown.

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777 Flight Crew Operations Manual Bulletin

Number: TII-101 R2

Issue Date: June 16, 2017

Airplane Effectivity: All Airplanes

Subject: Route Full Condition

Reason: To inform flight crew of an FMC issue if greater than 150 waypoints are loaded.

Revised to add operating instructions.

Background Information

The 777 FMC has a limit of 150 waypoints that may be loaded into a route. If a flight crew attempts to insert more than 150 waypoints into the FMC, a scratchpad message ROUTE FULL will show and it is not possible to load additional waypoints. If a flight plan with more than 150 waypoints is uplinked to the FMC, only the first 150 waypoints will be loaded followed by the FMC scratchpad message ROUTE FULL.

When the ROUTE FULL message is displayed and the loaded route contains a route discontinuity, it is possible to load additional waypoints beyond the system limit. The total number of flight legs can exceed 150 and the legs will overflow onto a 31st LEGS page. This may result in an FMC reset when the airplane sequences the next active waypoint and may deactivate or delete the route.

Operating Instructions

During all phases of flight, flight crew should ensure a maximum of 30 LEGS pages. If 30 LEGS pages are exceeded and the flight plan becomes inactive, the waypoints will be retained. Delete excess waypoints for a maximum of 30 LEGS pages and then the flight plan should be reactivated and executed. If the flight plan and performance data are deleted then all entries will need to be reloaded with a maximum of 30 LEGS pages.

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777 Flight Crew Operations Manual Bulletin

Number: TII-103 R1

Issue Date: February 19, 2018

Airplane Effectivity: All Airplanes

Subject: VNAV Descent on Approach Without a Valid Descent Path

Reason: To inform flight crews of a possible VNAV descent without a valid descent path when flying an approach.

Background Information

Boeing has received a report of a VNAV descent on a non-precision approach without a VNAV path after being vectored by ATC. The sequence of events leading up to the event were as follows:

1. The flight crew was vectored on a course parallel to the final approach course without intercepting the final approach course. The airplane flew abeam the runway without descending.
2. The airplane was close enough to the original final approach course that the FMC sequenced waypoints up to and including the Missed Approach Point (MAP) waypoint.
3. When the FMC sequenced the MAP, the VNAV page title changed from ACT XXXKT DES to ACT END OF DES removing the previous VNAV approach path.
4. The first missed approach waypoint then became the active waypoint on the legs page.
5. Then, ATC vectored the airplane for the same non-precision approach for a second time without the flight crew executing a go-around.
   (In order to allow VNAV to transition from the approach phase to the missed approach phase, one of the following must occur; pushing either TO/GA switch, or climbing at a rate greater than 600 feet per minute.)
6. The flight crew re-selected and executed the same approach via a DIR/INTC to the Final Approach Fix (FAF). VNAV was selected and VNAV PTH was shown on the FMA. After the FAF was sequenced, VNAV mode changed to VNAV SPD and the airplane began a descent to the MAP even though no valid VNAV path existed.

In summary, if a missed approach is flown, and the airplane has not transitioned from the approach phase to the missed approach phase, subsequent approach selection and engagement of VNAV can result in a descent in VNAV SPD without a valid descent path.

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Operating Instructions

In order to avoid the FMC VNAV transitioning to ACT END OF DES mode, do one of the following:

- Push either TO/GA switch for go-around, or
- Climb at a rate greater than 600 fpm, or
- After the MAP is sequenced, enter a cruise altitude on the VNAV CRZ page before selecting another approach.

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777 Flight Crew Operations Manual Bulletin

Number: TII-108

Issue Date: June 15, 2018

Airplane Effectivity: HS-TKK - HS-TKZ

Subject: Fuel Flow Blanking with GE90-100 Series Engines

Reason: To inform flight crews of fuel flow blanking at minimum idle during descent.

Background Information

Note: This bulletin applies to 777 airplanes equipped with GE90-100 series engines only.

Boeing has received reports of fuel flow indications blanking on GE90-100 series engines at or near minimum idle during descent. If the fuel flow display returns to normal at thrust levels above minimum idle, these blanking events can be considered a nuisance fault. Blanking at thrust levels at or above approach idle should be considered a valid fault which requires maintenance action and/or MEL relief.

Operating Instructions

No flight crew action is required, provided the fuel flow indication blanking occurs only at or near minimum idle thrust.

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777 Flight Crew Operations Manual Bulletin

Number: TII-109

Issue Date: January 23, 2019

Airplane Effectivity: HS-TJA - HS-TKR

Subject: Setting STEP Size to Zero When No Further Step Climbs Are Planned

Reason: Inaccurate FMC FUEL and ETA predictions.

Background Information

Fuel and ETA predictions assume the airplane climbs at each predicted optimum step climb point as airplane weight decreases. FMC-predicted step climb increments are based on the default STEP size shown on the VNAV CRZ page. Entering a STEP size of zero causes the FMC to assume a constant altitude cruise.

Operating Instructions

When required to cruise at an altitude below optimum due to air traffic, atmospheric conditions, or non-normal procedures, and no further step climbs are planned, set the STEP (L4) size to zero on the ACT ECON CRZ page. This ensures best available FMC FUEL and ETA predictions.

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777 Flight Crew Operations Manual Bulletin

Number: TII-110

Issue Date: July 16, 2019

Airplane Effectivity: HS-TJR - HS-TJW, HS-TKA - HS-TKF, HS-TKK - HS-TKR, HS-TKU - HS-TKZ

Subject: Error in Airplane Fuel Quantity Indications

Reason: To inform flight crews of a fuel system error that can cause the fuel indications to show fuel quantity greater than actual fuel quantity.

Background Information

All fuel quantity indications (EICAS, Fuel Synoptic, etc.) can show a greater fuel quantity than the actual fuel quantity. Each time fuel is added to the center tank when it is empty or near empty, the center tank fuel quantity system is recalibrated. In some conditions, an error occurs in the recalibration of the center tank fuel. This error causes the fuel quantity indicating system (FQIS) to calculate the center tank fuel quantity incorrectly. If this error occurs, fuel quantity indications can show a fuel quantity greater than actual fuel quantity when center tank fuel is greater than zero. When center tank fuel quantity is zero, the fuel quantity indications are correct. If this error is not detected before engine start, the FMC CALCULATED fuel also shows greater than actual fuel quantity at engine start.

In some situations, the FQIS can detect the error and recalculate center tank fuel quantity. If this occurs, the fuel quantity indications show a decrease in center tank fuel quantity faster than normal until the center tank fuel quantity shows the actual center tank fuel quantity. The EICAS message FUEL DISAGREE can appear. While the FQIS is correcting, the fuel indications may look like the center tank is leaking fuel.

Main tank fuel quantity indications are not affected by this error.

Operating Instructions

Before starting the engines, use the final fuel load documentation to verify that the initial airplane fuel, plus the fuel added for the flight, is the same as the total fuel quantity on EICAS. If EICAS does not show the total fuel quantity from this calculation, contact maintenance.

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777 Flight Crew Operations Manual Bulletin

Number: TII-112

Issue Date: October 18, 2019

Airplane Effectivity: All Airplanes

Subject: Erroneous Autopilot Flight Director System (AFDS) Guidance when Instrument Landing System (ILS) Signal Interference Occurs

Reason: To inform flight crews about erroneous AFDS guidance during ILS approaches

Background Information

This bulletin is being distributed to operators of 747-400, 747-8, 757, 767, 777, and 787 airplanes.

Boeing has received several reports of unexpected pitch guidance when capturing or tracking the glideslope during an instrument landing system (ILS) approach. In each event for which data was provided, Boeing has determined that glideslope signal interference occurred at the time of the unexpected pitch guidance and, in most of these events, the unexpected pitch guidance occurred during glideslope capture. ILS signal interference can occur when vehicles, aircraft, or other factors affect the localizer or glideslope signal.

This bulletin describes the autopilot flight director system (AFDS) operation during periods of localizer or glideslope signal degradation or signal instability, and the possible flight deck effects during such an event.

The AFDS can detect the degradation or instability of radio signals that support specific autopilot modes. When the AFDS detects a degraded or unstable signal during an ILS approach with the autopilot engaged, the affected AFDS mode changes to an attitude stabilizing mode based on inertial data at the time of the signal degradation or instability. The purpose of the attitude stabilizing mode is to prevent large and abrupt pitch and roll changes during short periods of localizer or glideslope signal interference. When the localizer or glideslope signal stabilizes and the airplane is within parameters for capture, the AFDS returns to tracking the localizer or glideslope. Alternatively, if the localizer or glideslope signal does not stabilize or the airplane is not within parameters for capture, the attitude stabilizing mode remains active. In this case, the AFDS continues to provide guidance in the attitude stabilizing mode, ***with possible high rates of descent and significant deviation from the localizer or glideslope.***

There is no direct indication to the pilot that the attitude stabilizing mode is active if the airplane is above 200 feet radio altitude and either:

- the localizer attitude stabilizing mode is active for less than 20 seconds or
- the glideslope attitude stabilizing mode is active for less than 15 seconds

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If the airplane is above 200 feet radio altitude and the attitude stabilizing mode remains active for 20 seconds or more (for localizer) or 15 seconds or more (for glideslope):

- the AUTOPILOT message shows (if autopilot is engaged) and
- the flight director roll or pitch bar is removed (if flight director is on) and
- an amber line shows through the affected flight mode annunciation (FMA).

Figure 1 shows the indications on a typical airplane model after an extended time in the attitude stabilizing mode.

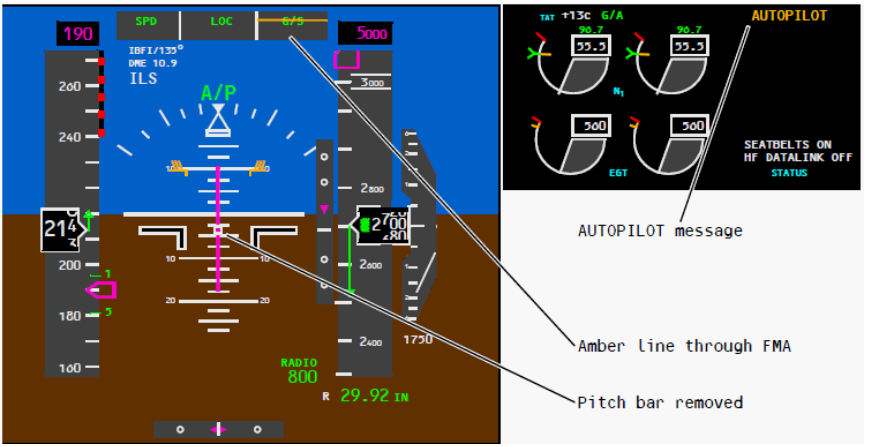

Figure 1—Indications Following Extended Time in Attitude Stabilizing Mode on a Typical Airplane Model

Similarly, there is no indication to the pilot that the attitude stabilizing mode is active if the attitude stabilizing mode remains active for less than 4 seconds while the airplane is at or below 200 feet radio altitude. If the airplane is at or below 200 feet radio altitude and the attitude stabilizing mode remains active for 4 seconds or more, the indications in Figure 1 show.

When these indications show, if the pilot manually disconnects the autopilot, the AUTOPILOT message blanks, the flight director roll and pitch bars show, and the amber line through the affected FMA blanks. ***However, if G/S is the pitch mode and the airplane is not within the parameters for glideslope capture, the flight director pitch bar continues to provide guidance to the attitude stabilizing mode and not to the glideslope signal. This can lead to high rates of descent and significant deviation from the ILS glideslope. Pilot intervention is needed to return the airplane to the glideslope or to perform a go-around/missed approach.*** If the AFDS is in the attitude stabilizing mode and the pilot manually disconnects the autopilot before the indications in Figure 1 show, the same condition can occur and the same pilot intervention is needed.

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Note that the autoland status annunciation of LAND 2 or LAND 3 is not an indication of proper AFDS localizer and glideslope tracking. LAND 2 and LAND 3 are only indications of the autopilot system level of redundancy.

All of the reports Boeing has received regarding this issue have been for unexpected pitch guidance during glideslope capture or tracking. The AFDS manages localizer capture and tracking differently from glideslope capture and tracking. Boeing has not received similar reports of unexpected guidance during localizer capture and tracking.

Operating Instructions

While on an ILS approach, monitor localizer and glideslope raw data and call out any significant deviations. Perform an immediate go-around if not within the criteria to continue the approach.

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General

This chapter contains:

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

Limitations and operational information are included if they are:

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

Limitations and operational information are not included if they are:

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

Limitations and 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., 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

AFM Limitations

Runway slope	±2%
# Maximum Takeoff and Landing Tailwind Component	10 knots
Maximum Takeoff and Landing Crosswind	30 knots
Maximum Operating Altitude	43,100 feet pressure altitude
Maximum Takeoff and Landing Altitude	8,400 feet pressure altitude

Door Mounted Power Assists and Escape Slides

Main door emergency power assists and evacuation slide systems must be armed with the mode select handle in the AUTOMATIC/ARMED position prior to taxi, takeoff and landing whenever passengers are carried.

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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.

AFM Operational Information

The maximum demonstrated takeoff and landing crosswind is 38 knots.

Severe Turbulent Air Penetration Speed

The turbulent air penetration speed (in severe turbulence) is defined as: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and above. Maintain a minimum speed of 15 knots above the minimum maneuvering speed at all altitudes when airspeed is below 0.82 Mach.

Non-AFM Operational Information

Do not operate HF radios during refueling operations.

Avoid weather radar operation in a hangar or within 50 feet (15.25 meters) of fueling operations or a fuel spill.

Avoid weather radar operation when personnel are within the area normally enclosed by the aircraft nose radome.

Note: The hangar restrictions do not apply to the weather radar test mode.

RVSM Operations

Prior to takeoff the maximum allowable difference between Captain's or First Officer's altitude display and field elevation is 75 feet.

The standby altimeter does not meet altimeter accuracy requirements of RVSM airspace.

Weight Limitations

AFM Limitations

	Maximum Taxi Weight (kg)	Maximum Takeoff Weight (kg)	Maximum Landing Weight (kg)	Maximum Zero Fuel Weight (kg)
-200	248,115	247,207	201,848	190,508
-200ER	295,742	294,835	208,652	195,044
-300	300,278	299,370	237,682	224,528
-300ER	352,441	351,534	251,290	237,682

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Air Systems

AFM Limitations

Cabin Pressurization

Maximum differential pressure (relief valves)	9.1 psi
Maximum allowable cabin pressure differential for takeoff and landing	0.11 psi

Anti-Ice, Rain

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

Ground Operations in Freezing Fog with Visibility of 300 Meters or Less

When freezing fog with visibility of 300 meters or less is reported and:

- The OAT is 0 deg. C to –6 deg. C then run up the engines to 50% N1 for 1 minute every 45 minutes taxi time, or
- The OAT is –7 deg. C to –13 deg. C then run up the engines to 59% N1 for 1 minute for every 45 minutes taxi time, or
- The OAT is colder than –13 deg. C and taxi time exceeds 45 minutes, there is no run-up procedure; the engines must be manually de-iced.

Regardless of temperature, if the core ice shedding procedure described above is not accomplished within 45 minutes total taxi time in freezing fog with visibility of 300 meters or less, but takeoff can be achieved within 60 minutes total taxi time in freezing fog with visibility of 300 meters or less, takeoff is permitted. A borescope inspection is required within 10 flights. Takeoff is not permitted if total taxi time in freezing fog with visibility of 300 meters or less exceeds 60 minutes without accomplishing the above core ice shed procedure. The engine core must be manually de-iced.

Autoflight

AFM Limitations

Autopilot/Flight Director System

The autopilot must not be engaged below a minimum engage altitude of 200 feet AGL after takeoff.

Without LAND 2 or LAND 3 annunciated, the autopilot must be disengaged below 200 feet AGL.

Automatic Landing

When landing weather minima are predicated on autoland operations the following limits apply:

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Maximum Allowable Wind Speeds	
# Headwind	25 knots
# Tailwind	10 knots
# Crosswind	25 knots

The maximum glideslope angle is 3.25°.

The minimum glideslope angle is 2.5°.

Automatic landings can be made using flaps 20 or 30, with both engines operative or one engine inoperative. The autopilot flight director system (AFDS) autoland status annunciation must display LAND 2 or LAND 3.

Non-AFM Operational Information

Do not use FLCH on final approach below 1,000 feet AFE.

Communications

AFM Limitations

TKA,B

HF Communication System

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

Non-AFM Operational information

TKK to TKR, TKU to TKZ

SATCOM Phone

Do not use SwiftBroadband service for ATC communications.

Engines

AFM Limitations

Thrust Setting Time Limit

Maximum thrust setting time limit for takeoff and go-around is 5 minutes.

Engine Limit Display Markings

Maximum and minimum limits are red.

Caution limits are amber.

Engine Oil System

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Oil temperature must be greater than –40 deg. C for engine start and 50 deg. C before advancing thrust levers to takeoff power.

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Engine Fuel System

The Following fuel specifications are approved for use:

- Jet A and Jet A-1 as specified in ASTM-D1655
- JP-5 as specified in MIL-DTL-5624
- JP-8 as specified in MIL-DTL-83133.

The use of JP–4 and Jet B fuels is prohibited.

The maximum tank fuel temperature is 49 deg. C.

Tank fuel temperature prior to takeoff must not be less than –40 deg. C or 3 deg. C above the fuel freezing point, whichever is higher. In-flight tank fuel temperature must be maintained at least 3 deg. C above the freezing point of the fuel being used. The use of Fuel System Icing Inhibitor additives does not change the minimum fuel tank temperature limit.

Reverse Thrust

Intentional selection of reverse thrust in flight is prohibited.

Backing the airplane with use of reverse thrust is prohibited.

After a rejected takeoff (RTO) is performed where thrust reversers were deployed, takeoff is prohibited until maintenance action is complete. TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

Non-AFM Operational Information

For ground operation (exclusive of takeoff) in tailwinds and crosswinds between 30 and 45 knots, engine power should be limited to a maximum of 70% N1. Avoid thrust levels above that required for normal taxi operation in all tailwinds and crosswinds greater than 45 knots. TKK to TKR, TKU to TKZ

APU

The APU's starter motors duty cycle for the electric starter motor and air turbine starter is 3 starts attempts in a 60 minute period each.

APU start cycle restrictions are:

Between Starts	Electric Starter Motor wait:	Air Turbine Starter wait:
1 and 2	1 minute	1 minute
2 and 3	1 minute	1 minute

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Flight Controls

AFM Limitations

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 VA.

Flap Operation

The maximum altitude with flaps extended is 20,000 feet.

Flight Instruments, Displays

AFM Operational Information

TKA to TKF, TKK to TKR, TKU to TKZ

Ground Maneuver Camera System

The ground maneuver cameras should not be used during takeoff, approach, and landing.

Flight Management, Navigation

AFM Limitations

ADIRU

ADIRU alignment must not be attempted at latitudes greater than 78°, 14.75 minutes.

Fuel System

AFM Limitations

Main tanks must be scheduled to be full if center tank fuel is loaded.

Note: The center tank may contain up to 1,360 kilograms of fuel with less than full main tanks provided center tank fuel weight plus actual zero fuel weight does not exceed the maximum zero fuel weight, and center of gravity limits are observed.

Fuel System—Loading

TJR to TJW, TKA to TKF,K, L,M,N

When center tank fuel is required for the mission, an additional 320 kilograms of reserve fuel must be added to the center tank fuel load.

Warning Systems

AFM Limitations

GPWS—Look-Ahead Terrain Alerting

Do not use the terrain display for navigation.

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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 database.

TCAS

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

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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. See Supplementary Procedures on page SP.05.1 for procedures that are done as required, for example the adverse weather procedures.

Normal procedures are written for a trained flight crew and assume:

- all systems operate normally
- the full use of all automated features (LNAV, VNAV, autoland, autopilot, and autothrottle). This does not preclude the possibility of manual flight for pilot proficiency where allowed.

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 required.

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

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

- check the MEL 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 MEL 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 effect 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 responsibility.

- The phase of flight areas of responsibility for both normal and non-normal procedures are shown in the Area of Responsibility illustration 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.

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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

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- thrust
- speed.

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

Preflight and Postflight Scan Flow

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 amplified Normal Procedures. For example, preflight procedure details are in the Preflight Procedure—Captain and Preflight Procedure—First Officer.

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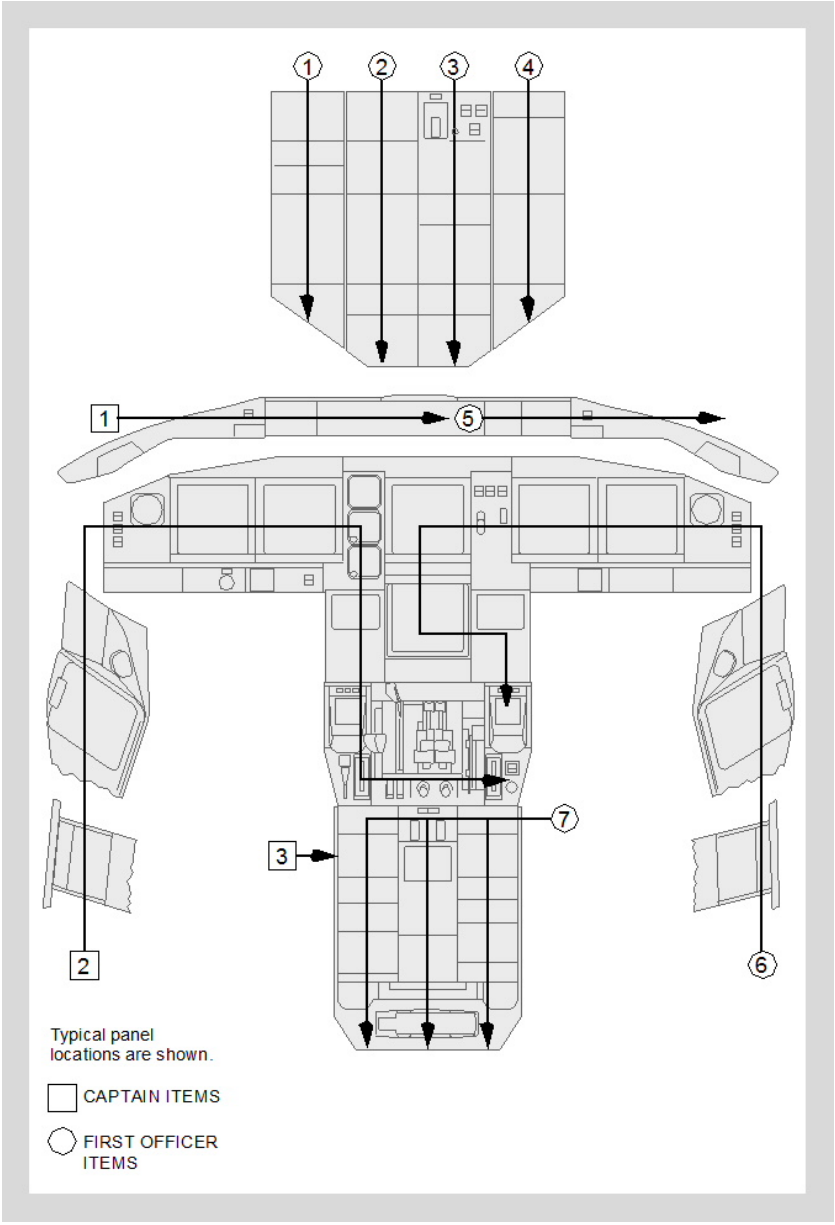

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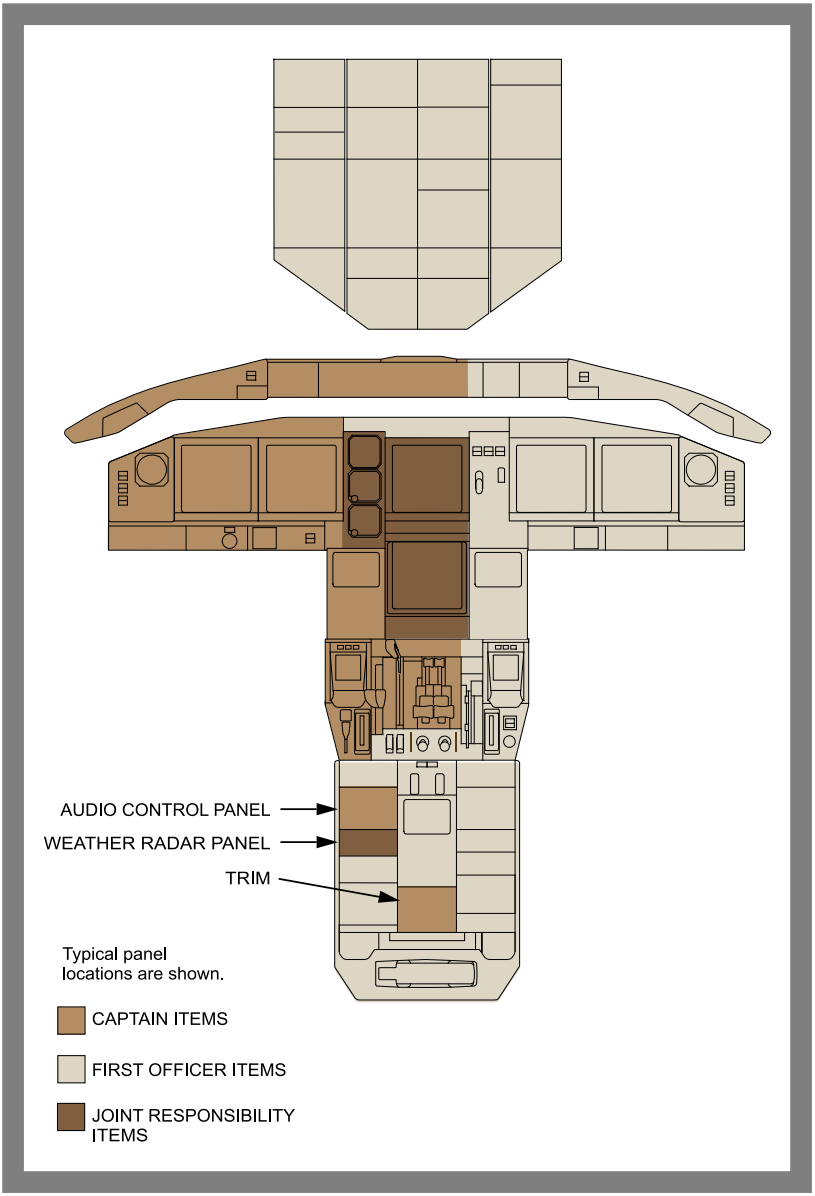
Areas of Responsibility—Captain as Pilot Flying or Taxiing



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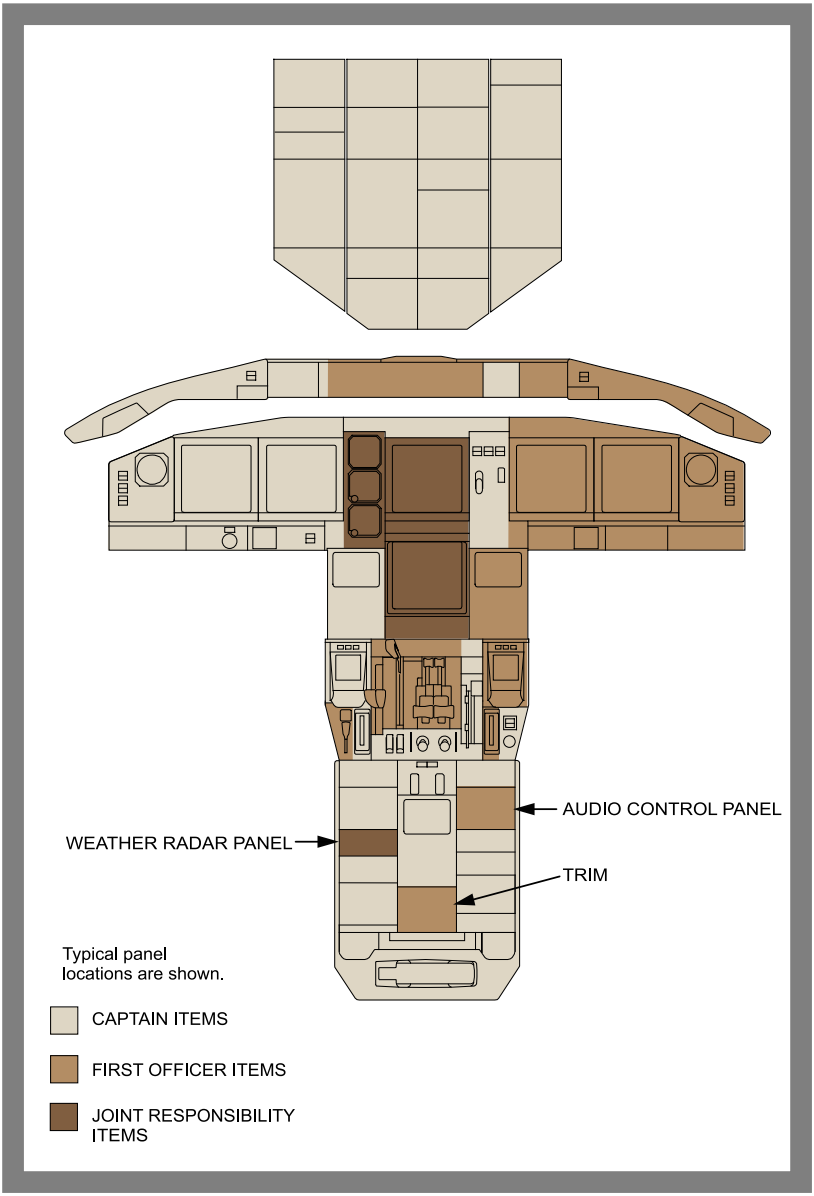
Areas of Responsibility—First Officer as Pilot Flying or Taxiing



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Examples of Quick Reference for Preflight Procedures

This is an example of Quick Reference for Preflight Procedures and is not kept up-to-date. The actual Quick Reference for Preflight Procedures can be found in flight deck, and in PilotDocs OH website.

THAI 777 — **QUICK REFERENCE FOR PREFLIGHT PROCEDURES** — Effective 15MAR12, Issue No. 4, Page 1

Electrical Power Up

BATTERY switch ..... ON
C1 & C2 PRIMARY pump switches ..... OFF
DEMAND pump selectors ..... OFF
WIPER selectors ..... OFF
Landing gear lever ..... DN
ALTERNATE FLAPS selector ..... OFF
Electrical power ..... Establish

Loose Equipment and Security Check

Check loose equipment according to Equipment checklist.

Flight deck security check ..... Checked

– Check suspicious objects in the following areas:
  - Seats/seat pockets
  - Entire floor area including pedals and beneath all seats
  - Ceiling, side and rear wall
  - All visible compartments
  - Coat room
  - Ash trays, etc.

Preflight Procedure—First Officer

HS-TJA - HS-TJH; before installation of IFE/PASS SEATS switch on Electrical panel
IFE/PASS SEATS power switch ..... ON
THRUST ASYMMETRY COMPENSATION switch ..... AUTO
PRIMARY FLIGHT COMPUTERS DISCONNECT switch ..... Guard closed
ELECTRICAL panel ..... Set
APU selector (as needed) ..... START, then ON

HS-TKA - HS-TKT
CAMERA LIGHTS switch ..... As needed
L WIPER selector ..... OFF
ELT switch ..... Guard closed
EMERGENCY LIGHTS switch ..... Guard closed
SERVICE INTERPHONE switch ..... OFF

HS-TJR - HS-TJW, HS-TKK - HS-TKR
PASSENGER OXYGEN switch ..... Guard closed

HS-TJA - HS-TJH, HS-TKA - HS-TKJ, HS-TKS - HS-TKT
PASSENGER OXYGEN ON light ..... Verify extinguished

WINDOW HEAT switches ..... ON

(cont'd) BKKOR

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THAI 777	QUICK REFERENCE FOR PREFLIGHT PROCEDURES	Effective 15MAR12 Issue No. 3 Page 2

RAM AIR TURBINE UNLOCKED light..... Verify extinguished
HYDRAULIC panel ..... Set
PASSENGER SIGNS panel ..... Set
Lighting panel ..... Set
APU fire panel ..... Set
CARGO FIRE panel ..... Set
ENGINE panel ..... Set
FUEL JETTISON panel ..... Set
FUEL panel ..... Set
ANTI–ICE panel ..... Set
Lighting panel ..... Set

HS-TKG - HS-TKJ, HS-TKS - HS-TKT
FORWARD CARGO AIR CONDITIONING ..... As needed

AIR CONDITIONING panel ..... Set
BLEED AIR panel ..... Set
PRESSURIZATION panel ..... Set
R WIPER selector ..... OFF
FLIGHT DIRECTOR switch ..... ON
Display select panel ..... Set
EFIS control panel ..... Set
Oxygen ..... Test and set
FORWARD PANEL BRIGHTNESS controls ..... Mid position
Instrument source select panel ..... Set
Clock ..... Set
INBOARD DISPLAY selector ..... MFD
FMC Selector ..... AUTO
Flight instruments ..... Check
Landing gear panel ..... Set
EICAS display ..... Check
MFD ..... Check
Center DISPLAY CONTROL source switch ..... Off
CENTER PANEL BRIGHTNESS controls ..... Mid position
Left radio tuning panel ..... Set
WEATHER RADAR panel ..... Set
Center radio tuning panel ..... Set
Engine fire panel ..... Set
Center CDU ..... Set
(cont'd)

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THAI 777	QUICK REFERENCE FOR PREFLIGHT PROCEDURES	Effective 24SEP10 Issue No. 2 Page 3

Flight deck printer ..... Set
Right radio tuning panel ..... Set
First officer's audio control panel ..... As needed
Transponder panel ..... Set

HS-TJA - HS-TKF
Evacuation COMMAND switch ..... Guard closed
FLOOR LIGHTS switch ..... As needed
OBSERVER AUDIO selector ..... NORM
AISLE STAND PANEL light control ..... Mid position
AISLE STAND FLOOD light control ..... Mid position
Seat ..... Adjust
Rudder pedals ..... Adjust
Seat belt and shoulder harness ..... Adjust

Do the PREFLIGHT checklist on the captain's command.

Preflight Procedure—Captain

EFIS control panel ..... Set
Mode control panel ..... Set
Oxygen ..... Test and set
FORWARD PANEL BRIGHTNESS controls ..... Mid position
Instrument source select panel ..... Set
Clock ..... Set
INBOARD DISPLAY selector ..... MFD
HEADING REFERENCE switch ..... NORM
Flight instruments ..... Check

ISFD not installed
Standby instruments ..... Check

ISFD installed
Integrated standby flight display ..... Set
ALTERNATE PITCH TRIM levers ..... Neutral
SPEEDBRAKE lever ..... DOWN
Reverse thrust levers ..... Down
Forward thrust levers ..... Closed
Flap lever ..... Set
Parking brake ..... Set
STABILIZER cutout switches ..... Guards closed
FUEL CONTROL switches ..... CUTOFF

(cont'd)

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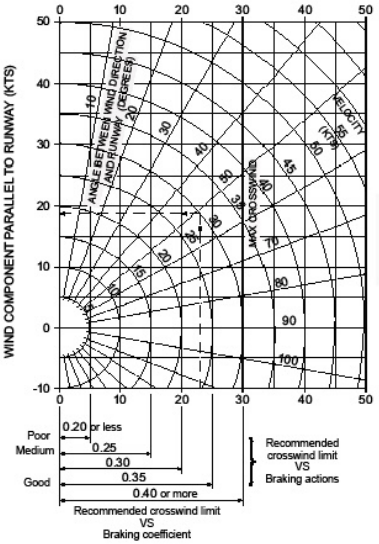
THAI 777	QUICK REFERENCE FOR PREFLIGHT PROCEDURES	Effective 24SEP10 Issue No. 2 Page 4

FUEL CONTROL switch fire warning lights .... Verify extinguished
ALTERNATE FLAPS panel ..... Set
Captain's audio control panel ..... As needed
Seat ..... Adjust
Rudder pedals ..... Adjust
Seat belt and shoulder harness ..... Adjust

Call "PREFLIGHT CHECKLIST"

Wind limit diagram
Crosswind Component (kt)



Corrections to MSA, MFA, MOCA & MORA

CONDITIONS:	ADD:
Temperature: Below standard	4% per 10°C
Altimeter 1013 hPa: QNH below 1013 hPa	30 ft per hPa
Wind speed: Above 30 kt	500 ft per 10 kt max 2000 ft

Corrections to altitudes below MSA at low temp (ft)

Reported OAT	Height above AD						
	200	400	600	800	1000	2000	3000
0°C	20	30	40	50	60	120	170
−10°C	20	40	60	80	100	200	290
−20°C	30	60	90	120	140	280	420
−30°C	40	80	120	150	190	380	570

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Preliminary Preflight Procedure—Captain or First Officer

The Preliminary Preflight Procedure assumes that the Electrical Power Up supplementary procedure and Loose Equipment and Security check are complete.

ADIRU switch . . . . . ON

Verify that the ON BAT light is extinguished.

Verify that the OFF light is extinguished.

Note: The realignment must be done if the time from last ADIRU alignment to the expected arrival time at destination exceeds 24 hours. In this case:

ADIRU switch—OFF 30 seconds, then ON

STATUS display . . . . . Check

Verify that only expected messages are shown.

Verify that the following are sufficient for flight:

- crew oxygen pressure
- passenger oxygen pressure
- hydraulic quantity
- engine oil quantity.

TJR to TJW, TKK to TKR, TKU to TKZ

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

Note: The following oxygen pressure drop test only needs to be performed at one crewmember station.

Oxygen pressure drop . . . . . Test

Oxygen mask—Stowed and doors closed

Crew oxygen pressure—Check STATUS display

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

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While continuing to hold the RESET/TEST switch down, push the EMERGENCY/TEST selector for 5 seconds. Verify that the yellow cross shows continuously in the flow indicator.

Verify that the crew oxygen pressure does not decrease more than 50 psig.

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

- decrease rapidly, or
- decrease more than 50 psig, or
- increase slowly back to normal.

RESET/TEST switch and EMERGENCY/TEST selector—Release

Verify that the yellow cross does not show in the flow indicator.

Normal/100% selector—100%

Crew oxygen pressure—Check STATUS display

Verify that the pressure is sufficient for dispatch.

Maintenance documents . . . . . Check

FLIGHT DECK ACCESS SYSTEM switch . . . . . Test and guard closed

Emergency equipment . . . . . Check

Fire extinguisher—Checked and stowed

Crash axe—Stowed

Escape ropes—Stowed

Other needed equipment—Checked and stowed

Overhead maintenance panel . . . . . Guards closed

Verify that all lights are extinguished.

TJR to TJW, TKK to TKR, TKU to TKZ

MEDICAL OUTLET POWER switch—As needed

CARGO TEMPERATURE selectors—As needed

Circuit breakers . . . . . Check

Parking brake . . . . . As needed

Set the parking brake to check the brake wear indicators during the exterior inspection.

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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 ENG RATING is correct.

Verify that the navigation data base ACTIVE date range is current.

Verify that the DRAG/FF is correct.

POS INIT page:

Verify that the time is correct.

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

Navigation Data . . . . . Set

RTE page:

Enter the route.

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 page. Check the LEGS pages as needed to ensure compliance with the flight plan.

Verify the correct RNP for the departure.

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NAV RADIO page:

Tune the navigation radios as needed.

Performance Data . . . . . Set

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

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

PERF INIT page:

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 as needed.

TKK to TKR, TKU to TKZ

Select the APU to pack mode, if needed.

Select a full or a derated climb thrust as needed.

TAKEOFF REF page:

Select or 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 gear pins (5) are removed
- 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.

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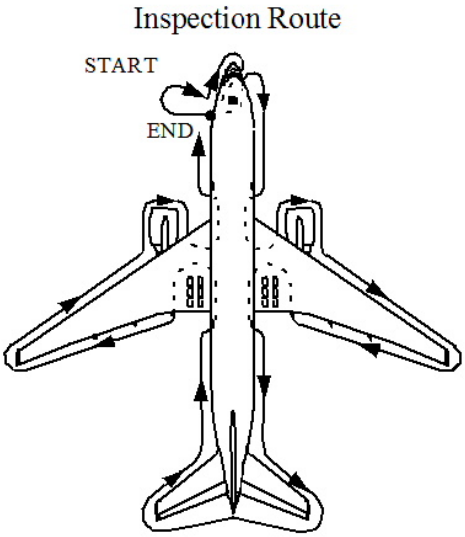
For cold weather operations see Cold Weather Operations on page SP.16.1.



Left Forward Fuselage

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

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

Oxygen pressure relief green disc . . . . . In place

Forward outflow valve . . . . . Check

Nose

Radome . . . . . Check

Diverter strips—Secure

Forward access door . . . . . Secure

Nose Wheel Well

Tires and wheels . . . . . Check

Gear strut and doors . . . . . Check

Nose wheel steering assembly . . . . . Check

Gear pin . . . . . Removed

Nose gear towing lever . . . . . As needed

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Nose gear towing lever pin . . . . . As needed

Exterior lights . . . . . Check

Wheel well light switches . . . . . As needed

Forward E and E 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 vents . . . . . Closed

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

Leading edge flaps . . . . . Check

Right Engine

Access panels . . . . . Latched

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

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

Thrust reverser . . . . . Stowed

Exhaust area and tailcone . . . . . Check

Right Wing and Leading Edge

Access panels . . . . . Latched

Leading edge slats . . . . . 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

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Aileron, flaperon, and trailing edge flaps . . . . . Check

Right Main 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 . . . . . Removed

Right Main Wheel Well

Wheel well . . . . . Check

Right Aft Fuselage

Ram air turbine door . . . . . Check

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

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

Oxygen pressure relief green disc . . . . . In place TJR to TJW, TKK to TKR, TKU to TKZ

Tail

Vertical stabilizer and rudder . . . . . Check

Tail skid . . . . . Check TKA to TKF, TKK to TKR

Verify that the tail skid is not damaged.

Horizontal stabilizer and elevator . . . . . Check

Static discharge wicks . . . . . Check

Strobe light . . . . . Check

APU exhaust outlet . . . . . Check

Left Aft Fuselage

Aft outflow valve . . . . . Check

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

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

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Left Main Wheel Well

Wheel well . . . . . Check

Left Main 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 . . . . . Removed

Left Wing Tip and Trailing Edge

Navigation and strobe lights . . . . . Check

Static discharge wicks . . . . . Check

Aileron, flaperon, and trailing edge flaps . . . . . Check

Fuel jettison nozzle . . . . . Check

Fuel tank vent . . . . . Check

Left Wing and Leading Edge

Wing Surfaces . . . . . Check

Fuel measuring sticks . . . . . Flush and secure

Fuel tank vent . . . . . Check

Leading edge slats . . . . . Check

Access panels . . . . . Latched

Left Engine

Exhaust area and tailcone . . . . . Check

Thrust reverser . . . . . Stowed

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

Access panels . . . . . Latched

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

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Left 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

Negative pressure relief vents . . . . . Closed

Positive pressure relief valves . . . . . Closed

Leading edge flaps . . . . . Check

Preflight Procedure—First Officer

The First Officer normally does this procedure. The Captain may do this procedure as needed.

THRUST ASYMMETRY COMPENSATION switch . . . . . AUTO

Verify that the OFF light is extinguished.

PRIMARY FLIGHT COMPUTERS DISCONNECT switch . . . . . Guard closed

Verify that the DISC light is extinguished.

ELECTRICAL panel . . . . . Set

BATTERY switch—ON

Verify that the OFF light is extinguished.

IFE/PASS SEATS power switch—ON

Verify that the OFF light is extinguished.

CABIN/UTILITY power switch—ON

Verify that the OFF light is extinguished.

APU GENERATOR switch—ON

Verify that the OFF light is extinguished.

BUS TIE switches—AUTO

Verify that the ISLN lights are extinguished.

GENERATOR CONTROL switches—ON

Verify that the OFF lights are illuminated.

Verify that the DRIVE lights are illuminated.

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BACKUP GENERATOR switches—ON

The OFF lights stay illuminated until the respective engine is started.

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

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

Verify that the FAULT light is extinguished.

TKA to TKF, TKK to TKR, TKU to TKZ

CAMERA LIGHTS switch . . . . . As needed

L WIPER selector . . . . . OFF

ELT switch . . . . . Guard closed

EMERGENCY LIGHTS switch . . . . . Guard closed

SERVICE INTERPHONE switch . . . . . OFF

TJR to TJW, TKK to TKR, TKU to TKZ

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

TJR to TJW, TKK to TKR, TKU to TKZ

PASSENGER OXYGEN SWITCH . . . . . Guard closed

TJA,B,C,D,G, H,TKA to TKF

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

TJA,B,C,D,G, H,TKA to TKF

PASSENGER OXYGEN ON light . . . . . Verify extinguished

WINDOW HEAT switches . . . . . ON

Verify that the INOP lights are extinguished.

WARNING: Do not push the RAM AIR TURBINE switch. The switch causes deployment of the ram air turbine.

RAM AIR TURBINE UNLOCKED light . . . . . Verify extinguished

HYDRAULIC panel . . . . . Set

LEFT and RIGHT ENGINE PRIMARY pump switches—ON

Verify that the FAULT lights are illuminated.

Center 1 and Center 2 ELECTRIC PRIMARY pump switches—OFF

Verify that the FAULT lights are illuminated.

DEMAND pump selectors—OFF

Verify that the FAULT lights are illuminated.

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PASSENGER SIGNS panel . . . . . Set

NO ELECTRONICS selector—As required

NO SMOKING selector—ON

SEAT BELTS selector—As required

TJR to TJW, TKK to TKR, TKU to TKZ, TJA,B,C,D,G, H,TKA to TKF

Lighting panel . . . . . Set

OVERHEAD panel light control—Mid position

CIRCUIT BREAKER panel light control—Mid position

MASTER BRIGHTNESS switch—ON

MASTER BRIGHTNESS control—As needed

GLARESHIELD PANEL light control—Mid position

FLOOD light control—Mid position

LANDING light switches—OFF

APU fire panel . . . . . Set

Verify that the APU BTL DISCH light is extinguished.

APU fire switch—In

Verify that the APU fire warning light is extinguished.

CARGO FIRE panel . . . . . Set

CARGO FIRE ARM switches—Off

Verify that the FWD and AFT fire warning lights are extinguished.

Verify that the cargo fire DISCH light is extinguished.

ENGINE panel . . . . . Set

EEC MODE switches—NORM

START selectors—NORM

AUTOSTART switch—ON

Verify that the OFF light is extinguished.

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FUEL JETTISON panel . . . . . Set

FUEL JETTISON NOZZLE switches—Off

Verify that the VALVE lights are extinguished.

FUEL TO REMAIN selector—IN

FUEL JETTISON ARM switch—Off

Verify that the FAULT light is extinguished.

FUEL panel . . . . . Set

CROSSFEED switches—OFF

Verify that the VALVE lights are extinguished.

FUEL PUMP switches—OFF

Verify that the left forward pump PRESS light is extinguished if the APU is on or is illuminated if the APU is off.

Verify that the other left and right pump PRESS lights are illuminated.

Verify that the center pump PRESS lights are extinguished.

ANTI–ICE panel . . . . . Set

WING anti–ice selector—AUTO

ENGINE anti–ice selectors—AUTO

Lighting panel . . . . . Set

BEACON light switch—OFF

NAVIGATION light switch—As needed

LOGO light switch—As needed

WING light switch—As needed

INDICATOR LIGHTS switch—As needed

RUNWAY TURNOFF light switches—OFF

TAXI light switch—OFF

STROBE light switch—OFF

AIR CONDITIONING panel . . . . . Set

EQUIPMENT COOLING switch—AUTO

Verify that the OVRD light is extinguished.

RECIRCULATION FANS switches—ON

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FLIGHT DECK TEMPERATURE control—mid AUTO position

CABIN TEMPERATURE control—Mid position

PACK switches—As required

TRIM AIR switches—ON

Verify that the FAULT lights are extinguished.

BLEED AIR panel . . . . . Set

LEFT, CENTER and RIGHT ISOLATION switches—AUTO

Verify that the CLOSED lights are extinguished.

ENGINE bleed switches—ON

The OFF lights stay illuminated until the respective engine is started.

APU bleed switch—AUTO

Verify that the OFF light is extinguished.

PRESSURIZATION panel . . . . . Set

OUTFLOW VALVE switches—AUTO

Verify that the MAN lights are extinguished.

LANDING ALTITUDE selector—IN

R WIPER selector . . . . . OFF

FLIGHT DIRECTOR switch . . . . . ON

Display select panel . . . . . Set

LOWER CENTER display switch—Push

EFIS control panel . . . . . Set

MINIMUMS reference selector—RADIO or BARO

MINIMUMS selector—Set decision height or altitude reference

FLIGHT PATH VECTOR switch—As needed

METERS switch—As needed

BAROMETRIC reference selector—IN or HPA

BAROMETRIC selector—Set local altimeter setting

VOR/ADF switches—As needed

ND mode selector—MAP

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ND CENTER switch—As needed

ND range selector—As needed

ND TRAFFIC switch—As needed

WEATHER RADAR—Off

Verify that the weather radar indications are not shown on the ND.

Map switches—As needed

Note: The oxygen test and set is not needed if the oxygen pressure drop test was done at this crewmember station during the Preliminary Preflight Procedure—Captain or First officer.

Oxygen . . . . . Test and set

Oxygen mask—Stowed and doors closed

RESET/TEST switch—Push and hold

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

RESET/TEST switch and EMERGENCY/TEST selector—Release

Verify that the yellow cross does not show in the flow indicator.

Normal/100% selector—100%

FORWARD PANEL BRIGHTNESS controls . . . . . Mid position

Instrument source select panel . . . . . Set

NAVIGATION source switch—Off

DISPLAY CONTROL source switch—Off

AIR DATA/ATT source switch—Off

Clock . . . . . Set

Time/date selector—UTC

INBOARD DISPLAY selector . . . . . MFD

FMC Selector . . . . . AUTO

Do the Initial Data and Navigation Data steps from the CDU Preflight Procedure and verify that the IRS alignment is complete before checking the flight instruments.

Flight instruments . . . . . Check

Verify that the flight instrument indications are correct.

Verify that only these flags are shown:

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- TCAS OFF
- 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 FLT DIR.

Select the map mode.

Landing gear panel . . . . . Set

Verify that the GND PROX light is extinguished.

FLAP OVERRIDE switch—Off

GEAR OVERRIDE switch—Off

TERRAIN OVERRIDE switch—Off

Landing gear lever—DN

ALTERNATE GEAR switch—Guard closed

AUTOBRAKE selector—RTO

EICAS display . . . . . Check

Verify that the primary engine indications show existing conditions.

Verify that no exceedance is shown.

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MFD . . . . . Check

Secondary ENGINE indications—Check

Verify that the secondary engine indications show existing conditions.

Verify that no exceedance is shown.

STATUS display switch—Push

Check status messages.

CHECKLIST display switch—Push

LOWER CENTER cursor location switch—Push

Verify that the lower center cursor location light is illuminated.

RESETS—Select

RESET ALL—Select

TJA,B,C,D,G,H,TKA to TKF

COMMUNICATION display switch—Push

MANAGER—Select

MASTER—Select

DATA LINK SYSTEM RESET—Select

CONFIRM RESET—Select

TJR to TJW, TKK to TKR, TKU to TKZ

COMMUNICATION display switch—Push

MANAGER—Select

SYSTEM INFORMATION—Select

Verify TAIL NUMBER is correct.

Center DISPLAY CONTROL source switch . . . . . Off

CENTER PANEL BRIGHTNESS controls . . . . . Mid position

Left radio tuning panel . . . . . Set

Verify that the OFF light is extinguished.

WEATHER RADAR panel . . . . . Set

Select system L for odd flight number, system R for even flight number.

Center radio tuning panel . . . . . Set

Verify that the OFF light is extinguished.

Observer's audio control panel . . . . . As needed

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Flight deck door panel . . . . . As needed

Engine fire panel . . . . . Set

Verify that the ENG BTL 1 DISCH and ENG BTL 2 DISCH lights are extinguished.

Engine fire switches—In

Verify that the LEFT and RIGHT fire warning lights are extinguished.

Center CDU . . . . . Set

Flight deck printer . . . . . Set

Verify that the PAPER light is extinguished.

Right radio tuning panel . . . . . Set

Verify that the OFF light is extinguished.

First Officer audio control panel . . . . . As needed

Transponder panel . . . . . Set TJA,B,C,D,G,H,TKA to TKF

Transponder switch—LEFT

Transponder mode selector—STBY

TCAS airspace switch—ABOVE

Transponder panel . . . . . Set TJR to TJW,TKK to TKR,TKU to TKZ

Transponder mode selector—STBY

Transponder selector—L or R alternating

Evacuation COMMAND switch . . . . . Guard closed TJA,B,C,D,G,H,

FLOOR LIGHTS switch . . . . . As needed TJR to TJW,TKA to TKF

OBSERVER AUDIO selector . . . . . NORM

AISLE STAND PANEL light control . . . . . Mid position

AISLE STAND FLOOD light control . . . . . Mid position

WARNING: Do not put objects between the seat and the aisle stand. Injury can occur when the seat is adjusted.

Seat . . . . . Adjust

Adjust the seat for optimum eye reference.

Whenever the seat is adjusted, verify a positive horizontal (fore and aft) seat lock by pushing against the seat.

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Rudder pedals . . . . . Adjust

Adjust the rudder pedals to allow full rudder pedal and brake pedal movement. Stow the rudder pedal adjust crank.

WARNING: If the rudder pedal adjust crank is not stowed after use the rudder pedals can move out of the desired position.

Seat belt and shoulder harness . . . . . Adjust

Do 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.

EFIS control panel . . . . . Set

MINIMUMS reference selector—RADIO or BARO

MINIMUMS selector—Set decision height or altitude reference

FLIGHT PATH VECTOR switch—As needed

METERS switch—As needed

BAROMETRIC reference selector—IN or HPA

BAROMETRIC selector—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—Off

Verify that the weather radar indications are not shown on the ND.

Map switches—As needed

Mode control panel . . . . . Set

FLIGHT DIRECTOR switch—ON

AUTOTHROTTLE ARM switches—ARM

Autopilot DISENGAGE bar—UP

HEADING/TRACK reference switch—As needed

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BANK LIMIT selector—AUTO

VERTICAL SPEED/FLIGHT PATH ANGLE reference switch—As needed

ALTITUDE increment selector—As needed

Note: The oxygen test and set is not needed if the oxygen pressure drop test was done at this crewmember station during the Preliminary Preflight Procedure—Captain or First officer.

Oxygen . . . . . Test and set

Oxygen mask—Stowed and doors closed

RESET/TEST switch—Push and hold

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

RESET/TEST switch and EMERGENCY/TEST selector—Release

Verify that the yellow cross does not show in the flow indicator.

Normal/100% selector—100%

FORWARD PANEL BRIGHTNESS controls . . . . . Mid position

Instrument source select panel . . . . . Set

NAVIGATION source switch—Off

DISPLAY CONTROL source switch—Off

AIR DATA/ATTITUDE source switch—Off

Clock . . . . . Set

Time/date selector—UTC

INBOARD DISPLAY selector . . . . . MFD

HEADING REFERENCE switch . . . . . NORM

Do the Initial Data and Navigation Data steps from the CDU Preflight Procedure and verify that the IRS alignment is complete before checking the flight instruments.

Flight instruments . . . . . Check

Verify that the flight instrument indications are correct.

Verify that only these flags are shown:

- TCAS OFF
- NO VSPD until takeoff V–speeds are selected.

Verify that the flight mode annunciations are correct:

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- autothrottle mode is blank
- roll mode is TO/GA
- pitch mode is TO/GA
- AFDS status is FLT DIR.

Select the map mode.

Integrated standby flight display . . . . . Set

Verify that the approach mode display is blank.

Set local altimeter setting.

Verify that the flight instrument indications are correct.

Verify that no flags or messages are shown.

ALTERNATE PITCH TRIM levers . . . . . Neutral

SPEEDBRAKE lever . . . . . DOWN

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 PARKING BRAKE SET message is shown.

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

STABILIZER cutout switches . . . . . Guards closed

FUEL CONTROL switches . . . . . CUTOFF

FUEL CONTROL switch fire warning lights . . . . . Verify extinguished

ALTERNATE FLAPS panel . . . . . Set

ALTERNATE FLAPS ARM switch—OFF

ALTERNATE FLAPS selector—OFF

Captain audio control panel . . . . . As needed

WARNING: Do not put objects between the seat and the aisle stand. Injury can occur when the seat is adjusted.

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Seat . . . . . Adjust

Adjust the seat for optimum eye reference.

Whenever the seat is adjusted, verify a positive horizontal (fore and aft) seat lock by pushing against the seat.

Rudder pedals . . . . . Adjust

Adjust the rudder pedals to allow full rudder pedal and brake pedal movement. Stow the rudder pedal adjust crank.

WARNING: If the rudder pedal adjust crank is not stowed after use the rudder pedals can move out of the desired position.

Seat belt and shoulder harness . . . . . Adjust

Call “PREFLIGHT CHECKLIST.”

Before Start Procedure

Start the Before Start Procedure after documents are on board.

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

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

IAS/MACH selector—Set V2

Arm LNAV as needed.

Arm VNAV as needed.

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

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Flight deck windows . . . . . Closed and locked C,F/O

Verify that the WINDOW NOT CLOSED decal does not show.

Verify that the orange indicator does not show.

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.

Notes: 1. Clearance must be obtained to pressurize the hydraulic system.

2. Pressurize the right system first to prevent fluid transfer between systems.

Right ELECTRIC DEMAND pump selector—AUTO

Verify that FAULT light is extinguished.

Center 1 and Center 2 ELECTRIC PRIMARY pump switches —ON

Verify that the Center 1 FAULT light is extinguished.

The Center 2 FAULT light may stay illuminated until after engine start because of load shedding.

Left ELECTRIC DEMAND pump selector—AUTO

Verify that the FAULT light is extinguished.

Center 1 and Center 2 AIR DEMAND pump selectors—AUTO

Verify that the FAULT lights are extinguished.

Fuel panel . . . . . Set F/O

LEFT and RIGHT FUEL PUMP switches—ON

Verify that the PRESS lights are extinguished.

If the FUEL IN CENTER message shows:

CENTER FUEL PUMP switches—ON

One or both PRESS lights may stay illuminated until after the engine start because of load shedding.

BEACON light switch . . . . . ON F/O

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CANCEL/RECALL and STAT switch . . . . . Push F/O

Verify that only the expected alert and status messages are shown.

CANCEL/RECALL switch . . . . . Push F/O

Verify that the messages cancel.

Trim . . . . . Set C

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

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

Obtain a clearance to start the engines.

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.

Ground handling personnel . . . . . Establish communications C

CAUTIONS:
1. **Do not hold or turn the nose wheel tiller during pushback or towing. This can damage the nose gear or the tow bar.**
2. **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.

Parking brake . . . . . Set or release C

Set or release as directed by ground handling personnel.

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When pushback or towing is complete:

Tow bar	Verify not connected	C
Nose gear steering	Verify not locked out	C

Engine Start Procedure

If there is no oil pressure indication after the EGT increases, do the ABORTED ENGINE START checklist

Select the secondary engine display.		F/O
Start sequence	Announce	C

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

The engines may be started at the same time.

Call “START ____ ENGINE”		C
Engine START selector	START	F/O
FUEL CONTROL switch	RUN	C
Verify that the oil pressure increases.		C,F/O

TKK to TKR, TKU to TKZ

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

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

If the engines were not started at the same time:

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

Before Taxi Procedure

Start the Before Taxi Procedure after both engines have been started.

APU selector	OFF	F/O
ENGINE ANTI–ICE selectors	As needed	F/O
Verify that the ground equipment is clear.		C,F/O
Call “FLAPS___” as needed for takeoff.		C
Flap lever	Set takeoff flaps	F/O

Note: Cold Weather operations may require additional considerations for both the FLAP lever setting and the Flight Control check.

Flight controls	Check	C

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

Note: To avoid nuisance FLIGHT CONTROLS faults, a complete cycle of the control wheel during the flight control check should be done slowly (more than

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approximately 6 seconds) and not combined with the check of the pitch controls.

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.

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

Transponder . . . . . As needed		F/O *
DELETION Recall . . . . . Check		C,F/O
Verify that only expected alert messages are shown.		
Update changes to the taxi briefing, as needed.		C or PF
Call “BEFORE TAXI CHECKLIST.”		C
Do the BEFORE TAXI checklist.		F/O

Before Takeoff Procedure

Start Before Takeoff Procedure before entering the departure runway.

Engine warm up requirements: TKK to TKR, TKU to TKZ
- engine oil temperature must be above the bottom of the temperature scale.

Engine warm up recommendations: TKK to TKR, TKU to TKZ
- run the engines for at least 3 minutes
- use a thrust setting normally used for taxi operations.

Engine warm up requirements: TJA,B,C,D,G, H, TJR to TJW, TKA to TKF
- engine oil temperature must be above the lower amber band before takeoff.

Engine warm up recommendations: TJA,B,C,D,G, H, TJR to TJW, TKA to TKF
- 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 or less:
  - run the engines for at least 3 minutes.
- use a thrust setting normally used for the taxi operations.

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Pilot Flying	Pilot Monitoring
	Notify the cabin crew to prepare for takeoff.
The pilot who will do the takeoff updates changes to the 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

Pilot Flying	Pilot Monitoring
Before entering the departure runway, verify that the runway and runway entry point are correct.	
	Set the STROBE light switch to ON. Use other lights as needed. Set the transponder mode selector to TA/RA.
When lining up in takeoff position on the runway, the captain shall confirm the check of compasses to correspond with runway heading and performance data to be valid for the actual runway and takeoff position by calling out, i.e., “TWO ONE RIGHT (ECHO) COMPASSES CHECKED” (21R-E). The first officer confirms by calling “CHECKED.”	
Verify that the airplane heading agrees with the assigned runway heading.	
	When cleared for takeoff, set all the LANDING light switches to ON.
Advance the thrust levers to approximately 1.05 EPR. Advance the thrust levers to approximately 55% N1. Allow the engines to stabilize.	
Push the TO/GA switch.	
If the first officer is going to perform PF duty during takeoff, the captain shall give control to him by announcing “YOUR CONTROLS”.	
Verify that the correct takeoff thrust is set.	
	Monitor the engine instruments during the takeoff. **Call out any abnormal indications.** Adjust takeoff thrust before 80 knots IAS as needed.

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF, TKK to TKR, TKU to TKZ

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Pilot Flying	Pilot Monitoring
	After takeoff thrust is set, call “THRUST SET” and speed for V1. During strong headwinds, if the thrust levers do not advance to the planned takeoff thrust, manually advance the thrust levers by 80 knots IAS.
After takeoff thrust is set, the Captain’s hand must be on the thrust levers until V1.	
Verify 80 knots and call “CHECKED.”	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. Establish a positive rate of climb.	At VR call “ROTATE.” -200,-200ER At VR call “ROTATE LONG BODY.” -300,-300ER Monitor airspeed and vertical speed.
	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 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.	Set the flap lever as directed.
Engage the autopilot when above the minimum altitude for autopilot engagement.	
	After flap retraction is complete, call out “CLEAN SPEED__” and set the ENGINE ANTI-ICE selectors to AUTO.
Call “AFTER TAKEOFF CHECKLIST.”	Do the AFTER TAKEOFF checklist.

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Takeoff Flap Retraction Speed Schedule

Takeoff Flaps	At “Display”	Select Flaps
20 or 15	"20" or "15"	5
	“5”	1
	“1”	UP
5	"5"	1
	“1”	UP

Climb and Cruise Procedure

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

Notes: 1. Maintain at least 15 knots above minimum maneuver speed when climbing through FL 200 to prevent the EICAS caution message, “AIRSPEED LOW” from occurring.

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

2. Use of VNAV or maximum climb thrust is recommended when performing all step climbs.

Pilot Flying	Pilot Monitoring
	During climb and cruise, verify the RNP as needed.
	At or above 10,000 feet MSL, set the LANDING light switches to OFF.
	Set the passenger signs as needed.
When climbing above transition altitude, set the altimeters to standard.	
	If the FUEL IN CENTER message shows, set both CENTER FUEL PUMP switches to ON. When the FUEL LOW CENTER message shows, set both CENTER FUEL PUMP switches to OFF.
	Before the top of descent, modify the active route as needed for the arrival and approach. Verify or enter the correct RNP for the arrival.

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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
	During descent, verify the RNP as needed.
Review all alert messages. Review all operational notes.	Recall and review all alert messages. Recall and review all operational notes.
Verify FLAP/VREF on the APPROACH REF page. For example: call out "Flap 25 Vee Ref 142 Minimum Baro 210" or "Flap 30, Vee Ref 137 Minimum Radio 50".	Enter FLAP/VREF on the APPROACH REF page.
Set the RADIO/BARO minimums as needed for the approach.	
Set and verify the NAV RADIO page for the approach.	
	Check landing performance.
	Set the AUTOBRAKE selector to the needed brake setting.
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
	During arrival and approach, verify the RNP as needed.
	Set the passenger signs as needed as consent from P-i-C.
	Set the external lights as needed.
At transition level, set and crosscheck the altimeters.	

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Pilot Flying	Pilot Monitoring
Update changes to the arrival and approach procedures as needed. Update changes to 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”	20	“20”
20	20	25 or 30	(VREF25 or VREF30) + wind additives

Landing Procedure—ILS

Complete the Landing Procedure before 1,000' RH.

Pilot Flying	Pilot Monitoring
	Notify the cabin crew to prepare for landing.
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.	
CAUTION: **To avoid unwanted glideslope captured prior to localizer captured, LOC mode should be selected initially, followed by the APP mode after localizer in captured.**	
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 glideslope with the localizer not captured.**	
Use HDG SEL/TRK SEL or HDG HOLD/TRK HOLD to intercept the final approach course as needed.	
	Call “LOCALIZER ALIVE.”

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Pilot Flying	Pilot Monitoring
Verify that the localizer is captured.	Verify final approach course heading.
	Call “GLIDESLOPE ALIVE.”
At glideslope alive, call: • “GEAR DOWN” • “FLAPS 20.”	
	Set the landing gear lever to DN. Set the flap lever to 20.
The captain sets the speedbrake lever to ARMED.	
Call "GEAR DOWN and checked."	Call "GEAR DOWN and checked."
At glide slope capture, call “FLAPS___” as needed for landing.	Set the flap lever as directed.
Set the missed approach altitude on the MCP.	
When landing FLAPS extended, call "LANDING CHECKLIST."	Do the LANDING CHECKLIST.
At the final approach fix or (LOM, MKR, DME) verify the crossing altitude.	
For CAT II/III approaches, verify the autoland status at 500 feet radio altitude.	
Call “LAND 2” or “LAND 3” or “NO AUTOLAND”.	Call “FIVE HUNDRED FEET”.

Landing Procedure—Instrument Approach Using VNAV

VNAV should be used only for approaches that have one of the following features:

- a published GP angle on the LEGS page for the final approach segment
- an RWxx waypoint at the approach end of the runway
- a missed approach waypoint before the approach end of the runway (for example, MXxx)

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 the cabin crew to prepare for landing.

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Pilot Flying	Pilot Monitoring
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 glidepath 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 anticipation cue or LOC pointer is shown • 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, TRK SEL, HDG HOLD, or TRK HOLD to intercept the final approach course as needed.	
Verify that LNAV is engaged or that the localizer is captured.	
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 ARMED.	
Beginning the final approach descent, call “FLAPS __” as needed for landing.	Set the flap lever as directed.
Call “LANDING CHECKLIST.”	Do the LANDING checklist.

TKK to TKR, TKU to TKZ TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

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Pilot Flying	Pilot Monitoring
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.	
Monitor the approach.	
If suitable visual reference is established at MDA(H), DA(H), or the missed approach point, disengage the autopilot. Maintain the glide path to landing.	

Go-Around and Missed Approach Procedure

Pilot Flying	Pilot Monitoring
At the same time: • push the TO/GA switch • call “FLAPS 20”.	
	Position 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 “POSITIVE RATE.”
Verify a positive rate of climb on the altimeter and call “GEAR UP.”	
	Set the landing gear lever to UP.
Limit bank angle to 15° if airspeed is below minimum maneuver speed.	
Above 400 feet radio altitude, select or verify a roll mode.	Verify that the missed approach altitude is set.
Verify that the missed approach route is tracked.	
At acceleration height, set speed to the maneuver speed for the planned flap setting.	
Call “FLAPS___” according to the flap retraction schedule.	Set the flap lever as directed.

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Pilot Flying	Pilot Monitoring
After flap are set to the planned flap setting and at or above flap maneuvering speed, select FLCH or VNAV as needed.	
Verify that climb thrust is set.	
Verify that the missed approach altitude is captured.	
Call “AFTER TAKEOFF CHECKLIST.”	Do the AFTER TAKEOFF checklist.

Landing Roll Procedure

Pilot Flying	Pilot Monitoring
Verify that the thrust levers are closed. Verify that the SPEEDBRAKE lever is UP.	Verify that the SPEEDBRAKE lever is UP. Call “SPEEDBRAKES UP.” If the SPEEDBRAKE lever is not UP, call “NO SPEEDBRAKES.”
Monitor the rollout progress.	
Verify correct autobrake operation.	
WARNING: After the reverse thrust levers are raised, a full stop landing must be made. If an engine remains in reverse, safe flight is not possible.	
Without delay, raise the reverse thrust levers to the interlocks and hold light pressure until the interlocks release. Then apply reverse thrust as needed.	Call “REVERSE GREEN” or “NO REVERSE LEFT” or “NO REVERSE RIGHT” or “NO REVERSE.”
By 60 knots IAS, start movement of the reverse thrust levers to reach the reverse idle detent before taxi speed.	Call “60 KNOTS.”
After the engines are at reverse idle, move the reverse thrust levers to full down.	
Before taxi speed, disarm the autobrake. 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.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Engine cooldown recommendations:

- run the engines for at least 1 minute

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- use a thrust setting no higher than that normally used for all engine taxi operations.

Engine cooldown recommendations:

TKK to TKR, TKU to TKZ

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

Pilot Flying	Pilot Monitoring
Set the weather radar to off.	
The Captain positions or verifies that the SPEEDBRAKE lever is DOWN.	
	Set the STROBE light switch to OFF. Set the LANDING and TAXI light switches as needed.
	Set the ENGINE ANTI-ICE selectors to ON, if needed.
	Set the exterior lights as needed.
	Set the AUTOBRAKE selector OFF.
	Set the flap lever to UP.
	Set the APU selector to START, then ON as needed.
	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 PARKING BRAKE SET message is shown.

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Electrical power . . . . . Set F/O

If APU power is needed:

Check that the APU RUNNING message is shown.

If external power is needed:

Verify that the PRIMARY EXTERNAL POWER AVAIL light is illuminated.

PRIMARY EXTERNAL POWER switch—Push

Verify that the ON light is illuminated.

If the SECONDARY EXTERNAL POWER AVAIL light is illuminated:

SECONDARY EXTERNAL POWER switch—Push

Verify that the ON light is illuminated.

FUEL CONTROL switches . . . . . CUTOFF C

If towing is needed:

Ground handling personnel . . . . . Establish communications C

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

CAUTIONS:
1. **Do not hold or turn the nose wheel tiller during pushback or towing. This can damage the nose gear or the tow bar.**
2. **Do not use airplane brakes to stop the airplane during pushback or towing. This can damage the nose gear or the tow bar.**

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

Set or release as directed by ground handling personnel.

SEAT BELTS selector . . . . . OFF F/O

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HYDRAULIC panel	Set	F/O

Note: Depressurize the right system last to prevent fluid transfer between systems.

Center 1, and Center 2 AIR DEMAND pump selectors—OFF

Left ELECTRIC DEMAND pump selector—OFF

Center 1 and Center 2 ELECTRIC PRIMARY pump switches —OFF

Right ELECTRIC DEMAND pump selector—OFF

FUEL PUMP switches	OFF	F/O
BEACON light switch	OFF	F/O
FLIGHT DIRECTOR switches	OFF	C,F/O
Transponder mode selector	STBY	F/O
Status messages	Check	F/O

Note: Disregard EICAS alert and status messages displayed during the PFC self test after hydraulic shutdown. Wait approximately 3 minutes after HYD PRESS SYS L+C +R message is shown before recording status and alert messages in the maintenance log.

After wheel chocks are in place:

Parking brake	Release	C
APU selector	As needed	F/O
Call “SHUTDOWN CHECKLIST.”		C
Do the SHUTDOWN checklist.		F/O

Secure Procedure

Start the secure procedure before leaving the cockpit when the flight is terminated.

ADIRU switch	OFF	F/O
EMERGENCY LIGHTS switch	OFF	F/O
PACK switches	OFF	F/O
Call “SECURE CHECKLIST.”		C
Do the SECURE checklist.		F/O

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General

This chapter contains procedures (adverse weather operation, engine crossbleed start, and so on) that are 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 memory. 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 respective chapter title for the system being addressed except for the Adverse Weather section.

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Doors

Entry/Service Door Closing

Gust lock latch . . . . . Release

Door . . . . . Close

Manually position the door aft and inboard to cover the entry.

Door handle . . . . . Rotate

Rotate forward 180° to the closed position. The door lowers into position, latches, and locks.

Mode select lever . . . . . AUTOMATIC

Observe yellow forward and aft girt bar flags are in view.

Entry/Service Door Opening

Mode select lever (interior only) . . . . . MANUAL

Note: Escape slide/raft and powered door opening is disarmed automatically when the door is opened from outside.

Door handle . . . . . Rotate

Rotate aft 180° to the open position. The door is lifted clear of the pressure stops.

Door . . . . . Open

Manually position the door outboard and forward to open. The gust lock latch automatically engages and locks door in the open position.

Emergency Equipment

Emergency Oxygen Use

Emergency oxygen should be used when necessary to provide positive pressure in the masks and goggles to prevent or evacuate contaminants. When positive pressure is not required, but contamination of flight deck air exists, 100% oxygen must be used. If prolonged use is required and the situation permits, oxygen availability should be extended by selecting normal flow. When oxygen use is no longer required, close the left hand oxygen compartment door, then push the RESET/TEST switch to restore normal boom microphone operation.

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Flight Deck Door Access System Test

Flight deck door . . . . . Open

Flight deck access system switch . . . . . OFF

Verify LOCK FAIL light illuminates.

Flight deck access system switch . . . . . NORM

Guard—Down

Verify LOCK FAIL light extinguishes.

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

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Air Conditioning Packs

Ground Conditioned Air Use

Before connecting ground conditioned air:

PACK switches (both)—OFF

[Prevents pack operation when conditioned air is supplied to the airplane. The pack or pack components can be damaged if operated with conditioned air.]

RECIRCULATION FANS switches (both)—OFF

[This step allows conditioned air unit to operate at maximum efficiency.]

After disconnecting ground conditioned air:

PACK switches (both)—AUTO

RECIRCULATION FANS switches (both)—ON

Packs Off Takeoff

Before takeoff:

PACK switches (both)—OFF

Wait 30 seconds before setting takeoff thrust.

[This step allows packs to shut down and EECs time to recompute maximum EPR line and reference/target EPR indications.]

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF, TKK to TKR, TKU to TKZ

[This step allows packs to shut down and EECs time to recompute maximum N1 line and reference/target N1 indications.]

After takeoff:

PACK switches (both)—AUTO

After engine thrust is reduced from takeoff to climb and reaching 3,000 feet above field elevation, position both pack switches to AUTO.

APU to Pack Takeoff

TKK to TKR, TKU to TKZ

Note: APU to Pack Takeoff is prohibited at airport altitudes above 6,900 feet field elevation.

Before start:

PACK switches (both)—AUTO

On the THRUST LIMIT Page, select one of the following takeoff thrust ratings:

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- full thrust
- percent derate.

Enter “APU” into the scratchpad and line select to the “SEL-APU” field. “APU” appears in small font representing the armed mode.

After engine start:

Leave APU running to supply air to the left pack.

Approximately one minute after second engine start, “APU” displays in large font representing the active mode.

Confirm proper configuration by noting a green “A-TO, A-TO1, or A-TO2” on EICAS.

Notes:
1. If cabin temperature becomes excessive during extended ground operation, establish dual pack operation by deleting the APU selection. To re-establish APU to Pack operation, enter “APU” into the scratchpad and line select to the “SEL-APU” field.
2. If an engine is shutdown after selecting APU to Pack operation, the engine cannot be started until APU to Pack takeoff mode has been deleted. To re-establish APU to Pack operation after start, re-enter “APU” into the scratchpad and line select to the “SEL-APU” field.

After climb thrust reduction:

APU Selector—Off.

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Anti-Ice Operation

Requirements for use of anti-ice and operational procedures for engine and wing anti-ice are contained in Supplementary Procedures, Adverse Weather Section SP.16.

Windshield Wiper Use

CAUTION: Windshield scratching will occur if the windshield wipers are operated on a dry windshield.

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AFDS

AFDS Operation

FLIGHT DIRECTOR switches . . . . . ON

Verify FLT DIR is displayed in the AFDS system status annunciator.

If the autopilot is desired:

AUTOPILOT engage switch . . . . . Push

Verify A/P is displayed in the AFDS system status annunciator.

Heading Hold

If the airplane is operating in polar regions:

HEADING REFERENCE switch . . . . . TRUE

HEADING/TRACK reference switch . . . . . Push

Verify HDG is displayed in the HDG/TRK window.

Heading/track HOLD switch . . . . . Push

Verify HDG HOLD is displayed in the roll mode annunciator.

Heading Select

Maintains the airplane heading the same as the selected heading.

If the airplane is operating in polar regions:

HEADING REFERENCE switch . . . . . TRUE

HEADING/TRACK reference switch . . . . . Push

Verify HDG is displayed in the HDG/TRK window.

Heading/track SELECT switch . . . . . Push

Verify HDG SEL is displayed in the roll mode annunciator.

Heading/track selector . . . . . Rotate

Set desired heading in the HDG/TRK window.

Track Hold

If the airplane is operating in polar regions:

HEADING REFERENCE switch . . . . . TRUE

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HEADING/TRACK switch . . . . . Push

Verify TRK is displayed in the HDG/TRK window.

Heading/track HOLD switch . . . . . Push

Verify TRK HOLD is displayed in the roll mode annunciator.

Track Select

Maintains the airplane track the same as the selected track.

If the airplane is operating in polar regions:

HEADING REFERENCE switch . . . . . TRUE

HEADING/TRACK reference switch . . . . . Push

Verify TRK is displayed in the HDG/TRK window.

Heading/track SELECT switch . . . . . Push

Verify TRK SEL is displayed in the roll mode annunciator.

Heading/track selector . . . . . Rotate

Set desired track in the HDG/TRK window.

Altitude Hold

Altitude HOLD switch . . . . . Push

Verify ALT is displayed in the pitch mode annunciator.

Flight Level Change, Climb or Descent

ALTITUDE selector . . . . . Rotate

Set the desired altitude in the MCP ALTITUDE window.

FLCH switch . . . . . Push

Verify FLCH SPD is displayed in the pitch mode annunciator.

IAS/MACH selector . . . . . Rotate

Set the desired speed in the IAS/MACH window.

Vertical Speed, Climb or Descent

ALTITUDE selector . . . . . Rotate

Set the desired altitude in the MCP ALTITUDE window.

VERTICAL SPEED/FLIGHT PATH ANGLE reference switch . . . . . Push

Verify V/S is displayed in the vertical speed/flight path angle window.

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VERTICAL SPEED/FLIGHT PATH ANGLE switch . . . . . Push

Verify V/S is displayed in the pitch mode annunciator.

VERTICAL SPEED/FLIGHT PATH ANGLE selector . . . . . Rotate

Set the desired vertical speed in the VERTICAL SPEED/FLIGHT PATH ANGLE window.

If a climb is desired:

Select climb thrust limit on the CDU THRUST LIM page.

Flight Path Angle, Climb or Descent

ALTITUDE selector . . . . . Rotate

Set the desired altitude in the MCP ALTITUDE window.

VERTICAL SPEED/FLIGHT PATH ANGLE Reference switch . . . . . Push

Verify FPA is displayed in the vertical speed/flight path angle window.

VERTICAL SPEED/FLIGHT PATH ANGLE switch . . . . . Push

Verify FPA is displayed in the pitch mode annunciator.

VERTICAL SPEED/FLIGHT PATH ANGLE selector . . . . . Rotate

Set the desired flight path angle in the VERTICAL SPEED/FLIGHT PATH ANGLE window.

If a climb is desired:

Select climb thrust limit on the CDU THRUST LIM page.

Autothrottle Operation

AUTOTHROTTLE ARM switches . . . . . ARM

If the pitch mode is TO/GA:

TO/GA switch . . . . . Push

Verify that THR REF is displayed in the autothrottle mode annunciator. THR REF changes to HOLD at 80 knots.

If the pitch mode is ALT, V/S, FPA, G/S, or no pitch mode:

AUTOTHROTTLE switch . . . . . Push

Verify that SPD is displayed in the autothrottle mode annunciator.

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If a constant speed is desired:

IAS/MACH selector . . . . . Rotate

Set the desired speed in the IAS/MACH window.

If climb or continuous thrust is desired:

CLB CON switch . . . . . Push

Verify that THR REF is displayed in the autothrottle mode annunciator.

If FLCH or VNAV is desired:

FLCH or VNAV switch . . . . . Push

Verify that THR REF, THR, SPD, IDLE, or HOLD as appropriate is displayed in the autothrottle mode annunciator.

If TO/GA is desired:

TO/GA switch . . . . . Push

The pitch mode will change to TO/GA. Verify that THR or THR REF is displayed in the autothrottle mode annunciator.

If the pitch mode is VNAV PTH, VNAV ALT, VNAV SPD, or FLCH SPD:

AUTOTHROTTLE switch . . . . . Push

Verify THR REF, THR, SPD, IDLE, or HOLD as appropriate is displayed in the autothrottle mode annunciator.

Instrument Approach—RNAV (RNP) AR

Notes:
1. Operators need approval to conduct RNAV (RNP) AR Instrument Approaches.
2. For RNAV (GPS) and RNAV (GNSS) procedures use the Landing Procedure—Instrument Approach using VNAV in Normal Procedures.
3. This procedure is not authorized using QFE.

The procedure below supplements normal Preflight, Cruise, Descent and Approach Procedures and replaces the Landing Procedure.

Preflight Procedure

Review RNP availability predictions.

Pre-approach Requirements

Airplane equipment required to begin the approach:

- 2 A/P s or 2 F/Ds (SINGLE SOURCE F/D alert not shown)

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- 2 CDUs
- EICAS Display
- 2 GPS Receivers
- 2 NDs
- 2 PFDs.

Verify the following messages are not shown:

- FMC L or FMC R *
- GNDPROXSYS
- NAV ADIRU INTERTIAL
- AIR DATA SYS *
- NAV UNABLE RNP
- SGL SOURCE RAD ALT
- TERR POS.

Note: Do the Go-around and Missed Approach Procedure if the NAV UNABLE RNP EICAS message or VERIFY POSITION FMC alert is shown unless suitable visual reference is established and maintained.

Do the following prior to starting the approach:

- verify the NAV UNABLE RNP alert is not displayed
- review RNP availability predictions
- verify the approach RNP is equal to or greater than:
  - 0.11 (A/P)
  - 0.14 (F/D)
  - 0.11 (F/D)

TJA,B,C,D,G, H,TKA to TKF *

- set current local altimeter (remote altimeter settings not allowed)
- verify wind is within limits published for the approach (if applicable)
- verify the reported airport temperature is within published limits for the approach
- review the maximum IAS for each segment of the approach as determined by aircraft category and applicable regulatory airspeed requirements.

Cruise Procedure

Pilot Flying	Pilot Monitoring
	When selecting the approach from the navigation database verify ACT RTE LEGS page matches the charted approach. Verify displayed glidepath (GP) angle is not less than the charted value minus 0.01°.

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Pilot Flying	Pilot Monitoring
	If there is an “at or above” altitude restriction before the FAF, it may be changed to an “at” altitude restriction using the same altitude. Speed modifications are allowed as long as the maximum published speed is not exceeded.

Descent Procedure

Pilot Flying	Pilot Monitoring
In the approach briefing include speed and altitude restrictions, missed approach, engine failure, and unable RNP procedures.	Verify RAD NAV INHIBIT—ON on the REF NAV DATA page.

Approach Procedure

Complete the Approach Procedure before the initial approach fix, or the start of radar vectors to the final approach course.

Notes: 1. When receiving radar vectors from ATC, intercept course modifications may be used to join the LNAV path at any point on the initial, intermediate, or missed approach segments.

2. Direct-To modifications are not permitted when:
   - the fix is the beginning of an RF leg
   - the fix is the Final Approach Fix (FAF) for the procedure.

Pilot Flying	Pilot Monitoring
	On the RNP PROGRESS page verify RNP for the approach.

TKK to TKR,
TKU to TKZ

3. For airplanes with NPS, verify that the vertical RNP is 125 feet. While there are no vertical RNP values published on the approach chart, the use of 125 feet will cause the NPS amber deviation exceedance alert to occur at 75 feet or slightly less deviation, since vertical ANP will be at least 50 feet at all times.

Landing Procedure

Pilot Flying	Pilot Monitoring
Initially: • If on radar vectors – HDG SEL	

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Pilot Flying	Pilot Monitoring
– Pitch mode (as needed) • If enroute to a fix – LNAV or other roll mode – VNAV or other pitch mode.	
	Notify the cabin crew to prepare for landing. Verify the cabin is secure.
Select TERR on map. Select CDU LEGS page.	Select TERR or WXR radar on map. Select RNP PROGRESS page.
Note: One pilot must have the map display in the 10 NM range to monitor path tracking during the final approach segment.	
Use LNAV and VNAV or other pitch mode for initial descent. VNAV is required FAF inbound. Some approach procedures can require use of VNAV from the IAF onward. On intercept heading, arm or verify LNAV.	
Call “FLAPS ___” according to the flap extension schedule or approach speed constraint.	Set the flap lever as directed.
Approximately 2 NM before the final approach fix and after ALT or VNAV PTH or VNAV ALT is annunciated: • set DA(H) on the MCP • select or verify VNAV • select or verify speed intervention.	Call “APPROACHING GLIDE PATH.”
Maximum Lateral Deviation (XTK ERROR): NPS amber indication or 1 × RNP. Maximum Vertical Deviation—FAF to DA: 75 feet. Monitor NPS.	
Maximum Lateral Deviation (XTK ERROR): 1 × RNP. Maximum Vertical Deviation—FAF to DA: 75 feet. Monitor RNP PROGRESS page.	
Approaching glidepath, 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.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

TKK to TKR, TKU to TKZ

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

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Pilot Flying	Pilot Monitoring
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 matches the charted value within 100 feet.	
Monitor the approach.	
If suitable visual reference is established at DA(H), disengage the autopilot. Maintain the glidepath to landing.	

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Note: If a go-around/missed approach is needed, track the required course manually using the trend vector and map until LNAV selected.

Instrument Approach Using Vertical Speed (V/S) or Flight Path Angle (FPA)

Pilot Flying	Pilot Monitoring
Initially: • If on radar vectors – HDG SEL – Pitch mode (as needed) • If enroute to a fix – LNAV or other roll mode – VNAV or other pitch mode.	
Call “FLAPS ___” according to the flap extension schedule.	Set the flap lever as directed.

Note: If required to remain at or above MDA(H) during the missed approach, missed approach must be initiated at least 50 feet above MDA(H).

Recommended roll modes:

- RNAV, GPS, LOC-BC, VOR or NDB approach: LNAV, TRK SEL, 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/TRK or HDG HOLD/TRK HOLD to intercept the final approach course, if needed.

Ensure appropriate navaids (VOR, LOC, or NDB) are tuned and identified before commencing the approach.

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Pilot Flying	Pilot Monitoring
Use LNAV or other roll mode to intercept the final approach course as needed.	
Approximately 2 NM before the final approach fix, set the first intermediate altitude constraint or MDA(H). If constraints or MDA(H) do not end in zero zero (00) for example, 1820, set the MCP ALTITUDE window to the closest 100 foot increment below the constraint or the closest 10 foot increment above the MDA(H). When the current constraint is assured, set the next constraint before ALT is engaged to achieve a continuous descent path.	Approximately 2 NM before the final approach fix, call "APPROACHING GLIDE PATH."
Call: • "GEAR DOWN" • "FLAPS 20"	Set the landing gear DN. Set the flap lever to 20.
Set the speedbrake lever to ARMED.	

At descent point:

Pilot Flying	Pilot Monitoring
Call “FLAPS ___” as needed for landing.	Set the flap lever as directed.

V/S or FPA switch . . . . . Push

Verify V/S or FPA mode annunciates.

Desired V/S or FPA . . . . . Set

Set desired V/S or FPA to descend to MDA(H). Use a V/S or FPA 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.

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After suitable visual reference is established:

A/P Disengage switch . . . . . Push

Disengage autopilot before descending below MDA(H).

Circling Approach

If a missed approach is needed at any time while circling, make an initial climbing turn toward the landing runway and intercept the missed approach course.

Configuration at MDA(H):

- Gear down
- Flaps 20 (landing flaps optional)
- Speedbrake armed.

MCP Altitude selector . . . . . Set

Accomplish an instrument approach, establish suitable visual reference, and level off at MDA(H).

Verify ALT or VNAV ALT mode annunciates.

Set ALT HOLD as needed.

MCP Altitude selector . . . . . Set Missed Approach Altitude

HDG SEL/TRK SEL switch . . . . . Push

Verify HDG SEL/HDG HOLD or TRK SEL/TRK HOLD mode annunciates.

Before starting the turn to base:

- Landing flaps (if not previously selected)
- Do the landing checklist.

Intercepting the landing profile:

Autopilot disengage switch . . . . . Push

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Flight Deck Communications System (Datalink)

The following procedures are one means which may be used to verify Pre-Departure Clearance, Digital-Automatic Terminal Information Service (D-ATIS), Oceanic Clearances, Weight and Balance and Takeoff Data messages transmitted via the COMPANY format.

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 that the D-ATIS altimeter setting numeric value and alpha value are identical. If the D-ATIS altimeter setting numeric value and alpha value are different, or the alpha value is not present, the flight crew must verify the altimeter setting by other means.

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 that the Weight and Balance numeric and alphabetic values are identical. If the Weight and Balance numeric and alphabetic values are different, the flight crew must not accept the Weight and Balance data.

Takeoff Data

The flight crew shall verify that the Takeoff Data numeric and alphabetic values are identical. If the Takeoff Data numeric and alphabetic values are different, the flight crew must not accept the Takeoff Data message.

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Electrical Power Down

The following procedure is accomplished to remove all electrical power from the airplane.

Before accomplishing the following steps, verify ADIRU, EMER LIGHTS, and PACK switches are off and HYD PRESS SYS L+C+R message is displayed.

APU selector and/or EXTERNAL POWER switch(es) . . . . . OFF

External power sources . . . . . Removed

Verify that the external power AVAIL lights are extinguished.

BATTERY switch . . . . . OFF

Electrical Power Up

The following procedure is accomplished to permit safe application of electrical power.

BATTERY switch . . . . . ON

C1 and C2 PRIMARY pump switches . . . . . OFF

DEMAND pump selectors . . . . . OFF

WIPER selectors . . . . . OFF

Landing gear lever . . . . . DN

ALTERNATE FLAPS selector . . . . . OFF

Electrical power . . . . . Establish

BUS TIE switches—AUTO

If external power is desired:

PRIMARY EXTERNAL POWER AVAIL light—Illuminated

PRIMARY EXTERNAL POWER switch—Push

If the SECONDARY EXTERNAL POWER AVAIL light is illuminated:

SECONDARY EXTERNAL POWER switch—Push

If APU power is desired:

APU GENERATOR switch—ON

APU selector—START, then ON

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APU Ground Pneumatic Start

Duct pressure . . . . . Observe

Observe duct pressure is a minimum of 15 PSI (less 1 PSI per 1,000 feet of pressure altitude).

Accomplish normal APU start.

Engine Battery Start

Accomplish the normal Exterior Inspection and the normal Preliminary Preflight Procedure—Captain or First Officer through “Circuit breakers……Check.”

BATTERY switch . . . . . ON

C1 and C2 PRIMARY pump switches . . . . . OFF

DEMAND pump selectors . . . . . OFF

WIPER selectors . . . . . OFF

Landing gear lever . . . . . DN

ALTERNATE FLAPS selector . . . . . OFF

STANDBY POWER switch (overhead maintenance panel) . . . . . Push to BAT, release to AUTO

Center bleed ISOLATION switch . . . . . OFF

Ground pneumatic source (if available) . . . . . Connect

If the APU is required for pneumatic power:

APU selector . . . . . START, then ON

Speedbrake lever . . . . . Down

Reverse thrust levers . . . . . Down

Thrust levers . . . . . Closed

Flap position indication and flap lever . . . . . Agree

Parking brake . . . . . Set

FUEL CONTROL switches . . . . . CUTOFF

Captain’s audio control panel . . . . . Set

Start the left engine using the normal Engine Start procedure. Bleed air is available only to the left engine.

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Limit start attempts to one autostart or two manual start attempts.

After left engine is started:

Ground pneumatic source (if used) . . . . . Disconnect

Center bleed ISOLATION switch . . . . . AUTO

Complete the normal Preflight, Before Start, and Engine Start procedures.

Engine Crossbleed Start

Do not accomplish a crossbleed start during pushback.

The APU must be shut down or the APU Bleed switch must be turned off.

Verify the area behind the airplane is clear of equipment and personnel before increasing thrust on operating engine.

Thrust lever (operating engine) . . . . . Advance

TKK to TKR, TKU to TKZ

Increase thrust until 5% N2 above idle (25 PSI minimum duct pressure).

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Increase thrust until 5% N3 above idle (25 PSI minimum duct pressure).

Accomplish normal engine start.

Engine Ground Pneumatic Start

Duct pressure . . . . . Observe

[Observe duct pressure is a minimum of 25 PSI (less 1 PSI per 1,000 feet of pressure altitude)].

Accomplish normal engine start.

Manual Engine Start

Do the Aborted Engine Start checklist for the following abort start conditions:

- there is no oil pressure rise before selecting RUN
- EGT exceeds limits

TKK to TKR, TKU to TKZ

- the EGT does not increase by 20 seconds after the FUEL CONTROL switch is moved to RUN

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

- the EGT does not increase by 30 seconds after the FUEL CONTROL switch is moved to RUN.

TKK to TKR, TKU to TKZ

- there is no N1 rotation indicated by 50% N2

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

- there is no N1 rotation indicated by 45% N3

TKK to TKR, TKU to TKZ

- N2 does not reach idle within two minutes after selecting RUN

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

- N3 does not reach idle within two minutes after selecting RUN.

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Select the secondary engine display. F/O

Start sequence . . . . . Announce C

AUTOSTART switch . . . . . OFF F/O

Call “START___ENGINE”. C

Engine START selector . . . . . START F/O

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

Verify EGT less than 100 degrees C. C TJA,B,C,D,G,H, TJR to TJW, TKA to TKF TKK to TKR, TKU to TKZ

When at maximum motoring (less than 1% increase in N2 for approximately 5 seconds):

FUEL CONTROL switch . . . . . RUN C

When at maximum motoring (less than 1% increase in N3 for approximately 5 seconds), or N3 greater than 25%, whichever occurs first: TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

FUEL CONTROL switch . . . . . RUN C

Observe initial EGT rise and EGT within limits. C,F/O

After the engine is stabilized at idle:

If AUTOSTART is operative:

AUTOSTART switch . . . . . ON F/O

The AUTOSTART switch may stay OFF between manual starts when both engines are to be started manually.

After the engine is stable at idle, start the other engine.

Manual Override Engine Start

Start the engine using normal engine start procedure, except direct the ground crew to: TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

- manually open the start valve after positioning START selector to START
- manually close the start valve at 50% N3.

Start the engine using normal engine start procedure, except direct the ground crew to: TKK to TKR, TKU to TKZ

- manually open the start valve after positioning START selector to START
- manually close the start valve at 62% N2.

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Heading Reference Switch Operation

Use TRUE when operating in regions where true referencing is needed.

Use NORM in all other regions.

HDG REF switch . . . . . NORM or TRUE

Notes: 1. Note: If using HDG SEL or TRK SEL and the HDG REF switch position is changed, the AFDS roll mode will change to HDG HOLD or TRK HOLD, respectively; HDG SEL or TRK SEL can be reselected.

2. If the HDG REF switch position must be changed for an approach, it must be changed before the APP mode is armed.

If the HDG REF switch position is changed after the APP mode is armed:

- the AFDS roll mode will not change from HDG SEL or TRK SEL to HDG HOLD or TRK HOLD, respectively
- the AFDS will not follow the MCP-selected heading
- LOC capture and tracking performance may be degraded
- exiting the APP mode restores normal operation of the HDG REF switch and the AFDS, APP mode can be reselected.

QFE Operation

Use this procedure when ATC altitude assignments are referenced to QFE altimeter settings.

Note: Do not use LNAV or VNAV.

INIT REF key . . . . . Push

<INDEX—Select

<APPROACH—Select

LANDING REF key—Select

Verify QFE selected.

[This sets the landing altitude to zero.]

Altimeters . . . . . Set

Set altimeters to QFE when below transition altitude/level.

If the QFE altimeter setting is beyond the range of the altimeters:

QNH procedures must be used with QNH set in the altimeters.

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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
- landing altitude indication (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.

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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 selector . . . . . Pull

Rotate to set the departure airport altitude manually. This reduces crew workload in the event of a return to the departure airport.

Do not accomplish the following checklist:

LANDING ALTITUDE

After engine start, override the LANDING ALTITUDE checklist.

Notes: 1. The LDG ALT flag is shown on the PFD.

2. The landing altitude indication (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 selector . . . . . Push

The FMC sets the destination altitude automatically.

VNAV key . . . . . Push

NEXT PAGE key . . . . . Push

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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 selector . . . . . Pull

Rotate to set the destination airport altitude manually.

Do not accomplish the following checklist:

LANDING ALTITUDE

Override the LANDING ALTITUDE checklist.

Notes: 1. The LDG ALT flag displays on the PFD.

2. The landing altitude indication (amber crosshatched area) does not display on the PFD altitude tape during landing.

3. The ARRIVALS page is not available for the destination airport.

Before Approach

NAV RAD key . . . . . Push

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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.

ADIRU Alignment/Position Update

If an ADIRU position update is desired during an automatic realignment (on ground only):

CDU . . . . . SET

When dash prompts appear on the SET INERTIAL POS line of the POS INIT page:

Enter the most accurate position.

If a manual ADIRU alignment is desired (on ground only):

ADIRU switch . . . . . OFF 30 seconds, then ON

Wait an additional 30 seconds.

CDU . . . . . SET

Enter the most accurate position in the boxes on the SET INERTIAL POS line of the POS INIT page.

Alignment requires from six to fifteen minutes depending on latitude (six minutes at the equator, ten minutes average).

FMS Position Update

When the FMC message VERIFY POSITION is displayed:

The FMC position may require updating.

POS REF page 2/3 . . . . . Select

POS REF 2/3 is the second page of POS INIT 1/3.

Compare the FMS positions with the displayed GPS, RADIO, and INERTIAL positions.

Select the most appropriate source for FMC position updating.

UPDATE ARM> . . . . . Select

The ARM prompt changes to ARMED and NOW prompts appear to the right of the remaining position sources.

Appropriate source UPDATE NOW> . . . . . Select

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Navaid Inhibit or Enable

Note: For terminal operations, if the airspace, FMC database, and charts are not referenced to the WGS-84 datum, inhibit GPS updates unless other appropriate procedures are used.

To inhibit GPS:

INIT REF key . . . . . Push

<INDEX . . . . . Select

<POS . . . . . Select

Displays the POS INIT page 1/3.

PREV PAGE key . . . . . Push

Displays the POS REF page 3/3.

GPS NAV . . . . . Select

Verify OFF displays in large font.

Note: The FMC uses inertial inputs only.

To enable radio updating:

INIT REF key . . . . . Push

<INDEX . . . . . Select

NAV DATA> . . . . . Select

Note: The default state of RAD NAV INHIBIT is ON; all radio updating is inhibited. ON displays.

RAD NAV INHIBIT . . . . . Select

Selection enables all radio updating. Verify OFF displays.

Second selection inhibits VOR/DME updating. Verify VOR displays. DME/DME updating is operable.

Third selection inhibits all radio updating; ON displays.

To inhibit VORs, VOR/DMEs, VORTACs, or DMEs:

INIT REF key . . . . . Push

<INDEX . . . . . Select

NAV DATA> . . . . . Select

To inhibit navaid data (up to two navaids):

Navaid identifier (NAVAID INHIBIT line) . . . . . Enter

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To inhibit VOR ONLY data (up to two VORs):

VOR identifier (VOR ONLY INHIBIT line) . . . . . Enter

RNP Manual Entry

The FMC automatically supplies default RNP values based on phase of flight. When the airplane is on a procedure or airway that has an RNP requirement, and does not have an RNP value stored in the navigation database, a manual RNP entry may be made.

POS REF page 2/3 . . . . . Select

POS REF 2/3 is the second page of POS INIT 1/3.

If the displayed RNP is different from the RNP for the current airway or procedure:

RNP . . . . . Enter

When the manually entered RNP is no longer required:

POS REF page 2/3 . . . . . Select

RNP . . . . . Delete

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Fuel Balancing

If fuel leak is suspected:

Accomplish the FUEL LEAK checklist.

If fuel balancing is desired prior to display of the FUEL IMBALANCE alert message:

Accomplish the FUEL IMBALANCE non-normal checklist.

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Introduction

Airplane operation in adverse weather conditions may require additional considerations due to the 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 (102 mm).

Cold Weather Operations

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 deg. C or below and any of the following exists:

- visible moisture (clouds, fog with visibility of one statute mile (1,600 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 engine anti-ice when OAT (on the ground) is above 10 deg. C. Do not use engine or wing anti-ice when TAT (in-flight) is above 10 deg. C.

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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 (3 mm) 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 and 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 static ports are clear.

Air conditioning inlets and exits . . . . . Check

Verify that the air inlets and exits, including the outflow valves, are free of snow and ice.

Engine inlets . . . . . Check

Verify that the inlet cowling is free of snow and ice.

Fuel tank vents . . . . . Check

Verify that all traces of ice and 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 must be free of snow and ice before APU start.

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Engine Start Procedure

Do the normal Engine Start Procedure with the following considerations:

TKK to TKR,
TKU to TKZ

- If the engine has been cold soaked for more than four hours at ambient temperatures below –40 deg. C, do not start or motor the engine. Maintenance personnel should do appropriate procedures for adverse weather heating of the 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
- displays may require additional warm-up time before displayed engine indications accurately show changing values. Displays may appear less bright than normal.

Engine Anti-ice Operation—On the Ground

Engine anti-ice must be selected ON immediately after both engines are started and remain on during all ground operations when icing conditions exist or are anticipated, except when the temperature is below –40 deg. C OAT.

WARNING: Do not rely on airframe visual icing cues before activating engine 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 engine anti-ice when OAT is above 10 deg. C.

When engine anti-ice is needed:

ENGINE ANTI-ICE selectors . . . . . ON F/O

When engine anti-ice is no longer needed:

ENGINE ANTI-ICE selectors . . . . . AUTO F/O

Before Taxi Procedure

Do the normal Before Taxi Procedure with the following modifications:

If there is snow or ice accumulation on the wing:

Consider delaying the flight control check until after de-icing/anti-icing is accomplished.

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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 flap drives to contamination. Leading edge devices are also susceptible to slush accumulations.

Call “FLAPS ___” as needed for takeoff. C

Flap lever . . . . . Set takeoff flaps, as needed F/O

Taxi–Out

CAUTION: Taxi at a reduced speed. Use smaller tiller and rudder inputs, and apply minimum thrust smoothly. Differential thrust may be used to help maintain airplane momentum during turns. At all other times, apply thrust evenly. Taxiing on slippery taxiways or runways at excessive speed or with high crosswinds may start a skid.

When engine anti-ice is required and the OAT is 3 deg. 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.

Run-up to a minimum of 50% N1 for approximately 1 second duration at intervals no greater than 60 minutes.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Engine Core Ice Shedding

Use the following core ice shed procedures when freezing fog with visibility 300 meters or less is reported.

If takeoff can be achieved within 45 minutes total taxi time:

Accomplish the existing Engine Anti-Ice Operation - On the Ground Supplementary Procedures prior to brake release for takeoff.

The core ice shed procedure is not required.

If takeoff cannot be achieved within 45 minutes total taxi time:

Accomplish the following core ice shed procedure:

- within 45 minutes total taxi time to clear the core ice from the engine
- at subsequent intervals no greater than every 45 minutes prior to takeoff.

If OAT is 0 deg. C to –6 deg. C:

Run-up to a minimum of 50% N1 for 60 seconds every 45 minutes.

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If OAT is –7 deg. C to –13 deg. C:

Run-up to a minimum of 59% N1 for 60 seconds every 45 minutes.

Note: Setting run-up thrust at 59% N1 is recommended as the takeoff Configuration Warning may be annunciated at 60% N1.

CAUTION: **Precautions must be taken for:**

- **Jet blast up to 900 feet (300 meters) behind the aircraft.**
- **Snow and ice at the edge of the taxi way that can be ingested by the engines.**
- **Slippery taxi surfaces.**
- **Airport noise restrictions.**

If OAT is below –13 deg. C:

There is no effective run-up procedure and manual de-icing is required.

Takeoff without accomplishing the core ice shedding procedure within 45 minutes total taxi time in freezing fog is permitted provided:

- the takeoff can be achieved within 60 minutes total taxi time in freezing fog
- a borescope inspection is performed within 10 flights
- a note is made in the log book of this condition.

Take off is not permitted if total taxi time in freezing fog with visibility 300 meters or less exceeds 60 minutes without having accomplished the above core ice shed procedure. The engine core must be manually de-iced.

Notes:

1. Total taxi time includes taxi-in time from the previous flight, if taxi-in occurred in freezing fog with visibility 300 meters or less and the temperature remains below freezing.
2. The engine may be considered free of ice prior to engine start if:
   - the engine is manually de-iced
   - visually inspected per the AMM
   - the above core ice shed run-up procedure is conducted within 5 minutes before engine shutdown during taxi-in.

If the engine is considered free of ice prior to engine start:

Use only the total taxi-out time.

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

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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 cause 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 areas.

PACK switches . . . . . OFF

Wait approximately 10 seconds after pack switches are off before positioning bleed switches to off to reduce pack wear.

ENGINE bleed switches (engines running) . . . . . OFF F/O

Reduces the possibility of fumes entering the air conditioning system.

APU bleed 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

Wait approximately one minute after de-icing is completed to restore engine and APU bleed air and pack operation to ensure all de-icing fluid has been cleared from the engines:

PACK switches . . . . . AUTO F/O

ENGINE bleed switches . . . . . ON F/O

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APU bleed switch . . . . . AUTO F/O

Flight Controls . . . . . Check, as needed C

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 because of slush, standing water, or icing conditions, or because exterior de-icing/anti-icing.

Engine oil temperature . . . . . Minimum 50 deg. C PF TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

Oil temperature must be at least 50 deg. C before takeoff.

Takeoff Procedure

Do the normal Takeoff Procedure with the following modification:

When engine anti-ice is required and the OAT is 3 deg. C or below:

The takeoff must be preceded by a static engine run-up. Use the following procedure:

Run-up to a minimum of 50% N1 and confirm stable engine operation before the start of the takeoff roll. TJA,B,C,D,G,H, TJR to TJW, TKA to TKF, TKK to TKR, TKU to TKZ

Note: Operation in icing conditions may result in engine vibration indications above the normal operating range during ice shedding.

Run-up to as high a thrust setting as practical (minimum of 50% N1), confirm stable engine operation, and if vibration indications are available, ensure engine vibration indications are below 4 units before the start of the takeoff roll. TKK to TKR, TKU to TKZ

Engine Anti-ice Operation—In-flight

Engine 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 deg. C SAT.

CAUTION: Do not use engine anti-ice when TAT is above 10 deg. C.

Manual Use of Engine Anti-ice

When using the engine anti-ice system manually in areas of possible icing, activate engine anti-ice before entering icing conditions.

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WARNING: **If using the engine anti-ice system manually, do not rely on airframe visual icing cues before activating engine 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 engine anti-ice is needed:

ENGINE ANTI-ICE selectors . . . . . ON PM

When manual use of engine anti-ice is no longer needed:

ENGINE ANTI-ICE selectors . . . . . AUTO or OFF PM

Fan Ice Removal

CAUTION: **Avoid prolonged operation in moderate to severe icing conditions.**

If moderate to severe icing conditions are encountered:

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

During flight in moderate to severe icing conditions for prolonged periods, if fan icing is suspected due to high engine vibration, the fan blades must be cleared of any ice. Do the following procedure on both engines, one engine at a time: quickly reduce thrust to idle for 5 seconds then restore the required thrust. If vibration persists, advance thrust lever to 90% N1 momentarily.

TKK to TKR, TKU to TKZ

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 15 minutes on both engines, one engine at a time: reduce thrust toward idle then increase to a minimum of 70% N1 for 10 to 30 seconds.

Note: Operation in icing conditions may result in displayed vibration levels up to and exceeding the normal operating range. Extended operation at high vibration levels in icing conditions will not result in engine damage.

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.

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.

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The secondary method is to select the WING ANTI-ICE selector ON when wing icing is possible and use the system as an anti-icer.

The airplane is capable of continued safe flight and landing in icing conditions in the event of an in-flight failure of the wing anti-ice system.

CAUTION: Do not use wing anti-ice when TAT is above 10 deg. C.

Manual Use of Wing Anti-ice

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

Refer to QRH.OI.2 Cold Temperature Altitude Corrections.

After Landing Procedure

CAUTION: Taxi at a reduced speed. Use smaller tiller and rudder inputs, and apply minimum thrust smoothly. Differential thrust may be used to help maintain airplane momentum during turns. At all other times, apply thrust evenly. 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 or taxiway contaminated with ice, snow, slush or standing water:
  - do not retract the flaps until the flap areas have been checked to be free of contaminants.
- engine 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 deg. C

WARNING: Do not rely on airframe visual icing cues before activating engine 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 engine anti-ice when OAT is above 10 deg. C.

When engine anti-ice is needed:

ENGINE ANTI-ICE selectors . . . . . ON F/O

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When engine anti-ice is no longer needed:

ENGINE ANTI-ICE selectors . . . . . AUTO F/O

When engine anti-ice is required and the OAT is 3 deg. 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.

Run-up to a minimum of 50% N1 for approximately 1 second duration at intervals no greater than 60 minutes.

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

When engine anti-ice is required and the OAT is 0 deg. C or below and freezing fog with visibility less than 300 meters (985 feet):

Do an engine run up, as needed, to minimize ice build-up. Use the following procedure:

Check that the area behind the airplane is clear. C

If reported OAT is 0 deg. C to –6 deg. C:

Run-up to a minimum of 50% N1 for for 60 seconds every 45 minutes.

If reported OAT is –7 deg. C to –13 deg. C:

Run-up to a minimum of 59% N1 for 60 seconds every 45 minutes.

Note: Setting run-up thrust at 59% N1 is recommended as the takeoff Configuration Warning may be annunciated at 60% N1.

If reported OAT is below –13 deg C:

Manual de-icing is required; there is no run-up procedure.

If the engine run-up is not accomplished within 5 minutes of engine shutdown, record taxi-in time since last engine run up.

Secure Procedure

Do the normal Secure Procedure with the following modifications:

If the airplane will be attended:

PACK switches . . . . . AUTO F/O

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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 switches . . . . . MAN F/O

OUTFLOW VALVE MANUAL switches . . . . . CLOSE F/O

Position the outflow valves fully closed to inhibit the intake of snow or 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 Chapter MT Maintenance Procedure.

Hot Weather Operation

During extended ground operations prior to flight deck preparation, consideration should be given to reducing the heat being generated on the flight deck. Window heat, radar, and other electronic components which contribute to a high temperature level on the flight deck may be turned off. All the flight deck air outlets should be open.

Both packs should be used (when possible) for maximum cooling. Recirculation fans should be on for maximum cooling capacity. To maximize the cooling capacity of the air conditioning system, the flight deck side windows and all doors, including cargo doors, should be kept closed as much as possible. All gasper outlets should be open and window shades on the hot (sun-exposed) side of the passenger cabin should be closed. Flight deck cooling can be improved by closing the flight deck door and lowering the side trays adjacent to the pilot seats.

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 probe is 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.

Moderate to Heavy Rain, Hail or Sleet

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 be avoided.

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Operation in a Sandy or Dusty Environment

The main hazards of a sandy or dusty environment are airplane surface erosion, especially of engine fan blades, accumulation of sand or dust on critical surfaces, and blockage. The effects of sand ingestion occur predominantly during takeoff, landing and taxi operations. The adverse effects, however, can occur if the airplane's flight path was through a cloud of visible sand or dust, or the airplane was parked during a sand or dust storm. Premature engine deterioration can result from sand or dust ingestion, causing increased fuelburn and reduced EGT margins.

CAUTION: After a sandstorm, if all taxiways and runways are not carefully inspected and swept for debris before flight ops are conducted, the risk of engine damage and wear is increased.

Exterior Inspection

Although removal of sand and dust contaminants is primarily a maintenance function, during the exterior inspection, the captain or first officer should carefully inspect areas where accumulation of sand or dust could change or affect normal system operations.

Do the normal Exterior Inspection with the following additional steps:

Windshield . . . . . Check

Verify that the windshield has been cleaned.

Note: Do not use windshield wipers for sand or dust removal.

Surfaces . . . . . Check

Verify that the upper surfaces of the wings and other control surfaces are free of sand.

CAUTION: Particular care should be taken to ensure that the fuselage and all surfaces are clean after a sand storm that occurs with a rain storm.

Air conditioning inlets and exits . . . . . Check

Verify that the air inlets and exits are free of sand and dust.

Verify that the cabin pressure outflow valves and both positive pressure relief valves are free of sand and dust.

Leading edge flaps . . . . . Check

Verify that all leading edges are undamaged.

Engine inlets . . . . . Check

Verify that the inlet cowling is free of sand and dust.

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Verify that the fan is free to rotate and fan blades are undamaged.

Fuel tank vents . . . . . Check

Verify that all vents are free of sand and dust.

Landing gear . . . . . Check

Verify that gear struts and doors are free of sand and dust build-up.

Vertical and horizontal stabilizers . . . . . Check

Verify that all leading edges are undamaged.

APU air inlet . . . . . Check

Ensure that the APU inlet door is free of sand and dust before APU start.

Preflight Procedure—First Officer

Do the normal Preflight Procedure—First Officer with the following modifications:

Note: Minimize the use of air conditioning, other than from a ground air conditioner, as much as possible. If the APU must be used for air conditioning, maintain a temperature as high as possible while still providing a tolerable flight deck and cabin environment.

APU bleed air switch . . . . . OFF F/O

If APU bleed air will be used and the APU is not operating:

APU . . . . . START, then ON F/O

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

Note: Run the APU for one full minute before using it as a bleed air source.

ENG BLEED switches . . . . . OFF F/O

APU bleed switch . . . . . AUTO F/O

Engine Start Procedure

Do the normal Engine Start Procedure with the following modifications:

Note: Use a filtered ground cart for pneumatic air for engine start, if available.

Engine START selector . . . . . START F/O

Verify that the N2 RPM increases. C,F/O

Allow maximum motoring for 2 minutes to help remove contaminants.

Note: Maximum motoring occurs when N2 acceleration is less than 1% in approximately 5 seconds.

TKK to TKR, TKU to TKZ

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TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Note: Maximum motoring occurs when N3 acceleration is less than 1% in approximately 5 seconds.

FUEL CONTROL switch . . . . . RUN C

Before Taxi Procedure

Do the normal Before Taxi Procedure with special emphasis on the following steps:

If bleed air is needed to maintain tolerable flight deck and cabin temperatures:

Use APU bleed air ratherthan engine bleed air during the taxi out. Limit APU bleed air use as much as possible to reduce sand and dust ingestion.

If APU bleed air will be used and the APU is not operating:

APU . . . . . START, then ON F/O

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

Note: Run the APU for one full minute before using it as a bleed air source.

ENG BLEED switches . . . . . OFF F/O

APU bleed switch . . . . . AUTO F/O

Flight controls . . . . . Check C

Verify that there is no increase in control forces due to sand or dust contaminants.

Taxi–Out

Do the following, if conditions allow, to minimize sand and dust ingestion by the engines and to improve visibility during taxi:

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

- Use all engines during taxi and taxi at low speed. Limit ground speed to 10 knots and maintain thrust below 40% N1 whenever possible to avoid creating a vortex during ground operations.

TKK to TKR, TKU to TKZ

- Use all engines during taxi and taxi at low speed. Limit ground speed to 10 knots and maintain thrust below 36% N1 whenever possible to avoid creating a vortex during ground operations.
- Maintain a greater than normal separation from other aircraft while taxiing and avoid the ingestion of another engine's wake.
- Avoid engine overhang of unprepared surfaces.
- Minimize thrust on the outboard side of the turn during 180° turns.
- In the event of a crosswind during 180° turns, turn away from the wind if possible to minimize sand and dust ingestion.

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- Whenever possible, avoid situations that would require the airplane to be brought to a complete stop.
- Avoid excessive braking. The presence of sand or dust will increase brake wear.

Before Takeoff Procedure

Do the normal Before Takeoff Procedure with the following modification:

If APU bleed air was used:

ENG BLEED switches . . . . . ON PM

APU selector . . . . . As needed PM

Takeoff

Do the following to minimize sand and dust ingestion by the engines during takeoff:

- Use the maximum assumed temperature thrust reduction that meets performance requirements.
- Before takeoff, allow sand and dust to settle if conditions allow.
- Do not take off into a sand or dust cloud.
- Use a rolling takeoff. Whenever possible, avoid setting high thrust at low speed.
- When visible sand and dust exist, consider delaying flap retraction until above the dust cloud, if operations permit.

Landing

Do the following to minimize sand and dust ingestion by the engines during landing:

- Use autobrakes on landing to help minimize the need for reverse thrust.
- If performance allows, minimize the use of reverse thrust to prevent ingestion of dust and sand and to prevent reduction of visibility. Reverse thrust is most effective at high speed

After Landing Procedure

Do the normal After Landing Procedure with the following modifications:

If bleed air is needed to maintain tolerable flight deck and cabin temperatures.:

Use APU bleed air ratherthan engine bleed air during the taxi in. Limit APU bleed air use as much as possible to reduce sand and dust ingestion

If APU bleed air will be used and the APU is not operating:

APU . . . . . START, then ON F/O

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

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Note: Run the APU for one full minute before using it as a bleed air source.

ENG BLEED switches . . . . . OFF F/O

APU bleed switch . . . . . AUTO F/O

Taxi-In

Do the following, if conditions allow, to minimize sand and dust ingestion by the engines and to improve visibility during the taxi-in:

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF TKK to TKR, TKU to TKZ

- Use all engines and taxi at low speed. Limit ground speed to 10 knots and maintain thrust below 40% N1 whenever possible.
- Use all engines during taxi and taxi at low speed. Limit ground speed to 10 knots and maintain thrust below 36% N1 whenever possible to avoid creating a vortex during ground operations .
- Maintain a greater than normal separation from other aircraft while taxiing and avoid the ingestion of another engine's wake.
- Avoid engine overhang of unprepared surfaces.
- In the event of a crosswind during 180° turns, turn away from the wind if possible to minimize sand and dust ingestion.
- Whenever possible, avoid situations that would require the airplane to be brought to a complete stop.
- Avoid excessive braking. The presence of sand or dust will increase brake wear.

Secure Procedure

Do the normal Secure Procedure with the following modifications:

OUTFLOW VALVE switches (both) . . . . . MAN F/O

OUTFLOW VALVE MANUAL switches (both) . . . . . CLOSE F/O

Position the outflow valves fully closed to inhibit the intake of sand and dust.

Additional procedures for securing the airplane during sandy or dusty conditions may be needed. These procedures are normally done by maintenance personnel, and include, but are not limited to:

- verify that engine covers, if applicable, are in place while the airplane is parked
- verify that airplane doors are closed
- verify that all openings are plugged or covered while the airplane is parked. Streamers should be used to remind personnel to remove before flight
- ensure all compartments are closed.

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Severe Turbulence

The turbulent air penetration speed provides ample protection from stall and high speed buffet, while also providing protection from exceeding the structural limit.

The recommended procedures for flight in severe turbulence are summarized below:

Passenger signs . . . . . ON

Advise passengers to fasten seatbelts prior to entering areas of reported or anticipated turbulence. Instruct flight attendants to check all passengers' seat belts are fastened.

Structural Considerations

Flap extension in an area of known turbulence should be delayed as long as possible because the airplane can withstand higher gust loads in the clean configuration. Diversion to another airfield is recommended if severe turbulence persists in the area.

Climb, Cruise, and Descent Considerations

After takeoff, and when established in a clean climb configuration, use of the autoflight system is recommended for flight through turbulence.

During climb and descent, use of VNAV or flight level change may result in excessive pitch changes as the AFDS attempts to fly speed with the elevators. Therefore, vertical speed mode (speed on autothrottles) is recommended for climb and descent in severe turbulence.

During cruise, VNAV and altitude hold modes both fly speed on autothrottles and can be used in turbulence.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

In severe turbulence during cruise, it may be necessary to disconnect the autothrottles to prevent excessive thrust changes. Thrust setting guidance is available on EICAS when VNAV is engaged. Set EPR at or slightly above the magenta VNAV target EPR indication. Change thrust setting only if required to modify an unacceptable speed trend.

TKK to TKR, TKU to TKZ

In severe turbulence during cruise, it may be necessary to disconnect the autothrottles to prevent excessive thrust changes. Thrust setting guidance is available on EICAS when VNAV is engaged. Set N1 at or slightly above the magenta VNAV target N1 indication. Change thrust setting only if required to modify an unacceptable speed trend.

Manual Flight in Severe Turbulence

If manual flight in severe turbulence becomes necessary, trim the airplane for the turbulent air penetration speed. 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.

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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 Non-Normal Maneuvers section 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 (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 an approach.

Precautions

If windshear is suspected, be 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.
- For optimum takeoff performance, use flaps 20 for takeoff unless limited by obstacle clearance and/or climb gradient. Flaps 15 may be used as a precautionary setting and will provide nearly equivalent performance to Flaps 20.
- Use the longest suitable runway provided it is clear of areas of known windshear.
- Use the flight director after takeoff.
- Consider increasing 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.

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- 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 and airspeed build-up. 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. If stick shaker is encountered, reduce pitch attitude. Do not exceed the Pitch limit Indication.

Approach and Landing

- Use either 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 the crosswind or tailwind limitations. Use electronic or visual glide path 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 15 knots.
- Avoid large thrust reductions or trim changes in response to sudden airspeed increases as these may be followed by airspeed decreases.
- Crosscheck flight director commands using vertical flight path 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 autopilot and autothrottle for the approach may provide more monitoring and recognition time.

Recovery

Accomplish the WINDSHEAR ESCAPE MANEUVER found in the Non-Normal Maneuvers section of this manual.

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Ice Crystal Icing (ICI)

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.

Ice crystal icing is 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.

Avoid ICI conditions. Flight in clouds containing high concentrations of ice crystals has been associated with engine vibration, engine power loss, engine damage, and airplane Total Air Temperature (TAT) probe icing.

Because these conditions can be difficult to recognize, careful preflight planning is a key component of in-flight situational awareness. When ICI is encountered or suspected, do the QRH Ice Crystal Icing NNC to mitigate the effect on the flight.

Recognizing Ice Crystal Icing

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 deg. C due to TAT probe icing.
- Areas of light to moderate turbulence.
- In IMC with:
  - no significant airframe icing and
  - 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).
- Smell of ozone or sulfur
- Humidity increase
- Static discharge around the windshield (St. Elmo’s fire)

Note: The icing conditions detection system does not detect ice crystal icing. It is designed to detect supercooled water only.

Avoiding Ice Crystal Icing

During flight in IMC, avoid flying directly over significant amber or red radar returns, even if there are no returns at airplane altitude.

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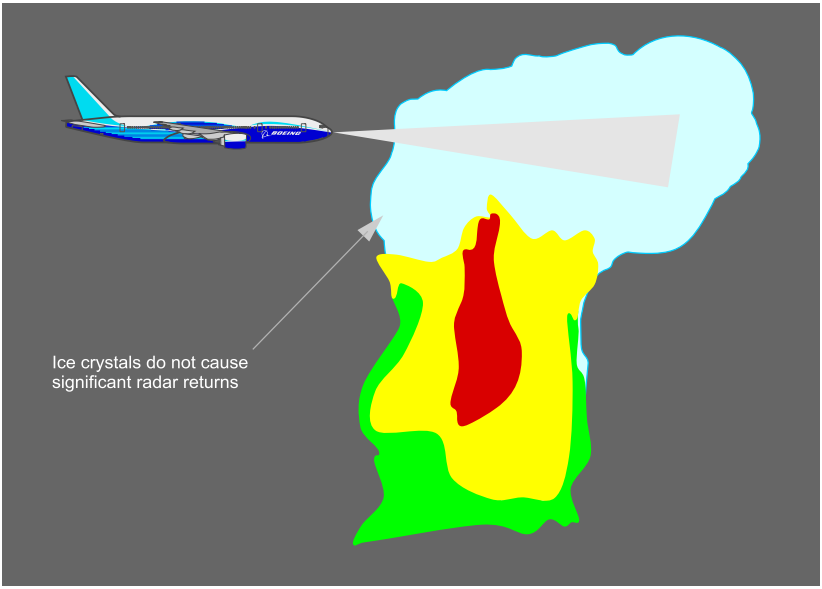
Use the weather radar controls to assess weather radar reflectivity below the airplane flight path. Refer to weather radar operating instructions for additional information.



Areas with higher risk of High Ice Water Content (HIWC) are identified by some aviation weather vendors. In these areas, ICI shoudl be suspected while operating in IMC. Use of this type of HIWC information is recommended for strategic preflight planning and in-flight adjustments in order to avoid potential ICI conditions.

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.

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777-200 TRENT875 KG M FAA TALPA PD.10

777-200ER TRENT892 KG M FAA TALPA PD.20

777-300 TRENT892 KG M FAA TALPA PD.30

777-300ER GE90-115BL KG M FAA TALPA PD.40

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Takeoff PD.13.1

Enroute PD.13.3

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Landing PD.13.5

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Takeoff Field Corrections

Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH (M) RUNWAY SLOPE (%)								
	–2.0	–1.5	–1.0	–0.5	0.0	0.5	1.0	1.5	2.0
1200	1250	1240	1230	1210	1200	1180	1150	1130	1100
1400	1470	1450	1430	1420	1400	1370	1330	1300	1270
1600	1690	1670	1640	1620	1600	1560	1520	1480	1430
1800	1910	1880	1850	1830	1800	1750	1700	1650	1600
2000	2130	2100	2060	2030	2000	1940	1880	1810	1750
2200	2350	2310	2270	2240	2200	2130	2050	1980	1900
2400	2570	2520	2480	2440	2400	2310	2230	2140	2050
2600	2780	2740	2690	2650	2600	2500	2400	2300	2200
2800	3000	2950	2900	2850	2800	2690	2580	2460	2350
3000	3220	3170	3110	3060	3000	2880	2750	2630	2500
3200	3440	3380	3320	3260	3200	3060	2930	2790	2650
3400	3660	3600	3530	3470	3400	3250	3100	2950	2800
3600	3880	3810	3740	3670	3600	3440	3280	3110	2950
3800	4100	4030	3950	3880	3800	3630	3450	3280	3100
4000	4320	4240	4160	4080	4000	3810	3630	3440	3250

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M) WIND COMPONENT (KTS)					
	–10	0	10	20	30	40
1200	970	1200	1280	1360	1450	1540
1400	1150	1400	1490	1580	1670	1770
1600	1330	1600	1690	1790	1890	1990
1800	1510	1800	1900	2000	2110	2210
2000	1690	2000	2110	2210	2320	2440
2200	1870	2200	2310	2430	2540	2660
2400	2050	2400	2520	2640	2760	2890
2600	2220	2600	2720	2850	2980	3110
2800	2400	2800	2930	3060	3200	3330
3000	2580	3000	3140	3280	3420	3560
3200	2760	3200	3340	3490	3640	3780
3400	2940	3400	3550	3700	3850	4010
3600	3120	3600	3760	3910	4070	4230
3800	3300	3800	3960	4130	4290	4450
4000	3480	4000	4170	4340	4510	4680

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Takeoff Field & Climb Limit Weights
Flaps 15
Sea Level Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	deg. C	–40	14	18	22	24	26	28	30	42	46	50
	deg. F	–40	57	64	72	75	79	82	86	108	115	122
1370	196.9		178.9	177.7	176.6	176.1	175.5	175.0	174.4	163.3	159.6	155.8
1400	199.8		181.5	180.3	179.2	178.6	178.1	177.5	176.9	165.7	161.9	158.1
1600	215.2		195.6	194.4	193.2	192.6	192.0	191.4	190.8	178.7	174.7	170.6
1800	229.2		208.6	207.2	205.9	205.3	204.7	204.0	203.4	190.7	186.5	182.1
2000	241.0		219.7	218.4	217.0	216.4	215.7	215.1	214.4	201.3	197.0	192.5
2200	252.2		230.4	229.0	227.6	226.9	226.3	225.6	224.9	211.4	206.9	202.3
2400	263.0		240.5	239.1	237.7	237.0	236.3	235.6	234.9	221.0	216.4	211.7
2600	273.3		250.2	248.7	247.2	246.5	245.8	245.1	244.4	230.1	225.4	220.5
2800	283.1		259.3	257.7	256.2	255.5	254.8	254.1	253.3	238.6	233.7	228.7
3000	292.3		267.6	266.1	264.5	263.8	263.0	262.3	261.5	246.3	241.2	236.1
3200	301.0		275.7	274.1	272.5	271.7	270.9	270.1	269.4	253.7	248.5	243.2
3400	309.5		283.4	281.7	280.1	279.3	278.5	277.7	276.9	260.8	255.5	250.0
3600	317.6		290.8	289.1	287.4	286.6	285.8	285.0	284.2	267.6	262.2	256.5
3800	325.3		297.9	296.1	294.4	293.6	292.7	291.9	291.1	274.1	268.5	262.8
4000	332.3		304.4	302.6	300.9	300.0	299.1	298.3	297.4	280.2	274.5	268.6
CLIMB LIMIT WT (1000 KG)	243.6		242.9	242.9	242.8	242.8	242.8	242.8	242.7	221.1	214.1	206.8

1000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	deg. C	–40	14	18	22	24	26	28	30	42	46	50
	deg. F	–40	57	64	72	75	79	82	86	108	115	122
1370	191.8		174.2	173.0	171.9	171.4	170.8	170.3	168.5	157.4	153.6	149.7
1400	194.5		176.7	175.5	174.4	173.9	173.3	172.8	170.9	159.7	155.9	151.9
1600	209.6		190.5	189.3	188.1	187.5	186.9	186.3	184.3	172.3	168.2	164.0
1800	223.2		203.1	201.8	200.6	200.0	199.3	198.7	196.6	183.9	179.6	175.2
2000	234.9		214.1	212.8	211.5	210.9	210.2	209.6	207.5	194.3	189.9	185.4
2200	246.0		224.6	223.3	221.9	221.3	220.6	220.0	217.7	204.2	199.7	195.0
2400	256.6		234.6	233.2	231.8	231.2	230.5	229.8	227.5	213.6	209.0	204.1
2600	266.7		244.1	242.6	241.2	240.5	239.8	239.1	236.8	222.5	217.7	212.7
2800	276.3		253.0	251.5	250.0	249.3	248.6	247.9	245.5	230.8	225.8	220.7
3000	285.2		261.1	259.6	258.1	257.4	256.6	255.9	253.4	238.2	233.1	227.8
3200	293.8		269.0	267.4	265.9	265.1	264.3	263.6	261.0	245.4	240.1	234.6
3400	302.0		276.6	274.9	273.3	272.5	271.8	271.0	268.4	252.2	246.8	241.2
3600	309.9		283.8	282.1	280.5	279.7	278.9	278.1	275.4	258.9	253.3	247.6
3800	317.4		290.7	288.9	287.3	286.5	285.6	284.8	282.1	265.1	259.5	253.6
4000	324.3		297.0	295.3	293.6	292.7	291.9	291.1	288.3	271.0	265.2	259.2
CLIMB LIMIT WT (1000 KG)	238.8		238.2	238.1	238.1	238.1	238.0	238.0	234.5	212.9	205.8	198.6

With engine bleed for packs off, increase field limit weight by 280 kg and climb limit weight by 1100 kg.
With engine anti-ice on, decrease field limit weight by 30 kg and climb limit weight by 50 kg.
With engine and wing anti-ice on, decrease field limit weight by 950 kg and climb limit weight by 1900 kg.

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Takeoff Field & Climb Limit Weights
Flaps 15
2000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	deg. C	–40	14	18	22	24	26	28	30	42	46	50
	deg. F	–40	57	64	72	75	79	82	86	108	115	122
1370	186.6	169.4	168.3	167.2	166.7	166.1	164.3	162.5	151.4	147.6	143.5	
1400	189.2	171.8	170.7	169.6	169.1	168.6	166.7	164.9	153.6	149.8	145.6	
1600	203.9	185.3	184.1	183.0	182.4	181.8	179.9	177.9	165.8	161.7	157.3	
1800	217.3	197.6	196.4	195.2	194.6	194.0	191.9	189.8	177.1	172.7	168.1	
2000	228.7	208.5	207.2	205.9	205.3	204.7	202.6	200.4	187.3	182.8	178.0	
2200	239.7	218.8	217.5	216.2	215.5	214.9	212.7	210.5	197.0	192.4	187.5	
2400	250.1	228.6	227.3	225.9	225.3	224.6	222.4	220.1	206.2	201.5	196.4	
2600	260.0	237.9	236.5	235.1	234.5	233.8	231.5	229.1	214.8	210.0	204.7	
2800	269.4	246.7	245.2	243.8	243.1	242.4	240.0	237.6	222.9	217.9	212.5	
3000	278.1	254.6	253.1	251.7	250.9	250.2	247.8	245.3	230.1	224.9	219.3	
3200	286.4	262.3	260.7	259.2	258.5	257.7	255.2	252.6	237.0	231.6	225.9	
3400	294.5	269.6	268.1	266.5	265.7	265.0	262.4	259.7	243.6	238.1	232.2	
3600	302.2	276.7	275.1	273.5	272.7	271.9	269.2	266.5	250.0	244.4	238.3	
3800	309.5	283.4	281.7	280.1	279.3	278.5	275.8	273.0	256.1	250.3	244.1	
4000	316.2	289.6	287.9	286.3	285.4	284.6	281.8	279.0	261.8	255.9	249.6	
CLIMB LIMIT WT (1000 KG)	234.0	233.3	233.2	233.2	233.1	233.1	229.7	226.1	204.6	197.5	190.4	

3000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	deg. C	–40	14	18	22	24	26	28	30	42	46	50
	deg. F	–40	57	64	72	75	79	82	86	108	115	122
1370	181.6	164.8	163.7	162.7	162.1	160.3	158.5	156.7	145.5	141.5	137.2	
1400	184.2	167.2	166.1	165.0	164.5	162.7	160.8	159.0	147.6	143.6	139.2	
1600	198.5	180.3	179.2	178.0	177.4	175.5	173.5	171.5	159.4	155.1	150.4	
1800	211.6	192.4	191.2	190.0	189.3	187.3	185.2	183.1	170.3	165.8	160.8	
2000	222.8	203.1	201.8	200.6	199.9	197.9	195.7	193.5	180.4	175.7	170.6	
2200	233.6	213.2	211.9	210.7	210.0	207.9	205.6	203.4	189.8	185.0	179.8	
2400	243.8	222.9	221.6	220.3	219.6	217.4	215.1	212.8	198.8	193.9	188.4	
2600	253.6	232.0	230.7	229.3	228.6	226.3	224.0	221.6	207.3	202.1	196.6	
2800	262.8	240.6	239.2	237.8	237.0	234.7	232.3	229.8	215.1	209.8	204.1	
3000	271.3	248.3	246.9	245.4	244.7	242.3	239.8	237.3	222.0	216.5	210.6	
3200	279.4	255.8	254.3	252.8	252.0	249.6	247.0	244.4	228.7	223.1	217.0	
3400	287.3	263.0	261.4	259.9	259.1	256.6	253.9	251.3	235.1	229.3	223.0	
3600	294.8	269.9	268.3	266.7	265.9	263.3	260.6	257.8	241.2	235.3	228.9	
3800	301.9	276.4	274.8	273.2	272.4	269.7	266.9	264.1	247.1	241.1	234.5	
4000	308.5	282.5	280.9	279.2	278.4	275.6	272.8	269.9	252.6	246.5	239.8	
CLIMB LIMIT WT (1000 KG)	229.3	228.6	228.6	228.5	228.4	225.0	221.5	217.9	196.6	189.5	182.6	

With engine bleed for packs off, increase field limit weight by 280 kg and climb limit weight by 1100 kg.
With engine anti-ice on, decrease field limit weight by 30 kg and climb limit weight by 50 kg.
With engine and wing anti-ice on, decrease field limit weight by 950 kg and climb limit weight by 1900 kg.

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Takeoff Obstacle Limit Weight

Flaps 15

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

Sea Level, 30 deg. C & Below, Zero Wind

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	229.0	245.0	255.1								
20	208.0	223.5	235.6	244.9	251.4	256.5					
40	189.4	204.5	217.3	227.2	235.1	241.5	246.4	250.7	254.0	256.7	259.0
60	175.8	191.3	203.8	214.1	222.4	229.2	234.9	239.6	243.5	247.0	250.2
80	165.6	180.7	193.1	203.4	212.0	219.1	225.1	230.3	234.7	238.4	241.7
100	157.1	171.8	184.1	194.3	203.0	210.4	216.7	222.1	226.8	230.9	234.5
120	149.2	164.1	176.2	186.5	195.2	202.6	209.2	214.8	219.7	224.0	227.9
140		157.4	169.4	179.5	188.3	195.8	202.4	208.2	213.3	217.8	221.8
160		151.2	163.2	173.3	182.1	189.7	196.3	202.1	207.4	212.1	216.2
180			157.5	167.6	176.3	184.0	190.7	196.7	201.9	206.7	211.0
200			152.4	162.4	171.1	178.8	185.6	191.6	196.9	201.7	206.1
220			147.5	157.6	166.3	174.0	180.8	186.9	192.3	197.1	201.5
240				153.2	161.8	169.5	176.3	182.4	187.9	192.8	197.3
260				149.0	157.6	165.3	172.1	178.2	183.8	188.8	193.3
Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.											

OAT Adjustment

OAT (deg. C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
30 & BELOW	0	0	0	0	0	0	0
32	–1.7	–2.1	–2.5	–2.9	–3.2	–3.6	–4.0
34	–3.4	–4.2	–4.9	–5.7	–6.5	–7.2	–8.0
36	–5.1	–6.3	–7.4	–8.6	–9.7	–10.8	–12.0
38	–6.8	–8.3	–9.9	–11.4	–12.9	–14.5	–16.0
40	–8.5	–10.4	–12.3	–14.3	–16.2	–18.1	–20.0
42	–10.2	–12.5	–14.7	–17.0	–19.2	–21.5	–23.7
44	–11.9	–14.5	–17.1	–19.7	–22.3	–24.9	–27.5
46	–13.5	–16.5	–19.4	–22.4	–25.4	–28.3	–31.3
48	–15.2	–18.5	–21.8	–25.1	–28.4	–31.7	–35.0
50	–16.9	–20.5	–24.2	–27.8	–31.5	–35.1	–38.8

Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
S.L. & BELOW	0	0	0	0	0	0	0
1000	–4.4	–5.3	–6.2	–7.2	–8.1	–9.0	–9.9
2000	–8.9	–10.6	–12.2	–13.9	–15.6	–17.2	–18.9
3000	–13.3	–15.7	–18.1	–20.5	–22.9	–25.3	–27.7

Wind Adjustment

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
15 TW	–17.8	–18.4	–19.0	–19.6	–20.2	–20.8	–21.4
10 TW	–11.9	–12.3	–12.7	–13.1	–13.5	–13.9	–14.3
0	0	0	0	0	0	0	0
10 HW	3.8	3.4	3.1	2.7	2.4	2.0	1.6
20 HW	7.6	6.9	6.2	5.4	4.7	4.0	3.3
30 HW	11.5	10.4	9.3	8.2	7.2	6.1	5.0
40 HW	15.4	13.9	12.5	11.0	9.6	8.1	6.7

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Takeoff Speeds

Flaps 15

V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	KIAS		
	V1	VR	V2
250	146	149	153
240	143	145	150
230	139	142	147
220	136	138	144
210	132	135	141
200	127	131	138
190	123	127	135
180	118	123	132
170	113	119	128
160	108	115	125
150	103	111	121
Check V1(MCG) and Minimum VR.			

V1, VR, V2 Adjustments*

TEMP		V1					VR					V2				
		PRESS ALT (FT)					PRESS ALT (FT)					PRESS ALT (FT)				
deg. C	deg. F	–2000	0	1000	2000	3000	–2000	0	1000	2000	3000	–2000	0	1000	2000	3000
50	122	3	4	5	6	8	1	2	2	3	4	–1	–1	–1	–1	–2
40	104	1	2	3	4	5	1	1	1	2	2	0	–1	–1	–1	–1
30	86	0	0	1	2	3	0	0	0	1	1	0	0	0	0	–1
20	68	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0
–40	–40	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0

Slope and Wind V1 Adjustments*

WEIGHT (1000 KG)	SLOPE (%)					WIND (KTS)							
	–2	–1	0	1	2	–5	–10	–5	0	10	20	30	40
260	–3	–1	0	2	2	–1	–1	0	0	0	1	1	1
240	–3	–2	0	2	2	–1	–1	0	0	0	1	1	1
220	–3	–1	0	2	2	–1	–1	0	0	0	1	1	2
200	–3	–1	0	2	2	–1	–1	0	0	0	1	1	2
180	–2	–1	0	2	2	–1	–1	0	0	0	1	1	2
160	–2	–1	0	2	2	–2	–1	0	0	0	1	2	2
*V1 not to exceed VR													

V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)									
		–2000		0		1000		2000		3000	
deg C	deg F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
50	122	106	107	104	105	103	103	101	102	99	100
40	104	110	111	108	109	106	107	105	105	103	103
30	86	113	113	112	113	110	111	109	109	107	107
20	68	113	113	112	113	111	112	110	111	109	110
–40	–40	114	114	113	113	112	112	111	111	110	110

Gear Down Dispatch

Takeoff Performance

Restriction/Recommendation

- Do not operate in icing conditions.

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- Takeoff with tailwind is not recommended.
- VMO/MMO limit is 270 kt/M 0.73.
- It is recommended to use flaps 5 and maximum thrust-rating for takeoff.
- Decrease the performance climb limited gross weight as follows:

Takeoff config	Flaps 5
Performance climb limited gross weight	-23%

Final Takeoff Condition

The flap retraction speed schedule is unchanged except:

- Final-Segment Climb-Speed: VREF + 60 KIAS.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 10 deg. C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
280	31800	–5	33200*	33200*	33200*	33200*	33200*
270	32600	–7	34300*	34300*	34300*	34300*	34200
260	33400	–8	35300*	35300*	35300*	35300*	35000
250	34200	–10	36100*	36100*	36100*	36100*	35800
240	35100	–12	36900*	36900*	36900*	36900*	36600
230	36000	–14	37700*	37700*	37700*	37700*	37500
220	36900	–14	38600*	38600*	38600*	38600*	38500
210	37900	–14	39500*	39500*	39500*	39500*	39400
200	38900	–14	40500*	40500*	40500*	40500*	40400
190	40000	–14	41600*	41600*	41600*	41600*	41500
180	41100	–14	42600*	42600*	42600*	42600*	42600
170	42300	–14	43000	43000	43000	43000	43000
160	43000	–14	43000	43000	43000	43000	43000
150	43000	–14	43000	43000	43000	43000	43000
140	43000	–14	43000	43000	43000	43000	43000

ISA + 15 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
280	31800	1	30800*	30800*	30800*	30800*	30800*
270	32600	–1	32700*	32700*	32700*	32700*	32700*
260	33400	–3	34000*	34000*	34000*	34000*	34000*
250	34200	–5	35200*	35200*	35200*	35200*	35200*
240	35100	–7	36100*	36100*	36100*	36100*	36100*
230	36000	–9	36800*	36800*	36800*	36800*	36800*
220	36900	–9	37700*	37700*	37700*	37700*	37700*
210	37900	–9	38600*	38600*	38600*	38600*	38600*
200	38900	–9	39500*	39500*	39500*	39500*	39500*
190	40000	–9	40600*	40600*	40600*	40600*	40600*
180	41100	–9	41600*	41600*	41600*	41600*	41600*
170	42300	–9	42800*	42800*	42800*	42800*	42800*
160	43000	–9	43000	43000	43000	43000	43000
150	43000	–9	43000	43000	43000	43000	43000
140	43000	–9	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
280	31800	7	27300*	27300*	27300*	27300*	27300*
270	32600	5	28600*	28600*	28600*	28600*	28600*
260	33400	3	30100*	30100*	30100*	30100*	30100*
250	34200	1	32700*	32700*	32700*	32700*	32700*
240	35100	–1	34700*	34700*	34700*	34700*	34700*
230	36000	–3	35700*	35700*	35700*	35700*	35700*
220	36900	–3	36400*	36400*	36400*	36400*	36400*
210	37900	–3	37300*	37300*	37300*	37300*	37300*
200	38900	–3	38200*	38200*	38200*	38200*	38200*
190	40000	–3	39200*	39200*	39200*	39200*	39200*
180	41100	–3	40300*	40300*	40300*	40300*	40300*
170	42300	–3	41400*	41400*	41400*	41400*	41400*
160	43000	–3	42500*	42500*	42500*	42500*	42500*
150	43000	–3	43000	43000	43000	43000	43000
140	43000	–3	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Trip 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
529	498	469	444	421	400	383	366	351	338	325
1051	990	934	884	840	800	766	735	706	680	656
1570	1480	1398	1325	1259	1200	1150	1104	1061	1022	987
2088	1970	1861	1765	1678	1600	1534	1473	1417	1365	1318
2605	2458	2324	2205	2098	2000	1919	1843	1773	1708	1649
3121	2946	2787	2645	2517	2400	2303	2212	2128	2051	1980
3635	3433	3249	305	2936	2800	2687	2582	2484	2394	2311
4147	3918	3709	3523	3355	3200	3071	2951	2840	2737	2643
4657	4402	4169	3961	3773	3600	3455	3321	3195	3080	2974
5166	4885	4628	4398	4191	4000	3840	3690	3551	3423	3305
5674	5367	5086	4836	4609	4400	4223	4059	3906	3765	3636
6180	5848	5544	5272	5027	4800	4607	4428	4261	4108	3967
6685	6328	6001	5709	5444	5200	4991	4797	4617	4450	4297
7190	6808	6458	6145	5861	5600	5375	5167	4972	4793	4628
7693	7287	6915	6581	6278	6000	5760	5536	5328	5136	4959
8195	7765	7370	7016	6695	6400	6144	5905	5683	5478	5290
8697	8243	7826	7452	7112	6800	6528	6274	6038	5821	5621
9199	8721	8282	7887	7529	7200	6911	6643	6394	6164	5952
9701	9199	8738	8323	7947	7600	7295	7012	6749	6506	6283
10204	9678	9194	8759	8364	8000	7679	7381	7104	6849	6614

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)							
	29		31		33		35	
	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)	FUEL (1000 KG)	TIME (HR:MIN)
400	6.9	1:05	6.7	1:04	6.7	1:03	6.7	1:03
800	12.4	2:00	12.1	1:58	11.9	1:56	11.7	1:56
1200	18.0	2:56	17.5	2:52	17.2	2:48	16.8	2:48
1600	23.7	3:50	23.0	3:45	22.5	3:40	22.1	3:40
2000	29.4	4:45	28.6	4:39	27.9	4:33	27.3	4:33
2400	35.3	5:38	34.3	5:31	33.5	5:23	32.8	5:23
2800	41.3	6:32	40.1	6:23	39.2	6:14	38.2	6:14
3200	47.4	7:24	46.0	7:14	44.9	7:05	43.9	7:05
3600	53.6	8:16	52.1	8:05	50.8	7:55	49.6	7:55
4000	59.9	9:08	58.1	8:56	56.7	8:45	55.4	8:45
4400	66.4	9:59	64.5	9:46	62.9	9:34	61.5	9:34
4800	72.9	10:50	70.8	10:36	69.0	10:23	67.6	10:23
5200	79.6	11:40	77.3	11:25	75.4	11:13	73.9	11:13
5600	86.5	12:29	84.0	12:14	81.9	12:02	80.4	12:02
6000	93.3	13:19	90.6	13:03	88.5	12:51	86.9	12:51
6400	100.5	14:08	97.7	13:52	95.4	13:41		
6800	107.7	14:57	104.7	14:41	102.4	14:30		
7200	115.0	15:46	111.9	15:30				
7600	122.5	16:35	119.4	16:19				
8000	130.1	17:24	126.9	17:08				

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Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	140	160	180	200	220
10	−1.2	−0.6	0.0	0.8	1.6
20	−2.4	−1.2	0.0	1.7	3.6
30	−3.6	−1.8	0.0	2.7	5.9
40	−4.8	−2.4	0.0	3.7	8.5
50	−6.0	−3.0	0.0	4.9	11.4
60	−7.3	−3.7	0.0	6.2	14.6
70	−8.6	−4.3	0.0	7.6	18.1
80	−9.9	−5.0	0.0	9.0	21.9
90	−11.2	−5.7	0.0	10.6	26.0
100	−12.6	−6.4	0.0	12.3	30.4
110	−14.0	−7.1	0.0	14.0	35.0
120	−15.4	−7.8	0.0	15.8	40.0
130	−16.9	−8.6	0.0	17.8	45.3
140	−18.4	−9.3	0.0	19.8	50.9

Based on 310/.84 climb, LRC cruise and .84/310/250 descent.

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Long Range Cruise Step Climb Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM) HEAD WIND COMPONENT (KTS)					GROUND DISTANCE (NM)	AIR DISTANCE (NM) TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
1040	981	928	881	839	800	765	732	703	675	650
1545	1461	1386	1318	1256	1200	1149	1102	1058	1018	981
2050	1941	1843	1754	1673	1600	1533	1471	1414	1361	1312
2555	2421	2300	2190	2091	2000	1917	1840	1769	1704	1643
3060	2900	2757	2627	2508	2400	2301	2209	2125	2047	1974
3565	3380	3214	3063	2925	2800	2685	2579	2481	2390	2306
4069	3859	3670	3499	3343	3200	3069	2948	2836	2733	2637
4574	4339	4127	3935	3760	3600	3453	3318	3192	3076	2968
5078	4818	4584	4371	4177	4000	3837	3687	3548	3419	3300
5582	5298	5041	4807	4595	4400	4221	4056	3904	3762	3631
6087	5777	5497	5243	5012	4800	4605	4426	4260	4106	3962
6591	6256	5954	5679	5429	5200	4989	4795	4616	4449	4294
7095	6735	6410	6115	5846	5600	5374	5165	4971	4792	4625
7599	7215	6867	6551	6264	6000	5758	5534	5327	5135	4957
8103	7694	7324	6987	6681	6400	6142	5904	5683	5479	5288
8607	8173	7780	7423	7098	6800	6526	6273	6039	5822	5620
9111	8652	8237	7859	7515	7200	6910	6643	6395	6165	5952
9615	9131	8693	8295	7933	7600	7294	7012	6751	6509	6283
10119	9610	9150	8731	8350	8000	7678	7382	7107	6852	6615

Trip Fuel and Time Required

AIR DIST (NM)	TRIP FUEL (1000 KG) LANDING WEIGHT (1000 KG)								TIME (HRS:MIN)
	140	150	160	170	180	190	200	210	
800	9.6	10.1	10.4	11.2	11.5	11.9	12.5	13.0	1:51
1200	13.6	14.3	14.9	15.7	16.4	17.1	17.9	18.7	2:41
1600	17.8	18.5	19.5	20.5	21.4	22.4	23.5	24.6	3:31
2000	21.9	22.9	24.1	25.4	26.6	27.9	29.2	30.5	4:21
2400	26.2	27.5	28.9	30.5	31.9	33.5	35.1	36.6	5:11
2800	30.5	32.1	33.8	35.6	37.4	39.2	41.1	42.9	6:00
3200	35.0	36.8	38.8	40.9	42.9	45.1	47.2	49.3	6:50
3600	39.5	41.7	43.9	46.3	48.7	51.0	53.5	55.9	7:40
4000	44.2	46.6	49.1	51.9	54.5	57.2	59.9	62.7	8:30
4400	49.0	51.6	54.5	57.5	60.4	63.5	66.6	69.7	9:19
4800	53.9	56.8	60.0	63.4	66.6	69.9	73.4	76.8	10:09
5200	58.9	62.1	65.7	69.3	72.8	76.5	80.3	84.1	10:58
5600	64.0	67.6	71.4	75.4	79.3	83.3	87.5	91.6	11:48
6000	69.2	73.2	77.3	81.6	85.9	90.3	94.8	99.2	12:38
6400	74.6	78.9	83.3	88.0	92.7	97.4	102.2	107.1	13:27
6800	80.1	84.7	89.5	94.6	99.6	104.7	109.9	115.1	14:17
7200	85.7	90.7	95.9	101.3	106.7	112.2	117.8		15:06
7600	91.5	96.8	102.4	108.3	114.0	119.9	125.9		15:56
8000	97.4	103.1	109.1	115.4	121.5	127.8	134.1		16:45

Based on 310/.84 climb, LRC and .84/310/250 descent.
Valid for all pressure altitudes with 4000 ft step climb to 2000 ft above optimum altitude.

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Short Trip 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
94	80	69	61	55	50	46	42	39	36	34
160	143	129	118	108	100	93	87	82	77	73
225	205	187	173	161	150	141	132	125	118	113
288	265	245	228	213	200	188	178	169	161	153
350	324	302	282	265	250	236	224	213	203	194
411	383	358	336	317	300	285	271	258	247	236
473	442	415	391	369	350	333	317	303	290	278
535	501	471	445	421	400	381	363	348	333	320
598	561	528	499	473	450	429	410	392	376	361
662	622	586	554	526	500	477	455	436	418	402

Trip Fuel and Time Required

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		140	160	180	200	220	
50	FUEL (1000 KG) ALT (FT)	1.5 9000	1.6 9000	1.7 9000	1.8 9000	1.9 8000	0:14
100	FUEL (1000 KG) ALT (FT)	2.3 18000	2.4 17000	2.6 17000	2.7 16000	2.9 16000	0:22
150	FUEL (1000 KG) ALT (FT)	3.0 25000	3.2 25000	3.8 24000	3.6 23000	3.8 22000	0:30
200	FUEL (1000 KG) ALT (FT)	3.6 32000	3.9 31000	4.1 30000	4.4 29000	4.7 28000	0:37
250	FUEL (1000 KG) ALT (FT)	4.2 37000	4.5 35000	4.8 34000	5.1 33000	5.4 32000	0:43
300	FUEL (1000 KG) ALT (FT)	4.7 40000	5.1 39000	5.4 38000	5.8 37000	6.2 36000	0:49
350	FUEL (1000 KG) ALT (FT)	5.2 42000	5.6 41000	6.0 39000	6.5 38000	6.9 36000	0:55
400	FUEL (1000 KG) ALT (FT)	5.7 42000	6.2 41000	6.6 40000	7.2 38000	7.6 36000	1:00
450	FUEL (1000 KG) ALT (FT)	6.2 42000	6.7 41000	7.2 40000	7.8 38000	8.4 36000	1:07
500	FUEL (1000 KG) ALT (FT)	6.7 42000	7.2 41000	7.8 40000	8.5 38000	9.1 36000	1:13

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Holding Planning
Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)									
	PRESSURE ALTITUDE (FT)									
	1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
260	7540	7450	7370	7150	7470	7650	7850	8110		
240	7120	7020	6920	6700	6750	6970	7120	7410		
220	6560	6460	6340	6280	6100	6330	6430	6620		
200	6020	5920	5780	5700	5520	5600	5750	5900	6260	
180	5640	5390	5260	5160	5100	4940	5150	5210	5530	5750
160	5130	5020	4760	4650	4580	4520	4430	4640	4880	5510
140	4660	4530	4390	4160	4070	4010	3880	3950	4190	4340

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
260	8070	7980	7710	7710	7870
240	7440	7350	7260	7180	7190
220	6970	6880	6760	6540	6540
200	6360	6270	6160	6070	5900
180	5910	5680	5570	5470	5290
160	5340	5230	5000	4900	4820
140	4800	4670	4550	4340	4250

These tables include 5% additional fuel for holding in a racetrack pattern.

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Crew Oxygen Requirements

Required Pressure (PSI) for One 114/115 Cubic Ft. Cylinder

BOTTLE TEMPERATURE		NUMBER OF CREW USING OXYGEN		
deg. C	deg. F	2	3	4
50	122	530	735	945
45	113	520	725	930
40	104	510	715	915
35	95	505	700	900
30	86	495	690	885
25	77	485	680	870
20	68	480	670	860
15	59	470	655	840
10	50	460	645	830
5	41	455	635	815
0	32	445	620	800
–5	23	440	610	785
–10	14	430	600	770
For more extensive than normal crew usage, add 1.2 psi/person/minute.				

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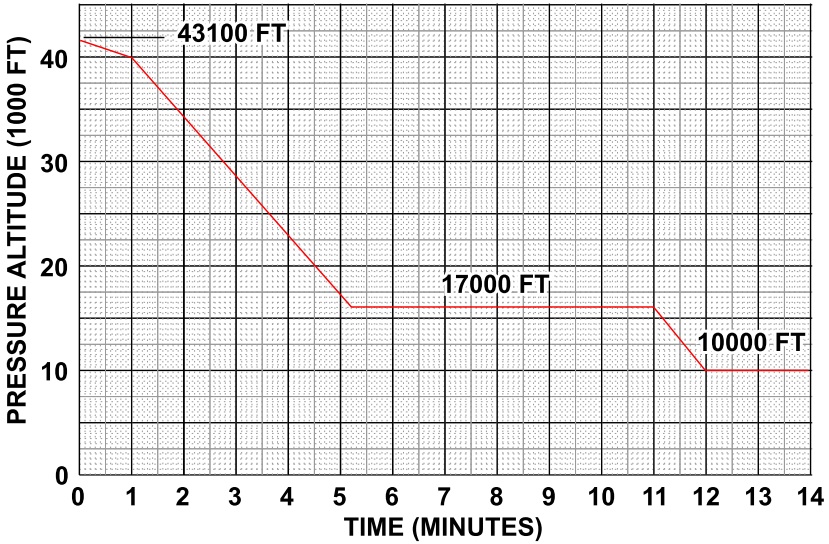
Oxygen Requirements
Passenger Oxygen System—Chemical
Maximum Altitude Envelope
Based on 12 Minute System



The passenger oxygen system will provide sufficient supplemental breathing oxygen for altitudes at or below this envelope.

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ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
28	145.5		
26	161.3	155.3	149.6
24	176.5	170.1	164.1
22	190.9	183.6	175.9
20	206.3	198.0	188.2
18	216.6	207.2	196.9
16	226.7	216.3	205.6
14	237.0	226.3	215.0
12	247.5	236.1	224.5
10	258.3	246.5	234.4
8	269.4	257.1	244.6
6	280.3	267.6	254.7
5	285.5	272.8	259.7

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG)										
	PRESSURE ALTITUDE (1000 FT)										
	6	8	10	12	14	16	18	20	22	24	26
ENGINE ONLY	–5.2	–5.5	–6.1	–5.6	–4.7	–4.1	–2.8	–1.6	–1.8	–1.3	–1.0
ENGINE AND WING	–6.5	–7.0	–7.7	–7.3	–6.6	–6.1	–4.9	–3.7	–3.8	–3.3	–3.0

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Landing Landing Field Limit Weight—Dry Runway
Flaps 30
Wind Adjusted Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	−15	−10	−5	0	10	20	30	40
1200				1200	1250	1350	1410	1500
1400		1130	1250	1400	1460	1560	1630	1730
1600	1200	1310	1440	1600	1670	1770	1860	1960
1800	1370	1490	1630	1800	1880	1980	2080	2190
2000	1540	1670	1830	2000	2090	2190	2300	2420
2200	1710	1860	2020	2200	2310	2400	2530	2650
2400	1880	2040	2210	2400	2520	2610	2750	2880
2600	2050	2220	2400	2600	2730	2820	2970	3110
2800	2220	2380	2580	2800	2940	3030	3190	3340
3000	2350	2530	2750	3000	3150	3240	3420	3570
3200	2480	2690	2930	3200	3360	3450	3640	3800
3400	2620	2840	3100	3400	3570	3660	3860	
3600	2750	3000	3280	3600	3780	3870		
3800	2880	3160	3450	3800				
4000	3010	3310	3620	4000				
4200	3140	3470	3800					
4400	3280	3620	3980					
4600	3410	3780	4150					
4800	3540	3940						
5000	3670	4090						

Field Limit Weight (1,000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1200	144.2	135.7			
1400	177.2	166.9	156.9	147.3	138.2
1600	210.9	198.6	186.7	175.4	164.8
1800	234.8	226.6	217.2	204.1	191.8
2000	253.9	245.1	236.4	227.9	219.2
2200	272.1	262.8	253.5	244.5	235.7
2400	289.3	279.5	269.9	260.4	251.0
2600	305.4	295.4	285.4	275.5	265.8
2800	321.0	310.4	300.1	289.9	279.8
3000		322.9	311.6	301.3	291.2
3200			322.1	311.3	300.9
3400				320.8	309.9
3600					318.6
3800					327.4

With 1 brake deactivated, decrease weight by 16,200 kg.
With 2 brakes deactivated, decrease weight by 32,900 kg.
With manual speedbrakes, decrease weight by 17,500 kg.

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Landing Field Limit Weight—Wet Runway
Flaps 30
Wind Adjusted Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	–15	–10	–5	0	10	20	30	40
1200						1350	1420	1520
1400				1400	1460	1570	1640	1750
1600		1290	1430	1600	1670	1780	1870	1980
1800	1350	1470	1620	1800	1880	1990	2090	2210
2000	1520	1650	1810	2000	2090	2200	2310	2440
2200	1690	1830	2000	2200	2300	2410	2540	2670
2400	1860	2020	2190	2400	2510	2620	2760	2900
2600	2030	2200	2390	2600	2720	2830	2980	3130
2800	2220	2380	2580	2800	2940	3040	3200	3360
3000	2370	2560	2757	3000	3150	3250	3430	3590
3200	2540	2720	2940	3200	3360	3460	3650	3820
3400	2670	2870	3120	3400	3570	3670	3870	4050
3600	2800	3030	3290	3600	3780	3880	4100	4280
3800	2940	3180	3470	3800	3990	4090	4320	
4000	3070	3340	3640	4000	4200			
4200	3200	3500	3820	4200				
4400	3330	3650	3990	4400				
4600	3460	3810	4170	4600				
4800	3600	3960	4340					
5000	3730	4120	4520					

Field Limit Weight (1,000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1400	147.1	138.4			
1600	175.8	165.5	155.6	146.1	137.0
1800	205.0	193.0	181.5	170.5	160.1
2000	228.7	219.3	207.9	195.4	183.5
2200	245.7	237.2	228.7	219.9	207.2
2400	262.0	252.9	244.0	235.2	226.7
2600	277.4	267.9	258.6	249.4	240.4
2800	292.1	282.3	272.6	263.0	253.6
3000	306.0	296.0	286.1	276.1	266.4
3200	319.6	309.1	298.8	288.7	278.6
3400		320.2	309.3	299.1	289.0
3600			318.5	307.8	297.6
3800				316.2	305.6
4000				324.5	313.3
4200					320.9

With 1 brake deactivated, decrease weight by 16,200 kg.
With 2 brakes deactivated, decrease weight by 32,900 kg.
With manual speedbrakes, decrease weight by 17,500 kg.

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Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		CLIMB LIMIT WEIGHT (1000 KG)			
		AIRPORT PRESSURE ALTITUDE (FT)			
deg. C	deg. F	0	1000	2000	3000
54	129	211			
50	122	219	210	201	
45	113	228	220	211	202
40	104	237	229	220	212
35	95	248	238	229	221
30	86	258	249	239	230
25	77	258	253	247	240
20	68	258	253	247	242
15	59	258	253	247	242
10 & BELOW	50 & BELOW	258	253	247	242

Based on engine bleed for packs on and engine anti-ice on or off and wing anti-ice off.
With packs off, increase allowable weight by 1200 kg.
With engine and wing anti-ice on, decrease allowable weight by 2300 kg.
Reduce allowable weight by 18,400 kg for ice accumulation when operating in icing conditions during any part of the flight with forecast landing temperatures below 10 deg. C.

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ENGINE INOP

ADVISORY INFORMATION

Go-Around Climb Gradient
Flaps 20, Gear Up
Based on engine bleed for packs on or off, engine anti-ice on or off and wing anti-ice off

OAT (deg. C)	REFERENCE GO-AROUND GRADIENT (%) PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
54	3.60					
50	4.06	2.99				
46	4.52	3.45	2.40			
42	4.98	3.91	2.86	1.90		
38	5.43	4.37	3.32	2.35	1.49	
34	5.89	4.83	3.78	2.79	1.91	1.07
30	6.35	5.28	4.23	3.23	2.31	1.47
26	6.36	5.73	4.69	3.68	2.71	1.84
22	6.36	5.74	5.14	4.12	3.13	2.23
18	6.36	5.74	5.14	4.55	3.55	2.60
14	6.37	5.75	5.15	4.56	3.96	2.99
10	6.37	5.75	5.15	4.56	3.96	3.35

Weight Adjustment

WEIGHT (1000 KG)	REFERENCE GO-AROUND GRADIENT (%)							
	1	2	3	4	5	6	7	8
220	–1.86	–2.05	–2.25	–2.44	–2.64	–2.85	–3.05	–3.26
200	–1.04	–1.15	–1.26	–1.37	–1.48	–1.59	–1.71	–1.83
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	1.33	1.47	1.60	1.75	1.89	2.06	2.22	2.39
140	3.08	3.39	3.71	4.05	4.40	4.77	5.15	5.55

Speed Adjustment

SPEED (KIAS)	WEIGHT ADJUSTED GO-AROUND GRADIENT (%)						
	0	2	4	6	8	10	12
VREF	–0.29	–0.30	–0.32	–0.32	–0.30	–0.29	–0.25
VREF+5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VREF+10	0.15	0.16	0.16	0.15	0.12	0.10	0.10
VREF+20	0.36	0.34	0.32	0.27	0.21	0.14	0.12
VREF+30	0.44	0.34	0.25	0.15	0.06	–0.03	–0.08

With engine and wing anti-ice on, decrease gradient by 0.1%.
When operating in icing conditions during any part of the flight with forecast landing temperatures below 10 deg. C, decrease gradient by 0.6%.

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Quick Turnaround Limit Weight
Flaps 30 Limit Weight (1,000 KG)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	235.4	226.3			
50	122	237.0	227.9	219.0	210.8	
45	113	238.9	229.8	220.9	212.5	204.5
40	104	241.0	231.8	222.7	214.3	206.3
35	95	243.1	233.8	224.7	216.0	208.0
30	86	245.2	235.9	226.6	217.9	209.7
25	77	247.4	238.0	228.7	219.7	211.4
20	68	249.7	240.1	230.8	221.7	213.3
15	59	252.0	242.4	232.9	223.7	215.1
10	50	254.5	244.6	235.1	225.8	217.1
5	41	257.0	247.0	237.4	228.0	219.0
0	32	259.5	249.4	239.7	230.2	221.1
–5	23	262.1	252.0	242.1	232.5	223.3
–10	14	265.6	254.6	244.5	234.9	225.5
–15	5	268.5	257.3	247.1	237.3	227.8
–20	–4	271.4	260.0	249.7	239.8	230.3
–30	–22	277.6	266.5	255.2	245.0	235.3
–40	–40	284.2	272.7	261.1	250.6	240.6
–50	–58	291.0	279.3	268.0	256.6	246.2
–54	–65	293.9	282.1	270.6	259.1	248.4

Increase weight by 2,100 kg per 1% uphill slope. Decrease weight by 5,100 kg per 1% downhill slope.
Increase weight by 5,800 kg per 10 knots headwind. Decrease weight by 35,200 kg per 10 knots tailwind.
Decrease weight by 13,200 kg when one brake is deactivated. Decrease weight by 27,300 kg when two brakes are deactivated.
After landing at weights exceeding those shown above, adjusted for slope and wind, wait at least 65 minutes and check that wheel thermal plugs have not melted before executing a takeoff.
As an alternate procedure, no waiting period is required if the BRAKE TEMP advisory message on EICAS is not displayed 10 to 15 minutes after parking.

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Performance Dispatch — Chapter PD
Text — Section 13

Introduction

This chapter contains self dispatch performance data intended primarily for use by flight crews in the event that information cannot be obtained from the airline dispatch office. The data provided is for a single takeoff flap at max takeoff thrust. The range of conditions covered is limited to those normally encountered in airline operation. 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.

Takeoff

The maximum allowable takeoff weight will be the least of the Field, Climb, and Obstacle Limit Weights as determined from the following tables. Tire and Brake Energy Limits are not shown as they are not limiting for the range of conditions shown in this chapter.

Field Limit Weight—Slope and Wind Corrections

These tables provide corrections to the field length available for the effects of runway slope and wind component along the runway. Enter the Slope Correction table with the available field length and runway slope to determine the slope corrected field length. Now enter the Wind Correction table with slope corrected field length and wind component to determine the slope and wind corrected field length.

Field and Climb Limit Weight

Tables are presented for selected airport pressure altitudes and show both Field and Climb Limit Weights. Enter the appropriate table for pressure altitude with “Slope and Wind Corrected Field Length” determined above and airport OAT to obtain Field Limit Weight. Also read Climb Limit Weight for the same OAT. Intermediate altitudes may be interpolated or use next higher altitude.

Obstacle Limit Weight

This table provides obstacle limit weights for reference airport conditions based on obstacle height above the runway surface and distance from brake release. Enter the correction tables to correct the reference Obstacle Limit Weight for the effects of OAT, pressure altitude and wind as indicated. In the case of multiple obstacles, enter the tables successively with each obstacle and determine the most limiting weight.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table as well as FMC computed takeoff speeds can be used for all performance conditions except where

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adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Normal takeoff speeds, V1, VR, and V2 are read from the table by entering with takeoff flap setting and brake release weight. Use the tables provided to correct takeoff speeds for altitude and actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind corrections to V1 are obtained by entering the Slope and Wind V1 Adjustment Table.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Brakes Deactivated

When operating with brakes deactivated, the runway/obstacle limit weight and the V1 must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway/obstacle limited weight by 2,900 kg and the V1 associated with the reduced weight by one knot. With two brakes deactivated, reduce the normal runway/obstacle limited weight by 6,200 kg and the V1 associated with the reduced weight by two knots. If the resulting V1 is less than V1(MCG), takeoff is permitted with V1 set equal to

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V1(MCG) provided the accelerate stop distance corrected for wind and slope exceeds approximately 1,410 m for one brake deactivated or 1,480 for two brakes deactivated.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

Enroute

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. Note that these tables consider 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 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5 g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43,100 ft.

Long Range Cruise Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination. Data is based on economy climb and descent speeds, and Long Range Cruise with normal engine bleed for air conditioning. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine trip fuel and time for a constant altitude cruise, 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 planned landing weight to obtain fuel required at the planned landing weight.

Long Range Cruise Step Climb Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination when flying a step climb profile. Step climb profiles are based on 4,000 ft step climbs to keep the flight within 2,000 ft of the optimum altitude for the current cruise weight. To determine trip fuel and time, enter the Ground to Air Miles Conversion table and determine air distance as discussed above. Then enter the Trip Fuel and Time required with air distance and planned landing weight to read trip fuel. Continue across the table to read trip time.

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Short Trip Fuel and Time

These tables are provided to determine trip fuel and time for short distances or alternates. The data considers the use of the FMC short trip optimum altitude. Obtain air distance from upper table using the ground distance and wind component to the alternate. Enter Trip Fuel and Time table with air distance and read trip fuel required for the expected landing weight, together with time to alternate at right. For distances greater than shown or other altitudes, use the Long Range Cruise Trip Fuel and Time tables.

Holding Planning

These tables provide total fuel flow information necessary for planning Flaps Up and Flaps 1 holding and reserve fuel requirements. Data is based on the FMC holding speed schedule which is the higher of the maximum endurance and flaps up maneuver speeds. As noted, the fuel flow is based on flight in a racetrack holding pattern. For holding in straight and level flight, reduce table values by 5%.

Oxygen Requirements

Flight Crew System

Regulations require that sufficient oxygen be provided to the flight crew to account for the greater of supplemental breathing oxygen in the event of a cabin depressurization or protective breathing in the event of smoke or harmful fumes in the flight deck. The oxygen quantity associated with these requirements is achieved with the minimum dispatch oxygen cylinder pressure. Enter the Crew Oxygen Requirements table with the number of crew plus observers using oxygen and read the minimum cylinder pressure required for the appropriate bottle temperature.

An additional quantity of oxygen is required when flight altitudes above 41,000 ft are planned. Regulations require that one active duty pilot must don the oxygen mask and breathe diluted oxygen for the duration of the flight above 41,000 ft. The additional quantity of oxygen required is 2.05 liters/person/minute (1.2 psi/person/minute for the single cylinder system), or 13 liters/person/minute (8 psi/person/minute) if 100% oxygen is selected during normal usage.

Net Level Off Weight

The Net Level Off Weight table is provided to determine terrain clearance capability in straight and level flight following an engine failure. Regulations require terrain clearance planning based on net performance which is the gross (or actual) gradient performance degraded by 1.1%. In addition, the net level off pressure altitude must clear the terrain by 1,000 ft.

To determine the maximum weight for terrain clearance, enter the table with required net level off pressure altitude and expected ISA deviation to obtain weight. Adjust weight for anti-ice operation as noted below the table.

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Landing

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for Flaps 30.

Maximum landing weight is the lowest of the field length limit weight, climb limit weight or maximum certified landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required.

Go-Around Climb Gradient

Enter the Reference Go-around Gradient table with airport OAT and pressure altitude to determine the reference Go-Around Gradient. Then adjust the reference gradient for airplane weight and speed using the tables provided to determine the weight and speed adjusted Go-Around Gradient. Apply the necessary engine bleed corrections as noted. Note that data is for one engine inoperative.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted adjustments as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent takeoff, or ensure the brake temperature is within limits using the alternate procedure described on the page.

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Takeoff Field Corrections PD.20.1

Takeoff Field & Climb Limit Weights PD.20.2

Takeoff Obstacle Limit Weight PD.20.5

Brake Energy Limits VMBE PD.20.7

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Long Range Cruise Maximum Operating Altitude PD.21.1

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Net Level Off Weight PD.21.13

Landing PD.22

Landing Landing Field Limit Weight—Dry Runway PD.22.1

Landing Field Limit Weight—Wet Runway PD.22.2

Landing Climb Limit Weight PD.22.3

Go-Around Climb Gradient PD.22.4

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Gear Down PD.23

Takeoff Climb Limit Weight PD.23.1

Landing Climb Limit Weight PD.23.2

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Takeoff Obstacle Limit Weight PD.23.3
Long Range Cruise Altitude Capability PD.23.5
Long Range Cruise Trip Fuel and Time PD.23.6
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Takeoff Field Corrections

Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH (M) RUNWAY SLOPE (%)								
	–2.0	–1.5	–1.0	–0.5	0.0	0.5	1.0	1.5	2.0
1200	1220	1220	1210	1210	1200	1180	1150	1130	1100
1400	1450	1440	1420	1410	1400	1370	1330	1300	1270
1600	1670	1660	1640	1620	1600	1560	1520	1480	1430
1800	1900	1880	1850	1830	1800	1750	1700	1650	1600
2000	2120	2090	2060	2030	2000	1940	1880	1820	1760
2200	2340	2310	2270	2240	2200	2130	2060	2000	1930
2400	2560	2520	2480	2440	2400	2320	2250	2170	2090
2600	2780	2740	2690	2650	2600	2510	2430	2340	2260
2800	3000	2950	2900	2850	2800	2710	2610	2520	2420
3000	3220	3170	3110	3060	3000	2890	2790	2680	2580
3200	3440	3380	3320	3260	3200	3080	2970	2850	2730
3400	3660	3600	3530	3470	3400	3270	3140	3020	2890
3600	3880	3810	3740	3670	3600	3460	3320	3180	3040
3800	4100	4030	3950	3880	3800	3650	3500	3350	3200
4000	4320	4240	4160	4080	4000	3840	3680	3520	3360
4200	4540	4460	4370	4290	4200	4030	3860	3680	3510
4400	4760	4670	4580	4490	4400	4220	4030	3850	3670
4600	4980	4890	4790	4700	4600	4410	4210	4020	3820
4800	5200	5100	5000	4900	4800	4600	4390	4190	3980
5000	5420	5320	5210	5110	5000	4780	4570	4350	4140

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M) WIND COMPONENT (KTS)							
	–15	–10	–5	0	10	20	30	40
1200	840	960	1080	1200	1270	1350	1440	1530
1400	1000	1140	1270	1400	1480	1570	1660	1760
1600	1170	1310	1460	1600	1690	1780	1880	1980
1800	1340	1490	1650	1800	1900	2000	2100	2210
2000	1510	1670	1840	2000	2100	2210	2320	2440
2200	1680	1850	2030	2200	2310	2430	2540	2660
2400	1850	2030	2220	2400	2520	2640	2770	2890
2600	2010	2210	2400	2600	2730	2860	2990	3120
2800	2180	2390	2590	2800	2930	3070	3210	3350
3000	2350	2570	2780	3000	3140	3290	3430	3570
3200	2520	2750	2970	3200	3350	3500	3650	3800
3400	2690	2930	3160	3400	3560	3710	3870	4030
3600	2860	3100	3350	3600	3770	3930	4090	4250
3800	3030	3280	3540	3800	3970	4140	4310	4480
4000	3190	3460	3730	4000	4180	4360	4530	4710
4200	3360	3640	3920	4200	4390	4570	4750	4930
4400	3530	3820	4110	4400	4600	4790	4980	5160
4600	3700	4000	4300	4600	4800	5000	5200	5390
4800	3870	4180	4490	4800	5010	5220	5420	5610
5000	4040	4360	4680	5000	5220	5430	5640	5840

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Takeoff Field & Climb Limit Weights
Flaps 15
Sea Level Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT											
	deg. C	–40	14	18	22	23	25	27	29	30	40	50
	deg. F	–40	57	64	72	73	77	81	84	86	104	122
1470	224.7		204.2	202.9	201.6	201.3	200.6	200.0	199.4	198.7	189.0	175.5
1600	235.2		213.9	212.6	211.3	210.9	210.3	209.6	209.0	208.3	198.2	184.2
1800	249.8		227.5	226.1	224.7	224.3	223.7	223.0	222.3	221.6	211.0	196.4
2000	263.2		240.0	238.5	237.1	236.7	236.0	235.3	234.6	233.9	222.8	207.7
2200	275.7		251.7	250.2	248.7	248.3	247.6	246.9	246.2	245.3	233.9	218.2
2400	287.6		262.8	261.2	259.7	259.3	258.5	257.8	257.0	256.2	244.4	228.2
2600	298.9		273.4	271.7	270.1	269.7	268.9	268.2	267.4	266.5	254.4	237.6
2800	309.8		283.5	281.8	280.2	279.8	279.0	278.2	277.4	276.5	264.0	246.7
3000	317.5		292.6	290.9	289.2	288.8	287.9	287.1	286.3	285.4	272.5	254.7
3200	317.5		301.1	299.3	297.6	297.1	296.3	295.5	294.6	293.7	280.5	262.3
3400	317.5		309.2	307.3	305.6	305.1	304.3	303.4	302.6	301.6	288.1	269.5
3600	317.5		316.9	315.0	313.2	312.8	311.9	311.0	310.1	309.2	295.4	276.4
3800	317.5		317.5	317.5	317.5	317.5	317.5	317.5	317.3	316.3	302.3	283.0
4000	317.5		317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	309.0	289.3
4200	317.5		317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	315.3	295.3
4400	317.5		317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	301.1
4600	317.5		317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	306.6
4800	317.5		317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	311.9
CLIMB LIMIT WT (1000 KG)	294.2		293.1	293.0	292.9	292.9	292.8	292.8	292.8	291.8	271.9	242.4

2,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT											
	deg. C	–40	14	18	22	23	25	27	29	30	40	50
	deg. F	–40	57	64	72	73	77	81	84	86	104	122
1470	211.3		191.9	190.7	189.5	189.2	188.6	187.3	185.7	184.9	175.4	162.9
1600	221.4		201.2	199.9	198.7	198.4	197.7	196.4	194.8	193.9	184.1	171.1
1800	235.3		214.2	212.8	211.5	211.2	210.6	209.2	207.5	206.6	196.2	182.7
2000	248.1		226.2	224.8	223.4	223.1	222.4	221.0	219.2	218.3	207.5	193.4
2200	260.1		237.4	236.0	234.5	234.2	233.5	232.0	230.1	229.2	218.0	203.4
2400	271.5		248.0	246.5	245.0	244.7	243.9	242.4	240.5	239.5	228.0	212.9
2600	282.3		258.1	256.5	255.0	254.6	253.9	252.3	250.3	249.3	237.4	221.9
2800	292.7		267.8	266.2	264.6	264.2	263.5	261.8	259.8	258.7	246.5	230.5
3000	302.1		276.4	274.8	273.1	272.7	272.0	270.3	268.2	267.1	254.5	238.0
3200	310.8		284.5	282.8	281.2	280.8	279.9	278.2	276.1	275.0	262.1	245.2
3400	317.5		292.2	290.5	288.8	288.4	287.6	285.8	283.6	282.5	269.3	252.0
3600	317.5		299.6	297.8	296.1	295.7	294.9	293.1	290.8	289.7	276.2	258.6
3800	317.5		306.6	304.8	303.1	302.6	301.8	300.0	297.7	296.5	282.8	264.9
4000	317.5		313.3	311.5	309.7	309.2	308.4	306.5	304.2	303.0	289.1	270.8
4200	317.5		317.5	317.5	316.0	315.6	314.7	312.8	310.5	309.3	295.1	276.6
4400	317.5		317.5	317.5	317.5	317.5	317.5	317.5	316.5	315.3	300.9	282.1
4600	317.5		317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	306.4	287.3
4800	317.5		317.5	317.5	317.5	317.5	317.5	317.5	317.5	317.5	311.7	292.3
CLIMB LIMIT WT (1000 KG)	278.2		277.1	277.1	277.0	277.0	276.9	274.8	271.7	270.1	250.9	224.7

With engine bleed for packs off, increase field limit weight by 280 kg and climb limit weight by 800 kg.
With engine anti-ice on, decrease field limit weight by 30 kg.
With engine and wing anti-ice on, decrease field limit weight by 750 kg and climb limit weight by 1,250 kg.

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Takeoff Field & Climb Limit Weights
Flaps 15
4,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	deg. C	-40	14	18	22	23	25	27	29	30	40	50
	deg. F	-40	57	64	72	73	77	81	84	86	104	122
1470	197.3		179.1	177.9	176.4	175.8	174.4	173.0	171.3	170.5	161.3	151.6
1600	206.8		187.9	186.7	185.1	184.4	183.0	181.6	179.9	179.0	169.4	159.3
1800	220.1		200.3	199.0	197.4	196.6	195.1	193.6	191.8	190.9	180.9	170.4
2000	232.3		211.7	210.4	208.7	207.9	206.4	204.8	202.9	202.0	191.5	180.6
2200	243.7		222.4	221.0	219.3	218.5	216.9	215.3	213.3	212.3	201.5	190.2
2400	254.5		232.5	231.1	229.2	228.4	226.8	225.1	223.1	222.1	210.9	199.2
2600	264.8		242.1	240.6	238.7	237.9	236.2	234.5	232.4	231.3	219.8	207.8
2800	274.7		251.3	249.8	247.8	247.0	245.2	243.5	241.3	240.2	228.4	215.9
3000	283.5		259.4	257.9	255.9	255.0	253.2	251.4	249.2	248.0	235.8	223.0
3200	291.8		267.1	265.5	263.5	262.6	260.7	258.9	256.6	255.4	242.9	229.8
3400	299.7		274.4	272.8	270.8	269.8	267.9	266.0	263.7	262.5	249.8	236.4
3600	307.2		281.5	279.8	277.7	276.8	274.8	272.9	270.5	269.3	256.3	242.6
3800	314.3		288.1	286.5	284.3	283.3	281.4	279.4	277.0	275.8	262.5	248.6
4000	317.5		294.5	292.8	290.6	289.6	287.6	285.6	283.2	281.9	268.4	254.3
4200	317.5		300.6	298.9	296.7	295.7	293.6	291.6	289.1	287.9	274.1	259.8
4400	317.5		306.5	304.7	302.5	301.4	299.4	297.3	294.8	293.5	279.6	265.0
4600	317.5		312.1	310.3	308.0	307.0	304.9	302.8	300.2	298.9	284.8	270.0
4800	317.5		317.4	315.6	313.3	312.2	310.1	308.0	305.4	304.1	289.8	274.8
CLIMB LIMIT WT (1000 KG)	259.6		258.6	258.6	257.6	256.5	254.1	251.5	248.3	246.7	228.8	209.8

6,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	deg. C	-40	14	18	22	23	25	27	29	30	40	50
	deg. F	-40	57	64	72	73	77	81	84	86	104	122
1470	183.9		166.8	165.5	163.7	163.3	161.8	160.3	158.7	157.9	149.4	140.1
1600	192.9		175.1	173.8	171.9	171.5	170.0	168.4	166.7	165.9	157.1	147.4
1800	205.5		186.9	185.5	183.5	183.1	181.5	179.8	178.1	177.2	168.0	157.9
2000	217.1		197.8	196.3	194.3	193.8	192.1	190.4	188.6	187.7	178.2	167.6
2200	228.0		208.0	206.4	204.4	203.9	202.1	200.3	198.5	197.5	187.7	176.7
2400	238.3		217.6	216.0	213.9	213.4	211.6	209.7	207.8	206.8	196.6	185.3
2600	248.0		226.7	225.1	222.9	222.4	220.5	218.6	216.6	215.6	205.1	193.4
2800	257.4		235.5	233.8	231.5	231.0	229.1	227.1	225.1	224.0	213.2	201.2
3000	265.8		243.1	241.4	239.1	238.5	236.5	234.5	232.4	231.3	220.2	207.8
3200	273.6		250.4	248.6	246.3	245.7	243.7	241.6	239.5	238.4	226.9	214.3
3400	281.1		257.4	255.6	253.2	252.6	250.5	248.4	246.2	245.1	233.4	220.5
3600	288.2		264.1	262.2	259.8	259.2	257.1	254.9	252.7	251.5	239.6	226.4
3800	295.0		270.5	268.6	266.0	265.4	263.3	261.1	258.8	257.7	245.5	232.1
4000	301.5		276.5	274.6	272.0	271.4	269.2	267.0	264.7	263.5	251.2	237.5
4200	307.7		282.4	280.4	277.8	277.2	275.0	272.7	270.3	269.1	256.6	242.7
4400	313.7		287.9	285.9	283.3	282.7	280.4	278.1	275.7	274.5	261.8	247.7
4600	317.5		293.3	291.2	288.5	287.9	285.6	283.3	280.9	279.6	266.7	252.4
4800	317.5		298.3	296.3	293.6	292.9	290.6	288.2	285.8	284.5	271.4	256.9
CLIMB LIMIT WT (1000 KG)	242.2		241.4	240.8	238.8	238.3	235.6	232.7	229.7	228.2	212.1	195.7

With engine bleed for packs off, increase field limit weight by 280 kg and climb limit weight by 800 kg.
With engine anti-ice on, decrease field limit weight by 30 kg.
With engine and wing anti-ice on, decrease field limit weight by 750 kg and climb limit weight by 1250 kg.

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Takeoff Field & Climb Limit Weights
Flaps 15
8,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)											
	OAT											
	deg. C	–40	14	18	22	23	25	27	29	30	40	50
	deg. F	–40	57	64	72	73	77	81	84	86	104	122
1470	171.7		155.5	153.4	151.4	150.9	149.7	148.2	146.6	145.8	137.2	128.4
1600	180.2		163.4	161.2	159.1	158.6	157.4	155.9	154.2	153.3	144.4	135.2
1800	192.2		174.6	172.3	170.1	169.6	168.3	166.7	164.9	164.0	154.7	145.1
2000	203.3		185.0	182.6	180.3	179.8	178.5	176.8	174.9	174.0	164.3	154.4
2200	213.7		194.7	192.2	189.9	189.3	188.0	186.3	184.3	183.4	173.3	163.0
2400	223.5		203.9	201.3	198.9	198.3	196.9	195.1	193.1	192.2	181.8	171.1
2600	232.8		212.6	210.0	207.5	206.9	205.4	203.6	201.5	200.5	189.8	178.8
2800	241.8		220.9	218.2	215.6	215.0	213.5	211.6	209.5	208.4	197.4	186.1
3000	249.6		228.2	225.4	222.7	222.1	220.5	218.6	216.4	215.3	203.9	192.3
3200	257.1		235.1	232.2	229.5	228.9	227.3	225.3	223.1	221.9	210.3	198.4
3400	264.2		241.8	238.8	236.0	235.4	233.8	231.7	229.5	228.3	216.4	204.2
3600	271.0		248.1	245.1	242.3	241.6	240.0	237.9	235.6	234.4	222.3	209.9
3800	277.5		254.2	251.1	248.3	247.6	245.9	243.8	241.4	240.2	227.9	215.2
4000	283.7		260.0	256.9	254.0	253.3	251.6	249.4	247.0	245.8	233.2	220.4
4200	289.6		265.6	262.4	259.4	258.7	257.0	254.8	252.3	251.1	238.4	225.3
4400	295.3		270.9	267.7	264.6	263.9	262.2	260.0	257.5	256.2	243.3	230.0
4600	300.8		276.0	272.7	269.6	268.9	267.2	264.9	262.4	261.1	248.0	234.5
4800	305.9		280.8	277.5	274.4	273.7	271.9	269.6	267.0	265.7	252.4	238.8
CLIMB LIMIT WT (1000 KG)	227.3		226.1	223.2	220.5	219.8	217.8	215.0	212.2	210.8	196.0	180.9

With engine bleed for packs off, increase field limit weight by 280 kg and climb limit weight by 800 kg.
With engine anti-ice on, decrease field limit weight by 30 kg.
With engine and wing anti-ice on, decrease field limit weight by 750 kg and climb limit weight by 1,250 kg.

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Takeoff Obstacle Limit Weight

Flaps 15

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

Sea Level, 29 deg. C & Below, Zero Wind

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	254.1	275.8	292.9	303.6	312.1						
20	235.0	254.0	269.9	283.1	293.5	300.5	306.0	310.5			
40	216.9	234.6	249.7	262.7	273.7	282.8	290.2	295.8	300.1	303.7	306.8
60	202.3	220.3	235.5	248.2	258.9	268.0	275.9	282.6	288.2	292.9	296.6
80	192.3	208.8	223.9	236.5	247.2	256.3	264.2	271.1	277.1	282.4	286.9
100	184.1	199.1	214.0	226.5	237.2	246.4	254.4	261.3	267.4	273.0	277.8
120	175.6	191.8	205.1	217.7	228.4	237.6	245.7	252.8	259.0	264.5	269.6
140	167.9	185.2	197.4	209.8	220.5	229.8	238.0	245.2	251.5	257.2	262.2
160	160.9	178.4	191.4	202.4	213.4	222.7	230.9	238.2	244.6	250.4	255.6
180	154.4	171.9	185.8	196.3	206.7	216.1	224.4	231.7	238.3	244.2	249.5
200		166.0	180.1	191.1	200.6	210.0	218.4	225.8	232.4	238.4	243.8
220		160.4	174.6	186.1	195.4	204.3	212.7	220.2	226.9	232.9	238.4
240		155.2	169.5	181.2	190.7	199.0	207.4	215.0	221.7	227.8	233.3
260			164.6	176.5	186.2	194.5	202.4	210.0	216.8	222.9	228.6
280			160.0	171.9	181.9	190.3	197.8	205.3	212.1	218.3	224.0
300			155.6	167.6	177.8	186.3	193.8	200.8	207.7	214.0	219.7

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustment

OAT (deg. C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
29 & BELOW	0	0	0	0	0	0	0	0
30	–1.1	–1.2	–1.4	–1.5	–1.6	–1.7	–1.9	–2.0
32	–3.3	–3.7	–4.1	–4.4	–4.8	–5.2	–5.6	–6.0
34	–5.5	–6.1	–6.8	–7.4	–8.0	–8.7	–9.3	–9.9
36	–7.7	–8.6	–9.5	–10.4	–11.3	–12.1	–13.0	–13.9
38	–9.9	–11.1	–12.2	–13.3	–14.5	–15.6	–16.7	–17.9
40	–12.1	–13.5	–14.9	–16.3	–17.7	–19.1	–20.5	–21.8
42	–15.7	–17.5	–19.4	–21.2	–23.0	–24.9	–26.7	–28.5
44	–19.3	–21.5	–23.8	–26.1	–28.4	–30.6	–32.9	–35.2
46	–22.8	–25.6	–28.3	–31.0	–33.7	–36.4	–39.1	–41.9
48	–26.4	–29.6	–32.7	–35.9	–39.0	–42.2	–45.4	–48.5
50	–30.0	–33.6	–37.2	–40.8	–44.4	–48.0	–51.6	–55.2

Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
S.L. & BELOW	0	0	0	0	0	0	0	0
1000	–6.7	–7.4	–8.1	–8.7	–9.4	–10.1	–10.8	–11.4
2000	–13.4	–14.8	–16.1	–17.5	–18.8	–20.2	–21.5	–22.9
3000	–20.6	–22.8	–25.0	–27.2	–29.4	–31.6	–33.8	–36.0
4000	–27.7	–30.8	–33.9	–36.9	–40.0	–43.0	–46.1	–49.2
5000	–33.8	–37.5	–41.3	–45.0	–48.7	–52.4	–56.1	–59.8
6000	–39.9	–44.3	–48.7	–53.0	–57.4	–61.8	–66.1	–70.5
7000	–45.4	–50.4	–55.4	–60.4	–65.4	–70.4	–75.4	–80.4
8000	–50.8	–56.5	–62.1	–67.8	–73.4	–79.1	–84.7	–90.4

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Takeoff Obstacle Limit Weight
Flaps 15
Wind Adjustment

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
15 TW	–28.4	–27.9	–27.5	–27.0	–26.5	–26.1	–25.6	–25.2
10 TW	–18.9	–18.6	–18.3	–18.0	–17.7	–17.4	–17.1	–16.8
5 TW	–9.5	–9.3	–9.2	–9.0	–8.8	–8.7	–8.5	–8.4
0	0	0	0	0	0	0	0	0
10 HW	3.2	3.0	2.8	2.6	2.3	2.1	1.9	1.7
20 HW	6.4	5.9	5.5	5.1	4.7	4.3	3.9	3.4
30 HW	9.8	9.1	8.5	7.8	7.1	6.5	5.8	5.2
40 HW	13.2	12.3	11.4	10.5	9.6	8.7	7.8	6.9

With engine bleed for packs off, increase weight by 300 kg.
With engine and wing anti-ice on, decrease weight by 1,400 kg.

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Brake Energy Limits VMBE
Maximum Brake Energy Speed

OAT (deg. C)	REFERENCE VMBE (KIAS)					
	PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
54	198	190				
50	198	191	184			
46	199	191	185	178		
42	200	192	185	179	172	
38	200	193	186	180	173	167
34	202	194	187	180	174	168
30	203	194	188	181	175	169
26	205	196	189	182	176	170
22	207	198	190	184	177	171
18	208	199	192	185	178	172
14	210	201	194	186	180	173
10	210	203	195	188	181	174
6	210	205	197	190	183	176
2	210	207	199	191	184	177
–2	210	209	201	193	186	179
–6	210	210	202	195	188	180
–10	210	210	204	197	189	182

Weight Adjusted VMBE

WEIGHT (1000 KG)	REFERENCE VMBE (KIAS)										
	160	165	170	175	180	185	190	195	200	205	210
160	205	210	210	210	210	210	210	210	210	210	210
170	196	202	209	210	210	210	210	210	210	210	210
180	188	194	201	207	210	210	210	210	210	210	210
190	182	188	194	200	206	210	210	210	210	210	210
200	177	183	188	194	200	206	210	210	210	210	210
210	172	178	183	189	194	200	205	210	210	210	210
220	168	173	178	184	189	195	200	205	210	210	210
230	164	169	174	179	184	190	195	200	205	210	210
240	160	165	170	175	180	185	190	195	200	205	210
250	156	161	166	171	176	181	185	190	195	200	205
260	153	158	162	167	172	177	181	186	191	195	200
270	150	155	159	164	168	173	177	182	187	191	196
280	147	152	156	161	165	169	174	178	183	187	192
290	145	149	153	158	162	166	171	175	179	183	188
300	142	147	151	155	159	163	167	172	176	180	184
310	140	144	148	152	156	161	165	169	173	177	181

Increase VMBE by 3 knots per 1% uphill runway slope. Decrease VMBE by 5 knots per 1% downhill runway slope.
Increase VMBE by 5 knots per 10 knots headwind. Decrease VMBE by 21 knots per 10 knots tailwind.
Decrease VMBE by 10 knots for one brake deactivated and 20 knots for two brakes deactivated.
Decrease brake release weight by 1600 kg for each knot V1 exceeds VMBE.
Determine normal V1, VR, V2 speeds for lower brake release weight.

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Takeoff Speeds
Flaps 15
V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	FLAPS 15		
	V1	VR	V2
300	157	162	168
290	153	159	165
280	150	156	163
270	147	153	160
260	144	150	157
250	140	146	154
240	137	143	152
230	133	139	149
220	129	136	146
210	126	132	143
200	121	129	140
190	117	125	136
180	112	121	133
170	107	117	130
160	103	113	126
150	98	108	123
140	93	104	119
Check V1(MCG), minimum VR and minimum V2.			

V1, VR, V2 Adjustments*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
deg. C	deg. F	–2	0	2	4	6	8	–2	0	2	4	6	8	–2	0	2	4	6	8
60	140	7	8	10	12	3	4	5	6	–2	–2	–3	–3						
50	122	4	5	7	9	11	13	2	2	3	4	5	6	–1	–1	–2	–2	–3	–3
40	104	1	2	4	7	8	10	1	1	2	3	4	5	0	–1	–1	–2	–2	–3
30	86	0	0	2	5	7	9	0	0	1	2	4	5	0	0	–1	–1	–2	–2
20	68	0	0	1	3	6	7	0	0	1	2	3	4	0	0	0	–1	–1	–2
–60	–76	0	0	1	3	5	7	0	0	1	2	3	4	0	0	0	–1	–1	–2

Slope and Wind V1 Adjustments*

WEIGHT (1000 KG)	SLOPE (%)					WIND (KTS)							
	–2	–1	0	1	2	–15	–10	–5	0	10	20	30	40
300	–5	–2	0	2	4	–2	–1	–1	0	0	1	1	2
280	–4	–2	0	2	4	–2	–1	0	0	0	1	1	2
260	–4	–2	0	2	3	–2	–1	0	0	0	1	1	2
240	–3	–1	0	2	3	–2	–1	0	0	0	1	1	2
220	–3	–1	0	2	3	–2	–1	0	0	0	1	1	2
200	–3	–1	0	2	3	–2	–1	0	0	0	1	1	2
180	–3	–1	0	2	3	–2	–1	0	0	1	1	2	2
160	–3	–1	0	2	3	–2	–1	0	0	1	1	2	2
140	–3	–1	0	2	3	–2	–1	0	0	1	1	2	2
*V1 not to exceed VR.													

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Takeoff Speeds
Flaps 15
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		–2000		0		2000		4000		6000		8000	
deg. C	deg. F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	113	114	109	111	108	109	106	108				
50	122	115	116	112	114	108	110	106	108	104	106	101	104
40	104	121	122	118	119	114	115	109	110	105	107	101	104
30	86	123	124	122	123	118	119	113	114	108	110	104	106
20	68	123	124	123	123	119	120	115	117	111	113	107	109
–60	–76	124	124	124	124	120	121	116	117	112	113	109	110

Minimum V2
Max Takeoff Thrust

PRESSURE ALTITUDE (FT)	–2000	0	2000	4000	6000	8000
SPEED (KIAS)	119	118	116	115	113	111

Gear Down Dispatch

Takeoff Performance

Restriction/Recommendation

- Do not operate in icing conditions.
- Takeoff with tailwind is not recommended.
- VMO/MMO limit is 270 kt/M 0.73.
- It is recommended to use flaps 5 and maximum thrust-rating for takeoff.
- Decrease the performance climb limited gross weight as follows:

Takeoff config	Flaps 5
Performance climb limited gross weight	-23%

Final Takeoff Condition

The flap retraction speed schedule is unchanged except:

Final-Segment Climb-Speed: VREF + 60 KIAS.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 10 deg. C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	–1	33500*	33500*	33500*	33400	31900
290	31100	–3	34300*	34300*	34300*	34100	32700
280	31800	–5	35200*	35200*	35200*	34900	33400
270	32600	–7	36100*	36100*	36100*	35600	34200
260	33400	–8	36800*	36800*	36800*	36400	35000
250	34200	–10	37600*	37600*	37600*	37200	35800
240	35100	–12	38400*	38400*	38400*	38100	36600
230	36000	–14	39300*	39300*	39300*	39000	37500
220	36900	–14	40200*	40200*	40200*	39900	38500
210	37900	–14	41100*	41100*	41100*	40900	39400
200	38900	–14	42100*	42100*	42100*	41900	40400
190	40000	–14	43000	43000	43000	42900	41500
180	41100	–14	43000	43000	43000	43000	42600
170	42300	–14	43000	43000	43000	43000	43000
160	43000	–14	43000	43000	43000	43000	43000
150	43000	–14	43000	43000	43000	43000	43000
140	43000	–14	43000	43000	43000	43000	43000

ISA + 15 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	4	32500*	32500*	32500*	32500*	31900
290	31100	3	33400*	33400*	33400*	33400*	32700
280	31800	1	34300*	34300*	34300*	34300*	33400
270	32600	–1	35200*	35200*	35200*	35200*	34200
260	33400	–3	36100*	36100*	36100*	36100*	35000
250	34200	–5	36900*	36900*	36900*	36900*	35800
240	35100	–7	37700*	37700*	37700*	37700*	36600
230	36000	–9	38600*	38600*	38600*	38600*	37500
220	36900	–9	39500*	39500*	39500*	39500*	38500
210	37900	–9	40400*	40400*	40400*	40400*	39400
200	38900	–9	41400*	41400*	41400*	41400*	40400
190	40000	–9	42400*	42400*	42400*	42400*	41500
180	41100	–9	43000	43000	43000	43000	42600
170	42300	–9	43000	43000	43000	43000	43000
160	43000	–9	43000	43000	43000	43000	43000
150	43000	–9	43000	43000	43000	43000	43000
140	43000	–9	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	10	31100*	31100*	31100*	31100*	31100*
290	31100	8	32100*	32100*	32100*	32100*	32100*
280	31800	7	33100*	33100*	33100*	33100*	33100*
270	32600	5	34100*	34100*	34100*	34100*	34100*
260	33400	3	35100*	35100*	35100*	35100*	35000
250	34200	1	36100*	36100*	36100*	36100*	35800
240	35100	–1	36800*	36800*	36800*	36800*	36600
230	36000	–3	37700*	37700*	37700*	37700*	37500
220	36900	–3	38600*	38600*	38600*	38600*	38500
210	37900	–3	39500*	39500*	39500*	39500*	39400
200	38900	–3	40500*	40500*	40500*	40500*	40400
190	40000	–3	41500*	41500*	41500*	41500*	41500
180	41100	–3	42600*	42600*	42600*	42600*	42600
170	42300	–3	43000	43000	43000	43000	43000
160	43000	–3	43000	43000	43000	43000	43000
150	43000	–3	43000	43000	43000	43000	43000
140	43000	–3	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Trip 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
1051	990	934	885	840	800	767	736	707	680	656
1571	1480	1398	1325	1260	1200	1151	1105	1062	1023	987
2089	1971	1863	1766	1680	1600	1535	1474	1417	1366	1318
2606	2459	2325	2206	2099	2000	1919	1843	1773	1708	1649
3121	2946	2787	2645	2517	2400	2303	2213	2129	2051	1980
3635	3433	3248	3084	2936	2800	2688	2583	2485	2394	2311
4147	3918	3709	3523	3355	3200	3072	2952	2840	2737	2643
4657	4402	4169	3961	3773	3600	3456	3321	3196	3080	2974
5166	4885	4628	4398	4191	4000	3839	3690	3551	3423	3305
5674	5367	5086	4836	4609	4400	4224	4059	3907	3766	3636
6181	5849	5545	5273	5027	4800	4608	4429	4262	4108	3967
6686	6329	6002	5709	5444	5200	4992	4798	4617	4451	4298
7190	6809	6459	6146	5862	5600	5376	5167	4973	4794	4629
7693	7288	6915	6582	6279	6000	5761	5537	5329	5137	4960
8196	7766	7371	7017	6696	6400	6145	5906	5684	5479	5291
8698	8244	7827	7453	7113	6800	6528	6275	6039	5822	5622
9200	8721	8282	7888	7530	7200	6913	6644	6395	6164	5953
9702	9199	8738	8323	7947	7600	7297	7014	6751	6508	6285
10204	9677	9194	8759	8365	8000	7681	7383	7106	6850	6615

Reference Fuel and Time Required

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)
800	12.4	2:00	12.1	1:58	11.9	1:56	11.7	1:54	11.5	1:52
1200	17.9	2:56	17.4	2:52	17.1	2:49	16.8	2:45	16.5	2:42
1600	23.6	3:51	23.0	3:46	22.5	3:41	22.0	3:36	21.6	3:32
2000	29.4	4:45	28.6	4:39	27.9	4:32	27.3	4:27	26.8	4:22
2400	35.2	5:39	34.2	5:31	33.4	5:24	32.7	5:17	32.1	5:12
2800	41.3	6:32	40.1	6:23	39.1	6:14	38.2	6:07	37.5	6:02
3200	47.4	7:24	46.0	7:14	44.9	7:05	43.8	6:57	43.1	6:52
3600	53.5	8:17	52.0	8:05	50.7	7:55	49.5	7:47	48.7	7:42
4000	59.9	9:08	58.2	8:56	56.7	8:44	55.4	8:36	54.6	8:32
4400	66.3	9:59	64.4	9:46	62.8	9:34	61.4	9:26	60.6	9:22
4800	72.9	10:50	70.8	10:36	68.9	10:23	67.5	10:16	66.8	10:12
5200	79.6	11:40	77.3	11:25	75.3	11:13	73.8	11:05	73.3	11:02
5600	86.4	12:29	83.9	12:14	81.8	12:02	80.3	11:55		
6000	93.3	13:19	90.6	13:03	88.5	12:51	86.9	12:45		
6400	100.4	14:08	97.6	13:52	95.3	13:40	93.8	13:35		
6800	107.6	14:57	104.6	14:41	102.3	14:30	101.0	14:25		
7200	114.9	15:46	111.8	15:30	109.5	15:19	108.4	15:15		
7600	122.4	16:35	119.3	16:19	116.9	16:09				
8000	130.1	17:23	126.8	17:08	124.6	16:58				

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Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1,000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	140	160	180	200	220
10	−1.2	−0.6	0.0	0.8	1.6
20	−2.4	−1.1	0.0	1.7	3.6
30	−3.6	−1.8	0.0	2.7	6.0
40	−4.8	−2.4	0.0	3.8	8.7
50	−6.0	−3.0	0.0	5.0	11.7
60	−7.3	−3.7	0.0	6.4	15.0
70	−8.6	−4.3	0.0	7.9	18.7
80	−9.9	−5.0	0.0	9.6	22.8
90	−11.2	−5.7	0.0	11.3	27.1
100	−12.6	−6.4	0.0	13.2	31.9
110	−14.0	−7.1	0.0	15.2	36.9
120	−15.4	−7.8	0.0	17.4	42.3
130	−16.9	−8.6	0.0	19.7	48.0
140	−18.3	−9.3	0.0	22.1	54.1

Based on 310/.84 climb, Long Range Cruise and .84/310/250 descent.

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Long Range Cruise Step Climb Trip 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
1040	981	928	881	839	800	765	732	703	675	650
1545	1461	1386	1318	1256	1200	1149	1102	1058	1018	981
2050	1941	1843	1754	1673	1600	1533	1471	1414	1361	1312
2555	2421	2300	2190	2091	2000	1917	1840	1769	1704	1643
3060	2900	2757	2627	2508	2400	2301	2209	2125	2047	1974
3564	3380	3214	3063	2925	2800	2685	2579	2481	2390	2306
4069	3859	3670	3499	3343	3200	3069	2948	2837	2733	2637
4573	4339	4127	3935	3760	3600	3453	3318	3192	3076	2968
5078	4818	4584	4371	4177	4000	3837	3687	3548	3419	3300
5582	5297	5040	4807	4595	4400	4221	4056	3904	3763	3631
6086	5776	5497	5243	5012	4800	4605	4426	4260	4106	3963
6590	6256	5953	5679	5429	5200	4990	4795	4616	4449	4294
7094	6735	6410	6115	5846	5600	5374	5165	4972	4792	4626
7598	7214	6867	6551	6264	6000	5758	5534	5328	5136	4957
8103	7693	7323	6987	6681	6400	6142	5904	5683	5479	5289
8607	8173	7780	7423	7098	6800	6526	6273	6039	5822	5620
9111	8652	8237	7859	7515	7200	6910	6643	6395	6165	5952
9616	9131	8693	8296	7933	7600	7294	7012	6751	6508	6283
10121	9611	9150	8732	8350	8000	7678	7381	7107	6852	6614

Trip Fuel and Time Required

AIR DIST (NM)	TRIP FUEL (1000 KG) LANDING WEIGHT (1000 KG)									TIME (HRS:MIN)
	140	150	160	170	180	190	200	210	220	
800	9.6	10.1	10.4	11.0	11.5	11.9	12.4	13.0	13.5	1:51
1200	13.6	14.2	14.9	15.7	16.4	17.1	17.9	18.7	19.4	2:41
1600	17.7	18.5	19.5	20.5	21.4	22.4	23.5	24.6	25.4	3:31
2000	21.9	22.9	24.2	25.5	26.6	27.9	29.3	30.6	31.7	4:21
2400	26.1	27.5	28.9	30.5	31.9	33.5	35.1	36.7	38.1	5:11
2800	30.5	32.1	33.8	35.6	37.4	39.2	41.1	42.9	44.7	6:00
3200	35.0	36.8	38.8	40.9	43.0	45.1	47.2	49.4	51.5	6:50
3600	39.5	41.7	43.9	46.4	48.7	51.1	53.5	56.0	58.4	7:40
4000	44.2	46.6	49.2	51.9	54.5	57.2	60.0	62.8	65.5	8:29
4400	49.0	51.7	54.6	57.6	60.5	63.5	66.6	69.8	72.7	9:19
4800	53.9	56.8	60.1	63.5	66.6	70.0	73.5	76.9	80.2	10:09
5200	58.9	62.2	65.7	69.4	72.9	76.6	80.4	84.2	87.8	10:58
5600	64.0	67.7	71.5	75.5	79.3	83.4	87.6	91.6	95.7	11:48
6000	69.2	73.3	77.4	81.7	85.9	90.4	94.9	99.3	103.7	12:37
6400	74.6	79.0	83.4	88.1	92.7	97.5	102.4	107.2		13:27
6800	80.2	84.8	89.6	94.7	99.7	104.8	110.1	115.4		14:17
7200	85.8	90.8	96.0	101.5	106.8	112.3				15:06
7600	91.6	96.9	102.5	108.4	114.1	120.0				15:56
8000	97.5	103.2	109.3	115.5	121.6	127.9				16:46

Based on 310/.84 climb, LRC and .84/310/250 descent.
Valid for all pressure altitudes with 4,000 ft step climb to 2,000 ft above optimum altitude.

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Short Trip 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
93	79	69	61	55	50	46	42	39	36	34
159	142	129	117	108	100	93	87	82	77	73
224	204	187	173	161	150	141	133	125	119	113
287	264	245	228	213	200	189	178	169	161	153
349	324	301	282	265	250	237	224	214	204	195
411	382	358	336	317	300	285	271	258	247	236
472	441	414	390	369	350	333	317	303	290	278
534	500	471	445	421	400	381	364	348	333	320
597	560	528	499	473	450	429	410	392	376	361
661	621	586	554	526	500	477	456	436	418	402

Trip Fuel and Time Required

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG) 140	160	180	200	220	TIME (HRS:MIN)
50	FUEL (1000 KG) ALT (FT)	1.5 10000	1.6 10000	1.7 9000	1.8 8000	1.9 8000	0:14
100	FUEL (1000 KG) ALT (FT)	2.3 19000	2.4 18000	2.6 17000	2.7 16000	2.9 15000	0:22
150	FUEL (1000 KG) ALT (FT)	3.0 27000	3.2 25000	3.4 24000	3.6 22000	3.8 21000	0:30
200	FUEL (1000 KG) ALT (FT)	3.6 34000	3.9 31000	4.1 29000	4.4 28000	4.6 26000	0:36
250	FUEL (1000 KG) ALT (FT)	4.2 39000	4.5 36000	4.8 34000	5.1 32000	5.4 30000	0:43
300	FUEL (1000 KG) ALT (FT)	4.7 43000	5.0 40000	5.4 37000	5.8 35000	6.2 33000	0:48
350	FUEL (1000 KG) ALT (FT)	5.1 43000	5.6 42000	6.0 39000	6.5 36000	6.9 34000	0:54
400	FUEL (1000 KG) ALT (FT)	5.6 43000	6.1 42000	6.6 39000	7.1 36000	7.6 34000	1:00
450	FUEL (1000 KG) ALT (FT)	6.1 43000	6.6 42000	7.2 39000	7.8 36000	8.3 34000	1:06
500	FUEL (1000 KG) ALT (FT)	6.6 43000	7.2 42000	7.8 39000	8.4 36000	9.1 34000	1:13

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Holding Planning
Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)									
	1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
300	8700	8640	8370	8470	8880	9070	9420			
280	8110	8030	7780	7780	8110	8350	8600	9090		
260	7540	7450	7370	7150	7470	7650	7850	8110		
240	7120	7020	6920	6700	6750	6970	7120	7410		
220	6560	6460	6340	6280	6100	6330	6430	6620	7170	
200	6020	5920	5780	5700	5520	5600	5750	5900	6260	
180	5640	5390	5260	5160	5100	4940	5150	5210	5530	5750
160	5130	5020	4760	4650	4580	4520	4430	4640	4880	5110
140	4660	4530	4390	4160	4070	4010	3880	3950	4190	4340

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
300	9360	9070	9040	9070	9130
280	8700	8630	8370	8390	8430
260	8070	7980	7710	7710	7870
240	7440	7350	7260	7180	7190
220	6970	6880	6760	6540	6540
200	6360	6270	6160	6070	5900
180	5910	5680	5570	5470	5290
160	5340	5230	5000	4900	4820
140	4800	4670	4550	4340	4250

These tables include 5% additional fuel for holding in a racetrack pattern.

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Crew Oxygen Requirements

Table 1

NUMBER OF CREW	OXYGEN REQUIRED (LITERS)
2	660
3	990
4	1320

Table 2

NUMBER OF CREW	OXYGEN REQUIRED FOR LEVEL OFF AT 14000 FT (LITERS)			
	TOTAL POST DECOMPRESSION TIME (HR)			
	2	3	4	5
2	660	960	1270	1570
3	980	1440	1900	2360
4	1310	1920	2530	3140

Table 3

NUMBER OF CREW	ADDITIONAL LITERS REQUIRED FOR EACH MINUTE HELD AT INTERMEDIATE ALTITUDE OTHER THAN 14000 FT				
	INTERMEDIATE PRESSURE ALTITUDE (FT)				
	UP TO 13999	14000	14001 TO 17999	18000 TO 21999	22000 TO 25000
	REGULATOR ON "NORMAL" OR (100%)				
2	0 (22)	0 (17)	1 (16)	3 (12)	6 (10)
3	0 (33)	0 (25)	2 (24)	5 (18)	8 (15)
4	0 (44)	0 (34)	2 (32)	6 (24)	11 (20)

For more extensive than normal crew usage, add 2.05 liters/person/minute for each crew member at 8,000 ft cabin altitude when regulator setting is NORMAL; or 13 liters/person/minute when regulator setting is 100%.

Instructions:

1. determine protective breathing requirements from Table 1
2. determine supplemental requirements for level off at 14,000 ft from Table 2 and correct for level off altitudes other than 14,000 ft using Table 3
3. flight crew system oxygen requirements are the larger of protective breathing (Table 1) or supplemental requirements (Table 2).

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Crew Oxygen Requirements

Table 4—Cylinder Volume to Pressure Conversion

OXYGEN VOLUME (1000 LITERS)	CYLINDER PRESSURE AT 21 deg. C (PSI)
.1	200
.3	300
.5	400
.7	500
.8	600
1.0	700
1.2	800
1.4	900
1.5	1000
1.7	1100
1.9	1200
2.1	1300
2.2	1400
2.4	1500
2.6	1600
2.7	1700
2.9	1800
3.1	1900
3.3	2000
Check maximum pressure in shaded area. Maximum cylinder pressure = 1,850 PSI at 21 deg. C. For maximum cylinder pressure at hotter or colder temperatures, add or subtract 32 PSI per 5 deg. C, respectively.	

Table 5—Temperature Corrections

CYLINDER PRESSURE AT 21 deg. C (PSI)	PRESSURE CORRECTION FOR EACH 5 deg. C ABOVE/BELOW 21 deg. C (PSI)
400	7/–7
600	11/–11
800	14/–14
1000	17/–17
1200	21/–21
1400	24/–24
1600	28/–28
1800	31/–31
2000	34/–34

Passenger Oxygen Requirements

Minimum passenger oxygen supply pressure for dispatch is 1,650 psi. If the passenger oxygen supply pressure is less than 1,650 psi, consult oxygen duration chart below to determine if the oxygen quantity is adequate for the intended flight.

Data is provided to determine minimum oxygen cylinder pressure dispatch requirement. Table 1 shows oxygen quantity required to complete an emergency descent to 14,000 ft, level off and continue for the duration of the post decompression time period to 10,000 ft. The minimum oxygen quantity required for a particular flight is obtained by entering Table 1 with the total number of passenger cabin occupants and planned cruise altitude, and reading oxygen volume required for the projected post decompression time above 10,000 ft.

Table 2 shows adjustments which must be applied to the Table 1 values in situations where the minimum enroute altitude after decompression exceeds 14,000 ft. The Table 2 adjustments reflect only the incremental increase in

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oxygen quantity associated with periods of post decompression flight at altitudes above 14,000 ft. Consequently, time spent holding at higher than 14,000 ft must also be included in the total post decompression time used in Table 1.

After determining the total volume (liters) required from Tables 1 and 2, isolate the passenger oxygen system cylinder configuration on the Cylinder Volume to Pressure Conversion table and read dispatch pressure required. Adjust this reading for cylinder temperature as required, using the adjustments given.

Normally, emergency descent should be carried out to FL 140 or below if terrain permits.

Minimum decompression time (10 min) approximates direct descent to FL 100.

Passenger oxygen system does not close automatically. To stop the flow, system should be reset when cabin altitude is below 12,000 ft.

If during post decompression cruise oxygen is needed after the passenger system supply becomes empty, the portable oxygen bottles shall be used.

DO NOT DEPLOY PASSENGER OXYGEN MASKS WITH CABIN ALTITUDE ELOW 14000 FT WHEN SMOKE OR AN ABNORMAL HEAT SOURCE IS PRESENT. THE USE OF PASSENGER OXYGEN MASKS MAY INCREASE THE POSSIBILITY OR SEVERITY OF CABIN FIRE AND WILL NOT PREVENT PASSENGER FROM INHALING SMOKE.

Table 1—Oxygen Quantity Required

NUMBER OF OCCUPANTS IN PASSENGER CABIN	TOTAL POST DECOMPRESSION TIME (hour)	PRESSURE ALTITUDE AT DECOMPRESSION (ft)				
		27000	31000	35000	39000	43000
		LITER REQUIRED				
100	0.17*	1280	1410	1630	1860	1990
	1	1680	1900	2200	2520	2720
	2	2340	2560	2860	3180	3380
	3	3000	3220	3520	3840	4040
200	0.17*	2550	2800	3200	3620	3870
	1	3350	3780	4340	4940	5230
	2	4670	5100	5660	6260	6640
	3	5990	6420	6980	7580	7960
300	0.17*	3810	4180	4770	5380	5750
	1	5010	5660	6480	7360	7930
	2	6990	7640	8460	9340	9910
	3	8970	9620	10440	11320	11890
400	0.17*	5070	5570	6340	7140	7620
	1	6680	7540	8620	9780	10530
	2	9320	10180	11260	12420	13170
	3	11960	12820	13900	15060	15810

Total post decompression time includes descent, level-off at intermediate altitude (if applicable) and flight at final level-off altitude.
Time to shut down 90% of masks at or below 14,000 ft pressure altitude is 11 minutes.
***Minimum post decompression time (10 min) approximates direct descent to 10,000 ft pressure altitude.**

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Table 2—Additional Oxygen Required

NUMBER OF OCCUPANTS IN PASSENGER CABIN	ADDITIONAL OXYGEN REQUIRED (Liters Per Minute above 14,000 ft Pressure Altitude)			
	INTERMEDIATE PRESSURE ALTITUDE			
	15000**	17000	21000	25000
100	33	120	165	230
200	66	240	330	460
300	99	360	495	690
400	132	480	660	920

Total oxygen quantity required is:
Emergency descent and level-off at or below 14,000 ft pressure altitude (from table 1) plus cruise above 14,000 ft pressure altitude (from table 2).
****30% of cabin occupants using oxygen.**

Table 3—Cylinder Volume to Pressure Conversion

CYLINDER PRESSURE AT 21 deg. C (PSI)	OXYGEN VOLUME (1000 liters)
100	.1
200	1.3
300	2.6
400	3.8
500	5.0
600	6.2
700	7.4
800	8.6
900	9.8
1000	11.1
1100	12.3
1200	13.5
1300	14.7
1400	15.9
1500	17.1
1600	18.3
1700	19.5
1800	20.8
1900	22.0
2000	23.2

Check maximum pressure in shaded area. Maximum cylinder pressure = 1,850 PSI at 21 deg. C. For maximum cylinder pressure at hotter or colder temperatures, add or subtract 32 PSI per 5 deg. C, respectively.

Table 4—Temperature Corrections

CYLINDER PRESSURE AT 21 deg. C (PSI)	PRESSURE CORRECTION FOR EACH 5 deg. C ABOVE/BELOW 21 deg. C (PSI)
400	7/–7
600	11/–11
800	14/–14
1000	17/–17
1200	21/–21
1400	24/–24
1600	28/–28
1800	31/–31
2000	34/–34

Example:

300 occupants (passengers and cabin crew), ambient temperature 31 deg. C, cruise at 39,000 ft.

Question:

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Minimum supply pressure based on 3 hr. post decompression and 5 minutes level off at FL 170 due to high terrain.

Solution:

1. from table 1, oxygen required is 11,320 ltr
2. from table 2, additional oxygen required for intermediate level off at FL 170 for 5 minutes = 360 × 5 = 1,800 ltr
3. total oxygen required = 11,320 + 1,800 = 13,120 ltr
4. from Cylinder Volume to Pressure Conversion Table, the required oxygen supply pressure at 21 deg. C is approximately 1,168 psi
5. additional oxygen pressure required due to temperature correction = (31–21) deg C × 20.36 psi per 5 deg C = 40.7 psi
6. total oxygen supply pressure for dispatch = 1,208.7 psi.

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ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1,000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
29	151.8		
28	159.5	151.6	
27	167.5	159.5	151.3
26	175.8	167.6	159.2
25	184.4	176.1	167.4
24	192.4	183.7	174.7
23	200.6	191.7	182.1
22	209.1	199.9	189.8
21	218.0	208.4	197.8
20	227.1	217.2	206.1
19	236.0	225.9	214.5
18	245.2	234.8	223.2
17	254.6	244.0	232.1
16	264.3	253.5	241.4
15	272.4	261.5	248.8
14	280.8	269.5	256.4
13	289.2	277.7	264.2
12	297.8	285.8	272.1
11	305.6	292.9	278.6
10	313.5	300.0	284.7
9		306.8	290.2
8		313.4	295.8
7			301.3
6			306.6
5			311.8
4			316.2

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG) PRESSURE ALTITUDE (1000 FT)								
	10	12	14	16	18	20	22	24	26
ENGINE ONLY	–4.3	–3.8	–3.3	–2.7	–1.9	–1.1	–1.4	–1.2	–0.9
ENGINE AND WING	–5.7	–5.2	–4.7	–4.2	–3.4	–2.6	–3.2	–3.0	–2.8

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Landing Landing Field Limit Weight—Dry Runway
Flaps 30
Wind Adjusted Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	−15	−10	−5	0	10	20	30	40
1200		1030	1120	1200	1280	1350	1430	1500
1400	1090	1190	1300	1400	1480	1570	1650	1730
1600	1240	1360	1480	1600	1690	1780	1880	1970
1800	1380	1520	1660	1800	1900	2000	2100	2200
2000	1530	1680	1840	2000	2110	2220	2330	2430
2200	1670	1850	2020	2200	2320	2430	2550	2670
2400	1820	2010	2210	2400	2530	2650	2780	2900
2600	1960	2170	2390	2600	2730	2870	3000	3130
2800	2110	2340	2570	2800	2940	3080	3230	3370
3000	2250	2500	2750	3000	3150	3300	3450	3600
3200	2400	2660	2930	3200	3360	3520	3680	3830
3400	2540	2830	3110	3400	3570	3730	3900	4070
3600	2690	2990	3300	3600	3780	3950	4130	4300
3800	2830	3150	3480	3800	3980	4170	4350	4530
4000	2980	3320	3660	4000	4190	4380	4580	4770
4200	3120	3480	3840	4200	4400	4600	4800	
4400	3270	3640	4020	4400	4610			
4600	3410	3810	4200	4600				
4800	3560	3970	4390	4800				
5000	3700	4130	4570					

Field Limit Weight (1,000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1400	177.2	166.9	156.9	144.9	138.2
1600	210.9	198.6	186.7	175.4	164.8
1800	234.8	226.6	217.2	204.1	191.8
2000	253.9	245.1	236.4	227.9	219.2
2200	273.6	262.8	253.5	244.5	235.7
2400	292.2	281.6	271.2	260.4	251.0
2600	309.6	299.0	287.9	276.9	266.6
2800	326.5	314.9	303.7	292.2	281.1
3000			315.8	304.2	293.0
3200			327.0	314.3	302.9
3400				324.3	312.0
3600					320.7

With 1 brake deactivated, decrease weight by 16,200 kg.
With 2 brakes deactivated, decrease weight by 34,700 kg.
With manual speedbrakes, decrease weight by 18,050 kg.

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Landing Field Limit Weight—Wet Runway
Flaps 30
Wind Adjusted Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	–15	–10	–5	0	10	20	30	40
1200				1200	1280	1360	1440	1520
1400		1200	1300	1400	1490	1570	1660	1750
1600	1250	1360	1480	1600	1700	1790	1890	1980
1800	1390	1530	1660	1800	1900	2010	2110	2220
2000	1540	1690	1850	2000	2110	2220	2340	2450
2200	1680	1850	2030	2200	2320	2440	2560	2680
2400	1830	2020	2210	2400	2530	2660	2790	2910
2600	1970	2180	2390	2600	2740	2870	3010	3150
2800	2120	2340	2570	2800	2950	3090	3240	3380
3000	2260	2510	2750	3000	3150	3310	3460	3610
3200	2410	2670	2940	3200	3360	3520	3690	3850
3400	2550	2830	3120	3400	3570	3740	3910	4080
3600	2700	3000	3300	3600	3780	3960	4140	4310
3800	2840	3160	3480	3800	3990	4170	4360	4550
4000	2990	3320	3660	4000	4200	4390	4590	4780
4200	3130	3490	3840	4200	4400	4610	4810	5010
4400	3280	3650	4030	4400	4610	4820	5040	5250
4600	3420	3810	4210	4600	4820	5040	5260	5480
4800	3570	3980	4390	4800	5030	5260	5490	
5000	3710	4140	4570	5000	5240	5470		

Field Limit Weight (1,000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1600	175.8	165.5	155.6	139.4	137.0
1800	205.0	193.0	181.5	170.5	160.1
2000	228.7	219.3	207.9	195.4	183.5
2200	245.7	237.2	228.7	219.9	207.2
2400	262.7	252.9	244.0	235.2	226.7
2600	279.3	268.8	258.6	249.4	240.4
2800	295.3	284.7	274.1	263.4	253.6
3000	310.3	299.7	288.6	277.6	267.3
3200	325.0	313.5	302.4	290.9	279.9
3400		327.2	313.4	301.8	290.6
3600			323.1	310.9	299.5
3800				319.6	307.7
4000					315.4
4200					323.0

With 1 brake deactivated, decrease weight by 16,200 kg.
With 2 brakes deactivated, decrease weight by 34,700 kg.
With manual speedbrakes, decrease weight by 18,050 kg.

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Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG) AIRPORT PRESSURE ALTITUDE (FT)					
deg. C	deg. F	–2000	0	2000	4000	6000	8000
54	129	258.6	243.7				
52	126	264.6	249.6				
50	122	270.9	255.3	236.3			
48	118	277.2	261.0	242.0			
46	115	283.6	266.6	247.5	227.9		
44	111	289.9	272.9	253.0	232.3		
42	108	294.5	279.4	258.3	236.5	219.7	
40	104	298.9	285.7	263.4	240.9	223.4	
38	100	303.1	290.9	268.8	244.9	226.8	209.6
36	97	307.2	296.1	273.9	249.0	230.3	212.9
34	93	311.2	300.9	278.2	253.1	233.7	216.1
32	90	311.3	305.3	282.4	256.9	237.2	219.3
30	86	311.3	309.7	286.6	260.6	240.8	222.4
28	82	311.4	309.7	290.4	264.4	244.5	225.8
26	79	311.4	309.7	294.1	267.9	248.0	229.2
24	75	311.5	309.8	294.9	271.1	251.4	232.5
22	72	311.6	309.8	294.9	274.2	253.5	234.1
20	68	311.6	309.9	294.9	274.8	254.5	235.5
18	64	311.6	309.9	295.0	274.9	255.6	237.2
16	61	311.6	310.0	295.1	274.9	256.1	239.0
14	57	311.7	310.0	295.1	275.0	256.1	240.5
12	54	311.7	310.1	295.2	275.0	256.2	240.6
10	50	311.8	310.2	295.2	275.1	256.2	240.7
–40	–40	312.9	311.5	296.6	276.3	257.3	241.7

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.
With engine bleed for packs off, increase weight by 900 kg.
With engine and wing anti-ice on, decrease weight by 1,450 kg.
When operating in icing conditions during any part of the flight with forecast landing temperature is below 10 deg. C, decrease weight by 20,800 kg.

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ENGINE INOP

ADVISORY INFORMATION

Go-Around Climb Gradient
Flaps 20, Gear Up
Based on engine bleed for packs on or off, engine anti-ice on or off and wing anti-ice off

OAT (deg. C)	REFERENCE GO-AROUND GRADIENT (%) PRESSURE ALTITUDE (FT)						
	–2000	0	2000	4000	6000	8000	10000
54	6.55	5.65					
50	7.31	6.40	5.22				
46	8.10	7.13	5.96	4.72			
42	8.73	7.92	6.64	5.24	4.18		
38	9.28	8.57	7.23	5.73	4.61	3.55	
34	9.78	9.11	7.74	6.22	5.03	3.95	
30	9.79	9.64	8.20	6.67	5.46	4.32	3.27
26	9.80	9.66	8.58	7.06	5.83	4.69	3.60
22	9.81	9.67	8.62	7.38	6.14	4.95	3.87
18	9.81	9.68	8.63	7.44	6.27	5.13	3.99
14	9.82	9.68	8.64	7.45	6.32	5.35	4.15
10	9.83	9.69	8.64	7.45	6.32	5.36	4.38

Weight Adjustment

WEIGHT (1000 KG)	REFERENCE GO-AROUND GRADIENT (%)									
	0	1	2	3	4	5	6	7	8	9
280	–2.98	–3.42	–3.87	–4.31	–4.75	–5.13	–5.50	–5.88	–6.27	–6.65
260	–3.06	–3.33	–3.61	–3.88	–4.15	–4.46	–4.79	–5.12	–5.46	–5.80
240	–2.50	–2.72	–2.94	–3.16	–3.38	–3.65	–3.92	–4.19	–4.46	–4.74
220	–1.88	–2.03	–2.18	–2.33	–2.48	–2.67	–2.88	–3.07	–3.28	–3.48
200	–1.13	–1.19	–1.25	–1.31	–1.37	–1.49	–1.61	–1.72	–1.83	–1.94
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
160	1.16	1.30	1.44	1.57	1.71	1.85	1.99	2.13	2.29	2.45
140	2.57	2.92	3.26	3.60	3.95	4.27	4.59	4.94	5.31	5.70

Speed Adjustment

SPEED (KIAS)	WEIGHT ADJUSTED GO-AROUND GRADIENT (%)									
	0	1	2	3	4	5	6	7	8	9
VREF	–0.27	–0.28	–0.29	–0.30	–0.31	–0.32	–0.32	–0.33	–0.33	–0.32
VREF+5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VREF+10	0.16	0.16	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.15
VREF+15	0.27	0.26	0.26	0.26	0.27	0.28	0.28	0.26	0.24	0.22
VREF+20	0.33	0.32	0.32	0.33	0.34	0.35	0.34	0.32	0.28	0.23
VREF+25	0.35	0.34	0.33	0.34	0.35	0.36	0.35	0.31	0.26	0.20
VREF+30	0.32	0.30	0.29	0.28	0.29	0.28	0.26	0.22	0.17	0.11

With engine and wing anti-ice on, decrease gradient by 0.1%.
When operating in icing conditions during any part of the flight with forecast landing temperatures below 10 deg. C, decrease gradient by 0.6%.

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Quick Turnaround Limit Weight
Flaps 30 Limit Weight (1,000 KG)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	235.4	226.3			
50	122	237.0	227.9	219.0	210.8	
45	113	238.9	229.8	220.9	212.5	204.5
40	104	241.0	231.8	222.7	214.3	206.3
35	95	243.1	233.8	224.7	216.0	208.0
30	86	245.2	235.9	226.6	217.9	209.7
25	77	247.4	238.0	228.7	219.7	211.4
20	68	249.7	240.1	230.8	221.7	213.3
15	59	252.0	242.4	232.9	223.7	215.1
10	50	254.5	244.6	235.1	225.8	217.1
5	41	257.0	247.0	237.4	228.0	219.0
0	32	259.5	249.4	239.7	230.2	221.1
–5	23	262.1	252.0	242.1	232.5	223.3
–10	14	265.6	254.6	244.5	234.9	225.5
–15	5	268.5	257.3	247.1	237.3	227.8
–20	–4	271.4	260.0	249.7	239.8	230.3
–30	–22	277.6	266.5	255.2	245.0	235.3
–40	–40	284.2	272.7	261.1	250.6	240.6
–50	–58	291.0	279.3	268.0	256.6	246.2
–54	–65	293.9	282.1	270.6	259.1	248.4

Increase weight by 2,100 kg per 1% uphill slope. Decrease weight by 5,100 kg per 1% downhill slope. Increase weight by 5,800 kg per 10 knots headwind. Decrease weight by 35,200 kg per 10 knots tailwind.
Decrease weight by 13,200 kg when one brake is deactivated. Decrease weight by 27,300 kg when two brakes are deactivated.
After landing at weights exceeding those shown above, adjusted for slope and wind, wait at least 65 minutes and check that wheel thermal plugs have not melted before executing a takeoff.
As an alternate procedure, no waiting period is required if the BRAKE TEMP advisory message on EICAS is not displayed 10 to 15 minutes after parking.

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GEAR DOWN

Takeoff Climb Limit Weight
Flaps 15

AIRPORT OAT		TAKEOFF CLIMB WEIGHT (1000 KG) AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	178.8	171.4	164.4	155.0	145.9
52	126	183.8	171.4	164.3	154.9	145.9
50	122	188.6	172.3	164.3	154.9	145.8
48	118	193.3	176.8	164.2	154.8	145.8
46	115	198.1	181.1	165.1	154.8	145.7
44	111	202.7	185.5	169.3	154.7	145.7
42	108	207.3	189.7	173.2	155.6	145.7
40	104	211.9	194.0	177.1	159.5	145.6
38	100	216.8	198.1	181.0	163.3	146.5
36	97	221.7	202.3	184.9	167.1	150.1
34	93	226.5	207.4	188.8	170.8	153.7
32	90	231.3	212.5	192.7	174.5	157.3
30	86	236.1	217.4	197.8	178.2	160.9
28	82	240.7	222.2	202.8	182.0	164.5
26	79	245.3	226.9	207.7	186.9	168.1
24	75	247.6	231.4	212.5	191.7	171.7
22	72	247.6	235.9	217.0	196.4	176.4
20	68	247.6	238.1	221.5	200.9	181.0
18	64	247.6	238.1	225.8	205.3	185.4
16	61	247.6	238.1	227.8	209.6	189.7
14	57	247.6	238.0	227.7	212.9	193.9
12	54	247.6	238.0	227.7	212.9	198.0
10	50	247.6	238.0	227.7	212.9	199.9
–40	–40	246.8	237.3	226.5	213.7	200.6

With engine bleed for packs off, increase weight by 100 kg.
With engine anti-ice on, decrease weight by 4,000 kg.
With engine and wing anti-ice on, decrease weight by 4,900 kg.

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GEAR DOWN

Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG) AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	211.0				
52	126	216.1				
50	122	221.2	205.2			
48	118	226.2	210.1			
46	115	231.0	214.9	198.0		
44	111	236.1	219.5	201.6		
42	108	241.3	224.0	205.1	190.5	
40	104	246.6	228.2	208.5	193.5	
38	100	250.4	232.3	211.9	196.4	181.6
36	97	254.2	236.0	215.3	199.3	184.4
34	93	258.0	239.4	218.6	202.1	187.1
32	90	261.7	242.7	221.8	204.9	189.7
30	86	265.4	245.9	224.8	207.8	192.3
28	82	265.3	248.7	227.8	210.6	194.9
26	79	265.4	251.6	230.4	213.5	197.6
24	75	265.4	252.2	232.9	216.3	200.2
22	72	265.5	252.2	235.3	218.0	201.4
20	68	265.5	252.2	235.8	218.8	202.5
18	64	265.5	252.3	235.9	219.7	204.0
16	61	265.6	252.3	235.9	220.1	205.7
14	57	265.6	252.4	235.9	220.1	207.2
12	54	265.7	252.4	236.0	220.2	207.2
10	50	265.8	252.4	236.0	220.2	207.2
–40	–40	266.9	253.5	237.0	221.1	208.0

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.
With engine bleed for packs off, increase weight by 700 kg.
With engine and wing anti-ice on, decrease weight by 1,150 kg.
When operating in icing conditions during any part of the flight with forecast landing temperature below 10 deg. C, decrease weight by 26,300 kg.

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GEAR DOWN

Takeoff Obstacle Limit Weight

Based on engine bleed for packs on, engine anti-ice off and wing anti-ice off

Flaps 15

Sea Level, 29 deg. C & Below, Zero Wind

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG) DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	240.0										
20	228.8	240.0	240.0								
40	211.3	225.9	237.1	240.0							
60	197.8	212.7	224.2	233.3	240.0	240.0					
80	186.9	201.7	213.5	223.0	230.7	237.1	240.0	240.0			
100	177.7	192.3	204.3	214.1	222.1	228.8	234.5	239.1	240.0		
120	169.7	184.2	196.1	206.1	214.4	221.3	227.3	232.4	236.8	240.0	240.0
140	162.7	177.0	188.9	198.9	207.4	214.6	220.7	226.1	230.7	234.8	238.4
160	156.4	170.5	182.3	192.4	200.9	208.3	214.7	220.2	225.0	229.3	233.1
180	150.7	164.6	176.3	186.4	195.1	202.5	209.0	214.8	219.7	224.2	228.1
200		159.2	170.9	180.9	189.6	197.2	203.8	209.6	214.8	219.3	223.4
220		154.2	165.8	175.8	184.5	192.2	198.9	204.8	210.0	214.7	218.9
240		149.6	161.2	171.1	179.8	187.5	194.2	200.2	205.6	210.4	214.7
260			156.8	166.7	175.4	183.0	189.9	195.9	201.3	206.2	210.6
280			152.7	162.5	171.2	178.9	185.7	191.8	197.3	202.3	206.7
300			148.8	158.6	167.3	174.9	181.8	188.0	193.5	198.5	203.0

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustments

OAT (deg. C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
29 & BELOW	0	0	0	0	0	0	0
30	–1.1	–1.3	–1.6	–1.8	–2.1	–2.3	–2.6
32	–2.7	–3.6	–4.5	–5.3	–6.2	–7.1	–8.0
34	–4.3	–5.8	–7.3	–8.8	–10.3	–11.9	–13.4
36	–5.9	–8.1	–10.2	–12.3	–14.5	–16.6	–18.8
38	–7.5	–10.3	–13.1	–15.8	–18.6	–21.4	–24.1
40	–9.2	–12.5	–15.9	–19.3	–22.7	–26.1	–29.5
42	–10.5	–14.5	–18.6	–22.7	–26.8	–30.9	–35.0
44	–11.8	–16.5	–21.3	–26.1	–30.9	–35.7	–40.5
46	–13.1	–18.5	–24.0	–29.5	–35.0	–40.5	–46.0
48	–14.4	–20.5	–26.7	–32.9	–39.1	–45.3	–51.4
50	–15.7	–22.5	–29.4	–36.3	–43.2	–50.0	–56.9

Pressure Altitude Adjustments

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
S.L. & BELOW	0	0	0	0	0	0	0
1000	–5.4	–6.1	–6.9	–7.7	–8.4	–9.2	–10.0
2000	–10.8	–12.3	–13.8	–15.3	–16.9	–18.4	–19.9
3000	–15.7	–18.2	–20.6	–23.0	–25.4	–27.8	–30.3
4000	–20.7	–24.0	–27.3	–30.6	–34.0	–37.3	–40.6
5000	–24.8	–29.3	–33.7	–38.1	–42.5	–46.9	–51.3
6000	–29.0	–34.5	–40.0	–45.5	–51.0	–56.5	–62.0
7000	–32.5	–39.3	–46.0	–52.8	–59.5	–66.2	–73.0
8000	–36.0	–44.0	–52.0	–60.0	–68.0	–76.0	–84.0

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GEAR DOWN

Takeoff Obstacle Limit Weight

Based on engine bleed for packs on, engine anti-ice off and wing anti-ice off

Wind Adjustments

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
15 TW	–20.8	–20.6	–20.5	–20.4	–20.2	–20.1	–20.0
10 TW	–13.8	–13.8	–13.7	–13.6	–13.5	–13.4	–13.3
5 TW	–6.9	–6.9	–6.8	–6.8	–6.8	–6.7	–6.7
0	0	0	0	0	0	0	0
10 HW	3.5	3.0	2.5	2.0	1.5	1.0	0.5
20 HW	7.0	6.0	5.0	4.0	3.0	2.0	1.0
30 HW	10.5	9.0	7.5	6.0	4.5	3.0	1.5
40 HW	14.0	12.0	10.0	8.0	6.0	4.0	2.0

With engine bleed for packs off, increase weight by 300 kg.
With engine anti-ice on, decrease weight by 1,000 kg.
With engine and wing anti-ice on, decrease weight by 1,700 kg.

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GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
300	13000	10400	7300
290	14600	12000	9100
280	16200	13700	11000
270	17800	15500	12800
260	19500	17200	14600
250	21100	18900	16400
240	22500	20500	18200
230	24000	22000	20100
220	25300	23600	21700
210	26300	25100	23300
200	27300	26100	25000
190	28300	27100	26000
180	29400	28200	27100
170	30600	29300	28200
160	32100	30500	29300
150	33800	32100	30600
140	35700	34000	32300

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GEAR DOWN

Long Range Cruise Trip 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
329	292	261	236	216	200	187	175	165	156	148
497	441	393	356	326	300	281	263	247	234	222
663	589	526	476	435	400	374	351	330	312	296
828	736	657	595	544	500	468	438	412	389	370
992	882	788	714	653	600	561	526	495	468	444
1155	1028	918	832	762	700	655	614	578	546	519
1317	1172	1048	950	870	800	748	702	661	625	593
1478	1317	1178	1068	978	899	841	790	743	702	667
1638	1461	1308	1186	1086	999	935	877	826	781	742
1797	1603	1437	1304	1194	1100	1029	966	910	860	818
1955	1746	1565	1421	1303	1200	1124	1055	993	939	893
2112	1887	1693	1538	1410	1300	1218	1143	1077	1018	968
2269	2028	1821	1655	1519	1400	1312	1232	1160	1097	1043
2426	2170	1950	1773	1627	1500	1406	1320	1244	1177	1119
2582	2311	2078	1890	1736	1600	1500	1409	1328	1256	1194
2736	2451	2205	2007	1843	1700	1594	1497	1411	1335	1269
2890	2591	2332	2124	1951	1800	1688	1586	1495	1415	1345
3043	2730	2459	2240	2059	1900	1782	1675	1579	1494	1421
3196	2868	2585	2356	2166	2000	1876	1764	1663	1574	1497
3348	3007	2711	2472	2274	2100	1970	1853	1747	1654	1573
3499	3144	2837	2588	2382	2200	2065	1942	1831	1734	1649
3650	3281	2962	2704	2489	2300	2159	2031	1916	1814	1725
3800	3418	3087	2819	2596	2400	2253	2120	2000	1894	1801
3949	3555	3213	2935	2704	2500	2347	2208	2083	1973	1877
4098	3691	3338	3050	2811	2600	2440	2296	2167	2053	1953
4247	3827	3462	3166	2918	2700	2534	2385	2251	2133	2029

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	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	7.5	0:52	7.2	0:50	6.9	0:48	6.7	0:47	6.6	0:46
300	11.1	1:16	10.6	1:13	10.1	1:10	9.7	1:07	9.5	1:05
400	14.8	1:40	14.0	1:35	13.3	1:31	12.7	1:27	12.3	1:24
500	18.5	2:03	17.5	1:58	16.6	1:52	15.8	1:47	15.2	1:43
600	22.2	2:27	20.9	2:20	19.8	2:13	18.8	2:07	18.1	2:02
700	26.0	2:50	24.5	2:42	23.1	2:33	22.0	2:26	21.1	2:20
800	29.8	3:13	28.0	3:03	26.4	2:54	25.1	2:46	24.0	2:38
900	33.7	3:36	31.7	3:25	29.8	3:14	28.2	3:05		
1000	37.5	3:59	35.3	3:46	33.2	3:34	31.4	3:24		
1100	41.5	4:21	39.0	4:07	36.7	3:55	34.7	3:44		
1200	45.4	4:43	42.7	4:28	40.2	4:15	38.0	4:03		
1300	49.5	5:05	46.5	4:49	43.7	4:35	41.3	4:22		
1400	53.5	5:27	50.3	5:10	47.2	4:54	44.6	4:40		
1500	57.7	5:49	54.1	5:31	50.8	5:14	48.0	4:59		
1600	61.8	6:10	58.0	5:51	54.5	5:33	51.4	5:18		
1700	66.1	6:31	61.9	6:11	58.1	5:53				
1800	70.3	6:53	65.9	6:31	61.8	6:12				
1900	74.6	7:13	69.9	6:51	65.6	6:31				
2000	78.9	7:34	73.9	7:11	69.3	6:50				

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GEAR DOWN

Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1,000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	140	160	180	200	220
10	–1.2	–0.6	0.0	0.7	1.4
15	–1.8	–0.9	0.0	1.0	2.1
20	–2.4	–1.2	0.0	1.4	2.8
25	–3.0	–1.5	0.0	1.7	3.4
30	–3.6	–1.8	0.0	2.0	4.1
35	–4.2	–2.1	0.0	2.4	4.9
40	–4.8	–2.4	0.0	2.7	5.6
45	–5.4	–2.7	0.0	3.0	6.3
50	–6.0	–3.0	0.0	3.4	7.1
55	–6.6	–3.3	0.0	3.7	7.9
60	–7.2	–3.6	0.0	4.1	8.6
65	–7.8	–3.9	0.0	4.4	9.4
70	–8.4	–4.2	0.0	4.8	10.3
75	–9.1	–4.6	0.0	5.2	11.1

Based on VREF 30 + 80 climb, Long Range Cruise and VREF 30 + 80 descent.

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GEAR DOWN

Short Trip 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
103	85	72	63	56	50	45	41	38	35	33
176	152	135	121	109	100	92	85	79	74	70
249	220	197	178	163	150	139	129	121	114	107
321	286	258	235	216	200	186	174	163	154	145
392	352	320	292	270	250	233	218	205	194	183
463	418	380	349	323	300	280	263	248	234	222
534	483	441	406	376	350	327	308	290	274	260
606	549	502	463	429	400	375	352	332	315	299
678	615	564	520	482	450	422	397	375	355	337
751	682	625	577	536	500	469	441	417	395	375

Trip Fuel and Time

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		140	160	180	200	220	
50	FUEL (1000 KG) ALT (FT)	1.8 14000	2.0 12000	2.2 10000	2.3 10000	2.5 8000	0:15
100	FUEL (1000 KG) ALT (FT)	3.2 24000	3.5 22000	3.8 20000	4.1 18000	4.4 16000	0:26
150	FUEL (1000 KG) ALT (FT)	4.4 30000	4.8 26000	5.2 24000	5.7 22000	6.2 20000	0:36
200	FUEL (1000 KG) ALT (FT)	5.5 30000	6.1 28000	6.6 26000	7.3 24000	7.9 20000	0:46
250	FUEL (1000 KG) ALT (FT)	6.6 30000	7.3 28000	8.1 26000	8.8 24000	9.6 20000	0:56
300	FUEL (1000 KG) ALT (FT)	7.8 30000	8.6 28000	9.5 26000	10.4 24000	11.4 20000	1:05
350	FUEL (1000 KG) ALT (FT)	8.9 30000	9.9 28000	10.9 26000	12.1 22000	13.2 20000	1:15
400	FUEL (1000 KG) ALT (FT)	10.1 30000	11.2 28000	12.3 26000	13.7 22000	14.9 20000	1:24
450	FUEL (1000 KG) ALT (FT)	11.3 30000	12.5 28000	13.8 26000	15.3 22000	16.7 20000	1:34
500	FUEL (1000 KG) ALT (FT)	12.4 30000	13.8 28000	15.2 26000	17.0 22000	18.9 18000	1:44

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GEAR DOWN

Holding Planning
Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)						
	1500	5000	10000	15000	20000	25000	30000
300	14180	14180	14220	14420			
280	13230	13230	13240	13350			
260	12320	12300	12290	12350	12610		
240	11430	11390	11370	11370	11500		
220	10580	10510	10480	10460	10510	10790	
200	10010	9680	9620	9590	9590	9730	
180	9200	8880	8790	8760	8730	8770	9030
160	8540	8440	8130	8090	8050	8050	8190
140	8230	8120	7800	7740	7820	7660	7750

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
300	13520	13510	13520	13640	
280	12630	12620	12600	12660	12940
260	11770	11740	11720	11750	11920
240	10910	10850	10830	10820	10910
220	10060	9990	9940	9920	9960
200	9460	9140	9070	9050	9050
180	8630	8530	8230	8200	8180
160	7920	7840	7530	7610	7580
460	7530	7450	7280	7190	7170

These tables include 5% additional fuel for holding in a racetrack pattern.

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GEAR DOWN
ENGINE INOP
MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
18	150.6		
17	156.6	149.1	
16	162.8	155.1	146.7
15	168.4	160.5	151.9
14	174.1	166.1	157.3
13	179.9	171.8	162.9
12	185.9	177.6	168.6
11	191.7	183.1	173.8
10	197.6	188.7	179.1
9	203.0	193.7	183.9
8	208.3	198.9	188.8
7	213.7	204.1	193.7
6	219.1	209.3	198.7
5	224.6	214.5	203.8
4	229.1	218.8	207.9
3	233.4	222.9	212.0
2	237.5	227.1	216.1

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG) PRESSURE ALTITUDE (1000 FT)					
	8	10	12	14	16	18
ENGINE ONLY	–3.3	–3.4	–3.4	–3.2	–2.4	–1.4
ENGINE AND WING	–4.1	–4.3	–4.4	–4.4	–3.6	–2.4

Performance Dispatch — Chapter PD
Text — Section 24

Introduction

This chapter contains self dispatch performance data intended primarily for use by flight crews in the event that information cannot be obtained from the airline dispatch office. The data provided is for a single takeoff flap at max takeoff thrust. The range of conditions covered is limited to those normally encountered in airline operation. 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.

Takeoff

The maximum allowable takeoff weight will be the least of the Field, Climb, Brake Energy, and Obstacle Limit Weights as determined from the following tables. Tire Limit is not shown as it is not limiting for the range of conditions shown in this chapter.

Field Limit Weight—Slope and Wind Corrections

These tables provide corrections to the field length available for the effects of runway slope and wind component along the runway. Enter the Slope Correction table with the available field length and runway slope to determine the slope corrected field length. Now enter the Wind Correction table with slope corrected field length and wind component to determine the slope and wind corrected field length.

Field and Climb Limit Weight

Tables are presented for selected airport pressure altitudes and show both Field and Climb Limit Weights. Enter the appropriate table for pressure altitude with “Slope and Wind Corrected Field Length” determined above and airport OAT to obtain Field Limit Weight. Also read Climb Limit Weight for the same OAT. Intermediate altitudes may be interpolated or use next higher altitude.

Obstacle Limit Weight

This table provides obstacle limit weights for reference airport conditions based on obstacle height above the runway surface and distance from brake release. Enter the correction tables to correct the reference Obstacle Limit Weight for the effects of OAT, pressure altitude and wind as indicated. In the case of multiple obstacles, enter the tables successively with each obstacle and determine the most limiting weight.

Brake Energy Limits VMBE

Tables are presented to determine the Maximum Brake Energy Speed VMBE. Compliance with this limitation is required to ensure that the brakes have enough

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capacity to execute a maximum effort stop from V1 without the use of thrust reversers. Enter the upper table with pressure altitude and OAT to determine the reference VMBE. Then enter the lower table with the reference VMBE and brake release weight to determine VMBE for a specific takeoff. Adjust for slope, wind and deactivated brakes as described below the table. The resulting VMBE must be greater than or equal to V1. If VMBE is less than V1, brake release weight must be decreased by the amount shown below the table.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table as well as FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Normal takeoff speeds, V1, VR, and V2 are read from the table by entering with takeoff flap setting and brake release weight. Use the tables provided to correct takeoff speeds for altitude and actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind corrections to V1 are obtained by entering the Slope and Wind V1 Adjustment Table.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available

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exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Brakes Deactivated

When operating with brakes deactivated, the runway/obstacle and brake energy limit weights and the V1 and VMBE must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway/obstacle limited weight by 3,500 kg and the V1 associated with the reduced weight by one knot. With two brakes deactivated, reduce the normal runway/obstacle limited weight by 7,300 kg and the V1 associated with the reduced weight by three knots. If the resulting V1 is less than V1(MCG), takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate stop distance corrected for wind and slope exceeds approximately 1,540 m for one brake deactivated or 1,610 m for two brakes deactivated.

For brake(s) deactivated, reduce VMBE by the amount shown on the Brake Energy Limit VMBE Chart. If the resulting VMBE is less than V1, the brake release weight must be reduced according to the instructions on the brake energy limit chart. The resulting V1 must not be less than V1(MCG). Determine VR and V2 for the actual weight.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

Enroute

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. Note that these tables consider 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 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5 g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43,100 ft.

Long Range Cruise Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination. Data is based on economy climb and descent speeds, and Long Range Cruise with normal engine bleed for air conditioning. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

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To determine trip fuel and time for a constant altitude cruise, 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 planned landing weight to obtain fuel required at the planned landing weight.

Long Range Cruise Step Climb Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination when flying a step climb profile. Step climb profiles are based on 4,000 ft step climbs to keep the flight within 2,000 ft of the optimum altitude for the current cruise weight. To determine trip fuel and time, enter the Ground to Air Miles Conversion table and determine air distance as discussed above. Then enter the Trip Fuel and Time required with air distance and planned landing weight to read trip fuel. Continue across the table to read trip time.

Short Trip Fuel and Time

These tables are provided to determine trip fuel and time for short distances or alternates. The data considers the use of the FMC short trip optimum altitude. Obtain air distance from upper table using the ground distance and wind component to the alternate. Enter Trip Fuel and Time table with air distance and read trip fuel required for the expected landing weight, together with time to alternate at right. For distances greater than shown or other altitudes, use the Long Range Cruise Trip Fuel and Time tables.

Holding Planning

These tables provide total fuel flow information necessary for planning Flaps Up and Flaps 1 holding and reserve fuel requirements. Data is based on the FMC holding speed schedule which is the higher of the maximum endurance and flaps up maneuver speeds. As noted, the fuel flow is based on flight in a racetrack holding pattern. For holding in straight and level flight, reduce table values by 5%.

Oxygen Requirements

Flight Crew System

Regulations require that sufficient oxygen be provided to the flight crew to account for the greater of supplemental breathing oxygen in the event of a cabin depressurization or protective breathing in the event of smoke or harmful fumes in the flight deck.

Tables are provided to determine the flight crew oxygen dispatch requirements. Table 1 shows minimum oxygen quantity necessary to ensure that protective breathing requirements are satisfied. Table 2 shows the supplemental oxygen requirement for loss of pressurization, emergency descent and total post

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decompression flight time above 10,000 ft. Table 3 gives adjustments that must be applied to Table 2 crew member supplemental requirements in situations where the enroute altitude after decompression will exceed 14,000 ft. The increments shown in Table 3 reflect only the increase in oxygen flow rate associated with periods of post decompression flight at altitudes other than 14,000 ft. Hence, this time must also be included in the Table 2 time value used.

Table 1, Table 2 and Table 3 values are based on “NORMAL” regulator settings. Table 3 also shows “100%” regulator setting adjustments that can be used if the operator chooses to schedule oxygen dispatch requirements based on pure oxygen availability.

An additional quantity of oxygen is required when flight altitudes above 41,000 ft are planned. Regulations require that one active duty pilot must don the oxygen mask and breathe diluted oxygen for the duration of the flight above 41,000 ft. The additional quantity of oxygen required is 2.05 liters/person/minute (1.2 psi/person/minute for the single cylinder system), or 13 liters/person/minute (8 psi/person/minute) if 100% oxygen is selected during normal usage.

After determining the total volume (liters) required for the flight crew by using the larger value from Table 1 or Table 2, obtain the dispatch pressure required from the Cylinder Volume to Pressure Conversion table (Table 4). Adjust this reading for cylinder temperature as required, using the adjustments given (Table 5).

Net Level Off Weight

The Net Level Off Weight table is provided to determine terrain clearance capability in straight and level flight following an engine failure. Regulations require terrain clearance planning based on net performance which is the gross (or actual) gradient performance degraded by 1.1%. In addition, the net level off pressure altitude must clear the terrain by 1,000 ft.

To determine the maximum weight for terrain clearance, enter the table with required net level off pressure altitude and expected ISA deviation to obtain weight. Adjust weight for anti-ice operation as noted below the table.

Extended Range Operations

Regulations require that flights conducted over a route that contains a point further than one hour’s time at “normal one engine inoperative speed” from an adequate diversion airport comply with rules set up specifically for “Extended Range Operation with Two Engine airplanes”. This section provides reserve fuel planning information for the "Critical Fuel Scenario" based on two engine operation at Long Range Cruise as well as single engine operation at Long Range Cruise.

Critical Fuel Reserves

Enter Ground to Air Mile Conversion table with forecast wind and ground distance to diversion airport from critical point to obtain air distance. Now enter

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Critical Fuel table with air distance and expected weight at the critical point and read required fuel. Apply the noted fuel adjustments as necessary. Regulations require a 5% allowance for performance deterioration unless a value has been established by the operator for in-service deterioration.

As noted below each table, the fuel required is the greater of the two engine fuel and the single engine fuel. This fuel is compared to the amount of fuel normally onboard the airplane at that point in the route. If the fuel required by the critical fuel reserves exceeds the amount of fuel normally expected, the fuel load must be adjusted accordingly.

Landing

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for Flaps 30.

Maximum landing weight is the lowest of the field length limit weight, climb limit weight or maximum certified landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required.

Go-Around Climb Gradient

Enter the Reference Go-around Gradient table with airport OAT and pressure altitude to determine the reference Go-Around Gradient. Then adjust the reference gradient for airplane weight and speed using the tables provided to determine the weight and speed adjusted Go-Around Gradient. Apply the necessary engine bleed corrections as noted. Note that data is for one engine inoperative.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted adjustments as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent takeoff, or ensure the brake temperature is within limits using the alternate procedure described on the page.

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Takeoff PD.30

Takeoff Field Corrections PD.30.1

Takeoff Field & Climb Limit Weights PD.30.2

Takeoff Obstacle Limit Weight PD.30.5

Tire Speed Limit PD.30.7

Brake Energy Limits VMBE PD.30.8

Takeoff Speeds PD.30.9

Gear Down Dispatch PD.30.10

Enroute PD.31

Long Range Cruise Maximum Operating Altitude PD.31.1

Long Range Cruise Trip Fuel and Time PD.31.3

Long Range Cruise Step Climb PD.31.5

Short Trip Fuel and Time PD.31.6

Holding Planning PD.31.7

Crew Oxygen Requirements PD.31.8

Oxygen Requirements PD.31.9

Net Level Off Weight PD.31.10

Landing PD.32

Landing Field Limit Weight—Dry Runway PD.32.1

Landing Field Limit Weight—Wet Runway PD.32.2

Landing Climb Limit Weight PD.32.3

Go-Around Climb Gradient PD.32.4

Quick Turnaround Limit Weight PD.32.5

Gear Down PD.33

Takeoff Climb Limit Weight PD.33.1

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Landing Climb Limit Weight PD.33.2
Takeoff Obstacle Limit Weight PD.33.3
Long Range Cruise Altitude Capability PD.33.5
Long Range Cruise Trip Fuel and Time PD.33.6
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Text PD.34

Introduction PD.34.1
Takeoff PD.34.1
Enroute PD.34.3
Landing PD.34.6

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Takeoff Field Corrections

Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH (M) RUNWAY SLOPE (%)								
	–2.0	–1.5	–1.0	–0.5	0.0	0.5	1.0	1.5	2.0
1200	1220	1220	1210	1210	1200	1180	1160	1140	1120
1400	1430	1420	1410	1410	1400	1380	1350	1330	1300
1600	1630	1630	1620	1610	1600	1570	1540	1510	1480
1800	1840	1830	1820	1810	1800	1770	1730	1700	1660
2000	2060	2050	2030	2020	2000	1960	1920	1880	1840
2200	2290	2270	2240	2220	2200	2160	2110	2070	2020
2400	2510	2480	2460	2430	2400	2350	2300	2250	2200
2600	2730	2700	2660	2630	2600	2540	2490	2430	2380
2800	2950	2910	2870	2840	2800	2740	2680	2620	2550
3000	3170	3120	3080	3040	3000	2930	2870	2800	2730
3200	3380	3340	3290	3250	3200	3130	3050	2980	2910
3400	3600	3550	3500	3450	3400	3320	3240	3160	3080
3600	3820	3770	3710	3660	3600	3520	3430	3350	3260
3800	4050	3980	3920	3860	3800	3710	3620	3520	3430
4000	4270	4200	4140	4070	4000	3900	3800	3700	3600
4200	4500	4420	4350	4270	4200	4090	3990	3880	3770
4400	4720	4640	4560	4480	4400	4280	4160	4040	3930
4600	4950	4860	4770	4690	4600	4470	4340	4210	4080
4800	5170	5080	4990	4890	4800	4660	4520	4380	4240
5000	5400	5300	5200	5100	5000	4850	4700	4540	4390

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M) WIND COMPONENT (KTS)							
	–15	–10	–5	0	10	20	30	40
1200	810	940	1070	1200	1250	1320	1400	1490
1400	990	1130	1260	1400	1460	1540	1630	1730
1600	1170	1310	1460	1600	1670	1760	1860	1960
1800	1350	1500	1650	1800	1890	1980	2090	2200
2000	1520	1680	1840	2000	2090	2190	2300	2430
2200	1680	1860	2030	2200	2290	2390	2520	2650
2400	1850	2030	2220	2400	2490	2600	2730	2880
2600	2010	2210	2400	2600	2700	2820	2950	3100
2800	2180	2380	2590	2800	2910	3030	3170	3330
3000	2340	2560	2780	3000	3120	3250	3390	3550
3200	2500	2740	2970	3200	3330	3470	3620	3780
3400	2670	2910	3160	3400	3540	3680	3840	4010
3600	2830	3090	3340	3600	3750	3900	4070	4240
3800	2990	3260	3530	3800	3950	4110	4280	4470
4000	3160	3440	3720	4000	4150	4320	4500	4700
4200	3320	3610	3910	4200	4360	4530	4710	4910
4400	3480	3790	4090	4400	4560	4730	4920	5120
4600	3640	3960	4280	4600	4770	4940	5130	5340
4800	3800	4130	4470	4800	4970	5150	5340	5550
5000	3960	4310	4650	5000	5180	5360	5560	5760

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Takeoff Field & Climb Limit Weights
Flaps 15
Sea Level Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	23	25	27	29	42	46	50
1220	191.2	172.9	171.8	170.6	170.3	169.8	169.2	168.7	157.3	152.6	148.1
1400	206.5	187.0	185.8	184.5	184.2	183.6	183.0	182.5	170.3	165.3	160.5
1600	221.9	201.3	200.0	198.7	198.4	197.7	197.1	196.5	183.6	178.4	173.3
1800	236.1	214.5	213.1	211.7	211.4	210.7	210.1	209.4	195.9	190.4	185.1
2000	249.2	226.7	225.3	223.9	223.5	222.8	222.1	221.5	207.4	201.7	196.1
2200	261.8	238.4	236.9	235.5	235.1	234.4	233.7	233.0	218.4	212.4	206.7
2400	273.4	249.2	247.6	246.1	245.7	245.0	244.3	243.5	228.4	222.3	216.3
2600	283.7	258.7	257.1	255.5	255.2	254.4	253.6	252.9	237.2	230.9	224.7
2800	293.7	267.9	266.2	264.6	264.2	263.4	262.6	261.9	245.7	239.2	232.8
3000	303.4	276.7	275.0	273.4	273.0	272.2	271.3	270.5	253.9	247.2	240.6
3200	312.4	285.1	283.4	281.7	281.3	280.4	279.6	278.8	261.8	254.8	248.1
3400	321.0	293.2	291.4	289.6	289.2	288.4	287.5	286.7	269.3	262.2	255.3
3600	324.3	300.8	299.0	297.2	296.8	295.9	295.0	294.2	276.4	269.2	262.2
3800	324.3	307.9	306.1	304.2	303.8	302.9	302.0	301.2	283.0	275.7	268.5
4000	324.3	314.7	312.8	311.0	310.5	309.6	308.7	307.9	289.4	281.9	274.6
4200	324.3	321.3	319.4	317.5	317.0	316.1	315.2	314.3	295.6	287.9	280.5
4400	324.3	324.3	324.3	323.8	323.3	322.4	321.5	320.5	301.5	293.7	286.2
4600	324.3	324.3	324.3	324.3	324.3	324.3	324.3	324.3	307.2	299.3	291.7
CLIMB LIMIT WT (1000 KG)	308.1	306.9	306.8	306.7	306.7	306.7	306.6	306.6	279.1	267.2	255.7

2,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	23	25	27	29	42	46	50
1220	179.4	162.2	161.1	160.0	159.8	159.2	158.1	156.8	146.0	141.6	136.8
1400	194.0	175.5	174.4	173.2	172.9	172.4	171.2	169.7	158.3	153.6	148.4
1600	208.7	189.2	187.9	186.7	186.4	185.8	184.6	183.0	170.9	165.9	160.4
1800	222.2	201.8	200.5	199.2	198.9	198.2	197.0	195.3	182.6	177.4	171.7
2000	234.7	213.5	212.1	210.8	210.5	209.8	208.5	206.8	193.6	188.1	182.1
2200	246.8	224.7	223.3	221.9	221.6	220.9	219.5	217.7	204.0	198.3	192.2
2400	257.8	234.9	233.5	232.1	231.7	231.0	229.6	227.7	213.5	207.6	201.2
2600	267.6	244.0	242.5	241.0	240.6	239.9	238.4	236.5	221.8	215.8	209.1
2800	277.1	252.7	251.2	249.6	249.3	248.5	247.0	245.0	229.9	223.6	216.7
3000	286.2	261.1	259.5	257.9	257.5	256.8	255.2	253.2	237.6	231.1	224.1
3200	294.9	269.1	267.5	265.9	265.5	264.7	263.1	261.0	245.0	238.4	231.2
3400	303.1	276.8	275.1	273.5	273.1	272.3	270.6	268.5	252.1	245.4	238.0
3600	311.0	284.1	282.4	280.7	280.3	279.4	277.7	275.6	258.9	252.0	244.4
3800	318.3	290.9	289.1	287.4	287.0	286.2	284.4	282.2	265.2	258.2	250.5
4000	324.3	297.4	295.6	293.9	293.4	292.6	290.8	288.6	271.3	264.1	256.3
4200	324.3	303.7	301.9	300.1	299.6	298.8	297.0	294.7	277.1	269.8	261.8
4400	324.3	309.7	307.9	306.1	305.6	304.8	302.9	300.6	282.7	275.3	267.2
4600	324.3	315.5	313.7	311.9	311.4	310.5	308.7	306.3	288.1	280.6	272.4
CLIMB LIMIT WT (1000 KG)	292.5	291.5	291.4	291.3	291.3	291.2	289.0	285.7	258.9	248.4	237.2

With engine bleed for packs off, increase field limit weight by 200 kg and climb limit weight by 900 kg.
With engine and wing anti-ice on, decrease field limit weight by 800 kg and climb limit weight by 1300 kg.

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Takeoff Field & Climb Limit Weights
Flaps 15
4,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	23	25	27	29	42	46	50
1220	167.2	151.1	150.1	148.8	148.2	147.1	145.9	144.5	133.4	129.8	126.4
1400	180.8	163.7	162.6	161.2	160.6	159.4	158.1	156.6	144.8	140.9	137.3
1600	194.8	176.6	175.5	174.0	173.4	172.1	170.7	169.1	156.6	152.5	148.7
1800	207.6	188.6	187.4	185.9	185.2	183.8	182.5	180.8	167.7	163.4	159.4
2000	219.6	199.8	198.5	196.9	196.2	194.8	193.4	191.6	178.0	173.5	169.3
2200	231.1	210.5	209.2	207.5	206.8	205.3	203.8	202.0	187.9	183.2	178.9
2400	241.5	220.2	218.9	217.2	216.4	214.9	213.3	211.4	196.8	192.0	187.5
2600	250.8	228.8	227.4	225.6	224.8	223.2	221.6	219.7	204.5	199.6	194.9
2800	259.7	237.0	235.6	233.7	232.9	231.3	229.6	227.6	212.0	206.9	202.1
3000	268.3	244.9	243.4	241.6	240.7	239.0	237.3	235.2	219.2	213.9	208.9
3200	276.5	252.5	251.0	249.1	248.2	246.5	244.8	242.6	226.2	220.7	215.7
3400	284.4	259.8	258.3	256.3	255.4	253.7	251.9	249.7	232.9	227.3	222.1
3600	291.8	266.8	265.2	263.2	262.3	260.5	258.7	256.4	239.2	233.6	228.3
3800	298.8	273.2	271.6	269.6	268.7	266.8	265.0	262.7	245.2	239.4	234.0
4000	305.4	279.4	277.8	275.7	274.8	272.9	271.0	268.7	250.9	245.0	239.5
4200	311.8	285.4	283.7	281.6	280.7	278.8	276.8	274.5	256.3	250.4	244.8
4400	318.0	291.1	289.5	287.3	286.3	284.4	282.5	280.1	261.6	255.6	249.9
4600	324.0	296.7	295.0	292.8	291.8	289.9	287.9	285.4	266.7	260.6	254.8
CLIMB LIMIT WT (1000 KG)	273.5	272.5	272.4	271.5	270.4	267.8	265.0	261.5	237.0	228.7	221.5

6,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	23	25	27	29	42	46	50
1220	155.4	140.2	139.0	137.4	137.0	135.6	134.2	132.8	122.8	119.7	116.5
1400	168.3	152.1	150.8	149.0	148.6	147.2	145.6	144.1	133.4	130.1	126.8
1600	181.5	164.3	162.9	161.1	160.7	159.1	157.5	155.9	144.6	141.1	137.5
1800	193.7	175.8	174.3	172.4	171.9	170.3	168.6	166.9	155.1	151.4	147.7
2000	205.1	186.4	184.9	182.9	182.4	180.7	179.0	177.2	164.9	161.0	157.2
2200	216.0	196.6	195.0	192.9	192.4	190.7	188.9	187.0	174.2	170.3	166.2
2400	226.0	205.8	204.2	202.0	201.5	199.7	197.8	195.9	182.6	178.5	174.4
2600	234.7	213.9	212.2	209.9	209.4	207.6	205.6	203.7	189.9	185.7	181.4
2800	243.1	221.6	219.9	217.6	217.0	215.1	213.1	211.1	196.9	192.6	188.1
3000	251.2	229.1	227.3	224.9	224.4	222.4	220.3	218.2	203.6	199.1	194.5
3200	259.0	236.3	234.5	232.0	231.5	229.4	227.3	225.2	210.2	205.6	200.9
3400	266.4	243.3	241.4	238.9	238.3	236.2	234.1	231.9	216.6	211.9	207.1
3600	273.5	249.8	247.9	245.4	244.8	242.7	240.5	238.2	222.6	217.8	212.9
3800	280.1	256.0	254.0	251.4	250.8	248.7	246.4	244.1	228.2	223.3	218.3
4000	286.4	261.9	259.9	257.2	256.6	254.4	252.1	249.8	233.6	228.6	223.5
4200	292.5	267.5	265.5	262.8	262.2	260.0	257.6	255.3	238.8	233.7	228.5
4400	298.4	273.0	270.9	268.2	267.6	265.3	262.9	260.5	243.8	238.6	233.4
4600	304.1	278.3	276.2	273.4	272.8	270.4	268.0	265.6	248.6	243.4	238.0
CLIMB LIMIT WT (1000 KG)	255.3	254.4	253.8	251.8	251.3	248.3	245.2	241.9	220.0	213.5	206.9

With engine bleed for packs off, increase field limit weight by 200 kg and climb limit weight by 900 kg.
With engine and wing anti-ice on, decrease field limit weight by 800 kg and climb limit weight by 1300 kg.

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Takeoff Field & Climb Limit Weights
Flaps 15
8,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	23	25	27	29	42	46	50
1220	145.0	129.8	127.9	126.0	125.6	124.6	123.2	121.9	112.6	109.7	106.7
1400	157.2	140.9	138.9	136.9	136.4	135.3	133.9	132.5	122.6	119.5	116.2
1600	169.7	152.6	150.4	148.3	147.8	146.6	145.1	143.6	133.1	129.8	126.4
1800	181.4	163.4	161.1	158.9	158.4	157.2	155.6	154.0	143.0	139.6	136.0
2000	192.3	173.5	171.1	168.9	168.3	167.0	165.4	163.7	152.3	148.7	145.0
2200	202.7	183.2	180.7	178.4	177.8	176.5	174.8	173.1	161.2	157.5	153.6
2400	212.1	192.0	189.4	187.0	186.4	185.0	183.3	181.4	169.1	165.3	161.3
2600	220.4	199.6	196.9	194.4	193.8	192.4	190.6	188.7	176.0	172.0	167.9
2800	228.4	206.9	204.1	201.5	200.9	199.4	197.6	195.6	182.5	178.4	174.2
3000	236.0	213.9	211.1	208.4	207.7	206.2	204.3	202.3	188.8	184.6	180.2
3200	243.4	220.7	217.8	215.1	214.5	212.9	210.9	208.9	195.0	190.7	186.2
3400	250.5	227.3	224.4	221.6	220.9	219.3	217.3	215.2	201.0	196.6	192.0
3600	257.3	233.6	230.6	227.7	227.0	225.4	223.3	221.2	206.8	202.2	197.5
3800	263.6	239.4	236.3	233.4	232.7	231.1	229.0	226.8	212.1	207.5	202.7
4000	269.6	245.0	241.8	238.9	238.2	236.5	234.4	232.1	217.2	212.5	207.6
4200	275.4	250.4	247.2	244.2	243.4	241.7	239.6	237.3	222.1	217.3	212.3
4400	281.0	255.6	252.3	249.3	248.5	246.8	244.6	242.3	226.8	221.9	216.9
4600	286.4	260.6	257.3	254.2	253.4	251.6	249.4	247.1	231.4	226.4	221.3
CLIMB LIMIT WT (1000 KG)	240.1	238.8	235.4	232.5	231.8	229.6	226.6	223.4	203.7	197.6	191.2

With engine bleed for packs off, increase field limit weight by 200 kg and climb limit weight by 900 kg.
With engine and wing anti-ice on, decrease field limit weight by 800 kg and climb limit weight by 1300 kg.

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Takeoff Obstacle Limit Weight

Flaps 15

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

Sea Level, 30 deg. C & Below, Zero Wind

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	242.9	265.1	283.9	300.0	311.5	319.5					
20	227.1	247.3	264.6	279.1	291.3	301.5	309.7	315.4			
40	211.2	229.8	246.0	259.8	272.3	282.9	291.9	299.6	306.0	310.9	314.9
60	197.6	216.2	231.6	245.9	258.3	269.0	278.1	285.9	292.7	298.6	303.7
80	186.4	204.6	220.8	234.7	246.8	257.4	266.6	274.6	281.6	287.7	293.1
100	176.6	195.2	211.4	224.9	236.9	247.4	256.6	264.7	271.9	278.2	283.8
120	168.6	187.0	202.8	216.4	228.1	238.6	247.8	256.0	263.2	269.7	275.5
140	161.7	179.6	195.1	208.7	220.3	230.6	239.9	248.1	255.4	262.0	267.9
160		172.9	188.2	201.5	213.3	223.4	232.6	240.9	248.2	254.9	260.9
180		166.8	181.8	195.0	206.6	216.9	225.9	234.2	241.6	248.4	254.4
200		161.1	175.9	188.9	200.5	210.8	219.8	228.0	235.5	242.3	248.4
220		156.4	170.5	183.4	194.8	205.0	214.2	222.3	229.7	236.5	242.8
240		154.4	165.5	178.1	189.4	199.6	208.8	216.9	224.3	231.2	237.4
260			160.8	173.3	184.5	194.5	203.7	211.9	219.3	226.1	232.4
280			155.9	168.7	179.8	189.8	198.8	207.1	214.6	221.3	227.6
300			154.2	164.4	175.4	185.3	194.3	202.5	210.0	216.8	223.0

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustment

OAT (deg. C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
29 & Below	0	0	0	0	0	0	0	0
30	–1.1	–1.2	–1.3	–1.4	–1.6	–1.7	–1.8	–1.9
32	–3.2	–3.6	–3.9	–4.3	–4.7	–5.0	–5.4	–5.7
34	–5.3	–6.0	–6.6	–7.2	–7.8	–8.4	–9.0	–9.6
36	–7.5	–8.3	–9.2	–10.0	–10.9	–11.7	–12.5	–13.4
38	–9.6	–10.7	–11.8	–12.9	–14.0	–15.0	–16.1	–17.2
40	–11.8	–13.1	–14.4	–15.7	–17.1	–18.4	–19.7	–21.0
42	–15.1	–16.8	–18.5	–20.2	–21.8	–23.5	–25.2	–26.9
44	–18.5	–20.5	–22.5	–24.6	–26.6	–28.7	–30.7	–32.7
46	–21.8	–24.2	–26.6	–29.0	–31.4	–33.8	–36.2	–38.6
48	–25.1	–27.9	–30.7	–33.4	–36.2	–38.9	–41.7	–44.4
50	–28.5	–31.6	–34.7	–37.8	–40.9	–44.0	–47.2	–50.3

Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
S.L. & Below	0	0	0	0	0	0	0	0
1000	–6.5	–7.2	–7.8	–8.4	–9.1	–9.7	–10.3	–10.9
2000	–13.1	–14.4	–15.6	–16.9	–18.1	–19.4	–20.6	–21.9
3000	–20.2	–22.2	–24.1	–26.1	–28.1	–30.1	–32.0	–34.0
4000	–27.3	–30.0	–32.7	–35.4	–38.0	–40.7	–43.4	–46.1
5000	–33.4	–36.9	–40.3	–43.8	–47.3	–50.7	–54.2	–57.7
6000	–39.5	–43.8	–48.0	–52.2	–56.5	–60.8	–65.0	–69.2
7000	–45.5	–50.5	–55.5	–60.5	–65.5	–70.5	–75.5	–80.5
8000	–51.5	–57.2	–63.0	–68.8	–74.5	–80.2	–86.0	–91.8

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Takeoff Obstacle Limit Weight
Flaps 15
Wind Adjustment

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	180	200	220	240	260	280	300	320
15 TW	–26.1	–26.1	–26.1	–26.2	–26.2	–26.2	–26.3	–26.3
10 TW	–17.4	–17.4	–17.4	–17.4	–17.5	–17.5	–17.5	–17.5
5 TW	–8.7	–8.7	–8.7	–8.7	–8.7	–8.7	–8.8	–8.8
0	0	0	0	0	0	0	0	0
10 HW	3.0	2.8	2.5	2.2	2.0	2.1	2.2	2.4
20 HW	6.0	5.5	5.0	4.5	4.0	4.2	4.5	4.8
30 HW	9.2	8.6	8.0	7.4	6.8	6.6	6.4	6.2
40 HW	12.4	11.7	11.0	10.3	9.6	9.0	8.3	7.6

With engine bleed for packs off, increase weight by 300 kg.
With engine and wing anti-ice on, decrease weight by 1,500 kg.

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Tire Speed Limit
Flaps 15

AIRPORT		TIRE SPEED LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
deg. C	deg. F	–2000	0	2000	4000	6000	8000
54	129	324.3	318.0	295.3	273.0	252.2	232.9
52	126	324.3	319.7	297.1	274.7	253.7	234.3
50	122	324.3	321.5	298.9	276.3	255.2	235.7
48	118	324.3	322.6	300.6	278.0	256.8	237.1
46	115	324.3	323.7	302.3	279.8	258.4	238.6
44	111	324.3	324.3	304.0	281.5	260.0	240.1
42	108	324.3	324.3	305.8	283.2	261.7	241.6
40	104	324.3	324.3	307.5	285.0	263.3	243.1
38	100	324.3	324.3	309.4	286.8	265.0	244.7
36	97	324.3	324.3	311.2	288.6	266.7	246.2
34	93	324.3	324.3	313.1	290.5	268.4	247.8
32	90	324.3	324.3	315.1	292.4	270.2	249.4
30	86	324.3	324.3	317.1	294.3	271.9	251.1
28	82	324.3	324.3	319.1	296.3	273.7	252.7
26	79	324.3	324.3	321.2	298.3	275.6	254.4
24	75	324.3	324.3	323.3	300.4	277.5	256.1
22	72	324.3	324.3	324.3	302.4	279.5	258.0
20	68	324.3	324.3	324.3	304.5	281.5	259.8
18	64	324.3	324.3	324.3	306.7	283.6	261.7
16	61	324.3	324.3	324.3	308.9	285.7	263.6
14	57	324.3	324.3	324.3	311.1	287.9	265.5
12	54	324.3	324.3	324.3	313.4	290.1	267.6
10	50	324.3	324.3	324.3	315.7	292.4	269.7
–40	–40	324.3	324.3	324.3	324.3	324.3	324.3

Increase tire speed limit weight by 2,400 kg per knot headwind.
Decrease tire speed limit weight by 3,000 kg per knot tailwind.

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Brake Energy Limits VMBE
Maximum Brake Energy Speed

OAT (deg. C)	REFERENCE VMBE (KIAS) PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
54	198	191				
50	199	191	185			
46	199	192	185	179		
42	200	193	186	179	173	
38	201	193	187	180	174	164
34	202	194	187	181	175	166
30	204	195	188	182	175	167
26	205	197	189	183	176	169
22	207	198	191	184	177	170
18	209	200	192	185	179	172
14	210	202	194	187	180	173
10	210	203	196	189	182	175
6	210	205	197	190	183	176
2	210	207	199	192	185	178
-2	210	209	201	194	186	179
-6	210	210	203	195	188	181
-10	210	210	205	197	190	183

Weight Adjusted VMBE

WEIGHT (1000 KG)	REFERENCE VMBE (KIAS)										
	160	165	170	175	180	185	190	195	200	205	210
180	186	193	200	207	210	210	210	210	210	210	210
200	177	182	188	194	200	206	210	210	210	210	210
220	168	173	178	184	189	194	200	205	210	210	210
240	160	165	170	175	180	185	190	195	200	205	210
260	153	158	163	167	172	177	181	186	191	195	200
280	148	152	156	161	165	170	174	178	183	187	192
300	143	147	151	155	160	164	168	172	176	180	184

Increase VMBE by 3 knots per 1% uphill runway slope. Decrease VMBE by 5 knots per 1% downhill runway slope.
Increase VMBE by 5 knot per 10 knots headwind. Decrease VMBE by 21 knots per 10 knots tailwind.
Decrease VMBE by 10 knots for one brake deactivated and 21 knots for two brakes deactivated.
Decrease brake release weight by 1,500 kg for each knot V1 exceeds VMBE.
Determine normal V1, VR, V2 speeds for lower brake release weight.

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Takeoff Speeds
Flaps 15
V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	KIAS		
	V1	VR	V2
320	174	183	187
310	170	179	184
300	167	176	181
290	163	173	179
280	160	169	176
270	157	166	173
260	153	163	171
250	149	159	168
240	146	156	165
230	142	152	162
220	137	148	158
210	133	144	155
200	129	140	152
190	123	136	148
180	119	131	145
170	114	127	141
160	108	122	137
Check V1(MCG) and minimum VR.			

V1, VR, V2 Adjustments*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
deg. C	deg. F	–2	0	2	4	6	8	–2	0	2	4	6	8	–2	0	2	4	6	8
60	140	8	10	12	14			4	4	5	6			–2	–2	–3	–3		
50	122	5	6	9	11	14	16	2	3	4	5	6	7	–1	–1	–2	–2	–3	–3
40	104	1	3	5	9	11	13	1	1	3	4	5	6	0	–1	–1	–2	–2	–3
30	86	0	0	3	6	9	11	0	0	1	3	4	5	0	0	–1	–1	–2	–2
20	68	0	0	2	4	7	10	0	0	1	2	3	5	0	0	0	–1	–1	–2
–60	–76	0	0	2	4	7	9	0	0	1	2	3	4	0	0	0	–1	–1	–2

Slope and Wind V1 Adjustments*

WEIGHT (1000 KG)	SLOPE (%)					WIND (KTS)							
	–2	–1	0	1	2	–15	–10	–5	0	10	20	30	40
320	–6	–3	0	3	5	–4	–2	–1	0	0	1	1	2
300	–5	–2	0	3	5	–3	–2	–1	0	0	1	1	2
280	–4	–2	0	3	4	–2	–1	0	0	0	1	1	2
260	–3	–1	0	3	4	–1	–1	0	0	1	2	2	2
240	–3	–1	0	2	4	–1	–1	0	0	1	2	2	2
220	–2	–1	0	2	4	–1	–1	0	0	1	2	2	2
200	–2	–1	0	2	4	–1	–1	0	0	1	2	2	3
180	–2	–1	0	2	4	–1	–1	0	0	1	2	2	3
160	–3	–1	0	2	4	–2	–1	0	0	1	2	2	3
* V1 not to exceed VR													

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Takeoff Speeds
Flaps 15
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		–2000		0		2000		4000		6000		8000	
deg. C	deg. F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	101	105	98	102	96	101	94	100				
50	122	103	108	100	105	96	101	94	100	93	98	90	96
40	104	108	112	106	110	102	107	97	102	93	99	90	96
30	86	110	114	109	114	105	110	101	106	97	102	93	98
20	68	110	114	110	114	106	111	103	108	99	104	95	100
–60	–76	111	115	111	114	107	111	104	108	100	105	97	102

Gear Down Dispatch

Takeoff Performance

Restriction/Recommendation

- Do not operate in icing conditions.
- Takeoff with tailwind is not recommended.
- VMO/MMO limit is 270 kt/M 0.73.
- It is recommended to use flaps 5 and maximum thrust-rating for takeoff.
- Decrease the performance climb limited gross weight as follows:

Takeoff config	Flaps 5
Performance climb limited gross weight	-28%

Final Takeoff Condition

The flap retraction speed schedule is unchanged except:

- Final-Segment Climb-Speed: VREF+60 KIAS.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 10 deg. C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	29700	0	33500*	33500*	33500*	33500*	32100
290	30500	–2	34300*	34300*	34300*	34300	32900
280	31200	–4	35200*	35200*	35200*	35100	33600
270	32000	–5	36100*	36100*	36100*	35800	34400
260	32800	–7	36700*	36700*	36700*	36600	35200
250	33700	–9	37500*	37500*	37500*	37400	36000
240	34500	–11	38300*	38300*	38300*	38300	36800
230	35400	–13	39100*	39100*	39100*	39100*	37700
220	36400	–15	40000*	40000*	40000*	40000*	38700
210	37300	–15	41000*	41000*	41000*	41000	39600
200	38300	–15	41900*	41900*	41900*	41900*	40600
190	39400	–15	42900*	42900*	42900*	42900*	41700
180	40500	–15	43100	43100	43100	43100	42800
170	41700	–15	43100	43100	43100	43100	43100
160	43000	–15	43100	43100	43100	43100	43100

ISA + 15 deg. C

WEIGHT (1,000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	29700	5	32400*	32400*	32400*	32400*	32100
290	30500	4	33300*	33300*	33300*	33300*	32900
280	31200	2	34200*	34200*	34200*	34200*	33600
270	32000	0	35100*	35100*	35100*	35100*	34400
260	32800	–2	36100*	36100*	36100*	36100*	35200
250	33700	–3	36700*	36700*	36700*	36700*	36000
240	34500	–5	37500*	37500*	37500*	37500*	36800
230	35400	–7	38300*	38300*	38300*	38300*	37700
220	36400	–9	39200*	39200*	39200*	39200*	38700
210	37300	–9	40100*	40100*	40100*	40100*	39600
200	38300	–9	41100*	41100*	41100*	41100*	40600
190	39400	–9	42100*	42100*	42100*	42100*	41700
180	40500	–9	43100	43100	43100	43100	42800
170	41700	–9	43100	43100	43100	43100	43100
160	43000	–9	43100	43100	43100	43100	43100

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	29700	11	30900*	30900*	30900*	30900*	30900*
290	30500	9	31900*	31900*	31900*	31900*	31900*
280	31200	8	32900*	32900*	32900*	32900*	32900*
270	32000	6	33800*	33800*	33800*	33800*	33800*
260	32800	4	34800*	34800*	34800*	34800*	34800*
250	33700	2	35800*	35800*	35800*	35800*	35800*
240	34500	0	36500*	36500*	36500*	36500*	36500*
230	35400	–2	37400*	37400*	37400*	37400*	37400*
220	36400	–3	38200*	38200*	38200*	38200*	38200*
210	37300	–3	39100*	39100*	39100*	39100*	39100*
200	38300	–3	40000*	40000*	40000*	40000*	40000*
190	39400	–3	41000*	41000*	41000*	41000*	41000*
180	40500	–3	42100*	42100*	42100*	42100*	42100*
170	41700	–3	43100	43100	43100	43100	43100
160	43000	–3	43100	43100	43100	43100	43100

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Trip 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
661	621	586	554	526	500	478	458	440	423	408
1310	1235	1166	1105	1050	1000	958	919	883	851	821
1956	1845	1744	1654	1574	1500	1438	1381	1328	1279	1234
2600	2454	2322	2204	2098	2000	1919	1843	1772	1708	1648
3242	3062	2899	2753	2621	2500	2399	2305	2217	2136	2062
3881	3669	3474	3301	3144	3000	2879	2766	2662	2565	2476
4518	4272	4048	3848	3667	3500	3359	3228	3106	2993	2890
5153	4875	4621	4394	4189	4000	3840	3690	3551	3422	3304
5786	5477	5194	4941	4711	4500	4320	4152	3995	3851	3718
6419	6079	5766	5487	5234	5000	4800	4613	4440	4279	4132
7052	6680	6339	6033	5756	5500	5280	5075	4884	4708	4546
7684	7281	6911	6579	6278	6000	5761	5537	5329	5137	4960
8316	7881	7483	7125	6800	6500	6241	5999	5774	5565	5374
8948	8482	8055	7670	7322	7000	6721	6460	6218	5994	5788
9580	9083	8627	8216	7844	7500	7201	6922	6663	6423	6202
10213	9684	9199	8762	8366	8000	7682	7384	7107	6851	6616

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	27		29		31		33		35	
	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	8.7	1:17	8.6	1:16	8.5	1:15	8.4	1:14	8.3	1:13
1000	16.4	2:26	16.0	2:24	15.7	2:21	15.5	2:19	15.3	2:17
1500	24.3	3:34	23.7	3:30	23.2	3:26	22.8	3:22	22.4	3:19
2000	32.2	4:42	31.3	4:36	30.6	4:30	30.1	4:25	29.6	4:22
2500	40.5	5:47	39.4	5:40	38.5	5:34	37.8	5:28	37.1	5:25
3000	48.7	6:53	47.4	6:45	46.4	6:37	45.5	6:30	44.6	6:27
3500	57.3	7:58	55.8	7:48	54.6	7:39	53.5	7:32	52.7	7:29
4000	65.9	9:02	64.2	8:51	62.8	8:41	61.6	8:34	60.7	8:31
4500	75.0	10:05	73.0	9:53	71.4	9:43	70.1	9:36	69.3	9:34
5000	84.0	11:08	81.9	10:55	80.0	10:45	78.6	10:38	77.9	10:36
5500	93.4	12:11	91.1	11:56	89.1	11:46	87.7	11:39		
6000	102.8	13:14	100.3	12:58	98.2	12:47	96.8	12:41		
6500	112.6	14:16	110.0	13:59	107.8	13:48	106.7	13:43		
7000	122.5	15:19	119.6	15:00	117.5	14:50	116.6	14:45		
7500	132.7	16:22	129.8	16:01	127.9	15:51				
8000	142.9	17:24	140.0	17:02	138.3	16:52				

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Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1,000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	160	180	200	220	240
10	–1.0	–0.5	0.0	0.7	1.4
20	–2.0	–1.1	0.0	1.4	3.1
30	–3.1	–1.6	0.0	2.2	5.1
40	–4.1	–2.2	0.0	3.2	7.3
50	–5.2	–2.8	0.0	4.3	9.9
60	–6.3	–3.3	0.0	5.5	12.7
70	–7.4	–3.9	0.0	6.8	15.8
80	–8.5	–4.5	0.0	8.3	19.2
90	–9.6	–5.0	0.0	9.8	22.9
100	–10.8	–5.6	0.0	11.5	26.9
110	–11.9	–6.2	0.0	13.3	31.2
120	–13.1	–6.8	0.0	15.3	35.8
130	–14.3	–7.3	0.0	17.3	40.6
140	–15.5	–7.9	0.0	19.5	45.7
150	–16.7	–8.5	0.0	21.8	51.2

Based on 310/.84 climb, Long Range Cruise and .84/310/250 descent.

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Long Range Cruise Step Climb
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
1293	1221	1157	1100	1047	1000	957	917	880	847	815
1924	1821	1729	1645	1569	1500	1437	1378	1325	1275	1229
2555	2421	2300	2190	2091	2000	1917	1840	1769	1704	1643
3186	3020	2871	2736	2612	2500	2397	2302	2214	2133	2057
3817	3620	3442	3281	3134	3000	2877	2763	2659	2562	2471
4447	4219	4013	3826	3656	3500	3357	3225	3103	2990	2885
5078	4818	4584	4371	4177	4000	3837	3687	3548	3419	3300
5708	5417	5155	4916	4699	4500	4317	4149	3993	3848	3714
6339	6017	5726	5461	5221	5000	4797	4610	4438	4277	4128
6969	6616	6297	6007	5742	5500	5277	5072	4882	4706	4542
7600	7215	6868	6552	6264	6000	5758	5534	5327	5135	4956
8231	7815	7439	7097	6785	6500	6238	5996	5772	5564	5370
8862	8415	8010	7642	7307	7000	6718	6457	6216	5993	5784
9494	9015	8581	8188	7829	7500	7198	6919	6661	6421	6198
10126	9615	9153	8733	8351	8000	7678	7380	7105	6850	6612

Trip Fuel and Time Required

AIR DIST (NM)	TRIP FUEL (1000 KG) LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
	160	180	200	220	240	
1000	12.9	14.1	15.3	16.5	17.8	2:16
1500	18.7	20.4	22.4	24.1	26.1	3:18
2000	24.7	27.0	29.7	32.0	34.7	4:21
2500	30.8	33.9	37.1	40.2	43.5	5:23
3000	37.1	40.9	44.8	48.6	52.6	6:25
3500	43.6	48.1	52.7	57.2	61.9	7:27
4000	50.2	55.5	60.8	66.1	71.5	8:29
4500	57.2	63.1	69.3	75.2	81.4	9:32
5000	64.3	70.9	77.9	84.6	91.5	10:34
5500	71.6	79.0	86.8	94.3	101.9	11:36
6000	79.1	87.4	96.0	104.3	112.7	12:38
6500	86.8	96.0	105.4	114.5	123.8	13:40
7000	94.8	104.9	115.1	125.0	135.5	14:43
7500	103.0	114.0	125.1	135.9	147.7	15:45
8000	111.5	123.3	135.3	147.2	160.4	16:48

Based on 310/.84 climb, LRC and .84/310/250 descent.
Valid for all pressure altitudes with 4,000 ft step climb to 2,000 ft above optimum altitude.

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Short Trip 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
89	77	68	61	55	50	46	43	40	37	35
156	140	127	117	108	100	93	87	82	78	74
221	202	186	172	160	150	141	133	126	119	114
285	262	243	227	213	200	189	179	170	162	154
347	322	300	281	265	250	237	225	214	204	195
409	381	357	336	317	300	285	271	259	247	237
471	440	414	390	369	350	333	317	303	290	279
533	499	470	444	421	400	381	364	348	334	320
595	559	527	499	473	450	429	410	392	376	362
660	620	585	554	525	500	477	456	437	419	403

Trip Fuel and Time Required

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG) 160	180	200	220	240	TIME (HRS:MIN)
50	FUEL (1000 KG) ALT (FT)	1.5 9000	1.6 9000	1.7 9000	1.8 9000	1.9 7000	0:13
100	FUEL (1000 KG) ALT (FT)	2.3 15000	2.4 17000	2.6 13000	2.7 13000	2.9 13000	0:21
150	FUEL (1000 KG) ALT (FT)	3.1 23000	3.2 23000	3.4 21000	3.6 21000	3.8 21000	0:29
200	FUEL (1000 KG) ALT (FT)	3.8 31000	4.0 29000	4.2 27000	4.5 25000	4.7 25000	0:36
250	FUEL (1000 KG) ALT (FT)	4.4 35000	4.7 33000	5.0 31000	5.3 29000	5.6 27000	0:42
300	FUEL (1000 KG) ALT (FT)	4.9 37000	5.3 37000	5.7 35000	6.0 33000	6.4 31000	0:48
350	FUEL (1000 KG) ALT (FT)	5.5 41000	5.9 39000	6.3 37000	6.7 35000	7.2 33000	0:54
400	FUEL (1000 KG) ALT (FT)	6.0 41000	6.5 39000	7.0 37000	7.5 35000	8.0 33000	1:00
450	FUEL (1000 KG) ALT (FT)	6.6 41000	7.1 39000	7.7 37000	8.2 35000	8.8 33000	1:06
500	FUEL (1000 KG) ALT (FT)	7.2 43000	7.7 39000	8.3 37000	8.9 35000	9.6 33000	1:13

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Holding Planning
Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)									
	1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
300	8680	8600	8410	8450	8810	8990	9400			
280	8120	8030	7830	7800	8080	8300	8590	9090		
260	7580	7470	7440	7180	7350	7630	7880	8170		
240	7180	6930	7000	6730	6810	6990	7140	7490		
220	6640	6530	6440	6170	6170	6250	6450	6680	7260	
200	6110	6000	5900	5770	5590	5670	5800	5980	6380	
180	5730	5480	5380	5240	5180	5030	5110	5270	5640	5880
160	5210	5090	4870	4720	4650	4490	4510	4710	4970	5140

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
300	9280	8990	9040	8990	9060
280	8650	8570	8380	8330	8370
260	8020	7930	7720	7650	7680
240	7400	7300	7260	7130	7140
220	6920	6830	6770	6500	6500
200	6320	6240	6170	5890	5860
180	5730	5650	5580	5450	5260
160	5300	5190	5000	4870	4790

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Crew Oxygen Requirements
Required Pressure (PSI) for One 114/115 Cubic Ft. Cylinder

BOTTLE TEMPERATURE		NUMBER OF CREW USING OXYGEN		
deg. C	deg. F	2	3	4
50	122	530	735	945
45	113	520	725	930
40	104	510	715	915
35	95	505	700	900
30	86	495	690	885
25	77	485	680	870
20	68	480	670	860
15	59	470	655	840
10	50	460	645	830
5	41	455	635	815
0	32	445	620	800
–5	23	440	610	785
–10	14	430	600	770
For more extensive than normal crew usage, add 1.2 psi/person/minute.				

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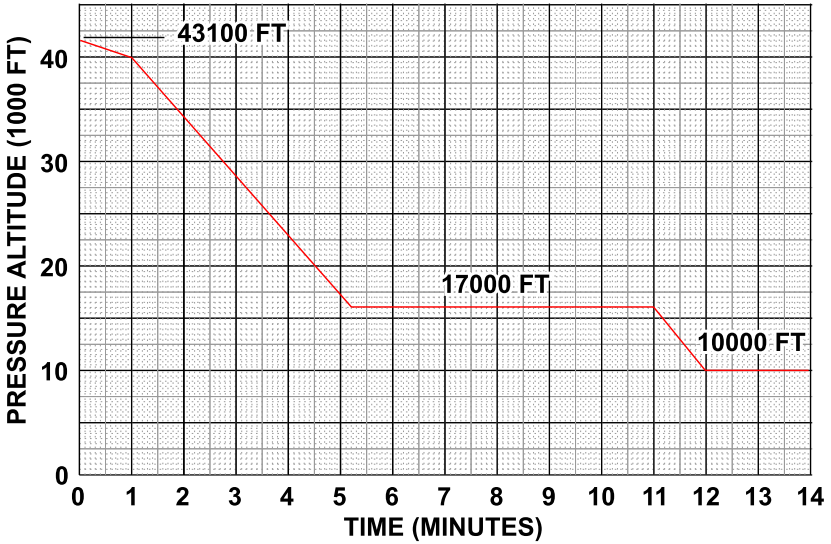
Oxygen Requirements
Passenger Oxygen System—Chemical
Maximum Altitude Envelope
Based on 12 Minute System



The passenger oxygen system will provide sufficient supplemental breathing oxygen for altitudes at or below this envelope.

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ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
26	172.8	164.7	156.5
24	189.1	180.7	171.8
22	205.7	196.7	186.8
20	223.5	213.8	203.0
18	241.3	231.2	219.8
16	260.2	249.6	237.8
14	276.5	265.5	252.6
12	293.2	281.6	267.6
10	308.8	295.5	279.9
8	322.8	308.2	290.9
6	324.3	319.6	301.7

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG)								
	PRESSURE ALTITUDE (1000 FT)								
	8	10	12	14	16	18	20	22	24
ENGINE ONLY	–3.9	–4.4	–3.6	–3.1	–2.6	–1.8	–1.2	–1.4	–1.1
ENGINE AND WING	–5.3	–5.7	–5.0	–4.6	–4.0	–3.3	–2.9	–3.1	–2.8

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Landing Field Limit Weight—Dry Runway
Flaps 30
Wind Adjusted Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	−15	−10	−5	0	10	20	30	40
1200				1200	1240	1330	1410	1510
1400		1150	1240	1400	1450	1540	1630	1740
1600	1210	1330	1430	1600	1660	1760	1860	1970
1800	1380	1500	1620	1800	1880	1980	2090	2210
2000	1540	1680	1820	2000	2090	2190	2320	2440
2200	1710	1860	2010	2200	2300	2410	2550	2670
2400	1880	2040	2210	2400	2510	2620	2780	2900
2600	2050	2220	2400	2600	2730	2870	3030	3200
2800	2220	2400	2570	2800	2940	3120	3290	3500
3000	2350	2540	2740	3000	3150	3380	3540	3800
3200	2490	2690	2910	3200	3360	3600	3800	4100
3400	2620	2830	3080	3400	3580	3830	4060	4400
3600	2750	2980	3250	3600	3790	4050	4310	4700
3800	2880	3120	3420	3800	4000	4280	4570	
4000	3020	3260	3590	4000	4210	4500		
4200	3150	3410	3760	4200	4430			
4400	3280	3550	3930	4400				
4600	3410	3690	4100	4600				
4800	3550	3840	4270	4800				
5000	3680	3980	4440					

Field Limit Weight (1,000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1200	144.2				
1400	176.9	166.6	156.6	146.9	
1600	210.2	198.0	186.2	174.9	164.3
1800	234.4	226.1	216.4	203.3	191.0
2000	253.8	244.8	236.0	227.4	218.1
2200	272.4	262.8	253.3	244.1	235.1
2400	290.3	280.1	270.0	260.2	250.7
2600	306.1	296.7	286.2	275.8	265.7
2800	319.4	310.4	301.1	290.8	280.2
3000	328.9	320.1	310.7	300.9	291.4
3200		329.4	319.5	309.2	299.7
3400			327.5	317.0	307.0
3600				324.2	314.0
3800				331.4	320.5
4000					326.9
4200					333.2

With 1 brake deactivated, decrease weight by 16,300 kg.
With 2 brakes deactivated, decrease weight by 33,200 kg.
With manual speedbrakes, decrease weight by 16,700 kg.

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Landing Field Limit Weight—Wet Runway
Flaps 30
Wind Adjusted Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	−15	−10	−5	0	10	20	30	40
1200						1340	1410	1530
1400				1400	1440	1550	1640	1760
1600		1310	1410	1600	1660	1770	1870	1990
1800	1350	1490	1610	1800	1870	1980	2100	2220
2000	1520	1670	1800	2000	2080	2200	2320	2450
2200	1690	1850	1990	2200	2290	2410	2550	2690
2400	1860	2030	2190	2400	2510	2630	2780	2920
2600	2030	2200	2380	2600	2720	2840	3010	3150
2800	2200	2380	2580	2800	2930	3060	3240	3400
3000	2370	2560	2770	3000	3140	3310	3500	3690
3200	2540	2740	2940	3200	3360	3570	3750	3990
3400	2670	2890	3110	3400	3570	3820	4010	4290
3600	2800	3030	3280	3600	3780	4050	4270	4600
3800	2940	3180	3450	3800	3990	4280	4520	4900
4000	3070	3320	3620	4000	4210	4500	4780	5200
4200	3200	3460	3790	4200	4420	4720	5040	
4400	3330	3610	3960	4400	4630	4950		
4600	3470	3750	4130	4600	4840			
4800	3600	3900	4300	4800				
5000	3730	4040	4470	5000				

Field Limit Weight (1,000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1400	147.0				
1600	175.5	165.2	155.3	145.7	
1800	204.4	192.5	181.0	170.0	159.6
2000	228.3	220.2	207.1	194.6	182.8
2200	245.5	236.8	228.2	219.0	206.3
2400	262.0	252.7	243.6	234.7	226.0
2600	277.9	268.1	258.5	249.0	239.9
2800	293.3	283.0	272.9	262.9	253.3
3000	306.7	297.3	286.8	276.4	266.3
3200	318.3	309.3	299.8	289.5	278.9
3400	326.9	318.1	308.7	298.8	289.2
3600		326.1	316.5	306.4	296.9
3800		334.2	323.6	313.3	303.6
4000			330.6	319.9	309.8
4200				326.1	315.7
4400				332.3	321.4
4600					326.9
4800					332.4

With 1 brake deactivated, decrease weight by 16,300 kg.
With 2 brakes deactivated, decrease weight by 33,200 kg.
With manual speedbrakes, decrease weight by 16,700 kg.

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Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)				
		AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	242.6				
52	126	248.6				
50	122	254.4	235.2			
48	118	260.1	241.0			
46	115	265.7	246.5	226.7		
44	111	271.6	252.0	231.1		
42	108	277.9	257.4	235.4	218.6	
40	104	283.9	262.6	239.8	222.3	
38	100	288.9	267.7	243.9	225.7	208.8
36	97	293.8	272.7	248.1	229.2	212.0
34	93	298.7	276.8	252.2	232.6	215.1
32	90	303.1	280.8	256.0	236.1	218.3
30	86	306.4	284.7	259.8	239.8	221.4
28	82	307.4	288.4	263.5	243.4	224.7
26	79	307.5	291.5	266.9	247.0	228.1
24	75	307.5	292.7	270.0	250.4	231.0
22	72	307.6	292.8	272.5	252.5	232.9
20	68	307.6	292.8	273.5	253.6	234.4
18	64	307.7	292.9	273.6	254.7	236.1
16	61	307.7	292.9	273.6	255.2	237.8
14	57	307.8	293.0	273.7	255.2	239.1
12	54	307.8	293.0	273.7	255.3	239.5
10	50	307.9	293.1	273.7	255.3	239.6
–40	–40	309.3	294.4	275.0	256.4	240.6

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.
With engine bleed for packs off, increase weight by 950 kg.
With engine and wing anti-ice on, decrease weight by 1,450 kg.
When operating in icing conditions during any part of the flight with forecast landing temperature below 10 deg. C, decrease weight by 20,450 kg.

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ENGINE INOP

ADVISORY INFORMATION

Go-Around Climb Gradient
Flaps 20, Gear Up
Based on engine bleed for packs on or off, engine anti-ice on or off and wing anti-ice off

OAT (deg. C)	REFERENCE GO-AROUND GRADIENT (%) PRESSURE ALTITUDE (FT)											
	–2000	–1000	0	1000	2000	3000	4000	5000	6000	7000	8000	8400
54	4.93	4.53	4.13									
50	4.93	5.21	4.80	4.27	3.76							
46	6.31	5.89	5.45	4.93	4.42	3.83	3.32					
42	6.86	6.59	6.15	7.21	5.02	4.36	3.79	3.30	2.84			
38	7.36	7.07	6.74	6.14	5.56	4.86	4.22	3.72	3.23	2.75	2.26	
34	7.81	7.55	7.21	6.61	6.00	5.32	4.66	4.12	3.59	3.10	2.62	2.44
30	7.82	7.80	7.69	7.03	6.42	5.72	5.06	4.50	3.98	3.46	2.96	2.77
26	7.83	7.81	7.70	7.24	6.76	6.07	5.41	4.86	4.32	3.81	3.30	3.07
22	7.83	7.81	7.70	7.24	6.79	6.26	5.70	5.10	4.60	4.04	3.53	3.33
18	7.84	7.82	7.71	7.25	6.80	6.27	5.75	5.24	4.71	4.22	3.70	3.47
14	7.84	7.82	7.71	7.26	6.80	6.27	5.76	5.25	4.75	4.32	3.88	3.68
10	7.85	7.83	7.72	7.26	6.81	6.28	5.76	5.25	4.76	4.32	3.88	3.71

Weight Adjustment

WEIGHT (1000 KG)	REFERENCE GO-AROUND GRADIENT (%)									
	0	1	2	3	4	5	6	7	8	9
320	–4.19	–4.16	–4.39	–4.90	–5.31	–5.73	–6.17	–6.54	–7.00	–7.58
300	–3.44	–3.55	–3.81	–4.23	–4.58	–4.94	–5.31	–5.64	–6.03	–6.51
280	–2.70	–2.93	–3.22	–3.56	–3.85	–4.15	–4.46	–4.74	–5.07	–5.44
260	–1.95	–2.32	–2.64	–2.88	–3.11	–3.35	–3.60	–3.85	–4.11	–4.37
240	–1.52	–1.72	–1.92	–2.09	–2.26	–2.44	–2.62	–2.80	–2.99	–3.18
220	–0.82	–0.95	–1.06	–1.15	–1.25	–1.35	–1.45	–1.55	–1.65	–1.74
200	0	0	0	0	0	0	0	0	0	0
180	1.08	1.18	1.29	1.39	1.51	1.63	1.76	1.90	2.03	2.17
160	2.31	2.62	2.90	3.15	3.42	3.70	3.99	4.30	4.65	5.03
140	3.55	4.06	4.52	4.91	5.33	5.76	6.22	6.70	7.27	7.90

Speed Adjustment

SPEED (KIAS)	WEIGHT ADJUSTED GO-AROUND GRADIENT (%)									
	0	1	2	3	4	5	6	7	8	9
VREF	–0.24	–0.25	–0.27	–0.28	–0.29	–0.29	–0.29	–0.29	–0.28	–0.28
VREF+5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VREF+10	0.17	0.17	0.16	0.17	0.18	0.18	0.17	0.16	0.14	0.13
VREF+20	0.32	0.30	0.29	0.30	0.30	0.30	0.29	0.26	0.23	0.21
VREF+30	0.35	0.30	0.25	0.22	0.20	0.18	0.16	0.14	0.11	0.09

With engine and wing anti-ice on, decrease gradient by 0.1%.
When operating in icing conditions during any part of the flight with forecast landing temperatures below 10 deg. C, decrease gradient by 0.6%.

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Quick Turnaround Limit Weight
Flaps 30

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	232.8				
50	122	234.4	225.2			
45	113	236.4	227.2	218.4		
40	104	238.4	229.2	220.2	211.9	
35	95	240.6	231.2	222.1	213.7	205.7
30	86	242.7	233.3	224.0	215.5	207.4
25	77	245.0	235.4	226.1	217.3	209.1
20	68	247.3	237.6	228.2	219.2	210.9
15	59	249.6	239.9	230.3	221.1	212.8
10	50	252.1	242.2	232.5	223.2	214.7
5	41	254.6	244.6	234.8	225.4	216.6
0	32	257.1	247.0	237.2	227.6	218.6
−5	23	259.8	249.6	239.6	229.9	220.7
−10	14	262.5	252.2	242.1	232.3	222.9
−15	5	265.3	254.9	244.7	234.8	225.2
−20	−4	268.2	257.6	247.3	237.3	227.7
−30	−22	274.2	263.4	252.9	242.6	232.7
−40	−40	280.5	269.5	258.7	248.2	238.1
−50	−58	287.2	275.9	264.9	254.2	243.8
−54	−65	289.9	278.6	267.5	256.7	246.1

Increase weight by 2,200 kg per 1% uphill slope. Decrease weight by 4,850 kg per 1% downhill slope. Increase weight by 5,900 kg per 10 knots headwind. Decrease weight by 33,400 kg per 10 knots tailwind.
Decrease weight by 12,700 kg when one brake is deactivated. Decrease weight by 26,100 kg when two brakes are deactivated.
After landing at weights exceeding those shown above, adjusted for slope and wind, wait at least 65 minutes and check that wheel thermal plugs have not melted before executing a takeoff.
As an alternate procedure, no waiting period is required if the BRAKE TEMP advisory message on EICAS is not displayed 10 to 15 minutes after parking.

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GEAR DOWN

Takeoff Climb Limit Weight
Flaps 15

AIRPORT OAT		TAKEOFF CLIMB WEIGHT (1000 KG) AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	176.6				
52	126	181.4				
50	122	186.1	170.3			
48	118	190.7	174.7			
46	115	195.3	178.9	163.3		
44	111	199.8	183.0	167.3		
42	108	204.2	187.2	171.2		
40	104	208.7	191.3	175.0	157.9	
38	100	213.6	195.3	178.8	161.5	
36	97	218.4	199.4	182.5	165.2	
34	93	223.3	204.4	186.2	168.8	
32	90	228.1	209.3	190.0	172.4	155.7
30	86	232.9	214.2	195.0	176.0	159.2
28	82	237.4	219.0	199.9	179.6	162.7
26	79	242.0	223.7	204.6	184.4	166.2
24	75	244.2	228.2	209.3	189.0	169.7
22	72	244.3	232.6	213.8	193.6	174.2
20	68	244.3	234.7	218.3	197.9	178.6
18	64	244.3	234.7	222.6	202.3	183.0
16	61	244.3	234.7	224.5	206.5	187.1
14	57	244.2	234.7	224.5	210.6	191.2
12	54	244.2	234.7	224.5	212.3	195.1
10	50	244.2	234.7	224.4	212.3	199.0
–40	–40	243.5	234.0	223.3	211.3	199.7

With engine bleed for packs off, increase weight by 150 kg.
With engine anti-ice on, decrease weight by 3,700 kg.
With engine and wing anti-ice on, decrease weight by 4,600 kg.

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GEAR DOWN

Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG) AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	209.9				
52	126	215.0				
50	122	220.0	204.2			
48	118	224.8	209.1			
46	115	229.7	213.7	197.1		
44	111	234.7	218.3	200.7		
42	108	240.0	222.6	204.1	189.6	
40	104	245.3	226.8	207.5	192.6	
38	100	249.2	230.9	210.8	195.5	180.8
36	97	253.0	234.7	214.2	198.3	183.5
34	93	256.9	238.1	217.4	201.1	186.2
32	90	260.6	241.4	220.5	204.0	188.8
30	86	264.3	244.6	223.4	206.8	191.3
28	82	264.2	247.5	226.4	209.6	193.9
26	79	264.2	250.4	229.1	212.4	196.6
24	75	264.3	250.9	231.5	215.1	199.2
22	72	264.3	251.0	233.9	216.7	200.5
20	68	264.3	251.0	234.5	217.6	201.6
18	64	264.4	251.1	234.5	218.4	203.0
16	61	264.4	251.1	234.5	218.8	204.6
14	57	264.5	251.1	234.6	218.9	206.1
12	54	264.5	251.2	234.6	218.9	206.1
10	50	264.6	251.2	234.7	218.9	206.2
8	46	264.6	251.3	234.7	219.0	206.2
6	43	264.7	251.3	234.8	219.0	206.2
4	39	264.7	251.3	234.8	219.1	206.3
2	36	264.8	251.4	234.8	219.1	206.3
0	32	264.8	251.4	234.9	219.1	206.4

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.
With engine bleed for packs off, increase weight by 800 kg.
With engine and wing anti-ice on, decrease weight by 1,100 kg.
When operating in icing conditions during any part of the flight with forecast landing temperature below 10 deg. C, decrease weight by 26,400 kg.

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GEAR DOWN

Takeoff Obstacle Limit Weight
Flaps 15
Sea Level, 30 deg. C & Below, Zero Wind

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG) DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	238.6										
20	222.1	238.6	238.6								
40	206.0	221.9	234.5	238.6							
60	193.3	209.2	221.7	231.9	238.6						
80	183.0	198.5	211.2	221.5	230.1	238.6	238.6				
100	174.1	189.4	202.0	212.6	221.3	228.8	235.1	238.6	238.6		
120	166.4	181.4	194.0	204.6	213.6	221.1	227.7	233.4	237.9	238.6	
140	159.2	174.3	186.8	197.4	206.5	214.3	220.9	226.8	232.0	236.5	238.6
160		167.9	180.3	190.9	200.0	207.9	214.8	220.7	226.0	230.8	235.0
180		162.1	174.4	184.9	194.1	202.0	209.0	215.1	220.5	225.3	229.7
200		156.8	168.9	179.4	188.6	196.6	203.6	209.9	215.4	220.3	224.7
220			163.9	174.3	183.5	191.5	198.6	204.9	210.6	215.6	220.1
240			159.2	169.6	178.7	186.7	193.9	200.3	206.0	211.1	215.8
260				165.1	174.2	182.3	189.4	195.9	201.7	206.9	211.6
280				160.9	170.0	178.0	185.2	191.7	197.5	202.8	207.6
300				157.0	166.0	174.0	181.3	187.7	193.6	198.9	203.8

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustments

OAT (deg. C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)					
	140	160	180	200	220	240
29 & BELOW	0	0	0	0	0	0
30	–0.5	–0.9	–1.3	–1.7	–2.1	–2.5
32	–1.4	–2.6	–3.8	–5.0	–6.3	–7.5
34	–2.3	–4.3	–6.4	–8.4	–10.5	–12.5
36	–3.2	–6.0	–8.9	–11.8	–14.6	–17.5
38	–4.1	–7.8	–11.5	–15.1	–18.8	–22.5
40	–5.0	–9.5	–14.0	–18.5	–23.0	–27.5
42	–6.0	–11.3	–16.6	–21.9	–27.2	–32.4
44	–7.1	–13.2	–19.2	–25.3	–31.3	–37.4
46	–8.1	–15.0	–21.8	–28.6	–35.5	–42.3
48	–9.2	–16.8	–24.4	–32.0	–39.6	–47.2
50	–10.2	–18.6	–27.0	–35.4	–43.8	–52.2

Pressure Altitude Adjustments

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)					
	140	160	180	200	220	240
S.L. & BELOW	0	0	0	0	0	0
1000	–4.4	–5.5	–6.6	–7.7	–8.8	–9.9
2000	–8.8	–11.0	–13.2	–15.4	–17.6	–19.8
3000	–13.1	–16.5	–19.9	–23.3	–26.7	–30.1
4000	–17.4	–22.0	–26.6	–31.2	–35.8	–40.4
5000	–21.7	–27.5	–33.3	–39.1	–44.9	–50.7
6000	–26.0	–33.0	–40.0	–47.0	–54.0	–61.0
7000	–30.3	–38.5	–46.7	–54.9	–63.1	–71.3
8000	–34.6	–44.0	–53.4	–62.8	–72.2	–81.6

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GEAR DOWN

Takeoff Obstacle Limit Weight
Flaps 15
Wind Adjustments

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)					
	140	160	180	200	220	240
15 TW	–27.2	–26.1	–24.9	–23.7	–22.6	–21.4
10 TW	–18.2	–17.4	–16.6	–15.8	–15.0	–14.2
5 TW	–9.1	–8.7	–8.3	–7.9	–7.5	–7.1
0	0	0	0	0	0	0
10 HW	4.2	3.8	3.3	2.9	2.4	2.0
20 HW	8.4	7.5	6.6	5.7	4.9	4.0
30 HW	11.9	10.7	9.6	8.4	7.2	6.1
40 HW	15.4	13.9	12.5	11.1	9.6	8.2

With engine bleed for packs off, increase weight by 300 kg.
With engine anti-ice on, decrease weight by 1,100 kg.
With engine and wing anti-ice on, decrease weight by 1,700 kg.

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GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
300	12900	10300	6800
290	14400	11900	8900
280	16000	13500	10800
270	17600	15100	12500
260	19200	16800	14300
250	20700	18500	16100
240	22100	20200	17900
230	23500	21700	19700
220	25000	23200	21300
210	25900	24800	22900
200	26900	25800	24500
190	28000	26800	25700
180	29000	27900	26800
170	30200	29000	27800
160	31500	30200	29000

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GEAR DOWN

Long Range Cruise Trip 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
332	295	263	238	218	200	188	176	166	157	149
499	443	395	357	327	300	281	264	248	235	223
665	591	527	477	436	400	374	352	331	313	298
830	737	658	596	545	500	469	440	415	392	373
994	884	789	714	653	600	563	529	498	471	448
1158	1030	920	833	762	700	656	617	581	550	523
1320	1175	1051	952	871	800	750	705	664	629	598
1481	1320	1181	1070	979	900	844	793	748	708	674
1642	1464	1310	1188	1088	1000	938	882	832	787	749
1802	1607	1439	1305	1196	1100	1032	970	915	867	824
1961	1750	1568	1423	1304	1200	1126	1059	999	946	900
2119	1892	1696	1540	1412	1300	1220	1148	1083	1026	976
2277	2034	1825	1658	1520	1400	1314	1237	1167	1106	1052
2434	2175	1953	1775	1628	1500	1409	1326	1251	1185	1128
2590	2316	2081	1892	1736	1600	1503	1415	1336	1265	1204
2745	2457	2208	2009	1844	1700	1597	1504	1420	1345	1280
2900	2597	2336	2126	1952	1800	1691	1593	1504	1425	1356
3054	2737	2463	2242	2060	1900	1786	1682	1588	1505	1433
3207	2876	2589	2359	2168	2000	1880	1770	1672	1585	1509

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	6		10		14		18		22	
	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	8.5	0:52	8.1	0:50	7.7	0:48	7.5	0:47	7.3	0:45
300	12.6	1:16	12.0	1:13	11.3	1:10	10.9	1:07	10.6	1:05
400	16.7	1:40	15.9	1:35	14.9	1:31	14.3	1:27	13.8	1:24
500	20.9	2:03	19.8	1:58	18.6	1:53	17.8	1:48	17.2	1:43
600	25.1	2:27	23.8	2:20	22.2	2:14	21.3	2:08	20.5	2:02
700	29.4	2:50	27.8	2:42	26.0	2:35	24.8	2:28	23.9	2:21
800	33.7	3:13	31.8	3:04	29.7	2:56	28.4	2:48	27.2	2:40
900	38.0	3:36	36.0	3:26	33.5	3:16	32.0	3:07	30.7	2:59
1000	42.4	3:59	40.1	3:48	37.4	3:37	35.7	3:27	34.2	3:18
1100	46.9	4:22	44.3	4:09	41.3	3:57	39.4	3:47	37.7	3:36
1200	51.4	4:44	48.5	4:31	45.2	4:18	43.1	4:06	41.3	3:54
1300	56.0	5:06	52.8	4:51	49.2	4:38	47.0	4:25		
1400	60.6	5:28	57.1	5:12	53.3	4:58	50.8	4:44		
1500	65.2	5:50	61.4	5:33	57.3	5:18				
1600	69.8	6:12	65.8	5:54	61.4	5:38				
1700	74.6	6:33	70.3	6:15	65.6	5:57				
1800	79.4	6:54	74.8	6:35	69.8	6:17				
1900	84.2	7:15	79.3	6:55	74.1	6:36				
2000	88.9	7:37	83.8	7:16	78.3	6:56				

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GEAR DOWN

Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1,000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)				
	160	180	200	220	240
10	–1.1	–0.6	0.0	0.7	1.4
15	–1.7	–0.8	0.0	1.1	2.1
20	–2.2	–1.1	0.0	1.4	2.8
25	–2.8	–1.4	0.0	1.7	3.4
30	–3.3	–1.7	0.0	2.0	4.1
35	–3.8	–1.9	0.0	2.4	4.7
40	–4.4	–2.2	0.0	2.7	5.4
45	–4.9	–2.5	0.0	3.0	6.1
50	–5.4	–2.7	0.0	3.4	6.7
55	–6.0	–3.0	0.0	3.7	7.4
60	–6.5	–3.2	0.0	4.0	8.0
65	–7.0	–3.5	0.0	4.4	8.7
70	–7.5	–3.7	0.0	4.7	9.3
75	–8.1	–4.0	0.0	5.1	10.0
80	–8.6	–4.2	0.0	5.4	10.6
85	–9.1	–4.5	0.0	5.7	11.3
90	–9.6	–4.7	0.0	6.1	11.9

Based on VREF + 80 climb, Long Range Cruise and VREF + 80 descent.

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GEAR DOWN

Short Trip 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
101	84	72	63	56	50	45	42	38	36	33
173	151	134	120	109	100	92	86	80	75	70
245	218	196	178	163	150	139	130	122	114	108
317	284	257	235	216	200	186	174	164	154	146
388	350	318	292	269	250	233	219	206	195	184
460	415	379	348	322	300	281	263	248	235	223
531	481	440	405	376	350	328	308	291	275	261
602	547	501	462	429	400	375	353	333	315	299
674	613	562	519	482	450	422	397	375	355	338
747	680	624	576	535	500	469	442	417	395	376

Trip Fuel and Time

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG)					TIME (HRS:MIN)
		140	160	180	200	220	
50	FUEL (1000 KG) ALT (FT)	1.9 12000	2.1 12000	2.2 12000	2.4 10000	2.6 10000	0:15
100	FUEL (1000 KG) ALT (FT)	3.3 24000	3.5 21000	3.8 20000	4.1 18000	4.4 16000	0:25
150	FUEL (1000 KG) ALT (FT)	4.4 30000	4.9 31000	5.3 25000	5.7 22000	6.2 22000	0:35
200	FUEL (1000 KG) ALT (FT)	5.6 30000	6.1 31000	6.7 28000	7.3 24000	7.9 24000	0:45
250	FUEL (1000 KG) ALT (FT)	6.7 33000	7.4 31000	8.1 29000	8.8 24000	9.6 25000	0:54
300	FUEL (1000 KG) ALT (FT)	7.8 30000	8.7 31000	9.5 29000	10.4 24000	11.3 25000	1:03
350	FUEL (1000 KG) ALT (FT)	9.0 30000	10.0 31000	10.9 29000	11.9 24000	13.0 25000	1:12
400	FUEL (1000 KG) ALT (FT)	10.1 30000	11.2 31000	12.3 28000	13.5 24000	14.7 24000	1:21
450	FUEL (1000 KG) ALT (FT)	11.3 30000	12.5 30000	13.8 28000	15.1 24000	16.4 24000	1:30
500	FUEL (1000 KG) ALT (FT)	12.5 30000	13.8 30000	15.2 28000	16.7 24000	18.2 24000	1:40

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GEAR DOWN

Holding Planning
Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)						
	1500	5000	10000	15000	20000	25000	30000
300	14110	14080	14220	14510			
280	13150	13130	13210	13380			
260	12300	12260	12320	12400	12730		
240	11490	11430	11480	11430	11700		
220	10680	10600	10640	10520	10730	11030	
200	9860	9780	9790	9660	9790	10000	
180	9280	8950	8930	8820	8810	9000	
160	8460	8340	8090	7980	7930	8080	8230

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
300	13550	13540	13660	13840	
280	12580	12570	12650	12740	
260	11710	11680	11750	11790	12050
240	10880	10820	10890	10820	11020
220	10030	9960	10000	9900	10050
200	9440	9120	9120	9030	9080
180	8590	8490	8260	8160	8150
160	7740	7660	7410	7420	7400

These tables include 5% additional fuel for holding in a racetrack pattern.

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GEAR DOWN
ENGINE INOP
MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
17	155.0		
16	161.1		
15	166.6	158.8	
14	172.3	164.4	155.7
13	178.1	170.1	161.2
12	184.0	175.9	166.9
11	189.8	181.2	172.0
10	195.6	186.8	177.3
9	201.0	191.8	182.1
8	206.3	196.9	187.0
7	211.6	202.1	191.9
6	217.0	207.2	196.8
5	222.5	212.5	201.8
4	226.9	216.7	206.0
3	231.2	220.8	210.0
2	235.3	224.9	214.1

Base on max continuous thrust limits with anti-ice off.
With engine anti-ice on, decrease level off weight by 3,400 kg.
With engine and wing anti-ice on, decrease level off weight by 4,500 kg.

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Introduction

This chapter contains self dispatch performance data intended primarily for use by flight crews in the event that information cannot be obtained from the airline dispatch office. The data provided is for a single takeoff flap at max takeoff thrust. The range of conditions covered is limited to those normally encountered in airline operation. 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.

Takeoff

The maximum allowable takeoff weight will be the least of the Field, Climb, Tire, Brake Energy and Obstacle Limit Weights as determined from the following tables.

Field Limit Weight—Slope and Wind Corrections

These tables provide corrections to the field length available for the effects of runway slope and wind component along the runway. Enter the Slope Correction table with the available field length and runway slope to determine the slope corrected field length. Now enter the Wind Correction table with slope corrected field length and wind component to determine the slope and wind corrected field length.

Field and Climb Limit Weight

Tables are presented for selected airport pressure altitudes and show both Field and Climb Limit Weights. Enter the appropriate table for pressure altitude with “Slope and Wind Corrected Field Length” determined above and airport OAT to obtain Field Limit Weight. Also read Climb Limit Weight for the same OAT. Intermediate altitudes may be interpolated or use next higher altitude.

Obstacle Limit Weight

This table provides obstacle limit weights for reference airport conditions based on obstacle height above the runway surface and distance from brake release. Enter the correction tables to correct the reference Obstacle Limit Weight for the effects of OAT, pressure altitude and wind as indicated. In the case of multiple obstacles, enter the tables successively with each obstacle and determine the most limiting weight.

Tire Speed Limit

Maximum tire speed limited weights are presented for 235 MPH tires. To determine the tire speed limit weight, enter the table with OAT, move to airport

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pressure altitude and read the tire speed limit weight. Adjust the tire speed limit weight according to the notes below the table to account for wind.

Brake Energy Limits VMBE

Tables are presented to determine the Maximum Brake Energy Speed VMBE. Compliance with this limitation is required to ensure that the brakes have enough capacity to execute a maximum effort stop from V1 without the use of thrust reversers. Enter the upper table with pressure altitude and OAT to determine the reference VMBE. Then enter the lower table with the reference VMBE and brake release weight to determine VMBE for a specific takeoff. Adjust for slope, wind and deactivated brakes as described below the table. The resulting VMBE must be greater than or equal to V1. If VMBE is less than V1, brake release weight must be decreased by the amount shown below the table.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table as well as FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Normal takeoff speeds, V1, VR, and V2 are read from the table by entering with takeoff flap setting and brake release weight. Use the tables provided to correct takeoff speeds for altitude and actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind corrections to V1 are obtained by entering the Slope and Wind V1 Adjustment Table.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the

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V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Brakes Deactivated

When operating with brakes deactivated, the runway/obstacle limit weights and the V1 and VMBE must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway/obstacle limited weight by 3,500 kg and the V1 associated with the reduced weight by one knot. With two brakes deactivated, reduce the normal runway/obstacle limited weight by 7,200 kg and the V1 associated with the reduced weight by three knots. If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate stop distance corrected for wind and slope exceeds approximately 1,200 m for one brake deactivated or 1,300 m for two brakes deactivated.

For brake(s) deactivated, reduce VMBE by the amount shown on the Brake Energy Limit VMBE Chart. If the resulting VMBE is less than V1, the brake release weight must be reduced according to the instructions on the brake energy limit chart. The resulting V1 must not be less than V1(MCG). Determine VR and V2 for the actual weight.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

Enroute

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. Note that these tables consider 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 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5 g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43,100 ft.

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Long Range Cruise Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination. Data is based on economy climb and descent speeds, and Long Range Cruise with normal engine bleed for air conditioning. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine trip fuel and time for a constant altitude cruise, 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 planned landing weight to obtain fuel required at the planned landing weight.

Long Range Cruise Step Climb Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination when flying a step climb profile. Step climb profiles are based on 4,000 ft step climbs to keep the flight within 2,000 ft of the optimum altitude for the current cruise weight. To determine trip fuel and time, enter the Ground to Air Miles Conversion table and determine air distance as discussed above. Then enter the Trip Fuel and Time required with air distance and planned landing weight to read trip fuel. Continue across the table to read trip time.

Short Trip Fuel and Time

These tables are provided to determine trip fuel and time for short distances or alternates. The data considers the use of the FMC short trip optimum altitude. Obtain air distance from upper table using the ground distance and wind component to the alternate. Enter Trip Fuel and Time table with air distance and read trip fuel required for the expected landing weight, together with time to alternate at right. For distances greater than shown or other altitudes, use the Long Range Cruise Trip Fuel and Time tables.

Holding Planning

These tables provide total fuel flow information necessary for planning Flaps Up and Flaps 1 holding and reserve fuel requirements. Data is based on the FMC holding speed schedule which is the higher of the maximum endurance and flaps up maneuver speeds. As noted, the fuel flow is based on flight in a racetrack holding pattern. For holding in straight and level flight, reduce table values by 5%.

Oxygen Requirements

Flight Crew System

Regulations require that sufficient oxygen be provided to the flight crew to account for the greater of supplemental breathing oxygen in the event of a cabin

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depressurization or protective breathing in the event of smoke or harmful fumes in the flight deck. The oxygen quantity associated with these requirements is achieved with the minimum dispatch oxygen cylinder pressure. Enter the Crew Oxygen Requirements table with the number of crew plus observers using oxygen and read the minimum cylinder pressure required for the appropriate bottle temperature.

An additional quantity of oxygen is required when flight altitudes above 41,000 ft are planned. Regulations require that one active duty pilot must don the oxygen mask and breathe diluted oxygen for the duration of the flight above 41,000 ft. The additional quantity of oxygen required is 2.05 liters/person/minute (1.2 psi/person/minute for the single cylinder system), or 13 liters/person/minute (8 psi/person/minute) if 100% oxygen is selected during normal usage.

Net Level Off Weight

The Net Level Off Weight table is provided to determine terrain clearance capability in straight and level flight following an engine failure. Regulations require terrain clearance planning based on net performance which is the gross (or actual) gradient performance degraded by 1.1%. In addition, the net level off pressure altitude must clear the terrain by 1,000 ft.

To determine the maximum weight for terrain clearance, enter the table with required net level off pressure altitude and expected ISA deviation to obtain weight. Adjust weight for anti-ice operation as noted below the table.

Extended Range Operations

Regulations require that flights conducted over a route that contains a point further than one hour's time at "normal one engine inoperative speed" from an adequate diversion airport comply with rules set up specifically for "Extended Range Operation with Two Engine airplanes". This section provides reserve fuel planning information for the "Critical Fuel Scenario" based on two engine operation at Long Range Cruise as well as single engine operation at Long Range Cruise.

Critical Fuel Reserves

Enter Ground to Air Mile Conversion table with forecast wind and ground distance to diversion airport from critical point to obtain air distance. Now enter Critical Fuel table with air distance and expected weight at the critical point and read required fuel. Apply the noted fuel adjustments as necessary. Regulations require a 5% allowance for performance deterioration unless a value has been established by the operator for in-service deterioration.

As noted below each table, the fuel required is the greater of the two engine fuel and the single engine fuel. This fuel is compared to the amount of fuel normally onboard the airplane at that point in the route. If the fuel required by the critical fuel reserves exceeds the amount of fuel normally expected, the fuel load must be adjusted accordingly.

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Landing

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for Flaps 30.

Maximum landing weight is the lowest of the field length limit weight, climb limit weight or maximum certified landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required.

Go-Around Climb Gradient

Enter the Reference Go-around Gradient table with airport OAT and pressure altitude to determine the reference Go-Around Gradient. Then adjust the reference gradient for airplane weight and speed using the tables provided to determine the weight and speed adjusted Go-Around Gradient. Apply the necessary engine bleed corrections as noted. Note that data is for one engine inoperative.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted adjustments as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent takeoff, or ensure the brake temperature is within limits using the alternate procedure described on the page.

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Takeoff PD.40

Takeoff Field Corrections—Dry Runway PD.40.1

Takeoff Field & Climb Limit Weights—Dry Runway PD.40.2

Takeoff Field Corrections—Wet Runway PD.40.5

Takeoff Field & Climb Limit Weights—Wet Runway PD.40.6

Takeoff Obstacle Limit Weight PD.40.9

Tire Speed Limit PD.40.11

Takeoff Speeds—Dry Runway PD.40.12

Takeoff Speeds—Wet Runway PD.40.14

Gear Down Dispatch PD.40.15

Enroute PD.41

Long Range Cruise Maximum Operating Altitude PD.41.1

Long Range Cruise Trip Fuel and Time PD.41.4

Long Range Cruise Step Climb PD.41.6

Short Trip Fuel and Time PD.41.7

Holding Planning PD.41.8

Crew Oxygen Requirements PD.41.9

Passenger Oxygen Requirements PD.41.10

Net Level Off Weight PD.41.14

Decompression Critical Fuel Reserves—LRC Cruise PD.41.15

Decompression Critical Fuel Reserves—LRC Cruise PD.41.16

Driftdown Critical Fuel Reserves—LRC Driftdown/Cruise PD.41.17

Landing PD.42

Landing Field Limit Weight—Dry Runway PD.42.1

Landing Field Limit Weight—Wet Runway PD.42.2

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Landing Climb Limit Weight PD.42.3
Go-Around Climb Gradient PD.42.4
Quick Turnaround Limit Weight PD.42.5

Gear Down PD.43
Takeoff Climb Limit Weight PD.43.1
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Long Range Cruise Trip Fuel and Time PD.43.6
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Takeoff Field Corrections—Dry Runway

Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH (M) RUNWAY SLOPE (%)								
	–2.0	–1.5	–1.0	–0.5	0.0	0.5	1.0	1.5	2.0
1200	1230	1220	1210	1210	1200	1190	1180	1170	1160
1400	1450	1430	1420	1410	1400	1380	1360	1350	1330
1600	1670	1650	1630	1620	1600	1580	1550	1530	1500
1800	1880	1860	1840	1820	1800	1770	1740	1710	1670
2000	2100	2080	2050	2030	2000	1960	1920	1890	1850
2200	2320	2290	2260	2230	2200	2150	2110	2060	2020
2400	2540	2510	2470	2440	2400	2350	2300	2240	2190
2600	2760	2720	2680	2640	2600	2540	2480	2420	2370
2800	2980	2940	2890	2850	2800	2730	2670	2600	2540
3000	3200	3150	3100	3050	3000	2930	2860	2780	2710
3200	3420	3370	3310	3260	3200	3120	3040	2960	2880
3400	3640	3580	3520	3460	3400	3310	3230	3140	3060
3600	3860	3800	3730	3670	3600	3510	3410	3320	3230
3800	4080	4010	3940	3870	3800	3700	3600	3500	3400
4000	4300	4220	4150	4070	4000	3890	3790	3680	3580
4200	4520	4440	4360	4280	4200	4090	3970	3860	3750
4400	4740	4650	4570	4480	4400	4280	4160	4040	3920
4600	4960	4870	4780	4690	4600	4470	4350	4220	4090
4800	5180	5080	4990	4890	4800	4670	4530	4400	4270
5000	5400	5300	5200	5100	5000	4860	4720	4580	4440

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M) WIND COMPONENT (KTS)							
	–15	–10	–5	0	10	20	30	40
1200	900	1000	1100	1200	1270	1350	1430	1510
1400	1070	1180	1290	1400	1480	1560	1650	1730
1600	1230	1360	1480	1600	1690	1770	1860	1960
1800	1400	1530	1670	1800	1890	1990	2080	2180
2000	1570	1710	1860	2000	2100	2200	2300	2410
2200	1730	1890	2040	2200	2300	2410	2520	2630
2400	1900	2070	2230	2400	2510	2620	2740	2860
2600	2070	2240	2420	2600	2720	2830	2960	3080
2800	2230	2420	2610	2800	2920	3050	3180	3310
3000	2400	2600	2800	3000	3130	3260	3390	3530
3200	2570	2780	2990	3200	3330	3470	3610	3760
3400	2730	2960	3180	3400	3540	3680	3830	3980
3600	2900	3130	3370	3600	3750	3900	4050	4200
3800	3070	3310	3560	3800	3950	4110	4270	4430
4000	3230	3490	3740	4000	4160	4320	4490	4650
4200	3400	3670	3930	4200	4370	4530	4700	4880
4400	3570	3840	4120	4400	4570	4750	4920	5100
4600	3730	4020	4310	4600	4780	4960	5140	5330
4800	3900	4200	4500	4800	4980	5170	5360	5550
5000	4070	4380	4690	5000	5190	5380	5580	5780

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Takeoff Field & Climb Limit Weights—Dry Runway
Flaps 15
Sea Level Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	26	30	34	38	42	46	50
1400	248.9	224.7	223.2	221.7	220.3	218.9	214.5	209.1	203.1	197.0	190.8
1600	268.1	242.3	240.7	239.1	237.6	236.1	231.3	225.6	219.2	212.7	206.1
1800	286.1	258.7	257.0	255.4	253.7	252.1	247.1	241.0	234.3	227.4	220.4
2000	302.9	274.2	272.4	270.6	268.9	267.2	261.9	255.5	248.5	241.2	233.9
2200	318.5	288.6	286.7	284.9	283.1	281.3	275.8	269.2	261.8	254.2	246.6
2400	333.1	302.1	300.2	298.3	296.4	294.6	288.9	282.0	274.4	266.5	258.6
2600	346.0	314.0	311.9	310.0	308.1	306.2	300.3	293.2	285.3	277.2	269.0
2800	360.3	327.3	325.2	323.2	321.2	319.3	313.2	305.9	297.8	289.4	280.9
3000	371.7	337.7	335.5	333.5	331.4	329.4	323.2	315.6	307.3	298.6	289.9
3200	378.7	347.7	345.5	343.3	341.3	339.2	332.8	325.0	316.4	307.5	298.6
3400	378.7	357.2	355.0	352.8	350.7	348.6	342.0	334.0	325.2	316.0	306.9
3600	378.7	366.4	364.1	361.9	359.7	357.5	350.8	342.6	333.6	324.2	314.9
3800	378.7	375.1	372.7	370.4	368.2	366.0	359.1	350.7	341.6	332.0	322.5
4000	378.7	378.7	378.7	378.6	376.3	374.1	367.1	358.6	349.2	339.5	329.8
4200	378.7	378.7	378.7	378.7	378.7	378.7	374.8	366.2	356.6	346.7	336.8
4400	378.7	378.7	378.7	378.7	378.7	378.7	378.7	373.5	363.8	353.7	343.7
4600	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	370.7	360.5	350.3
CLIMB LIMIT WT (1000 KG)	373.4	373.4	373.3	373.1	372.9	372.8	360.3	346.1	330.6	315.5	300.6

2,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	26	30	34	38	42	46	50
1400	232.8	210.9	209.5	208.1	206.8	202.9	198.7	193.6	188.0	181.5	175.1
1600	250.9	227.5	226.0	224.5	223.1	219.0	214.5	209.0	203.1	196.1	189.3
1800	267.9	243.1	241.5	239.9	238.4	234.1	229.3	223.5	217.2	209.8	202.6
2000	283.7	257.7	256.0	254.4	252.8	248.3	243.2	237.1	230.5	222.7	215.1
2200	298.6	271.4	269.7	268.0	266.3	261.6	256.4	250.0	243.1	235.0	227.1
2400	312.5	284.3	282.5	280.8	279.0	274.1	268.7	262.1	255.0	246.6	238.4
2600	324.7	295.6	293.7	291.9	290.1	285.1	279.5	272.6	265.2	256.5	248.1
2800	338.3	308.3	306.4	304.5	302.7	297.5	291.7	284.7	277.1	268.1	259.4
3000	349.0	318.2	316.2	314.2	312.4	307.0	301.0	293.8	285.9	276.7	267.7
3200	359.3	327.6	325.6	323.6	321.6	316.1	310.0	302.5	294.5	285.0	275.8
3400	369.2	336.7	334.6	332.5	330.6	324.9	318.6	311.0	302.7	293.0	283.5
3600	378.7	345.4	343.2	341.1	339.1	333.3	326.9	319.0	310.6	300.6	290.9
3800	378.7	353.6	351.4	349.2	347.2	341.3	334.7	326.7	318.1	307.9	298.0
4000	378.7	361.4	359.2	357.1	354.9	348.9	342.2	334.1	325.3	314.9	304.8
4200	378.7	369.1	366.8	364.6	362.5	356.3	349.5	341.2	332.3	321.7	311.5
4400	378.7	376.4	374.1	371.9	369.7	363.5	356.6	348.1	339.0	328.3	317.9
4600	378.7	378.7	378.7	378.7	376.7	370.4	363.4	354.8	345.5	334.7	324.1
CLIMB LIMIT WT (1000 KG)	353.4	353.3	353.2	353.0	352.9	343.3	332.8	319.6	305.5	290.3	276.8

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.
With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1900 kg.
With engine and wing anti-ice on, decrease field limit weight by 950 kg and climb limit weight by 1750 kg.

UNCONTROLLED IF DOWNLOADED OR PRINTED

Takeoff Field & Climb Limit Weights—Dry Runway
Flaps 15
4,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	26	30	34	38	42	46	50
1400	217.2	196.9	195.6	194.3	191.4	187.7	183.2	178.3	172.5	166.4	161.1
1600	234.3	212.6	211.2	209.8	206.7	202.7	198.0	192.7	186.5	180.0	174.3
1800	250.2	227.3	225.8	224.3	221.0	216.8	211.8	206.2	199.7	192.8	186.7
2000	265.2	241.1	239.5	238.0	234.6	230.1	224.8	219.0	212.1	204.9	198.5
2200	279.2	254.1	252.5	250.9	247.3	242.7	237.2	231.1	223.9	216.4	209.7
2400	292.4	266.4	264.7	263.1	259.3	254.5	248.8	242.5	235.1	227.3	220.4
2600	304.0	277.1	275.3	273.6	269.8	264.8	258.9	252.4	244.7	236.6	229.5
2800	317.0	289.3	287.5	285.7	281.7	276.6	270.5	263.8	255.9	247.6	240.2
3000	327.1	298.5	296.7	294.8	290.7	285.5	279.2	272.3	264.1	255.6	248.0
3200	336.7	307.4	305.5	303.6	299.4	294.0	287.6	280.5	272.0	263.3	255.5
3400	346.0	315.9	314.0	312.1	307.8	302.2	295.6	288.3	279.7	270.7	262.7
3600	354.9	324.1	322.1	320.2	315.8	310.1	303.3	295.9	287.0	277.8	269.6
3800	363.4	331.9	329.9	327.9	323.4	317.5	310.7	303.0	294.0	284.6	276.3
4000	371.4	339.4	337.3	335.3	330.7	324.7	317.8	310.0	300.8	291.2	282.7
4200	378.7	346.6	344.5	342.4	337.8	331.7	324.6	316.7	307.3	297.6	288.9
4400	378.7	353.6	351.5	349.3	344.6	338.5	331.2	323.2	313.7	303.8	295.0
4600	378.7	360.4	358.2	356.0	351.2	345.0	337.6	329.4	319.8	309.7	300.8
CLIMB LIMIT WT (1000 KG)	329.7	329.6	329.5	329.3	323.9	315.8	305.3	294.2	280.8	267.3	256.0

6,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	26	30	34	38	42	46	50
1400	202.1	183.0	181.6	179.2	175.5	171.0	167.1	162.8	157.6	152.6	147.7
1600	218.1	197.7	196.3	193.6	189.7	184.9	180.7	176.1	170.6	165.3	160.1
1800	233.1	211.5	210.0	207.2	203.0	198.0	193.5	188.6	182.8	177.2	171.6
2000	247.2	224.5	222.9	220.0	215.6	210.3	205.6	200.5	194.4	188.5	182.7
2200	260.5	236.9	235.2	232.1	227.6	222.1	217.2	211.8	205.4	199.3	193.2
2400	273.0	248.5	246.8	243.6	238.9	233.2	228.1	222.6	215.9	209.5	203.3
2600	283.9	258.6	256.8	253.5	248.7	242.7	237.5	231.8	224.9	218.3	211.8
2800	296.3	270.2	268.4	265.0	260.0	253.9	248.4	242.5	235.5	228.7	222.0
3000	305.8	278.9	277.0	273.5	268.3	262.1	256.5	250.4	243.2	236.1	229.3
3200	314.8	287.2	285.3	281.7	276.4	269.9	264.2	257.9	250.5	243.3	236.2
3400	323.6	295.2	293.3	289.5	284.1	277.5	271.6	265.2	257.6	250.2	242.9
3600	332.0	302.9	300.9	297.1	291.6	284.8	278.8	272.2	264.4	256.8	249.4
3800	339.9	310.3	308.2	304.3	298.7	291.8	285.6	278.9	270.9	263.2	255.6
4000	347.5	317.3	315.2	311.3	305.5	298.5	292.2	285.4	277.2	269.4	261.7
4200	354.9	324.2	322.0	318.0	312.2	305.0	298.6	291.7	283.4	275.4	267.5
4400	362.0	330.8	328.6	324.5	318.6	311.3	304.8	297.7	289.3	281.2	273.2
4600	368.9	337.2	335.0	330.8	324.8	317.4	310.8	303.6	295.1	286.8	278.7
CLIMB LIMIT WT (1000 KG)	306.1	306.1	306.0	302.6	295.5	286.3	278.0	268.7	257.3	246.3	236.2

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.
With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1900 kg.
With engine and wing anti-ice on, decrease field limit weight by 950 kg and climb limit weight by 1750 kg.

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Takeoff Field & Climb Limit Weights—Dry Runway
Flaps 15
8,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	26	30	34	38	42	46	50
1400	185.6	167.6	165.3	162.1	158.1	154.4	150.5	146.0	141.4	136.8	132.2
1600	200.5	181.2	178.8	175.4	171.1	167.1	163.0	158.2	153.3	148.4	143.5
1800	214.5	194.1	191.5	187.8	183.3	179.1	174.7	169.7	164.4	159.3	154.1
2000	227.7	206.2	203.5	199.7	194.9	190.5	185.9	180.6	175.1	169.7	164.2
2200	240.1	217.8	215.0	211.0	206.0	201.4	196.6	191.1	185.3	179.7	174.0
2400	251.9	228.7	225.8	221.7	216.5	211.8	206.8	201.0	195.1	189.2	183.3
2600	262.1	238.1	235.1	230.8	225.5	220.6	215.5	209.5	203.4	197.3	191.2
2800	273.8	249.1	246.0	241.6	236.1	231.0	225.7	219.6	213.3	207.1	200.8
3000	282.6	257.2	254.0	249.4	243.8	238.6	233.1	226.8	220.3	213.9	207.4
3200	291.0	264.9	261.6	256.9	251.1	245.8	240.2	233.7	227.0	220.4	213.7
3400	299.1	272.3	269.0	264.2	258.2	252.7	247.0	240.3	233.5	226.7	219.8
3600	306.9	279.5	276.1	271.2	265.1	259.4	253.5	246.7	239.7	232.8	225.8
3800	314.4	286.3	282.9	277.8	271.6	265.9	259.9	252.9	245.7	238.7	231.5
4000	321.5	293.0	289.4	284.3	278.0	272.1	266.0	258.9	251.6	244.4	237.1
4200	328.4	299.4	295.8	290.5	284.1	278.1	271.9	264.7	257.3	249.9	242.5
4400	335.1	305.6	301.9	296.6	290.0	284.0	277.6	270.3	262.8	255.3	247.8
4600	341.6	311.6	307.8	302.4	295.8	289.6	283.2	275.8	268.1	260.5	252.9
CLIMB LIMIT WT (1000 KG)	281.5	281.4	278.2	272.0	263.9	256.4	248.2	238.8	228.6	219.0	209.4

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.
With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1,900 kg.
With engine and wing anti-ice on, decrease field limit weight by 950 kg and climb limit weight by 1,750 kg.

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Takeoff Field Corrections—Wet Runway

Slope Corrections

FIELD LENGTH AVAILABLE (M)	SLOPE CORRECTED FIELD LENGTH (M)								
	RUNWAY SLOPE (%)								
	–2.0	–1.5	–1.0	–0.5	0.0	0.5	1.0	1.5	2.0
1200	1220	1210	1210	1200	1200	1190	1180	1170	1150
1400	1440	1430	1420	1410	1400	1380	1360	1350	1330
1600	1660	1650	1630	1620	1600	1580	1550	1530	1500
1800	1890	1860	1840	1820	1800	1770	1740	1710	1680
2000	2110	2080	2050	2030	2000	1960	1920	1890	1850
2200	2330	2300	2260	2230	2200	2160	2110	2070	2020
2400	2550	2510	2480	2440	2400	2350	2300	2250	2200
2600	2770	2730	2690	2640	2600	2540	2480	2430	2370
2800	3000	2950	2900	2850	2800	2740	2670	2610	2540
3000	3220	3160	3110	3050	3000	2930	2860	2790	2720
3200	3440	3380	3320	3260	3200	3120	3050	2970	2890
3400	3660	3600	3530	3470	3400	3320	3230	3150	3060
3600	3880	3810	3740	3670	3600	3510	3420	3330	3240
3800	4110	4030	3950	3880	3800	3700	3610	3510	3410
4000	4330	4250	4160	4080	4000	3900	3790	3690	3580
4200	4550	4460	4370	4290	4200	4090	3980	3870	3760
4400	4770	4680	4590	4490	4400	4280	4170	4050	3930
4600	4990	4890	4800	4700	4600	4480	4350	4230	4110
4800	5220	5110	5010	4900	4800	4670	4540	4410	4280
5000	5440	5330	5220	5110	5000	4860	4730	4590	4450

Wind Corrections

SLOPE CORR'D FIELD LENGTH (M)	SLOPE & WIND CORRECTED FIELD LENGTH (M)							
	WIND COMPONENT (KTS)							
	–15	–10	–5	0	10	20	30	40
1200	860	970	1090	1200	1280	1360	1450	1540
1400	1030	1150	1280	1400	1480	1570	1670	1770
1600	1200	1330	1470	1600	1690	1790	1890	2000
1800	1360	1510	1650	1800	1900	2000	2110	2230
2000	1530	1690	1840	2000	2100	2210	2330	2460
2200	1700	1870	2030	2200	2310	2430	2550	2690
2400	1870	2050	2220	2400	2510	2640	2770	2920
2600	2040	2220	2410	2600	2720	2850	2990	3150
2800	2200	2400	2600	2800	2930	3060	3210	3380
3000	2370	2580	2790	3000	3130	3280	3430	3610
3200	2540	2760	2980	3200	3340	3490	3660	3840
3400	2710	2940	3170	3400	3540	3700	3880	4070
3600	2870	3120	3360	3600	3750	3920	4100	4300
3800	3040	3290	3550	3800	3960	4130	4320	4530
4000	3210	3470	3740	4000	4160	4340	4540	4760
4200	3380	3650	3930	4200	4370	4550	4760	4990
4400	3540	3830	4110	4400	4570	4770	4980	5220
4600	3710	4010	4300	4600	4780	4980	5200	5450
4800	3880	4190	4490	4800	4990	5190	5420	5680
5000	4050	4360	4680	5000	5190	5410	5640	5910

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Takeoff Field & Climb Limit Weights—Wet Runway
Flaps 15
Sea Level Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	26	30	34	38	42	46	50
1800	284.0	255.6	253.9	252.1	250.5	248.8	243.6	237.3	230.3	223.2	216.2
2000	300.4	270.4	268.5	266.7	264.9	263.2	257.6	250.9	243.6	236.0	228.5
2200	315.7	284.1	282.1	280.2	278.4	276.5	270.7	263.6	255.9	247.9	240.1
2400	330.2	297.1	295.0	293.0	291.0	289.1	283.0	275.6	267.5	259.2	251.0
2600	343.5	308.9	306.8	304.7	302.6	300.6	294.3	286.6	278.1	269.4	260.8
2800	359.0	323.0	320.8	318.6	316.5	314.4	307.8	299.8	290.9	281.9	273.0
3000	371.0	333.7	331.4	329.1	326.9	324.7	317.9	309.5	300.4	291.0	281.8
3200	378.7	344.6	342.2	339.9	337.6	335.4	328.2	319.6	310.1	300.4	290.8
3400	378.7	355.3	352.8	350.4	348.0	345.7	338.4	329.4	319.6	309.6	299.7
3600	378.7	365.5	363.0	360.5	358.1	355.7	348.1	338.9	328.8	318.5	308.2
3800	378.7	375.3	372.7	370.1	367.6	365.2	357.4	347.9	337.6	326.9	316.4
4000	378.7	378.7	378.7	378.7	376.9	374.3	366.4	356.7	346.0	335.1	324.3
4200	378.7	378.7	378.7	378.7	378.7	378.7	375.1	365.1	354.2	343.1	332.0
4400	378.7	378.7	378.7	378.7	378.7	378.7	378.7	373.4	362.2	350.8	339.5
4600	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	370.0	358.3	346.7
4800	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	377.5	365.5	353.7
5000	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	372.6	360.5
5200	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	378.7	367.0
CLIMB LIMIT WT (1000 KG)	373.4	373.4	373.3	373.1	372.9	372.8	360.3	346.1	330.6	315.5	300.6

2,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	26	30	34	38	42	46	50
1800	264.7	239.3	237.7	236.1	234.5	230.1	225.1	219.2	212.8	205.9	199.4
2000	280.0	253.1	251.3	249.6	248.0	243.3	238.0	231.7	224.9	217.6	210.8
2200	294.3	265.9	264.0	262.3	260.5	255.6	250.1	243.4	236.3	228.6	221.4
2400	307.7	278.0	276.1	274.2	272.4	267.2	261.4	254.4	247.0	238.9	231.4
2600	320.1	289.0	287.0	285.1	283.2	277.7	271.7	264.4	256.7	248.2	240.4
2800	334.6	302.3	300.2	298.2	296.2	290.6	284.3	276.8	268.7	259.9	251.7
3000	345.7	312.2	310.0	307.9	305.9	300.0	293.5	285.7	277.3	268.2	259.7
3200	357.1	322.3	320.1	317.9	315.8	309.7	303.0	294.9	286.2	276.7	268.0
3400	368.1	332.3	330.0	327.7	325.5	319.2	312.3	303.9	294.9	285.1	276.1
3600	378.7	341.8	339.4	337.1	334.9	328.4	321.2	312.6	303.3	293.3	283.9
3800	378.7	350.9	348.5	346.1	343.8	337.1	329.8	320.9	311.3	301.0	291.4
4000	378.7	359.7	357.2	354.8	352.4	345.6	338.0	328.9	319.1	308.5	298.7
4200	378.7	368.3	365.7	363.2	360.8	353.8	346.1	336.7	326.7	315.8	305.7
4400	378.7	376.6	374.0	371.4	368.9	361.8	353.8	344.3	334.0	322.9	312.6
4600	378.7	378.7	378.7	378.7	376.8	369.5	361.4	351.6	341.1	329.8	319.2
4800	378.7	378.7	378.7	378.7	378.7	377.0	368.7	358.7	348.0	336.4	325.6
5000	378.7	378.7	378.7	378.7	378.7	378.7	375.8	365.6	354.7	342.8	331.8
5200	378.7	378.7	378.7	378.7	378.7	378.7	378.7	372.2	361.1	349.1	337.8
CLIMB LIMIT WT (1000 KG)	353.4	353.3	353.2	353.0	352.9	343.3	332.8	319.6	305.5	290.3	276.8

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.
With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1,900 kg.
With engine and wing anti-ice on, decrease field limit weight by 1,100 kg and climb limit weight by 1,750 kg.

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Takeoff Field & Climb Limit Weights—Wet Runway
Flaps 15
4,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	26	30	34	38	42	46	50
1800	246.5	222.9	221.4	219.9	216.6	212.3	207.4	202.3	196.4	190.2	184.8
2000	260.7	235.7	234.1	232.5	229.0	224.4	219.2	213.9	207.6	201.0	195.2
2200	273.9	247.6	245.9	244.3	240.5	235.7	230.2	224.6	218.0	211.1	205.0
2400	286.4	258.9	257.1	255.3	251.4	246.4	240.7	234.8	227.8	220.6	214.2
2600	297.8	269.1	267.2	265.4	261.3	256.0	250.1	243.9	236.7	229.1	222.5
2800	311.4	281.6	279.7	277.7	273.5	268.0	261.8	255.4	247.9	240.0	233.1
3000	321.7	290.7	288.7	286.7	282.3	276.6	270.2	263.5	255.7	247.6	240.4
3200	332.2	300.0	298.0	295.9	291.4	285.5	278.8	271.9	263.8	255.4	248.0
3400	342.4	309.2	307.1	305.0	300.3	294.2	287.3	280.1	271.8	263.1	255.4
3600	352.3	318.1	315.9	313.7	308.8	302.6	295.4	288.1	279.5	270.5	262.6
3800	361.7	326.5	324.3	322.0	317.0	310.6	303.3	295.7	286.9	277.6	269.5
4000	370.8	334.7	332.4	330.1	325.0	318.4	310.8	303.1	294.0	284.5	276.2
4200	378.7	342.6	340.3	337.9	332.7	325.9	318.2	310.3	301.0	291.3	282.7
4400	378.7	350.3	347.9	345.5	340.2	333.2	325.3	317.2	307.7	297.8	289.0
4600	378.7	357.8	355.4	352.9	347.4	340.3	332.3	324.0	314.2	304.1	295.1
4800	378.7	365.1	362.5	360.0	354.4	347.2	338.9	330.5	320.5	310.1	301.0
5000	378.7	372.1	369.5	366.9	361.2	353.8	345.4	336.8	326.6	316.0	306.7
5200	378.7	378.7	376.2	373.6	367.8	360.2	351.7	342.9	332.5	321.7	312.2
CLIMB LIMIT WT (1000 KG)	329.7	329.6	329.5	329.3	323.9	315.8	305.3	294.2	280.8	267.3	256.0

6,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG) OAT (deg. C)										
	–40	14	18	22	26	30	34	38	42	46	50
1800	228.9	207.0	205.6	203.0	199.2	194.6	190.5	186.1	180.9	175.8	170.8
2000	242.0	218.8	217.3	214.5	210.6	205.7	201.4	196.7	191.1	185.7	180.5
2200	254.2	229.8	228.2	225.3	221.1	216.0	211.4	206.5	200.7	195.0	189.4
2400	265.8	240.2	238.6	235.5	231.1	225.8	221.0	215.8	209.7	203.7	197.9
2600	276.3	249.6	247.9	244.7	240.1	234.5	229.5	224.2	217.7	211.5	205.5
2800	289.1	261.3	259.5	256.2	251.5	245.7	240.4	234.9	228.2	221.7	215.4
3000	298.5	269.7	267.8	264.4	259.4	253.4	248.0	242.2	235.3	228.5	222.0
3200	308.1	278.3	276.3	272.8	267.7	261.4	255.8	249.8	242.7	235.7	228.9
3400	317.6	286.7	284.7	281.1	275.8	269.3	263.5	257.3	249.9	242.7	235.7
3600	326.7	294.9	292.8	289.0	283.6	276.9	271.0	264.6	256.9	249.5	242.3
3800	335.4	302.7	300.6	296.7	291.1	284.3	278.1	271.6	263.7	256.1	248.7
4000	343.8	310.2	308.1	304.1	298.4	291.3	285.1	278.3	270.3	262.4	254.9
4200	352.0	317.6	315.4	311.3	305.4	298.2	291.8	284.9	276.6	268.6	260.9
4400	359.9	324.7	322.5	318.3	312.2	304.9	298.3	291.2	282.8	274.6	266.6
4600	367.6	331.6	329.3	325.0	318.9	311.3	304.6	297.4	288.7	280.3	272.2
4800	375.0	338.3	335.9	331.6	325.3	317.6	310.7	303.3	294.5	285.9	277.7
5000	378.7	344.8	342.3	337.9	331.5	323.6	316.6	309.1	300.1	291.3	282.9
5200	378.7	351.0	348.5	344.0	337.5	329.5	322.3	314.6	305.4	296.5	287.9
CLIMB LIMIT WT (1000 KG)	306.1	306.1	306.0	302.6	295.5	286.3	278.0	268.7	257.3	246.3	236.2

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.
With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1,900 kg.
With engine and wing anti-ice on, decrease field limit weight by 1,100 kg and climb limit weight by 1,750 kg.

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Takeoff Field & Climb Limit Weights—Wet Runway
Flaps 15
8,000 FT Pressure Altitude

CORR'D FIELD LENGTH (M)	FIELD LIMIT WEIGHT (1000 KG)										
	OAT (deg. C)										
	–40	14	18	22	26	30	34	38	42	46	50
1800	211.1	190.9	188.6	185.2	181.1	177.3	173.3	168.7	164.0	159.5	155.0
2000	223.2	201.7	199.3	195.7	191.4	187.3	183.1	178.2	173.2	168.4	163.7
2200	234.4	211.9	209.2	205.5	200.9	196.7	192.2	187.1	181.9	176.8	171.8
2400	245.0	221.4	218.7	214.8	210.0	205.5	200.8	195.5	190.0	184.7	179.4
2600	254.6	230.0	227.1	223.0	218.0	213.4	208.5	202.9	197.2	191.6	186.2
2800	266.5	240.9	237.9	233.7	228.5	223.6	218.6	212.8	206.8	201.0	195.4
3000	275.1	248.5	245.4	241.0	235.6	230.6	225.3	219.3	213.1	207.1	201.2
3200	283.9	256.3	253.1	248.6	243.0	237.8	232.3	226.1	219.7	213.5	207.3
3400	292.5	264.0	260.7	256.0	250.2	244.9	239.2	232.8	226.2	219.7	213.4
3600	300.9	271.5	268.1	263.2	257.3	251.7	245.9	239.3	232.5	225.8	219.3
3800	308.8	278.7	275.2	270.2	264.1	258.4	252.4	245.6	238.5	231.7	225.1
4000	316.6	285.6	282.0	276.9	270.6	264.8	258.7	251.7	244.5	237.5	230.6
4200	324.1	292.4	288.7	283.4	277.0	271.0	264.7	257.6	250.2	243.0	236.0
4400	331.3	298.9	295.1	289.8	283.2	277.0	270.6	263.3	255.7	248.4	241.2
4600	338.4	305.2	301.4	295.9	289.1	282.9	276.3	268.8	261.1	253.6	246.2
4800	345.2	311.3	307.4	301.8	294.9	288.5	281.8	274.1	266.3	258.6	251.1
5000	351.8	317.2	313.2	307.5	300.5	293.9	287.1	279.3	271.2	263.4	255.8
5200	358.2	322.9	318.9	313.0	305.9	299.2	292.2	284.3	276.0	268.1	260.3
CLIMB LIMIT WT (1000 KG)	281.5	281.4	278.2	272.0	263.9	256.4	248.2	238.8	228.6	219.0	209.4

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off or auto.
With engine bleed for packs off, increase field limit weight by 500 kg and climb limit weight by 1,900 kg.
With engine and wing anti-ice on, decrease field limit weight by 1,100 kg and climb limit weight by 1,750 kg.

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Takeoff Obstacle Limit Weight

Flaps 15

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

Sea Level, 30 deg. C & Below, Zero Wind

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)										
	DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	296.6	322.2	345.4	365.3							
20	280.4	304.4	324.6	342.3	357.7	369.4					
40	262.0	286.2	305.2	321.5	335.6	348.0	358.4	366.9	373.8		
60	247.2	270.6	289.9	305.8	319.4	331.3	341.7	351.1	358.7	365.2	370.8
80	234.7	257.3	276.7	292.7	306.2	317.9	328.3	337.4	345.5	352.6	358.8
100	223.8	245.8	264.9	281.2	294.8	306.5	316.8	325.9	334.0	341.2	347.8
120	214.1	235.8	254.4	270.6	284.5	296.3	306.6	315.7	323.9	331.2	337.9
140	205.5	226.7	245.1	261.1	275.0	287.1	297.4	306.6	314.9	322.3	329.0
160	197.9	218.6	236.6	252.4	266.2	278.4	289.0	298.3	306.6	314.1	320.9
180	190.9	211.1	228.9	244.4	258.2	270.4	281.2	290.6	299.0	306.5	313.4
200	184.4	204.2	221.7	237.1	250.7	262.9	273.7	283.4	291.9	299.5	306.4
220	178.4	197.9	215.1	230.3	243.8	255.9	266.8	276.5	285.2	292.9	299.9
240	172.7	192.1	208.9	223.9	237.4	249.4	260.2	270.0	278.8	286.6	293.7
260		186.6	203.1	218.0	231.3	243.2	254.0	263.8	272.6	280.7	287.9
280		181.4	197.8	212.4	225.6	237.5	248.2	258.0	266.8	274.9	282.3
300		176.5	192.8	207.2	220.2	232.0	242.7	252.4	261.3	269.4	276.8

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustments

OAT (deg. C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)						
	160	200	240	280	320	360	400
30 & Below	0	0	0	0	0	0	0
32	–2.8	–3.5	–4.2	–4.8	–5.5	–6.2	–6.9
34	–5.6	–6.9	–8.3	–9.7	–11.1	–12.4	–13.8
36	–8.3	–10.4	–12.5	–14.5	–16.6	–18.6	–20.7
38	–11.1	–13.9	–16.6	–19.4	–22.1	–24.9	–27.6
40	–13.9	–17.3	–20.8	–24.2	–27.6	–31.1	–34.5
42	–17.3	–21.5	–25.6	–29.8	–33.9	–38.1	–42.2
44	–20.8	–25.6	–30.5	–35.4	–40.2	–45.1	–49.9
46	–24.2	–29.8	–35.4	–40.9	–46.5	–52.1	–57.6
48	–27.7	–34.0	–40.2	–46.5	–52.8	–59.1	–65.4
50	–31.1	–38.1	–45.1	–52.1	–59.1	–66.1	–73.1

Pressure Altitude Adjustment

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	160	200	240	280	320	360	400
S.L. & Below	0	0	0	0	0	0	0
1000	–6.9	–8.4	–9.8	–11.2	–12.7	–14.1	–15.5
2000	–13.9	–16.8	–19.6	–22.5	–25.3	–28.2	–31.0
3000	–20.3	–24.5	–28.7	–32.8	–37.0	–41.2	–45.4
4000	–26.7	–32.2	–37.7	–43.2	–48.7	–54.2	–59.7
5000	–33.6	–40.5	–47.4	–54.3	–61.3	–68.2	–75.1
6000	–40.5	–48.8	–57.2	–65.5	–73.8	–82.2	–90.5
7000	–47.2	–57.0	–66.8	–76.7	–86.5	–96.3	–106.1
8000	–53.8	–65.2	–76.5	–87.8	–99.1	–110.4	–121.8

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Takeoff Obstacle Limit Weight
Flaps 15
Wind Adjustment

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)						
	160	200	240	280	320	360	400
15 TW	–35.5	–36.1	–36.7	–37.3	–37.9	–38.5	–39.1
10 TW	–23.7	–24.1	–24.5	–24.9	–25.3	–25.7	–26.1
5 TW	–11.8	–12.0	–12.2	–12.4	–12.6	–12.8	–13.0
0	0	0	0	0	0	0	0
10 HW	4.0	3.8	3.6	3.4	3.2	3.0	2.8
20 HW	7.9	7.5	7.2	6.8	6.4	6.0	5.6
30 HW	12.2	11.5	10.9	10.2	9.5	8.9	8.2
40 HW	16.5	15.6	14.6	13.7	12.7	11.8	10.8

With engine bleed for packs off, increase weight by 900 kg.
With engine and wing anti-ice on, decrease weight by 2,000 kg.

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Tire Speed Limit
Flaps 15

AIRPORT OAT		TIRE SPEED LIMIT WEIGHT (1000 KG) AIRPORT PRESSURE ALTITUDE (FT)				
(deg. C)	(deg. F)	0	2000	4000	6000	8000
54	129	367.5	338.4	312.9	289.7	268.1
52	126	369.5	340.4	314.7	291.3	269.6
50	122	371.4	342.4	316.4	293.0	271.2
48	118	373.5	345.2	318.3	294.7	272.8
46	115	375.6	347.9	320.1	296.4	274.3
44	111	377.0	350.4	321.9	298.1	276.0
42	108	377.9	352.8	323.8	299.9	277.6
40	104	378.7	355.2	325.7	301.6	279.2
38	100	378.7	357.2	327.7	303.4	281.0
36	97	378.7	359.2	329.8	305.3	282.7
34	93	378.7	361.3	331.9	307.1	284.4
32	90	378.7	363.5	334.2	309.1	286.2
30	86	378.7	365.8	336.4	311.1	288.0
28	82	378.7	368.1	338.7	313.1	289.9
26	79	378.7	370.4	341.1	315.1	291.9
24	75	378.7	373.0	343.6	317.1	293.8
22	72	378.7	375.7	346.5	319.3	295.7
20	68	378.7	378.3	351.2	321.6	297.7
18	64	378.7	378.7	353.9	323.9	299.8
16	61	378.7	378.7	356.4	326.4	301.9
14	57	378.7	378.7	359.0	329.0	304.1
12	54	378.7	378.7	361.7	331.6	306.4
10	50	378.7	378.7	364.3	334.3	308.7
–40	–40	378.7	378.7	378.7	378.7	378.7

Increase tire speed limit weight by 2550 kg per knot headwind.
Decrease tire speed limit weight by 5400 kg per knot tailwind.

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Takeoff Speeds—Dry Runway
Flaps 15
V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	KIAS		
	V1	VR	V2
380	175	184	190
360	170	179	185
340	165	174	181
320	160	168	177
300	154	162	172
280	148	155	167
260	142	149	162
240	134	142	156
220	126	134	151
200	117	127	145
180	107	118	139
160	97	110	131

Check V1(MCG) and minimum VR.

V1, VR, V2 Adjustments*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
deg. C	deg. F	–2	0	2	4	6	8	–2	0	2	4	6	8	–2	0	2	4	6	8
70	158	12	14					7	8					–4	–4				
60	140	8	10	12	14			4	6	7	8			–3	–3	–4	–4		
50	122	5	6	8	10	13	16	3	4	5	6	8	9	–2	–2	–3	–3	–4	–5
40	104	1	3	5	7	10	13	1	2	3	5	6	8	–1	–1	–2	–2	–3	–4
30	86	0	0	2	5	8	11	0	0	2	3	5	7	0	0	–1	–2	–2	–3
20	68	0	0	2	4	6	9	0	0	1	2	4	6	0	0	–1	–1	–2	–3
–60	–76	0	0	2	4	6	8	0	0	1	2	4	5	0	0	–1	–1	–2	–2

Slope and Wind V1 Adjustments*

WEIGHT (1000 KG)	SLOPE (%)					WIND (KTS)							
	–2	–1	0	1	2	–15	–10	–5	0	10	20	30	40
380	–4	–1	0	3	5	–2	–1	0	0	1	3	4	4
360	–4	–1	0	3	5	–2	–1	0	0	1	3	3	4
340	–3	–1	0	3	4	–2	–1	0	0	1	2	3	3
320	–3	–1	0	2	4	–2	–1	0	0	1	2	3	3
300	–3	–1	0	2	4	–2	–1	0	0	1	2	2	3
280	–2	–1	0	2	3	–2	–1	0	0	1	2	2	3
260	–2	0	0	2	3	–2	–1	0	0	1	2	2	3
240	–2	0	0	2	3	–1	–1	0	0	1	2	2	3
220	–1	0	0	2	3	–1	–1	0	0	1	2	3	3
200	–1	0	0	3	4	–1	0	0	0	1	2	3	4
180	–1	0	0	3	4	–1	0	1	0	1	3	3	4
160	–1	1	0	3	4	–1	0	1	0	2	3	4	5

*V1 not to exceed VR.

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Takeoff Speeds—Dry Runway
Flaps 15
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		–2000		0		2000		4000		6000		8000	
deg. C	deg. F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	116	118	113	115	111	113	109	111				
50	122	119	121	116	118	111	113	109	111	106	109	103	106
40	104	126	127	123	124	118	120	113	115	108	111	103	106
30	86	128	130	128	130	123	125	118	120	112	115	106	109
20	68	129	130	129	130	125	126	120	122	116	118	110	113
–60	–76	130	130	130	130	126	126	121	122	117	118	112	114

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Takeoff Speeds—Wet Runway
Flaps 15
V1, VR, V2 for Max Takeoff Thrust

WEIGHT (1000 KG)	KIAS		
	V1	VR	V2
380	169	184	190
360	163	179	185
340	157	174	181
320	151	168	177
300	144	162	172
280	137	155	167
260	130	149	162
240	122	142	156
220	114	134	151
200	106	127	145
180	96	118	139
160	88	110	131

Check V1(MCG) and minimum VR.

V1, VR, V2 Adjustments*

TEMP		V1						VR						V2					
		PRESS ALT (1000 FT)						PRESS ALT (1000 FT)						PRESS ALT (1000 FT)					
deg. C	deg. F	–2	0	2	4	6	8	–2	0	2	4	6	8	–2	0	2	4	6	8
70	158	14	16					7	8					–4	–4				
60	140	10	11	14	16			4	6	7	8			–3	–3	–4	–4		
50	122	5	7	9	12	14	17	3	4	5	6	8	9	–2	–2	–3	–3	–4	–5
40	104	2	3	6	8	11	14	1	2	3	5	6	8	–1	–1	–2	–2	–3	–4
30	86	0	0	3	5	8	12	0	0	2	3	5	7	0	0	–1	–2	–2	–3
20	68	0	0	2	4	7	10	0	0	1	2	4	6	0	0	–1	–1	–2	–3
–60	–76	0	0	2	4	6	9	0	0	1	2	4	5	0	0	–1	–1	–2	–2

Slope and Wind V1 Adjustments*

WEIGHT (1000 KG)	SLOPE (%)					WIND (KTS)							
	–2	–1	0	1	2	–15	–10	–5	0	10	20	30	40
380	–6	–3	0	3	6	–3	–2	–1	0	1	2	3	4
360	–6	–3	0	3	6	–4	–3	–1	0	1	2	3	4
340	–6	–3	0	3	5	–4	–3	–1	0	1	2	3	4
320	–5	–3	0	3	5	–5	–3	–2	0	1	2	3	4
300	–5	–3	0	2	5	–5	–3	–2	0	1	2	3	4
280	–5	–2	0	2	5	–5	–3	–2	0	1	2	3	4
260	–4	–2	0	2	4	–5	–3	–1	0	1	2	3	4
240	–4	–2	0	2	4	–5	–3	–1	0	1	3	4	5
220	–3	–1	0	3	4	–5	–3	–1	0	1	3	4	5
200	–2	–1	0	3	5	–4	–2	–1	0	2	3	4	5
180	–2	0	0	3	5	–4	–2	0	0	2	4	5	6
160	–1	1	0	4	5	–3	–2	0	0	2	4	6	7

*V1 not to exceed VR

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Takeoff Speeds—Wet Runway
Flaps 15
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		–2000		0		2000		4000		6000		8000	
deg. C	deg. F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	116	118	113	115	111	113	109	111				
50	122	119	121	116	118	111	113	109	111	106	109	103	106
40	104	126	127	123	124	118	120	113	115	108	111	103	106
30	86	128	130	128	130	123	125	118	120	112	115	106	109
20	68	129	130	129	130	125	126	120	122	116	118	110	113
–60	–76	130	130	130	130	126	126	121	122	117	118	112	114

Gear Down Dispatch

Takeoff Performance

Restriction/Recommendation

- Do not operate in icing conditions.
- Takeoff with tailwind is not recommended.
- VMO/MMO limit is 270 kt/M 0.73.
- It is recommended to use flaps 15 and maximum thrust-rating for takeoff.
- Decrease the performance climb limited gross weight as follows:

Takeoff config	Flaps 15
Performance climb limited gross weight	-19%

Final Takeoff Condition

The flap retraction speed schedule is unchanged except:

Final-Segment Climb-Speed: VREF + 70 KIAS.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust, Forward C.G. (7.5% MAC - FMC Default)
ISA + 10 deg. C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	4	30400	28700	27200
350	28500	3	31000	29400	27800
340	29200	1	31600	30000	28500
330	29800	0	32100	30500	29000
320	30500	–2	32600	31000	29500
310	31200	–3	33200	31600	30000
300	31900	–5	33700	32100	30600
290	32600	–7	34300	32700	31200
280	33400	–8	34900	33300	31800
270	34100	–10	35500	33900	32400
260	34900	–12	36100	34500	33100
250	35800	–14	36800	35200	33800
240	36600	–15	37500	35900	34500
230	37500	–15	38200	36600	35200
220	38400	–15	39000	37400	36000
210	39400	–15	39700	38200	36800
200	40400	–15	40600	39100	37700
190	41500	–15	41500	39900	38600
180	42600	–15	42400	40900	39600
170	43100	–15	43100	42100	40800
160	43100	–15	43100	43100	42100

ISA + 15 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	10	30400	28700	27200
350	28500	8	31000	29400	27800
340	29200	7	31600	30000	28500
330	29800	5	32100	30500	29000
320	30500	4	32600	31000	29500
310	31200	2	33200	31600	30000
300	31900	1	33700	32100	30600
290	32600	–1	34300	32700	31200
280	33400	–3	34900	33300	31800
270	34100	–4	35500	33900	32400
260	34900	–6	36100	34500	33100
250	35800	–8	36800	35200	33800
240	36600	–9	37500	35900	34500
230	37500	–9	38200	36600	35200
220	38400	–9	39000	37400	36000
210	39400	–9	39700	38200	36800
200	40400	–9	40600	39100	37700
190	41500	–9	41500	39900	38600
180	42600	–9	42400	40900	39600
170	43100	–9	43100	42100	40800
160	43100	–9	43100	43100	42100

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust, Forward C.G. (7.5% MAC - FMC Default)
ISA + 20 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	15	30400	28700	27200
350	28500	14	31000	29400	27800
340	29200	13	31600	30000	28500
330	29800	11	32100	30500	29000
320	30500	10	32600	31000	29500
310	31200	8	33200	31600	30000
300	31900	6	33700	32100	30600
290	32600	5	34300	32700	31200
280	33400	3	34900	33300	31800
270	34100	1	35500	33900	32400
260	34900	–1	36100	34500	33100
250	35800	–2	36800	35200	33800
240	36600	–3	37500	35900	34500
230	37500	–3	38200	36600	35200
220	38400	–3	39000	37400	36000
210	39400	–3	39700	38200	36800
200	40400	–3	40600	39100	37700
190	41500	–3	41500	39900	38600
180	42600	–3	42400	40900	39600
170	43100	–3	43100	42100	40800
160	43100	–3	43100	43100	42100

Max Climb Thrust, Mid C.G. (30% MAC)
ISA + 10 deg. C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	4	31400	29800	28300
350	28500	3	32000	30400	28900
340	29200	1	32700	31000	29500
330	29800	0	33200	31500	30000
320	30500	–2	33700	32100	30500
310	31200	–3	34200	32600	31100
300	31900	–5	34700	33100	31600
290	32600	–7	35300	33700	32200
280	33400	–8	35900	34300	32800
270	34100	–10	36500	34900	33400
260	34900	–12	37100	35500	34100
250	35800	–14	37800	36200	34800
240	36600	–15	38500	36900	35500
230	37500	–15	39200	37600	36200
220	38400	–15	40000	38400	37000
210	39400	–15	40700	39200	37800
200	40400	–15	41600	40000	38600
190	41500	–15	42500	40900	39500
180	42600	–15	43100	41900	40500
170	43100	–15	43100	43100	41700
160	43100	–15	43100	43100	43000

Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust, Mid C.G. (30% MAC)
ISA + 15 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	10	31400	29800	28300
350	28500	8	32000	30400	28900
340	29200	7	32700	31000	29500
330	29800	5	33200	31500	30000
320	30500	4	33700	32100	30500
310	31200	2	34200	32600	31100
300	31900	1	34700	33100	31600
290	32600	–1	35300	33700	32200
280	33400	–3	35900	34300	32800
270	34100	–4	36500	34900	33400
260	34900	–6	37100	35500	34100
250	35800	–8	37800	36200	34800
240	36600	–9	38500	36900	35500
230	37500	–9	39200	37600	36200
220	38400	–9	40000	38400	37000
210	39400	–9	40700	39200	37800
200	40400	–9	41600	40000	38600
190	41500	–9	42500	40900	39500
180	42600	–9	43100	41900	40500
170	43100	–9	43100	43100	41700
160	43100	–9	43100	43100	43000

Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

ISA + 20 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	15	31400	29800	28300
350	28500	14	32000	30400	28900
340	29200	13	32700	31000	29500
330	29800	11	33200	31500	30000
320	30500	10	33700	32100	30500
310	31200	8	34200	32600	31100
300	31900	6	34700	33100	31600
290	32600	5	35300	33700	32200
280	33400	3	35900	34300	32800
270	34100	1	36500	34900	33400
260	34900	–1	37100	35500	34100
250	35800	–2	37800	36200	34800
240	36600	–3	38500	36900	35500
230	37500	–3	39200	37600	36200
220	38400	–3	40000	38400	37000
210	39400	–3	40700	39200	37800
200	40400	–3	41600	40000	38600
190	41500	–3	42500	40900	39500
180	42600	–3	43100	41900	40500
170	43100	–3	43100	43100	41700
160	43100	–3	43100	43100	43000

Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Trip 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
1058	994	937	886	841	800	766	735	706	679	655
1580	1487	1403	1328	1261	1200	1150	1104	1061	1021	985
2101	1979	1868	1769	1681	1600	1534	1473	1416	1364	1316
2620	2469	2332	2210	2100	2000	1918	1842	1771	1706	1647
3138	2959	2795	2650	2520	2400	2302	2211	2127	2049	1978
3654	3447	3258	3090	2939	2800	2687	2581	2483	2392	2309
4168	3933	3719	3529	3358	3200	3071	2950	2838	2735	2641
4679	4418	4180	3968	3776	3600	3455	3320	3194	3078	2972
5190	4903	4640	4406	4194	4000	3839	3689	3550	3421	3303
5699	5386	5099	4844	4612	4400	4224	4059	3906	3764	3635
6207	5868	5558	5281	5030	4800	4608	4429	4262	4108	3966
6713	6348	6015	5717	5448	5200	4992	4798	4618	4451	4298
7217	6828	6472	6153	5865	5600	5376	5168	4973	4794	4629
7721	7307	6928	6590	6283	6000	5761	5537	5329	5137	4960
8224	7786	7385	7026	6700	6400	6145	5906	5685	5480	5292
8726	8264	7841	7461	7117	6800	6529	6276	6040	5823	5623
9228	8742	8296	7897	7534	7200	6913	6645	6396	6166	5955
9728	9219	8751	8332	7951	7600	7297	7015	6752	6509	6286
10228	9695	9206	8767	8368	8000	7681	7384	7107	6852	6617

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	27		29		31		33		35	
	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)
800	13.3	2:02	13.0	2:00	12.8	1:57	12.6	1:54	12.4	1:52
1200	19.3	2:58	18.9	2:54	18.5	2:50	18.2	2:46	17.9	2:43
1600	25.5	3:53	24.9	3:49	24.4	3:42	23.9	3:37	23.4	3:33
2000	31.6	4:49	30.8	4:43	30.2	4:35	29.6	4:28	28.9	4:23
2400	38.0	5:43	37.1	5:35	36.3	5:26	35.5	5:18	34.6	5:13
2800	44.4	6:37	43.3	6:28	42.3	6:17	41.4	6:08	40.4	6:03
3200	51.0	7:30	49.7	7:19	48.5	7:07	47.4	6:58	46.2	6:53
3600	57.7	8:23	56.2	8:11	54.9	7:58	53.5	7:47	52.2	7:42
4000	64.4	9:15	62.7	9:02	61.2	8:48	59.7	8:37	58.2	8:32
4400	71.4	10:06	69.5	9:52	67.8	9:37	66.1	9:26	64.5	9:22
4800	78.4	10:58	76.3	10:42	74.3	10:26	72.4	10:16	70.7	10:11
5200	85.5	11:48	83.2	11:31	81.0	11:16	79.0	11:05	77.2	11:01
5600	92.8	12:38	90.3	12:20	87.9	12:04	85.7	11:54	84.0	11:51
6000	100.1	13:28	97.4	13:10	94.7	12:53	92.3	12:43	90.7	12:41
6400	107.7	14:17	104.7	13:58	101.8	13:42	99.4	13:33	98.0	13:30
6800	115.3	15:06	112.0	14:47	109.0	14:31	106.5	14:22	105.4	14:20
7200	123.1	15:55	119.5	15:36	116.3	15:20	113.9	15:11	113.1	15:10
7600	131.0	16:43	127.2	16:24	123.8	16:09	121.5	16:01	121.3	16:00
8000	138.9	17:31	134.8	17:12	131.3	16:58	129.2	16:50	129.4	16:50

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Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1,000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)					
	160	180	200	220	240	260
10	–1.0	–0.5	0.0	0.6	1.3	1.9
20	–2.1	–1.0	0.0	1.1	2.3	4.0
30	–3.1	–1.6	0.0	1.7	3.8	6.7
40	–4.2	–2.2	0.0	2.4	5.5	9.8
50	–5.4	–2.8	0.0	3.3	7.5	13.5
60	–6.5	–3.3	0.0	4.3	9.9	17.8
70	–7.6	–3.9	0.0	5.4	12.6	22.5
80	–8.8	–4.5	0.0	6.7	15.6	27.8
90	–9.9	–5.1	0.0	8.1	19.0	33.7
100	–11.1	–5.7	0.0	9.6	22.6	40.1
110	–12.3	–6.2	0.0	11.3	26.6	47.0
120	–13.5	–6.8	0.0	13.1	30.9	54.4
130	–14.7	–7.4	0.0	15.0	35.5	62.4
140	–15.9	–8.0	0.0	17.1	40.4	70.9
150	–17.1	–8.6	0.0	19.4	45.7	80.0

Based on 310/.84 climb, Long Range Cruise and .84/310/250 descent.

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Long Range Cruise Step Climb
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
1040	981	928	881	839	800	765	732	703	675	650
1545	1461	1386	1318	1256	1200	1149	1102	1058	1018	981
2050	1941	1843	1754	1673	1600	1533	1471	1414	1361	1312
2555	2421	2300	2190	2091	2000	1917	1840	1769	1704	1643
3060	2900	2757	2626	2508	2400	2301	2209	2125	2047	1974
3564	3380	3213	3063	2925	2800	2685	2579	2481	2390	2306
4068	3859	3670	3499	3343	3200	3069	2948	2837	2733	2637
4572	4338	4127	3935	3760	3600	3453	3318	3193	3077	2969
5076	4817	4583	4371	4177	4000	3837	3687	3549	3420	3300
5580	5296	5039	4807	4594	4400	4221	4057	3905	3763	3632
6083	5775	5496	5242	5011	4800	4606	4426	4261	4107	3964
6587	6253	5952	5678	5429	5200	4990	4796	4617	4450	4296
7090	6732	6408	6114	5846	5600	5374	5166	4973	4794	4628
7593	7210	6864	6550	6263	6000	5758	5536	5329	5138	4960
8095	7688	7320	6985	6680	6400	6143	5905	5686	5482	5292
8598	8166	7776	7421	7097	6800	6527	6275	6042	5826	5624
9100	8644	8231	7856	7514	7200	6911	6645	6398	6169	5956
9602	9122	8687	8292	7931	7600	7296	7015	6755	6513	6289
10104	9599	9142	8727	8348	8000	7680	7385	7111	6858	6621

Trip Fuel and Time Required

AIR DIST (NM)	TRIP FUEL (1000 KG) LANDING WEIGHT (1000 KG)											TIME (HRS:MIN)
	160	170	180	190	200	210	220	230	240	250	260	
800	10.4	10.8	11.2	11.6	12.2	12.6	13.0	13.4	13.9	14.5	14.9	1:50
1200	14.8	15.3	15.9	16.6	17.4	18.0	18.6	19.3	20.1	20.9	21.4	2:40
1600	19.2	20.0	20.8	21.7	22.8	23.6	24.4	25.3	26.4	27.4	28.1	3:30
2000	23.7	24.7	25.7	27.0	28.2	29.2	30.3	31.5	32.9	34.0	35.0	4:20
2400	28.3	29.5	30.8	32.3	33.7	35.0	36.3	37.9	39.4	40.8	42.0	5:10
2800	33.0	34.4	36.0	37.7	39.4	40.9	42.6	44.3	46.0	47.7	49.2	5:59
3200	37.8	39.4	41.3	43.2	45.1	46.9	48.9	50.9	52.8	54.8	56.6	6:49
3600	42.6	44.6	46.7	48.9	51.1	53.2	55.4	57.6	59.8	62.0	64.1	7:38
4000	47.6	49.9	52.2	54.6	57.1	59.6	62.0	64.4	66.9	69.5	71.8	8:28
4400	52.8	55.3	57.9	60.5	63.4	66.0	68.7	71.4	74.2	77.1	79.6	9:17
4800	58.0	60.8	63.6	66.6	69.8	72.6	75.5	78.6	81.7	84.8	87.6	10:06
5200	63.4	66.4	69.5	72.8	76.2	79.3	82.5	85.9	89.4	92.7	95.7	10:56
5600	68.8	72.1	75.5	79.2	82.8	86.2	89.7	93.5	97.2	100.7	104.1	11:45
6000	74.4	77.9	81.7	85.7	89.6	93.2	97.1	101.1	105.1	109.0	112.7	12:34
6400	80.0	83.9	88.0	92.3	96.4	100.5	104.7	109.0	113.2	117.4	121.4	13:23
6800	85.8	90.0	94.5	99.0	103.5	107.9	112.4	116.9	121.5	126.0	130.3	14:12
7200	91.7	96.4	101.1	105.8	110.7	115.5	120.2	125.0	129.9	134.8	139.5	15:01
7600	97.8	102.8	107.8	112.8	118.1	123.2	128.2	133.4	138.6	143.9	148.8	15:50
8000	104.1	109.3	114.6	120.1	125.7	131.0	136.4	141.9	147.6	153.1	158.3	16:39

Based on 310/.84 climb, LRC and .84/310/250 descent.
Valid for all pressure altitudes with 4000 ft step climb to 2000 ft above optimum altitude.

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Short Trip 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
96	81	70	62	55	50	46	42	39	36	34
160	143	129	118	108	100	93	87	82	77	73
224	204	187	173	161	150	141	133	125	119	113
287	264	244	227	213	200	189	178	169	161	154
348	323	301	282	265	250	237	225	214	204	195
410	382	357	336	317	300	285	271	259	247	237
471	440	414	390	369	350	333	317	303	290	279
533	499	470	444	421	400	381	364	348	334	320
595	559	527	499	473	450	429	410	393	376	362
660	620	585	554	525	500	477	456	437	419	403

Trip Fuel and Time Required

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG) 160	180	200	220	240	260	TIME (HRS:MIN)
50	FUEL (1000 KG) ALT (FT)	1.7 11000	1.8 11000	1.9 9000	2.0 9000	2.1 7000	2.2 5000	0:14
100	FUEL (1000 KG) ALT (FT)	2.5 15000	2.6 15000	2.8 13000	2.9 13000	3.1 13000	3.2 13000	0:22
150	FUEL (1000 KG) ALT (FT)	3.3 23000	3.4 23000	3.6 23000	3.8 21000	4.0 21000	4.2 21000	0:30
200	FUEL (1000 KG) ALT (FT)	3.9 29000	4.1 27000	4.4 27000	4.6 27000	4.9 25000	5.1 23000	0:36
250	FUEL (1000 KG) ALT (FT)	4.5 37000	4.8 31000	5.1 29000	5.4 29000	5.7 27000	6.0 29000	0:42
300	FUEL (1000 KG) ALT (FT)	5.1 43000	5.4 39000	5.8 37000	6.1 37000	6.5 35000	6.8 33000	0:48
350	FUEL (1000 KG) ALT (FT)	5.6 43000	6.0 41000	6.4 39000	6.8 37000	7.2 35000	7.6 33000	0:54
400	FUEL (1000 KG) ALT (FT)	6.1 43000	6.6 41000	7.0 39000	7.5 37000	7.9 35000	8.4 33000	1:00
450	FUEL (1000 KG) ALT (FT)	6.6 43000	7.1 41000	7.7 39000	8.2 37000	8.7 35000	9.2 35000	1:06
500	FUEL (1000 KG) ALT (FT)	7.1 43000	7.7 41000	8.3 39000	8.8 37000	9.4 35000	10.0 35000	1:13

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Holding Planning
Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)									
	PRESSURE ALTITUDE (FT)									
	1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
360	9490	9380	9290	9600	9920	10280	10770			
340	8960	8880	8770	8910	9320	9600	9950			
320	8440	8360	8250	8260	8720	8910	9200			
300	7930	7840	7730	7700	8040	8270	8540			
280	7430	7330	7220	7180	7340	7660	7890			
260	6940	6830	6710	6660	6690	7070	7250	7490		
240	6490	6360	6210	6140	6140	6390	6610	6810		
220	6070	5920	5740	5660	5640	5710	6000	6170		
200	5670	5500	5310	5230	5170	5150	5390	5540	5850	
180	5270	5110	4900	4820	4730	4780	4700	4930	5180	
160	5010	4840	4630	4520	4410	4340	4320	4360	4540	4670

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR)				
	PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
360	10360	10330	10290	10380	10610
340	9740	9690	9630	9670	9890
320	9140	9080	9020	9030	9220
300	8560	8490	8420	8420	8570
280	7980	7920	7820	7810	7900
260	7430	7340	7230	7220	7270
240	6890	6780	6660	6630	6660
220	6390	6250	6110	6060	6060
200	5910	5750	5580	5500	5480
180	5460	5280	5090	4990	4940
160	5120	4950	4730	4620	4550

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DELETION

Crew Oxygen Requirements

Table 1

NUMBER OF CREW	OXYGEN REQUIRED (LITERS)
2	660
3	990
4	1320

Table 2

NUMBER OF CREW	OXYGEN REQUIRED FOR LEVEL OFF AT 14000 FT (LITERS)			
	TOTAL POST DECOMPRESSION TIME (HR)			
	2	3	4	5
2	660	960	1270	1570
3	980	1440	1900	2360
4	1310	1920	2530	3140

Table 3

NUMBER OF CREW	ADDITIONAL LITERS REQUIRED FOR EACH MINUTE HELD AT INTERMEDIATE ALTITUDE OTHER THAN 14000 FT				
	INTERMEDIATE PRESSURE ALTITUDE (FT)				
	UP TO 13999	14000	14001 TO 17999	18000 TO 21999	22000 TO 25000
	REGULATOR ON "NORMAL" OR (100%)				
2	0 (22)	0 (17)	1 (16)	3 (12)	6 (10)
3	0 (33)	0 (25)	2 (24)	5 (18)	8 (15)
4	0 (44)	0 (34)	2 (32)	6 (24)	11 (20)

For more extensive than normal crew usage, add 2.05 liters/person/minute for each crew member at 8,000 ft cabin altitude when regulator setting is NORMAL; or 13 liters/person/minute when regulator setting is 100%.

Instructions:

1. Determine protective breathing requirements from Table 1.
2. Determine supplemental requirements for level off at 14,000 ft from Table 2 and correct for level off altitudes other than 14,000 ft using Table 3.
3. Flight crew system oxygen requirement are the larger of protective breathing (Table 1) or supplemental requirements (Table 2).

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Crew Oxygen Requirements

Table 4—Cylinder Volume to Pressure Conversion

OXYGEN VOLUME (1000 LITERS)	CYLINDER PRESSURE AT 21 deg. C (PSI)
0.1	200
0.3	300
0.5	400
0.7	500
0.8	600
1.0	700
1.2	800
1.4	900
1.5	1000
1.7	1100
1.9	1200
2.1	1300
2.2	1400
2.4	1500
2.6	1600
2.7	1700
2.9	1800
3.1	1900
3.3	2000
Check maximum pressure in shaded area. Maximum cylinder pressure = 1,850 PSI at 21 deg. C. For maximum cylinder pressure at hotter or colder temperature, add or subtract 32 PSI per 5 deg. C respectively.	

Table 5—Temperature Corrections

CYLINDER PRESSURE AT 21 deg. C (PSI)	PRESSURE CORRECTION FOR EACH 5 deg. C ABOVE/BELOW 21 deg. C (PSI)
400	7/–7
600	11/–11
800	14/–14
1000	17/–17
1200	21/–21
1400	24/–24
1600	28/–28
1800	31/–31
2000	34/–34

Passenger Oxygen Requirements

Minimum passenger oxygen supply pressure for dispatch is 1,650 psi. If the passenger oxygen supply pressure is less than 1,650 psi, consult oxygen duration chart below to determine if the oxygen quantity is adequate for the intended flight.

Data is provided to determine minimum oxygen cylinder pressure dispatch requirement. Table 1 shows oxygen quantity required to complete an emergency descent to 14,000 ft, level off and continue for the duration of the post decompression time period to 10,000 ft. The minimum oxygen quantity required for a particular flight is obtained by entering Table 1 with the total number of passenger cabin occupants and planned cruise altitude, and reading oxygen volume required for the projected post decompression time above 10,000 ft.

Table 2 shows adjustments which must be applied to the Table 1 values in situations where the minimum enroute altitude after decompression exceeds 14,000 ft. The Table 2 adjustments reflect only the incremental increase in

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oxygen quantity associated with periods of post decompression flight at altitudes above 14,000 ft. Consequently, time spent holding at higher than 14,000 ft must also be included in the total post decompression time used in Table 1.

After determining the total volume (liters) required from Tables 1 and 2, isolate the passenger oxygen system cylinder configuration on the Cylinder Volume to Pressure Conversion table and read dispatch pressure required. Adjust this reading for cylinder temperature as required, using the adjustments given.

Normally, emergency descent should be carried out to FL 140 or below if terrain permits.

Minimum decompression time (10 min) approximates direct descent to FL 100.

Passenger oxygen system does not close automatically. To stop the flow, system should be reset when cabin altitude is below 12,000 ft.

If during post decompression cruise oxygen is needed after the passenger system supply becomes empty, the portable oxygen bottles shall be used.

DO NOT DEPLOY PASSENGER OXYGEN MASKS WITH CABIN ALTITUDE ELOW 14,000 FT WHEN SMOKE OR AN ABNORMAL HEAT SOURCE IS PRESENT. THE USE OF PASSENGER OXYGEN MASKS MAY INCREASE THE POSSIBILITY OR SEVERITY OF CABIN FIRE AND WILL NOT PREVENT PASSENGER FROM INHALING SMOKE.

Table 1—Oxygen Quantity Required

NUMBER OF OCCUPANTS IN PASSENGER CABIN	TOTAL POST DECOMPRESSION TIME (hour)	PRESSURE ALTITUDE AT DECOMPRESSION (ft)				
		27000	31000	35000	39000	43000
		LITER REQUIRED				
100	0.17*	1280	1410	1630	1860	1990
	1	1680	1900	2200	2520	2720
	2	2340	2560	2860	3180	3380
	3	3000	3220	3520	3840	4040
200	0.17*	2550	2800	3200	3620	3870
	1	3350	3780	4340	4940	5230
	2	4670	5100	5660	6260	6640
	3	5990	6420	6980	7580	7960
300	0.17*	3810	4180	4770	5380	5750
	1	5010	5660	6480	7360	7930
	2	6990	7640	8460	9340	9910
	3	8970	9620	10440	11320	11890
400	0.17*	5070	5570	6340	7140	7620
	1	6680	7540	8620	9780	10530
	2	9320	10180	11260	12420	13170
	3	11960	12820	13900	15060	15810

Total post decompression time includes descent, level-off at intermediate altitude (if applicable) and flight at final level-off altitude.
Time to shut down 90% of masks at or below 14,000 ft pressure altitude is 11 minutes.
***Minimum post decompression time (10 min) approximates direct descent to 10,000 ft pressure altitude.**

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Table 2—Additional Oxygen Required

NUMBER OF OCCUPANTS IN PASSENGER CABIN	ADDITIONAL OXYGEN REQUIRED (Liters Per Minute above 14000 ft Pressure Altitude)			
	INTERMEDIATE PRESSURE ALTITUDE			
	15000**	17000	21000	25000
100	33	120	165	230
200	66	240	330	460
300	99	360	495	690
400	132	480	660	920
Total oxygen quantity required is: **Emergency descent and level-off at or below 14,000 ft pressure altitude (from table 1) plus cruise above 14,000 ft pressure altitude (from table 2).** ****30% of cabin occupants using oxygen.**				

Table 3—Cylinder Volume to Pressure Conversion

CYLINDER PRESSURE AT 21 deg. C (PSI)	OXYGEN VOLUME (1000 liters)
100	.1
200	1.3
300	2.6
400	3.8
500	5.0
600	6.2
700	7.4
800	8.6
900	9.8
1000	11.1
1100	12.3
1200	13.5
1300	14.7
1400	15.9
1500	17.1
1600	18.3
1700	19.5
1800	20.8
1900	22.0
2000	23.2
Check maximum pressure in shaded area. Maximum cylinder pressure = 1,850 PSI at 21 deg. C. For maximum cylinder pressure at hotter or colder temperatures, add or subtract 32 PSI per 5 deg. C, respectively.	

Table 4—Temperature Corrections

CYLINDER PRESSURE AT 21 deg. C (PSI)	PRESSURE CORRECTION FOR EACH 5 deg. C ABOVE/BELOW 21 deg. C (PSI)
400	7/–7
600	11/–11
800	14/–14
1000	17/–17
1200	21/–21
1400	24/–24
1600	28/–28
1800	31/–31
2000	34/–34

Example:

300 occupants (passengers and cabin crew), ambient temperature 31 deg. C, cruise at 39,000 ft.

Question:

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Minimum supply pressure based on 3 hr. post decompression and 5 minutes level off at FL 170 due to high terrain.

Solution:

1. from table 1, oxygen required is 11,320 ltr
2. from table 2, additional oxygen required for intermediate level off at FL 170 for 5 minutes = 360 × 5 = 1,800 ltr
3. total oxygen required = 11,320 + 1,800 = 13,120 ltr
4. from Cylinder Volume to Pressure Conversion Table, the required oxygen supply pressure at 21 deg. C is approximately 1,168 psi
5. additional oxygen pressure required due to temperature correction = (31–21) deg C × 20.36 psi per 5 deg C = 40.7 psi
6. total oxygen supply pressure for dispatch = 1,208.7 psi.

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ENGINE INOP

MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
30	181.1	179.2	173.7
28	195.4	191.0	184.0
26	210.7	205.0	197.4
24	227.1	219.9	212.1
22	244.3	236.6	228.1
20	268.7	262.0	252.1
18	291.1	282.3	271.4
16	315.5	304.7	292.9
14	337.0	324.3	311.2
12	358.8	345.0	331.5
10	378.0	363.8	348.4

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG) PRESSURE ALTITUDE (1000 FT)								
	14	16	18	20	22	24	26	28	30
ENGINE ONLY	–0.7	–0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINE AND WING	–2.6	–1.8	–1.5	–1.0	–1.2	–1.2	–1.2	–1.3	–1.2

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ALL ENGINES

Decompression Critical Fuel Reserves—LRC Cruise
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
282	261	242	226	212	200	189	179	170	162	155
565	522	485	453	425	400	378	358	340	324	310
847	783	727	679	637	600	567	537	511	486	464
1130	1044	970	906	850	800	756	716	681	649	619
1412	1304	1212	1132	1062	1000	945	895	851	811	774
1694	1565	1455	1359	1274	1200	1134	1075	1021	973	929
1977	1826	1697	1585	1487	1400	1323	1254	1191	1135	1084
2259	2087	1939	1811	1699	1600	1512	1433	1362	1297	1239
2541	2348	2182	2038	1912	1800	1701	1612	1532	1459	1393
2824	2609	2424	2264	2124	2000	1890	1791	1702	1622	1548
3106	2870	2667	2491	2336	2200	2079	1970	1872	1784	1703
3389	3131	2909	2717	2549	2400	2268	2149	2042	1946	1858
3671	3392	3152	2943	2761	2600	2457	2328	2213	2108	2013
3953	3652	3394	3170	2973	2800	2646	2507	2383	2270	2168
4236	3913	3637	3396	3186	3000	2835	2687	2553	2432	2322

Critical Fuel (1,000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)									
	180	200	220	240	260	280	300	320	340	360
200	4.4	4.6	4.9	5.1	5.3	5.5	5.7	5.9	6.1	6.3
400	8.1	8.4	8.8	9.2	9.6	9.9	10.3	10.6	10.9	11.3
600	11.7	12.2	12.7	13.2	13.8	14.3	14.8	15.3	15.8	16.3
800	15.4	16.0	16.6	17.3	18.0	18.6	19.3	19.9	20.5	21.2
1000	19.0	19.8	20.6	21.4	22.2	23.0	23.7	24.5	25.3	26.1
1200	22.6	23.4	24.4	25.4	26.4	27.3	28.2	29.1	30.0	31.0
1400	26.1	27.1	28.2	29.3	30.4	31.6	32.6	33.6	34.7	35.8
1600	29.6	30.8	32.0	33.2	34.5	35.8	37.0	38.1	39.3	40.6
1800	33.1	34.4	35.8	37.2	38.6	40.0	41.3	42.6	43.9	45.3
2000	36.6	38.1	39.6	41.1	42.6	44.2	45.7	47.1	48.5	50.0
2200	40.0	41.6	43.3	44.9	46.6	48.3	50.0	51.5	53.1	54.7
2400	43.4	45.1	46.9	48.7	50.5	52.4	54.2	55.9	57.6	59.3
2600	45.8	48.7	50.6	52.5	54.5	56.4	58.4	60.2	62.0	63.9
2800	50.2	52.2	54.2	56.3	58.4	60.5	62.6	64.5	66.5	68.5
3000	53.6	55.7	57.9	60.1	62.3	64.6	66.8	68.9	71.0	73.1

Based on: Emergency descent to 10,000 ft, level cruise at 10,000 ft, 250 KIAS descent to 1,500 ft, 15 minutes hold at 1,500 ft, approach and land. Allowance for performance deterioration not included.

Adjustments:

- **increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors**
- **increase fuel required 0.7% per 10 deg. C above ISA**
- **when icing conditions are forecast, use the greater of engine and wing anti-ice on (3%) for the total forecast time or engine and wing anti-ice on and ice drag (8%) for 10% of the forecast time.**

Compare the critical fuel reserves required for all engine cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

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ENGINE INOP

Decompression Critical Fuel Reserves—LRC Cruise
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
283	262	243	227	213	200	189	179	170	162	155
570	526	487	454	425	400	377	357	339	323	308
857	790	732	682	638	600	566	536	508	484	462
1144	1053	976	909	851	800	755	714	678	645	615
1431	1317	1221	1137	1064	1000	943	892	847	806	769
1718	1581	1465	1365	1277	1200	1132	1071	1016	967	922
2005	1845	1709	1592	1490	1400	1320	1249	1185	1128	1075
2292	2109	1954	1820	1703	1600	1509	1428	1355	1289	1229
2579	2373	2198	2047	1916	1800	1697	1606	1524	1450	1382
2866	2637	2443	2275	2129	2000	1886	1784	1693	1611	1536
3153	2901	2687	2502	2342	2200	2075	1963	1862	1772	1689
3440	3165	2932	2730	2554	2400	2263	2141	2032	1933	1843
3727	3429	3176	2958	2767	2600	2452	2320	2201	2094	1996
4014	3693	3421	3185	2980	2800	2640	2498	2370	2255	2150
4300	3957	3665	3413	3193	3000	2829	2676	2539	2416	2303

Critical Fuel (1,000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)									
	180	200	220	240	260	280	300	320	340	360
200	4.2	4.5	4.8	5.1	5.3	5.5	5.8	6.0	6.3	6.5
400	7.8	8.3	8.8	9.3	9.7	10.2	10.6	11.1	11.5	11.9
600	11.4	12.0	12.7	13.4	14.0	14.7	15.4	16.0	16.6	17.2
800	14.9	15.8	16.7	17.5	18.4	19.2	20.0	20.9	21.7	22.5
1000	18.5	19.6	20.6	21.7	22.7	23.7	24.7	25.7	26.7	27.6
1200	21.9	23.2	24.5	25.7	27.0	28.2	29.3	30.6	31.7	32.8
1400	25.2	26.7	28.3	29.7	31.1	32.5	33.9	35.3	36.6	38.0
1600	28.6	30.3	32.0	33.7	35.2	36.8	38.4	39.9	41.5	43.0
1800	32.0	33.9	35.8	37.6	39.4	41.1	42.8	44.6	46.3	48.0
2000	35.4	37.4	39.5	41.6	43.5	45.4	47.3	49.3	51.2	53.0
2200	38.6	40.9	43.2	45.4	47.5	49.6	51.7	53.8	55.9	57.9
2400	41.8	44.2	46.7	49.1	51.5	53.7	56.0	58.3	60.5	62.7
2600	45.0	47.6	50.3	52.9	55.4	57.9	60.3	62.8	65.2	67.6
2800	48.2	51.0	53.9	56.7	59.4	62.0	64.6	67.2	69.9	72.4
3000	51.3	54.3	57.4	60.4	63.3	66.1	68.8	71.6	74.4	77.1

Based on: Emergency descent to 10,000 ft, level cruise at 10,000 ft, 250 KIAS descent to 1,500 ft, 15 minutes hold at 1,500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

Adjustments:

- **increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors**
- **increase fuel required 0.7% per 10 deg. C above ISA**
- **when icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (10%) for 10% of the forecast time.**

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

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ENGINE INOP

Driftdown Critical Fuel Reserves—LRC Driftdown/Cruise 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
261	246	232	220	209	200	191	182	175	168	162
523	492	465	441	419	400	381	365	350	336	323
786	740	699	662	629	600	572	547	525	504	484
1050	988	933	884	840	800	763	730	699	671	645
1316	1237	1168	1106	1050	1000	954	912	874	838	806
1582	1487	1403	1328	1260	1200	1144	1094	1048	1005	966
1848	1737	1638	1550	1471	1400	1335	1276	1222	1172	1126
2116	1987	1874	1772	1682	1600	1525	1457	1395	1338	1286
2383	2238	2110	1995	1892	1800	1715	1639	1569	1505	1445
2651	2489	2346	2218	2103	2000	1906	1820	1742	1671	1605
2920	2740	2582	2440	2314	2200	2096	2002	1916	1837	1764
3188	2992	2818	2663	2524	2400	2286	2183	2089	2003	1924
3457	3243	3054	2886	2735	2600	2477	2365	2263	2169	2083
3726	3494	3290	3109	2946	2800	2667	2546	2436	2335	2242
3994	3746	3526	3331	3157	3000	2857	2728	2610	2501	2401

Critical Fuel (1,000 KG)

AIR DISTANCE (NM)	WEIGHT AT CRITICAL POINT (1000 KG)									
	180	200	220	240	260	280	300	320	340	360
200	4.9	5.2	5.4	5.6	5.8	6.0	6.3	6.4	6.7	7.0
400	7.9	8.4	8.9	9.4	9.9	10.3	10.8	11.3	11.9	12.5
600	10.6	11.4	12.3	13.0	13.7	14.4	15.2	16.0	16.9	17.8
800	13.4	14.5	15.5	16.5	17.5	18.5	19.5	20.6	21.8	23.0
1000	16.1	17.4	18.8	20.0	21.3	22.5	23.8	25.1	26.6	28.1
1200	18.7	20.3	21.9	23.5	25.0	26.5	28.0	29.6	31.4	33.1
1400	21.3	23.2	25.1	26.9	28.6	30.4	32.2	34.0	36.1	38.1
1600	23.9	26.0	28.1	30.2	32.2	34.3	36.3	38.4	40.7	43.0
1800	26.5	28.8	31.2	33.5	35.8	38.1	40.4	42.7	45.3	47.9
2000	29.0	31.6	34.2	36.8	39.3	41.9	44.4	47.0	49.8	52.7
2200	31.5	34.3	37.2	40.0	42.8	45.6	48.3	51.2	54.3	57.4
2400	33.9	37.0	40.1	43.2	46.3	49.3	52.3	55.4	58.7	62.1
2600	36.3	39.7	43.0	46.4	49.7	53.0	56.2	59.5	63.1	66.7
2800	38.7	42.3	45.9	49.5	53.1	56.6	60.0	63.6	67.5	71.3
3000	41.1	44.9	48.7	52.6	56.4	60.2	63.8	67.6	71.7	75.8

Based on: Driftdown to and cruise at level off altitude, 250 KIAS descent to 1,500 ft, 15 minutes hold at 1,500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

Adjustments:

- **increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is useused; otherwise, increase diversion fuel by 5% to account for wind errors**
- **increase fuel required 0.7% per 10 deg. C above ISA**
- **when icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (12%) for 10% of the forecast time.**

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

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Landing Field Limit Weight—Dry Runway
Flaps 30
Wind Adjusted Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	−15	−10	−5	0	10	20	30	40
1200		1010	1100	1200	1240	1270	1310	1350
1400	1090	1170	1280	1400	1460	1500	1560	1620
1600	1230	1340	1460	1600	1670	1730	1810	1890
1800	1380	1500	1640	1800	1890	1960	2060	2150
2000	1520	1660	1820	2000	2100	2190	2300	2420
2200	1670	1830	2000	2200	2320	2420	2550	2680
2400	1810	1990	2180	2400	2530	2640	2800	2950
2600	1960	2150	2360	2600	2740	2870	3050	3220
2800	2110	2320	2540	2800	2960	3100	3300	3480
3000	2250	2480	2720	3000	3170	3330	3540	3750
3200	2400	2650	2900	3200	3390	3560	3790	4010
3400	2540	2810	3080	3400	3600	3790	4040	4280
3600	2690	2970	3260	3600	3820	4020	4290	4550
3800	2830	3140	3440	3800	4030	4250	4540	4810
4000	2980	3300	3620	4000	4250	4480	4780	5080
4200	3120	3460	3800	4200	4460	4710	5030	5350
4400	3270	3630	3980	4400	4680	4940	5280	5610
4600	3410	3790	4160	4600	4890	5170	5530	5880
4800	3560	3950	4340	4800	5110	5400	5780	
5000	3710	4120	4520	5000	5320	5630		

Field Limit Weight (1,000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1400	182.6	171.4	160.6	150.2	
1600	219.0	205.3	192.6	180.5	168.9
1800	257.1	241.2	225.9	211.4	197.8
2000	292.9	277.6	260.3	243.8	228.0
2200	309.3	301.3	292.8	276.6	258.8
2400	321.9	313.1	305.0	297.0	287.1
2600	334.6	324.5	315.2	307.0	298.8
2800	347.8	336.0	325.7	316.1	307.8
3000	361.9	348.0	336.2	325.8	316.0
3200	373.7	361.1	347.0	335.3	324.7
3400	385.1	371.8	359.1	344.2	333.4
3600		382.1	368.9	356.2	341.5
3800			378.2	365.1	352.3
4000			387.4	373.6	360.5
4200				381.9	368.3
4400					375.9
4600					383.5

With manual speedbrakes, decrease weight by 21,700 kg.
With 1 brake deactivated, decrease weight by 22,800 kg.
With 2 brakes deactivated, decrease weight by 46,300 kg.

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Landing Field Limit Weight—Wet Runway
Flaps 30
Wind Adjusted Field Length (M)

FIELD LENGTH AVAILABLE (M)	WIND COMPONENT (KTS)							
	–15	–10	–5	0	10	20	30	40
1200				1200	1240	1250	1280	1320
1400		1180	1280	1400	1450	1480	1530	1580
1600	1240	1340	1460	1600	1660	1710	1780	1850
1800	1390	1500	1640	1800	1880	1940	2030	2120
2000	1530	1670	1820	2000	2090	2170	2280	2380
2200	1680	1830	2000	2200	2310	2400	2520	2650
2400	1830	2000	2180	2400	2520	2630	2770	2910
2600	1970	2160	2360	2600	2740	2860	3020	3180
2800	2120	2320	2540	2800	2950	3090	3270	3450
3000	2260	2490	2720	3000	3170	3320	3520	3710
3200	2410	2650	2900	3200	3380	3550	3760	3980
3400	2550	2810	3080	3400	3600	3780	4010	4240
3600	2700	2980	3260	3600	3810	4000	4260	4510
3800	2840	3140	3440	3800	4030	4230	4510	4780
4000	2990	3300	3620	4000	4240	4460	4760	5040
4200	3130	3470	3800	4200	4450	4690	5000	5310
4400	3280	3630	3980	4400	4670	4920	5250	5580
4600	3430	3800	4160	4600	4880	5150	5500	5840
4800	3570	3960	4340	4800	5100	5380	5750	6110
5000	3720	4120	4520	5000	5310	5610	6000	6370

Field Limit Weight (1,000 KG)

WIND CORRECTED FIELD LENGTH (M)	AIRPORT PRESSURE ALTITUDE (FT)				
	0	2000	4000	6000	8000
1400	150.2				
1600	181.0	169.9	159.2		
1800	212.5	199.3	187.0	175.2	163.9
2000	245.5	230.2	215.6	201.8	189.0
2200	278.9	261.7	245.3	229.7	214.7
2400	300.6	291.9	275.4	258.0	241.3
2600	313.3	305.3	297.4	286.2	268.3
2800	324.1	315.0	306.9	298.8	289.4
3000	335.2	325.0	315.6	307.4	299.2
3200	346.4	335.1	324.8	315.3	307.0
3400	359.3	344.9	334.0	323.7	314.3
3600	369.7	357.2	342.6	332.0	321.7
3800	379.7	366.8	354.2	340.0	329.3
4000		375.9	363.0	349.6	336.6
4200		384.8	371.4	358.5	343.5
4400			379.4	366.3	353.4
4600			387.4	373.6	360.5
4800				380.8	367.3
5000				388.0	373.9
5200					380.5
5400					387.1

With manual speedbrakes, decrease weight by 21700 kg.
With 1 brake deactivated, decrease weight by 22800 kg.
With 2 brakes deactivated, decrease weight by 46300 kg.

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Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
(deg. C)	(deg. F)	–2000	0	2000	4000	6000	8000
54	129	304.9	284.8				
52	126	313.0	291.7				
50	122	321.0	299.0	274.7			
48	118	329.1	307.4	281.2			
46	115	337.3	315.9	288.2	265.3		
44	111	345.2	323.9	295.9	272.2		
42	108	352.5	332.1	304.6	278.8	255.6	
40	104	359.7	340.5	312.9	285.6	261.5	
38	100	366.9	349.0	320.7	292.2	267.2	237.5
36	97	373.4	356.3	327.9	298.5	272.1	242.3
34	93	378.7	363.3	335.4	304.7	276.5	247.0
32	90	378.7	370.4	341.7	310.6	280.5	251.3
30	86	378.7	376.6	347.1	317.1	284.8	255.1
28	82	378.7	376.7	351.7	322.0	289.4	258.9
26	79	378.7	376.8	357.1	325.9	294.0	262.5
24	75	378.7	376.9	357.2	329.0	298.9	266.5
22	72	378.7	377.0	357.3	332.2	302.2	270.7
20	68	378.7	377.1	357.3	332.3	304.3	274.3
18	64	378.7	377.2	357.4	332.4	306.4	276.8
16	61	378.7	377.3	357.5	332.4	306.4	278.6
14	57	378.7	377.3	357.6	332.5	306.5	280.1
12	54	378.7	377.4	357.7	332.6	306.5	280.2
10	50	378.7	377.4	357.7	332.7	306.6	280.3
8	46	378.7	377.5	357.8	332.7	306.6	280.3
6	43	378.7	377.5	357.8	332.8	306.6	280.2
4	40	378.7	377.5	354.6	320.5	293.0	258.9
2	36	378.7	377.6	354.6	320.5	293.0	258.9
0	32	378.7	377.6	354.7	320.6	293.0	259.0
–40	–40	378.7	377.7	354.6	320.6	293.0	259.0

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.
With engine bleed for packs off, increase weight by 1350 kg.
With engine and wing anti-ice on, decrease weight by 2200 kg.
When operating in icing conditions during any part of the flight with forecast landing temperature below 10 deg. C, decrease weight by 21950 kg.

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ENGINE INOP

ADVISORY INFORMATION

Go-Around Climb Gradient
Flaps 20, Gear Up
Based on engine bleed for packs on or off, engine anti-ice on or off and wing anti-ice off.

OAT (deg. C)	REFERENCE GO-AROUND GRADIENT (%) PRESSURE ALTITUDE (FT)					
	–2,000	0	2000	4000	6000	8000
54	6.24	5.26	4.08			
50	7.02	6.00	4.72	3.63	2.62	1.26
46	7.84	6.81	5.46	4.24	3.15	1.74
42	8.61	7.64	6.25	4.96	3.73	2.24
38	9.35	8.47	7.01	5.63	4.32	2.76
34	9.80	9.22	7.70	6.22	4.79	3.25
30	9.81	9.82	8.23	6.76	5.23	3.66
26	9.83	9.83	8.68	7.19	5.73	4.05
22	9.85	9.83	8.68	7.49	6.07	4.48
18	9.87	9.84	8.69	7.50	6.29	4.78
14	9.89	9.85	8.70	7.50	6.29	4.97
10	9.90	9.86	8.70	7.50	6.29	4.97

Weight Adjustment

WEIGHT (1000 KG)	REFERENCE GO-AROUND GRADIENT (%)										
	0	1	2	3	4	5	6	7	8	9	10
360	–3.07	–3.51	–3.94	–4.39	–4.79	–5.22	–5.64	–6.06	–6.46	–6.88	–7.26
340	–2.79	–3.19	–3.58	–3.99	–4.35	–4.74	–5.12	–5.49	–5.86	–6.23	–6.58
320	–2.50	–2.85	–3.19	–3.55	–3.86	–4.21	–4.54	–4.87	–5.19	–5.52	–5.83
300	–2.16	–2.46	–2.74	–3.04	–3.30	–3.59	–3.87	–4.14	–4.41	–4.70	–4.96
280	–1.75	–1.98	–2.20	–2.43	–2.63	–2.86	–3.07	–3.29	–3.50	–3.72	–3.91
260	–1.23	–1.39	–1.54	–1.69	–1.82	–1.98	–2.12	–2.27	–2.41	–2.57	–2.71
240	–0.58	–0.65	–0.72	–0.79	–0.85	–0.92	–0.99	–1.05	–1.12	–1.19	–1.26
225	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
220	0.23	0.26	0.28	0.30	0.32	0.35	0.37	0.39	0.42	0.45	0.47
200	1.18	1.32	1.47	1.61	1.74	1.89	2.02	2.17	2.32	2.47	2.61
180	2.19	2.51	2.83	3.11	3.43	3.74	4.04	4.36	4.70	5.03	5.32

Speed Adjustment

SPEED (KIAS)	WEIGHT ADJUSTED GO-AROUND GRADIENT (%)										
	0	1	2	3	4	5	6	7	8	9	10
VREF	–0.22	–0.23	–0.23	–0.23	–0.23	–0.22	–0.22	–0.22	–0.21	–0.21	–0.21
VREF+5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VREF+10	0.08	0.07	0.07	0.07	0.09	0.11	0.12	0.11	0.12	0.10	0.10
VREF+20	0.17	0.14	0.12	0.13	0.16	0.19	0.19	0.17	0.17	0.14	0.13
VREF+30	0.14	0.10	0.08	0.08	0.10	0.05	0.03	0.01	–0.01	–0.07	–0.04

With engine bleed for packs off, increase gradient by 0.1%.
With engine and wing anti-ice on, decrease gradient by 0.1%.
When operating in icing conditions during any part of the flight with forecast landing temperature below 10 deg. C, decrease gradient by 0.7%

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Quick Turnaround Limit Weight
Flaps 30 Limit Weight (1,000 KG)

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	231.5				
50	122	233.0	224.3			
45	113	234.9	226.1	217.6		
40	104	236.8	227.9	219.4	210.9	
35	95	238.8	229.9	221.2	212.7	204.3
30	86	240.9	231.8	223.1	214.6	206.1
25	77	242.9	233.9	225.0	216.5	207.9
20	68	245.1	235.9	227.0	218.4	209.8
15	59	247.3	238.1	229.0	220.3	211.7
10	50	249.5	240.3	231.1	222.3	213.7
5	41	251.9	242.5	233.3	224.3	215.7
0	32	254.3	244.8	235.5	226.4	217.7
–5	23	256.7	247.1	237.8	228.6	219.8
–10	14	259.3	249.5	240.1	230.9	221.9
–15	5	261.9	252.1	242.5	233.2	224.1
–20	–4	264.6	254.7	245.0	235.6	226.4
–30	–22	270.2	260.1	250.2	240.6	231.2
–40	–40	275.9	265.8	255.7	245.9	236.3
–50	–58	282.1	271.9	261.6	251.5	241.7
–54	–65	284.7	274.3	264.1	253.9	243.9

Increase weight by 2,150 kg per 1% uphill slope. Decrease weight by 3,450 kg per 1% downhill slope. Increase weight by 5,950 kg per 10 knots headwind. Decrease weight by 31,550 kg per 10 knots tailwind.
Decrease weight by 12,500 kg when one brake is deactivated. Decrease weight by 25,450 kg when two brakes are deactivated.
After landing at weights exceeding those shown above, adjusted for slope and wind, wait at least 65 minutes and check that wheel thermal plugs have not melted before executing a takeoff.
Alternate procedure:
No sooner than 10 and no later than 15 minutes after parking, check for the BRAKE TEMP advisory message on EICAS. If the message is not displayed, no waiting period is required. If it is displayed, do not dispatch until at lease 65 minutes after landing or until the Brake Temperature Monitoring System (BTMS) readings on the Landing Gear Synoptic Display are all 3.0 or lower. Check that wheel thermal plugs have not melted before making a subsequent takeoff.

Note: If any brake temperature display digit is blank or the BRAKE TEMP SYS status message is displayed, then this alternate procedure cannot be used.

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GEAR DOWN

Takeoff Climb Limit Weight
Flaps 15

AIRPORT OAT		TAKEOFF CLIMB WEIGHT (1000 KG) AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	234.8	224.0	208.0	187.2	
52	126	240.2	223.9	213.9	192.6	
50	122	246.0	225.1	214.8	198.0	171.1
48	118	252.0	230.7	214.7	203.1	176.2
46	115	257.9	236.2	215.8	203.6	181.3
44	111	263.7	241.5	220.8	203.5	186.2
42	108	269.2	246.8	225.7	204.6	188.9
40	104	274.8	252.3	230.8	204.6	188.8
38	100	281.0	258.1	236.2	214.0	189.9
36	97	287.2	263.9	241.7	219.1	194.3
34	93	293.5	269.8	247.3	224.4	198.8
32	90	299.1	275.6	252.8	229.5	203.6
30	86	304.4	281.7	258.4	234.9	208.6
28	82	309.8	287.7	264.1	240.1	213.4
26	79	314.6	293.2	269.3	245.3	218.5
24	75	317.0	298.0	274.1	250.1	223.3
22	72	317.1	302.3	278.5	254.3	228.4
20	68	317.2	304.4	282.3	257.8	232.9
18	65	317.3	304.4	285.8	260.9	236.5
16	61	317.4	304.4	287.5	263.2	239.6
14	58	317.4	304.4	287.5	265.2	242.3
10	50	317.5	304.5	287.4	266.0	245.1
–40	–40	315.7	302.5	284.4	262.7	242.7

With engine bleed for packs off, increase weight by 800 kg.
With engine anti-ice on, decrease weight by 1,800 kg.
With engine and wing anti-ice on, decrease weight by 4,200 kg.

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GEAR DOWN

Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG) AIRPORT PRESSURE ALTITUDE (FT)				
deg. C	deg. F	0	2000	4000	6000	8000
54	129	256.3				
52	126	262.6				
50	122	268.8	247.1			
48	118	275.6	253.2			
46	115	282.7	259.8	239.0		
44	111	289.4	266.9	245.5		
42	108	296.4	273.8	251.4	230.2	
40	104	303.7	280.5	257.6	235.4	
38	100	310.6	286.2	263.3	240.7	213.4
36	97	317.2	292.0	268.4	244.9	217.7
34	93	323.8	298.1	273.0	244.8	222.1
32	90	329.9	303.4	277.6	252.3	225.8
30	86	335.7	308.2	282.4	256.2	229.3
28	82	335.8	312.3	286.6	260.3	232.6
26	79	335.9	316.9	289.9	264.7	235.9
24	75	336.0	316.9	292.3	268.5	239.6
22	72	336.1	317.0	294.9	271.0	243.4
20	68	336.1	317.2	294.9	272.6	246.7
18	64	336.2	317.2	295.0	274.2	248.9
16	61	336.3	317.2	295.0	274.3	250.5
14	57	336.4	317.3	295.1	274.3	251.9
12	54	336.4	317.4	295.1	274.3	252.0
10	50	336.5	317.4	295.1	274.3	252.0
–40	–40	336.7	317.4	295.5	274.6	252.2

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.
With engine bleed for packs off, increase weight by 1,750 kg.
With engine and wing anti-ice on, decrease weight by 1,700 kg.
When operating in icing conditions during any part of the flight with forecast landing temperature below 10 deg. C, decrease weight by 30,650 kg.

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GEAR DOWN

Takeoff Obstacle Limit Weight
Flaps 15
Sea Level, 30 deg. C & Below, Zero Wind
Based on engine bleed for packs on, engine and wing anti-ice off

OBSTACLE HEIGHT (M)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG) DISTANCE FROM BRAKE RELEASE (100 M)										
	25	30	35	40	45	50	55	60	65	70	75
5	293.7										
20	272.9	294.4									
40	253.0	274.0	290.2	302.7							
60	237.9	258.1	274.5	287.6	298.0						
80	225.5	245.1	261.4	274.8	285.7	294.7	302.2				
100	214.9	234.1	250.1	263.6	274.9	284.3	292.2	298.9	304.6	308.3	309.4
120	205.6	224.4	240.3	253.7	265.2	274.9	283.2	290.2	296.3	301.6	306.1
140	197.5	215.8	231.5	244.9	256.4	266.3	274.8	282.2	288.6	294.1	299.1
160	190.2	208.1	223.6	236.9	248.4	258.4	267.1	274.7	281.4	287.2	292.3
180	183.5	201.1	216.4	229.7	241.1	251.2	260.0	267.8	274.6	280.6	286.0
200	177.3	194.8	209.7	222.9	234.4	244.5	253.4	261.2	268.2	274.4	280.0
220	171.7	188.9	203.6	216.7	228.2	238.2	247.2	255.1	262.2	268.6	274.3
240		183.4	198.0	210.9	222.3	232.4	241.4	249.4	256.6	263.0	268.8
260		178.2	192.8	205.4	216.8	226.9	235.9	244.0	251.2	257.7	263.7
280		173.4	187.8	200.4	211.6	221.7	230.7	238.8	246.1	252.7	258.7
300		168.9	183.1	195.6	206.7	216.8	225.8	233.9	241.3	247.9	254.0

Obstacle height must be calculated from lowest point of the runway to conservatively account for runway slope.

OAT Adjustments

OAT (deg. C)	REFERENCE OBSTACLE LIMIT WEIGHT (1000 KG)							
	160	180	200	220	240	260	280	300
30 & BELOW	0	0	0	0	0	0	0	0
32	–2.8	–3.2	–3.6	–4.1	–4.5	–4.9	–5.3	–5.7
34	–5.6	–6.5	–7.3	–8.1	–8.9	–9.7	–10.6	–11.4
36	–8.5	–9.7	–10.9	–12.2	–13.4	–14.6	–15.8	–17.1
38	–11.3	–12.9	–14.6	–16.2	–17.8	–19.5	–21.1	–22.8
40	–14.1	–16.2	–18.2	–20.3	–22.3	–24.4	–26.4	–28.4
42	–16.8	–19.3	–21.8	–24.3	–26.8	–29.2	–31.7	–34.2
44	–19.6	–22.5	–25.4	–28.3	–31.2	–34.1	–37.0	–40.0
46	–22.3	–25.6	–29.0	–32.3	–35.7	–39.0	–42.4	–45.7
48	–25.0	–28.8	–32.6	–36.3	–40.1	–43.9	–47.7	–51.5
50	–27.7	–31.9	–36.1	–40.4	–44.6	–48.8	–53.0	–57.2

Pressure Altitude Adjustments

ALT (FT)	OAT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	160	180	200	220	240	260	280	300
S.L. & BELOW	0	0	0	0	0	0	0	0
1000	–6.9	–7.5	–8.2	–8.9	–9.6	–10.3	–11.0	–11.7
2000	–13.7	–15.1	–16.5	–17.9	–19.3	–20.7	–22.1	–23.5
3000	–19.5	–21.7	–23.8	–26.0	–28.1	–30.3	–32.4	–34.6
4000	–25.3	–28.2	–31.1	–34.0	–36.9	–39.8	–42.7	–45.6
5000	–32.3	–35.9	–39.6	–43.2	–46.9	–50.5	–54.1	–57.8
6000	–39.3	–43.7	–48.0	–52.4	–56.8	–61.2	–65.5	–69.9
7000	–45.7	–50.9	–56.0	–61.2	–66.4	–71.5	–76.7	–81.8
8000	–52.2	–58.1	–64.1	–70.0	–75.9	–81.8	–87.8	–93.7

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GEAR DOWN

Takeoff Obstacle Limit Weight
Flaps 15
Wind Adjustments

WIND (KTS)	OAT & ALT ADJUSTED OBSTACLE LIMIT WEIGHT (1000 KG)							
	160	180	200	220	240	260	280	300
15 TW	–18.3	–20.0	–21.7	–23.3	–25.0	–26.7	–28.3	–30.0
10 TW	–12.2	–13.3	–14.4	–15.6	–16.7	–17.8	–18.9	–20.0
5 TW	–6.1	–6.7	–7.2	–7.8	–8.3	–8.9	–9.4	–10.0
0	0	0	0	0	0	0	0	0
10 HW	3.5	3.3	3.2	3.0	2.8	2.7	2.5	2.3
20 HW	7.0	6.7	6.3	6.0	5.7	5.3	5.0	4.7
30 HW	11.5	10.8	10.2	9.5	8.8	8.2	7.5	6.8
40 HW	16.0	15.0	14.0	13.0	12.0	11.0	10.0	9.0

With engine bleed for packs off, increase weight by 950 kg.
With engine anti-ice on, decrease weight by 1,600 kg.
With engine and wing anti-ice on, decrease weight by 3,950 kg.

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GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
360	18200	16100	13700
350	18800	16900	14400
340	19400	17600	15100
330	20000	18200	15800
320	20700	19100	16800
310	21800	20300	18000
300	22800	21400	19300
290	24000	22500	20600
280	25100	23700	22000
270	26200	24800	23300
260	27300	26100	24600
250	28500	27500	26000
240	29700	28900	27400
230	30600	30200	28900
220	31400	31100	30300
210	32300	32000	31400
200	33200	33000	32500
200	34100	34000	33700
180	35000	34900	33700
170	36000	36000	35800
160	37000	37000	36800

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GEAR DOWN

Long Range Cruise Trip 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
334	296	264	239	218	200	187	175	165	156	149
500	444	396	358	327	300	281	264	249	235	224
666	591	527	477	436	400	375	352	332	314	299
830	738	659	596	545	500	469	441	416	393	374
993	883	789	714	653	600	563	530	500	473	450
1156	1029	920	833	762	700	657	618	583	552	525
1318	1173	1050	951	870	800	751	707	667	632	601
1479	1318	1179	1069	979	900	845	796	751	712	677
1639	1462	1309	1187	1087	1000	939	884	835	791	753
1799	1605	1438	1305	1196	1100	1033	973	919	871	829
1958	1748	1567	1423	1304	1200	1128	1062	1003	951	905
2116	1890	1696	1540	1412	1300	1222	1151	1087	1030	981
2273	2032	1824	1658	1520	1400	1316	1240	1171	1110	1058
2430	2174	1952	1775	1628	1500	1410	1329	1255	1191	1134
2586	2315	2080	1892	1736	1600	1504	1418	1340	1271	1211
2741	2455	2208	2009	1844	1700	1599	1507	1425	1351	1287
2896	2595	2335	2125	1952	1800	1693	1596	1509	1432	1364
3050	2734	2461	2242	2060	1900	1788	1686	1594	1512	1441
3203	2873	2588	2358	2167	2000	1882	1776	1679	1593	1518

Reference Fuel and Time Required

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	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	7.7	0:52	7.4	0:50	7.2	0:48	7.1	0:46	7.0	0:45
300	11.4	1:16	10.8	1:12	10.4	1:09	10.1	1:06	9.9	1:03
400	15.0	1:40	14.2	1:35	13.6	1:30	13.1	1:26	12.8	1:22
500	18.6	2:03	17.6	1:57	16.8	1:51	16.1	1:46	15.6	1:41
600	22.3	2:26	21.1	2:19	20.1	2:12	19.3	2:05	18.6	1:59
700	26.0	2:49	24.6	2:41	23.4	2:32	22.4	2:24	21.6	2:17
800	29.8	3:12	28.1	3:02	26.8	2:53	25.5	2:44	24.6	2:35
900	33.5	3:35	31.6	3:24	30.1	3:13	28.7	3:03	27.6	2:53
1000	37.3	3:58	35.1	3:46	33.4	3:34	31.8	3:22	30.6	3:11
1100	41.2	4:20	38.8	4:07	36.9	3:54	35.1	3:41	33.8	3:29
1200	45.1	4:42	42.5	4:28	40.3	4:13	38.4	4:00	37.0	3:47
1300	49.0	5:05	46.2	4:49	43.8	4:33	41.7	4:18	40.1	4:04
1400	53.0	5:27	49.8	5:10	47.3	4:53	45.0	4:37	43.3	4:22
1500	56.9	5:49	53.5	5:31	50.7	5:13	48.2	4:56	46.4	4:39
1600	61.0	6:10	57.4	5:51	54.3	5:32	51.7	5:14	49.8	4:56
1700	65.1	6:31	61.2	6:11	58.0	5:51	55.1	5:32	53.1	5:13
1800	69.2	6:53	65.1	6:31	61.6	6:10	58.6	5:50	56.4	5:30
1900	73.3	7:14	68.9	6:52	65.2	6:30	62.1	6:08	59.8	5:48
2000	77.4	7:35	72.8	7:12	68.8	6:49	65.5	6:26	63.1	6:05

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GEAR DOWN

Long Range Cruise Trip Fuel and Time
Fuel Required Adjustment (1,000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	LANDING WEIGHT (1000 KG)					
	160	180	200	220	240	260
5	–0.5	–0.3	0.0	0.3	0.7	1.0
10	–1.0	–0.5	0.0	0.6	1.3	2.0
15	–1.6	–0.8	0.0	1.0	2.0	3.0
20	–2.1	–1.1	0.0	1.3	2.6	4.0
25	–2.6	–1.3	0.0	1.6	3.3	5.0
30	–3.2	–1.6	0.0	2.0	4.0	6.1
35	–3.7	–1.9	0.0	2.3	4.6	7.1
40	–4.2	–2.2	0.0	2.6	5.3	8.2
45	–4.8	–2.4	0.0	3.0	6.0	9.3
50	–5.3	–2.7	0.0	3.3	6.7	10.4
55	–5.8	–3.0	0.0	3.6	7.5	11.5
60	–6.4	–3.2	0.0	4.0	8.2	12.7
65	–6.9	–3.5	0.0	4.3	8.9	13.8
70	–7.5	–3.8	0.0	4.7	9.7	15.0
75	–8.0	–4.0	0.0	5.0	10.4	16.2
80	–8.5	–4.3	0.0	5.4	11.2	17.4

Based on VREF + 80 climb, Long Range Cruise and VREF + 80 descent.

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GEAR DOWN

Short Trip 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
105	86	73	63	56	50	45	41	38	35	33
174	152	134	120	109	100	92	85	80	75	70
245	217	195	177	163	150	139	130	122	115	108
314	282	256	234	216	200	186	175	164	155	147
384	347	316	290	269	250	234	219	207	196	185
452	411	376	347	322	300	281	264	250	236	224
521	474	436	403	375	350	328	309	292	277	264
590	539	496	459	428	400	376	354	335	318	303
659	603	556	515	480	450	423	399	378	359	342
730	668	616	572	534	500	470	444	421	399	380

Trip Fuel and Time

AIR DISTANCE (NM)		LANDING WEIGHT (1000 KG) 160	180	200	220	240	260	TIME (HRS:MIN)
50	FUEL (1000 KG) ALT (FT)	2.2 11000	2.3 11000	2.5 11000	2.6 11000	2.8 9000	2.9 9000	0:16
100	FUEL (1000 KG) ALT (FT)	3.6 21000	3.8 21000	4.1 19000	4.3 19000	4.6 17000	4.9 17000	0:26
150	FUEL (1000 KG) ALT (FT)	4.8 27000	5.2 27000	5.6 25000	5.9 23000	6.3 23000	6.7 21000	0:35
200	FUEL (1000 KG) ALT (FT)	6.0 33000	6.5 31000	7.0 27000	7.5 27000	8.0 25000	8.5 23000	0:44
250	FUEL (1000 KG) ALT (FT)	7.2 33000	7.8 31000	8.4 29000	9.0 27000	9.6 25000	10.2 23000	0:52
300	FUEL (1000 KG) ALT (FT)	8.3 33000	9.0 33000	9.8 29000	10.5 27000	11.3 25000	12.0 25000	1:01
350	FUEL (1000 KG) ALT (FT)	9.5 33000	10.3 33000	11.1 31000	12.0 29000	12.9 27000	13.8 25000	1:09
400	FUEL (1000 KG) ALT (FT)	10.7 33000	11.6 33000	12.5 31000	13.5 29000	14.6 27000	15.6 25000	1:17
450	FUEL (1000 KG) ALT (FT)	11.9 33000	12.9 33000	13.9 31000	15.1 29000	16.2 27000	17.4 25000	1:26
500	FUEL (1000 KG) ALT (FT)	13.0 33000	14.1 33000	15.4 31000	16.6 29000	17.9 27000	19.2 25000	1:34

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GEAR DOWN

Holding Planning
Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)						
	1500	5000	10000	15000	20000	25000	30000
360	15590						
340	14930	14940					
320	14020	14000					
300	13010	12990	12950				
280	12150	12140	12080				
260	11360	11350	11280	11340			
240	10600	10580	10500	10530	10640		
220	9880	9830	9750	9760	9860		
200	9160	9090	9000	8990	9070	9190	
180	8460	8370	8270	8260	8300	8370	8580
160	7760	7670	7540	7530	7530	7580	7740

Flaps 1

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)				
	1500	5000	10000	15000	20000
360	15290	15370	15350	15590	16370
340	14580	14620	14600	14800	15370
320	13630	13650	13640	13760	14190
300	12620	12620	12600	12720	12980
280	11740	11740	11700	11810	12030
260	10930	10910	10860	10970	11100
240	10140	10100	10030	10110	10220
220	9380	9310	9240	9280	9380
200	8620	8530	8440	8460	8540
180	7880	7780	7670	7660	7710
160	7150	7050	6920	6870	6910

These tables include 5% additional fuel for holding in a racetrack pattern.

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GEAR DOWN
ENGINE INOP
MAX CONTINUOUS THRUST

Net Level Off Weight

PRESSURE ALTITUDE (1000 FT)	LEVEL OFF WEIGHT (1000 KG)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
20	169.8	169.8	
18	180.3	178.3	174.3
16	192.5	190.8	186.9
14	205.6	204.8	199.7
12	221.7	219.6	213.0
10	237.9	235.2	228.3
8	254.9	251.1	244.7
6	274.1	267.1	257.3
4	290.9	280.1	267.4
2	304.5	291.6	278.0
0	316.7	302.3	287.7

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	LEVEL OFF WEIGHT ADJUSTMENT (1000 KG)									
	PRESSURE ALTITUDE (1000 FT)									
	0	2	4	6	8	10	12	14	16	18
ENGINE ONLY	0.0	–0.6	–1.0	–1.1	–1.0	–0.8	–0.7	–0.1	0.0	0.0
ENGINE AND WING	–2.2	–2.9	–2.9	–3.0	–2.6	–2.3	–1.9	–1.5	–1.2	–1.0

Introduction

This chapter contains self dispatch performance data intended primarily for use by flight crews in the event that information cannot be obtained from the airline dispatch office. The data provided is for a single takeoff flap at max takeoff thrust. The range of conditions covered is limited to those normally encountered in airline operation. 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.

Takeoff

The maximum allowable takeoff weight will be the least of the Field, Climb, Tire Speed, and Obstacle Limit Weights as determined from the following tables. Brake Energy Limit is not shown as it is not limiting for the range of conditions shown in this chapter. When determining a maximum weight for a wet runway, the dry runway limit weight must also be checked and the lower of the two weights used.

Field Limit Weight—Slope and Wind Corrections

These tables for wet and dry runways provide corrections to the field length available for the effects of runway slope and wind component along the runway. Enter the Slope Correction table with the available field length and runway slope to determine the slope corrected field length. Now enter the Wind Correction table with slope corrected field length and wind component to determine the slope and wind corrected field length.

Field and Climb Limit Weight

Tables are presented for selected airport pressure altitudes and runway condition and show both Field and Climb Limit Weights. Enter the appropriate table for pressure altitude and runway condition with “Slope and Wind Corrected Field Length” determined above and airport OAT to obtain Field Limit Weight. Also read Climb Limit Weight for the same OAT. Intermediate altitudes may be interpolated or use next higher altitude.

When finding a maximum weight for a wet runway, the dry runway limit weight must also be determined and the lower of the two weights used.

Obstacle Limit Weight

This table provides obstacle limit weights for reference airport conditions based on obstacle height above the runway surface and distance from brake release. Enter the correction tables to correct the reference Obstacle Limit Weight for the effects of OAT, pressure altitude and wind as indicated. In the case of multiple

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obstacles, enter the tables successively with each obstacle and determine the most limiting weight.

Tire Speed Limit

Maximum tire speed limited weights are presented for 235 MPH tires. To determine the tire speed limit weight, enter the table with OAT, move to airport pressure altitude and read the tire speed limit weight. Adjust the tire speed limit weight according to the notes below the table to account for wind.

Takeoff Speeds

The speeds presented in the Takeoff Speeds table as well as FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy, or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Normal takeoff speeds, V1, VR, and V2 are read from either the wet or dry table by entering with takeoff flap setting and brake release weight. Use the tables provided to correct takeoff speeds for altitude and actual temperature or assumed temperature for reduced thrust takeoffs. Slope and wind corrections to V1 are obtained by entering the Slope and Wind V1 Adjustment Table.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available

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exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Brakes Deactivated

When operating with brakes deactivated, the runway/obstacle limit weight and the V1 must be reduced to allow for reduced braking capability. A simplified method which conservatively accounts for the reduced braking capability of one brake deactivated is to reduce the normal runway/obstacle limited weight by 3,800 kg for a dry runway or 2,250 kg for a wet runway and the V1 associated with the reduced weight by 2 knots. With two brakes deactivated, reduce the normal runway/obstacle limited weight by 7,700 kg for a dry runway or 4,700 kg for a wet runway and the V1 associated with the reduced weight by 5 knots for a dry runway or 3 knots for a wet runway. If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the dry accelerate stop distance corrected for wind and slope exceeds approximately 1,500 m for one brake deactivated or 1,550 m for two brakes deactivated. For wet runways, the corrected accelerate stop distance should exceed approximately 1,900 m for one brake deactivated or 1,950 m for two brakes deactivated.

Detailed analysis for the specific case from the Airplane Flight Manual may yield a less restrictive penalty.

One Thrust Reverser Inoperative

Wet runway takeoff performance presented for all brakes operating is based on the use of one thrust reverser during deceleration. When operating with a thrust reverser inoperative, the runway/obstacle limited takeoff weight and V1 speed must be reduced to account for the reduced deceleration capability. A simplified method which conservatively accounts for this is to reduce the normal wet runway/obstacle limited weight by 5,350 kg and the V1 associated with the reduced weight by 3 knots.

If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to V1(MCG) provided the accelerate stop distance available corrected for wind and slope exceeds approximately 1,950 m.

Enroute

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 at two center of gravity positions: 7.5% MAC (FMC default) for use when no center of gravity is entered on the PERF INIT page, and 30% MAC (typical mid cruise center of gravity) for use when 30% MAC is entered. Crews may interpolate between these values to determine the airplane's capability at other specific center of gravity positions. Note that these tables consider both

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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 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of approximately 1.3 g (39° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43,100 ft.

Long Range Cruise Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination. Data is based on economy climb and descent speeds, and Long Range Cruise with normal engine bleed for air conditioning. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

To determine trip fuel and time for a constant altitude cruise, 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 planned landing weight to obtain fuel required at the planned landing weight.

Long Range Cruise Step Climb Trip Fuel and Time

These tables are provided to determine trip fuel and time required to destination when flying a step climb profile. Step climb profiles are based on 4,000 ft step climbs to keep the flight within 2,000 ft of the optimum altitude for the current cruise weight. To determine trip fuel and time, enter the Ground to Air Miles Conversion table and determine air distance as discussed above. Then enter the Trip Fuel and Time required with air distance and planned landing weight to read trip fuel. Continue across the table to read trip time.

Short Trip Fuel and Time

These tables are provided to determine trip fuel and time for short distances or alternates. The data considers the use of the FMC short trip optimum altitude. Obtain air distance from upper table using the ground distance and wind component to the alternate. Enter Trip Fuel and Time table with air distance and read trip fuel required for the expected landing weight, together with time to alternate at right. For distances greater than shown or other altitudes, use the Long Range Cruise Trip Fuel and Time tables.

Holding Planning

These tables provide total fuel flow information necessary for planning Flaps Up and Flaps 1 holding and reserve fuel requirements. Data is based on the FMC

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holding speed schedule which is the higher of the maximum endurance and flaps up maneuver speeds. As noted, the fuel flow is based on flight in a racetrack holding pattern. For holding in straight and level flight, reduce table values by 5%.

Oxygen Requirements

Flight Crew System

Regulations require that sufficient oxygen be provided to the flight crew to account for the greater of supplemental breathing oxygen in the event of a cabin depressurization or protective breathing in the event of smoke or harmful fumes in the flight deck. The oxygen quantity associated with these requirements is achieved with the minimum dispatch oxygen cylinder pressure. Enter the Crew Oxygen Requirements table with the number of crew plus observers using oxygen and read the minimum cylinder pressure required for the appropriate bottle temperature.

An additional quantity of oxygen is required when flight altitudes above 41,000 ft are planned. Regulations require that one active duty pilot must don the oxygen mask and breathe diluted oxygen for the duration of the flight above 41,000 ft. The additional quantity of oxygen required is 2.05 liters/person/minute (1.2 psi/person/minute for the single cylinder system), or 13 liters/person/minute (8 psi/person/minute) if 100% oxygen is selected during normal usage.

Net Level Off Weight

The Net Level Off Weight table is provided to determine terrain clearance capability in straight and level flight following an engine failure. Regulations require terrain clearance planning based on net performance which is the gross (or actual) gradient performance degraded by 1.1%. In addition, the net level off pressure altitude must clear the terrain by 1,000 ft.

To determine the maximum weight for terrain clearance, enter the table with required net level off pressure altitude and expected ISA deviation to obtain weight. Adjust weight for anti-ice operation as noted below the table.

Extended Range Operations

Regulations require that flights conducted over a route that contains a point further than one hour’s time at “normal one engine inoperative speed” from an adequate diversion airport comply with rules set up specifically for “Extended Range Operation with Two Engine airplanes”. This section provides reserve fuel planning information for the "Critical Fuel Scenario" based on two engine operation at Long Range Cruise as well as single engine operation at Long Range Cruise.

Critical Fuel Reserves

Enter Ground to Air Mile Conversion table with forecast wind and ground distance to diversion airport from critical point to obtain air distance. Now enter

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Critical Fuel table with air distance and expected weight at the critical point and read required fuel. Apply the noted fuel adjustments as necessary. Regulations require a 5% allowance for performance deterioration unless a value has been established by the operator for in-service deterioration.

As noted below each table, the fuel required is the greater of the two engine fuel and the single engine fuel. This fuel is compared to the amount of fuel normally onboard the airplane at that point in the route. If the fuel required by the critical fuel reserves exceeds the amount of fuel normally expected, the fuel load must be adjusted accordingly.

Landing

Tables are provided for determining the maximum landing weight as limited by field length or climb requirements for Flaps 30.

Maximum landing weight is the lowest of the field length limit weight, climb limit weight or maximum certified landing weight.

Landing Field Limit Weight

Obtain wind corrected field length by entering upper table with field length available and wind component along the runway. Now enter table with wind corrected field length and pressure altitude to read field limit weight for the expected runway condition.

Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required.

Go-Around Climb Gradient

Enter the Reference Go-around Gradient table with airport OAT and pressure altitude to determine the reference Go-Around Gradient. Then adjust the reference gradient for airplane weight and speed using the tables provided to determine the weight and speed adjusted Go-Around Gradient. Apply the necessary engine bleed corrections as noted. Note that data is for one engine inoperative.

Quick Turnaround Limit Weight

Enter table with airport pressure altitude and OAT to read maximum quick turnaround weight. Apply the noted adjustments as required.

If the landing weight exceeds the maximum quick turnaround weight, wait the specified time and then check that the wheel thermal plugs have not melted before executing a subsequent takeoff, or ensure the brake temperature is within limits using the alternate procedure described on the page.

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Gear Down

This section provides flight planning data for revenue operation with gear down.

Takeoff/Landing Climb Limit Weight

Enter table with airport OAT and pressure altitude to determine Takeoff Climb Limit Weight with gear down. Correct the weight obtained for engine bleed configuration as required.

The remaining gear down tables in this section are identical in format and usage to the corresponding gear up tables previously described.

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777-200 TRENT875 KG M FAA TALPA PI.10

777-200ER TRENT892 KG M FAA TALPA PI.20

777-300 TRENT892 KG M FAA TALPA PI.30

777-300ER GE90-115BL KG M FAA TALPA PI.40

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777-200 TRENT875 KG M FAA TALPA

General PI.10

Maximum Allowable Clearway PI.10.1

Clearway and Stopway V1 Adjustments PI.10.2

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Long Range Cruise Altitude Capability PI.17.2

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Maximum Allowable Clearway

FIELD LENGTH (M)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (M)
1500	180
2000	230
2500	280
3000	330
3500	380
4000	430
4500	480

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Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (M)	NORMAL V1 (KIAS)			
	100	120	140	160
300	–3	–3	–3	–3
200	–3	–3	–2	–2
100	–2	–2	–1	–1
0	0	0	0	0
–100	3	2	2	2
–200	4	3	2	2
–300	6	4	2	2

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VREF

WEIGHT (1000 KG)	FLAPS		
	30	25	20
250	151	159	164
240	148	156	161
230	145	152	158
220	142	149	154
210	139	145	150
200	135	142	147
190	132	138	143
180	128	134	139
170	124	131	135
160	121	127	131
150	117	123	127
140	113	118	123

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Flap Maneuver Speed

FLAP POSITION	MANEUVER SPEED
FLAPS 0	VREF30 + 80
FLAPS 1	VREF30 + 60
FLAPS 5	VREF30 + 40
FLAPS 15	VREF30 + 20
FLAPS 20	VREF30 + 20
FLAPS 25	VREF25
FLAPS 30	VREF30

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ADVISORY INFORMATION

Slush/Standing Water Takeoff
Maximum Reverse Thrust
Weight Adjustment (1000 KG)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
300	–36.3	–41.0	–45.7	–42.3	–47.0	–51.7	–54.8	–59.5	–64.2
280	–32.9	–37.6	–42.3	–38.1	–42.8	–47.5	–49.0	–53.7	–58.4
260	–29.5	–34.2	–38.9	–33.9	–38.6	–43.3	–43.2	–47.9	–52.6
240	–26.1	–30.8	–35.5	–29.7	–34.4	–39.1	–37.4	–42.1	–46.8
220	–22.7	–27.4	–32.1	–25.5	–30.2	–34.9	–31.6	–36.3	–41.0
200	–19.3	–24.0	–28.7	–21.3	–26.0	–30.7	–25.8	–30.5	–35.2
180	–15.9	–20.6	–25.3	–17.1	–21.8	–26.5	–20.0	–24.7	–29.4
160	–12.5	–17.2	–21.9	–12.9	–17.6	–22.4	–14.1	–18.9	–23.6
140	–9.1	–13.8	–18.5	–8.7	–13.4	–18.2	–8.3	–13.0	–17.8

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1600							107.3		
1800	117.8			130.3			151.2		
2000	164.3			176.1	111.9		195.2	133.6	
2200	210.9	145.6		221.9	157.7		239.2	177.5	115.9
2400	257.4	192.2	127.0	267.7	203.5	139.3	283.2	221.5	159.9
2600	303.9	238.7	173.5	313.5	249.3	185.1	327.1	265.5	203.8
2800		285.2	220.0		295.1	230.9		309.5	247.8
3000		331.7	266.5			276.7			291.8
3200			313.0			322.5			335.8

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water adjustment.
2. Adjust field length available by –40 m/+35 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
260	–16	–14	–12	–11	–9	–7	0	0	0
240	–19	–17	–15	–14	–12	–10	–4	–2	0
220	–20	–18	–16	–16	–14	–12	–8	–6	–4
200	–22	–20	–18	–18	–16	–14	–11	–9	–7
180	–23	–21	–19	–20	–18	–16	–14	–12	–10
160	–23	–21	–19	–21	–19	–17	–17	–15	–13
140	–24	–22	–20	–23	–21	–19	–19	–17	–15

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

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ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
Weight Adjustment (1000 KG)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
300	–47.6	–52.9	–58.2	–55.1	–60.3	–65.6	–71.4	–76.6	–81.9
280	–43.5	–48.7	–54.0	–49.5	–54.7	–60.0	–62.4	–67.6	–72.9
260	–39.3	–44.6	–49.9	–44.0	–49.3	–54.6	–54.1	–59.3	–64.6
240	–35.2	–40.4	–45.7	–38.8	–44.1	–49.3	–46.5	–51.7	–57.0
220	–31.0	–36.3	–41.6	–33.8	–39.1	–44.3	–39.6	–44.9	–50.1
200	–26.9	–32.2	–37.4	–28.9	–34.2	–39.5	–33.5	–38.7	–44.0
180	–22.8	–28.0	–33.3	–24.3	–29.6	–34.8	–28.0	–33.3	–38.5
160	–18.6	–23.9	–29.2	–19.8	–25.1	–30.4	–23.3	–28.6	–33.8
140	–14.5	–19.8	–25.0	–15.4	–20.7	–26.0	–18.9	–24.1	–29.4

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2400							148.3		
2600				140.9			200.7	123.6	
2800	155.9			197.2	115.0		251.2	176.6	
3000	217.8	127.8		256.6	170.8		300.0	228.0	152.1
3200	284.2	188.6		320.0	228.6	144.9		277.6	204.4
3400		252.7	160.3		290.0	201.4		325.5	254.8
3600		321.9	222.4			261.0			303.4
3800			289.2			324.7			

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water adjustment.
2. Adjust field length available by –60 m/+55 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
260	–26	22	–18	–19	–15	–11	–3	0	0
240	–29	–25	–21	–22	–18	–14	–8	–4	0
220	–31	–27	–23	–26	–22	–18	–13	–9	–5
200	–34	–30	–26	–30	–26	–22	–19	–15	–11
180	–36	–32	–28	–33	–29	–25	–25	–21	–17
160	–38	–34	–30	–35	–31	–27	–30	–26	–22
140	–39	–35	–31	–37	–33	–29	–34	–30	–26

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

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ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
Weight Adjustments (1000 KG)

DRY 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
300	0	–1.5	–2.9	–14.2	–15.6	–17.1	–29.8	–31.3	–32.7
280	0	–1.5	–2.9	–15.9	–17.4	–18.8	–30.2	–31.6	–33.1
260	–1.9	–3.3	–4.8	–17.1	–18.6	–20.0	–30.0	–31.4	–32.9
240	–3.3	–4.8	–6.2	–17.4	–18.9	–20.3	–28.9	–30.3	–31.8
220	–4.0	–5.5	–6.9	–16.8	–18.3	–19.7	–27.0	–28.4	–29.9
200	–4.0	–5.5	–6.9	–15.4	–16.9	–18.3	–24.2	–25.6	–27.1
180	–3.3	–4.8	–6.2	–13.1	–14.6	–16.0	–20.6	–22.0	–23.5
160	–1.9	–3.3	–4.8	–9.9	–14.6	–12.8	–16.0	–17.5	–18.9

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	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
1400	165								
1600	240	181							
1800	315	256	196	147					
2000		330	271	206	145				
2200			346	264	203	143			
2400				323	262	201	155		
2600					321	260	195	137	
2800						319	235	177	
3000							275	217	158
3200							315	257	198
3400							355	297	238
3600								337	278
3800									318

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust “Good” field length available by –25 m/+20 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Medium” field length available by –35 m/+30 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Poor” field length available by –45 m/+40 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

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ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
V1 Adjustments (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
260	–6	–4	–2	–14	–12	–10	–25	–23	–21
240	–7	–5	–3	–17	–15	–13	–29	–27	–25
220	–8	–6	–4	–19	–17	–15	–32	–30	–28
200	–10	–8	–6	–21	–19	–17	–35	–33	–31
180	–10	–8	–6	–23	–21	–19	–38	–36	–34
160	–11	–9	–7	–24	–22	–20	–40	–38	–36

1. Obtain V1, VR and V2 for the actual weight.

2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

No Reverse Thrust
Weight Adjustment (1000 KG)

DRY 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
300	–2.7	–3.3	–3.8	–24.5	–25.1	–25.6	–44.6	–45.2	–45.7
280	–5.5	–6.0	–6.6	–25.8	–26.3	–26.9	–43.2	–43.7	–44.3
260	–7.5	–8.0	–8.6	–26.3	–26.8	–27.3	–41.1	–41.7	–42.2
240	–8.8	–9.4	–9.9	–25.9	–26.4	–27.0	–38.4	–39.0	–39.5
220	–9.4	–10.0	–10.5	–24.7	–25.2	–25.8	–35.2	–35.7	–36.3
200	–9.3	–9.9	–10.4	–22.6	–23.2	–23.7	–31.3	–31.8	–32.4
180	–8.5	–9.0	–9.6	–19.8	–20.3	–20.8	–26.8	–27.4	–27.9
160	–7.0	–7.5	–8.0	–16.0	–16.6	–17.1	–21.7	–22.3	–22.8
140	–5.1	–5.7	–6.2	–12.0	–12.6	–13.1	–16.4	–16.9	–17.5

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Slippery Runway Takeoff
No Reverse Thrust
V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	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
1600	149.2								
1800	259.8	191.4	103.6						
2000		288.3	227.3						
2200			314.5						
2400				171.8					
2600				269.1	168.0				
2800					265.9	164.0			
3000						262.7			
3400							110.2		
3600							173.3		
3800							237.5	140.2	
4000							303.3	203.7	107.2
4200								268.6	170.3
4400								335.1	234.4
4600									300.1

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust “Good” field length available by –25 m/+20 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Medium” field length available by –40 m/+35 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Poor” field length available by –65 m/+60 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

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
260	–8	–4	0	–20	–16	–12	–39	–35	–31
240	–10	–6	–2	–24	–20	–16	–43	–39	–35
220	–12	–8	–4	–27	–23	–19	–49	–45	–41
200	–14	–10	–6	–31	–27	–23	–54	–50	–46
180	–16	–12	–8	–34	–30	–26	–58	–54	–50
160	–17	–13	–9	–37	–33	–29	–61	–57	–53
140	–19	–15	–11	–40	–36	–32	–64	–60	–56

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

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Minimum Control Speeds
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)					
		0		4000		8000	
deg. C	deg. F	V1(MCG)	VR Min	V1(MCG)	VR Min	V1(MCG)	VR Min
60	140	103	103	98	99		
50	122	104	105	98	99	94	95
40	104	108	109	101	102	94	95
30	86	112	113	105	106	97	99
20	68	112	113	108	109	101	102
–60	–76	113	113	109	109	104	104

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Go-around EPR

Based on engine bleed for packs on and anti-ice off

REPORTED OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)										
deg. C	deg. F	deg. C	–2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000
56	133	60	1.245	1.257	1.255	1.253	1.251	1.249	1.248	1.247	1.247	1.247	1.247
51	124	55	1.262	1.276	1.274	1.271	1.270	1.268	1.267	1.266	1.267	1.268	1.268
46	115	50	1.279	1.295	1.294	1.293	1.290	1.288	1.287	1.286	1.288	1.289	1.289
41	106	45	1.297	1.314	1.314	1.314	1.312	1.311	1.309	1.308	1.308	1.310	1.311
36	97	40	1.315	1.334	1.335	1.335	1.334	1.334	1.333	1.332	1.333	1.333	1.333
31	88	35	1.323	1.354	1.356	1.357	1.357	1.357	1.357	1.356	1.357	1.357	1.358
26	79	30	1.323	1.359	1.369	1.379	1.380	1.381	1.382	1.382	1.381	1.382	1.384
21	70	25	1.323	1.359	1.369	1.380	1.391	1.402	1.408	1.410	1.411	1.410	1.410
17	62	20	1.323	1.359	1.369	1.380	1.391	1.402	1.415	1.428	1.440	1.441	1.443
12	53	15	1.323	1.359	1.369	1.380	1.391	1.402	1.415	1.428	1.441	1.455	1.470
9 & BELOW	49 & BELOW	13 & BELOW	1.324	1.359	1.369	1.380	1.391	1.402	1.415	1.428	1.441	1.455	1.470

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)						
	–2000	0	2000	4000	6000	8000	10000
PACKS OFF	0.003	0.003	0.003	0.003	0.004	0.004	0.005
1 PACK ON—2 BLEED SOURCES	–0.003	–0.003	–0.003	–0.003	–0.004	–0.004	–0.005
1 PACK ON—1 BLEED SOURCE	–0.003	–0.003	–0.003	–0.003	–0.004	–0.004	–0.005
WING ANTI-ICE ON	–0.002	–0.004	–0.004	–0.005	–0.005	–0.006	–0.006

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Max Climb EPR

Based on engine bleed for packs on and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)/SPEED (IAS OR MACH)									
	0	5	10	15	20	25	30	35	40	43
	310	310	310	310	310	310	310	0.84	0.84	0.84
60	1.099	1.088	1.086	1.093	1.104	1.101	1.083	1.116	1.110	1.108
50	1.130	1.120	1.103	1.093	1.104	1.101	1.083	1.116	1.110	1.108
40	1.164	1.157	1.140	1.125	1.110	1.101	1.083	1.116	1.110	1.108
30	1.170	1.197	1.184	1.169	1.156	1.132	1.088	1.116	1.110	1.108
20	1.170	1.197	1.218	1.218	1.207	1.183	1.144	1.130	1.110	1.108
10	1.170	1.197	1.218	1.242	1.265	1.247	1.206	1.196	1.175	1.173
0	1.170	1.197	1.218	1.242	1.273	1.294	1.278	1.275	1.249	1.246
–10	1.170	1.197	1.218	1.242	1.273	1.294	1.301	1.365	1.341	1.338
–15 & BELOW	1.170	1.197	1.218	1.242	1.273	1.294	1.301	1.384	1.382	1.379

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	0	10	20	30	40	43
1 PACK ON - 2 BLEED SOURCES	–0.004	–0.009	–0.012	–0.016	–0.027	–0.030
1 PACK ON - 1 BLEED SOURCE	–0.004	–0.009	–0.012	–0.016	–0.027	–0.030
2 PACKS ON - 1 BLEED SOURCE	–0.004	–0.009	–0.012	–0.016	–0.027	–0.030
ENGINE ANTI-ICE ON	–0.008	–0.015	–0.006	–0.003	–0.004	–0.005
ENGINE & WING*	–0.010	–0.018	–0.012	–0.011	–0.015	–0.017
ENGINE & WING**	–0.011	–0.021	–0.018	–0.018	–0.026	–0.029

***Wing anti-ice on, packs on, or packs off with 2 bleed sources.**
****Wing anti-ice, single bleed source and both packs off.**

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Flight With Unreliable Airspeed/Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82M)	PITCH ATT V/S (FT/MIN)	3.5 1100	3.0 400		
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	4.0 1800	3.5 1200	4.0 800	4.0 400
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	6.0 2900	6.0 2100	5.5 1600	5.5 1100
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	8.5 3800	7.5 2800	7.0 2200	7.0 1700
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	10.5 4300	9.0 3300	8.5 2600	8.5 2100

Cruise

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82 M)	PITCH ATT EPR (Alt Mode %N1)	2.0 1.129 (81.1)	2.5 1.249 (85.5)		
35000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 1.065 (78.9)	2.0 1.118 (78.9)	2.5 1.203 (82.3)	3.0 1.356 (87.2)
30000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 1.021 (75.4)	2.0 1.059 (77.5)	3.0 1.119 (80.4)	3.5 1.196 (83.8)
25000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 0.997 (72.1)	2.0 1.024 (74.1)	3.0 1.067 (76.7)	3.5 1.124 (79.8)
20000 (270 KIAS)	PITCH ATT EPR (Alt Mode %N1)	2.0 0.986 (67.6)	2.5 1.008 (70.0)	3.0 1.039 (73.0)	4.0 1.081 (76.0)
15000 (270 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 0.977 (64.0)	2.5 0.994 (66.4)	3.0 1.018 (69.2)	4.0 1.048 (72.5)

Descent

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82M)	PITCH ATT V/S (FT/MIN)	–1.0 –2500	–0.5 –2400		
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –2200	–0.5 –1900	0.5 –1900	1.0 –1900
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	–1.0 –1800	0.0 –1600	0.5 –1600	1.5 –1600
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –1700	–0.5 –1500	0.5 –1400	1.5 –1400
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –1500	–0.5 –1400	0.5 –1300	1.5 –1300

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Flight With Unreliable Airspeed/Turbulent Air Penetration
Altitude and/or vertical speed indications may also be unreliable.

Holding
Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)			
		160	200	240	280
10000	PITCH ATT	4.0	4.5	5.0	5.0
	EPR	1.004	1.017	1.029	1.040
	(Alt Mode %N1)	(52.7)	(59.2)	(64.0)	(68.2)
	KIAS	202	216	234	253
5000	PITCH ATT	4.0	4.5	5.0	5.0
	EPR	0.999	1.009	1.019	1.027
	(Alt Mode %N1)	(48.8)	(54.1)	(59.9)	(64.1)
	KIAS	202	216	233	251

Terminal Area (5000 FT)
Set Thrust for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		160	200	240	280	300
FLAPS UP (GEAR UP) (VREF 30+80)	PITCH ATT	4.5	5.0	5.5	5.5	6.0
	EPR	1.000	1.011	1.023	1.037	1.044
	(Alt Mode %N1)	(49.0)	(54.4)	(60.3)	(64.5)	(66.5)
	KIAS	201	215	228	240	246
FLAPS 1 (GEAR UP) (VREF 30+60)	PITCH ATT	6.0	6.5	7.0	7.0	7.5
	EPR	1.017	1.029	1.045	1.062	1.070
	(Alt Mode %N1)	(50.0)	(56.0)	(61.9)	(66.4)	(68.3)
	KIAS	181	195	208	220	226
FLAPS 5 (GEAR UP) (VREF 30+40)	PITCH ATT	5.0	5.5	6.0	6.0	6.0
	EPR	1.029	1.047	1.066	1.085	1.095
	(Alt Mode %N1)	(50.8)	(58.1)	(63.4)	(67.9)	(69.8)
	KIAS	161	175	188	200	206
FLAPS 15 (GEAR UP) (VREF 30+20)	PITCH ATT	6.0	6.0	6.5	6.5	7.0
	EPR	1.043	1.064	1.088	1.113	1.124
	(Alt Mode %N1)	(52.4)	(60.0)	(65.6)	(70.1)	(72.0)
	KIAS	141	155	168	180	186
FLAPS 20 (GEAR DOWN) (VREF 30+20)	PITCH ATT	4.5	4.5	5.0	5.0	5.0
	EPR	1.071	1.100	1.132	1.167	1.184
	(Alt Mode %N1)	(60.2)	(66.7)	(71.8)	(76.1)	(78.0)
	KIAS	141	155	168	180	186

Final Approach (1500 FT)
Gear Down, Set Thrust for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		160	200	240	280	300
FLAPS 20 (VREF 20+10)	PITCH ATT	1.0	1.5	1.5	1.5	1.5
	EPR	1.006	1.010	1.015	1.022	1.025
	(Alt Mode %N1)	(39.0)	(43.2)	(47.2)	(51.0)	(52.6)
	KIAS	141	157	171	184	190
FLAPS 25 (VREF 25+10)	PITCH ATT	0.0	0.5	0.5	0.5	0.5
	EPR	1.029	1.041	1.054	1.069	1.077
	(Alt Mode %N1)	(47.1)	(52.4)	(58.2)	(62.8)	(64.8)
	KIAS	137	152	165	178	184
FLAPS 30 (VREF 30+10)	PITCH ATT	–0.5	0.0	0.0	0.0	0.0
	EPR	1.048	1.066	1.086	1.108	1.119
	(Alt Mode %N1)	(52.1)	(59.3)	(64.6)	(68.9)	(70.8)
	KIAS	131	145	158	170	176

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Flight With Unreliable Airspeed/Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Go-Around

Flaps 20, Gear Up, Set Go-Around Thrust

Normal Mode

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		160	200	240	280	300
10000	PITCH ATT	15.0	12.0	10.0	9.0	8.5
	V/S (FT/MIN)	3200	2400	1900	1400	1200
	KIAS	141	155	169	181	187
5000	PITCH ATT	17.0	13.5	11.5	10.0	9.0
	V/S (FT/MIN)	3500	2700	2100	1700	1500
	KIAS	141	155	168	180	187
SEA LEVEL	PITCH ATT	19.0	15.0	12.5	11.0	10.0
	V/S (FT/MIN)	3800	3000	2400	1900	1700
	KIAS	141	155	168	180	186

Alternate Mode EEC

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		160	200	240	280	300
10000	PITCH ATT	14.0	11.5	9.5	8.0	7.5
	V/S (FT/MIN)	2900	2200	1600	1200	1000
	KIAS	141	155	169	181	187
5000	PITCH ATT	15.5	12.5	10.5	9.0	8.5
	V/S (FT/MIN)	3100	2400	1800	1400	1200
	KIAS	141	155	168	180	187
SEA LEVEL	PITCH ATT	17.5	14.0	11.5	10.0	9.5
	V/S (FT/MIN)	3400	2600	2100	1600	1400
	KIAS	141	155	168	180	186

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 10 deg. C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
280	31800	–5	33200*	33200*	33200*	33200*	33200*
270	32600	–7	34300*	34300*	34300*	34300*	34200
260	33400	–8	35300*	35300*	35300*	35300*	35000
250	34200	–10	36100*	36100*	36100*	36100*	35800
240	35100	–12	36900*	36900*	36900*	36900*	36600
230	36000	–14	37700*	37700*	37700*	37700*	37500
220	36900	–14	38600*	38600*	38600*	38600*	38500
210	37900	–14	39500*	39500*	39500*	39500*	39400
200	38900	–14	40500*	40500*	40500*	40500*	40400
190	40000	–14	41600*	41600*	41600*	41600*	41500
180	41100	–14	42600*	42600*	42600*	42600*	42600
170	42300	–14	43000	43000	43000	43000	43000
160	43000	–14	43000	43000	43000	43000	43000
150	43000	–14	43000	43000	43000	43000	43000
140	43000	–14	43000	43000	43000	43000	43000

ISA + 15 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
280	31800	1	30800*	30800*	30800*	30800*	30800*
270	32600	–1	32700*	32700*	32700*	32700*	32700*
260	33400	–3	34000*	34000*	34000*	34000*	34000*
250	34200	–5	35200*	35200*	35200*	35200*	35200*
240	35100	–7	36100*	36100*	36100*	36100*	36100*
230	36000	–9	36800*	36800*	36800*	36800*	36800*
220	36900	–9	37700*	37700*	37700*	37700*	37700*
210	37900	–9	38600*	38600*	38600*	38600*	38600*
200	38900	–9	39500*	39500*	39500*	39500*	39500*
190	40000	–9	40600*	40600*	40600*	40600*	40600*
180	41100	–9	41600*	41600*	41600*	41600*	41600*
170	42300	–9	42800*	42800*	42800*	42800*	42800*
160	43000	–9	43000	43000	43000	43000	43000
150	43000	–9	43000	43000	43000	43000	43000
140	43000	–9	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
280	31800	7	27300*	27300*	27300*	27300*	27300*
270	32600	5	28600*	28600*	28600*	28600*	28600*
260	33400	3	30100*	30100*	30100*	30100*	30100*
250	34200	1	32700*	32700*	32700*	32700*	32700*
240	35100	–1	34700*	34700*	34700*	34700*	34700*
230	36000	–3	35700*	35700*	35700*	35700*	35700*
220	36900	–3	36400*	36400*	36400*	36400*	36400*
210	37900	–3	37300*	37300*	37300*	37300*	37300*
200	38900	–3	38200*	38200*	38200*	38200*	38200*
190	40000	–3	39200*	39200*	39200*	39200*	39200*
180	41100	–3	40300*	40300*	40300*	40300*	40300*
170	42300	–3	41400*	41400*	41400*	41400*	41400*
160	43000	–3	42500*	42500*	42500*	42500*	42500*
150	43000	–3	43000	43000	43000	43000	43000
140	43000	–3	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		25	27	29	31	33	35	37	39	41	43
260	EPR	1.064	1.085	1.111	1.142	**1.193**	**1.266**				
	MACH	.770	.796	.821	.838	**.841**	**.839**				
	KIAS	324	322	319	313	**301**	**287**				
	FF/ENG	4095	4094	4085	4045	**3988**	**3985**				
240	EPR	1.047	1.066	1.088	1.115	1.148	**1.201**	**1.284**			
	MACH	.746	.772	.799	.823	.839	**.840**	**.839**			
	KIAS	313	312	310	307	300	**287**	**274**			
	FF/ENG	3762	3759	3758	3747	3705	**3645**	**3691**			
220	EPR	1.033	1.048	1.068	1.090	1.118	1.153	**1.209**	1.297		
	MACH	.721	.746	.773	.800	.825	.840	**.840**	.839		
	KIAS	302	300	299	297	294	287	**274**	261		
	FF/ENG	3437	3429	3427	3425	3413	3372	**3337**	3416		
200	EPR	1.021	1.033	1.048	1.068	1.090	1.118	1.155	**1.212**	1.300	
	MACH	.695	.719	.745	.772	.799	.825	.840	**.840**	.839	
	KIAS	290	289	287	286	284	281	274	**262**	249	
	FF/ENG	3123	3108	3100	3098	3095	3085	3065	**3054**	3127	
180	EPR	1.009	1.020	1.032	1.047	1.066	1.089	1.117	1.153	**1.208**	**1.293**
	MACH	.667	.690	.714	.740	.768	.796	.822	.839	**.840**	**.839**
	KIAS	278	276	275	273	272	270	268	262	**250**	**238**
	FF/ENG	2881	2853	2834	2775	2772	2770	2779	2784	**2773**	**2826**
160	EPR	1.000	1.008	1.018	1.030	1.044	1.063	1.085	1.114	1.147	**1.199**
	MACH	.636	.659	.682	.707	.733	.761	.790	.817	.837	**.841**
	KIAS	264	263	261	260	259	257	256	254	249	**239**
	FF/ENG	2589	2558	2532	2463	2454	2449	2464	2494	2505	**2500**
140	EPR	0.992	0.998	1.006	1.016	1.026	1.040	1.057	1.080	1.106	1.138
	MACH	.602	.625	.648	.671	.696	.722	.750	.778	.807	.831
	KIAS	249	248	247	246	244	243	242	241	239	236
	FF/ENG	2357	2271	2243	2217	2196	2183	2190	2217	2242	2263

Boldface area approximates optimum altitude.

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Long Range Cruise Enroute Fuel and Time—Low Altitude
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
283	262	243	226	213	200	191	182	174	167	161
567	524	485	453	425	400	382	366	351	337	324
851	786	729	680	638	600	573	549	526	505	486
1136	1050	974	908	851	800	764	732	701	673	648
1423	1314	1218	1136	1064	1000	956	914	876	842	810
1711	1580	1463	1364	1277	1200	1147	1097	1052	1010	972
2000	1846	1709	1592	1491	1400	1337	1279	1226	1177	1133
2290	2112	1954	1820	1704	1600	1528	1462	1401	1345	1295
2581	2380	2201	2049	1918	1800	1720	1645	1576	1513	1456
2874	2649	2449	2279	2132	2000	1910	1827	1751	1680	1617

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	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	3.6	0:39	3.1	0:37	2.6	0:36	2.3	0:35	2.0	0:34
400	7.6	1:14	6.8	1:11	5.9	1:06	5.3	1:04	4.8	1:01
600	11.5	1:50	10.5	1:44	9.1	1:37	8.4	1:33	7.6	1:29
800	15.4	2:26	14.2	2:18	12.4	2:09	11.4	2:03	10.4	1:57
1000	19.4	3:02	17.9	2:53	15.6	2:40	14.4	2:33	13.2	2:26
1200	23.3	3:38	21.5	3:27	18.8	3:12	17.4	3:03	16.0	2:54
1400	27.1	4:15	25.1	4:02	21.9	3:44	20.3	3:33	18.7	3:23
1600	31.0	4:53	28.7	4:37	25.1	4:16	23.2	4:03	21.5	3:51
1800	34.7	5:30	32.2	5:13	28.2	4:48	26.1	4:34	24.2	4:20
2000	38.5	6:08	35.7	5:49	31.2	5:21	29.0	5:04	26.9	4:49

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)							
	160	180	200	220	240	260	280	300
5	–0.3	–0.2	0.0	0.2	0.5	0.7	1.0	1.2
10	–0.7	–0.4	0.0	0.5	1.1	1.6	2.2	2.7
15	–1.1	–0.6	0.0	0.8	1.7	2.5	3.4	4.2
20	–1.6	–0.8	0.0	1.1	2.2	3.4	4.5	5.7
25	–2.0	–1.0	0.0	1.4	2.8	4.2	5.7	7.1
30	–2.5	–1.2	0.0	1.6	3.3	5.0	6.7	8.5
35	–3.0	–1.4	0.0	1.8	3.8	5.7	7.8	9.9
40	–3.4	–1.7	0.0	2.0	4.2	6.5	8.8	11.3

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Long Range Cruise Enroute Fuel and Time—High Altitude
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
525	495	467	442	420	400	383	368	353	340	328
1045	985	931	883	840	800	767	737	709	683	659
1566	1477	1396	1324	1259	1200	1152	1107	1065	1026	991
2089	1970	1862	1766	1679	1600	1536	1476	1420	1369	1322
2614	2465	2329	2208	2100	2000	1920	1845	1776	1712	1653
3141	2961	2797	2651	2520	2400	2304	2215	2131	2054	1984
3670	3458	3265	3094	2941	2800	2688	2584	2486	2397	2315
4201	3957	3735	3538	3362	3200	3072	2952	2842	2739	2645
4734	4457	4206	3983	3783	3600	3456	3321	3196	3081	2975
5269	4959	4206	4428	4205	4000	3840	3690	3551	3423	3305
5806	5463	5151	4874	4627	4400	4223	4058	3905	3764	3634
6346	5968	5625	5321	5049	4800	4607	4426	4259	4104	3962
6888	6475	6100	5768	5471	5200	4990	4794	4612	4444	4290
7433	6984	6576	6216	5894	5600	5373	5161	4964	4783	4617
7981	7495	7054	6665	6317	6000	5756	5528	5316	5121	4943
8532	8008	7533	7114	6741	6400	6138	5894	5668	5460	5269
9086	8523	8013	7565	7165	6800	6521	6261	6020	5797	5594
9643	9041	8496	8017	7589	7200	6903	6627	6370	6134	5918
10204	9561	8980	8469	8014	7600	7285	6992	6721	6470	6241
10769	10084	9465	8922	8440	8000	7667	7357	7070	6806	6564

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37 & ABOVE	
	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)
400	4.7	1:01	4.5	0:60	4.4	0:59	4.2	0:58	4.1	0:57
800	10.2	1:56	9.9	1:53	9.6	1:51	9.3	1:49	9.0	1:47
1200	15.6	2:52	15.1	2:48	14.7	2:44	14.3	2:40	13.9	2:38
1600	21.0	3:49	20.3	3:43	19.7	3:37	19.2	3:32	18.7	3:28
2000	26.4	4:45	25.4	4:38	24.7	4:31	24.0	4:24	23.5	4:19
2400	31.6	5:44	30.3	5:35	29.5	5:26	28.7	5:18	28.1	5:10
2800	36.7	6:42	35.3	6:31	34.3	6:21	33.4	6:11	32.6	6:02
3200	41.8	7:41	40.1	7:29	39.0	7:16	38.0	7:05	37.1	6:54
3600	46.7	8:41	44.9	8:27	43.6	8:13	42.4	7:60	41.5	7:47
4000	51.7	9:42	49.6	9:25	48.2	9:09	46.9	8:55	45.8	8:40
4400	56.4	10:44	54.2	10:25	52.7	10:08	51.3	9:51	50.1	9:35
4800	61.2	11:46	58.8	11:25	57.2	11:06	55.6	10:47	54.4	10:29
5200	65.8	12:49	63.3	12:26	61.6	12:05	59.9	11:45	58.5	11:24
5600	70.4	13:53	67.8	13:28	65.8	13:05	64.1	12:43	62.6	12:20
6000	74.9	14:57	72.2	14:30	70.1	14:05	68.2	13:41	66.7	13:16
6400	79.4	16:04	76.4	15:34	74.2	15:07	72.2	14:41	70.6	14:14
6800	83.9	17:11	80.7	16:39	78.3	16:09	76.2	15:40	74.4	15:11
7200	88.3	18:19	84.9	17:44	82.4	17:12	80.1	16:41	78.3	16:10
7600	92.6	19:28	89.0	18:50	86.3	18:16	83.9	17:43	82.0	17:09
8000	96.9	20:38	93.2	19:57	90.3	19:20	87.8	18:45	85.7	18:09

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Long Range Cruise Enroute Fuel and Time—High Altitude
Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	160	180	200	220	240
10	–1.0	–0.4	0.0	1.0	2.4
20	–2.1	–1.0	0.0	1.8	4.4
30	–3.1	–1.6	0.0	2.6	6.2
40	–4.2	–2.1	0.0	3.4	7.9
50	–5.3	–2.7	0.0	4.1	9.3
60	–6.4	–3.2	0.0	4.7	10.7
70	–7.5	–3.7	0.0	5.3	11.8
80	–8.5	–4.2	0.0	5.9	12.8
90	–9.6	–4.7	0.0	6.4	13.6
100	–10.7	–5.2	0.0	6.8	14.3

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Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)						
	260	240	220	200	180	160	140
43				43	10	0	7
41			42	12	0	3	19
39		38	12	0	2	14	33
37	32	10	0	1	11	28	49
35	7	0	1	10	24	43	64
33	0	2	10	23	39	58	78
31	3	10	22	37	54	72	91
29	12	23	36	52	68	85	102
27	24	37	51	66	81	97	112
25	38	51	65	79	93	107	121

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.**

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Descent at .84/310/250 KIAS

PRESSURE ALT (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	93	100	107	114	119	124	130	136	142	148
TIME (MINUTES)	19	20	21	22	23	23	24	25	25	26

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Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
300	EPR	1.023	1.031	1.047	1.059	1.075	1.123	1.198			
	KIAS	260	260	262	277	302	306	311			
	FF/ENG	4350	4320	4190	4230	4440	4530	4710			
280	EPR	1.02	1.027	1.04	1.055	1.067	1.108	1.169			
	KIAS	251	251	253	261	286	295	299			
	FF/ENG	4060	4020	3890	3890	4060	4180	4300			
260	EPR	1.017	1.023	1.034	1.052	1.063	1.092	1.145	1.265		
	KIAS	242	242	243	246	266	283	287	279		
	FF/ENG	3770	3720	3690	3580	3740	3830	3920	4060		
240	EPR	1.014	1.019	1.029	1.045	1.059	1.074	1.124	1.203		
	KIAS	232	233	234	235	247	272	275	279		
	FF/ENG	3560	3510	3460	3350	3380	3490	3560	3710		
220	EPR	1.01	1.015	1.024	1.037	1.055	1.066	1.105	1.167		
	KIAS	223	223	224	224	230	251	262	266		
	FF/ENG	3280	3230	3170	3140	3050	3160	3220	3310		
200	EPR	1.006	1.009	1.017	1.028	1.047	1.061	1.084	1.138	1.249	
	KIAS	216	216	216	216	216	229	249	253	249	
	FF/ENG	3010	2960	2890	2850	2760	2800	2880	2950	3130	
180	EPR	1.001	1.004	1.01	1.019	1.033	1.056	1.068	1.113	1.186	1.289
	KIAS	209	209	209	209	209	209	230	239	242	232
	FF/ENG	2820	2700	2630	2580	2550	2470	2570	2600	2770	2870
160	EPR	0.997	0.999	1.004	1.01	1.022	1.039	1.062	1.088	1.147	1.202
	KIAS	202	202	202	202	202	202	206	224	227	229
	FF/ENG	2570	2510	2380	2320	2290	2260	2220	2320	2440	2560
140	EPR	0.994	0.996	0.998	1.003	1.011	1.025	1.044	1.069	1.115	1.154
	KIAS	194	194	194	194	194	194	194	202	211	213
	FF/ENG	2330	2260	2190	2080	2040	2000	1940	1970	2100	2170

This table includes 5% additional fuel for holding in a racetrack pattern.

Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
260	EPR	1.043	1.053	1.071	1.101	1.145
	KIAS	216	216	216	216	216
	FF/ENG	4030	3990	3850	3850	3930
240	EPR	1.036	1.045	1.061	1.085	1.123
	KIAS	209	209	209	209	209
	FF/ENG	3720	3680	3630	3590	3600
220	EPR	1.029	1.037	1.051	1.071	1.103
	KIAS	203	203	203	203	203
	FF/ENG	3480	3440	3380	3270	3270
200	EPR	1.023	1.029	1.042	1.057	1.084
	KIAS	196	196	196	196	196
	FF/ENG	3180	3140	3080	3040	2950
180	EPR	1.017	1.022	1.033	1.046	1.066
	KIAS	189	189	189	189	189
	FF/ENG	2960	2840	2790	2740	2650
160	EPR	1.012	1.016	1.024	1.035	1.050
	KIAS	182	182	182	182	182
	FF/ENG	2670	2620	2500	2450	2410
140	EPR	1.008	1.011	1.016	1.025	1.037
	KIAS	174	174	174	174	174
	FF/ENG	2400	2340	2270	2170	2120

This table includes 5% additional fuel for holding in a racetrack pattern.

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ADVISORY INFORMATION

Reported Braking Action

RUNWAY CONDITION CODE	RUNWAY SURFACE CONDITION DESCRIPTION	REPORTED BRAKING ACTION
6	Dry	Dry
5	Wet (Smooth, Grooved or PFC) or Frost 3 mm (0.12 inches) or less of: Water, Slush, Dry Snow or Wet Snow	Good
4	Compacted Snow at or below –15 deg. C OAT	Good to Medium
3	Wet (Slippery), Dry Snow or Wet Snow (any depth) over Compacted Snow Greater than 3 mm (0.12 inches) of : Dry Snow or Wet Snow Compacted Snow at OAT warmer than –15 deg. C	Medium
2	Greater than 3 mm (0.12 inches) of: Water or Slush	Medium to Poor
1	Ice	Poor
0	Wet Ice, Water on top of Compacted Snow, Dry Snow or Wet Snow over Ice	Nil

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Normal Configuration Operational Landing Distance
Flaps 30

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF30	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1195	30/–5	25	–40/145	10/–10	25/–25	40	10	30
AUTOBRAKE MAX	1530	25/–5	30	–60/200	0/0	35/–35	75	0	0
AUTOBRAKE 4	1850	30/–10	45	–80/280	0/–5	45/–45	90	0	0
AUTOBRAKE 3	2170	35/–10	50	–105/350	10/–10	60/–60	110	0	0
AUTOBRAKE 2	2405	45/–25	65	–115/410	15/–35	65/–65	110	5	5
AUTOBRAKE 1	2580	50/–30	75	–130/455	45/–65	70/–70	100	105	105
Good Reported Braking Action									
MAX MANUAL	1580	25/–10	35	–70/245	35/–30	35/–35	60	65	145
AUTOBRAKE MAX	1670	30/–10	40	–75/260	30/–25	35/–35	70	65	150
AUTOBRAKE 4	1855	30/–10	45	–80/290	10/–5	45/–45	90	5	30
AUTOBRAKE 3	2170	35/–10	50	–105/350	10/–10	60/–60	110	0	0
AUTOBRAKE 2	2405	45/–25	65	–115/410	15/–35	65/–65	110	5	5
AUTOBRAKE 1	2580	50/–30	75	–130/455	45/–65	70/–70	100	105	105
Good To Medium Reported Braking Action									
MAX MANUAL	1820	30/–15	45	–90/325	60/–50	40/–40	65	125	295
AUTOBRAKE MAX	1870	35/–15	50	–90/335	55/–40	40/–40	80	120	295
AUTOBRAKE 4	1975	35/–15	50	–95/350	50/–35	50/–50	85	100	245
AUTOBRAKE 3	2220	35/–15	55	–110/390	35/–25	60/–60	110	45	165
AUTOBRAKE 2	2435	45/–25	65	–120/435	35/–45	65/–65	110	30	105
AUTOBRAKE 1	2595	50/–30	75	–135/470	60/–70	70/–70	100	115	160
Medium Reported Braking Action									
MAX MANUAL	2060	40/–25	60	–110/405	85/–70	45/–45	75	185	450
AUTOBRAKE MAX	2075	40/–15	60	–110/410	80/–60	45/–45	85	175	445
AUTOBRAKE 4	2095	40/–15	60	–110/410	85/–65	50/–50	80	190	460
AUTOBRAKE 3	2275	40/–15	60	–120/430	60/–35	60/–60	110	90	330
AUTOBRAKE 2	2465	45/–25	65	–125/460	50/–50	65/–65	110	50	205
AUTOBRAKE 1	2610	50/–30	75	–140/490	75/–75	70/–70	100	125	215
Medium To Poor Reported Braking Action									
MAX MANUAL	2325	45/–30	70	–135/520	145/–100	55/–55	80	290	770
AUTOBRAKE MAX	2335	50/–25	70	–135/520	140/–95	55/–55	85	285	765
AUTOBRAKE 4	2355	50/–25	70	–135/520	145/–100	60/–60	85	295	780
AUTOBRAKE 3	2455	50/–25	70	–140/535	130/–75	60/–60	105	245	710
AUTOBRAKE 2	2600	50/–30	70	–145/555	110/–85	65/–65	110	175	600
AUTOBRAKE 1	2715	55/–30	80	–155/580	125/–100	70/–70	100	225	565
Poor Reported Braking Action									
MAX MANUAL	2590	50/–35	80	–160/635	200/–130	65/–65	85	395	1085
AUTOBRAKE MAX	2595	60/–35	80	–160/635	200/–130	65/–65	85	395	1085
AUTOBRAKE 4	2615	60/–35	80	–160/635	200/–140	65/–65	85	405	1100
AUTOBRAKE 3	2635	60/–30	80	–160/640	200/–115	65/–65	100	395	1095
AUTOBRAKE 2	2735	60/–35	80	–165/650	175/–115	70/–70	110	300	990
AUTOBRAKE 1	2820	60/–35	85	–175/665	180/–125	70/–70	100	330	920

Reference distance is based on sea level, standard day, no wind or slope, VREF 30 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 70 m.
For autobrake and manual speedbrakes, increase reference landing distance by 60 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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ADVISORY INFORMATION

Normal Configuration Operational Landing Distance
Flaps 25

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF25	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1240	30/–10	25	–40/150	10/–10	25/–25	40	15	35
AUTOBRAKE MAX	1625	25/–15	35	–65/205	0/0	35/–35	75	0	0
AUTOBRAKE 4	1975	35/–25	45	–85/295	0/–5	45/–45	100	0	0
AUTOBRAKE 3	2330	40/–30	60	–110/360	10/–10	65/–65	115	0	0
AUTOBRAKE 2	2565	50/–40	70	–120/420	30/–45	70/–70	105	35	35
AUTOBRAKE 1	2725	60/–45	80	–140/470	60/–70	70/–70	100	165	175
Good Reported Braking Action									
MAX MANUAL	1645	30/–15	40	–70/255	35/–30	35/–35	60	75	165
AUTOBRAKE MAX	1750	30/–15	40	–75/265	30/–30	40/–40	70	80	180
AUTOBRAKE 4	1980	35/–25	45	–85/300	10/–5	45/–45	100	5	30
AUTOBRAKE 3	2330	40/–30	60	–110/360	10/–10	65/–65	115	0	0
AUTOBRAKE 2	2565	50/–40	70	–120/420	30/–45	70/–70	105	35	35
AUTOBRAKE 1	2725	60/–45	80	–140/470	60/–70	70/–70	100	165	175
Good To Medium Reported Braking Action									
MAX MANUAL	1900	35/–25	50	–90/335	60/–50	45/–45	65	140	350
AUTOBRAKE MAX	1960	35/–25	50	–90/340	55/–45	45/–45	80	140	350
AUTOBRAKE 4	2090	35/–25	50	–100/355	50/–30	50/–50	90	105	280
AUTOBRAKE 3	2380	45/–30	60	–115/405	35/–25	65/–65	115	45	175
AUTOBRAKE 2	2595	50/–40	70	–125/450	45/–55	70/–70	105	60	140
AUTOBRAKE 1	2735	60/–45	80	–140/485	70/–75	70/–70	100	180	230
Medium Reported Braking Action									
MAX MANUAL	2155	40/–35	60	–110/415	85/–70	50/–50	75	205	530
AUTOBRAKE MAX	2170	40/–30	60	–110/415	80/–65	50/–50	85	200	520
AUTOBRAKE 4	2200	40/–30	60	–115/415	85/–60	50/–50	85	205	535
AUTOBRAKE 3	2430	45/–30	65	–120/450	60/–40	65/–65	115	90	350
AUTOBRAKE 2	2625	50/–40	75	–130/475	65/–65	70/–70	105	80	245
AUTOBRAKE 1	2750	60/–45	80	–145/500	85/–80	75/–75	100	195	290
Medium To Poor Reported Braking Action									
MAX MANUAL	2430	50/–40	70	–140/530	145/–100	60/–60	80	330	900
AUTOBRAKE MAX	2440	50/–35	70	–140/530	145/–100	60/–60	85	325	895
AUTOBRAKE 4	2465	50/–35	70	–140/530	145/–100	60/–60	85	330	910
AUTOBRAKE 3	2600	50/–35	75	–145/550	125/–75	65/–65	110	260	805
AUTOBRAKE 2	2755	55/–45	80	–150/570	120/–90	70/–70	105	205	690
AUTOBRAKE 1	2860	60/–50	85	–160/590	140/–105	75/–75	100	295	680
Poor Reported Braking Action									
MAX MANUAL	2705	60/–45	80	–165/645	200/–130	65/–65	85	450	1270
AUTOBRAKE MAX	2710	60/–45	85	–165/645	205/–140	70/–70	85	450	1270
AUTOBRAKE 4	2730	60/–45	85	–165/645	200/–140	70/–70	85	455	1280
AUTOBRAKE 3	2770	60/–40	85	–165/650	195/–110	70/–70	110	425	1260
AUTOBRAKE 2	2890	60/–45	85	–175/665	180/–120	75/–75	105	335	1135
AUTOBRAKE 1	2970	65/–50	90	–180/680	190/–130	75/–75	100	395	1075

Reference distance is based on sea level, standard day, no wind or slope, VREF 25 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 70 m.
For autobrake and manual speedbrakes, increase reference landing distance by 60 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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Normal Configuration Operational Landing Distance
Flaps 20

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF20	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1285	35/–15	25	–45/150	10/–10	25/–25	40	15	40
AUTOBRAKE MAX	1695	30/–25	35	–65/215	0/0	35/–35	75	0	0
AUTOBRAKE 4	2080	35/–35	50	–85/300	0/–5	50/–50	105	0	0
AUTOBRAKE 3	2465	45/–40	65	–110/380	5/–10	65/–65	120	0	0
AUTOBRAKE 2	2725	50/–50	75	–125/435	25/–45	75/–75	115	35	35
AUTOBRAKE 1	2895	65/–60	85	–145/490	60/–75	75/–75	110	165	175
Good Reported Braking Action									
MAX MANUAL	1720	30/–25	40	–75/260	40/–35	35/–40	60	85	195
AUTOBRAKE MAX	1825	30/–30	45	–75/270	35/–30	40/–40	70	85	205
AUTOBRAKE 4	2085	35/–35	50	–90/310	5/–5	50/–50	105	5	35
AUTOBRAKE 3	2465	45/–40	65	–110/380	5/–10	65/–65	120	0	0
AUTOBRAKE 2	2725	55/–50	75	–125/435	25/–45	75/–75	115	35	35
AUTOBRAKE 1	2895	65/–60	85	–145/490	60/–75	75/–75	110	165	175
Good To Medium Reported Braking Action									
MAX MANUAL	1995	35/–30	50	–95/340	65/–55	45/–45	65	165	410
AUTOBRAKE MAX	2055	35/–35	55	–95/350	65/–50	50/–50	80	160	410
AUTOBRAKE 4	2200	40/–35	60	–105/370	45/–35	55/–55	100	120	330
AUTOBRAKE 3	2515	45/–40	65	–120/420	30/–25	65/–65	120	50	215
AUTOBRAKE 2	2750	50/–50	80	–130/465	45/–55	75/–75	115	60	160
AUTOBRAKE 1	2910	65/–60	90	–145/505	70/–80	80/–80	110	180	240
Medium Reported Braking Action									
MAX MANUAL	2270	45/–40	65	–115/425	90/–75	50/–50	75	240	620
AUTOBRAKE MAX	2280	45/–40	65	–115/425	90/–70	60/–60	85	230	610
AUTOBRAKE 4	2320	45/–40	65	–115/425	85/–65	60/–60	90	235	625
AUTOBRAKE 3	2565	45/–40	70	–125/460	50/–40	65/–70	120	105	425
AUTOBRAKE 2	2780	50/–50	80	–140/490	65/–65	75/–75	115	80	290
AUTOBRAKE 1	2925	65/–60	90	–150/520	85/–85	80/–80	110	195	305
Medium To Poor Reported Braking Action									
MAX MANUAL	2565	55/–50	80	–145/545	150/–110	60/–60	80	380	1060
AUTOBRAKE MAX	2575	55/–50	80	–145/545	155/–105	65/–65	85	375	1060
AUTOBRAKE 4	2600	55/–50	80	–145/545	150/–105	65/–65	90	380	1070
AUTOBRAKE 3	2750	55/–50	80	–150/565	125/–80	70/–70	115	295	955
AUTOBRAKE 2	2920	60/–55	85	–160/585	125/–95	80/–80	115	230	825
AUTOBRAKE 1	3035	65/–60	95	–165/605	140/–115	80/–80	110	310	785
Poor Reported Braking Action									
MAX MANUAL	2860	65/–60	90	–175/660	215/–145	70/–70	85	520	1500
AUTOBRAKE MAX	2865	65/–60	90	–175/660	220/–145	70/–70	85	520	1505
AUTOBRAKE 4	2885	65/–60	90	–175/660	215/–145	70/–70	90	525	1520
AUTOBRAKE 3	2935	65/–60	90	–175/665	200/–120	75/–75	110	490	1490
AUTOBRAKE 2	3055	65/–60	90	–180/685	185/–125	80/–80	115	380	1365
AUTOBRAKE 1	3150	70/–65	100	–185/695	195/–145	80/–80	110	425	1265

Reference distance is based on sea level, standard day, no wind or slope, VREF 20 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 75 m.
For autobrake and manual speedbrakes, increase reference landing distance by 60 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
Airspeed Unreliable (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1355	30/–15	30	–45/155	15/–15	25/–25	N/A	30	65
AUTOBRAKE MAX	1600	25/–20	35	–60/200	0/0	35/–35	N/A	0	0
AUTOBRAKE 2	2670	50/–45	75	–120/405	5/–25	75/–75	N/A	10	10
Good Reported Braking Action									
MAX MANUAL	1815	30/–25	45	–75/260	45/–40	40/–40	N/A	115	275
AUTOBRAKE MAX	1820	30/–30	45	–75/260	40/–35	40/–45	N/A	115	270
AUTOBRAKE 2	2670	50/–45	75	–120/405	5/–25	75/–75	N/A	10	10
Good To Medium Reported Braking Action									
MAX MANUAL	2090	40/–35	60	–95/335	75/–60	50/–50	N/A	215	550
AUTOBRAKE MAX	2090	40/–40	60	–95/335	75/–60	50/–55	N/A	210	545
AUTOBRAKE 2	2700	50/–50	75	–125/435	30/–35	75/–75	N/A	45	250
Medium Reported Braking Action									
MAX MANUAL	2365	45/–40	70	–115/410	105/–80	60/–60	N/A	310	825
AUTOBRAKE MAX	2360	45/–45	70	–115/410	110/–85	60/–60	N/A	305	820
AUTOBRAKE 3	2505	45/–40	70	–120/425	75/–35	65/–65	N/A	195	715
Medium To Poor Reported Braking Action									
MAX MANUAL	2655	55/–50	85	–140/520	165/–115	70/–70	N/A	470	1380
AUTOBRAKE MAX	2655	55/–55	85	–140/520	175/–125	70/–70	N/A	465	1380
AUTOBRAKE 3	2740	55/–50	85	–145/530	150/–90	70/–70	N/A	405	1325
Poor Reported Braking Action									
MAX MANUAL	2945	65/–60	100	–165/625	225/–150	75/–75	N/A	625	1930
AUTOBRAKE MAX	2950	65/–60	100	–165/625	235/–160	75/–75	N/A	625	1935
AUTOBRAKE 3	2970	65/–55	100	–165/630	225/–140	75/–75	N/A	615	1930

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1870	35/–30	50	–95/360	75/–60	45/–45	60	180	460
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1870	35/–30	50	–95/360	75/–60	45/–45	60	180	460
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2110	45/–35	60	–120/460	125/–90	50/–50	65	285	785
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2350	50/–40	70	–145/560	175/–115	55/–55	70	390	1105
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	2755	65/–50	90	–200/835	400/–200	65/–65	75	725	2735
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3160	75/–60	110	–250/1110	625/–280	75/–75	80	1055	4365
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1790	35/–20	50	–95/350	75/–60	40/–40	65	160	390
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1790	35/–20	50	–95/350	75/–60	40/–40	65	160	390
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2020	40/–25	60	–120/450	125/–90	50/–50	70	255	670
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2250	45/–30	70	–140/550	175/–115	55/–55	70	345	945
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	2650	60/–40	85	–195/825	395/–195	65/–65	75	655	2405
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3045	70/–50	100	–245/1095	615/–275	75/–75	80	965	3860
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG SHUTDOWN L, R (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1125	30/–15	20	–40/135	15/–10	20/–20	35	0	20
AUTOBRAKE MAX	1470	25/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2390	45/–40	65	–110/380	10/–10	65/–65	125	0	0
Good Reported Braking Action									
MAX MANUAL	1555	25/–25	35	–70/235	40/–35	35/–35	55	0	95
AUTOBRAKE MAX	1645	25/–25	40	–70/245	35/–30	40/–40	65	0	100
AUTOBRAKE 2	2390	45/–40	65	–110/380	10/–10	65/–65	125	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1850	35/–35	50	–90/320	75/–60	45/–45	65	0	205
AUTOBRAKE MAX	1895	35/–35	50	–90/325	70/–55	50/–50	75	0	205
AUTOBRAKE 2	2430	45/–45	70	–120/410	35/–25	65/–65	125	0	80
Medium Reported Braking Action									
MAX MANUAL	2140	40/–40	60	–110/400	105/–85	55/–55	75	0	310
AUTOBRAKE MAX	2145	40/–40	60	–110/400	105/–75	55/–55	85	0	305
AUTOBRAKE 3	2285	45/–40	65	–115/415	80/–50	60/–60	105	0	250
Medium To Poor Reported Braking Action									
MAX MANUAL	2490	50/–50	75	–140/525	190/–130	65/–65	85	0	545
AUTOBRAKE MAX	2495	55/–50	75	–140/525	190/–125	65/–65	90	0	540
AUTOBRAKE 3	2580	55/–50	80	–145/535	180/–115	70/–70	100	0	520
Poor Reported Braking Action									
MAX MANUAL	2835	60/–55	90	–170/650	270/–170	75/–75	90	0	775
AUTOBRAKE MAX	2840	65/–60	90	–170/650	275/–175	75/–75	90	0	775
AUTOBRAKE 3	2875	65/–60	90	–175/655	275/–175	75/–75	90	0	785

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG SHUTDOWN L, R (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1040	25/–5	20	–35/125	10/–10	20/–20	35	0	15
AUTOBRAKE MAX	1330	20/–5	25	–50/175	0/0	30/–30	60	0	0
AUTOBRAKE 2	2090	40/–10	55	–105/355	10/–10	55/–55	115	0	0
Good Reported Braking Action									
MAX MANUAL	1405	20/–10	30	–65/225	35/–30	30/–30	55	0	65
AUTOBRAKE MAX	1495	25/–10	35	–65/235	30/–25	35/–35	65	0	70
AUTOBRAKE 2	2090	40/–10	55	–105/355	10/–10	55/–55	115	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1660	30/–15	40	–85/305	65/–55	40/–40	65	0	140
AUTOBRAKE MAX	1705	30/–15	45	–85/310	60/–45	45/–45	75	0	145
AUTOBRAKE 2	2130	40/–15	60	–110/385	35/–20	55/–55	115	0	60
Medium Reported Braking Action									
MAX MANUAL	1910	35/–20	50	–105/380	95/–75	45/–45	70	0	215
AUTOBRAKE MAX	1915	35/–15	50	–105/380	90/–65	50/–50	80	0	215
AUTOBRAKE 3	2025	40/–15	55	–110/390	75/–45	50/–50	95	0	180
Medium To Poor Reported Braking Action									
MAX MANUAL	2210	45/–30	65	–135/500	170/–115	55/–55	80	0	380
AUTOBRAKE MAX	2215	45/–25	65	–135/500	170/–110	60/–60	85	0	380
AUTOBRAKE 3	2285	50/–25	65	–135/505	160/–100	60/–60	90	0	365
Poor Reported Braking Action									
MAX MANUAL	2505	55/–35	75	–160/615	240/–150	65/–65	85	0	540
AUTOBRAKE MAX	2510	55/–35	75	–160/615	245/–155	65/–65	85	0	540
AUTOBRAKE 3	2540	55/–35	75	–160/615	245/–155	65/–65	85	0	545

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAP/SLAT CONTROL (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1105	30/–15	20	–40/130	10/–10	20/–20	35	15	35
AUTOBRAKE MAX	1470	25/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2350	45/–45	65	–110/375	25/–45	60/–60	95	40	40
Good Reported Braking Action									
MAX MANUAL	1485	25/–20	35	–65/225	30/–30	30/–30	50	70	165
AUTOBRAKE MAX	1575	25/–25	35	–65/235	30/–25	35/–35	60	75	175
AUTOBRAKE 2	2350	45/–45	65	–110/375	25/–45	60/–60	95	40	40
Good To Medium Reported Braking Action									
MAX MANUAL	1720	35/–30	45	–85/295	55/–50	40/–40	60	135	340
AUTOBRAKE MAX	1770	35/–30	45	–85/300	55/–40	40/–40	70	135	340
AUTOBRAKE 2	2375	45/–45	70	–115/400	40/–55	65/–65	95	60	140
MAX MANUAL	1950	40/–35	55	–100/365	80/–65	45/–45	65	200	515
AUTOBRAKE MAX	1960	40/–35	55	–100/365	75/–55	45/–45	75	195	505
AUTOBRAKE 3	2220	40/–35	60	–110/400	50/–35	55/–55	100	80	335
Medium To Poor Reported Braking Action									
MAX MANUAL	2200	50/–45	65	–125/470	130/–95	55/–55	70	315	875
AUTOBRAKE MAX	2210	50/–45	70	–125/470	130/–90	55/–55	75	315	875
AUTOBRAKE 3	2370	50/–40	70	–130/490	115/–70	60/–60	100	240	780
Poor Reported Braking Action									
MAX MANUAL	2450	55/–50	75	–145/570	180/–120	60/–60	75	430	1235
AUTOBRAKE MAX	2455	55/–50	80	–145/570	185/–125	60/–60	75	430	1240
AUTOBRAKE 3	2520	55/–45	75	–150/575	175/–100	65/–65	95	400	1220

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (Flaps ≤ 5)
VREF 30+40

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1325	40/–10	30	–45/155	15/–15	25/–25	40	30	70
AUTOBRAKE MAX	1860	25/–5	45	–65/215	0/0	45/–45	75	0	0
AUTOBRAKE 2	3015	55/–40	95	–130/430	50/–70	85/–85	105	190	190
Good Reported Braking Action									
MAX MANUAL	1745	25/–15	45	–70/240	35/–30	40/–40	50	110	270
AUTOBRAKE MAX	1925	30/–10	50	–75/260	15/–10	45/–45	75	75	245
AUTOBRAKE 2	3015	55/–40	95	–130/430	50/–70	85/–85	105	190	190
Good To Medium Reported Braking Action									
MAX MANUAL	2040	35/–20	60	–90/320	65/–50	50/–50	60	215	570
AUTOBRAKE MAX	2145	40/–20	60	–95/330	50/–40	55/–55	75	195	550
AUTOBRAKE 2	3040	60/–40	95	–135/455	65/–80	85/–85	105	210	330
Medium Reported Braking Action									
MAX MANUAL	2335	45/–25	70	–110/395	90/–70	60/–60	65	315	865
AUTOBRAKE MAX	2365	45/–25	70	–110/395	80/–65	60/–60	75	310	850
AUTOBRAKE 3	2885	50/–30	85	–130/455	50/–60	80/–80	110	120	495
Medium To Poor Reported Braking Action									
MAX MANUAL	2645	55/–35	85	–135/505	145/–105	70/–70	75	490	1505
AUTOBRAKE MAX	2670	55/–35	85	–135/505	145/–100	70/–70	80	490	1500
AUTOBRAKE 3	3025	60/–35	95	–150/545	115/–90	85/–85	110	330	1265
Poor Reported Braking Action									
MAX MANUAL	2955	65/–40	100	–160/610	200/–135	75/–75	80	665	2140
AUTOBRAKE MAX	2970	65/–40	100	–160/610	205/–135	75/–75	85	670	2150
AUTOBRAKE 3	3160	65/–40	100	–165/630	175/–115	85/–85	105	535	2030

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (5 < Flaps < 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1170	30/–5	25	–40/135	15/–10	20/–20	35	20	45
AUTOBRAKE MAX	1580	25/–5	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2565	50/–30	75	–115/395	25/–45	70/–70	105	65	65
Good Reported Braking Action									
MAX MANUAL	1580	25/–10	40	–65/230	35/–30	35/–35	50	90	215
AUTOBRAKE MAX	1675	25/–10	40	–70/240	30/–20	40/–40	65	95	225
AUTOBRAKE 2	2565	50/–30	75	–115/395	25/–45	70/–70	105	65	65
Good To Medium Reported Braking Action									
MAX MANUAL	1835	35/–20	50	–85/305	60/–50	45/–45	60	175	450
AUTOBRAKE MAX	1890	35/–15	50	–90/310	60/–45	45/–45	70	175	450
AUTOBRAKE 2	2590	50/–30	75	–120/420	40/–55	70/–70	105	85	200
Medium Reported Braking Action									
MAX MANUAL	2090	40/–25	60	–105/375	85/–65	50/–50	65	255	680
AUTOBRAKE MAX	2105	40/–20	60	–105/380	85/–65	50/–50	75	250	675
AUTOBRAKE 3	2430	40/–20	65	–115/420	40/–40	65/–65	105	90	455
Medium To Poor Reported Braking Action									
MAX MANUAL	2365	50/–30	75	–130/480	140/–100	60/–60	75	400	1170
AUTOBRAKE MAX	2380	50/–30	75	–130/485	140/–100	60/–60	80	400	1175
AUTOBRAKE 3	2585	50/–25	75	–135/510	105/–75	70/–70	100	290	1045
Poor Reported Braking Action									
MAX MANUAL	2635	55/–35	85	–150/585	190/–130	65/–65	80	540	1660
AUTOBRAKE MAX	2650	60/–35	85	–155/585	195/–130	65/–65	80	545	1670
AUTOBRAKE 3	2740	55/–30	85	–155/595	170/–110	70/–70	95	490	1630

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (Flaps ≥ 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1115	30/–15	20	–40/130	10/–10	20/–20	35	15	35
AUTOBRAKE MAX	1470	20/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2365	45/–45	65	–110/380	20/–40	65/–65	100	30	30
Good Reported Braking Action									
MAX MANUAL	1495	25/–20	35	–65/225	35/–30	30/–35	50	75	170
AUTOBRAKE MAX	1585	25/–25	40	–65/235	30/–25	35/–35	60	75	180
AUTOBRAKE 2	2365	45/–45	65	–110/380	20/–40	65/–65	100	30	30
Good To Medium Reported Braking Action									
MAX MANUAL	1735	35/–30	45	–85/300	60/–50	40/–40	60	145	355
AUTOBRAKE MAX	1785	35/–30	50	–85/305	55/–45	45/–45	70	140	355
AUTOBRAKE 2	2390	45/–45	70	–115/405	40/–50	65/–65	100	50	140
Medium Reported Braking Action									
MAX MANUAL	1970	40/–35	55	–100/370	80/–65	45/–45	65	210	540
AUTOBRAKE MAX	1980	40/–35	55	–100/370	80/–60	50/–50	75	200	530
AUTOBRAKE 3	2230	40/–35	60	–110/400	45/–35	55/–60	105	90	370
Medium To Poor Reported Braking Action									
MAX MANUAL	2230	50/–45	70	–125/475	135/–95	55/–55	70	330	925
AUTOBRAKE MAX	2235	50/–45	70	–125/475	135/–95	55/–55	75	325	920
AUTOBRAKE 3	2390	50/–45	70	–130/490	110/–70	60/–65	100	260	835
Poor Reported Braking Action									
MAX MANUAL	2485	55/–50	80	–150/575	185/–125	60/–60	75	450	1305
AUTOBRAKE MAX	2490	55/–50	80	–150/575	190/–125	60/–60	75	450	1310
AUTOBRAKE 3	2550	55/–50	80	–150/580	175/–105	65/–65	95	425	1295

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS PRIMARY FAIL (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1235	25/–15	25	–45/145	15/–15	25/–25	45	20	45
AUTOBRAKE MAX	1470	20/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2405	45/–45	65	–115/385	0/–20	65/–65	120	5	5
Good Reported Braking Action									
MAX MANUAL	1635	25/–25	40	–70/240	40/–35	35/–35	60	90	210
AUTOBRAKE MAX	1650	30/–25	40	–70/245	35/–30	35/–35	70	85	205
AUTOBRAKE 2	2405	45/–45	65	–115/385	0/–20	65/–65	120	5	5
Good To Medium Reported Braking Action									
MAX MANUAL	1885	35/–35	50	–90/315	65/–55	45/–45	70	170	430
AUTOBRAKE MAX	1885	35/–35	50	–90/315	65/–55	45/–45	75	165	425
AUTOBRAKE 2	2435	45/–45	65	–120/410	25/–30	65/–65	120	30	175
Medium Reported Braking Action									
MAX MANUAL	2130	40/–40	60	–105/390	90/–70	50/–50	75	245	645
AUTOBRAKE MAX	2120	40/–40	60	–105/385	95/–75	50/–50	80	245	640
AUTOBRAKE 3	2265	40/–35	60	–115/405	60/–35	60/–60	110	140	545
Medium To Poor Reported Braking Action									
MAX MANUAL	2400	50/–50	75	–130/495	150/–105	60/–60	85	380	1100
AUTOBRAKE MAX	2395	50/–50	75	–130/490	155/–110	60/–60	85	380	1100
AUTOBRAKE 3	2475	50/–45	75	–135/505	130/–80	65/–65	105	325	1050
Poor Reported Braking Action									
MAX MANUAL	2665	60/–55	85	–155/595	205/–135	65/–65	90	515	1550
AUTOBRAKE MAX	2665	60/–55	85	–155/595	210/–140	65/–65	90	515	1555
AUTOBRAKE 3	2685	60/–50	85	–155/600	200/–125	70/–70	100	510	1555

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLIGHT CONTROL MODE (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1260	25/–15	25	–45/150	15/–15	25/–25	50	25	50
AUTOBRAKE MAX	1470	20/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2410	45/–40	65	–115/385	0/–10	65/–65	130	0	0
Good Reported Braking Action									
MAX MANUAL	1680	30/–25	40	–70/250	40/–35	35/–35	65	100	235
AUTOBRAKE MAX	1675	30/–25	40	–70/245	35/–30	40/–40	70	95	225
AUTOBRAKE 2	2410	45/–40	65	–115/385	0/–10	65/–65	130	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1940	40/–35	55	–90/325	70/–55	45/–45	75	190	485
AUTOBRAKE MAX	1935	40/–35	55	–90/320	70/–60	50/–50	80	185	475
AUTOBRAKE 2	2445	45/–45	65	–120/410	25/–25	65/–65	130	35	235
Medium Reported Braking Action									
MAX MANUAL	2200	45/–40	65	–110/395	95/–75	55/–55	85	275	735
AUTOBRAKE MAX	2190	45/–40	65	–110/395	105/–85	55/–55	85	270	725
AUTOBRAKE 3	2285	45/–40	65	–115/410	75/–35	60/–60	110	200	665
Medium To Poor Reported Braking Action									
MAX MANUAL	2480	55/–50	80	–135/505	155/–110	65/–65	90	425	1260
AUTOBRAKE MAX	2475	55/–50	80	–135/505	165/–120	65/–65	90	425	1255
AUTOBRAKE 3	2525	55/–50	80	–140/510	150/–85	65/–65	110	390	1225
Poor Reported Braking Action									
MAX MANUAL	2755	65/–55	90	–160/610	215/–145	70/–70	95	575	1780
AUTOBRAKE MAX	2760	65/–55	90	–160/610	225/–150	70/–70	95	575	1785
AUTOBRAKE 3	2765	65/–55	90	–160/610	225/–135	70/–70	105	575	1785

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLIGHT CONTROLS (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1370	25/–5	30	–45/160	20/–20	30/–30	60	40	90
AUTOBRAKE MAX	1580	25/–5	35	–60/195	0/0	35/–35	70	0	10
AUTOBRAKE 2	2630	45/–20	70	–120/405	0/–20	75/–75	130	0	0
Good Reported Braking Action									
MAX MANUAL	1850	30/–10	50	–75/265	55/–45	45/–45	80	145	360
AUTOBRAKE MAX	1850	30/–10	50	–75/265	50/–45	45/–45	85	135	345
AUTOBRAKE 2	2630	45/–20	70	–120/405	0/–20	75/–75	130	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2130	40/–20	65	–95/345	85/–70	55/–55	90	255	685
AUTOBRAKE MAX	2130	40/–20	65	–95/345	85/–70	55/–55	90	250	680
AUTOBRAKE 2	2670	50/–20	75	–125/430	30/–35	75/–75	130	60	375
Medium Reported Braking Action									
MAX MANUAL	2405	50/–25	75	–115/420	115/–90	60/–60	95	365	1010
AUTOBRAKE MAX	2405	50/–25	75	–115/420	120/–95	60/–60	95	365	1010
AUTOBRAKE 3	2505	50/–15	70	–120/430	85/–45	65/–65	115	295	950
Medium To Poor Reported Braking Action									
MAX MANUAL	2690	60/–35	90	–145/530	180/–125	70/–70	100	535	1630
AUTOBRAKE MAX	2695	60/–35	90	–145/530	185/–130	70/–70	100	535	1635
AUTOBRAKE 3	2745	60/–25	90	–145/535	165/–95	75/–70	115	500	1605
Poor Reported Braking Action									
MAX MANUAL	2975	70/–40	105	–170/635	240/–160	75/–75	100	700	2250
AUTOBRAKE MAX	2985	70/–40	105	–170/635	245/–165	75/–75	100	705	2260
AUTOBRAKE 3	2985	70/–35	105	–170/635	245/–145	80/–75	110	705	2260

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS C (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1235	25/–15	25	–45/145	15/–15	25/–25	45	20	45
AUTOBRAKE MAX	1470	20/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2405	45/–45	65	–115/385	0/–20	65/–65	120	5	5
Good Reported Braking Action									
MAX MANUAL	1635	25/–25	40	–70/240	40/–35	35/–35	60	90	210
AUTOBRAKE MAX	1650	30/–25	40	–70/245	35/–30	35/–35	70	85	205
AUTOBRAKE 2	2405	45/–45	65	–115/385	0/–20	65/–65	120	5	5
Good To Medium Reported Braking Action									
MAX MANUAL	1885	35/–35	50	–90/315	65/–55	45/–45	70	170	430
AUTOBRAKE MAX	1885	35/–35	50	–90/315	65/–55	45/–45	75	165	425
AUTOBRAKE 2	2435	45/–45	65	–120/410	25/–30	65/–65	120	30	175
Medium Reported Braking Action									
MAX MANUAL	2130	40/–40	60	–105/390	90/–70	50/–50	75	245	645
AUTOBRAKE MAX	2120	40/–40	60	–105/385	95/–75	50/–50	80	245	640
AUTOBRAKE 3	2265	40/–35	60	–115/405	60/–35	60/–60	110	140	545
Medium To Poor Reported Braking Action									
MAX MANUAL	2400	50/–50	75	–130/495	150/–105	60/–60	85	380	1100
AUTOBRAKE MAX	2395	50/–50	75	–130/490	155/–110	60/–60	85	380	1100
AUTOBRAKE 3	2475	50/–45	75	–135/505	130/–80	65/–65	105	325	1050
Poor Reported Braking Action									
MAX MANUAL	2665	60/–55	85	–155/595	205/–135	65/–65	90	515	1550
AUTOBRAKE MAX	2665	60/–55	85	–155/595	210/–140	65/–65	90	515	1555
AUTOBRAKE 3	2685	60/–50	85	–155/600	200/–125	70/–70	100	510	1555

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1135	25/–10	20	–40/140	15/–15	20/–20	40	0	20
AUTOBRAKE MAX	1410	20/–15	30	–55/180	0/0	30/–30	65	0	0
AUTOBRAKE 2	2280	40/–30	60	–110/370	0/–10	60/–60	120	0	0
Good Reported Braking Action									
MAX MANUAL	1575	25/–20	40	–70/245	45/–35	35/–35	60	0	100
AUTOBRAKE MAX	1635	25/–20	40	–70/250	35/–30	40/–40	70	0	105
AUTOBRAKE 2	2280	40/–30	60	–110/370	0/–10	60/–60	120	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1880	35/–25	50	–95/335	85/–65	45/–45	75	0	220
AUTOBRAKE MAX	1910	35/–25	50	–95/335	80/–65	50/–50	80	0	225
AUTOBRAKE 2	2335	45/–30	65	–120/410	35/–25	65/–65	120	0	110
Medium Reported Braking Action									
MAX MANUAL	2180	40/–30	60	–115/420	120/–90	55/–55	85	0	340
AUTOBRAKE MAX	2180	40/–30	60	–115/420	125/–95	55/–55	85	0	340
AUTOBRAKE 3	2250	45/–30	60	–120/430	110/–65	60/–60	100	0	340
Medium To Poor Reported Braking Action									
MAX MANUAL	2550	50/–40	75	–150/565	220/–145	70/–70	95	0	605
AUTOBRAKE MAX	2555	50/–40	75	–150/565	225/–150	70/–70	95	0	605
AUTOBRAKE 3	2605	55/–40	75	–155/570	215/–135	70/–70	100	0	610
Poor Reported Braking Action									
MAX MANUAL	2920	60/–50	90	–185/705	320/–195	80/–80	100	0	870
AUTOBRAKE MAX	2930	60/–50	90	–185/705	325/–200	80/–80	100	0	870
AUTOBRAKE 3	2960	65/–50	90	–185/705	320/–200	80/–80	100	0	880

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1090	25/–5	20	–40/135	15/–10	20/–20	40	0	15
AUTOBRAKE MAX	1330	20/–5	25	–50/175	0/0	30/–30	60	0	0
AUTOBRAKE 2	2120	40/–10	55	–105/355	0/–10	55/–55	115	0	0
Good Reported Braking Action									
MAX MANUAL	1500	25/–10	35	–70/240	40/–35	35/–35	65	0	85
AUTOBRAKE MAX	1555	25/–10	35	–75/245	35/–30	35/–35	70	0	85
AUTOBRAKE 2	2120	40/–10	55	–105/355	0/–10	55/–55	115	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1790	35/–15	45	–95/330	80/–65	45/–45	75	0	190
AUTOBRAKE MAX	1820	35/–15	45	–95/330	80/–60	45/–45	80	0	190
AUTOBRAKE 2	2175	40/–15	60	–115/395	40/–30	60/–60	115	0	105
Medium Reported Braking Action									
MAX MANUAL	2080	40/–20	55	–115/415	115/–90	50/–50	85	0	290
AUTOBRAKE MAX	2080	40/–20	55	–115/415	120/–90	55/–55	85	0	290
AUTOBRAKE 3	2140	40/–20	60	–115/420	115/–75	55/–55	90	0	300
Medium To Poor Reported Braking Action									
MAX MANUAL	2440	50/–30	70	–150/555	220/–140	65/–65	95	0	520
AUTOBRAKE MAX	2445	50/–30	70	–150/555	225/–145	65/–65	95	0	525
AUTOBRAKE 3	2490	50/–30	75	–150/560	215/–135	65/–65	95	0	535
Poor Reported Braking Action									
MAX MANUAL	2795	60/–35	85	–180/695	320/–190	75/–75	100	0	750
AUTOBRAKE MAX	2805	60/–35	85	–180/695	325/–195	75/–75	100	0	755
AUTOBRAKE 3	2835	60/–35	85	–180/695	315/–195	75/–75	100	0	765

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L+C (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1390	30/–5	30	–50/165	20/–20	30/–30	55	0	35
AUTOBRAKE MAX	1580	25/–5	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2630	45/–10	70	–120/405	0/0	75/–75	140	0	0
Good Reported Braking Action									
MAX MANUAL	1945	30/–10	50	–80/280	60/–50	45/–45	80	0	165
AUTOBRAKE MAX	1930	30/–10	50	–80/280	55/–45	50/–50	85	0	160
AUTOBRAKE 2	2630	45/–10	70	–120/405	0/0	75/–75	140	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2320	40/–20	65	–110/380	110/–85	60/–60	95	0	355
AUTOBRAKE MAX	2310	40/–20	65	–110/380	110/–85	60/–60	100	0	350
AUTOBRAKE 2	2705	50/–15	75	–130/445	65/–25	75/–75	140	0	240
Medium Reported Braking Action									
MAX MANUAL	2695	50/–25	80	–135/475	160/–120	70/–70	105	0	545
AUTOBRAKE MAX	2685	50/–25	80	–135/475	165/–125	70/–70	110	0	540
AUTOBRAKE 3	2715	55/–25	80	–135/480	160/–105	75/–75	110	0	550
Medium To Poor Reported Braking Action									
MAX MANUAL	3150	65/–35	100	–175/630	285/–185	85/–85	115	0	960
AUTOBRAKE MAX	3150	65/–35	100	–175/630	295/–195	85/–85	120	0	960
AUTOBRAKE 3	3165	70/–35	100	–175/635	290/–180	90/–90	120	0	965
Poor Reported Braking Action									
MAX MANUAL	3605	75/–45	115	–210/785	410/–250	100/–100	125	0	1375
AUTOBRAKE MAX	3610	80/–45	120	–210/785	420/–260	100/–100	125	0	1380
AUTOBRAKE 3	3615	80/–45	120	–210/785	420/–250	100/–100	130	0	1380

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L+R (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1490	20/–5	35	–55/190	30/–25	35/–35	65	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2250	35/–10	60	–105/355	105/–85	60/–60	100	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2855	50/–20	80	–145/505	230/–160	80/–80	120	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	3455	60/–25	95	–185/655	355/–235	100/–100	135	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	4355	80/–35	120	–260/950	905/–415	135/–135	155	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	5255	95/–45	140	–335/1240	1455/–590	165/–165	170	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1235	20/–10	25	–45/160	20/–20	25/–25	50	0	35
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1715	30/–20	45	–80/285	55/–45	40/–40	70	0	145
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2030	40/–30	55	–105/385	105/–80	50/–50	80	0	290
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2345	45/–35	65	–130/480	150/–110	60/–60	85	0	430
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	2720	55/–45	80	–170/640	290/–170	75/–75	95	0	735
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3090	65/–55	95	–205/795	425/–225	85/–85	100	0	1035
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1180	15/–5	25	–45/155	20/–15	25/–25	45	0	25
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1615	25/–10	40	–75/275	55/–45	40/–40	65	0	115
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	1905	35/–20	50	–100/370	100/–75	50/–50	75	0	235
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2195	40/–25	60	–125/465	145/–105	55/–55	85	0	350
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	2545	50/–30	75	–160/620	275/–160	65/–65	90	0	595
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	2890	60/–35	85	–195/775	400/–215	75/–75	95	0	840
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R+C (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1690	25/–5	40	–65/220	40/–35	40/–40	75	0	95
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2360	40/–15	65	–110/375	105/–85	60/–60	100	0	345
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2780	55/–25	85	–140/500	185/–135	75/–75	110	0	645
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	3200	65/–35	100	–170/625	265/–185	85/–85	120	0	945
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	3680	80/–45	120	–220/820	515/–270	100/–100	130	0	1555
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	4160	95/–55	140	–265/1015	760/–355	115/–115	135	0	2165
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH DOWN AUTHORITY (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1220	25/–10	20	–40/145	15/–10	20/–20	45	10	25
AUTOBRAKE MAX	1410	20/–15	30	–55/180	0/0	30/–30	65	0	0
AUTOBRAKE 2	2280	40/–30	60	–110/370	5/–20	60/–60	115	5	5
Good Reported Braking Action									
MAX MANUAL	1580	25/–15	35	–65/235	35/–30	35/–35	55	55	130
AUTOBRAKE MAX	1590	25/–15	35	–65/235	35/–30	35/–35	65	60	135
AUTOBRAKE 2	2285	40/–30	60	–110/370	5/–20	60/–60	115	5	5
Good To Medium Reported Braking Action									
MAX MANUAL	1805	30/–25	45	–85/305	60/–50	40/–40	65	115	280
AUTOBRAKE MAX	1805	30/–25	45	–85/305	60/–50	40/–40	70	115	285
AUTOBRAKE 2	2325	45/–35	65	–115/395	30/–30	60/–60	115	30	100
Medium Reported Braking Action									
MAX MANUAL	2025	35/–30	55	–100/375	80/–65	45/–45	70	170	430
AUTOBRAKE MAX	2020	35/–30	55	–100/375	85/–65	45/–45	75	170	430
AUTOBRAKE 3	2160	40/–25	55	–110/395	55/–25	55/–55	110	80	305
Medium To Poor Reported Braking Action									
MAX MANUAL	2265	45/–35	65	–125/475	130/–95	55/–55	75	275	750
AUTOBRAKE MAX	2265	45/–35	65	–125/475	135/–95	55/–55	80	275	750
AUTOBRAKE 3	2345	45/–35	65	–130/485	120/–70	60/–60	100	225	680
Poor Reported Braking Action									
MAX MANUAL	2500	50/–40	75	–150/575	180/–120	60/–60	80	375	1065
AUTOBRAKE MAX	2510	50/–40	75	–150/575	185/–125	60/–60	80	380	1065
AUTOBRAKE 3	2525	50/–40	75	–150/575	180/–110	60/–60	90	365	1055

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH DOWN AUTHORITY (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1170	25/–5	20	–40/140	15/–10	20/–20	45	10	20
AUTOBRAKE MAX	1330	20/–5	25	–50/175	0/0	30/–30	65	0	0
AUTOBRAKE 2	2120	40/–15	55	–105/355	0/–5	55/–55	115	0	0
Good Reported Braking Action									
MAX MANUAL	1505	20/–10	35	–65/230	35/–30	30/–30	55	50	110
AUTOBRAKE MAX	1520	25/–10	35	–65/230	35/–30	30/–30	65	50	110
AUTOBRAKE 2	2130	40/–15	55	–105/355	5/–10	55/–55	120	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1720	30/–15	45	–85/300	60/–45	40/–40	65	100	240
AUTOBRAKE MAX	1725	30/–15	45	–85/300	60/–50	40/–40	70	100	240
AUTOBRAKE 2	2165	40/–15	55	–110/380	25/–20	55/–60	120	20	85
Medium Reported Braking Action									
MAX MANUAL	1930	35/–20	50	–100/365	80/–60	45/–45	70	150	365
AUTOBRAKE MAX	1925	35/–15	50	–100/365	85/–65	45/–45	75	150	365
AUTOBRAKE 3	2015	35/–10	50	–105/380	55/–25	50/–50	105	80	280
Medium To Poor Reported Braking Action									
MAX MANUAL	2160	45/–25	60	–125/465	130/–90	50/–50	75	240	640
AUTOBRAKE MAX	2165	45/–25	60	–125/465	135/–95	55/–55	80	245	640
AUTOBRAKE 3	2210	45/–20	60	–125/475	120/–70	55/–55	95	205	595
Poor Reported Braking Action									
MAX MANUAL	2390	50/–30	70	–145/565	175/–120	55/–55	80	330	910
AUTOBRAKE MAX	2400	50/–30	70	–145/565	185/–125	60/–60	80	335	910
AUTOBRAKE 3	2400	50/–25	70	–145/565	185/–115	60/–60	85	330	910

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH UP AUTHORITY (Flaps ≤ 15)
VREF 30+40

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1300	40/–10	25	–45/150	15/–15	25/–25	40	25	60
AUTOBRAKE MAX	1860	25/–5	45	–65/215	0/0	45/–45	75	0	0
AUTOBRAKE 2	2895	55/–40	90	–125/420	65/–70	80/–80	85	240	260
Good Reported Braking Action									
MAX MANUAL	1725	25/–15	45	–70/240	35/–30	40/–40	50	100	235
AUTOBRAKE MAX	1935	30/–10	50	–75/260	20/–15	45/–45	75	65	210
AUTOBRAKE 2	2895	55/–40	90	–125/420	65/–70	80/–80	85	240	260
Good To Medium Reported Braking Action									
MAX MANUAL	2005	35/–20	55	–90/315	60/–50	50/–50	60	190	475
AUTOBRAKE MAX	2145	40/–20	60	–95/330	50/–40	55/–55	75	170	470
AUTOBRAKE 2	2920	55/–40	90	–130/445	80/–80	80/–80	85	260	370
Medium Reported Braking Action									
MAX MANUAL	2280	40/–25	65	–105/390	85/–70	55/–55	65	275	715
AUTOBRAKE MAX	2355	45/–25	70	–110/395	75/–60	60/–60	75	275	725
AUTOBRAKE 3	2810	50/–35	80	–125/445	65/–65	75/–75	90	140	420
Medium To Poor Reported Braking Action									
MAX MANUAL	2570	50/–35	80	–130/495	140/–100	65/–65	70	420	1195
AUTOBRAKE MAX	2620	55/–35	85	–135/500	135/–95	70/–70	80	415	1205
AUTOBRAKE 3	2945	55/–40	90	–145/535	120/–95	80/–80	90	295	980
Poor Reported Braking Action									
MAX MANUAL	2855	60/–40	95	–155/595	190/–130	75/–75	75	560	1675
AUTOBRAKE MAX	2885	60/–40	95	–155/600	190/–125	75/–75	80	555	1680
AUTOBRAKE 3	3075	60/–40	100	–165/620	175/–125	80/–80	90	445	1535

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH UP AUTHORITY (Flaps ≥ 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1145	30/–5	20	–40/135	10/–10	20/–20	35	15	35
AUTOBRAKE MAX	1580	25/–5	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2495	50/–30	75	–115/390	40/–55	65/–65	85	95	95
Good Reported Braking Action									
MAX MANUAL	1535	25/–10	35	–65/225	30/–30	35/–35	50	75	170
AUTOBRAKE MAX	1665	25/–5	40	–70/240	25/–15	40/–40	70	75	180
AUTOBRAKE 2	2495	50/–30	75	–115/390	40/–55	65/–65	85	95	95
Good To Medium Reported Braking Action									
MAX MANUAL	1780	35/–15	45	–85/300	55/–50	45/–45	55	140	350
AUTOBRAKE MAX	1865	35/–15	50	–85/310	50/–35	45/–45	70	140	350
AUTOBRAKE 2	2520	50/–30	75	–120/415	55/–65	65/–65	85	115	185
Medium Reported Braking Action									
MAX MANUAL	2025	40/–20	55	–100/370	80/–65	50/–50	60	205	525
AUTOBRAKE MAX	2065	40/–20	60	–100/375	70/–55	50/–50	70	205	520
AUTOBRAKE 3	2385	40/–20	65	–115/410	50/–45	60/–65	95	80	305
Medium To Poor Reported Braking Action									
MAX MANUAL	2285	50/–30	70	–125/475	130/–95	60/–60	65	325	890
AUTOBRAKE MAX	2310	50/–30	70	–125/475	130/–90	60/–60	75	325	890
AUTOBRAKE 3	2530	50/–25	75	–135/500	105/–75	65/–70	95	220	745
Poor Reported Braking Action									
MAX MANUAL	2545	55/–35	80	–150/575	180/–120	65/–65	70	440	1255
AUTOBRAKE MAX	2550	55/–35	80	–150/575	185/–120	65/–65	75	440	1255
AUTOBRAKE 3	2670	55/–30	80	–155/585	160/–105	70/–70	95	360	1185

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PRI FLIGHT COMPUTERS (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1260	25/–15	25	–45/150	15/–15	25/–25	50	25	50
AUTOBRAKE MAX	1470	20/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2410	45/–40	65	–115/385	0/–10	65/–65	130	0	0
Good Reported Braking Action									
MAX MANUAL	1680	30/–25	40	–70/250	40/–35	35/–35	65	100	235
AUTOBRAKE MAX	1675	30/–25	40	–70/245	35/–30	40/–40	70	95	225
AUTOBRAKE 2	2410	45/–40	65	–115/385	0/–10	65/–65	130	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1940	40/–35	55	–90/325	70/–55	45/–45	75	190	485
AUTOBRAKE MAX	1935	40/–35	55	–90/320	70/–60	50/–50	80	185	475
AUTOBRAKE 2	2445	45/–45	65	–120/410	25/–25	65/–65	130	35	235
Medium Reported Braking Action									
MAX MANUAL	2200	45/–40	65	–110/395	90/–75	55/–55	85	275	735
AUTOBRAKE MAX	2190	45/–40	65	–110/395	105/–85	55/–55	85	270	725
AUTOBRAKE 3	2285	45/–40	65	–115/410	75/–35	60/–60	110	200	665
Medium To Poor Reported Braking Action									
MAX MANUAL	2480	55/–50	80	–135/505	155/–110	65/–65	90	425	1260
AUTOBRAKE MAX	2475	55/–50	80	–135/505	165/–120	65/–65	90	425	1255
AUTOBRAKE 3	2525	55/–50	80	–140/510	150/–85	65/–65	110	390	1225
Poor Reported Braking Action									
MAX MANUAL	2755	65/–55	90	–160/610	215/–145	70/–70	95	575	1780
AUTOBRAKE MAX	2760	65/–55	90	–160/610	225/–150	70/–70	95	575	1785
AUTOBRAKE 3	2765	65/–55	90	–160/610	225/–135	70/–70	105	575	1785

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SLATS DRIVE (Flaps 20)
VREF 30+30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1260	30/–5	25	–40/145	15/–15	25/–25	40	25	50
AUTOBRAKE MAX	1715	25/–5	40	–60/205	0/0	40/–40	75	0	0
AUTOBRAKE 2	2730	50/–35	80	–120/410	50/–60	75/–75	90	135	135
Good Reported Braking Action									
MAX MANUAL	1705	25/–15	45	–70/245	40/–35	40/–40	55	95	225
AUTOBRAKE MAX	1825	30/–10	45	–75/255	30/–20	45/–45	70	100	240
AUTOBRAKE 2	2730	50/–35	80	–120/410	50/–60	75/–75	90	135	135
Good To Medium Reported Braking Action									
MAX MANUAL	1970	35/–20	55	–90/320	65/–55	50/–50	60	175	445
AUTOBRAKE MAX	2050	40/–20	55	–95/325	55/–45	50/–50	75	175	445
AUTOBRAKE 2	2755	55/–35	85	–125/435	65/–70	75/–75	90	160	255
Medium Reported Braking Action									
MAX MANUAL	2235	40/–25	65	–110/390	90/–70	55/–55	65	255	660
AUTOBRAKE MAX	2270	45/–25	65	–110/395	80/–65	55/–55	80	250	650
AUTOBRAKE 3	2615	45/–25	75	–120/435	60/–50	70/–70	100	105	400
Medium To Poor Reported Braking Action									
MAX MANUAL	2515	50/–35	80	–135/495	145/–105	65/–65	70	390	1085
AUTOBRAKE MAX	2535	55/–35	80	–135/500	140/–100	65/–65	80	385	1080
AUTOBRAKE 3	2770	55/–30	85	–140/525	120/–85	75/–75	100	270	915
Poor Reported Braking Action									
MAX MANUAL	2790	60/–40	90	–155/600	200/–135	70/–70	75	520	1510
AUTOBRAKE MAX	2795	60/–40	90	–155/600	200/–135	70/–70	80	520	1510
AUTOBRAKE 3	2920	60/–35	95	–160/610	180/–115	75/–75	100	430	1430

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SPOILERS (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1110	25/–10	20	–40/135	15/–10	20/–20	40	15	35
AUTOBRAKE MAX	1410	20/–15	30	–55/180	0/0	30/–30	65	0	0
AUTOBRAKE 2	2260	40/–35	60	–110/370	15/–30	60/–60	100	15	15
Good Reported Braking Action									
MAX MANUAL	1480	25/–20	35	–65/225	35/–30	30/–30	55	75	170
AUTOBRAKE MAX	1550	25/–20	35	–65/235	30/–25	35/–35	65	75	175
AUTOBRAKE 2	2260	40/–35	60	–110/370	15/–30	60/–60	100	15	15
Good To Medium Reported Braking Action									
MAX MANUAL	1710	35/–25	45	–85/295	60/–50	40/–40	65	140	350
AUTOBRAKE MAX	1745	35/–25	45	–85/300	60/–45	40/–40	70	140	350
AUTOBRAKE 2	2290	45/–35	65	–115/395	30/–40	60/–60	100	40	135
Medium Reported Braking Action									
MAX MANUAL	1940	40/–30	55	–100/365	80/–65	45/–45	70	205	525
AUTOBRAKE MAX	1940	40/–30	55	–100/365	85/–65	45/–45	70	200	520
AUTOBRAKE 3	2130	40/–25	55	–110/390	50/–35	55/–55	100	95	405
Medium To Poor Reported Braking Action									
MAX MANUAL	2185	50/–35	65	–125/470	135/–95	55/–55	75	320	885
AUTOBRAKE MAX	2190	50/–35	65	–125/470	140/–95	55/–55	75	315	885
AUTOBRAKE 3	2300	50/–35	65	–130/485	115/–75	60/–60	95	260	830
Poor Reported Braking Action									
MAX MANUAL	2430	55/–40	75	–145/570	185/–125	60/–60	80	430	1245
AUTOBRAKE MAX	2435	55/–40	75	–145/570	190/–125	60/–60	80	430	1245
AUTOBRAKE 3	2470	55/–40	75	–150/575	180/–115	60/–60	90	425	1250

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SPOILERS (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1065	20/–5	20	–35/130	10/–10	20/–20	40	15	30
AUTOBRAKE MAX	1330	20/–5	25	–50/175	0/0	30/–30	65	0	0
AUTOBRAKE 2	2110	40/–15	55	–105/355	5/–20	55/–55	105	0	0
Good Reported Braking Action									
MAX MANUAL	1415	20/–10	35	–60/220	35/–30	30/–30	55	60	145
AUTOBRAKE MAX	1475	25/–10	35	–65/230	30/–25	30/–30	65	65	145
AUTOBRAKE 2	2110	40/–15	55	–105/355	5/–20	55/–55	105	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1635	30/–15	45	–80/290	60/–50	40/–40	65	120	295
AUTOBRAKE MAX	1665	30/–15	45	–85/295	60/–45	40/–40	70	120	295
AUTOBRAKE 2	2135	40/–20	55	–110/380	25/–30	55/–55	105	25	115
Medium Reported Braking Action									
MAX MANUAL	1850	35/–20	50	–100/360	80/–65	45/–45	70	175	445
AUTOBRAKE MAX	1855	35/–20	50	–100/360	85/–60	45/–45	70	175	445
AUTOBRAKE 3	1995	35/–15	50	–105/380	55/–35	50/–50	95	100	370
Medium To Poor Reported Braking Action									
MAX MANUAL	2090	45/–25	60	–125/460	135/–95	50/–50	75	280	755
AUTOBRAKE MAX	2095	45/–25	60	–125/465	140/–95	55/–55	75	280	755
AUTOBRAKE 3	2175	45/–25	65	–125/475	120/–80	55/–55	90	245	725
Poor Reported Braking Action									
MAX MANUAL	2325	50/–30	70	–145/560	185/–120	55/–55	80	380	1060
AUTOBRAKE MAX	2330	50/–30	70	–145/565	190/–125	60/–60	80	380	1065
AUTOBRAKE 3	2355	50/–30	75	–145/565	185/–120	60/–60	85	385	1075

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
STABILIZER (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1185	30/–5	25	–40/140	15/–10	25/–25	40	20	45
AUTOBRAKE MAX	1580	25/–5	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2535	50/–30	75	–115/395	35/–50	70/–70	90	65	65
Good Reported Braking Action									
MAX MANUAL	1595	25/–10	40	–65/235	35/–30	35/–35	55	85	200
AUTOBRAKE MAX	1695	25/–10	40	–70/245	30/–25	40/–40	65	90	210
AUTOBRAKE 2	2535	50/–30	75	–115/395	35/–50	70/–70	90	65	65
Good To Medium Reported Braking Action									
MAX MANUAL	1845	35/–20	50	–85/310	60/–50	45/–45	60	160	400
AUTOBRAKE MAX	1905	35/–15	50	–90/315	55/–45	45/–45	70	160	400
AUTOBRAKE 2	2560	50/–30	75	–120/420	50/–60	70/–70	90	90	180
Medium Reported Braking Action									
MAX MANUAL	2095	40/–25	60	–105/380	85/–70	50/–50	65	230	595
AUTOBRAKE MAX	2110	40/–20	60	–105/380	80/–60	50/–50	75	225	585
AUTOBRAKE 3	2405	45/–20	65	–115/415	50/–40	65/–65	100	90	380
Medium To Poor Reported Braking Action									
MAX MANUAL	2360	50/–30	75	–130/485	140/–100	60/–60	70	355	995
AUTOBRAKE MAX	2370	50/–30	75	–130/485	140/–95	60/–60	75	355	995
AUTOBRAKE 3	2560	50/–25	75	–135/505	115/–75	70/–70	100	260	870
Poor Reported Braking Action									
MAX MANUAL	2620	55/–35	85	–150/585	190/–130	65/–65	75	480	1395
AUTOBRAKE MAX	2630	55/–35	85	–150/585	195/–130	65/–65	75	480	1400
AUTOBRAKE 3	2710	55/–30	85	–155/595	180/–110	70/–70	100	430	1355

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)			
		AIRPORT PRESSURE ALTITUDE (FT)			
deg. C	deg. F	0	1000	2000	3000
54	129	211			
50	122	219	210	201	
45	113	228	220	211	202
40	104	237	229	220	212
35	95	248	238	229	221
30	86	258	249	239	230
25	77	258	253	247	240
20	68	258	253	247	242
15	59	258	253	247	242
10 & BELOW	50 & BELOW	258	253	247	242

Based on engine bleed for 2 packs on and engine anti-ice on or off and wing anti-ice off.
With engine bleed packs off, increase allowable weight by 1,200 kg.
With engine and wing anti-ice on, decrease allowable weight by 2,300 kg.
Reduce allowable weight by 18,400 kg for ice accumulation when operating in icing conditions during any part of the flight with forecast landing temperatures below 10 deg. C.

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ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Reference Brake Energy (Millions of Foot Pounds)

WEIGHT (1000 KG)	OAT (deg. C)	BRAKES ON SPEED (KIAS) 80			100			120			140			160			180		
		PRESSURE ALTITUDE (1000 FT) 0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8
300	0	17.3	19.1	21.2	26.1	29.1	32.6	36.4	40.8	46.0	47.9	53.9	61.0	60.4	68.1	77.1	73.2	82.4	93.0
	10	17.9	19.7	21.8	27.0	30.0	33.7	37.6	42.1	47.5	49.5	55.7	63.0	62.4	70.4	79.6	75.6	85.0	95.8
	15	18.2	20.0	22.2	27.4	30.5	34.2	38.2	42.9	48.3	50.3	56.7	64.1	63.5	71.5	80.8	76.8	86.3	97.2
	20	18.4	20.3	22.5	27.9	31.0	34.8	38.9	43.6	49.1	51.2	57.6	65.1	64.5	72.7	82.1	78.0	87.6	98.5
	30	18.8	20.8	23.1	28.6	31.8	35.7	39.9	44.7	50.5	52.6	59.2	66.9	66.3	74.7	84.3	80.2	90.0	101.1
	40	19.1	21.0	23.4	29.0	32.4	36.3	40.6	45.6	51.5	53.7	60.5	68.4	67.8	76.4	86.3	82.0	92.0	103.3
280	0	16.4	18.0	20.0	24.7	27.4	30.7	34.3	38.4	43.2	45.1	50.7	57.3	56.9	64.1	72.6	69.0	77.8	87.9
	10	16.9	18.6	20.6	25.5	28.3	31.7	35.4	39.7	44.7	46.6	52.4	59.3	58.8	66.3	74.9	71.3	80.3	90.6
	15	17.2	18.9	20.9	25.9	28.8	32.2	36.0	40.4	45.5	47.4	53.3	60.3	59.8	67.4	76.2	72.5	81.6	92.0
	20	17.4	19.2	21.3	26.3	29.3	32.8	36.6	41.0	46.2	48.2	54.2	61.2	60.7	68.5	77.3	73.6	82.8	93.3
	30	17.8	19.6	21.8	27.0	30.0	33.6	37.6	42.1	47.5	49.5	55.7	63.0	62.5	70.4	79.5	75.7	85.1	95.8
	40	18.0	19.8	22.0	27.4	30.5	34.2	38.3	42.9	48.4	50.5	56.9	64.4	63.8	72.0	81.3	77.4	87.0	97.9
260	0	15.5	17.0	18.8	23.2	25.8	28.8	32.2	36.0	40.5	42.3	47.5	53.7	53.3	60.0	67.9	64.7	73.0	82.6
	10	15.9	17.5	19.4	24.0	26.6	29.7	33.3	37.2	41.9	43.7	49.1	55.5	55.0	62.0	70.2	66.9	75.4	85.1
	15	16.2	17.8	19.7	24.4	27.0	30.2	33.8	37.8	42.6	44.4	49.9	56.4	56.0	63.1	71.3	68.0	76.6	86.5
	20	16.5	18.1	20.0	24.8	27.5	30.7	34.4	38.5	43.3	45.2	50.8	57.3	56.9	64.1	72.5	69.1	77.8	87.8
	30	16.8	18.5	20.4	25.4	28.2	31.5	35.3	39.5	44.5	46.4	52.2	58.9	58.5	65.9	74.5	71.0	79.9	90.1
	40	17.0	18.7	20.7	25.7	28.6	32.0	35.9	40.2	45.3	47.3	53.3	60.2	59.8	67.4	76.2	72.6	81.8	92.2
240	0	14.6	15.9	17.6	21.8	24.1	26.9	30.1	33.6	37.8	39.4	44.2	49.9	49.6	55.8	63.2	60.3	68.0	76.9
	10	15.0	16.4	18.1	22.5	24.9	27.8	31.1	34.7	39.0	40.7	45.7	51.6	51.2	57.7	65.3	62.3	70.2	79.4
	15	15.2	16.7	18.4	22.8	25.3	28.3	31.6	35.3	39.7	41.4	46.5	52.5	52.1	58.7	66.3	63.3	71.4	80.7
	20	15.5	16.9	18.7	23.2	25.7	28.7	32.1	35.9	40.3	42.1	47.3	53.3	53.0	59.7	67.4	64.4	72.5	81.9
	30	15.8	17.3	19.2	23.7	26.3	29.4	32.9	36.8	41.4	43.2	48.6	54.8	54.4	61.3	69.3	66.2	74.6	84.2
	40	15.9	17.5	19.4	24.1	26.7	29.9	33.5	37.5	42.2	44.1	49.6	56.0	55.6	62.7	70.9	67.7	76.3	86.1
220	0	13.6	14.9	16.4	20.3	22.4	25.0	28.0	31.2	35.0	36.5	40.9	46.1	45.8	51.6	58.3	55.7	62.8	71.1
	10	14.1	15.4	16.9	20.9	23.2	25.8	28.9	32.2	36.1	37.7	42.3	47.7	47.3	53.3	60.2	57.6	64.9	73.4
	15	14.3	15.6	17.2	21.3	23.5	26.2	29.4	32.7	36.7	38.4	43.0	48.5	48.2	54.2	61.2	58.5	66.0	74.6
	20	14.5	15.9	17.5	21.6	23.9	26.7	29.8	33.3	37.3	39.0	43.7	49.3	49.0	55.1	62.2	59.5	67.0	75.8
	30	14.8	16.2	17.9	22.1	24.5	27.3	30.6	34.1	38.3	40.0	44.9	50.6	50.3	56.6	64.0	61.2	68.9	77.9
	40	14.9	16.3	18.1	22.4	24.8	27.7	31.1	34.7	39.0	40.8	45.8	51.7	51.3	57.9	65.4	62.5	70.5	79.7
200	0	12.7	13.9	15.3	18.8	20.8	23.1	25.8	28.7	32.2	33.6	37.5	42.3	42.0	47.2	53.3	51.0	57.4	65.0
	10	13.1	14.3	15.7	19.4	21.4	23.8	26.6	29.6	33.2	34.7	38.8	43.7	43.4	48.8	55.1	52.7	59.4	67.1
	15	13.3	14.5	16.0	19.7	21.8	24.2	27.1	30.1	33.8	35.2	39.5	44.4	44.1	49.6	56.0	53.6	60.4	68.2
	20	13.5	14.8	16.3	20.0	22.1	24.6	27.5	30.6	34.3	35.8	40.1	45.2	44.9	50.4	56.9	54.5	61.3	69.3
	30	13.8	15.1	16.6	20.5	22.6	25.2	28.2	31.4	35.2	36.8	41.2	46.4	46.1	51.8	58.5	56.0	63.1	71.3
	40	13.9	15.2	16.8	20.8	22.9	25.6	28.6	31.9	35.8	37.4	42.0	47.3	47.0	52.9	59.8	57.2	64.5	72.9
180	0	11.8	12.9	14.1	17.4	19.1	21.2	23.6	26.2	29.3	30.6	34.1	38.4	38.1	42.7	48.2	46.1	51.9	58.6
	10	12.2	13.3	14.6	17.9	19.7	21.9	24.4	27.1	30.3	31.6	35.3	39.6	39.3	44.1	49.8	47.6	53.6	60.6
	15	12.4	13.5	14.8	18.2	20.0	22.2	24.8	27.5	30.8	32.1	35.9	40.3	40.0	44.9	50.7	48.5	54.5	61.6
	20	12.6	13.7	15.0	18.5	20.3	22.6	25.2	28.0	31.3	32.6	36.4	41.0	40.7	45.6	51.5	49.2	55.4	62.6
	30	12.8	14.0	15.3	18.9	20.8	23.1	25.8	28.7	32.1	33.5	37.4	42.1	41.8	46.9	52.9	50.6	57.0	64.4
	40	12.9	14.1	15.5	19.1	21.1	23.4	26.2	29.1	32.6	34.0	38.1	42.9	42.6	47.8	54.0	51.7	58.2	65.8

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 and enter table with sea level, 15 deg. C.

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ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Event Adjusted Brake Energy (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	6.3	15.6	24.9	34.0	43.2	52.3	61.6	70.9	80.4
	MAX AUTO	6.1	14.4	22.8	31.3	40.0	49.0	58.2	67.7	77.6
	AUTOBRAKE 4	5.9	13.6	21.2	29.1	37.1	45.5	54.2	63.3	73.0
	AUTOBRAKE 3	5.6	12.7	19.7	26.9	34.2	41.9	49.8	58.3	67.3
	AUTOBRAKE 2	5.3	11.8	18.2	24.8	31.5	38.4	45.6	53.3	61.5
	AUTOBRAKE 1	5.2	11.0	16.8	22.8	28.9	35.2	41.9	48.9	56.4

2 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	5.8	14.7	23.4	32.0	40.4	48.8	57.2	65.6	74.2
	MAX AUTO	4.3	11.6	18.9	26.4	34.1	42.0	50.2	58.9	68.0
	AUTOBRAKE 4	3.6	9.2	15.0	21.1	27.5	34.4	41.7	49.6	58.2
	AUTOBRAKE 3	2.5	6.6	11.1	15.9	21.0	26.7	32.8	39.5	46.8
	AUTOBRAKE 2	1.4	4.4	7.6	11.3	15.3	19.7	24.5	29.8	35.6
	AUTOBRAKE 1	1.0	3.0	5.3	7.8	10.6	13.9	17.5	21.7	26.4

Cooling Time (Minutes)

	EVENT ADJUSTED BRAKE ENERGY (MILLIONS OF FOOT POUNDS)									
	16 & BELOW	17	18	20	24	28	32	35	36 TO 44	45 & ABOVE
INFLIGHT GEAR DOWN	NO SPECIAL PROCEDURE REQUIRED	1	2	3	4	6	7	7	CAUTION	FUSE PLUG MELT ZONE
GROUND		11	18	26	42	55	66	73		
BTMS	UP TO 2.4	2.4	2.6	2.9	3.4	4.0	4.5	4.9	5.0 TO 6.3	6.3 & 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 10 percent.

For two brakes deactivated, increase brake energy by 20 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. (When inflight with gear extended, the BTMS indications may vary between individual brakes, due to airstream effects.)

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ENGINE INOP

Initial Max Continuous EPR
Based on .84M, engine bleed for packs on and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20 & ABOVE	1.185	1.158	1.139	1.135	1.13	1.113	1.111	1.109	1.108
15	1.226	1.200	1.168	1.166	1.163	1.145	1.143	1.141	1.139
10	1.267	1.246	1.215	1.197	1.196	1.178	1.176	1.174	1.173
5	1.300	1.292	1.266	1.239	1.229	1.211	1.210	1.208	1.206
0	1.300	1.324	1.317	1.286	1.275	1.251	1.250	1.248	1.246
–5	1.300	1.324	1.348	1.333	1.320	1.297	1.296	1.294	1.292
–10	1.300	1.324	1.348	1.357	1.365	1.343	1.341	1.340	1.338
–15	1.300	1.324	1.348	1.357	1.384	1.385	1.383	1.381	1.379
–20	1.300	1.324	1.348	1.357	1.384	1.385	1.383	1.381	1.379
–25	1.300	1.324	1.348	1.357	1.384	1.385	1.383	1.381	1.379
–30	1.300	1.324	1.348	1.357	1.384	1.385	1.383	1.381	1.379
–35 & BELOW	1.300	1.324	1.348	1.357	1.384	1.385	1.383	1.381	1.379

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ENGINE INOP

Max Continuous EPR
Based on .84M, engine bleed for packs on and anti-ice off
37000 FT to 29000 FT Pressure Altitudes

37000 FT PRESS ALT		TAT (deg. C)											
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
200	0.63	1.411	1.411	1.411	1.411	1.411	1.383	1.343	1.303	1.266	1.233	1.200	1.174
240	0.74	1.396	1.396	1.396	1.396	1.396	1.396	1.382	1.340	1.298	1.256	1.223	1.189
280	0.86	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.342	1.297	1.252	1.208
35000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
200	0.60	1.418	1.418	1.418	1.418	1.418	1.395	1.356	1.317	1.280	1.249	1.218	1.192
240	0.71	1.397	1.397	1.397	1.397	1.397	1.397	1.387	1.347	1.307	1.267	1.234	1.202
280	0.82	1.393	1.393	1.393	1.393	1.393	1.393	1.393	1.393	1.360	1.315	1.270	1.229
33000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
200	0.58	1.393	1.393	1.393	1.393	1.393	1.393	1.359	1.322	1.286	1.255	1.226	1.197
240	0.68	1.375	1.375	1.375	1.375	1.375	1.375	1.375	1.346	1.309	1.271	1.238	1.208
280	0.79	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.357	1.312	1.268	1.226
320	0.89	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.275	1.235
31000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10
200	0.55	1.387	1.387	1.387	1.387	1.387	1.373	1.338	1.303	1.269	1.241	1.213	1.186
240	0.66	1.364	1.364	1.364	1.364	1.364	1.364	1.358	1.322	1.287	1.251	1.222	1.193
280	0.76	1.358	1.358	1.358	1.358	1.358	1.358	1.358	1.358	1.323	1.279	1.236	1.199
320	0.85	1.334	1.334	1.334	1.334	1.334	1.334	1.334	1.334	1.334	1.312	1.263	1.215
29000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10	15
200	0.53	1.404	1.404	1.404	1.404	1.404	1.378	1.346	1.314	1.283	1.254	1.225	1.209
240	0.63	1.380	1.380	1.380	1.380	1.380	1.380	1.357	1.321	1.286	1.254	1.225	1.196
280	0.73	1.359	1.359	1.359	1.359	1.359	1.359	1.359	1.345	1.306	1.267	1.228	1.199
320	0.82	1.338	1.338	1.338	1.338	1.338	1.338	1.338	1.338	1.337	1.291	1.244	1.198
360	0.91	1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.232	1.196

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	37	35	33	31	29
ENGINE ONLY	–0.004	–0.003	–0.003	–0.003	–0.004
ENGINE & WING*	–0.014	–0.012	–0.011	–0.011	–0.011
ENGINE & WING**	–0.023	–0.021	–0.020	–0.019	–0.018

***Wing anti-ice on, packs on.**
****Wing anti-ice on, packs off.**

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ENGINE INOP

Max Continuous EPR
Based on .84M, engine bleed for packs on and anti-ice off
27000 FT to 20000 FT Pressure Altitudes

27000 FT PRESS ALT		TAT (deg. C)											
KIAS	M	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10	15
200	0.51	1.420	1.420	1.420	1.420	1.420	1.416	1.387	1.358	1.330	1.300	1.270	1.240
240	0.60	1.397	1.397	1.397	1.397	1.397	1.397	1.391	1.358	1.324	1.291	1.261	1.232
280	0.70	1.377	1.377	1.377	1.377	1.377	1.377	1.377	1.377	1.343	1.305	1.267	1.235
320	0.79	1.331	1.331	1.331	1.331	1.331	1.331	1.331	1.331	1.331	1.307	1.267	1.227
360	0.88	1.260	1.260	1.260	1.260	1.260	1.260	1.260	1.260	1.260	1.260	1.256	1.218
25000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–35	–30	–25	–20	–15	–10	–5	0	5	10	15	20
200	0.49	1.436	1.436	1.436	1.436	1.436	1.423	1.397	1.372	1.345	1.314	1.283	1.259
240	0.58	1.414	1.414	1.414	1.414	1.414	1.414	1.396	1.365	1.334	1.303	1.273	1.243
280	0.67	1.393	1.393	1.393	1.393	1.393	1.393	1.393	1.377	1.340	1.304	1.268	1.238
320	0.76	1.340	1.340	1.340	1.340	1.340	1.340	1.340	1.340	1.334	1.297	1.259	1.222
360	0.85	1.268	1.268	1.268	1.268	1.268	1.268	1.268	1.268	1.268	1.268	1.242	1.206
24000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–35	–30	–25	–20	–15	–10	–5	0	5	10	15	20
200	0.48	1.435	1.435	1.435	1.435	1.435	1.430	1.403	1.376	1.349	1.319	1.289	1.258
240	0.57	1.409	1.409	1.409	1.409	1.409	1.409	1.401	1.370	1.339	1.309	1.279	1.249
280	0.66	1.381	1.381	1.381	1.381	1.381	1.381	1.381	1.376	1.341	1.305	1.270	1.240
320	0.75	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.299	1.263	1.226
360	0.83	1.266	1.266	1.266	1.266	1.266	1.266	1.266	1.266	1.266	1.266	1.245	1.210
22000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–30	–25	–20	–15	–10	–5	0	5	10	15	20	25
200	0.46	1.432	1.432	1.432	1.432	1.432	1.416	1.386	1.356	1.326	1.298	1.269	1.249
240	0.55	1.404	1.404	1.404	1.404	1.404	1.404	1.384	1.353	1.321	1.291	1.263	1.235
280	0.63	1.365	1.365	1.365	1.365	1.365	1.365	1.365	1.343	1.310	1.277	1.246	1.219
320	0.72	1.318	1.318	1.318	1.318	1.318	1.318	1.318	1.318	1.303	1.269	1.236	1.203
360	0.80	1.257	1.257	1.257	1.257	1.257	1.257	1.257	1.257	1.257	1.250	1.217	1.184
20000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–30	–25	–20	–15	–10	–5	0	5	10	15	20	25
200	0.44	1.428	1.428	1.428	1.428	1.428	1.428	1.398	1.366	1.333	1.305	1.278	1.250
240	0.53	1.406	1.406	1.406	1.406	1.406	1.406	1.405	1.372	1.339	1.306	1.278	1.251
280	0.61	1.352	1.352	1.352	1.352	1.352	1.352	1.352	1.350	1.318	1.285	1.253	1.226
320	0.69	1.304	1.304	1.304	1.304	1.304	1.304	1.304	1.304	1.304	1.273	1.241	1.210
360	0.77	1.245	1.245	1.245	1.245	1.245	1.245	1.245	1.245	1.245	1.245	1.220	1.190

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	27	25	24	22	20
ENGINE ONLY	–0.005	–0.005	–0.006	–0.007	–0.006
ENGINE & WING*	–0.011	–0.012	–0.012	–0.013	–0.012
ENGINE & WING**	–0.019	–0.019	–0.019	–0.019	–0.018

***Wing anti-ice on, packs on.**
****Wing anti-ice on, packs off.**

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ENGINE INOP

Max Continuous EPR
Based on .84M, engine bleed for packs on and anti-ice off
18000 FT to 5000 FT Pressure Altitudes

18000 FT PRESS ALT								TAT (deg. C)					
KIAS	M	–25	–20	–15	–10	–5	0	5	10	15	20	25	30
200	0.42	1.407	1.407	1.407	1.407	1.407	1.399	1.368	1.337	1.307	1.281	1.255	1.231
240	0.51	1.390	1.390	1.390	1.390	1.390	1.390	1.377	1.346	1.314	1.284	1.258	1.232
280	0.59	1.336	1.336	1.336	1.336	1.336	1.336	1.336	1.321	1.291	1.260	1.231	1.206
320	0.67	1.286	1.286	1.286	1.286	1.286	1.286	1.286	1.286	1.274	1.244	1.215	1.186
360	0.75	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.230	1.224	1.195	1.166
16000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–25	–20	–15	–10	–5	0	5	10	15	20	25	30
200	0.41	1.388	1.388	1.388	1.388	1.388	1.388	1.372	1.343	1.314	1.286	1.261	1.236
240	0.49	1.370	1.370	1.370	1.370	1.370	1.370	1.370	1.347	1.318	1.288	1.261	1.236
280	0.57	1.321	1.321	1.321	1.321	1.321	1.321	1.322	1.321	1.295	1.267	1.238	1.212
320	0.64	1.276	1.276	1.276	1.276	1.276	1.276	1.276	1.276	1.276	1.249	1.221	1.193
360	0.72	1.225	1.225	1.225	1.225	1.225	1.225	1.226	1.225	1.225	1.225	1.203	1.175
14000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–20	–15	–10	–5	0	5	10	15	20	25	30	35
200	0.39	1.374	1.374	1.374	1.374	1.374	1.374	1.349	1.321	1.294	1.269	1.245	1.221
240	0.47	1.352	1.352	1.352	1.352	1.352	1.352	1.347	1.319	1.291	1.263	1.239	1.216
280	0.54	1.316	1.316	1.316	1.316	1.316	1.316	1.316	1.305	1.278	1.250	1.223	1.200
320	0.62	1.264	1.264	1.264	1.264	1.264	1.264	1.264	1.264	1.253	1.227	1.20	1.174
360	0.69	1.221	1.221	1.221	1.221	1.221	1.221	1.221	1.221	1.221	1.211	1.185	1.159
12000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–15	–10	–5	0	5	10	15	20	25	30	35	40
200	0.38	1.360	1.360	1.360	1.360	1.360	1.355	1.329	1.302	1.276	1.253	1.230	1.207
240	0.45	1.336	1.336	1.336	1.336	1.336	1.336	1.322	1.295	1.268	1.243	1.220	1.198
280	0.52	1.305	1.305	1.305	1.305	1.305	1.305	1.305	1.284	1.258	1.231	1.207	1.185
320	0.60	1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.251	1.230	1.205	1.180	1.157
360	0.67	1.209	1.209	1.209	1.209	1.209	1.209	1.209	1.209	1.209	1.189	1.164	1.140
10000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–15	–10	–5	0	5	10	15	20	25	30	35	40
200	0.36	1.350	1.350	1.350	1.350	1.350	1.350	1.337	1.311	1.286	1.262	1.240	1.218
240	0.43	1.323	1.323	1.323	1.323	1.323	1.323	1.323	1.300	1.274	1.249	1.227	1.205
280	0.51	1.289	1.289	1.289	1.289	1.289	1.289	1.289	1.288	1.262	1.237	1.211	1.190
320	0.58	1.243	1.243	1.243	1.243	1.243	1.243	1.243	1.243	1.237	1.213	1.188	1.163
360	0.65	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.193	1.170	1.146
5000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–10	–5	0	5	10	15	20	25	30	35	40	45
200	0.33	1.318	1.318	1.318	1.318	1.318	1.318	1.318	1.301	1.278	1.255	1.235	1.217
240	0.40	1.287	1.287	1.287	1.287	1.287	1.287	1.287	1.284	1.262	1.239	1.216	1.198
280	0.46	1.261	1.261	1.261	1.261	1.261	1.261	1.261	1.261	1.249	1.227	1.204	1.183
320	0.53	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.225	1.208	1.186	1.164
360	0.59	1.186	1.186	1.186	1.186	1.186	1.186	1.186	1.186	1.186	1.186	1.165	1.144

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	18	16	14	12	10	5
ENGINE ONLY	–0.010	–0.013	–0.015	–0.015	–0.015	–0.010
ENGINE & WING*	–0.015	–0.018	–0.019	–0.018	–0.018	–0.012
ENGINE & WING**	–0.020	–0.022	–0.023	–0.022	–0.021	–0.013

***Wing anti-ice on, packs on.**
****Wing anti-ice on, packs off.**

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ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
260	250	262	17700	15900	13700
240	232	253	20600	19100	17200
220	213	242	23000	21800	20400
200	194	232	25400	24400	23200
180	174	220	27400	26500	25700
160	155	207	29600	28700	27700

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ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability
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
134	125	118	111	105	100	95	91	87	83	80
275	256	239	224	212	200	190	180	172	164	157
415	385	360	337	318	300	284	270	257	246	235
554	514	480	450	424	400	379	360	343	327	313
692	642	600	562	529	500	474	450	429	409	392
829	770	719	674	635	600	569	540	515	492	470
965	897	838	786	741	700	664	631	601	574	549
1100	1023	957	898	846	800	759	721	687	657	629
1235	1149	1075	1010	952	900	854	812	774	740	708
1370	1275	1193	1121	1057	1000	949	903	861	822	788
1504	1401	1311	1232	1162	1100	1044	993	947	905	867
1638	1526	1429	1344	1268	1200	1139	1084	1034	989	947
1772	1652	1547	1455	1373	1300	1234	1175	1121	1072	1027
1906	1778	1665	1566	1479	1400	1329	1266	1208	1155	1106
2040	1903	1783	1678	1584	1500	1425	1356	1294	1238	1186
2175	2029	1902	1789	1689	1600	1520	1447	1381	1321	1265
2310	2155	2020	1901	1795	1700	1615	1538	1467	1403	1345
2446	2282	2139	2013	1900	1800	1710	1628	1554	1486	1424

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG) WEIGHT AT START OF DRIFTDOWN (1000 KG)						TIME (HR:MIN)
	160	180	200	220	240	260	
100	0.8	0.9	1.0	1.1	1.2	1.3	0:15
200	1.9	2.1	2.4	2.6	2.8	3.0	0:33
300	3.2	3.6	3.9	4.3	4.7	5.0	0:50
400	4.5	5.1	5.6	6.1	6.6	7.1	1:07
500	5.8	6.5	7.2	7.9	8.6	9.3	1:23
600	7.1	7.9	8.7	9.5	10.4	11.3	1:39
700	8.3	9.2	10.2	11.2	12.2	13.2	1:55
800	9.5	10.6	11.7	12.8	13.9	15.2	2:11
900	10.7	11.9	13.2	14.4	15.7	17.1	2:26
1000	11.9	13.2	14.6	16.1	17.5	19.0	2:42
1100	13.1	14.6	16.1	17.7	19.2	20.9	2:57
1200	14.3	15.9	17.5	19.3	21.0	22.8	3:12
1300	15.4	17.2	19.0	20.9	22.7	24.7	3:28
1400	16.6	18.5	20.4	22.4	24.4	26.6	3:43
1500	17.8	19.8	21.9	24.0	26.1	28.5	3:58
1600	18.9	21.1	23.3	25.6	27.8	30.3	4:14
1700	20.1	22.4	24.7	27.1	29.5	32.2	4:29
1800	21.2	23.7	26.1	28.7	31.2	34.0	4:45

APU fuel included.
Driftdown at optimum speed and cruise at LRC speed.

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ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 0 deg. C & BELOW	ISA + 10 deg. C	ISA + 20 deg. C
260	10500	10200	4200
240	14400	14200	8500
220	18600	18400	13000
200	22400	22200	17700
180	25700	25600	21900
160	27900	27800	25600
140	30400	30200	27900

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MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)							
		10	15	17	19	21	23	25	27
260	EPR	1.213							
	MACH	.577							
	KIAS	321							
	FF/ENG	8069							
240	EPR	1.188	1.260	1.298					
	MACH	.558	.606	.627					
	KIAS	310	307	306					
	FF/ENG	7412	7389	7412					
220	EPR	1.164	1.226	1.258	1.297				
	MACH	.538	.585	.605	.626				
	KIAS	298	296	294	294				
	FF/ENG	6764	6736	6728	6748				
200	EPR	1.141	1.195	1.223	1.254	1.293	1.339		
	MACH	.516	.562	.581	.601	.623	.648		
	KIAS	286	284	283	282	281	281		
	FF/ENG	6126	6094	6085	6077	6089	6140		
180	EPR	1.119	1.166	1.189	1.217	1.247	1.284	1.330	
	MACH	.492	.537	.556	.576	.596	.617	.642	
	KIAS	272	271	270	269	268	267	267	
	FF/ENG	5490	5462	5451	5443	5434	5438	5475	
160	EPR	1.098	1.139	1.158	1.181	1.207	1.237	1.272	1.316
	MACH	.466	.510	.529	.548	.568	.588	.609	.633
	KIAS	258	257	256	256	255	254	253	252
	FF/ENG	4862	4838	4827	4817	4809	4800	4796	4817
140	EPR	1.079	1.111	1.129	1.148	1.169	1.194	1.222	1.255
	MACH	.440	.480	.498	.517	.536	.556	.577	.598
	KIAS	243	241	241	241	240	239	238	237
	FF/ENG	4258	4216	4209	4200	4191	4182	4174	4166

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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
287	264	244	227	213	200	191	182	174	167	160
576	530	489	455	426	400	381	364	348	334	321
865	796	735	684	640	600	572	546	522	501	482
1156	1064	982	913	853	800	763	729	698	669	643
1448	1332	1229	1142	1067	1000	953	910	871	835	803
1742	1602	1477	1372	1281	1200	1144	1092	1045	1002	963
2036	1871	1725	1602	1495	1400	1335	1274	1219	1168	1122
2332	2141	1973	1831	1709	1600	1525	1456	1392	1334	1282
2629	2414	2223	2062	1924	1800	1715	1637	1565	1500	1441

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	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	3.4	0:40	3.0	0:38	2.6	0:37	2.4	0:36	2.1	0:34
400	7.1	1:17	6.5	1:13	6.0	1:10	5.5	1:07	5.2	1:03
600	10.9	1:54	10.0	1:48	9.3	1:43	8.7	1:38	8.2	1:33
800	14.5	2:31	13.5	2:24	12.6	2:17	11.8	2:10	11.2	2:02
1000	18.2	3:09	16.9	2:59	15.8	2:51	14.9	2:42	14.2	2:32
1200	21.8	3:47	20.3	3:35	19.1	3:25	17.9	3:14	17.1	3:02
1400	25.3	4:26	23.7	4:12	22.2	3:59	20.9	3:47	20.0	3:33
1600	28.8	5:05	27.0	4:48	25.4	4:33	23.9	4:19	22.9	4:03
1800	32.3	5:44	30.3	5:25	28.5	5:08	26.9	4:52	25.7	4:34

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	160	180	200	220	240
5	–0.5	–0.3	0.0	0.4	1.0
10	–1.1	–0.5	0.0	0.9	2.1
15	–1.7	–0.8	0.0	1.4	3.1
20	–2.3	–1.1	0.0	1.9	4.1
25	–2.9	–1.4	0.0	2.3	5.1
30	–3.5	–1.7	0.0	2.7	5.9
35	–4.1	–2.0	0.0	3.0	6.7

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MAX CONTINUOUS THRUST

Holding
Flaps up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
300	EPR	1.163	1.200	1.271			
	KIAS	260	260	262			
	FF/ENG	8080	8090	8160			
280	EPR	1.147	1.179	1.242	1.327		
	KIAS	251	251	253	261		
	FF/ENG	7480	7480	7530	7730		
260	EPR	1.131	1.159	1.215	1.294		
	KIAS	242	242	243	246		
	FF/ENG	6890	6900	6910	7010		
240	EPR	1.116	1.141	1.189	1.259	1.352	
	KIAS	232	233	234	235	247	
	FF/ENG	6310	6310	6320	6370	6620	
220	EPR	1.101	1.124	1.165	1.225	1.310	
	KIAS	223	223	224	224	230	
	FF/ENG	5760	5740	5740	5760	5880	
200	EPR	1.087	1.105	1.141	1.192	1.268	1.370
	KIAS	216	216	216	216	216	229
	FF/ENG	5240	5200	5190	5190	5240	5480
180	EPR	1.074	1.089	1.119	1.161	1.224	1.316
	KIAS	209	209	209	209	209	209
	FF/ENG	4850	4690	4660	4660	4680	4750
160	EPR	1.062	1.075	1.097	1.133	1.184	1.260
	KIAS	202	202	202	202	202	202
	FF/ENG	4350	4300	4150	4150	4140	4170
140	EPR	1.049	1.060	1.079	1.107	1.148	1.210
	KIAS	194	194	194	194	194	194
	FF/ENG	3860	3810	3660	3690	3680	3640

This table includes 5% additional fuel for holding in a racetrack pattern.

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ADVISORY INFORMATION

Gear Down Landing Rate of Climb Available
Flaps 20

TAT (deg. C)	RATE OF CLIMB (FT/MIN) PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
52	330	270	130	10	–110	–210
50	360	300	160	30	–80	–190
48	390	330	200	60	–60	–160
46	420	360	230	90	–30	–140
44	450	390	260	120	–10	–110
42	480	420	290	150	20	–90
40	510	450	320	190	50	–60
38	540	480	350	220	90	–40
36	580	520	390	250	120	–10
34	610	550	420	280	150	20
32	610	580	450	310	180	50
30	610	610	480	350	210	80
20	630	630	550	480	380	240
10	640	640	570	490	420	340
0	650	650	580	500	430	350
–20	680	680	600	530	450	360
–40	710	710	630	550	470	380

Rate of climb capability shown is valid for 180000 kg, gear down at VREF20 + 5.
Decrease rate of climb 45 ft/min per 5000 kg greater than 180,000 kg.
Increase rate of climb 55 ft/min per 5000 kg less than 180,000 kg.

Flaps 30

TAT (deg. C)	RATE OF CLIMB (FT/MIN) PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
52	–130	–200	–330	–460	–580	–680
50	–100	–170	–300	–440	–550	–660
48	–70	–140	–270	–410	–530	–640
46	–50	–110	–250	–390	–510	–620
44	–20	–90	–220	–360	–490	–600
42	10	–60	–190	–330	–460	–570
40	30	–30	–160	–300	–430	–550
38	60	0	–140	–270	–400	–530
36	90	30	–110	–240	–380	–500
34	120	50	–80	–210	–350	–470
32	120	80	–50	–190	–320	–450
30	120	110	–20	–160	–290	–420
20	120	110	40	–40	–140	–290
10	130	120	40	–40	–120	–200
0	130	120	40	–40	–120	–210
–20	140	130	50	–40	–120	–210
–40	150	140	50	–30	–120	–220

Rate of climb capability shown is valid for 180,000 kg, gear down at VREF30 + 5.
Decrease rate of climb 45 ft/min per 5,000 kg greater than 180,000 kg.
Increase rate of climb 55 ft/min per 5,000 kg less than 180,000 kg.

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ALTERNATE MODE EEC

Limit Weight

PERFORMANCE LIMIT	ALTERNATE MODE EEC LIMIT WEIGHT (1000 KG)						
	PRIMARY MODE PERFORMANCE LIMIT WEIGHT (1000 KG)						
	140	160	180	200	220	240	260
FIELD	136	156	172	194	212	230	250
CLIMB	134	153	171	191	211	230	250
OBSTACLE	135	154	173	192	210	231	251
NET LEVEL OFF WEIGHT	135	155	174	193	213	232	251
LANDING CLIMB	135	154	173	192	212	231	251

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ALTERNATE MODE EEC

Takeoff Speed Adjustment

TAKEOFF SPEEDS	TAKEOFF SPEED ADJUSTMENT (KTS)
V1	+1
VR	0
V2	0

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ALTERNATE MODE EEC

Max Takeoff %N1

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)										
deg. C	deg. F	–2000	0	1000	2000	3000	4000	5000	6000	7000	8000	8400
55	131	87.8	88.8	88.6	88.4	88.1	87.9	87.7	87.6	87.6	87.5	87.5
50	122	88.4	89.4	89.3	89.1	89.0	88.8	88.7	88.6	88.6	88.6	88.6
45	113	88.8	89.9	89.9	89.8	89.6	89.4	89.3	89.2	89.3	89.3	89.3
40	104	89.2	90.4	90.4	90.4	90.3	90.2	90.1	90.0	90.0	90.0	90.0
35	95	89.6	90.8	90.8	90.8	90.8	90.7	90.7	90.7	90.7	90.7	90.7
30	86	89.0	91.1	91.2	91.2	91.3	91.3	91.2	91.2	91.3	91.3	91.3
25	77	88.3	90.3	90.9	91.4	91.7	91.7	91.8	91.8	91.8	91.8	91.8
20	68	87.6	89.6	90.1	90.6	91.2	91.7	92.3	92.4	92.3	92.3	92.3
15	59	86.8	88.8	89.3	89.8	90.4	90.9	91.5	92.1	92.6	92.8	92.7
10	50	86.0	88.0	88.5	89.0	89.6	90.1	90.7	91.3	91.8	92.3	92.3
5	41	85.3	87.2	87.8	88.3	88.8	89.3	89.9	90.5	91.0	91.5	91.5
0	32	84.5	86.5	87.0	87.5	88.0	88.5	89.1	89.7	90.2	90.6	90.7
–10	14	83.0	84.9	85.4	85.8	86.4	86.9	87.4	88.0	88.5	89.0	89.0
–20	–4	81.4	83.2	83.7	84.2	84.7	85.0	85.7	86.3	86.8	87.2	87.3
–30	–22	79.7	81.6	82.0	82.5	83.0	83.5	84.0	84.6	85.1	85.5	85.6
–40	–40	78.1	79.9	80.3	80.8	81.3	81.8	82.3	82.9	83.3	83.7	83.8
–50	–58	76.4	78.1	78.6	79.0	79.5	80.0	80.5	81.1	81.5	81.9	82.0

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
PACKS OFF	0.1	0.1	0.1	0.2	0.2	0.2
WING ANTI-ICE ON	–0.1	–0.1	–0.2	–0.2	–0.3	–0.3

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ALTERNATE MODE EEC

Max Climb %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (FT)/SPEED (KIAS OR MACH)									
	0	5000	10000	15000	20000	25000	30000	35000	40000	43000
	310	310	310	310	310	310	310	.84	.84	.84
60	81.1	81.7	83.6	85.9	88.6	90.4	91.1	93.5	93.3	93.1
50	82.4	83.1	83.6	84.6	87.2	89.0	89.7	92.1	91.8	91.7
40	83.7	84.5	84.8	85.4	86.3	87.6	88.3	90.7	90.4	90.3
30	82.8	85.7	86.2	86.6	87.5	87.8	87.3	89.2	89.0	88.8
20	81.5	84.2	86.6	87.8	88.6	88.7	88.4	88.3	87.5	87.4
15	80.8	83.5	85.9	88.2	89.1	89.3	88.9	89.0	88.1	88.0
10	80.1	82.8	85.1	87.4	89.5	89.8	89.5	89.5	88.7	88.6
5	79.3	82.0	84.4	86.6	89.0	90.2	90.0	89.8	89.1	89.1
0	78.6	81.3	83.6	85.8	88.2	89.9	90.3	90.5	89.7	89.6
–5	77.9	80.6	82.8	85.0	87.4	89.1	90.1	91.0	90.2	90.2
–10	77.2	79.8	82.1	84.2	86.5	88.2	89.3	91.5	90.8	90.7
–15	76.4	79.0	81.3	83.4	85.7	87.4	88.4	91.3	91.2	91.1
–20	75.7	78.3	80.5	82.6	84.9	86.5	87.6	90.4	90.3	90.2
–25	74.9	77.5	79.7	81.8	84.0	85.7	86.7	89.5	89.4	89.3
–30	74.2	76.7	78.9	81.0	83.2	84.8	85.8	88.6	88.5	88.4
–35	73.4	75.9	78.1	80.1	82.3	83.9	84.9	87.7	87.6	87.5
–40	72.6	75.1	77.2	79.3	81.5	83.1	84.0	86.7	86.7	86.6

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)									
	0	5000	10000	15000	20000	25000	30000	35000	40000	43000
ENGINE ANTI-ICE ON	–0.5	–0.6	–0.8	–0.7	–0.2	–0.2	–0.1	–0.1	–0.1	–0.2
ENGINE & WING ANTI-ICE ON	–0.6	–0.7	–0.9	–0.9	–0.5	–0.5	–0.4	–0.4	–0.5	–0.6

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ALTERNATE MODE EEC

Max Cruise %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (FT)									
	25000	27000	29000	31000	33000	35000	37000	39000	41000	43000
25	86.6	86.5	86.9	87.8	87.8	87.8	87.8	87.8	87.8	87.8
20	87.0	86.7	86.8	87.3	87.3	87.1	87.0	87.0	87.0	87.0
15	87.6	87.2	87.2	87.4	87.4	87.3	86.7	86.7	86.7	86.6
10	88.1	87.8	87.8	88.0	87.9	87.9	87.2	87.1	87.0	86.9
5	88.4	88.2	88.3	88.5	88.5	88.2	87.6	87.5	87.5	87.4
0	88.2	88.4	88.6	88.9	89.0	88.9	88.2	88.1	88.1	88.0
–5	87.4	87.6	88.1	88.7	89.3	89.3	88.7	88.6	88.6	88.5
–10	86.5	86.8	87.3	87.9	89.0	89.7	89.1	89.1	89.0	89.0
–15	85.7	85.9	86.5	87.0	88.2	89.3	89.3	89.3	89.3	89.2
–20	84.9	85.1	85.6	86.2	87.3	88.5	88.5	88.4	88.4	88.3
–25	84.0	84.3	84.8	85.3	86.5	87.6	87.6	87.6	87.5	87.5
–30	83.2	83.4	83.9	84.5	85.6	86.7	86.7	86.7	86.6	86.6
–35	82.3	82.6	83.1	83.6	84.7	85.8	85.8	85.8	85.7	85.7

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)				
	25000	30000	35000	40000	43000
ENGINE ANTI-ICE ON	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING ANTI-ICE ON	–0.3	–0.3	–0.4	–0.4	–0.5

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ALTERNATE MODE EEC

Go-Around %N1

Based on engine bleed for packs on, engine anti-ice on or off, wing anti-ice off

AIRPORT OAT		TAT	PRESSURE ALTITUDE (FT)											
deg. C	deg. F	(deg. C)	–2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
52	126	55	88.0	88.9	88.8	88.6	88.5	88.3	88.3	88.3	88.3	88.4	88.4	88.4
47	117	50	88.4	89.5	89.4	89.3	89.2	89.0	88.9	88.9	89.0	89.1	89.1	89.2
42	108	45	88.9	90.0	90.0	90.0	89.9	89.8	89.7	89.6	89.6	89.7	89.8	89.8
37	99	40	89.3	90.4	90.5	90.5	90.5	90.4	90.4	90.3	90.3	90.4	90.4	90.4
32	90	35	89.1	90.9	90.9	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.1	91.1
27	81	30	88.3	90.4	90.9	91.4	91.5	91.5	91.6	91.6	91.6	91.6	91.7	91.7
22	72	25	87.6	89.6	90.2	90.7	91.3	91.8	92.1	92.2	92.3	92.2	92.2	92.3
17	63	20	86.9	88.9	89.4	89.9	90.5	91.1	91.7	92.3	92.8	92.9	92.9	93.0
12	54	15	86.1	88.1	88.6	89.2	89.7	90.3	90.9	91.5	92.1	92.7	93.5	93.8
7	45	10	85.4	87.3	87.9	88.4	89.0	89.5	90.1	90.7	91.3	91.9	92.7	93.4
2	36	5	84.6	86.6	87.1	87.6	88.2	88.7	89.3	89.9	90.5	91.1	91.8	92.5
–3	27	0	83.9	85.8	86.3	86.8	87.4	87.9	88.5	89.1	89.7	90.3	91.0	91.7
–13	9	–10	82.3	84.2	84.7	85.2	85.8	86.3	86.8	87.4	88.0	88.6	89.3	90.0
–23	–9	–20	80.7	82.6	83.1	83.6	84.1	84.6	85.2	85.7	86.3	86.9	87.6	88.3
–33	–27	–30	79.1	80.9	81.4	81.9	82.4	82.9	83.5	84.0	84.6	85.2	85.9	86.5
–43	–45	–40	77.5	79.3	79.7	80.2	80.7	81.2	81.7	82.3	82.8	83.4	84.1	84.7
–53	–63	–50	75.8	77.5	78.0	78.5	79.0	79.5	80.0	80.5	81.0	81.6	82.3	82.9

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)						
	–2000	0	2000	4000	6000	8000	10000
PACKS OFF	0.1	0.1	0.1	0.2	0.2	0.2	0.2
1 PACK ON	–0.1	–0.1	–0.1	–0.2	–0.2	–0.2	–0.2
WING ANTI-ICE ON	–0.2	–0.2	–0.2	–0.2	–0.3	–0.3	–0.3

UNCONTROLLED IF DOWNLOADED OR PRINTED

ALTERNATE MODE EEC
ENGINE INOP

Initial Max Continuous %N1
Based on .84M, engine bleed for packs on or off and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	90.6	89.6	88.8	88.6	88.3	87.6	87.5	87.4	87.4
15	91.3	90.4	89.2	89.1	89.0	88.2	88.1	88.1	88.0
10	91.9	91.2	90.2	89.5	89.5	88.8	88.7	88.7	88.6
5	92.1	91.8	91.0	90.1	89.8	89.2	89.2	89.1	89.1
0	91.2	92.0	91.8	90.8	90.5	89.7	89.7	89.6	89.6
–5	90.4	91.1	91.9	91.4	91.0	90.3	90.3	90.2	90.2
–10	89.5	90.3	91.0	91.3	91.5	90.9	90.8	90.8	90.7
–15	88.7	89.4	90.1	90.4	91.3	91.3	91.2	91.2	91.1
–20	87.8	88.5	89.3	89.5	90.4	90.4	90.3	90.3	90.2
–25	87.0	87.7	88.4	88.6	89.5	89.5	89.4	89.4	89.3
–30	86.1	86.8	87.5	87.8	88.6	88.6	88.5	88.5	88.4
–35	85.2	85.9	86.6	86.8	87.7	87.7	87.6	87.6	87.5
–40	84.3	85.0	85.7	85.9	86.7	86.7	86.7	86.6	86.6

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
ENGINE ONLY	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.3	–0.3	–0.3	–0.4	–0.4	–0.4	–0.5	–0.5	–0.6
ENGINE & WING**	–0.6	–0.6	–0.6	–0.6	–0.7	–0.8	–0.8	–0.9	–1.0

*Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

UNCONTROLLED IF DOWNLOADED OR PRINTED
DRAFT

ALTERNATE MODE EEC
ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
320 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	87.7	88.2	88.3	88.5	88.7	89.0	89.3	89.5	89.6	89.6	88.8	88.3	87.8	87.8	88.6	89.3
25	87.0	88.8	88.9	89.1	89.3	89.6	89.9	90.0	90.2	90.2	89.4	88.8	88.4	88.4	89.2	89.9
20	86.3	88.4	89.2	89.7	89.9	90.2	90.4	90.6	90.7	90.7	89.9	89.3	88.9	89.0	89.8	90.3
15	85.5	87.6	88.4	89.3	90.2	90.6	90.9	91.2	91.3	91.4	90.6	90.1	89.4	89.4	90.1	90.5
10	84.8	86.9	87.7	88.6	89.4	90.3	91.2	91.6	91.8	91.9	91.3	90.9	90.3	89.9	90.4	90.8
5	84.0	86.1	86.9	87.8	88.6	89.5	90.4	91.4	92.2	92.4	91.8	91.6	91.0	90.4	91.0	91.2
0	83.3	85.3	86.1	87.0	87.8	88.7	89.6	90.5	91.4	91.8	91.8	92.3	91.6	90.8	91.4	91.7
–5	82.5	84.5	85.3	86.2	87.0	87.9	88.8	89.7	90.5	90.9	91.0	91.4	91.3	90.8	91.8	92.0
–10	81.7	83.7	84.5	85.4	86.2	87.1	87.9	88.9	89.7	90.1	90.1	90.6	90.4	90.0	91.0	91.2
–15	81.0	82.9	83.7	84.6	85.4	86.2	87.1	88.0	88.8	89.2	89.2	89.7	89.6	89.1	90.1	90.3
–20	80.2	82.1	82.9	83.7	84.5	85.4	86.2	87.2	88.0	88.3	88.4	88.8	88.7	88.2	89.3	89.4
–25	79.4	81.3	82.1	82.9	83.7	84.5	85.4	86.3	87.1	87.5	87.5	88.0	87.8	87.4	88.4	88.5
–30	78.6	80.5	81.2	82.1	82.8	83.7	84.5	85.4	86.2	86.6	86.6	87.1	86.9	86.5	87.5	87.6
–35	77.8	79.7	80.4	81.2	82.0	82.8	83.7	84.5	85.3	85.7	85.7	86.2	86.0	85.6	86.6	86.7
–40	76.9	78.8	79.5	80.4	81.1	81.9	82.8	83.6	84.4	84.8	84.8	85.3	85.1	84.7	85.7	85.8

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.5	–0.7	–0.7	–0.6	–0.5	–0.4	–0.2	–0.2	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.6	–0.9	–0.9	–0.8	–0.7	–0.6	–0.4	–0.5	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4
ENGINE & WING**	–0.7	–1.0	–1.0	–1.0	–0.9	–0.8	–0.7	–0.7	–0.7	–0.7	–0.7	–0.6	–0.6	–0.6	–0.6	–0.7

*Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

280 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	87.6	87.9	87.8	87.9	88.0	88.1	88.3	88.4	88.5	88.7	88.2	87.6	87.4	88.2	89.3	88.9
25	87.5	88.5	88.5	88.6	88.6	88.7	88.9	89.0	89.3	89.4	88.4	87.3	86.7	87.4	88.5	88.1
20	86.7	89.0	89.1	89.2	89.2	89.3	89.5	89.6	89.8	90.0	89.0	87.9	87.1	87.4	87.9	87.7
15	86.0	88.4	89.3	89.7	89.8	89.9	90.0	90.1	90.3	90.4	89.5	88.5	87.7	88.0	88.6	88.4
10	85.2	87.7	88.5	89.3	90.1	90.3	90.5	90.6	90.8	91.0	90.0	88.9	88.2	88.6	89.2	88.9
5	84.5	86.9	87.7	88.5	89.3	90.1	91.0	91.0	91.3	91.5	90.6	89.6	88.8	89.0	89.6	89.3
0	83.7	86.1	86.9	87.7	88.5	89.3	90.2	91.0	91.9	92.2	91.2	90.2	89.6	89.6	90.1	89.9
–5	82.9	85.3	86.1	86.9	87.6	88.5	89.4	90.2	91.3	91.9	91.7	90.7	90.3	90.3	90.7	90.4
–10	82.2	84.5	85.3	86.1	86.8	87.7	88.6	89.3	90.4	91.1	90.8	90.5	90.7	90.9	91.3	90.9
–15	81.4	83.7	84.5	85.3	86.0	86.8	87.7	88.5	89.5	90.2	89.9	89.6	89.9	90.5	91.5	90.9
–20	80.6	82.9	83.7	84.4	85.2	86.0	86.9	87.6	88.7	89.3	89.1	88.7	89.0	89.6	90.6	90.1
–25	79.8	82.1	82.8	83.6	84.3	85.1	86.0	86.8	87.8	88.4	88.2	87.9	88.1	88.7	89.7	89.2
–30	79.0	81.2	82.0	82.7	83.5	84.3	85.1	85.9	86.9	87.5	87.3	87.0	87.2	87.8	88.8	88.3
–35	78.2	80.4	81.1	81.9	82.6	83.4	84.3	85.0	86.0	86.6	86.4	86.1	86.3	86.9	87.9	87.3
–40	77.3	79.5	80.3	81.0	81.7	82.5	83.4	84.1	85.1	85.7	85.5	85.2	85.4	86.0	86.9	86.4

UNCONTROLLED IF DOWNLOADED OR PRINTED

ALTERNATE MODE EEC
ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
280 KIAS
%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.5	–0.7	–0.7	–0.6	–0.5	–0.4	–0.2	–0.3	–0.2	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.6	–0.8	–0.8	–0.8	–0.7	–0.6	–0.5	–0.5	–0.5	–0.5	–0.5	–0.4	–0.4	–0.4	–0.4	–0.4
ENGINE & WING**	–0.7	–1.0	–1.0	–1.0	–0.9	–0.8	–0.7	–0.7	–0.7	–0.7	–0.7	–0.7	–0.7	–0.7	–0.7	–0.8

**Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

240 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	87.0	86.9	87.0	87.1	87.4	87.6	87.6	87.6	88.2	88.5	87.8	87.3	87.1	87.7	88.5	88.5
25	87.5	87.6	87.6	87.7	88.0	88.3	88.3	88.0	87.6	87.8	87.1	86.6	86.3	87.0	87.8	87.7
20	87.0	88.2	88.3	88.4	88.6	88.9	88.9	88.6	88.4	88.3	86.8	85.9	85.6	86.2	87.1	87.0
15	86.2	88.5	88.8	89.0	89.2	89.5	89.5	89.2	89.0	89.0	87.6	86.4	85.3	85.5	86.3	86.3
10	85.5	87.7	88.7	89.5	89.7	90.0	90.1	89.7	89.5	89.5	88.2	87.0	86.1	86.0	86.2	86.1
5	84.7	87.0	87.9	88.9	89.9	90.5	90.6	90.2	89.9	89.9	88.6	87.6	86.6	86.6	86.9	86.8
0	83.9	86.2	87.1	88.1	89.1	90.3	91.2	90.6	90.4	90.3	89.1	88.0	87.1	87.1	87.4	87.4
–5	83.2	85.4	86.3	87.3	88.3	89.5	90.5	90.7	90.8	90.7	89.6	88.5	87.6	87.6	87.8	87.9
–10	82.4	84.6	85.5	86.5	87.5	88.6	89.6	89.8	90.3	90.6	90.1	89.0	88.1	88.1	88.4	88.5
–15	81.6	83.8	84.7	85.6	86.6	87.8	88.8	89.0	89.4	89.8	89.4	89.1	88.6	88.6	89.0	89.2
–20	80.8	83.0	83.8	84.8	85.8	86.9	87.9	88.1	88.5	88.9	88.5	88.2	88.0	88.8	89.7	89.8
–25	80.0	82.1	83.0	84.0	84.9	86.1	87.0	87.2	87.7	88.0	87.6	87.3	87.1	87.9	89.1	89.4
–30	79.2	81.3	82.2	83.1	84.1	85.2	86.2	86.3	86.8	87.1	86.7	86.5	86.2	87.0	88.2	88.5
–35	78.4	80.5	81.3	82.2	83.2	84.3	85.3	85.5	85.9	86.2	85.8	85.6	85.3	86.1	87.3	87.6
–40	77.6	79.6	80.5	81.4	82.3	83.4	84.4	84.5	85.0	85.3	84.9	84.7	84.4	85.2	86.4	86.6

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.5	–0.7	–0.7	–0.6	–0.5	–0.4	–0.3	–0.3	–0.2	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.6	–0.8	–0.8	–0.8	–0.7	–0.6	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5
ENGINE & WING**	–0.7	–1.0	–1.0	–1.0	–1.0	–0.8	–0.8	–0.8	–0.8	–0.8	–0.8	–0.8	–0.8	–0.9	–0.9	–0.9

**Wing anti-ice on, packs on.*
***Wing anti-ice on, packs off.*

UNCONTROLLED IF DOWNLOADED OR PRINTED
DRAFT

ALTERNATE MODE EEC
ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
200 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	86.8	86.4	86.1	85.9	85.6	85.6	86.7	87.5	88.3	88.7	87.8	86.9	86.1	86.6	87.6	87.4
25	87.4	87.0	86.7	86.5	86.4	86.4	86.5	86.8	87.6	87.9	87.1	86.2	85.4	85.9	86.9	86.7
20	87.6	87.7	87.4	87.1	87.0	87.1	87.2	87.1	86.9	87.2	86.4	85.4	84.7	85.2	86.2	86.0
15	86.8	88.3	88.0	87.8	87.7	87.7	87.8	87.8	87.7	87.6	85.8	84.7	83.9	84.5	85.4	85.2
10	86.1	88.2	88.6	88.4	88.3	88.3	88.4	88.4	88.3	88.3	86.6	84.8	83.2	83.7	84.7	84.5
5	85.3	87.4	88.0	88.7	88.8	88.9	89.0	88.9	88.8	88.8	87.3	85.5	83.9	83.7	83.9	83.7
0	84.5	86.6	87.2	87.9	88.7	89.4	89.6	89.3	89.2	89.2	87.8	86.1	84.6	84.4	84.6	84.3
–5	83.8	85.8	86.4	87.1	87.9	88.9	90.1	89.8	89.5	89.4	88.1	86.7	85.1	85.0	85.3	85.0
–10	83.0	85.0	85.6	86.3	87.1	88.1	89.3	89.7	89.8	89.6	88.4	87.1	85.8	85.5	85.7	85.6
–15	82.2	84.2	84.8	85.5	86.3	87.2	88.4	88.8	89.2	89.4	88.8	87.6	86.3	86.1	86.3	86.2
–20	81.4	83.4	84.0	84.7	85.4	86.4	87.5	88.0	88.3	88.5	88.1	87.7	86.9	86.6	86.9	86.8
–25	80.6	82.5	83.1	83.8	84.6	85.5	86.7	87.1	87.5	87.6	87.3	86.9	86.5	87.2	87.6	87.5
–30	79.8	81.7	82.3	83.0	83.7	84.7	85.8	86.2	86.6	86.8	86.4	86.0	85.7	86.3	87.5	87.7
–35	78.9	80.8	81.4	82.1	82.9	83.8	84.9	85.3	85.7	85.9	85.5	85.1	84.8	85.4	86.6	86.8
–40	78.1	80.0	80.6	81.2	82.0	82.9	84.0	84.4	84.8	84.9	84.6	84.2	83.9	84.5	85.7	85.9

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.5	–0.8	–0.7	–0.7	–0.6	–0.4	–0.3	–0.3	–0.3	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1	–0.2
ENGINE & WING*	–0.6	–0.9	–0.9	–0.9	–0.8	–0.7	–0.5	–0.6	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.6
ENGINE & WING**	–0.7	–1.0	–1.0	–1.0	–1.0	–0.9	–0.8	–0.8	–0.8	–0.8	–0.9	–0.8	–0.9	–0.9	–1.0	–1.0

*Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

UNCONTROLLED IF DOWNLOADED OR PRINTED

GEAR DOWN

220 KIAS Max Climb EPR

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)														
	0	5	10	12	14	16	18	20	22	24	26	28	30	32	34
55	1.152	1.150	1.166	1.168	1.171	1.176	1.182	1.189	1.196	1.200	1.193	1.178	1.164	1.164	1.171
50	1.166	1.161	1.166	1.168	1.171	1.176	1.182	1.189	1.196	1.200	1.193	1.178	1.164	1.164	1.171
45	1.182	1.177	1.166	1.168	1.171	1.176	1.182	1.189	1.196	1.200	1.193	1.178	1.164	1.164	1.171
40	1.199	1.193	1.185	1.175	1.171	1.176	1.182	1.189	1.196	1.200	1.193	1.178	1.164	1.164	1.171
35	1.217	1.212	1.204	1.195	1.186	1.176	1.182	1.189	1.196	1.200	1.193	1.178	1.164	1.164	1.171
30	1.229	1.233	1.223	1.215	1.207	1.199	1.191	1.189	1.196	1.200	1.193	1.178	1.164	1.164	1.171
25	1.229	1.255	1.246	1.236	1.228	1.221	1.215	1.208	1.201	1.200	1.193	1.178	1.164	1.164	1.171
20	1.229	1.265	1.269	1.260	1.252	1.244	1.238	1.232	1.226	1.215	1.193	1.178	1.164	1.164	1.171
15	1.229	1.265	1.292	1.284	1.277	1.269	1.262	1.256	1.251	1.240	1.219	1.189	1.164	1.164	1.171
10	1.229	1.265	1.297	1.305	1.301	1.295	1.290	1.284	1.276	1.266	1.245	1.216	1.188	1.174	1.171
5	1.229	1.265	1.297	1.305	1.315	1.321	1.317	1.312	1.306	1.294	1.272	1.242	1.215	1.202	1.198
0	1.229	1.265	1.297	1.305	1.315	1.326	1.341	1.341	1.336	1.326	1.303	1.270	1.242	1.231	1.228
–5	1.229	1.265	1.297	1.305	1.315	1.326	1.341	1.356	1.366	1.357	1.335	1.303	1.274	1.260	1.258
–10	1.229	1.265	1.297	1.305	1.315	1.326	1.341	1.356	1.371	1.381	1.368	1.337	1.308	1.296	1.294
–15	1.229	1.265	1.297	1.305	1.315	1.326	1.341	1.356	1.371	1.381	1.380	1.368	1.342	1.332	1.332

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)							
	0	5	10	15	20	25	30	35
ENGINE ONLY	–0.008	–0.010	–0.015	–0.015	–0.006	–0.005	–0.003	–0.003
ENGINE AND WING*	–0.010	–0.012	–0.018	–0.019	–0.012	–0.012	–0.011	–0.012
*Wing anti-ice on, packs on.								

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GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
260	13700	11200	8200
240	17100	14800	12200
220	20500	18600	16000
200	23800	22100	20000
180	26500	25400	23800
160	28900	27800	26600
140	32100	30400	29100

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GEAR DOWN

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
260	EPR	1.192	1.261								
	MACH	.458	.501								
	KIAS	253	252								
	FF/ENG	6367	6344								
240	EPR	1.169	1.231	1.261							
	MACH	.441	.484	.501							
	KIAS	244	243	243							
	FF/ENG	5839	5818	5811							
220	EPR	1.147	1.202	1.229	1.259	1.295					
	MACH	.422	.465	.482	.500	.519					
	KIAS	233	234	233	233	232					
	FF/ENG	5304	5300	5291	5283	5299					
200	EPR	1.127	1.174	1.197	1.224	1.255	1.290				
	MACH	.402	.445	.462	.480	.498	.517				
	KIAS	222	223	223	223	222	222				
	FF/ENG	4772	4784	4779	4771	4763	4773				
180	EPR	1.110	1.147	1.167	1.190	1.218	1.247	1.281	1.324		
	MACH	.387	.422	.439	.457	.475	.493	.512	.534		
	KIAS	213	212	212	212	212	211	211	211		
	FF/ENG	4327	4262	4268	4264	4257	4249	4252	4286		
160	EPR	1.094	1.125	1.141	1.160	1.185	1.211	1.240	1.275	1.317	
	MACH	.372	.403	.419	.436	.454	.472	.492	.513	.535	
	KIAS	205	202	202	202	202	202	202	202	202	
	FF/ENG	3925	3818	3812	3805	3799	3797	3802	3815	3845	
140	EPR	1.079	1.106	1.120	1.136	1.157	1.180	1.205	1.233	1.267	1.308
	MACH	.352	.387	.403	.419	.436	.454	.473	.493	.515	.537
	KIAS	194	194	194	194	194	194	194	194	194	194
	FF/ENG	3474	3496	3491	3486	3475	3468	3407	3409	3419	3444

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GEAR DOWN

Long Range Cruise Enroute 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
324	290	260	236	217	200	189	179	170	161	154
656	584	523	474	435	400	378	357	339	323	308
991	882	788	714	653	600	567	536	509	484	462
1329	1181	1053	953	871	800	755	714	677	644	615
1670	1482	1320	1193	1090	1000	943	892	845	804	767
2014	1785	1589	1434	1309	1200	1132	1070	1014	964	919
2362	2091	1859	1676	1528	1400	1320	1248	1182	1123	1071
2715	2400	2130	1919	1748	1600	1508	1425	1349	1282	1223
3073	2711	2403	2163	1968	1800	1696	1602	1517	1441	1373
3434	3026	2678	2407	2189	2000	1884	1779	1684	1599	1524
3799	3343	2954	2652	2410	2200	2072	1955	1850	1756	1674
4169	3662	3232	2898	2631	2400	2259	2132	2016	1914	1824
4542	3984	3511	3145	2853	2600	2447	2308	2183	2071	1974
4921	4309	3792	3393	3075	2800	2635	2485	2349	2229	2123
5303	4637	4074	3641	3297	3000	2822	2661	2515	2386	2272
5689	4968	4358	3890	3519	3200	3010	2837	2681	2542	2421
6081	5301	4643	4140	3742	3400	3197	3012	2846	2698	2569
6477	5638	4930	4391	3966	3600	3384	3188	3011	2854	2717
6877	5977	5220	4643	4190	3800	3571	3363	3176	3010	2865
7283	6320	5510	4896	4414	4000	3758	3538	3340	3165	3012

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	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	6.7	0:49	6.1	0:47	5.3	0:44	4.8	0:42	4.4	0:40
400	13.9	1:37	12.9	1:31	11.5	1:24	10.7	1:20	10.1	1:16
600	21.0	2:25	19.5	2:17	17.5	2:06	16.4	1:59	15.6	1:53
800	27.9	3:15	26.0	3:04	23.4	2:48	22.0	2:39	20.9	2:30
1000	34.7	4:04	32.4	3:51	29.3	3:30	27.5	3:19	26.2	3:07
1200	41.3	4:55	38.6	4:40	35.0	4:14	32.9	3:59	31.3	3:45
1400	47.8	5:46	44.7	5:28	40.6	4:58	38.2	4:40	36.3	4:23
1600	54.2	6:38	50.8	6:17	46.2	5:42	43.4	5:22	41.3	5:02
1800	60.5	7:31	56.7	7:07	51.7	6:27	48.5	6:03	46.1	5:41
2000	66.7	8:24	62.6	7:57	57.2	7:12	53.6	6:45	51.0	6:20
2200	72.9	9:19	68.3	8:48	62.4	7:58	58.5	7:28	55.6	7:00
2400	79.0	10:14	74.0	9:39	67.7	8:44	63.4	8:11	60.2	7:39
2600	85.1	11:10	79.5	10:31	72.8	9:31	68.2	8:54	64.8	8:20
2800	91.0	12:07	85.0	11:24	77.8	10:18	73.0	9:38	69.2	9:01
3000	96.9	13:04	90.4	12:17	82.8	11:06	77.7	10:22	73.6	9:41
3200	102.5	14:03	95.7	13:12	87.6	11:54	82.3	11:07	77.9	10:23
3400	108.1	15:02	101.0	14:06	92.4	12:43	86.8	11:53	82.2	11:05
3600	113.6	16:02	106.2	15:02	97.1	13:33	91.3	12:38	86.4	11:47
3800	119.0	17:04	111.3	15:58	101.7	14:23	95.6	13:24	90.5	12:30
4000	124.4	18:05	116.4	16:54	106.3	15:13	100.0	14:11	94.7	13:13

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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)				
	160	180	200	220	240
10	–1.2	–0.6	0.0	0.9	1.9
20	–2.0	–1.1	0.0	1.7	3.7
30	–2.8	–1.5	0.0	2.5	5.4
40	–3.7	–1.9	0.0	3.2	6.9
50	–4.5	–2.4	0.0	3.9	8.3
60	–5.4	–2.8	0.0	4.5	9.6
70	–6.3	–3.3	0.0	5.1	10.8
80	–7.2	–3.7	0.0	5.6	11.9
90	–8.2	–4.2	0.0	6.1	12.9
100	–9.1	–4.6	0.0	6.5	13.7
110	–10.1	–5.1	0.0	6.9	14.5
120	–11.1	–5.5	0.0	7.2	15.1
130	–12.1	–6.0	0.0	7.4	15.6

Based on Long Range Cruise and VREF30+80 descent.

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GEAR DOWN

Descent at VREF 30+80

PRESSURE ALT (1000 FT)	17	19	21	23	25	27	29	31	33	35
DISTANCE (NM)	41	45	49	53	57	61	65	69	73	78
TIME (MINUTES)	12	12	13	14	15	16	16	17	18	18

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GEAR DOWN

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
260	EPR	1.110	1.134	1.179	1.247		
	KIAS	236	236	236	236		
	FF/ENG	6190	6180	6170	6200		
240	EPR	1.097	1.119	1.159	1.218	1.302	
	KIAS	229	229	229	229	229	
	FF/ENG	5750	5730	5720	5720	5780	
220	EPR	1.087	1.105	1.140	1.191	1.264	
	KIAS	223	223	223	223	223	
	FF/ENG	5330	5290	5280	5260	5280	
200	EPR	1.077	1.092	1.123	1.167	1.231	1.324
	KIAS	216	216	216	216	216	216
	FF/ENG	5040	4880	4850	4830	4830	4900
180	EPR	1.067	1.081	1.107	1.145	1.200	1.279
	KIAS	209	209	209	209	209	209
	FF/ENG	4640	4480	4430	4420	4400	4430
160	EPR	1.058	1.070	1.092	1.125	1.171	1.240
	KIAS	202	202	202	202	202	202
	FF/ENG	4240	4190	4030	4010	3990	3990
140	EPR	1.049	1.060	1.079	1.106	1.145	1.205
	KIAS	194	194	194	194	194	194
	FF/ENG	3840	3800	3640	3670	3660	3580

This table includes 5% additional fuel for holding in a racetrack pattern.

Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
260	EPR	1.113	1.137	1.181	1.247	
	KIAS	216	216	216	216	
	FF/ENG	5920	5900	5890	5900	
240	EPR	1.101	1.122	1.162	1.219	1.302
	KIAS	209	209	209	209	209
	FF/ENG	5490	5460	5450	5440	5480
220	EPR	1.090	1.108	1.143	1.192	1.265
	KIAS	203	203	203	203	203
	FF/ENG	5060	5020	5000	4990	5010
200	EPR	1.080	1.095	1.125	1.167	1.230
	KIAS	196	196	196	196	196
	FF/ENG	4760	4600	4570	4560	4560
180	EPR	1.069	1.083	1.108	1.145	1.198
	KIAS	189	189	189	189	189
	FF/ENG	4340	4300	4140	4130	4120
160	EPR	1.059	1.072	1.092	1.124	1.167
	KIAS	182	182	182	182	182
	FF/ENG	3930	3890	3740	3770	3760
140	EPR	1.049	1.060	1.079	1.103	1.140
	KIAS	174	174	174	174	174
	FF/ENG	3590	3550	3500	3360	3350

This table includes 5% additional fuel for holding in a racetrack pattern.

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		VREF + 80 DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFTDOWN	LEVEL OFF		ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
220	207	221	400		
200	189	214	4600	2200	
180	171	207	8400	6400	4000
160	152	200	12000	10200	8200

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
200	2200		
180	6600	4300	1200
160	10600	8700	6400
140	14500	12700	10800

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MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)					
		5	7	9	11	13	15
180	EPR	1.273	1.305				
	MACH	.346	.359				
	KIAS	209	209				
	FF/ENG	8291	8303				
160	EPR	1.238	1.266	1.298	1.335		
	MACH	.334	.346	.359	.373		
	KIAS	202	202	202	202		
	FF/ENG	7496	7504	7513	7541		
140	EPR	1.205	1.228	1.256	1.287	1.323	1.365
	MACH	.321	.333	.345	.359	.373	.387
	KIAS	194	194	194	194	194	194
	FF/ENG	6729	6721	6725	6732	6750	6799

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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
349	305	269	241	219	200	187	175	164	154	146
529	462	406	363	329	300	279	261	245	230	218
710	620	544	486	440	400	372	347	325	306	290
892	778	682	608	550	500	465	434	406	382	361
1075	937	820	731	660	600	558	520	487	457	433
1259	1096	958	854	771	700	651	606	567	533	504
1444	1256	1097	976	882	800	743	692	647	608	575
1630	1416	1236	1099	992	900	836	778	727	683	646
1817	1577	1375	1222	1103	1000	928	864	807	758	717

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	6		8		10		12		14	
	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	6.9	0:54	6.6	0:53	6.4	0:52	6.1	0:50	5.9	0:49
300	10.5	1:21	10.1	1:19	9.8	1:17	9.5	1:15	9.2	1:13
400	14.1	1:48	13.6	1:45	13.2	1:42	12.8	1:39	12.5	1:36
500	17.6	2:15	17.0	2:11	16.5	2:08	16.0	2:04	15.6	2:00
600	21.0	2:42	20.4	2:38	19.7	2:33	19.2	2:29	18.8	2:25
700	24.5	3:10	23.7	3:04	23.0	2:59	22.4	2:54	21.9	2:49
800	28.0	3:37	27.1	3:31	26.3	3:25	25.6	3:19	25.1	3:13
900	31.3	4:05	30.3	3:58	29.5	3:51	28.7	3:44	28.1	3:37
1000	34.6	4:33	33.6	4:25	32.6	4:17	31.8	4:10	31.1	4:02

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)				
	140	160	180	200	220
4	–0.4	–0.2	0.0	0.3	0.8
6	–0.7	–0.3	0.0	0.5	1.2
8	–0.9	–0.5	0.0	0.7	1.6
10	–1.2	–0.6	0.0	0.9	2.0
12	–1.4	–0.7	0.0	1.0	2.4
14	–1.7	–0.8	0.0	1.2	2.7
16	–1.9	–1.0	0.0	1.4	3.1
18	–2.1	–1.1	0.0	1.5	3.5
20	–2.4	–1.2	0.0	1.7	3.8
22	–2.6	–1.3	0.0	1.8	4.1
24	–2.9	–1.4	0.0	2.0	4.5
26	–3.1	–1.6	0.0	2.1	4.8
28	–3.3	–1.7	0.0	2.3	5.1
30	–3.6	–1.8	0.0	2.4	5.4
32	–3.8	–1.9	0.0	2.6	5.7
34	–4.1	–2.0	0.0	2.7	6.0
36	–4.3	–2.2	0.0	2.9	6.3

Based on Long Range Cruise and VREF30+80 descent. Includes APU fuel burn.

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)			
		1500	5000	10000	15000
200	EPR	1.256			
	KIAS	216			
	FF/ENG	9530			
180	EPR	1.226	1.273		
	KIAS	209	209		
	FF/ENG	8700	8710		
160	EPR	1.197	1.238	1.316	
	KIAS	202	202	202	
	FF/ENG	7880	7870	7900	
140	EPR	1.171	1.205	1.271	1.365
	KIAS	194	194	194	194
	FF/ENG	7090	7070	7060	7140

This table includes 5% additional fuel for holding in a racetrack pattern.

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Introduction

This chapter contains information to supplement performance data from the Flight Management Computer. 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

FMC Takeoff Speeds

FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Clearway and Stopway V1 Adjustments

Takeoff speed corrections are to be applied to V1 when using takeoff weights based on the use of clearway and stopway.

Adjust V1 by the amount shown in the table. The adjusted V1 must not exceed VR. If V1 is greater than VR, VR may be increased to equal V1. The resultant V2 will be increased by the same amount that VR was increased.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF Speeds

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

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Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver 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/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/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.

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 13 mm (0.5 inches) 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 dry field/obstacle limit weight for the takeoff flap setting
2. enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude
3. adjust field length available for temperature by amount shown on chart
4. enter the V1(MCG) Limit Weight table with the field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

1. determine takeoff speeds V1, VR and V2 for actual brake release weight using Takeoff Speeds from the Performance Dispatch chapter or from the FMC
2. if V1(MCG) limited, set V1 = V1(MCG). If not limited by V1(MCG) considerations, enter 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 V1(MCG), set V1 = V1(MCG).

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Slippery Runway

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. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on 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.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Go-Around EPR

To find Go-Around EPR based on normal engine bleed for packs on and anti-ice off, enter the Go-Around EPR table with airport pressure altitude and reported OAT or TAT and read EPR. EPR adjustments are shown for engine bleeds for various conditions.

Max Climb EPR

This table shows Max Climb EPR for a 310/.84 climb speed schedule, normal engine bleed for 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.

Flight with Unreliable Airspeed/Turbulent Air Penetration

Body 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 may also cause unreliable airspeed/Mach indications. Climb, cruise and descent information is based on the recommended turbulent air penetration speed schedule: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and

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above; maintain a minimum speed of 15 knots above the minimum maneuvering speed when below 0.82 Mach. This schedule provides ample protection from stall and high speed buffet, while also providing protection from exceeding structural limits. The Climb, Cruise and Descent tables 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 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. Note that these tables consider 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 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5 g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43,100 ft.

Long Range Cruise Control

These tables provide target EPR, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude, .84 Mach approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

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 .84/310/250 descent. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

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

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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 at .84/310/250

Distance and time for descent are shown for a .84/310/250 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 30 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 is based on VREF30 + 60 speed schedule. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read EPR, IAS and fuel flow per engine.

Advisory Information

Reported Braking Action

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. A table is provided that correlates runway condition code to runway surface condition description and reported braking action that can then be used to determine the appropriate Normal Configuration Landing Distance or Non-Normal Configuration Landing Distance.

Normal Configuration Operational Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and runways with good, good-to-medium, medium, medium-to-poor, and poor reported braking action. Landing distances (reference distances plus adjustments) are 115% of the actual landing distance. The Normal

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Configuration Landing Distance tables should be used enroute to make a landing distance assessment for time of arrival.

The reference landing distance is the distance from threshold to complete stop. It includes an air distance allowance of 1500 ft from threshold to touchdown. The reference distance is based on a reference landing weight and speed at sea level, standard day, zero wind, zero slope, two-engine maximum reverse thrust, and auto speedbrakes.

To use these tables, determine the reference landing distance for the selected braking configuration and reported braking action. Adjust this reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers. Each correction is applied independently to the reference landing distance. A correction for use of manual speedbrakes is provided in the table notes.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" reported 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 appropriate 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. Landing distances and adjustments are provided for dry runways and runways with good, good-to-medium, medium, medium-to-poor, and poor reported braking action. Landing distances (reference distances plus adjustments) are representative of the actual landing distance, and are not factored. The Non-Normal Configuration Landing Distance tables should be used enroute to make a landing distance assessment for time of arrival.

The reference landing distance is the distance from threshold to complete stop. It includes an air distance allowance of 1,500 ft from threshold to touchdown. The reference distance is based on a reference landing weight and speed at sea level, standard day, zero wind, zero slope, and maximum available reverse thrust.

Tables for Non-Normal Configuration Landing Distance in this section are similar in format and used in the same manner as tables for the Normal Configuration Landing Distance previously described.

For an engine inoperative landing, check the rate of climb capability shown in Gear Down Landing Rate of Climb Available tables to ensure adequate climb performance.

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Landing Climb Limit Weight

In the event an overweight landing is necessary and the fuel dump system is unavailable, landing climb limits should be checked if a Flaps 30 landing is planned. Enter the table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required. At weights exceeding those shown, plan a Flaps 20 landing.

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 appropriate Event Adjusted Brake Energy Table (No Reverse Thrust or 2 Engine Reverse) with the reference brake energy per brake and the type of braking used during landing (Max Manual, Max Auto, or Autobrake). 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 5.0 or higher on the EICAS indication and disappear as the hottest brake cools with an EICAS indication of 3.5. Note that even without an EICAS advisory message, brake cooling is recommended.

Engine Inoperative

Initial Max Continuous EPR

The Initial Max Continuous EPR setting for use following an engine failure is shown. The table is based on the typical all engine cruise Mach number of .84

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to provide a target EPR setting at the start of driftdown. Once driftdown is established, the Max Continuous EPR table should be used to determine EPR for the given conditions.

Max Continuous EPR

Power setting is based on one engine operating with one bleed source for pack(s) operating and all anti-ice bleeds off. Enter the table for appropriate pressure altitude with IAS or Mach and TAT to read Max Continuous EPR. Apply the anti-ice corrections below the table as required.

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 considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/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. If altitudes other than the level off altitude is used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

Table show the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on LRC speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

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Long Range Cruise Control

The table provides target EPR, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (KG/HR)				
	GROSS WEIGHT (1000 KG)				
	300	260	220	180	140
43				160	140
39			180	160	145
35		200	190	170	140
31	230	220	195	165	140
25	230	220	195	175	155
20	235	230	205	185	165
15	235	235	215	200	185
10	240	240	230	220	200
5	270	270	255	240	220

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 single engine Long Range Cruise speed and .84/310/250 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 off reference fuel corrections table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down Landing Rate of Climb Available

Rate of climb data is provided as guidance information in the event an engine inoperative landing is planned. The tables show gear down rate of climb available for Flaps 20 and Flaps 30. Enter the table with TAT and pressure altitude to read rate of climb available. Apply adjustments shown to correct for weight.

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Alternate Mode EEC

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, net level off and landing climb weights. To determine limit weights for operations with the EEC in the ALTERNATE mode, enter the table with the limit weights for PRIMARY mode EEC operation and read the associated limit weight for each performance condition. 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—Digital Performance Information may yield less restrictive limit weights.

Takeoff Speed Adjustment

Takeoff speeds for the reduced weight should be increased by the amount shown in the Takeoff Speeds Adjustments Table. The adjusted V1 should not exceed the adjusted VR.

Note: The FMC does incorporate ALTERNATE Mode EEC performance in its takeoff speeds calculations.

Max Takeoff %N1

Takeoff power settings are presented for normal air condition bleed. Max Takeoff %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode 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.

Max Climb %N1

This table shows Max Climb %N1 for a 310/.84 climb speed schedule with anti-ice off. Enter the table with pressure altitude and TAT to read Max Climb %N1. Apply bleed adjustments as required.

Max Cruise %N1

Maximum Cruise %N1 is presented for .84M, which approximates Long Range Cruise speed. Enter the table with pressure altitude and TAT to read Max Cruise %N1. Appropriate bleed adjustments are shown.

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Go-Around %N1

Go-Around power setting for ALTERNATE MODE EEC operation is presented for normal engine bleed for packs on. Go-Around %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode 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.

Alternate Mode EEC, Engine Inoperative

Initial Max Continuous %N1

Initial Max Continuous %N1 settings for use following an engine failure are presented. The table is based on the typical all engine cruise Mach number of .84 to provide a target %N1 setting at the start of driftdown. Appropriate bleed adjustments are shown. Once driftdown is established, the Max Continuous %N1 table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Max Continuous %N1 settings are presented as a function of pressure altitude and TAT for engine inoperative speeds of 320, 280, 240, and 200 KIAS. Power settings may be interpolated for intermediate airspeeds. Apply bleed adjustments as required.

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 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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General PI.20

Maximum Allowable Clearway PI.20.1

Clearway and Stopway V1 Adjustments PI.20.2

VREF PI.20.3

Flap Maneuver Speed PI.20.4

Slush/Standing Water Takeoff PI.20.5

Slippery Runway Takeoff PI.20.8

Minimum Control Speeds PI.20.11

Go-around EPR PI.20.12

Max Climb EPR PI.20.13

Flight With Unreliable Airspeed/Turbulent Air Penetration PI.20.14

All Engine PI.21

Long Range Cruise Maximum Operating Altitude PI.21.1

Long Range Cruise Control PI.21.3

Long Range Cruise Enroute Fuel and Time—Low Altitude PI.21.4

Long Range Cruise Enroute Fuel and Time—High Altitude PI.21.5

Long Range Cruise Wind-Altitude Trade PI.21.7

Descent at .84/310/250 KIAS PI.21.8

Holding PI.21.9

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Reported Braking Action PI.22.1

Normal Configuration Operational Landing Distance PI.22.2

Non-Normal Configuration Landing Distance PI.22.5

Landing Climb Limit Weight PI.22.34

Recommended Brake Cooling Schedule PI.22.35

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Engine Inoperative PI.23

Initial Max Continuous EPR PI.23.1

Max Continuous EPR PI.23.2

Driftdown Speed/Level Off Altitude PI.23.5

Driftdown/LRC Cruise Range Capability PI.23.6

Long Range Cruise Altitude Capability PI.23.7

Long Range Cruise Control PI.23.8

Long Range Cruise Diversion Fuel and Time PI.23.9

Holding PI.23.10

Gear Down Landing Rate of Climb Available PI.23.11

Alternate Mode EEC PI.24

Limit Weight PI.24.1

Takeoff Speed Adjustment PI.24.2

Max Takeoff %N1 ..... PI.24.3

Max Climb %N1 ..... PI.24.4

Max Cruise %N1 ..... PI.24.5

Go-Around %N1 ..... PI.24.6

Alternate Mode EEC, Engine INOP PI.25

Initial Max Continuous %N1 ..... PI.25.1

Max Continuous %N1 ..... PI.25.2

Gear Down PI.26

220 KIAS Max Climb EPR PI.26.1

Long Range Cruise Altitude Capability PI.26.2

Long Range Cruise Control PI.26.3

Long Range Cruise Enroute Fuel and Time PI.26.4

Descent at VREF 30+80 ..... PI.26.6

Holding PI.26.7

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Gear Down, Engine INOP PI.27

Driftdown Speed/Level Off Altitude PI.27.1

Long Range Cruise Altitude Capability PI.27.2

Long Range Cruise Control PI.27.3

Long Range Cruise Diversion Fuel and Time PI.27.4

Holding PI.27.5

Text PI.28

Introduction PI.28.1

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Alternate Mode EEC, Engine Inoperative PI.28.11

Gear Down PI.28.11

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Maximum Allowable Clearway

FIELD LENGTH (M)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (M)
1500	170
2000	210
2500	250
3000	300
3500	340
4000	380
4500	430

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Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (M)	NORMAL V1 (KIAS)			
	100	120	140	160
300	–3	–3	–3	–4
200	–3	–3	–3	–3
100	–2	–1	–1	–1
0	0	0	0	0
–100	3	2	2	1
–200	5	4	3	3
–300	6	4	4	4

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VREF

Flaps 30

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
300	164	164	165	165	165	166
280	159	159	159	160	160	161
260	154	154	154	154	155	155
240	148	148	148	148	148	149
220	142	142	142	142	142	142
200	135	135	135	135	135	135
180	128	128	128	128	128	128
160	123	121	121	121	121	121
140	123	121	118	116	114	113

Flaps 25

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
300	172	172	173	173	173	173
280	167	167	167	167	167	168
260	162	162	162	162	162	162
240	155	155	156	156	156	156
220	149	149	149	149	149	149
200	142	142	142	142	142	142
180	134	134	134	135	135	135
160	127	127	127	127	127	127
140	123	121	118	118	118	118

Flaps 20

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
300	178	178	179	179	180	181
280	173	173	173	173	174	174
260	167	167	168	168	168	168
240	161	161	161	161	161	162
220	154	154	154	154	154	154
200	147	147	147	147	147	147
180	139	139	139	139	139	139
160	131	131	131	131	131	131
140	123	122	122	123	123	123

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Flap Maneuver Speed

FLAP POSITION	MANEUVER SPEED
FLAPS 0	VREF30 + 80
FLAPS 1	VREF30 + 60
FLAPS 5	VREF30 + 40
FLAPS 15	VREF30 + 20
FLAPS 20	VREF30 + 20
FLAPS 25	VREF25
FLAPS 30	VREF30

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ADVISORY INFORMATION

Slush/Standing Water Takeoff Maximum Reverse Thrust Weight Adjustment (1000 KG)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.08 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	–32.9	–38.0	–43.0	–38.5	–43.6	–48.7	–50.7	–55.8	–60.9
300	–30.9	–36.0	–41.0	–35.8	–40.8	–45.9	–46.2	–51.3	–56.4
280	–28.6	–33.7	–38.8	–32.8	–37.9	–43.0	–41.7	–46.8	–51.8
260	–26.1	–31.2	–36.3	–29.6	–34.7	–39.8	–37.0	–42.0	–47.1
240	–23.4	–28.5	–33.5	–26.2	–31.3	–36.4	–32.1	–37.2	–42.3
220	–20.4	–25.4	–30.5	–22.6	–27.6	–32.7	–27.2	–32.3	–37.4
200	–17.1	–22.2	–27.3	–18.7	–23.8	–28.9	–22.1	–27.2	–32.3
180	–13.6	–18.6	–23.7	–14.6	–19.7	–24.8	–16.9	–22.0	–27.1
160	–9.8	–14.9	–19.9	–10.3	–15.4	–20.5	–11.6	–16.7	–21.8
140	–5.9	–11.0	–16.1	–5.9	–11.0	–16.1	–6.2	–11.3	–16.4

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1800							109.3		
2000	109.8			123.7			147.5	103.3	
2200	148.5	103.7		162.3	117.5		185.9	141.5	
2400	187.4	142.4		201.6	156.2	111.4	225.4	179.8	135.4
2600	227.7	181.2	136.3	242.3	195.3	150.1	266.0	219.1	173.7
2800	269.7	221.2	175.0	284.4	235.7	189.0	307.9	259.5	212.8
3000	313.5	262.9	214.8	328.3	277.7	229.2	350.8	301.2	253.0
3200	358.6	306.5	256.2	372.5	321.3	270.9		344.0	294.5
3400		351.4	299.4			314.3			337.2
3600			344.3			358.6			

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water adjustment.
2. Adjust field length available by –55 m/+55 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

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ADVISORY INFORMATION

Slush/Standing Water Takeoff
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	–18	–14	–10	–13	–9	–5	–5	–1	3
300	–19	–15	–11	–14	–10	–6	–4	0	4
280	–20	–16	–12	–16	–12	–8	–5	–1	3
260	–22	–18	–14	–18	–14	–10	–8	–4	0
240	–24	–20	–16	–20	–16	–12	–11	–7	–3
220	–25	–21	–17	–22	–18	–14	–15	–11	–7
200	–26	–22	–18	–23	–19	–15	–18	–14	–10
180	–26	–22	–18	–24	–20	–16	–20	–16	–12
160	–26	–22	–18	–24	–20	–16	–20	–16	–12
140	–26	–22	–18	–24	–20	–16	–20	–16	–12

1. Obtain V1, VR and V2 for the actual weight.

2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

No Reverse Thrust
Weight Adjustment (1000 KG)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	–45.2	–51.2	–57.2	–51.6	–57.6	–63.5	–65.3	–71.3	–77.2
300	–42.0	–48.0	–54.0	–47.3	–53.3	–59.3	–58.7	–64.7	–70.7
280	–38.7	–44.7	–50.7	–43.1	–49.1	–55.1	–52.4	–58.4	–64.4
260	–35.2	–41.2	–47.2	–38.8	–44.8	–50.8	–46.3	–52.3	–58.3
240	–31.6	–37.6	–43.6	–34.5	–40.5	–46.4	–40.5	–46.4	–52.4
220	–27.9	–33.9	–39.9	–30.1	–36.1	–42.1	–34.8	–40.8	–46.8
200	–24.0	–30.0	–36.0	–25.7	–31.7	–37.7	–29.4	–35.4	–41.3
180	–20.0	–26.0	–32.0	–21.3	–27.2	–33.2	–24.2	–30.1	–36.1
160	–15.9	–21.9	–27.9	–16.8	–22.8	–28.8	–19.2	–25.1	–31.1
140	–11.7	–17.7	–23.7	–12.3	–18.3	–24.3	–14.2	–20.2	–26.2

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ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2600							113.4		
2800							158.1	109.0	
3000				132.3			203.1	153.7	104.6
3200	131.8			180.4	127.6		248.9	198.6	149.3
3400	182.1	126.9		229.4	175.6	122.9	295.6	244.4	194.2
3600	233.3	177.2	122.0	279.7	224.6	170.9	343.2	291.0	239.9
3800	286.0	228.3	172.2	331.4	274.7	219.7		338.5	286.4
4000	339.8	280.7	223.2		326.3	269.8			333.8
4200		334.5	275.5			321.2			
4400			329.2						

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water adjustment.
2. Adjust field length available by –75 m/+70 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
300	–30	–24	–18	–23	–17	–11	–8	–2	0
280	–32	–26	–20	–26	–20	–14	–11	–5	0
260	–34	–28	–22	–29	–23	–17	–15	–9	–3
240	–37	–31	–25	–32	–26	–20	–20	–14	–8
220	–39	–33	–27	–35	–29	–23	–25	–19	–13
200	–41	–35	–29	–38	–32	–26	–30	–24	–18
180	–42	–36	–30	–40	–34	–28	–34	–28	–22
160	–43	–37	–31	–41	–35	–29	–37	–31	–25
140	–44	–38	–32	–42	–36	–30	–39	–33	–27

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

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ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
Weight Adjustments (1000 KG)

DRY 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
320	0.0	–1.5	–2.9	–14.9	–16.3	–17.8	–31.3	–32.8	–34.2
300	0.0	–1.5	–2.9	–16.3	–17.7	–19.2	–31.2	–32.7	–34.1
280	–0.4	–1.9	–3.3	–17.1	–18.5	–20.0	–30.6	–32.0	–33.5
260	–1.9	–3.4	–4.8	–17.3	–18.7	–20.2	–29.3	–30.7	–32.2
240	–2.9	–4.4	–5.8	–16.8	–18.3	–19.7	–27.4	–28.8	–30.3
220	–3.4	–4.9	–6.3	–15.7	–17.2	–18.6	–24.9	–26.3	–27.8
200	–3.4	–4.9	–6.3	–14.0	–15.4	–16.9	–21.8	–23.2	–24.7
180	–2.9	–4.4	–5.8	–11.6	–13.1	–14.5	–18.1	–19.5	–21.0
160	–1.9	–3.3	–4.8	–8.6	–10.1	–11.5	–13.8	–15.2	–16.7
140	–0.6	–2.0	–3.5	–5.3	–6.8	–8.2	–9.2	–10.6	–12.1

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	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
1400	104.2								
1600	182.9	135.0							
1800	258.6	212.9	165.8						
2000	330.7	287.1	242.3	146.3	100.0				
2200		358.5	315.2	201.1	154.3	108.0			
2400				257.7	209.3	162.3	114.1		
2600				316.4	266.2	217.5	148.1	104.6	
2800				376.2	325.2	274.7	182.5	138.6	
3000						333.9	218.3	172.7	129.1
3200							256.0	208.1	163.1
3400							295.9	245.2	198.0
3600							338.1	284.5	234.6
3800								326.2	273.3
4000								368.6	314.3

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.

2. Adjust “Good” field length available by –30 m/+30 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Medium” field length available by –40 m/+40 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Poor” field length available by –60 m/+60 m for every 5 deg. C above/below 4 deg. C.

3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.

4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

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ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
V1 Adjustments (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
320	–3	–1	1	–12	–10	–8	–24	–22	–20
300	–4	–2	0	–14	–12	–10	–27	–25	–23
280	–6	–4	–2	–16	–14	–12	–30	–28	–26
260	–7	–5	–3	–19	–17	–15	–33	–31	–29
240	–9	–7	–5	–21	–19	–17	–36	–34	–32
220	–10	–8	–6	–23	–21	–19	–39	–37	–35
200	–11	–9	–7	–25	–23	–21	–41	–39	–37
180	–12	–10	–8	–26	–24	–22	–43	–41	–39
160	–13	–11	–9	–27	–25	–23	–44	–42	–40
140	–14	–12	–10	–28	–26	–24	–45	–43	–41

1. Obtain V1, VR and V2 for the actual weight.

2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

No Reverse Thrust
Weight Adjustment (1000 KG)

DRY 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
320	–1.4	–2.5	–3.6	–24.7	–25.8	–26.8	–44.3	–45.4	–46.5
300	–4.2	–5.3	–6.4	–25.7	–26.8	–27.9	–42.6	–43.7	–44.8
280	–6.4	–7.4	–8.5	–26.1	–27.2	–28.3	–40.6	–41.7	–42.8
260	–7.9	–9.0	–10.1	–25.9	–27.0	–28.0	–38.4	–39.5	–40.5
240	–8.9	–10.0	–11.0	–24.9	–26.0	–27.1	–35.8	–36.9	–38.0
220	–9.2	–10.3	–11.4	–23.2	–24.3	–25.4	–33.0	–34.1	–35.2
200	–8.9	–10.0	–11.1	–20.9	–22.0	–23.1	–29.8	–30.9	–32.0
180	–8.0	–9.1	–10.2	–17.9	–19.0	–20.1	–26.4	–27.5	–28.6
160	–6.5	–7.6	–8.7	–14.2	–15.3	–16.3	–22.7	–23.8	–24.9
140	–4.8	–5.9	–7.0	–10.2	–11.3	–12.4	–18.9	–20.0	–21.1

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ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	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
1800	133.8								
2000	263.1	202.4	118.1						
2200	347.5	303.6	253.6						
2400			339.9						
2600				100.3					
2800				218.2	133.5				
3000				307.3	244.4	166.7			
3200					328.1	268.7			
3400						348.8			
3800							119.9		
4000							172.3	111.6	
4200							226.9	164.0	103.3
4400							285.2	218.1	155.7
4600							347.6	275.8	209.3
4800								337.6	266.4
5000									327.7

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust “Good” field length available by –30 m/+30 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Medium” field length available by –50 m/+45 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Poor” field length available by –75 m/+70 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

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
300	–7	–3	0	–21	–17	–13	–41	–37	–33
280	–9	–5	–1	–24	–20	–16	–46	–42	–38
260	–11	–7	–3	–27	–23	–19	–50	–46	–42
240	–13	–9	–5	–31	–27	–23	–55	–51	–47
220	–15	–11	–7	–34	–30	–26	–59	–55	–51
200	–17	–13	–9	–37	–33	–29	–63	–59	–55
180	–19	–15	–11	–41	–37	–33	–67	–63	–59
160	–21	–17	–13	–44	–40	–36	–70	–66	–62
140	–23	–19	–15	–47	–43	–39	–72	–68	–64

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

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Minimum Control Speeds
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)					
		0		4000		8000	
deg. C	deg. F	V1(MCG)	Min VR	V1(MCG)	Min VR	V1(MCG)	Min VR
60	140	109	111	106	108		
50	122	112	114	106	108	101	104
40	104	118	119	109	110	101	104
30	86	122	123	113	114	104	106
20	68	123	123	115	117	107	109
–60	–76	124	124	116	117	109	110

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Go-around EPR

Based on engine bleed for packs on and anti-ice off

REPORTED OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)											
deg. C	deg. F	deg. C	–2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
66	150	70	1.269	1.282	1.284	1.287	1.289	1.290	1.290	1.289	1.287	1.284	1.281	1.278
56	133	60	1.316	1.324	1.328	1.332	1.335	1.337	1.339	1.339	1.338	1.336	1.334	1.332
51	124	55	1.347	1.356	1.356	1.355	1.359	1.361	1.363	1.365	1.364	1.362	1.361	1.359
46	115	50	1.380	1.390	1.392	1.392	1.388	1.387	1.388	1.390	1.389	1.388	1.388	1.387
41	106	45	1.406	1.429	1.428	1.428	1.421	1.416	1.416	1.416	1.415	1.414	1.414	1.414
36	97	40	1.431	1.461	1.461	1.460	1.453	1.446	1.445	1.445	1.444	1.443	1.442	1.441
31	88	35	1.443	1.492	1.491	1.491	1.483	1.477	1.475	1.474	1.473	1.473	1.472	1.471
26	79	30	1.443	1.498	1.511	1.518	1.512	1.505	1.506	1.505	1.504	1.504	1.502	1.502
21	70	25	1.443	1.498	1.511	1.521	1.526	1.531	1.527	1.529	1.528	1.527	1.525	1.525
17	62	20	1.443	1.498	1.511	1.521	1.526	1.531	1.535	1.539	1.545	1.546	1.541	1.539
12	53	15	1.443	1.498	1.511	1.521	1.526	1.531	1.535	1.539	1.547	1.555	1.563	1.561
8 & BELOW	46 & BELOW	12 & BELOW	1.443	1.498	1.511	1.521	1.526	1.531	1.535	1.539	1.547	1.555	1.563	1.571

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)						
	–2000	0	2000	4000	6000	8000	10000
PACKS OFF	0.003	0.003	0.003	0.003	0.004	0.004	0.005
1 PACK ON—2 BLEED SOURCES	–0.003	–0.003	–0.003	–0.003	–0.004	–0.004	–0.005
1 PACK ON—1 BLEED SOURCE	–0.003	–0.003	–0.003	–0.003	–0.004	–0.004	–0.005
WING ANTI-ICE ON	–0.002	–0.004	–0.004	–0.005	–0.005	–0.006	–0.006

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Max Climb EPR

Based on engine bleed for packs on and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)/SPEED (IAS OR MACH)									
	0	5	10	15	20	25	30	35	40	43
	310	310	310	310	310	310	310	0.84	0.84	0.84
60	1.132	1.122	1.127	1.146	1.166	1.159	1.152	1.174	1.178	1.170
50	1.168	1.161	1.147	1.146	1.166	1.159	1.152	1.174	1.178	1.170
40	1.209	1.205	1.191	1.184	1.173	1.159	1.152	1.174	1.178	1.170
30	1.217	1.253	1.243	1.237	1.228	1.196	1.157	1.174	1.178	1.170
20	1.217	1.253	1.284	1.298	1.292	1.259	1.228	1.191	1.178	1.170
10	1.217	1.253	1.284	1.329	1.364	1.337	1.307	1.273	1.260	1.257
0	1.217	1.253	1.284	1.329	1.374	1.399	1.402	1.367	1.351	1.348
–10	1.217	1.253	1.284	1.329	1.374	1.399	1.434	1.482	1.468	1.465
–15 & BELOW	1.217	1.253	1.284	1.329	1.374	1.399	1.434	1.506	1.521	1.518

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)									
	0	5	10	15	20	25	30	35	40	43
ENGINE ONLY	–0.008	–0.010	–0.015	–0.015	–0.006	–0.005	–0.003	–0.003	–0.004	–0.005
ENGINE & WING*	–0.010	–0.012	–0.018	–0.020	–0.012	–0.012	–0.011	–0.014	–0.017	–0.019
ENGINE & WING**	–0.012	–0.014	–0.021	–0.025	–0.018	–0.019	–0.020	–0.024	–0.029	–0.033

***Wing anti-ice on, packs on.**
****Wing anti-ice on, single bleed source and both packs off.**

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Flight With Unreliable Airspeed/Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82M)	PITCH ATT V/S (FT/MIN)	4.0 1600	3.5 800		
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	4.5 2300	4.5 1600	4.0 1100	4.5 700
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	7.5 3700	7.0 2700	6.5 2100	6.5 1600
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	10.0 4500	8.5 3400	8.0 2700	8.0 2100
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	12.0 5100	10.5 3900	9.5 3100	9.0 2500

Cruise

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82 M)	PITCH ATT EPR (Alt Mode %N1)	2.0 1.129 (81.1)	2.5 1.249 (85.5)		
35000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 1.065 (78.9)	2.0 1.118 (81.1)	2.5 1.203 (84.4)	3.0 1.356 (89.3)
30000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 1.021 (75.4)	2.0 1.059 (77.5)	3.0 1.119 (80.4)	3.5 1.196 (83.8)
25000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 0.997 (72.1)	2.0 1.024 (74.1)	3.0 1.067 (76.7)	3.5 1.124 (79.8)
20000 (270 KIAS)	PITCH ATT EPR (Alt Mode %N1)	2.0 0.986 (67.6)	2.5 1.008 (70.0)	3.0 1.039 (73.0)	4.0 1.081 (76.0)
15000 (270 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 0.977 (64.0)	2.5 0.994 (66.4)	3.0 1.018 (69.2)	4.0 1.048 (72.5)

Descent

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)			
		160	200	240	280
40000 (.82M)	PITCH ATT V/S (FT/MIN)	–1.0 –2500	–0.5 –2400		
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –2200	–0.5 –1900	0.5 –1900	1.0 –1900
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	–1.0 –1800	0.0 –1600	0.5 –1600	1.5 –1600
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –1700	–0.5 –1500	0.5 –1400	1.5 –1400
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –1500	–0.5 –1400	0.5 –1300	1.5 –1300

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Flight With Unreliable Airspeed/Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Holding

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)			
		160	200	240	280
10000	PITCH ATT	4.0	4.5	5.0	5.0
	EPR	1.004	1.017	1.029	1.040
	(Alt Mode %N1)	(52.7)	(59.2)	(64.0)	(68.2)
	KIAS	202	216	234	253
5000	PITCH ATT	4.0	4.5	5.0	5.0
	EPR	0.999	1.009	1.019	1.027
	(Alt Mode %N1)	(48.8)	(54.1)	(59.9)	(64.1)
	KIAS	202	216	233	251

Terminal Area (5000 FT)

Set Thrust for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		160	200	240	280	300
FLAPS UP (GEAR UP) (VREF 30+80)	PITCH ATT	4.0	5.0	5.5	5.5	6.0
	EPR	0.999	1.011	1.023	1.037	1.044
	(Alt Mode %N1)	(49.1)	(54.4)	(60.3)	(64.5)	(66.5)
	KIAS	203	215	228	240	246
FLAPS 1 (GEAR UP) (VREF 30+60)	PITCH ATT	5.5	6.5	7.0	7.0	7.5
	EPR	1.015	1.029	1.045	1.062	1.070
	(Alt Mode %N1)	(50.1)	(56.0)	(61.9)	(66.4)	(68.3)
	KIAS	183	195	208	220	226
FLAPS 5 (GEAR UP) (VREF 30+40)	PITCH ATT	4.5	5.5	6.0	6.0	6.0
	EPR	1.028	1.047	1.066	1.085	1.095
	(Alt Mode %N1)	(50.8)	(58.1)	(63.4)	(67.9)	(69.8)
	KIAS	163	175	188	200	206
FLAPS 15 (GEAR UP) (VREF 30+20)	PITCH ATT	5.5	6.0	6.5	6.5	7.0
	EPR	1.042	1.064	1.088	1.113	1.124
	(Alt Mode %N1)	(52.3)	(60.0)	(65.6)	(70.1)	(72.0)
	KIAS	143	155	168	180	186
FLAPS 20 (GEAR DOWN) (VREF 30+20)	PITCH ATT	4.0	4.5	5.0	5.0	5.0
	EPR	1.071	1.100	1.132	1.167	1.184
	(Alt Mode %N1)	(60.4)	(66.7)	(71.8)	(76.1)	(78.0)
	KIAS	143	155	168	180	186

Final Approach (1500 FT)

Gear Down, Set Thrust for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		160	200	240	280	300
FLAPS 20 (VREF 20+10)	PITCH ATT	1.0	1.5	1.5	1.5	1.5
	EPR	1.006	1.010	1.015	1.022	1.025
	(Alt Mode %N1)	(39.0)	(43.2)	(47.2)	(51.0)	(52.6)
	KIAS	141	157	171	184	190
FLAPS 25 (VREF 25+10)	PITCH ATT	1.0	1.0	1.0	1.0	1.0
	EPR	1.035	1.046	1.060	1.074	1.082
	(Alt Mode %N1)	(49.0)	(54.2)	(59.7)	(63.7)	(65.7)
	KIAS	137	152	165	178	184
FLAPS 30 (VREF 30+10)	PITCH ATT	0.5	1.0	1.0	1.0	1.0
	EPR	1.057	1.072	1.092	1.114	1.126
	(Alt Mode %N1)	(55.2)	(60.8)	(65.7)	(69.9)	(71.8)
	KIAS	133	145	158	170	176

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Flight With Unreliable Airspeed/Turbulent Air Penetration
Altitude and/or vertical speed indications may also be unreliable.
Go-Around
Flaps 20, Gear Up, Set Go-Around Thrust
Normal Mode

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		160	200	240	280	300
10000	PITCH ATT	16.5	13.0	11.0	9.5	9.0
	V/S (FT/MIN)	3600	2800	2200	1700	1500
	KIAS	141	155	169	181	187
5000	PITCH ATT	19.5	15.5	13.0	11.5	10.5
	V/S (FT/MIN)	4200	3400	2700	2200	2000
	KIAS	141	155	168	180	187
SEA LEVEL	PITCH ATT	23.0	18.5	15.5	13.5	12.5
	V/S (FT/MIN)	4900	3900	3200	2700	2400
	KIAS	143	155	168	180	186

Alternate Mode EEC

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		160	200	240	280	300
10000	PITCH ATT	15.5	12.5	10.5	9.0	8.5
	V/S (FT/MIN)	3400	2600	2000	1500	1300
	KIAS	141	155	169	181	187
5000	PITCH ATT	19.0	15.0	12.5	11.0	10.0
	V/S (FT/MIN)	4000	3100	2500	2000	1800
	KIAS	141	155	168	180	187
SEA LEVEL	PITCH ATT	21.5	17.5	14.5	12.5	11.5
	V/S (FT/MIN)	4600	3600	2900	2400	2200
	KIAS	143	155	168	180	186

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 10 deg. C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	–1	33500*	33500*	33500*	33400	31900
290	31100	–3	34300*	34300*	34300*	34100	32700
280	31800	–5	35200*	35200*	35200*	34900	33400
270	32600	–7	36100*	36100*	36100*	35600	34200
260	33400	–8	36800*	36800*	36800*	36400	35000
250	34200	–10	37600*	37600*	37600*	37200	35800
240	35100	–12	38400*	38400*	38400*	38100	36600
230	36000	–14	39300*	39300*	39300*	39000	37500
220	36900	–14	40200*	40200*	40200*	39900	38500
210	37900	–14	41100*	41100*	41100*	40900	39400
200	38900	–14	42100*	42100*	42100*	41900	40400
190	40000	–14	43000	43000	43000	42900	41500
180	41100	–14	43000	43000	43000	43000	42600
170	42300	–14	43000	43000	43000	43000	43000
160	43000	–14	43000	43000	43000	43000	43000
150	43000	–14	43000	43000	43000	43000	43000
140	43000	–14	43000	43000	43000	43000	43000

ISA + 15 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	4	32500*	32500*	32500*	32500*	31900
290	31100	3	33400*	33400*	33400*	33400*	32700
280	31800	1	34300*	34300*	34300*	34300*	33400
270	32600	–1	35200*	35200*	35200*	35200*	34200
260	33400	–3	36100*	36100*	36100*	36100*	35000
250	34200	–5	36900*	36900*	36900*	36900*	35800
240	35100	–7	37700*	37700*	37700*	37700*	36600
230	36000	–9	38600*	38600*	38600*	38600*	37500
220	36900	–9	39500*	39500*	39500*	39500*	38500
210	37900	–9	40400*	40400*	40400*	40400*	39400
200	38900	–9	41400*	41400*	41400*	41400*	40400
190	40000	–9	42400*	42400*	42400*	42400*	41500
180	41100	–9	43000	43000	43000	43000	42600
170	42300	–9	43000	43000	43000	43000	43000
160	43000	–9	43000	43000	43000	43000	43000
150	43000	–9	43000	43000	43000	43000	43000
140	43000	–9	43000	43000	43000	43000	43000

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
300	30300	10	31100*	31100*	31100*	31100*	31100*
290	31100	8	32100*	32100*	32100*	32100*	32100*
280	31800	7	33100*	33100*	33100*	33100*	33100*
270	32600	5	34100*	34100*	34100*	34100*	34100*
260	33400	3	35100*	35100*	35100*	35100*	35000
250	34200	1	36100*	36100*	36100*	36100*	35800
240	35100	–1	36800*	36800*	36800*	36800*	36600
230	36000	–3	37700*	37700*	37700*	37700*	37500
220	36900	–3	38600*	38600*	38600*	38600*	38500
210	37900	–3	39500*	39500*	39500*	39500*	39400
200	38900	–3	40500*	40500*	40500*	40500*	40400
190	40000	–3	41500*	41500*	41500*	41500*	41500
180	41100	–3	42600*	42600*	42600*	42600*	42600
170	42300	–3	43000	43000	43000	43000	43000
160	43000	–3	43000	43000	43000	43000	43000
150	43000	–3	43000	43000	43000	43000	43000
140	43000	–3	43000	43000	43000	43000	43000

***Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.**

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Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		25	27	29	31	33	35	37	39	41	43
300	EPR	1.106	1.131	**1.168**	**1.229**	1.326					
	MACH	.772	.802	**.834**	**.840**	.838					
	KIAS	325	325	**325**	**314**	300					
	FF/ENG	4499	4533	**4621**	**4641**	4746					
280	EPR	1.083	1.106	1.135	**1.182**	1.247	1.365				
	MACH	.772	.802	.834	**.841**	.839	.838				
	KIAS	325	325	325	**314**	300	287				
	FF/ENG	4289	4321	4375	**4343**	4305	4482				
260	EPR	1.064	1.085	1.111	1.142	**1.193**	1.266	1.412			
	MACH	.770	.796	.821	.838	**.841**	.839	.839			
	KIAS	324	322	319	313	**301**	287	274			
	FF/ENG	4095	4094	4085	4045	**3988**	3985	4261			
240	EPR	1.047	1.066	1.088	1.115	1.148	**1.201**	1.284			
	MACH	.746	.772	.799	.823	.839	**.840**	.839			
	KIAS	313	312	310	307	300	**287**	274			
	FF/ENG	3762	3759	3758	3747	3705	**3645**	3691			
220	EPR	1.033	1.048	1.068	1.090	1.118	1.153	**1.209**	1.297		
	MACH	.721	.746	.773	.800	.825	.840	**.840**	.839		
	KIAS	302	300	299	297	294	287	**274**	261		
	FF/ENG	3437	3429	3427	3425	3413	3372	**3337**	3416		
200	EPR	1.021	1.033	1.048	1.068	1.090	1.118	1.155	**1.212**	1.300	
	MACH	.695	.719	.745	.772	.799	.825	.840	**.840**	.839	
	KIAS	290	289	287	286	284	281	274	**262**	249	
	FF/ENG	3123	3108	3100	3098	3095	3085	3065	**3054**	3127	
180	EPR	1.009	1.020	1.032	1.047	1.066	1.089	1.117	1.153	**1.208**	1.293
	MACH	.667	.690	.714	.740	.768	.796	.822	.839	**.840**	.839
	KIAS	278	276	275	273	272	270	268	262	**250**	238
	FF/ENG	2881	2853	2834	2775	2772	2770	2779	2784	**2773**	2826
160	EPR	1.000	1.008	1.018	1.030	1.044	1.063	1.085	1.114	1.147	**1.199**
	MACH	.636	.659	.682	.707	.733	.761	.790	.817	.837	**.841**
	KIAS	264	263	261	260	259	257	256	254	249	**239**
	FF/ENG	2589	2558	2532	2463	2454	2449	2464	2494	2505	**2500**

Boldface area approximates optimum altitude.

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Long Range Cruise Enroute Fuel and Time—Low Altitude
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
283	262	243	226	213	200	191	182	174	167	161
567	524	485	453	425	400	382	366	351	337	324
851	786	729	680	638	600	573	549	526	505	486
1136	1050	974	908	851	800	764	732	701	673	648
1423	1314	1218	1136	1064	1000	956	914	876	842	810
1711	1580	1463	1364	1277	1200	1147	1097	1052	1010	972
2000	1846	1709	1592	1491	1400	1337	1279	1226	1177	1133
2290	2112	1954	1820	1704	1600	1528	1462	1401	1345	1295
2581	2380	2201	2049	1918	1800	1720	1645	1576	1513	1456
2874	2649	2449	2279	2132	2000	1910	1827	1751	1680	1617

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	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	3.6	0:39	3.1	0:37	2.6	0:36	2.3	0:35	2.0	0:34
400	7.6	1:14	6.8	1:11	5.9	1:06	5.3	1:04	4.8	1:01
600	11.5	1:50	10.5	1:44	9.1	1:37	8.4	1:33	7.6	1:29
800	15.4	2:26	14.2	2:18	12.4	2:09	11.4	2:03	10.4	1:57
1000	19.4	3:02	17.9	2:53	15.6	2:40	14.4	2:33	13.2	2:26
1200	23.3	3:38	21.5	3:27	18.8	3:12	17.4	3:03	16.0	2:54
1400	27.1	4:15	25.1	4:02	21.9	3:44	20.3	3:33	18.7	3:23
1600	31.0	4:53	28.7	4:37	25.1	4:16	23.2	4:03	21.5	3:51
1800	34.7	5:30	32.2	5:13	28.2	4:48	26.1	4:34	24.2	4:20
2000	38.5	6:08	35.7	5:49	31.2	5:21	29.0	5:04	26.9	4:49

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)							
	160	180	200	220	240	260	280	300
5	–0.3	–0.2	0.0	0.2	0.5	0.7	1.0	1.2
10	–0.7	–0.4	0.0	0.5	1.1	1.6	2.2	2.7
15	–1.1	–0.6	0.0	0.8	1.7	2.5	3.4	4.2
20	–1.6	–0.8	0.0	1.1	2.2	3.4	4.5	5.7
25	–2.0	–1.0	0.0	1.4	2.8	4.2	5.7	7.1
30	–2.5	–1.2	0.0	1.6	3.3	5.0	6.7	8.5
35	–3.0	–1.4	0.0	1.8	3.8	5.7	7.8	9.9
40	–3.4	–1.7	0.0	2.0	4.2	6.5	8.8	11.3

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Long Range Cruise Enroute Fuel and Time—High Altitude
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
525	495	467	442	420	400	383	368	353	340	328
1045	985	931	883	840	800	767	737	709	683	659
1566	1477	1396	1324	1259	1200	1152	1107	1065	1026	991
2089	1970	1862	1766	1679	1600	1536	1476	1420	1369	1322
2614	2465	2329	2208	2100	2000	1920	1845	1776	1712	1653
3141	2961	2797	2651	2520	2400	2304	2215	2131	2054	1984
3670	3458	3265	3094	2941	2800	2688	2584	2486	2397	2315
4201	3957	3735	3538	3362	3200	3072	2952	2842	2739	2645
4734	4457	4206	3983	3783	3600	3456	3321	3196	3081	2975
5269	4959	4677	4428	4205	4000	3840	3690	3551	3423	3305
5806	5463	5151	4874	4627	4400	4223	4058	3905	3764	3634
6346	5968	5625	5321	5049	4800	4607	4426	4259	4104	3962
6888	6475	6100	5768	5471	5200	4990	4794	4612	4444	4290
7433	6984	6576	6216	5894	5600	5373	5161	4964	4783	4617
7981	7495	7054	6665	6317	6000	5756	5528	5316	5121	4943
8532	8008	7533	7114	6741	6400	6138	5894	5668	5460	5269
9086	8523	8013	7565	7165	6800	6521	6261	6020	5797	5594
9643	9041	8496	8017	7589	7200	6903	6627	6370	6134	5918
10204	9561	8980	8469	8014	7600	7285	6992	6721	6470	6241
10769	10084	9465	8922	8440	8000	7667	7357	7070	6806	6564

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37 & ABOVE	
	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)
400	4.7	1:01	4.5	0:60	4.4	0:59	4.2	0:58	4.1	0:57
800	10.2	1:56	9.9	1:53	9.6	1:51	9.3	1:49	9.0	1:47
1200	15.6	2:52	15.1	2:48	14.7	2:44	14.3	2:40	13.9	2:38
1600	21.0	3:49	20.3	3:43	19.7	3:37	19.2	3:32	18.7	3:28
2000	26.4	4:45	25.4	4:38	24.7	4:31	24.0	4:24	23.5	4:19
2400	31.6	5:44	30.3	5:35	29.5	5:26	28.7	5:18	28.1	5:10
2800	36.7	6:42	35.3	6:31	34.3	6:21	33.4	6:11	32.6	6:02
3200	41.8	7:41	40.1	7:29	39.0	7:16	38.0	7:05	37.1	6:54
3600	46.7	8:41	44.9	8:27	43.6	8:13	42.4	7:60	41.5	7:47
4000	51.7	9:42	49.6	9:25	48.2	9:09	46.9	8:55	45.8	8:40
4400	56.4	10:44	54.2	10:25	52.7	10:08	51.3	9:51	50.1	9:35
4800	61.2	11:46	58.8	11:25	57.2	11:06	55.6	10:47	54.4	10:29
5200	65.8	12:49	63.3	12:26	61.6	12:05	59.9	11:45	58.5	11:24
5600	70.4	13:53	67.8	13:28	65.8	13:05	64.1	12:43	62.6	12:20
6000	74.9	14:57	72.2	14:30	70.1	14:05	68.2	13:41	66.7	13:16
6400	79.4	16:04	76.4	15:34	74.2	15:07	72.2	14:41	70.6	14:14
6800	83.9	17:11	80.7	16:39	78.3	16:09	76.2	15:40	74.4	15:11
7200	88.3	18:19	84.9	17:44	82.4	17:12	80.1	16:41	78.3	16:10
7600	92.6	19:28	89.0	18:50	86.3	18:16	83.9	17:43	82.0	17:09
8000	96.9	20:38	93.2	19:57	90.3	19:20	87.8	18:45	85.7	18:09

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Long Range Cruise Enroute Fuel and Time—High Altitude
Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)							
	160	180	200	220	240	260	280	300
10	–1.1	–0.5	0.0	0.6	2.1	6.3	12.7	21.3
20	–2.1	–1.1	0.0	1.1	4.0	9.5	17.3	27.5
30	–3.1	–1.6	0.0	1.7	5.7	12.3	21.4	32.9
40	–4.2	–2.1	0.0	2.4	7.4	14.9	24.9	37.5
50	–5.3	–2.7	0.0	3.1	8.8	17.1	28.0	41.4
60	–6.4	–3.2	0.0	3.8	10.2	19.1	30.5	44.5
70	–7.5	–3.8	0.0	4.5	11.4	20.7	32.6	46.8
80	–8.6	–4.3	0.0	5.1	12.4	22.1	34.1	48.4
90	–9.7	–4.9	0.0	5.6	13.4	23.2	35.1	49.2
100	–10.9	–5.4	0.0	6.1	14.1	24.0	35.7	49.2

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Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)						
	260	240	220	200	180	160	140
43				43	10	0	7
41			42	12	0	3	19
39		38	12	0	2	14	33
37	32	10	0	1	11	28	49
35	7	0	1	10	24	43	64
33	0	2	10	23	39	58	78
31	3	10	22	37	54	72	91
29	12	23	36	52	68	85	102
27	24	37	51	66	81	97	112
25	38	51	65	79	93	107	121

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.**

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Descent at .84/310/250 KIAS

PRESSURE ALT (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	93	100	107	114	119	124	130	136	142	148
TIME (MINUTES)	19	20	21	22	23	23	24	25	25	26

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Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
300	EPR	1.023	1.031	1.047	1.059	1.075	1.123	1.198			
	KIAS	260	260	262	277	302	306	311			
	FF/ENG	4350	4320	4190	4230	4440	4530	4710			
280	EPR	1.020	1.027	1.040	1.055	1.067	1.108	1.169	1.356		
	KIAS	251	251	253	261	286	295	299	279		
	FF/ENG	4060	4020	3890	3890	4060	4180	4300	4550		
260	EPR	1.017	1.023	1.034	1.052	1.063	1.092	1.145	1.265		
	KIAS	242	242	243	246	266	283	287	279		
	FF/ENG	3770	3720	3690	3580	3740	3830	3920	4060		
240	EPR	1.014	1.019	1.029	1.045	1.059	1.074	1.124	1.203		
	KIAS	232	233	234	235	247	272	275	279		
	FF/ENG	3560	3510	3460	3350	3380	3490	3560	3710		
220	EPR	1.011	1.015	1.024	1.037	1.055	1.066	1.105	1.167	1.357	
	KIAS	222	223	224	224	230	251	262	266	249	
	FF/ENG	3280	3230	3170	3140	3050	3160	3220	3310	3590	
200	EPR	1.006	1.010	1.018	1.030	1.048	1.061	1.084	1.138	1.249	
	KIAS	215	215	215	215	215	229	249	253	249	
	FF/ENG	3010	2960	2890	2850	2760	2800	2880	2950	3130	
180	EPR	1.002	1.005	1.011	1.020	1.034	1.056	1.068	1.113	1.186	1.289
	KIAS	208	208	208	208	208	209	230	239	242	232
	FF/ENG	2810	2690	2630	2580	2550	2470	2570	2600	2770	2870
160	EPR	0.997	0.999	1.003	1.009	1.021	1.038	1.062	1.088	1.147	1.202
	KIAS	203	203	203	203	203	203	206	224	227	229
	FF/ENG	2570	2510	2390	2330	2290	2270	2220	2320	2440	2560
140	EPR	0.991	0.992	0.994	0.998	1.006	1.017	1.035	1.068	1.115	1.154
	KIAS	203	203	203	203	203	203	203	203	211	213
	FF/ENG	2400	2330	2250	2130	2090	2050	1980	1980	2100	2170

This table includes 5% additional fuel for holding in a racetrack pattern.

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DRAFT

Holding
Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
300	EPR	1.060	1.073	1.100	1.140	1.199
	KIAS	224	224	224	224	224
	FF/ENG	4700	4560	4540	4560	4600
280	EPR	1.052	1.064	1.086	1.121	1.172
	KIAS	219	219	219	219	219
	FF/ENG	4370	4330	4200	4210	4230
260	EPR	1.044	1.054	1.073	1.103	1.147
	KIAS	214	214	214	214	214
	FF/ENG	4040	3990	3860	3860	3940
240	EPR	1.037	1.046	1.062	1.087	1.125
	KIAS	208	208	208	208	208
	FF/ENG	3720	3680	3630	3590	3600
220	EPR	1.030	1.038	1.052	1.072	1.105
	KIAS	202	202	202	202	202
	FF/ENG	3480	3440	3380	3270	3270
200	EPR	1.024	1.030	1.043	1.059	1.085
	KIAS	195	195	195	195	195
	FF/ENG	3180	3130	3080	3040	2950
180	EPR	1.018	1.023	1.034	1.047	1.067
	KIAS	188	188	188	188	188
	FF/ENG	2950	2840	2780	2730	2640
160	EPR	1.012	1.016	1.023	1.034	1.050
	KIAS	183	183	183	183	183
	FF/ENG	2680	2620	2500	2450	2420
140	EPR	1.005	1.008	1.013	1.021	1.033
	KIAS	183	183	183	183	183
	FF/ENG	2470	2400	2280	2230	2180

This table includes 5% additional fuel for holding in a racetrack pattern.

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ADVISORY INFORMATION

Reported Braking Action

RUNWAY CONDITION CODE	RUNWAY SURFACE CONDITION DESCRIPTION	REPORTED BRAKING ACTION
6	Dry	Dry
5	Wet (Smooth, Grooved or PFC) or Frost 3 mm (0.12 inches) or less of: Water, Slush, Dry Snow or Wet Snow	Good
4	Compacted Snow at or below –15 deg. C OAT	Good to Medium
3	Wet (Slippery), Dry Snow or Wet Snow (any depth) over Compacted Snow Greater than 3 mm (0.12 inches) of : Dry Snow or Wet Snow Compacted Snow at OAT warmer than –15 deg. C	Medium
2	Greater than 3 mm (0.12 inches) of: Water or Slush	Medium to Poor
1	Ice	Poor
0	Wet Ice, Water on top of Compacted Snow, Dry Snow or Wet Snow over Ice	Nil

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Normal Configuration Operational Landing Distance
Flaps 30

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF30	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1195	30/–5	25	–40/145	10/–10	25/–25	40	10	30
AUTOBRAKE MAX	1530	25/–5	30	–60/200	0/0	35/–35	75	0	0
AUTOBRAKE 4	1850	30/–10	45	–80/280	0/–5	45/–45	90	0	0
AUTOBRAKE 3	2170	35/–10	50	–105/350	10/–10	60/–60	110	0	0
AUTOBRAKE 2	2405	45/–25	65	–115/410	15/–35	65/–65	110	5	5
AUTOBRAKE 1	2580	50/–30	75	–130/455	45/–65	70/–70	100	105	105
Good Reported Braking Action									
MAX MANUAL	1580	25/–10	35	–70/245	35/–30	35/–35	60	65	145
AUTOBRAKE MAX	1670	30/–10	40	–75/260	30/–25	35/–35	70	65	150
AUTOBRAKE 4	1855	30/–10	45	–80/290	10/–5	45/–45	90	5	30
AUTOBRAKE 3	2170	35/–10	50	–105/350	10/–10	60/–60	110	0	0
AUTOBRAKE 2	2405	45/–25	65	–115/410	15/–35	65/–65	110	5	5
AUTOBRAKE 1	2580	50/–30	75	–130/455	45/–65	70/–70	100	105	105
Good To Medium Reported Braking Action									
MAX MANUAL	1820	30/–15	45	–90/325	60/–50	40/–40	65	125	295
AUTOBRAKE MAX	1870	35/–15	50	–90/335	55/–40	40/–40	80	120	295
AUTOBRAKE 4	1975	35/–15	50	–95/350	50/–35	50/–50	85	100	245
AUTOBRAKE 3	2220	35/–15	55	–110/390	35/–25	60/–60	110	45	165
AUTOBRAKE 2	2435	45/–25	65	–120/435	35/–45	65/–65	110	30	105
AUTOBRAKE 1	2595	50/–30	75	–135/470	60/–70	70/–70	100	115	160
Medium Reported Braking Action									
MAX MANUAL	2060	40/–25	60	–110/405	85/–70	45/–45	75	185	450
AUTOBRAKE MAX	2075	40/–15	60	–110/410	80/–60	45/–45	85	175	445
AUTOBRAKE 4	2095	40/–15	60	–110/410	85/–65	50/–50	80	190	460
AUTOBRAKE 3	2275	40/–15	60	–120/430	60/–35	60/–60	110	90	330
AUTOBRAKE 2	2465	45/–25	65	–125/460	50/–50	65/–65	110	50	205
AUTOBRAKE 1	2610	50/–30	75	–140/490	75/–75	70/–70	100	125	215
Medium To Poor Reported Braking Action									
MAX MANUAL	2325	45/–30	70	–135/520	145/–100	55/–55	80	290	770
AUTOBRAKE MAX	2335	50/–25	70	–135/520	140/–95	55/–55	85	285	765
AUTOBRAKE 4	2355	50/–25	70	–135/520	145/–100	60/–60	85	295	780
AUTOBRAKE 3	2455	50/–25	70	–140/535	130/–75	60/–60	105	245	710
AUTOBRAKE 2	2600	50/–30	70	–145/555	110/–85	65/–65	110	175	600
AUTOBRAKE 1	2715	55/–30	80	–155/580	125/–100	70/–70	100	225	565
Poor Reported Braking Action									
MAX MANUAL	2590	50/–35	80	–160/635	200/–130	65/–65	85	395	1085
AUTOBRAKE MAX	2595	60/–35	80	–160/635	200/–130	65/–65	85	395	1085
AUTOBRAKE 4	2615	60/–35	80	–160/635	200/–140	65/–65	85	405	1100
AUTOBRAKE 3	2635	60/–30	80	–160/640	200/–115	65/–65	100	395	1095
AUTOBRAKE 2	2735	60/–35	80	–165/650	175/–115	70/–70	110	300	990
AUTOBRAKE 1	2820	60/–35	85	–175/665	180/–125	70/–70	100	330	920

Reference distance is based on sea level, standard day, no wind or slope, VREF 30 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 70 m.
For autobrake and manual speedbrakes, increase reference landing distance by 60 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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ADVISORY INFORMATION

Normal Configuration Operational Landing Distance
Flaps 25

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF25	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1240	30/–10	25	–40/150	10/–10	25/–25	40	15	35
AUTOBRAKE MAX	1625	25/–15	35	–65/205	0/0	35/–35	75	0	0
AUTOBRAKE 4	1975	35/–25	45	–85/295	0/–5	45/–45	100	0	0
AUTOBRAKE 3	2330	40/–30	60	–110/360	10/–10	65/–65	115	0	0
AUTOBRAKE 2	2565	50/–40	70	–120/420	30/–45	70/–70	105	35	35
AUTOBRAKE 1	2725	60/–45	85	–140/470	60/–70	70/–70	100	165	175
Good Reported Braking Action									
MAX MANUAL	1645	30/–15	40	–70/255	35/–30	35/–35	60	75	165
AUTOBRAKE MAX	1750	30/–15	40	–75/265	30/–30	40/–40	70	80	180
AUTOBRAKE 4	1980	35/–25	45	–85/300	10/–5	45/–45	100	5	30
AUTOBRAKE 3	2330	40/–30	60	–110/360	10/–10	65/–65	115	0	0
AUTOBRAKE 2	2565	50/–40	70	–120/420	30/–45	70/–70	105	35	35
AUTOBRAKE 1	2725	60/–45	80	–140/470	60/–70	70/–70	100	165	175
Good To Medium Reported Braking Action									
MAX MANUAL	1900	35/–25	50	–90/335	60/–50	45/–45	65	140	350
AUTOBRAKE MAX	1960	35/–25	50	–90/340	55/–45	45/–45	80	140	350
AUTOBRAKE 4	2090	35/–25	50	–100/355	50/–30	50/–50	90	105	280
AUTOBRAKE 3	2380	45/–30	60	–115/405	35/–25	65/–65	115	45	175
AUTOBRAKE 2	2595	50/–40	70	–125/450	45/–55	70/–70	105	60	140
AUTOBRAKE 1	2735	60/–45	80	–140/485	70/–75	70/–70	100	180	230
Medium Reported Braking Action									
MAX MANUAL	2155	40/–35	60	–110/415	85/–70	50/–50	75	205	530
AUTOBRAKE MAX	2170	40/–30	60	–110/415	80/–65	50/–50	85	200	520
AUTOBRAKE 4	2200	40/–30	60	–115/415	85/–60	50/–50	85	205	535
AUTOBRAKE 3	2430	45/–30	65	–120/450	60/–40	65/–65	115	90	350
AUTOBRAKE 2	2625	50/–40	75	–130/475	65/–65	70/–70	105	80	245
AUTOBRAKE 1	2750	60/–45	80	–145/500	85/–80	75/–75	100	195	290
Medium To Poor Reported Braking Action									
MAX MANUAL	2430	50/–40	70	–140/530	145/–100	60/–60	80	330	900
AUTOBRAKE MAX	2440	50/–35	70	–140/530	145/–100	60/–60	85	325	895
AUTOBRAKE 4	2465	50/–35	70	–140/530	145/–100	60/–60	85	330	910
AUTOBRAKE 3	2600	50/–35	75	–145/550	125/–75	65/–65	110	260	805
AUTOBRAKE 2	2755	55/–45	80	–150/570	120/–90	70/–70	105	205	690
AUTOBRAKE 1	2860	60/–50	85	–160/590	140/–105	75/–75	100	295	680
Poor Reported Braking Action									
MAX MANUAL	2705	60/–45	80	–165/645	200/–130	65/–65	85	450	1270
AUTOBRAKE MAX	2710	60/–45	85	–165/645	205/–140	70/–70	85	450	1270
AUTOBRAKE 4	2730	60/–45	85	–165/645	200/–140	70/–70	85	455	1280
AUTOBRAKE 3	2770	60/–40	85	–165/650	195/–110	70/–70	110	425	1260
AUTOBRAKE 2	2890	60/–45	85	–175/665	180/–120	75/–75	105	335	1135
AUTOBRAKE 1	2970	65/–50	90	–180/680	190/–130	75/–75	100	395	1075

Reference distance is based on sea level, standard day, no wind or slope, VREF 25 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 70 m.
For autobrake and manual speedbrakes, increase reference landing distance by 60 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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ADVISORY INFORMATION

Normal Configuration Operational Landing Distance
Flaps 20

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABOVE/ BELOW ISA	PER 5 KTS ABOVE VREF20	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1285	35/–15	25	–45/150	10/–10	25/–25	40	15	40
AUTOBRAKE MAX	1695	30/–25	35	–65/215	0/0	35/–35	75	0	0
AUTOBRAKE 4	2080	35/–35	50	–85/300	0/–5	50/–50	105	0	0
AUTOBRAKE 3	2465	45/–40	65	–110/380	5/–10	65/–65	120	0	0
AUTOBRAKE 2	2725	50/–50	75	–125/435	25/–45	75/–75	115	35	35
AUTOBRAKE 1	2895	65/–60	85	–145/490	60/–75	75/–75	110	165	175
Good Reported Braking Action									
MAX MANUAL	1720	30/–25	40	–75/260	40/–35	35/–40	60	85	195
AUTOBRAKE MAX	1825	30/–30	45	–75/270	35/–30	40/–40	70	85	205
AUTOBRAKE 4	2085	35/–35	50	–90/310	5/–5	50/–50	105	5	35
AUTOBRAKE 3	2465	45/–40	65	–110/380	5/–10	65/–65	120	0	0
AUTOBRAKE 2	2725	55/–50	75	–125/435	25/–45	75/–75	115	35	35
AUTOBRAKE 1	2895	65/–60	85	–145/490	60/–75	75/–75	110	165	175
Good To Medium Reported Braking Action									
MAX MANUAL	1995	35/–30	50	–95/340	65/–55	45/–45	65	165	410
AUTOBRAKE MAX	2055	35/–35	55	–95/350	65/–50	50/–50	80	160	410
AUTOBRAKE 4	2200	40/–35	60	–105/370	45/–35	55/–55	100	120	330
AUTOBRAKE 3	2515	45/–40	65	–120/420	30/–25	65/–65	120	50	215
AUTOBRAKE 2	2750	50/–50	80	–130/465	45/–55	75/–75	115	60	160
AUTOBRAKE 1	2910	65/–60	90	–145/505	70/–80	80/–80	110	180	240
Medium Reported Braking Action									
MAX MANUAL	2270	45/–40	65	–115/425	90/–75	50/–50	75	240	620
AUTOBRAKE MAX	2280	45/–40	65	–115/425	90/–70	60/–60	85	230	610
AUTOBRAKE 4	2320	45/–40	65	–115/425	85/–65	60/–60	90	235	625
AUTOBRAKE 3	2565	45/–40	70	–125/460	50/–40	65/–70	120	105	425
AUTOBRAKE 2	2780	50/–50	80	–140/490	65/–65	75/–75	115	80	290
AUTOBRAKE 1	2925	65/–60	90	–150/520	85/–85	80/–80	110	195	305
Medium To Poor Reported Braking Action									
MAX MANUAL	2565	55/–50	80	–145/545	150/–110	60/–60	80	380	1060
AUTOBRAKE MAX	2575	55/–50	80	–145/545	155/–105	65/–65	85	375	1060
AUTOBRAKE 4	2600	55/–50	80	–145/545	150/–105	65/–65	90	380	1070
AUTOBRAKE 3	2750	55/–50	80	–150/565	125/–80	70/–70	115	295	955
AUTOBRAKE 2	2920	60/–55	85	–160/585	125/–95	80/–80	115	230	825
AUTOBRAKE 1	3035	65/–60	95	–165/605	140/–115	80/–80	110	310	785
Poor Reported Braking Action									
MAX MANUAL	2860	65/–60	90	–175/660	215/–145	70/–70	85	520	1500
AUTOBRAKE MAX	2865	65/–60	90	–175/660	220/–145	70/–70	85	520	1505
AUTOBRAKE 4	2885	65/–60	90	–175/660	215/–145	70/–70	90	525	1520
AUTOBRAKE 3	2935	65/–60	90	–175/665	200/–120	75/–75	110	490	1490
AUTOBRAKE 2	3055	65/–60	90	–180/685	185/–125	80/–80	115	380	1365
AUTOBRAKE 1	3150	70/–65	100	–185/695	195/–145	80/–80	110	425	1265

Reference distance is based on sea level, standard day, no wind or slope, VREF 20 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 75 m.
For autobrake and manual speedbrakes, increase reference landing distance by 60 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
Airspeed Unreliable (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1355	30/–15	30	–45/155	15/–15	25/–25	N/A	30	65
AUTOBRAKE MAX	1600	25/–20	35	–60/200	0/0	35/–35	N/A	0	0
AUTOBRAKE 2	2670	50/–45	75	–120/405	5/–25	75/–75	N/A	10	10
Good Reported Braking Action									
MAX MANUAL	1815	30/–25	45	–75/260	45/–40	40/–40	N/A	115	275
AUTOBRAKE MAX	1820	30/–30	45	–75/260	40/–35	40/–45	N/A	115	270
AUTOBRAKE 2	2670	50/–45	75	–120/405	5/–25	75/–75	N/A	10	10
Good To Medium Reported Braking Action									
MAX MANUAL	2090	40/–35	60	–95/335	75/–60	50/–50	N/A	215	550
AUTOBRAKE MAX	2090	40/–40	60	–95/335	75/–60	50/–55	N/A	210	545
AUTOBRAKE 2	2700	50/–50	75	–125/435	30/–35	75/–75	N/A	45	250
Medium Reported Braking Action									
MAX MANUAL	2365	45/–40	70	–115/410	105/–80	60/–60	N/A	310	825
AUTOBRAKE MAX	2360	45/–45	70	–115/410	110/–85	60/–60	N/A	305	820
AUTOBRAKE 3	2505	45/–40	70	–120/425	75/–35	65/–65	N/A	195	715
Medium To Poor Reported Braking Action									
MAX MANUAL	2655	55/–50	85	–140/520	165/–115	70/–70	N/A	470	1380
AUTOBRAKE MAX	2655	55/–55	85	–140/520	175/–125	70/–70	N/A	465	1380
AUTOBRAKE 3	2740	55/–50	85	–145/530	150/–90	70/–70	N/A	405	1325
Poor Reported Braking Action									
MAX MANUAL	2945	65/–60	100	–165/625	225/–150	75/–75	N/A	625	1930
AUTOBRAKE MAX	2950	65/–60	100	–165/625	235/–160	75/–75	N/A	625	1935
AUTOBRAKE 3	2970	65/–55	100	–165/630	225/–140	75/–75	N/A	615	1930

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1870	35/–30	50	–95/360	75/–60	45/–45	60	180	460
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1870	35/–30	50	–95/360	75/–60	45/–45	60	180	460
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2110	45/–35	60	–120/460	125/–90	50/–50	65	285	785
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2350	50/–40	70	–145/560	175/–115	55/–55	70	390	1105
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	2755	65/–50	90	–200/835	400/–200	65/–65	75	725	2735
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3160	75/–60	110	–250/1110	625/–280	75/–75	80	1055	4365
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1790	35/–20	50	–95/350	75/–60	40/–40	65	160	390
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1790	35/–20	50	–95/350	75/–60	40/–40	65	160	390
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2020	40/–25	60	–120/450	125/–90	50/–50	70	255	670
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2250	45/–30	70	–140/550	175/–115	55/–55	70	345	945
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	2650	60/–40	85	–195/825	395/–195	65/–65	75	655	2405
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3045	70/–50	100	–245/1095	615/–275	75/–75	80	965	3860
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG SHUTDOWN L, R (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1125	30/–15	20	–40/135	15/–10	20/–20	35	0	20
AUTOBRAKE MAX	1470	25/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2390	45/–40	65	–110/380	10/–10	65/–65	125	0	0
Good Reported Braking Action									
MAX MANUAL	1555	25/–25	35	–70/235	40/–35	35/–35	55	0	95
AUTOBRAKE MAX	1645	25/–25	40	–70/245	35/–30	40/–40	65	0	100
AUTOBRAKE 2	2390	45/–40	65	–110/380	10/–10	65/–65	125	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1850	35/–35	50	–90/320	75/–60	45/–45	65	0	205
AUTOBRAKE MAX	1895	35/–35	50	–90/325	70/–55	50/–50	75	0	205
AUTOBRAKE 2	2430	45/–45	70	–120/410	35/–25	65/–65	125	0	80
Medium Reported Braking Action									
MAX MANUAL	2140	40/–40	60	–110/400	105/–85	55/–55	75	0	310
AUTOBRAKE MAX	2145	40/–40	60	–110/400	105/–75	55/–55	85	0	305
AUTOBRAKE 3	2285	45/–40	65	–115/415	80/–50	60/–60	105	0	250
Medium To Poor Reported Braking Action									
MAX MANUAL	2490	50/–50	75	–140/525	190/–130	65/–65	85	0	545
AUTOBRAKE MAX	2495	55/–50	75	–140/525	190/–125	65/–65	90	0	540
AUTOBRAKE 3	2580	55/–50	80	–145/535	180/–115	70/–70	100	0	520
Poor Reported Braking Action									
MAX MANUAL	2835	60/–55	90	–170/650	270/–170	75/–75	90	0	775
AUTOBRAKE MAX	2840	65/–60	90	–170/650	275/–175	75/–75	90	0	775
AUTOBRAKE 3	2875	65/–60	90	–175/655	275/–175	75/–75	90	0	785

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG SHUTDOWN L, R (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1040	25/–5	20	–35/125	10/–10	20/–20	35	0	15
AUTOBRAKE MAX	1330	20/–5	25	–50/175	0/0	30/–30	60	0	0
AUTOBRAKE 2	2090	40/–10	55	–105/355	10/–10	55/–55	115	0	0
Good Reported Braking Action									
MAX MANUAL	1405	20/–10	30	–65/225	35/–30	30/–30	55	0	65
AUTOBRAKE MAX	1495	25/–10	35	–65/235	30/–25	35/–35	65	0	70
AUTOBRAKE 2	2090	40/–10	55	–105/355	10/–10	55/–55	115	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1660	30/–15	40	–85/305	65/–55	40/–40	65	0	140
AUTOBRAKE MAX	1705	30/–15	45	–85/310	60/–45	45/–45	75	0	145
AUTOBRAKE 2	2130	40/–15	60	–110/385	35/–20	55/–55	115	0	60
Medium Reported Braking Action									
MAX MANUAL	1910	35/–20	50	–105/380	95/–75	45/–45	70	0	215
AUTOBRAKE MAX	1915	35/–15	50	–105/380	90/–65	50/–50	80	0	215
AUTOBRAKE 3	2025	40/–15	55	–110/390	75/–45	50/–50	95	0	180
Medium To Poor Reported Braking Action									
MAX MANUAL	2210	45/–30	65	–135/500	170/–115	55/–55	80	0	380
AUTOBRAKE MAX	2215	45/–25	65	–135/500	170/–110	60/–60	85	0	380
AUTOBRAKE 3	2285	50/–25	65	–135/505	160/–100	60/–60	90	0	365
Poor Reported Braking Action									
MAX MANUAL	2505	55/–35	75	–160/615	240/–150	65/–65	85	0	540
AUTOBRAKE MAX	2510	55/–35	75	–160/615	245/–155	65/–65	85	0	540
AUTOBRAKE 3	2540	55/–35	75	–160/615	245/–155	65/–65	85	0	545

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAP/SLAT CONTROL (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1105	30/–15	20	–40/130	10/–10	20/–20	35	15	35
AUTOBRAKE MAX	1470	25/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2350	45/–45	65	–110/375	25/–45	60/–60	95	40	40
Good Reported Braking Action									
MAX MANUAL	1485	25/–20	35	–65/225	30/–30	30/–30	50	70	165
AUTOBRAKE MAX	1575	25/–25	35	–65/235	30/–25	35/–35	60	75	175
AUTOBRAKE 2	2350	45/–45	65	–110/375	25/–45	60/–60	95	40	40
Good To Medium Reported Braking Action									
MAX MANUAL	1720	35/–30	45	–85/295	55/–50	40/–40	60	135	340
AUTOBRAKE MAX	1770	35/–30	45	–85/300	55/–40	40/–40	70	135	340
AUTOBRAKE 2	2375	45/–45	70	–115/400	40/–55	65/–65	95	60	140
Medium Reported Braking Action									
MAX MANUAL	1950	40/–35	55	–100/365	80/–65	45/–45	65	200	515
AUTOBRAKE MAX	1960	40/–35	55	–100/365	75/–55	45/–45	75	195	505
AUTOBRAKE 3	2220	40/–35	60	–110/400	50/–35	55/–55	100	80	335
Medium To Poor Reported Braking Action									
MAX MANUAL	2200	50/–45	65	–125/470	130/–95	55/–55	70	315	875
AUTOBRAKE MAX	2210	50/–45	70	–125/470	130/–90	55/–55	75	315	875
AUTOBRAKE 3	2370	50/–40	70	–130/490	115/–70	60/–60	100	240	780
Poor Reported Braking Action									
MAX MANUAL	2450	55/–50	75	–145/570	180/–120	60/–60	75	430	1235
AUTOBRAKE MAX	2455	55/–50	80	–145/570	185/–125	60/–60	75	430	1240
AUTOBRAKE 3	2520	55/–45	75	–150/575	175/–100	65/–65	95	400	1220

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (Flaps ≤ 5)
VREF 30+40

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1325	40/–10	30	–45/155	15/–15	25/–25	40	30	70
AUTOBRAKE MAX	1860	25/–5	45	–65/215	0/0	45/–45	75	0	0
AUTOBRAKE 2	3015	55/–40	95	–130/430	50/–70	85/–85	105	190	190
Good Reported Braking Action									
MAX MANUAL	1745	25/–15	45	–70/240	35/–30	40/–40	50	110	270
AUTOBRAKE MAX	1925	30/–10	50	–75/260	15/–10	45/–45	75	75	245
AUTOBRAKE 2	3015	55/–40	95	–130/430	50/–70	85/–85	105	190	190
Good To Medium Reported Braking Action									
MAX MANUAL	2040	35/–20	60	–90/320	65/–50	50/–50	60	215	570
AUTOBRAKE MAX	2145	40/–20	60	–95/330	50/–40	55/–55	75	195	550
AUTOBRAKE 2	3040	60/–40	95	–135/455	65/–80	85/–85	105	210	330
Medium Reported Braking Action									
MAX MANUAL	2335	45/–25	70	–110/395	90/–70	60/–60	65	315	865
AUTOBRAKE MAX	2365	45/–25	70	–110/395	80/–65	60/–60	75	310	850
AUTOBRAKE 3	2885	50/–30	85	–130/455	50/–60	80/–80	110	120	495
Medium To Poor Reported Braking Action									
MAX MANUAL	2645	55/–35	85	–135/505	145/–105	70/–70	75	490	1505
AUTOBRAKE MAX	2670	55/–35	85	–135/505	145/–100	70/–70	80	490	1500
AUTOBRAKE 3	3025	60/–35	95	–150/545	115/–90	85/–85	110	330	1265
Poor Reported Braking Action									
MAX MANUAL	2955	65/–40	100	–160/610	200/–135	75/–75	80	665	2140
AUTOBRAKE MAX	2970	65/–40	100	–160/610	205/–135	75/–75	85	670	2150
AUTOBRAKE 3	3160	65/–40	100	–165/630	175/–115	85/–85	105	535	2030

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (5 < Flaps < 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1170	30/–5	25	–40/135	15/–10	20/–20	35	20	45
AUTOBRAKE MAX	1580	25/–5	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2565	50/–30	75	–115/395	25/–45	70/–70	105	65	65
Good Reported Braking Action									
MAX MANUAL	1580	25/–10	40	–65/230	35/–30	35/–35	50	90	215
AUTOBRAKE MAX	1675	25/–10	40	–70/240	30/–20	40/–40	65	95	225
AUTOBRAKE 2	2565	50/–30	75	–115/395	25/–45	70/–70	105	65	65
Good To Medium Reported Braking Action									
MAX MANUAL	1835	35/–20	50	–85/305	60/–50	45/–45	60	175	450
AUTOBRAKE MAX	1890	35/–15	50	–90/310	60/–45	45/–45	70	175	450
AUTOBRAKE 2	2590	50/–30	70	–120/420	40/–55	70/–70	105	85	200
Medium Reported Braking Action									
MAX MANUAL	2090	40/–25	60	–105/375	85/–65	50/–50	65	255	680
AUTOBRAKE MAX	2105	40/–20	60	–105/380	85/–65	50/–50	75	250	675
AUTOBRAKE 3	2430	40/–20	65	–115/420	40/–40	65/–65	105	90	455
Medium To Poor Reported Braking Action									
MAX MANUAL	2365	50/–30	75	–130/480	140/–100	60/–60	75	400	1170
AUTOBRAKE MAX	2380	50/–30	75	–130/485	140/–100	60/–60	80	400	1175
AUTOBRAKE 3	2585	50/–25	75	–135/510	105/–75	70/–70	100	290	1045
Poor Reported Braking Action									
MAX MANUAL	2635	55/–35	85	–150/585	190/–130	65/–65	80	540	1660
AUTOBRAKE MAX	2650	60/–35	85	–155/585	195/–130	65/–65	80	545	1670
AUTOBRAKE 3	2740	55/–30	85	–155/595	170/–110	70/–70	95	490	1630

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (Flaps ≥ 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1115	30/–15	20	–40/130	10/–10	20/–20	35	15	35
AUTOBRAKE MAX	1470	20/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2365	45/–45	65	–110/380	20/–40	65/–65	100	30	30
Good Reported Braking Action									
MAX MANUAL	1495	25/–20	35	–65/225	35/–30	30/–35	50	75	170
AUTOBRAKE MAX	1585	25/–25	40	–65/235	30/–25	35/–35	60	75	180
AUTOBRAKE 2	2365	45/–45	65	–110/380	20/–40	65/–65	100	30	30
Good To Medium Reported Braking Action									
MAX MANUAL	1735	35/–30	45	–85/300	60/–50	40/–40	60	145	355
AUTOBRAKE MAX	1785	35/–30	50	–85/305	55/–45	45/–45	70	140	355
AUTOBRAKE 2	2390	45/–45	70	–115/405	40/–50	65/–65	100	50	140
Medium Reported Braking Action									
MAX MANUAL	1970	40/–35	55	–100/370	80/–65	45/–45	65	210	540
AUTOBRAKE MAX	1980	40/–35	55	–100/370	80/–60	50/–50	75	200	530
AUTOBRAKE 3	2230	40/–35	60	–110/400	45/–35	55/–60	105	90	370
Medium To Poor Reported Braking Action									
MAX MANUAL	2230	50/–45	70	–125/475	135/–95	55/–55	70	330	925
AUTOBRAKE MAX	2235	50/–45	70	–125/475	135/–95	55/–55	75	325	920
AUTOBRAKE 3	2390	50/–45	70	–130/490	110/–70	60/–65	100	260	835
Poor Reported Braking Action									
MAX MANUAL	2485	55/–50	80	–150/575	185/–125	60/–60	75	450	1305
AUTOBRAKE MAX	2490	55/–50	80	–150/575	190/–125	60/–60	75	450	1310
AUTOBRAKE 3	2550	55/–50	80	–150/580	175/–105	65/–65	95	425	1295

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS PRIMARY FAIL (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1235	25/–15	25	–45/145	15/–15	25/–25	45	20	45
AUTOBRAKE MAX	1470	20/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2405	45/–45	65	–115/385	0/–20	65/–65	120	5	5
Good Reported Braking Action									
MAX MANUAL	1635	25/–25	40	–70/240	40/–35	35/–35	60	90	210
AUTOBRAKE MAX	1650	30/–25	40	–70/245	35/–30	35/–35	70	85	205
AUTOBRAKE 2	2405	45/–45	65	–115/385	0/–20	65/–65	120	5	5
Good To Medium Reported Braking Action									
MAX MANUAL	1885	35/–35	50	–90/315	65/–55	45/–45	70	170	430
AUTOBRAKE MAX	1885	35/–35	50	–90/315	65/–55	45/–45	75	165	425
AUTOBRAKE 2	2435	45/–45	65	–120/410	25/–30	65/–65	120	30	175
Medium Reported Braking Action									
MAX MANUAL	2130	40/–40	60	–105/390	90/–70	50/–50	75	245	645
AUTOBRAKE MAX	2120	40/–40	60	–105/385	95/–75	50/–50	80	245	640
AUTOBRAKE 3	2265	40/–35	60	–115/405	60/–35	60/–60	110	140	545
Medium To Poor Reported Braking Action									
MAX MANUAL	2400	50/–50	75	–130/495	150/–105	60/–60	85	380	1100
AUTOBRAKE MAX	2395	50/–50	75	–130/490	155/–110	60/–60	85	380	1100
AUTOBRAKE 3	2475	50/–45	75	–135/505	130/–80	65/–65	105	325	1050
Poor Reported Braking Action									
MAX MANUAL	2665	60/–55	85	–155/595	205/–135	65/–65	90	515	1550
AUTOBRAKE MAX	2665	60/–55	85	–155/595	210/–140	65/–65	90	515	1555
AUTOBRAKE 3	2685	60/–50	85	–155/600	200/–125	70/–70	100	510	1555

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLIGHT CONTROL MODE (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1260	25/–15	25	–45/150	15/–15	25/–25	50	25	50
AUTOBRAKE MAX	1470	20/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2410	45/–40	65	–115/385	0/–10	65/–65	130	0	0
Good Reported Braking Action									
MAX MANUAL	1680	30/–25	40	–70/250	40/–35	35/–35	65	100	235
AUTOBRAKE MAX	1675	30/–25	40	–70/245	35/–30	40/–40	70	95	225
AUTOBRAKE 2	2410	45/–40	65	–115/385	0/–10	65/–65	130	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1940	40/–35	55	–90/325	70/–55	45/–45	75	190	485
AUTOBRAKE MAX	1935	40/–35	55	–90/320	70/–60	50/–50	80	185	475
AUTOBRAKE 2	2445	45/–45	65	–120/410	25/–25	65/–65	130	35	235
Medium Reported Braking Action									
MAX MANUAL	2200	45/–40	65	–110/395	95/–75	55/–55	85	275	735
AUTOBRAKE MAX	2190	45/–40	65	–110/395	105/–85	55/–55	85	270	725
AUTOBRAKE 3	2285	45/–40	65	–115/410	75/–35	60/–60	110	200	665
Medium To Poor Reported Braking Action									
MAX MANUAL	2480	55/–50	80	–135/505	155/–110	65/–65	90	425	1260
AUTOBRAKE MAX	2475	55/–50	80	–135/505	165/–120	65/–65	90	425	1255
AUTOBRAKE 3	2525	55/–50	80	–140/510	150/–85	65/–65	110	390	1225
Poor Reported Braking Action									
MAX MANUAL	2755	65/–55	90	–160/610	215/–145	70/–70	95	575	1780
AUTOBRAKE MAX	2760	65/–55	90	–160/610	225/–150	70/–70	95	575	1785
AUTOBRAKE 3	2765	65/–55	90	–160/610	225/–135	70/–70	105	575	1785

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLIGHT CONTROLS (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1370	25/–5	30	–45/160	20/–20	30/–30	60	40	90
AUTOBRAKE MAX	1580	25/–5	35	–60/195	0/0	35/–35	70	0	10
AUTOBRAKE 2	2630	45/–20	70	–120/405	0/–20	75/–75	130	0	0
Good Reported Braking Action									
MAX MANUAL	1850	30/–10	50	–75/265	55/–45	45/–45	80	145	360
AUTOBRAKE MAX	1850	30/–10	50	–75/265	50/–45	45/–45	85	135	345
AUTOBRAKE 2	2630	45/–20	70	–120/405	0/–20	75/–75	130	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2130	40/–20	65	–95/345	85/–70	55/–55	90	255	685
AUTOBRAKE MAX	2130	40/–20	65	–95/345	85/–70	55/–55	90	250	680
AUTOBRAKE 2	2670	50/–20	75	–125/430	30/–35	75/–75	130	60	375
Medium Reported Braking Action									
MAX MANUAL	2405	50/–25	75	–115/420	115/–90	60/–60	95	365	1010
AUTOBRAKE MAX	2405	50/–25	75	–115/420	120/–95	60/–60	95	365	1010
AUTOBRAKE 3	2505	50/–15	70	–120/430	85/–45	65/–65	115	295	950
Medium To Poor Reported Braking Action									
MAX MANUAL	2690	60/–35	90	–145/530	180/–125	70/–70	100	535	1630
AUTOBRAKE MAX	2695	60/–35	90	–145/530	185/–130	70/–70	100	535	1635
AUTOBRAKE 3	2745	60/–25	90	–145/535	165/–95	75/–70	115	500	1605
Poor Reported Braking Action									
MAX MANUAL	2975	70/–40	105	–170/635	240/–160	75/–75	100	700	2250
AUTOBRAKE MAX	2985	70/–40	105	–170/635	245/–165	75/–75	100	705	2260
AUTOBRAKE 3	2985	70/–35	105	–170/635	245/–145	80/–75	110	705	2260

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS C (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1235	25/–15	25	–45/145	15/–15	25/–25	45	20	45
AUTOBRAKE MAX	1470	20/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2405	45/–45	65	–115/385	0/–20	65/–65	120	5	5
Good Reported Braking Action									
MAX MANUAL	1635	25/–25	40	–70/240	40/–35	35/–35	60	90	210
AUTOBRAKE MAX	1650	30/–25	40	–70/245	35/–30	35/–35	70	85	205
AUTOBRAKE 2	2405	45/–45	65	–115/385	0/–20	65/–65	120	5	5
Good To Medium Reported Braking Action									
MAX MANUAL	1885	35/–35	50	–90/315	65/–55	45/–45	70	170	430
AUTOBRAKE MAX	1885	35/–35	50	–90/315	65/–55	45/–45	75	165	425
AUTOBRAKE 2	2435	45/–45	65	–120/410	25/–30	65/–65	120	30	175
Medium Reported Braking Action									
MAX MANUAL	2130	40/–40	60	–105/390	90/–70	50/–50	75	245	645
AUTOBRAKE MAX	2120	40/–40	60	–105/385	95/–75	50/–50	80	245	640
AUTOBRAKE 3	2265	40/–35	60	–115/405	60/–35	60/–60	110	140	545
Medium To Poor Reported Braking Action									
MAX MANUAL	2400	50/–50	75	–130/495	150/–105	60/–60	85	380	1100
AUTOBRAKE MAX	2395	50/–50	75	–130/490	155/–110	60/–60	85	380	1100
AUTOBRAKE 3	2475	50/–45	75	–135/505	130/–80	65/–65	105	325	1050
Poor Reported Braking Action									
MAX MANUAL	2665	60/–55	85	–155/595	205/–135	65/–65	90	515	1550
AUTOBRAKE MAX	2665	60/–55	85	–155/595	210/–140	65/–65	90	515	1555
AUTOBRAKE 3	2685	60/–50	85	–155/600	200/–125	70/–70	100	510	1555

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1135	25/–10	20	–40/140	15/–15	20/–20	40	0	20
AUTOBRAKE MAX	1410	20/–15	30	–55/180	0/0	30/–30	65	0	0
AUTOBRAKE 2	2280	40/–30	60	–110/370	0/–10	60/–60	120	0	0
Good Reported Braking Action									
MAX MANUAL	1575	25/–20	40	–70/245	45/–35	35/–35	60	0	100
AUTOBRAKE MAX	1635	25/–20	40	–70/250	35/–30	40/–40	70	0	105
AUTOBRAKE 2	2280	40/–30	60	–110/370	0/–10	60/–60	120	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1880	35/–25	50	–95/335	85/–65	45/–45	75	0	220
AUTOBRAKE MAX	1910	35/–25	50	–95/335	80/–65	50/–50	80	0	225
AUTOBRAKE 2	2335	45/–30	65	–120/410	35/–25	65/–65	120	0	110
Medium Reported Braking Action									
MAX MANUAL	2180	40/–30	60	–115/420	120/–90	55/–55	85	0	340
AUTOBRAKE MAX	2180	40/–30	60	–115/420	125/–95	55/–55	85	0	340
AUTOBRAKE 3	2250	45/–30	60	–120/430	110/–65	60/–60	100	0	340
Medium To Poor Reported Braking Action									
MAX MANUAL	2550	50/–40	75	–150/565	220/–145	70/–70	95	0	605
AUTOBRAKE MAX	2555	50/–40	75	–150/565	225/–150	70/–70	95	0	605
AUTOBRAKE 3	2605	55/–40	75	–155/570	215/–135	70/–70	100	0	610
Poor Reported Braking Action									
MAX MANUAL	2920	60/–50	90	–185/705	320/–195	80/–80	100	0	870
AUTOBRAKE MAX	2930	60/–50	90	–185/705	325/–200	80/–80	100	0	870
AUTOBRAKE 3	2960	65/–50	90	–185/705	320/–200	80/–80	100	0	880

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1090	25/–5	20	–40/135	15/–10	20/–20	40	0	15
AUTOBRAKE MAX	1330	20/–5	25	–50/175	0/0	30/–30	60	0	0
AUTOBRAKE 2	2120	40/–10	55	–105/355	0/–10	55/–55	115	0	0
Good Reported Braking Action									
MAX MANUAL	1500	25/–10	35	–70/240	40/–35	35/–35	65	0	85
AUTOBRAKE MAX	1555	25/–10	35	–75/245	35/–30	35/–35	70	0	85
AUTOBRAKE 2	2120	40/–10	55	–105/355	0/–10	55/–55	115	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1790	35/–15	45	–95/330	80/–65	45/–45	75	0	190
AUTOBRAKE MAX	1820	35/–15	45	–95/330	80/–60	45/–45	80	0	190
AUTOBRAKE 2	2175	40/–15	60	–115/395	40/–30	60/–60	115	0	105
Medium Reported Braking Action									
MAX MANUAL	2080	40/–20	55	–115/415	115/–90	50/–50	85	0	290
AUTOBRAKE MAX	2080	40/–20	55	–115/415	120/–90	55/–55	85	0	290
AUTOBRAKE 3	2140	40/–20	60	–115/420	115/–75	55/–55	90	0	300
Medium To Poor Reported Braking Action									
MAX MANUAL	2440	50/–30	70	–150/555	220/–140	65/–65	95	0	520
AUTOBRAKE MAX	2445	50/–30	70	–150/555	225/–145	65/–65	95	0	525
AUTOBRAKE 3	2490	50/–30	75	–150/560	215/–135	65/–65	95	0	535
Poor Reported Braking Action									
MAX MANUAL	2795	60/–35	85	–180/695	320/–190	75/–75	100	0	750
AUTOBRAKE MAX	2805	60/–35	85	–180/695	325/–195	75/–75	100	0	755
AUTOBRAKE 3	2835	60/–35	85	–180/695	315/–195	75/–75	100	0	765

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L+C (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1390	30/–5	30	–50/165	20/–20	30/–30	55	0	35
AUTOBRAKE MAX	1580	25/–5	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2630	45/–10	70	–120/405	0/0	75/–75	140	0	0
Good Reported Braking Action									
MAX MANUAL	1945	30/–10	50	–80/280	60/–50	45/–45	80	0	165
AUTOBRAKE MAX	1930	30/–10	50	–80/280	55/–45	50/–50	85	0	160
AUTOBRAKE 2	2630	45/–10	70	–120/405	0/0	75/–75	140	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2320	40/–20	65	–110/380	110/–85	60/–60	95	0	355
AUTOBRAKE MAX	2310	40/–20	65	–110/380	110/–85	60/–60	100	0	350
AUTOBRAKE 2	2705	50/–15	75	–130/445	65/–25	75/–75	140	0	240
Medium Reported Braking Action									
MAX MANUAL	2695	50/–25	80	–135/475	160/–120	70/–70	105	0	545
AUTOBRAKE MAX	2685	50/–25	80	–135/475	165/–125	70/–70	110	0	540
AUTOBRAKE 3	2715	55/–25	80	–135/480	160/–105	75/–75	110	0	550
Medium To Poor Reported Braking Action									
MAX MANUAL	3150	65/–35	100	–175/630	285/–185	85/–85	115	0	960
AUTOBRAKE MAX	3150	65/–35	100	–175/630	295/–195	85/–85	120	0	960
AUTOBRAKE 3	3165	70/–35	100	–175/635	290/–180	90/–90	120	0	965
Poor Reported Braking Action									
MAX MANUAL	3605	75/–45	115	–210/785	410/–250	100/–100	125	0	1375
AUTOBRAKE MAX	3610	80/–45	120	–210/785	420/–260	100/–100	125	0	1380
AUTOBRAKE 3	3615	80/–45	120	–210/785	420/–250	100/–100	130	0	1380

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L+R (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1490	20/–5	35	–55/190	30/–25	35/–35	65	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2250	35/–10	60	–105/355	105/–85	60/–60	100	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2855	50/–20	80	–145/505	230/–160	80/–80	120	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	3455	60/–25	95	–185/655	355/–235	100/–100	135	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	4355	80/–35	120	–260/950	905/–415	135/–135	155	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	5255	95/–45	140	–335/1240	1455/–590	165/–165	170	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1235	20/–10	25	–45/160	20/–20	25/–25	50	0	35
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1715	30/–20	45	–80/285	55/–45	40/–40	70	0	145
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2030	40/–30	55	–105/385	105/–80	50/–50	80	0	290
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2345	45/–35	65	–130/480	150/–110	60/–60	85	0	430
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	2720	55/–45	80	–170/640	290/–170	75/–75	95	0	735
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3090	65/–55	95	–205/795	425/–225	85/–85	100	0	1035
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1180	15/–5	25	–45/155	20/–15	25/–25	45	0	25
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1615	25/–10	40	–75/275	55/–45	40/–40	65	0	115
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	1905	35/–20	50	–100/370	100/–75	50/–50	75	0	235
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2195	40/–25	60	–125/465	145/–105	55/–55	85	0	350
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	2545	50/–30	75	–160/620	275/–160	65/–65	90	0	595
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	2890	60/–35	85	–195/775	400/–215	75/–75	95	0	840
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R+C (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1690	25/–5	40	–65/220	40/–35	40/–40	75	0	95
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2360	40/–15	65	–110/375	105/–85	60/–60	100	0	345
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2780	55/–25	85	–140/500	185/–135	75/–75	110	0	645
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	3200	65/–35	100	–170/625	265/–185	85/–85	120	0	945
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	3680	80/–45	120	–220/820	515/–270	100/–100	130	0	1555
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	4160	95/–55	140	–265/1015	760/–355	115/–115	135	0	2165
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH DOWN AUTHORITY (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1220	25/–10	20	–40/145	15/–10	20/–20	45	10	25
AUTOBRAKE MAX	1410	20/–15	30	–55/180	0/0	30/–30	65	0	0
AUTOBRAKE 2	2280	40/–30	60	–110/370	5/–20	60/–60	115	5	5
Good Reported Braking Action									
MAX MANUAL	1580	25/–15	35	–65/235	35/–30	35/–35	55	55	130
AUTOBRAKE MAX	1590	25/–15	35	–65/235	35/–30	35/–35	65	60	135
AUTOBRAKE 2	2285	40/–30	60	–110/370	5/–20	60/–60	115	5	5
Good To Medium Reported Braking Action									
MAX MANUAL	1805	30/–25	45	–85/305	60/–50	40/–40	65	115	280
AUTOBRAKE MAX	1805	30/–25	45	–85/305	60/–50	40/–40	70	115	285
AUTOBRAKE 2	2325	45/–35	65	–115/395	30/–30	60/–60	115	30	100
Medium Reported Braking Action									
MAX MANUAL	2025	35/–30	55	–100/375	80/–65	45/–45	70	170	430
AUTOBRAKE MAX	2020	35/–30	55	–100/375	85/–65	45/–45	75	170	430
AUTOBRAKE 3	2160	40/–25	55	–110/395	55/–25	55/–55	110	80	305
Medium To Poor Reported Braking Action									
MAX MANUAL	2265	45/–35	65	–125/475	130/–95	55/–55	75	275	750
AUTOBRAKE MAX	2265	45/–35	65	–125/475	135/–95	55/–55	80	275	750
AUTOBRAKE 3	2345	45/–35	65	–130/485	120/–70	60/–60	100	225	680
Poor Reported Braking Action									
MAX MANUAL	2500	50/–40	75	–150/575	180/–120	60/–60	80	375	1065
AUTOBRAKE MAX	2510	50/–40	75	–150/575	185/–125	60/–60	80	380	1065
AUTOBRAKE 3	2525	50/–40	75	–150/575	180/–110	60/–60	90	365	1055

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH DOWN AUTHORITY (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1170	25/–5	20	–40/140	15/–10	20/–20	45	10	20
AUTOBRAKE MAX	1330	20/–5	25	–50/175	0/0	30/–30	65	0	0
AUTOBRAKE 2	2120	40/–15	55	–105/355	0/–5	55/–55	115	0	0
Good Reported Braking Action									
MAX MANUAL	1505	20/–10	35	–65/230	35/–30	30/–30	55	50	110
AUTOBRAKE MAX	1520	25/–10	35	–65/230	35/–30	30/–30	65	50	110
AUTOBRAKE 2	2130	40/–15	55	–105/355	5/–10	55/–55	120	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1720	30/–15	45	–85/300	60/–45	40/–40	65	100	240
AUTOBRAKE MAX	1725	30/–15	45	–85/300	60/–50	40/–40	70	100	240
AUTOBRAKE 2	2165	40/–15	55	–110/380	25/–20	55/–60	120	20	85
Medium Reported Braking Action									
MAX MANUAL	1930	35/–20	50	–100/365	80/–60	45/–45	70	150	365
AUTOBRAKE MAX	1925	35/–15	50	–100/365	85/–65	45/–45	75	150	365
AUTOBRAKE 3	2015	35/–10	50	–105/380	55/–25	50/–50	105	80	280
Medium To Poor Reported Braking Action									
MAX MANUAL	2160	45/–25	60	–125/465	130/–90	50/–50	75	240	640
AUTOBRAKE MAX	2165	45/–25	60	–125/465	135/–95	55/–55	80	245	640
AUTOBRAKE 3	2210	45/–20	60	–125/475	120/–70	55/–55	95	205	595
Poor Reported Braking Action									
MAX MANUAL	2390	50/–30	70	–145/565	175/–120	55/–55	80	330	910
AUTOBRAKE MAX	2400	50/–30	70	–145/565	185/–125	60/–60	80	335	910
AUTOBRAKE 3	2400	50/–25	70	–145/565	185/–115	60/–60	85	330	910

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH UP AUTHORITY (Flaps ≤ 15)
VREF 30+40

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1300	40/–10	25	–45/150	15/–15	25/–25	40	25	60
AUTOBRAKE MAX	1860	25/–5	45	–65/215	0/0	45/–45	75	0	0
AUTOBRAKE 2	2895	55/–40	90	–125/420	65/–70	80/–80	85	240	260
Good Reported Braking Action									
MAX MANUAL	1725	25/–15	45	–70/240	35/–30	40/–40	50	100	235
AUTOBRAKE MAX	1935	30/–10	50	–75/260	20/–15	45/–45	75	65	210
AUTOBRAKE 2	2895	55/–40	90	–125/420	65/–70	80/–80	85	240	260
Good To Medium Reported Braking Action									
MAX MANUAL	2005	35/–20	55	–90/315	60/–50	50/–50	60	190	475
AUTOBRAKE MAX	2145	40/–20	60	–95/330	50/–40	55/–55	75	170	470
AUTOBRAKE 2	2920	55/–40	90	–130/445	80/–80	80/–80	85	260	370
Medium Reported Braking Action									
MAX MANUAL	2280	40/–25	65	–105/390	85/–70	55/–55	65	275	715
AUTOBRAKE MAX	2355	45/–25	70	–110/395	75/–60	60/–60	75	275	725
AUTOBRAKE 3	2810	50/–35	80	–125/445	65/–65	75/–75	90	140	420
Medium To Poor Reported Braking Action									
MAX MANUAL	2570	50/–35	80	–130/495	140/–100	65/–65	70	420	1195
AUTOBRAKE MAX	2620	55/–35	85	–135/500	135/–95	70/–70	80	415	1205
AUTOBRAKE 3	2945	55/–40	90	–145/535	120/–95	80/–80	90	295	980
Poor Reported Braking Action									
MAX MANUAL	2855	60/–40	95	–155/595	190/–130	75/–75	75	560	1675
AUTOBRAKE MAX	2885	60/–40	95	–155/600	190/–125	75/–75	80	555	1680
AUTOBRAKE 3	3075	60/–40	100	–165/620	175/–125	80/–80	90	445	1535

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH UP AUTHORITY (Flaps ≥ 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1145	30/–5	20	–40/135	10/–10	20/–20	35	15	35
AUTOBRAKE MAX	1580	25/–5	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2495	50/–30	75	–115/390	40/–55	65/–65	85	95	95
Good Reported Braking Action									
MAX MANUAL	1535	25/–10	35	–65/225	30/–30	35/–35	50	75	170
AUTOBRAKE MAX	1665	25/–5	40	–70/240	25/–15	40/–40	70	75	180
AUTOBRAKE 2	2495	50/–30	75	–115/390	40/–55	65/–65	85	95	95
Good To Medium Reported Braking Action									
MAX MANUAL	1780	35/–15	45	–85/300	55/–50	45/–45	55	140	350
AUTOBRAKE MAX	1865	35/–15	50	–85/310	50/–35	45/–45	70	140	350
AUTOBRAKE 2	2520	50/–30	75	–120/415	55/–65	65/–65	85	115	185
Medium Reported Braking Action									
MAX MANUAL	2025	40/–20	55	–100/370	80/–65	50/–50	60	205	525
AUTOBRAKE MAX	2065	40/–20	60	–100/375	70/–55	50/–50	70	205	520
AUTOBRAKE 3	2385	40/–20	65	–115/410	50/–45	60/–65	95	80	305
Medium To Poor Reported Braking Action									
MAX MANUAL	2285	50/–30	70	–125/475	130/–95	60/–60	65	325	890
AUTOBRAKE MAX	2310	50/–30	70	–125/475	130/–90	60/–60	75	325	890
AUTOBRAKE 3	2530	50/–25	75	–135/500	105/–75	65/–70	95	220	745
Poor Reported Braking Action									
MAX MANUAL	2545	55/–35	80	–150/575	180/–120	65/–65	70	440	1255
AUTOBRAKE MAX	2550	55/–35	80	–150/575	185/–120	65/–65	75	440	1255
AUTOBRAKE 3	2670	55/–30	80	–155/585	160/–105	70/–70	95	360	1185

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PRI FLIGHT COMPUTERS (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1260	25/–15	25	–45/150	15/–15	25/–25	50	25	50
AUTOBRAKE MAX	1470	20/–20	30	–55/185	0/0	30/–30	65	0	0
AUTOBRAKE 2	2410	45/–40	65	–115/385	0/–10	65/–65	130	0	0
Good Reported Braking Action									
MAX MANUAL	1680	30/–25	40	–70/250	40/–35	35/–35	65	100	235
AUTOBRAKE MAX	1675	30/–25	40	–70/245	35/–30	40/–40	70	95	225
AUTOBRAKE 2	2410	45/–40	65	–115/385	0/–10	65/–65	130	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1940	40/–35	55	–90/325	70/–55	45/–45	75	190	485
AUTOBRAKE MAX	1935	40/–35	55	–90/320	70/–60	50/–50	80	185	475
AUTOBRAKE 2	2445	45/–45	65	–120/410	25/–25	65/–65	130	35	235
Medium Reported Braking Action									
MAX MANUAL	2200	45/–40	65	–110/395	90/–75	55/–55	85	275	735
AUTOBRAKE MAX	2190	45/–40	65	–110/395	105/–85	55/–55	85	270	725
AUTOBRAKE 3	2285	45/–40	65	–115/410	75/–35	60/–60	110	200	665
Medium To Poor Reported Braking Action									
MAX MANUAL	2480	55/–50	80	–135/505	155/–110	65/–65	90	425	1260
AUTOBRAKE MAX	2475	55/–50	80	–135/505	165/–120	65/–65	90	425	1255
AUTOBRAKE 3	2525	55/–50	80	–140/510	150/–85	65/–65	110	390	1225
Poor Reported Braking Action									
MAX MANUAL	2755	65/–55	90	–160/610	215/–145	70/–70	95	575	1780
AUTOBRAKE MAX	2760	65/–55	90	–160/610	225/–150	70/–70	95	575	1785
AUTOBRAKE 3	2765	65/–55	90	–160/610	225/–135	70/–70	105	575	1785

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SLATS DRIVE (Flaps 20)
VREF 30+30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1260	30/–5	25	–40/145	15/–15	25/–25	40	125	50
AUTOBRAKE MAX	1715	25/–5	40	–60/205	0/0	40/–40	75	0	0
AUTOBRAKE 2	2730	50/–35	80	–120/410	50/–60	75/–75	90	135	135
Good Reported Braking Action									
MAX MANUAL	1705	25/–15	45	–70/245	40/–35	40/–40	55	95	225
AUTOBRAKE MAX	1825	30/–10	45	–75/255	30/–20	45/–45	70	100	240
AUTOBRAKE 2	2730	50/–35	80	–120/410	50/–60	75/–75	90	135	135
Good To Medium Reported Braking Action									
MAX MANUAL	1970	35/–20	55	–90/320	65/–55	50/–50	60	175	445
AUTOBRAKE MAX	2050	40/–20	55	–95/325	55/–45	50/–50	75	175	445
AUTOBRAKE 2	2755	55/–35	85	–125/435	65/–70	75/–75	90	160	255
Medium Reported Braking Action									
MAX MANUAL	2235	40/–25	55	–110/390	90/–70	55/–55	65	255	660
AUTOBRAKE MAX	2270	45/–25	65	–110/395	80/–65	55/–55	80	250	650
AUTOBRAKE 3	2615	45/–25	75	–120/435	60/–50	70/–70	100	105	400
Medium To Poor Reported Braking Action									
MAX MANUAL	2515	50/–35	80	–135/495	145/–105	65/–65	70	390	1085
AUTOBRAKE MAX	2535	55/–35	80	–135/500	140/–100	65/–65	80	385	1080
AUTOBRAKE 3	2770	55/–30	85	–140/525	120/–85	75/–75	100	270	915
Poor Reported Braking Action									
MAX MANUAL	2790	60/–40	90	–155/600	200/–135	70/–70	75	520	1510
AUTOBRAKE MAX	2795	60/–40	90	–155/600	200/–135	70/–70	80	520	1510
AUTOBRAKE 3	2920	60/–35	95	–160/610	180/–115	75/–75	100	430	1430

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SPOILERS (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1110	25/–10	20	–40/135	15/–10	20/–20	40	15	35
AUTOBRAKE MAX	1410	20/–15	30	–55/180	0/0	30/–30	65	0	0
AUTOBRAKE 2	2260	40/–35	60	–110/370	15/–30	60/–60	100	15	15
Good Reported Braking Action									
MAX MANUAL	1480	25/–20	35	–65/225	35/–30	30/–30	55	75	170
AUTOBRAKE MAX	1550	25/–20	35	–65/235	30/–25	35/–35	65	75	175
AUTOBRAKE 2	2260	40/–35	60	–110/370	15/–30	60/–60	100	15	15
Good To Medium Reported Braking Action									
MAX MANUAL	1710	35/–25	45	–85/295	60/–50	40/–40	65	140	350
AUTOBRAKE MAX	1745	35/–25	45	–85/300	60/–45	40/–40	70	140	350
AUTOBRAKE 2	2290	45/–35	65	–115/395	30/–40	60/–60	100	40	135
Medium Reported Braking Action									
MAX MANUAL	1940	40/–30	55	–100/365	80/–65	45/–45	70	205	525
AUTOBRAKE MAX	1940	40/–30	55	–100/365	85/–65	45/–45	70	200	520
AUTOBRAKE 3	2130	40/–25	55	–110/390	50/–35	55/–55	100	95	405
Medium To Poor Reported Braking Action									
MAX MANUAL	2185	50/–35	65	–125/470	135/–95	55/–55	75	320	885
AUTOBRAKE MAX	2190	50/–35	65	–125/470	140/–95	55/–55	75	315	885
AUTOBRAKE 3	2300	50/–35	65	–130/485	115/–75	60/–60	95	260	830
Poor Reported Braking Action									
MAX MANUAL	2430	55/–40	75	–145/570	185/–125	60/–60	80	430	1245
AUTOBRAKE MAX	2435	55/–40	75	–145/570	190/–125	60/–60	80	430	1245
AUTOBRAKE 3	2470	55/–40	75	–150/575	180/–115	60/–60	90	425	1250

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SPOILERS (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1065	20/–5	20	–35/130	10/–10	20/–20	40	15	30
AUTOBRAKE MAX	1330	20/–5	25	–50/175	0/0	30/–30	65	0	0
AUTOBRAKE 2	2110	40/–15	55	–105/355	5/–20	55/–55	105	0	0
Good Reported Braking Action									
MAX MANUAL	1415	20/–10	35	–60/220	35/–30	30/–30	55	60	145
AUTOBRAKE MAX	1475	25/–10	35	–65/230	30/–25	30/–30	65	65	145
AUTOBRAKE 2	2110	40/–15	55	–105/355	5/–20	55/–55	105	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1635	30/–15	45	–80/290	60/–50	40/–40	65	120	295
AUTOBRAKE MAX	1665	30/–15	45	–85/295	60/–45	40/–40	70	120	295
AUTOBRAKE 2	2135	40/–20	55	–110/380	25/–30	55/–55	105	25	115
Medium Reported Braking Action									
MAX MANUAL	1850	35/–20	50	–100/360	80/–65	45/–45	70	175	445
AUTOBRAKE MAX	1855	35/–20	50	–100/360	85/–60	45/–45	70	175	445
AUTOBRAKE 3	1995	35/–15	50	–105/380	55/–35	50/–50	95	100	370
Medium To Poor Reported Braking Action									
MAX MANUAL	2090	45/–25	60	–125/460	135/–95	50/–50	75	280	755
AUTOBRAKE MAX	2095	45/–25	60	–125/465	140/–95	55/–55	75	280	755
AUTOBRAKE 3	2175	45/–25	65	–125/475	120/–80	55/–55	90	245	725
Poor Reported Braking Action									
MAX MANUAL	2325	50/–30	70	–145/560	185/–120	55/–55	80	380	1060
AUTOBRAKE MAX	2330	50/–30	70	–145/565	190/–125	60/–60	80	380	1065
AUTOBRAKE 3	2355	50/–30	75	–145/565	185/–120	60/–60	85	385	1075

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
STABILIZER (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	200000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 200000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1185	30/–5	25	–40/140	15/–10	25/–25	40	20	45
AUTOBRAKE MAX	1580	25/–5	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2535	50/–30	75	–115/395	35/–50	70/–70	90	65	65
Good Reported Braking Action									
MAX MANUAL	1595	25/–10	40	–65/235	35/–30	35/–35	55	85	200
AUTOBRAKE MAX	1695	25/–10	40	–70/245	30/–25	40/–40	65	90	210
AUTOBRAKE 2	2535	50/–30	75	–115/395	35/–50	70/–70	90	65	65
Good To Medium Reported Braking Action									
MAX MANUAL	1845	35/–20	50	–85/310	60/–50	45/–45	60	160	400
AUTOBRAKE MAX	1905	35/–15	50	–90/315	55/–45	45/–45	70	160	400
AUTOBRAKE 2	2560	50/–30	75	–120/420	50/–60	70/–70	90	90	180
Medium Reported Braking Action									
MAX MANUAL	2095	40/–25	60	–105/380	85/–70	50/–50	65	230	595
AUTOBRAKE MAX	2110	40/–20	60	–105/380	80/–60	50/–50	75	225	585
AUTOBRAKE 3	2405	45/–20	65	–115/415	50/–40	65/–65	100	90	380
Medium To Poor Reported Braking Action									
MAX MANUAL	2360	50/–30	75	–130/485	140/–100	60/–60	70	355	995
AUTOBRAKE MAX	2370	50/–30	75	–130/485	140/–95	60/–60	75	355	995
AUTOBRAKE 3	2560	50/–25	75	–135/505	115/–75	70/–70	100	260	870
Poor Reported Braking Action									
MAX MANUAL	2620	55/–35	85	–150/585	190/–130	65/–65	75	480	1395
AUTOBRAKE MAX	2630	55/–35	85	–150/585	195/–130	65/–65	75	480	1400
AUTOBRAKE 3	2710	55/–35	85	–155/595	180/–110	70/–70	100	430	1355

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
deg. C	deg. F	–2000	0	2000	4000	6000	8000
54	129	258.6	243.7				
52	126	264.6	249.6				
50	122	270.9	255.3	236.3			
48	118	277.2	261.0	242.0			
46	115	283.6	266.6	247.5	227.9		
44	111	289.9	272.9	253.0	232.3		
42	108	294.5	279.4	258.3	236.5	219.7	
40	104	298.9	285.7	263.4	240.9	223.4	
38	100	303.1	290.9	268.8	244.9	226.8	209.6
36	97	307.2	296.1	273.9	249.0	230.3	212.9
34	93	311.2	300.9	278.2	253.1	233.7	216.1
32	90	311.3	305.3	282.4	256.9	237.2	219.3
30	86	311.3	309.7	286.6	260.6	240.8	222.4
28	82	311.4	309.7	290.4	264.4	244.5	225.8
26	79	311.4	309.7	294.1	267.9	248.0	229.2
24	75	311.5	309.8	294.9	271.1	251.4	232.5
22	72	311.6	309.8	294.9	274.2	253.5	234.1
20	68	311.6	309.9	294.9	274.8	254.5	235.5
18	64	311.6	309.9	295.0	274.9	255.6	237.2
16	61	311.6	310.0	295.1	274.9	256.1	239.0
14	57	311.7	310.0	295.1	275.0	256.1	240.5
12	54	311.7	310.1	295.2	275.0	256.2	240.6
10	50	311.8	310.2	295.2	275.1	256.2	240.7
–40	–40	312.9	311.5	296.6	276.3	257.3	241.7

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off.
With engine bleed for packs off, increase weight by 900 kg.
With engine and wing anti-ice on, decrease weight by 1,450 kg.
When operating in icing conditions during any part of the flight with forecast landing temperature is below 10 deg. C, decrease weight by 20,800 kg.

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ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Reference Brake Energy (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)																	
		80			100			120			140			160			180		
WEIGHT (1000 KG)	OAT (deg. C)	PRESSURE ALTITUDE (1000 FT)																	
		0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8
300	0	17.3	19.1	21.2	26.1	29.1	32.6	36.4	40.8	46.0	47.9	53.9	61.0	60.4	68.1	77.1	73.2	82.4	93.0
	10	17.9	19.7	21.8	27.0	30.0	33.7	37.6	42.1	47.5	49.5	55.7	63.0	62.4	70.4	79.6	75.6	85.0	95.8
	15	18.2	20.0	22.2	27.4	30.5	34.2	38.2	42.9	48.3	50.3	56.7	64.1	63.5	71.5	80.8	76.8	86.3	97.2
	20	18.4	20.3	22.5	27.9	31.0	34.8	38.9	43.6	49.1	51.2	57.6	65.1	64.5	72.7	82.1	78.0	87.6	98.5
	30	18.8	20.8	23.1	28.6	31.8	35.7	39.9	44.7	50.5	52.6	59.2	66.9	66.3	74.7	84.3	80.2	90.0	101.1
	40	19.1	21.0	23.4	29.0	32.4	36.3	40.6	45.6	51.5	53.7	60.5	68.4	67.8	76.4	86.3	82.0	92.0	103.3
280	0	16.4	18.0	20.0	24.7	27.4	30.7	34.3	38.4	43.2	45.1	50.7	57.3	56.9	64.1	72.6	69.0	77.8	87.9
	10	16.9	18.6	20.6	25.5	28.3	31.7	35.4	39.7	44.7	46.6	52.4	59.3	58.8	66.3	74.9	71.3	80.3	90.6
	15	17.2	18.9	20.9	25.9	28.8	32.2	36.0	40.4	45.5	47.4	53.3	60.3	59.8	67.4	76.2	72.5	81.6	92.0
	20	17.4	19.2	21.3	26.3	29.3	32.8	36.6	41.0	46.2	48.2	54.2	61.2	60.7	68.5	77.3	73.6	82.8	93.3
	30	17.8	19.6	21.8	27.0	30.0	33.6	37.6	42.1	47.5	49.5	55.7	63.0	62.5	70.4	79.5	75.7	85.1	95.8
	40	18.0	19.8	22.0	27.4	30.5	34.2	38.3	42.9	48.4	50.5	56.9	64.4	63.8	72.0	81.3	77.4	87.0	97.9
260	0	15.5	17.0	18.8	23.2	25.8	28.8	32.2	36.0	40.5	42.3	47.5	53.7	53.3	60.0	67.9	64.7	73.0	82.6
	10	15.9	17.5	19.4	24.0	26.6	29.7	33.3	37.2	41.9	43.7	49.1	55.5	55.0	62.0	70.2	66.9	75.4	85.1
	15	16.2	17.8	19.7	24.4	27.0	30.2	33.8	37.8	42.6	44.4	49.9	56.4	56.0	63.1	71.3	68.0	76.6	86.5
	20	16.5	18.1	20.0	24.8	27.5	30.7	34.4	38.5	43.3	45.2	50.8	57.3	56.9	64.1	72.5	69.1	77.8	87.8
	30	16.8	18.5	20.4	25.4	28.2	31.5	35.3	39.5	44.5	46.4	52.2	58.9	58.5	65.9	74.5	71.0	79.9	90.1
	40	17.0	18.7	20.7	25.7	28.6	32.0	35.9	40.2	45.3	47.3	53.3	60.2	59.8	67.4	76.2	72.6	81.8	92.2
240	0	14.6	15.9	17.6	21.8	24.1	26.9	30.1	33.6	37.8	39.4	44.2	49.9	49.6	55.8	63.2	60.3	68.0	76.9
	10	15.0	16.4	18.1	22.5	24.9	27.8	31.1	34.7	39.0	40.7	45.7	51.6	51.2	57.7	65.3	62.3	70.2	79.4
	15	15.2	16.7	18.4	22.8	25.3	28.3	31.6	35.3	39.7	41.4	46.5	52.5	52.1	58.7	66.3	63.3	71.4	80.7
	20	15.5	16.9	18.7	23.2	25.7	28.7	32.1	35.9	40.3	42.1	47.3	53.3	53.0	59.7	67.4	64.4	72.5	81.9
	30	15.8	17.3	19.2	23.7	26.3	29.4	32.9	36.8	41.4	43.2	48.6	54.8	54.4	61.3	69.3	66.2	74.6	84.2
	40	15.9	17.5	19.4	24.1	26.7	29.9	33.5	37.5	42.2	44.1	49.6	56.0	55.6	62.7	70.9	67.7	76.3	86.1
220	0	13.6	14.9	16.4	20.3	22.4	25.0	28.0	31.2	35.0	36.5	40.9	46.1	45.8	51.6	58.3	55.7	62.8	71.1
	10	14.1	15.4	16.9	20.9	23.2	25.8	28.9	32.2	36.1	37.7	42.3	47.7	47.3	53.3	60.2	57.6	64.9	73.4
	15	14.3	15.6	17.2	21.3	23.5	26.2	29.4	32.7	36.7	38.4	43.0	48.5	48.2	54.2	61.2	58.5	66.0	74.6
	20	14.5	15.9	17.5	21.6	23.9	26.7	29.8	33.3	37.3	39.0	43.7	49.3	49.0	55.1	62.2	59.5	67.0	75.8
	30	14.8	16.2	17.9	22.1	24.5	27.3	30.6	34.1	38.3	40.0	44.9	50.6	50.3	56.6	64.0	61.2	68.9	77.9
	40	14.9	16.3	18.1	22.4	24.8	27.7	31.1	34.7	39.0	40.8	45.8	51.7	51.3	57.9	65.4	62.5	70.5	79.7
200	0	12.7	13.9	15.3	18.8	20.8	23.1	25.8	28.7	32.2	33.6	37.5	42.3	42.0	47.2	53.3	51.0	57.4	65.0
	10	13.1	14.3	15.7	19.4	21.4	23.8	26.6	29.6	33.2	34.7	38.8	43.7	43.4	48.8	55.1	52.7	59.4	67.1
	15	13.3	14.5	16.0	19.7	21.8	24.2	27.1	30.1	33.8	35.2	39.5	44.4	44.1	49.6	56.0	53.6	60.4	68.2
	20	13.5	14.8	16.3	20.0	22.1	24.6	27.5	30.6	34.3	35.8	40.1	45.2	44.9	50.4	56.9	54.5	61.3	69.3
	30	13.8	15.1	16.6	20.5	22.6	25.2	28.2	31.4	35.2	36.8	41.2	46.4	46.1	51.8	58.5	56.0	63.1	71.3
	40	13.9	15.2	16.8	20.8	22.9	25.6	28.6	31.9	35.8	37.4	42.0	47.3	47.0	52.9	59.8	57.2	64.5	72.9
180	0	11.8	12.9	14.1	17.4	19.1	21.2	23.6	26.2	29.3	30.6	34.1	38.4	38.1	42.7	48.2	46.1	51.9	58.6
	10	12.2	13.3	14.6	17.9	19.7	21.9	24.4	27.1	30.3	31.6	35.3	39.6	39.3	44.1	49.8	47.6	53.6	60.6
	15	12.4	13.5	14.8	18.2	20.0	22.2	24.8	27.5	30.8	32.1	35.9	40.3	40.0	44.9	50.7	48.5	54.5	61.6
	20	12.6	13.7	15.0	18.5	20.3	22.6	25.2	28.0	31.3	32.6	36.4	41.0	40.7	45.6	51.5	49.2	55.4	62.6
	30	12.8	14.0	15.3	18.9	20.8	23.1	25.8	28.7	32.1	33.5	37.4	42.1	41.8	46.9	52.9	50.6	57.0	64.4
	40	12.9	14.1	15.5	19.1	21.1	23.4	26.2	29.1	32.6	34.0	38.1	42.9	42.6	47.8	54.0	51.7	58.2	65.8

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 and enter table with sea level, 15 deg. C.

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ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Event Adjusted Brake Energy (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	6.3	15.6	24.9	34.0	43.2	52.3	61.6	70.9	80.4
	MAX AUTO	6.1	14.4	22.8	31.3	40.0	49.0	58.2	67.7	77.6
	AUTOBRAKE 4	5.9	13.6	21.2	29.1	37.1	45.5	54.2	63.3	73.0
	AUTOBRAKE 3	5.6	12.7	19.7	26.9	34.2	41.9	49.8	58.3	67.3
	AUTOBRAKE 2	5.3	11.8	18.2	24.8	31.5	38.4	45.6	53.3	61.5
	AUTOBRAKE 1	5.2	11.0	16.8	22.8	28.9	35.2	41.9	48.9	56.4

2 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	5.8	14.7	23.4	32.0	40.4	48.8	57.2	65.6	74.2
	MAX AUTO	4.3	11.6	18.9	26.4	34.1	42.0	50.2	58.9	68.0
	AUTOBRAKE 4	3.6	9.2	15.0	21.1	27.5	34.4	41.7	49.6	58.2
	AUTOBRAKE 3	2.5	6.6	11.1	15.9	21.0	26.7	32.8	39.5	46.8
	AUTOBRAKE 2	1.4	4.4	7.6	11.3	15.3	19.7	24.5	29.8	35.6
	AUTOBRAKE 1	1.0	3.0	5.3	7.8	10.6	13.9	17.5	21.7	26.4

Cooling Time (Minutes)

	EVENT ADJUSTED BRAKE ENERGY (MILLIONS OF FOOT POUNDS)									
EVENT	16 & BELOW	17	18	20	24	28	32	35	36 TO 44	45 & ABOVE
INFLIGHT GEAR DOWN	NO SPECIAL PROCEDURE REQUIRED	1	2	3	4	6	7	7	CAUTION	FUSE PLUG MELT ZONE
GROUND		11	18	26	42	55	66	73		
BTMS	UP TO 2.4	2.4	2.6	2.9	3.4	4.0	4.5	4.9	5.0 TO 6.3	6.3 & 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 10 percent.

For two brakes deactivated, increase brake energy by 20 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. (When inflight with gear extended, the BTMS indications may vary between individual brakes, due to air-stream effects.)

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ENGINE INOP

Initial Max Continuous EPR
Based on .84M, engine bleed for packs on and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20 & ABOVE	1.243	1.234	1.226	1.211	1.192	1.183	1.181	1.175	1.170
15	1.284	1.275	1.263	1.250	1.232	1.222	1.220	1.216	1.212
10	1.327	1.319	1.307	1.288	1.273	1.264	1.262	1.259	1.257
5	1.364	1.366	1.354	1.337	1.314	1.306	1.304	1.302	1.300
0	1.364	1.402	1.406	1.388	1.368	1.355	1.354	1.351	1.349
−5	1.364	1.402	1.439	1.444	1.424	1.412	1.411	1.408	1.406
−10	1.364	1.402	1.439	1.473	1.482	1.471	1.469	1.467	1.465
−15	1.364	1.402	1.439	1.473	1.506	1.523	1.523	1.521	1.518
−20 & BELOW	1.364	1.402	1.439	1.473	1.506	1.523	1.523	1.521	1.518

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ENGINE INOP

Max Continuous EPR
Based on engine bleed for packs on or off and anti-ice off
37000 FT to 29000 FT Pressure Altitudes

37000 FT PRESS ALT								TAT (deg. C)					
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
200	0.63	1.531	1.531	1.531	1.531	1.531	1.489	1.436	1.385	1.341	1.302	1.263	1.233
240	0.74	1.534	1.534	1.534	1.534	1.534	1.534	1.517	1.455	1.402	1.349	1.308	1.268
280	0.86	1.506	1.506	1.506	1.506	1.506	1.506	1.506	1.506	1.469	1.413	1.356	1.304
35000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
200	0.60	1.517	1.517	1.517	1.517	1.517	1.486	1.433	1.385	1.341	1.304	1.267	1.234
240	0.71	1.514	1.514	1.514	1.514	1.514	1.514	1.502	1.444	1.394	1.344	1.305	1.266
280	0.82	1.519	1.519	1.519	1.519	1.519	1.519	1.519	1.519	1.476	1.417	1.362	1.311
33000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
200	0.58	1.499	1.499	1.499	1.499	1.499	1.499	1.447	1.401	1.358	1.323	1.290	1.257
240	0.68	1.491	1.491	1.491	1.491	1.491	1.491	1.491	1.452	1.402	1.355	1.314	1.278
280	0.79	1.489	1.489	1.489	1.489	1.489	1.489	1.489	1.489	1.472	1.414	1.363	1.314
320	0.89	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.389	1.338
31000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10
200	0.55	1.480	1.480	1.480	1.480	1.480	1.461	1.414	1.372	1.332	1.303	1.274	1.245
240	0.66	1.471	1.471	1.471	1.471	1.471	1.471	1.461	1.410	1.365	1.322	1.291	1.260
280	0.76	1.459	1.459	1.459	1.459	1.459	1.459	1.459	1.459	1.415	1.366	1.321	1.281
320	0.85	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.406	1.353	1.306
29000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10	15
200	0.53	1.493	1.493	1.493	1.493	1.493	1.454	1.411	1.369	1.334	1.302	1.270	1.252
240	0.63	1.475	1.475	1.475	1.475	1.475	1.475	1.441	1.395	1.352	1.315	1.286	1.255
280	0.73	1.446	1.446	1.446	1.446	1.446	1.446	1.446	1.426	1.378	1.334	1.293	1.259
320	0.82	1.413	1.413	1.413	1.413	1.413	1.413	1.413	1.413	1.413	1.362	1.317	1.273
360	0.91	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.330	1.284

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	37	35	33	31	29
ENGINE ONLY	–0.004	–0.003	–0.003	–0.003	–0.003
ENGINE & WING*	–0.015	–0.014	–0.013	–0.012	–0.012
ENGINE & WING**	–0.026	–0.024	–0.022	–0.021	–0.020

*** Wing anti-ice on, packs on.**
****Wing anti-ice on, packs off.**

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ENGINE INOP

Max Continuous EPR
Based on engine bleed for packs on or off and anti-ice off
27000 FT to 20000 FT Pressure Altitudes

27000 FT PRESS ALT		TAT (deg. C)											
KIAS	M	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10	15
200	0.51	1.507	1.507	1.507	1.507	1.507	1.499	1.452	1.409	1.368	1.336	1.302	1.268
240	0.60	1.488	1.488	1.488	1.488	1.488	1.488	1.483	1.434	1.391	1.349	1.317	1.286
280	0.70	1.443	1.443	1.443	1.443	1.443	1.443	1.443	1.443	1.398	1.355	1.314	1.279
320	0.79	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.368	1.323	1.282
360	0.88	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.325	1.281
25000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–35	–30	–25	–20	–15	–10	–5	0	5	10	15	20
200	0.49	1.521	1.521	1.521	1.521	1.521	1.496	1.450	1.407	1.369	1.337	1.303	1.278
240	0.58	1.502	1.502	1.502	1.502	1.502	1.502	1.477	1.431	1.389	1.350	1.316	1.282
280	0.67	1.450	1.450	1.450	1.450	1.450	1.450	1.450	1.430	1.384	1.344	1.305	1.273
320	0.76	1.386	1.386	1.386	1.386	1.386	1.386	1.386	1.386	1.380	1.335	1.296	1.257
360	0.85	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.288	1.249
24000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–35	–30	–25	–20	–15	–10	–5	0	5	10	15	20
200	0.48	1.523	1.523	1.523	1.523	1.523	1.512	1.465	1.420	1.379	1.346	1.312	1.278
240	0.57	1.502	1.502	1.502	1.502	1.502	1.502	1.490	1.443	1.399	1.357	1.324	1.289
280	0.66	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.447	1.400	1.358	1.316	1.283
320	0.75	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.350	1.309	1.269
360	0.83	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.300	1.259
22000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–30	–25	–20	–15	–10	–5	0	5	10	15	20	25
200	0.46	1.523	1.523	1.523	1.523	1.523	1.496	1.449	1.404	1.364	1.330	1.295	1.271
240	0.55	1.505	1.505	1.505	1.505	1.505	1.505	1.473	1.426	1.380	1.341	1.307	1.273
280	0.63	1.463	1.463	1.463	1.463	1.463	1.463	1.463	1.433	1.387	1.342	1.302	1.269
320	0.72	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.385	1.340	1.297	1.255
360	0.80	1.336	1.336	1.336	1.336	1.336	1.336	1.336	1.336	1.336	1.329	1.287	1.246
20000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–30	–25	–20	–15	–10	–5	0	5	10	15	20	25
200	0.44	1.519	1.519	1.519	1.519	1.519	1.519	1.477	1.429	1.383	1.346	1.311	1.275
240	0.53	1.512	1.512	1.512	1.512	1.512	1.512	1.509	1.461	1.413	1.366	1.329	1.294
280	0.61	1.469	1.469	1.469	1.469	1.469	1.469	1.469	1.465	1.417	1.368	1.321	1.287
320	0.69	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.376	1.329	1.283
360	0.77	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.317	1.274

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	27	25	24	22	20
ENGINE ONLY	–0.004	–0.005	–0.006	–0.007	–0.006
ENGINE & WING*	–0.012	–0.012	–0.012	–0.013	–0.012
ENGINE & WING**	–0.019	–0.019	–0.019	–0.019	–0.018

*** Wing anti-ice on, packs on.**
****Wing anti-ice on, packs off.**

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ENGINE INOP

Max Continuous EPR
Based on engine bleed for packs on or off and anti-ice off
18000 FT to 5000 FT Pressure Altitudes

18000 FT PRESS ALT								TAT (deg. C)					
KIAS	M	–25	–20	–15	–10	–5	0	5	10	15	20	25	30
200	0.42	1.511	1.511	1.511	1.511	1.511	1.500	1.455	1.411	1.369	1.337	1.305	1.275
240	0.51	1.515	1.515	1.515	1.515	1.515	1.515	1.495	1.449	1.403	1.362	1.328	1.293
280	0.59	1.472	1.472	1.472	1.472	1.472	1.472	1.472	1.447	1.400	1.354	1.313	1.282
320	0.67	1.424	1.424	1.424	1.424	1.424	1.424	1.424	1.424	1.402	1.356	1.311	1.269
360	0.75	1.362	1.362	1.362	1.362	1.362	1.362	1.362	1.362	1.362	1.349	1.305	1.262
16000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–25	–20	–15	–10	–5	0	5	10	15	20	25	30
200	0.41	1.504	1.504	1.504	1.504	1.504	1.504	1.479	1.438	1.396	1.360	1.332	1.304
240	0.49	1.511	1.511	1.511	1.511	1.511	1.511	1.511	1.477	1.432	1.389	1.354	1.322
280	0.57	1.474	1.474	1.474	1.474	1.474	1.474	1.474	1.474	1.432	1.387	1.344	1.310
320	0.64	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.384	1.340	1.296
360	0.72	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.337	1.294
14000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–20	–15	–10	–5	0	5	10	15	20	25	30	35
200	0.39	1.488	1.488	1.488	1.488	1.488	1.488	1.452	1.413	1.373	1.343	1.315	1.288
240	0.47	1.491	1.491	1.491	1.491	1.491	1.491	1.484	1.444	1.402	1.361	1.330	1.298
280	0.54	1.463	1.463	1.463	1.463	1.463	1.463	1.463	1.449	1.407	1.365	1.324	1.293
320	0.62	1.417	1.417	1.417	1.417	1.417	1.417	1.417	1.417	1.400	1.357	1.315	1.275
360	0.69	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.354	1.313	1.272
12000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–15	–10	–5	0	5	10	15	20	25	30	35	40
200	0.38	1.475	1.475	1.475	1.475	1.475	1.468	1.431	1.393	1.355	1.329	1.302	1.276
240	0.45	1.473	1.473	1.473	1.473	1.473	1.473	1.453	1.415	1.375	1.339	1.308	1.277
280	0.52	1.452	1.452	1.452	1.452	1.452	1.452	1.452	1.424	1.385	1.344	1.308	1.275
320	0.60	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.373	1.333	1.292	1.257
360	0.67	1.359	1.359	1.359	1.359	1.359	1.359	1.359	1.359	1.359	1.327	1.288	1.248
10000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–15	–10	–5	0	5	10	15	20	25	30	35	40
200	0.36	1.462	1.462	1.462	1.462	1.462	1.462	1.444	1.408	1.371	1.338	1.311	1.284
240	0.43	1.452	1.452	1.452	1.452	1.452	1.452	1.452	1.421	1.383	1.345	1.313	1.283
280	0.51	1.438	1.438	1.438	1.438	1.438	1.438	1.438	1.433	1.397	1.358	1.318	1.286
320	0.58	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.382	1.344	1.305	1.265
360	0.65	1.344	1.344	1.344	1.344	1.344	1.344	1.344	1.344	1.344	1.332	1.295	1.258
5000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–10	–5	0	5	10	15	20	25	30	35	40	45
200	0.33	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.399	1.367	1.334	1.306	1.282
240	0.40	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.394	1.361	1.328	1.295	1.269
280	0.46	1.382	1.382	1.382	1.382	1.382	1.382	1.382	1.382	1.365	1.330	1.295	1.263
320	0.53	1.349	1.349	1.349	1.349	1.349	1.349	1.349	1.349	1.349	1.323	1.288	1.253
360	0.59	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.270	1.237

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	18	16	14	12	10	5
ENGINE ONLY	–0.010	–0.013	–0.015	–0.015	–0.015	–0.010
ENGINE & WING*	–0.015	–0.018	–0.019	–0.019	–0.018	–0.012
ENGINE & WING**	–0.021	–0.024	–0.024	–0.023	–0.022	–0.014

*** Wing anti-ice on, packs on.**
****Wing anti-ice on, packs off.**

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ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFTDOWN	LEVEL OFF		ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
300	290	282	17500	16100	14600
280	271	273	19400	18000	16600
260	252	264	21300	20000	18600
240	232	253	23300	22100	20700
220	213	243	25400	24200	22900
200	194	231	27400	26200	25100
180	174	219	29500	28300	27200
160	154	206	32200	30600	29500

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MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability
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
136	127	119	112	106	100	95	90	86	82	79
272	254	238	224	211	200	190	181	173	165	158
407	380	356	335	317	300	285	271	259	248	238
541	505	474	447	422	400	380	362	346	331	317
675	631	592	558	527	500	475	453	433	414	397
808	755	709	669	633	600	571	544	520	498	477
940	880	827	780	738	700	666	635	607	581	558
1072	1004	944	890	843	800	761	726	694	665	638
1204	1128	1061	1001	948	900	857	817	782	749	719
1335	1251	1177	1112	1053	1000	952	909	869	833	799
1467	1375	1294	1222	1158	1100	1048	1000	957	917	880
1598	1499	1411	1333	1263	1200	1143	1091	1044	1001	961
1729	1622	1527	1443	1368	1300	1239	1183	1132	1085	1042
1860	1746	1644	1554	1473	1400	1334	1274	1219	1169	1122
1992	1869	1761	1664	1578	1500	1429	1365	1306	1253	1203
2123	1993	1878	1775	1683	1600	1525	1456	1394	1336	1284
2255	2117	1995	1886	1788	1700	1620	1548	1481	1420	1364
2388	2241	2112	1997	1893	1800	1716	1639	1568	1504	1445

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG) WEIGHT AT START OF DRIFTDOWN (1000 KG)								TIME (HRS:MIN)
	160	180	200	220	240	260	280	300	
100	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	0:16
200	2.5	2.6	2.8	2.9	3.1	3.2	3.3	3.4	0:32
300	3.8	4.1	4.4	4.7	5.0	5.2	5.5	5.7	0:47
400	5.1	5.6	6.0	6.5	6.9	7.4	7.8	8.2	1:03
500	6.4	7.0	7.6	8.2	8.9	9.4	10.0	10.6	1:18
600	7.7	8.4	9.1	9.9	10.7	11.4	12.1	12.9	1:33
700	8.9	9.8	10.6	11.5	12.5	13.3	14.2	15.1	1:47
800	10.1	11.1	12.1	13.1	14.2	15.2	16.3	17.3	2:02
900	11.3	12.5	13.6	14.7	16.0	17.2	18.3	19.5	2:16
1000	12.5	13.8	15.1	16.4	17.7	19.1	20.4	21.6	2:31
1100	13.6	15.1	16.5	18.0	19.5	20.9	22.4	23.8	2:45
1200	14.8	16.4	18.0	19.5	21.2	22.8	24.4	25.9	2:59
1300	16.0	17.7	19.4	21.1	22.9	24.7	26.4	28.1	3:14
1400	17.1	19.0	20.8	22.7	24.6	26.5	28.4	30.2	3:28
1500	18.3	20.3	22.3	24.2	26.3	28.3	30.3	32.3	3:42
1600	19.4	21.6	23.7	25.8	28.0	30.1	32.3	34.4	3:57
1700	20.6	22.8	25.1	27.3	29.7	32.0	34.2	36.5	4:11
1800	21.7	24.1	26.5	28.8	31.3	33.7	36.2	38.5	4:26

Includes APU fuel burn.
Driftdown at optimum driftdown speed and cruise at LRC speed.

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MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
300	15000	12700	10300
290	15700	13600	11200
280	16300	14400	12000
270	17000	15300	13000
260	18100	16500	14600
250	19200	17600	15800
240	20300	18800	17000
230	21400	20000	18200
220	22500	21100	19400
210	23600	22300	20700
200	24800	23500	22000
190	26000	24800	23400
180	27300	26000	24800
170	28600	27300	26100
160	30000	28600	27400

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MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)							
		10	15	17	19	21	23	25	27
300	EPR	1.259	1.366						
	MACH	.585	.641						
	KIAS	325	325						
	FF/ENG	8919	9092						
280	EPR	1.236	1.333	1.383					
	MACH	.585	.641	.665					
	KIAS	325	325	325					
	FF/ENG	8548	8681	8780					
260	EPR	1.213	1.297	1.341	1.398				
	MACH	.577	.627	.651	.680				
	KIAS	321	318	318	320				
	FF/ENG	8069	8080	8152	8331				
240	EPR	1.188	1.260	1.298	1.344	1.402			
	MACH	.558	.606	.627	.652	.681			
	KIAS	310	307	306	306	308			
	FF/ENG	7412	7389	7412	7482	7658			
220	EPR	1.164	1.226	1.258	1.297	1.343	1.402		
	MACH	.538	.585	.605	.626	.651	.681		
	KIAS	298	296	294	294	294	296		
	FF/ENG	6764	6736	6728	6748	6810	6972		
200	EPR	1.141	1.195	1.223	1.254	1.293	1.339	1.398	
	MACH	.516	.562	.581	.601	.623	.648	.677	
	KIAS	286	284	283	282	281	281	282	
	FF/ENG	6126	6094	6085	6077	6089	6140	6273	
180	EPR	1.119	1.166	1.189	1.217	1.247	1.284	1.330	1.386
	MACH	.492	.537	.556	.576	.596	.617	.642	.671
	KIAS	272	271	270	269	268	267	267	268
	FF/ENG	5490	5462	5451	5443	5434	5438	5475	5573
160	EPR	1.098	1.139	1.158	1.181	1.207	1.237	1.272	1.316
	MACH	.466	.510	.529	.548	.568	.588	.609	.633
	KIAS	258	257	256	256	255	254	253	252
	FF/ENG	4862	4838	4827	4817	4809	4800	4796	4817

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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
287	264	244	227	213	200	191	182	174	167	160
576	530	489	455	426	400	381	364	348	334	321
865	796	735	684	640	600	572	546	522	501	482
1156	1064	982	913	853	800	763	729	698	669	643
1448	1332	1229	1142	1067	1000	953	910	871	835	803
1742	1602	1477	1372	1281	1200	1144	1092	1045	1002	963
2036	1871	1725	1602	1495	1400	1335	1274	1219	1168	1122
2332	2141	1973	1831	1709	1600	1525	1456	1392	1334	1282
2629	2414	2223	2062	1924	1800	1715	1637	1565	1500	1441

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	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	3.4	0:40	3.0	0:38	2.6	0:37	2.4	0:36	2.1	0:34
400	7.1	1:17	6.5	1:13	6.0	1:10	5.5	1:07	5.2	1:03
600	10.9	1:54	10.0	1:48	9.3	1:43	8.7	1:38	8.2	1:33
800	14.5	2:31	13.5	2:24	12.6	2:17	11.8	2:10	11.2	2:02
1000	18.2	3:09	16.9	2:59	15.8	2:51	14.9	2:42	14.2	2:32
1200	21.8	3:47	20.3	3:35	19.1	3:25	17.9	3:14	17.1	3:02
1400	25.3	4:26	23.7	4:12	22.2	3:59	20.9	3:47	20.0	3:33
1600	28.8	5:05	27.0	4:48	25.4	4:33	23.9	4:19	22.9	4:03
1800	32.3	5:44	30.3	5:25	28.5	5:08	26.9	4:52	25.7	4:34

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)							
	160	180	200	220	240	260	280	300
2	–0.1	–0.1	0.0	0.1	0.3	0.4	0.6	0.7
4	–0.4	–0.2	0.0	0.4	0.7	1.1	1.5	1.9
6	–0.6	–0.3	0.0	0.6	1.2	1.8	2.4	3.1
8	–0.9	–0.4	0.0	0.8	1.6	2.5	3.4	4.3
10	–1.1	–0.5	0.0	1.0	2.1	3.2	4.3	5.4
12	–1.3	–0.7	0.0	1.2	2.5	3.8	5.2	6.6
14	–1.6	–0.8	0.0	1.4	2.9	4.5	6.1	7.7
16	–1.8	–0.9	0.0	1.6	3.3	5.1	6.9	8.8
18	–2.0	–1.0	0.0	1.8	3.7	5.7	7.8	10.0
20	–2.3	–1.1	0.0	2.0	4.1	6.3	8.6	11.1
22	–2.5	–1.2	0.0	2.2	4.5	6.9	9.5	12.1
24	–2.8	–1.4	0.0	2.4	4.9	7.5	10.3	13.2
26	–3.0	–1.5	0.0	2.5	5.2	8.1	11.1	14.3
28	–3.2	–1.6	0.0	2.7	5.6	8.7	11.9	15.4
30	–3.5	–1.7	0.0	2.9	5.9	9.2	12.7	16.4
32	–3.7	–1.8	0.0	3.0	6.2	9.7	13.5	17.4
34	–3.9	–2.0	0.0	3.1	6.6	10.3	14.2	18.5

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ENGINE INOP

MAX CONTINUOUS THRUST

Holding
Flaps up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
300	EPR	1.163	1.200	1.271	1.363		
	KIAS	260	260	262	277		
	FF/ENG	8080	8090	8160	8510		
280	EPR	1.147	1.179	1.242	1.327	1.460	
	KIAS	251	251	253	261	286	
	FF/ENG	7480	7480	7530	7730	8420	
260	EPR	1.131	1.159	1.215	1.294	1.401	
	KIAS	242	242	243	246	266	
	FF/ENG	6890	6900	6910	7010	7430	
240	EPR	1.116	1.141	1.189	1.259	1.352	
	KIAS	232	233	234	235	247	
	FF/ENG	6310	6310	6320	6370	6620	
220	EPR	1.102	1.124	1.165	1.225	1.310	1.437
	KIAS	222	223	224	224	230	251
	FF/ENG	5750	5740	5740	5760	5880	6350
200	EPR	1.088	1.106	1.142	1.193	1.269	1.370
	KIAS	215	215	215	215	215	229
	FF/ENG	5230	5190	5190	5180	5230	5480
180	EPR	1.075	1.090	1.119	1.161	1.225	1.316
	KIAS	208	208	208	208	208	209
	FF/ENG	4840	4680	4650	4650	4670	4750
160	EPR	1.061	1.074	1.097	1.133	1.183	1.259
	KIAS	203	203	203	203	203	203
	FF/ENG	4360	4310	4160	4160	4160	4180
140	EPR	1.047	1.058	1.076	1.105	1.146	1.208
	KIAS	203	203	203	203	203	203
	FF/ENG	3960	3910	3760	3740	3780	3750

This table includes 5% additional fuel for holding in a racetrack pattern.

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ADVISORY INFORMATION

Gear Down Landing Rate of Climb Available
Flaps 20

TAT (deg. C)	RATE OF CLIMB (FT/MIN) PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
52	550	460				
50	600	510	380			
48	650	550	420			
46	690	600	470	310		
44	720	650	510	340		
42	760	690	550	370	230	
40	790	730	580	400	260	
38	820	760	610	440	290	150
36	840	800	650	470	320	180
34	840	830	680	500	350	200
32	850	850	710	530	380	230
30	850	850	730	550	410	260
20	870	870	760	620	480	340
10	890	890	770	630	490	360
0	900	900	790	650	500	370
–20	940	940	820	670	520	390
–40	990	990	860	710	550	400

Rate of climb capability shown is valid for 200,000 kg, gear down at VREF 20+5.
Decrease rate of climb 40 ft/min per 5,000 kg greater than 200,000 kg.
Increase rate of climb 60 ft/min per 5,000 kg less than 200,000 kg.

Flaps 30

TAT (deg. C)	RATE OF CLIMB (FT/MIN) PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
52	50	–50				
50	90	–10	–140			
48	130	30	–100			
46	170	80	–60	–220		
44	200	120	–20	–190		
42	230	160	20	–160	–290	
40	260	190	50	–130	–270	
38	290	230	80	–100	–240	–380
36	310	260	110	–70	–220	–360
34	310	290	130	–40	–190	–340
32	320	310	160	–20	–170	–310
30	320	310	180	10	–140	–290
20	320	320	200	60	–80	–220
10	330	330	210	70	–80	–210
0	340	330	210	70	–80	–210
–20	360	350	220	70	–80	–210
–40	380	370	240	80	–80	–220

Rate of climb capability shown is valid for 200,000 kg, gear down at VREF 30+5.
Decrease rate of climb 40 ft/min per 5,000 kg greater than 200,000 kg.
Increase rate of climb 60 ft/min per 5,000 kg less than 200,000 kg.

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ALTERNATE MODE EEC

Limit Weight

PERFORMANCE LIMIT	ALTERNATE MODE EEC LIMIT WEIGHT (1000 KG)									
	PRIMARY MODE PERFORMANCE LIMIT WEIGHT (1000 KG)									
	140	160	180	200	220	240	260	280	300	320
FIELD	134.5	153.0	171.5	190.0	208.5	227.0	245.5	264.0	282.5	301.0
CLIMB	127.9	146.2	164.5	182.8	201.1	219.4	237.6	255.9	274.2	292.5
OBSTACLE	130.0	148.1	166.2	184.3	202.4	220.5	238.6	256.7	274.8	292.9
NET LEVEL OFF WEIGHT	130.0	148.4	166.9	185.3	203.8	222.2	240.7	259.1	277.5	296.0
LANDING CLIMB	127.2	145.6	164.1	182.5	200.9	219.4	237.8	256.2	274.6	293.1

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ALTERNATE MODE EEC

Takeoff Speed Adjustment

TAKEOFF SPEEDS	TAKEOFF SPEED ADJUSTMENT (KTS)
V1	+1
VR	0
V2	0

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ALTERNATE MODE EEC

Max Takeoff %N1

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)										
deg. C	deg. F	–2000	0	1000	2000	3000	4000	5000	6000	7000	8000	8400
55	131	92.4	92.7	92.9	93.1	93.3	93.4	93.4	93.4	93.3	93.2	93.1
50	122	93.4	93.9	93.9	93.9	93.9	94.0	94.1	94.1	94.0	94.0	93.9
45	113	94.4	95.0	95.0	95.0	94.8	94.7	94.7	94.7	94.7	94.6	94.6
40	104	94.9	96.3	96.1	96.1	95.7	95.4	95.3	95.3	95.3	95.3	95.2
35	95	95.4	96.9	97.0	96.9	96.5	96.1	96.1	96.0	96.0	96.0	96.0
30	86	94.9	98.0	97.8	97.8	97.4	97.0	96.9	96.9	96.8	96.8	96.7
25	77	94.1	97.4	97.8	98.2	97.9	97.6	97.8	97.7	97.6	97.6	97.6
20	68	93.3	96.6	97.0	97.4	97.6	97.8	97.7	97.8	97.9	97.8	97.8
15	59	92.5	95.7	96.1	96.6	96.8	96.9	97.2	97.4	97.8	98.0	97.9
10	50	91.7	94.9	95.3	95.7	95.9	96.1	96.3	96.5	96.9	97.3	97.5
5	41	90.9	94.0	94.4	94.9	95.1	95.2	95.5	95.7	96.1	96.5	96.6
0	32	90.1	93.2	93.6	94.0	94.2	94.4	94.6	94.8	95.2	95.6	95.8
–10	14	88.4	91.5	91.9	92.3	92.5	92.6	92.9	93.1	93.5	93.8	94.0
–20	–4	86.7	89.7	90.1	90.5	90.7	90.9	91.1	91.3	91.7	92.0	92.2
–30	–22	85.0	87.9	88.3	88.7	88.9	89.0	89.3	89.5	89.8	90.2	90.3
–40	–40	83.2	86.1	86.5	86.9	87.0	87.2	87.4	87.6	88.0	88.3	88.5
–50	–58	81.4	84.2	84.6	85.0	85.1	85.3	85.5	85.7	86.1	86.4	86.5

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
PACKS OFF	0.1	0.2	0.2	0.2	0.2	0.2
WING ANTI-ICE ON	–0.1	–0.2	–0.2	–0.3	–0.3	–0.3

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ALTERNATE MODE EEC

Max Climb %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (FT)/SPEED (KIAS OR MACH)									
	0	5000	10000	15000	20000	25000	30000	35000	40000	43000
	310	310	310	310	310	310	310	.84	.84	.84
60	83.9	84.6	86.7	89.4	92.2	93.4	94.5	96.1	96.3	96.0
50	85.4	86.2	86.7	88.1	90.8	92.0	93.1	94.7	94.9	94.5
40	86.8	87.5	88.0	88.9	89.8	90.6	91.6	93.2	93.4	93.1
30	85.9	88.8	89.4	90.2	91.0	90.8	90.5	91.7	91.9	91.6
20	84.5	87.3	89.8	91.3	92.1	91.8	91.9	90.9	90.3	90.0
15	83.7	86.6	89.1	91.7	92.6	92.5	92.3	91.5	91.1	90.9
10	83.0	85.8	88.3	90.9	93.2	93.1	92.9	92.1	91.7	91.5
5	82.3	85.1	87.5	90.1	92.8	93.9	93.6	92.5	92.2	92.1
0	81.5	84.3	86.7	89.3	92.0	93.9	94.5	93.3	92.8	92.7
–5	80.8	83.5	85.9	88.5	91.1	93.0	94.6	94.3	93.8	93.7
–10	80.0	82.7	85.1	87.7	90.3	92.1	93.7	95.4	94.9	94.8
–15	79.3	81.9	84.3	86.8	89.4	91.2	92.9	95.4	96.0	95.9
–20	78.5	81.1	83.5	86.0	88.5	90.4	91.9	94.5	95.0	94.9
–25	77.7	80.3	82.7	85.1	87.7	89.5	91.0	93.5	94.1	94.0
–30	76.9	79.5	81.8	84.3	86.8	88.5	90.1	92.6	93.1	93.0
–35	76.1	78.7	81.0	83.4	85.9	87.6	89.2	91.6	92.2	92.1
–40	75.3	77.9	80.1	82.5	85.0	86.7	88.2	90.7	91.2	91.1

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)									
	0	5000	10000	15000	20000	25000	30000	35000	40000	43000
ENGINE ANTI-ICE ON	–0.4	–0.5	–0.7	–0.6	–0.3	–0.2	–0.1	–0.1	–0.1	–0.2
ENGINE & WING ANTI-ICE ON	–0.5	–0.6	–0.8	–0.8	–0.5	–0.5	–0.4	–0.5	–0.6	–0.7

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ALTERNATE MODE EEC

Max Cruise %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (FT)									
	25000	27000	29000	31000	33000	35000	37000	39000	41000	43000
25	89.6	89.4	89.5	89.9	89.2	89.3	89.6	89.5	89.3	89.1
20	90.1	90.0	90.1	90.4	89.9	89.2	88.9	88.8	88.6	88.4
15	90.7	90.5	90.6	90.9	90.5	89.9	89.5	89.5	89.3	89.2
10	91.1	91.0	91.1	91.4	90.9	90.4	90.1	90.1	90.0	89.9
5	91.7	91.5	91.6	91.9	91.4	90.8	90.6	90.5	90.5	90.4
0	91.5	91.9	92.2	92.5	92.0	91.4	91.1	91.0	91.0	90.9
–5	90.7	91.1	91.8	92.6	92.7	92.1	91.8	91.7	91.7	91.6
–10	89.8	90.2	91.0	91.7	92.6	92.9	92.6	92.5	92.5	92.4
–15	89.0	89.4	90.1	90.8	91.7	92.7	93.2	93.1	93.1	93.0
–20	88.1	88.5	89.2	89.9	90.8	91.8	92.2	92.2	92.2	92.1
–25	87.2	87.6	88.3	89.0	89.9	90.9	91.3	91.3	91.3	91.2
–30	86.3	86.7	87.5	88.1	89.0	89.9	90.4	90.4	90.3	90.3
–35	85.4	85.8	86.5	87.2	88.1	89.0	89.5	89.4	89.4	89.3

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)				
	25000	30000	35000	40000	43000
ENGINE ANTI-ICE ON	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING ANTI-ICE ON	–0.4	–0.4	–0.5	–0.5	–0.6

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ALTERNATE MODE EEC

Go-Around %N1

Based on engine bleed for packs on, engine anti-ice on or off, wing anti-ice off

AIRPORT OAT		TAT	PRESSURE ALTITUDE (FT)											
deg. C	deg. F	(deg. C)	–2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
51	124	55	93.4	93.9	93.9	93.8	94.0	94.2	94.3	94.3	94.3	94.2	94.1	94.1
46	115	50	94.4	95.0	95.1	95.1	94.9	94.8	94.9	95.0	94.9	94.9	94.9	94.8
41	106	45	95.1	96.2	96.1	96.1	95.8	95.6	95.6	95.6	95.5	95.5	95.5	95.5
36	97	40	95.5	97.0	97.0	96.9	96.6	96.2	96.2	96.2	96.1	96.1	96.0	96.0
31	88	35	95.3	97.7	97.7	97.7	97.3	97.0	96.9	96.9	96.8	96.8	96.8	96.7
26	79	30	94.6	97.3	98.0	98.4	98.0	97.7	97.7	97.6	97.6	97.6	97.5	97.5
21	70	25	93.8	96.5	97.2	97.8	98.1	98.3	98.1	98.2	98.2	98.1	98.0	98.0
17	62	20	93.0	95.7	96.4	97.0	97.2	97.5	97.8	98.0	98.3	98.3	98.1	97.9
12	53	15	92.2	94.9	95.5	96.1	96.4	96.7	96.9	97.1	97.6	98.0	98.3	98.3
7	45	10	91.4	94.0	94.7	95.3	95.6	95.9	96.1	96.3	96.7	97.1	97.5	97.9
2	36	5	90.6	93.2	93.9	94.4	94.7	95.0	95.2	95.4	95.9	96.3	96.6	97.0
–3	27	0	89.8	92.4	93.0	93.6	93.9	94.1	94.4	94.6	95.0	95.4	95.8	96.1
–13	9	–10	88.1	90.7	91.3	91.9	92.1	92.4	92.6	92.8	93.3	93.6	94.0	94.3
–23	–9	–20	86.4	88.9	89.5	90.1	90.4	90.6	90.8	91.0	91.5	91.8	92.2	92.5
–33	–27	–30	84.7	87.1	87.8	88.3	88.6	88.8	89.0	89.2	89.6	90.0	90.3	90.7
–43	–45	–40	82.9	85.3	85.9	86.5	86.7	87.0	87.2	87.4	87.8	88.1	88.5	88.8
–53	–63	–50	81.1	83.5	84.1	84.6	84.8	85.1	85.3	85.5	85.9	86.2	86.5	86.9

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)						
	–2000	0	2000	4000	6000	8000	10000
PACKS OFF	0.1	0.1	0.2	0.2	0.2	0.2	0.2
1 PACK ON	–0.1	–0.1	–0.2	–0.2	–0.2	–0.2	–0.2
WING ANTI-ICE ON	–0.1	–0.2	–0.2	–0.3	–0.3	–0.3	–0.3

UNCONTROLLED IF DOWNLOADED OR PRINTED

ALTERNATE MODE EEC ENGINE INOP

Initial Max Continuous %N1

Based on .84M, engine bleed for packs on or off and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	92.7	92.4	92.1	91.6	90.9	90.5	90.5	90.2	90.0
15	93.2	92.9	92.5	92.1	91.5	91.2	91.1	91.0	90.9
10	93.7	93.5	93.1	92.5	92.1	91.8	91.7	91.6	91.5
5	94.1	94.1	93.7	93.2	92.5	92.3	92.2	92.1	92.1
0	93.2	94.4	94.6	94.0	93.3	92.9	92.9	92.8	92.8
–5	92.4	93.6	94.8	94.9	94.3	93.9	93.9	93.8	93.7
–10	91.5	92.7	93.9	95.1	95.4	95.0	95.0	94.9	94.8
–15	90.6	91.8	93.0	94.2	95.4	96.0	96.0	95.9	95.9
–20	89.7	90.9	92.1	93.3	94.5	95.1	95.1	95.0	94.9
–25	88.9	90.0	91.2	92.3	93.6	94.1	94.1	94.1	94.0
–30	88.0	89.1	90.3	91.4	92.6	93.2	93.2	93.1	93.0
–35	87.0	88.2	89.3	90.5	91.6	92.2	92.2	92.1	92.1
–40	86.1	87.2	88.4	89.5	90.7	91.3	91.2	91.2	91.1

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
ENGINE ONLY	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.2	–0.2
ENGINE & WING*	–0.4	–0.4	–0.4	–0.4	–0.5	–0.5	–0.6	–0.6	–0.7
ENGINE & WING**	–0.6	–0.6	–0.7	–0.8	–0.9	–0.9	–1.0	–1.1	–1.2

*Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

UNCONTROLLED IF DOWNLOADED OR PRINTED
DRAFT

ALTERNATE MODE EEC
ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
320 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	93.6	94.2	94.1	93.7	93.4	92.7	92.1	91.6	91.2	91.1	90.9	91.0	91.0	90.5	90.8	91.9
25	92.9	95.0	95.0	94.6	94.3	93.5	92.9	92.2	91.7	91.6	91.6	91.7	91.7	91.3	91.5	92.3
20	92.1	94.6	95.6	95.6	95.3	94.5	93.8	93.0	92.3	92.1	92.0	92.2	92.2	91.8	92.0	92.7
15	91.3	93.8	94.8	95.5	96.3	95.6	94.9	93.8	93.0	92.7	92.6	92.7	92.7	92.3	92.5	93.2
10	90.5	93.0	94.0	94.7	95.5	95.7	96.0	94.8	93.7	93.3	93.2	93.3	93.2	92.9	93.0	93.8
5	89.7	92.2	93.1	93.9	94.6	94.9	95.1	94.8	94.5	94.1	94.0	94.0	93.8	93.5	93.7	94.6
0	88.9	91.3	92.3	93.0	93.8	94.0	94.3	93.9	93.6	93.5	94.1	94.8	94.6	94.3	94.5	95.4
–5	88.1	90.5	91.4	92.2	92.9	93.1	93.4	93.1	92.8	92.7	93.2	93.9	94.4	94.7	95.5	95.9
–10	87.2	89.6	90.6	91.3	92.0	92.3	92.5	92.2	91.9	91.8	92.3	93.0	93.5	93.8	94.6	95.0
–15	86.4	88.8	89.7	90.4	91.2	91.4	91.7	91.3	91.0	90.9	91.4	92.2	92.6	92.9	93.7	94.1
–20	85.6	87.9	88.8	89.6	90.3	90.5	90.8	90.4	90.1	90.0	90.6	91.3	91.7	92.0	92.8	93.2
–25	84.7	87.1	88.0	88.7	89.4	89.6	89.9	89.5	89.2	89.1	89.7	90.4	90.8	91.1	91.9	92.2
–30	83.9	86.2	87.1	87.8	88.5	88.7	89.0	88.6	88.3	88.2	88.7	89.4	89.9	90.2	91.0	91.3
–35	83.0	85.3	86.2	86.9	87.6	87.8	88.0	87.7	87.4	87.3	87.8	88.5	89.0	89.2	90.0	90.4
–40	82.1	84.4	85.3	85.9	86.6	86.8	87.1	86.8	86.5	86.4	86.9	87.6	88.0	88.3	89.1	89.4

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.4	–0.6	–0.6	–0.6	–0.6	–0.4	–0.3	–0.3	–0.2	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.5	–0.8	–0.8	–0.8	–0.8	–0.6	–0.5	–0.5	–0.5	–0.4	–0.4	–0.4	–0.4	–0.4	–0.5	–0.4
ENGINE & WING**	–0.6	–0.9	–1.0	–1.0	–1.0	–0.9	–0.8	–0.8	–0.7	–0.7	–0.7	–0.7	–0.7	–0.8	–0.8	–0.8

Wing anti-ice on, packs on.
***Wing anti-ice on, packs off.**

280 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	93.2	93.6	93.4	92.9	92.6	91.8	91.1	90.7	90.3	90.1	89.9	90.0	90.4	91.1	91.8	91.8
25	93.2	94.5	94.3	93.8	93.2	92.3	91.7	91.4	91.1	90.8	90.1	89.6	89.6	90.3	91.1	91.0
20	92.4	95.4	95.3	94.8	94.3	93.2	92.2	91.9	91.5	91.4	90.8	90.3	90.2	90.4	90.5	90.6
15	91.7	94.8	95.8	95.9	95.5	94.3	93.3	92.6	92.0	91.8	91.2	90.9	90.8	91.0	91.2	91.3
10	90.9	94.0	94.9	95.8	96.6	95.6	94.6	93.6	92.8	92.5	91.8	91.3	91.3	91.6	91.8	91.9
5	90.0	93.1	94.1	94.9	95.7	95.8	95.8	94.8	93.7	93.3	92.5	92.0	91.9	92.1	92.3	92.3
0	89.2	92.3	93.3	94.1	94.8	95.0	95.2	95.2	94.9	94.3	93.4	92.9	92.7	92.9	93.1	93.0
–5	88.4	91.4	92.4	93.2	94.0	94.1	94.3	94.4	94.4	94.3	94.4	93.9	93.7	93.9	94.1	94.0
–10	87.6	90.6	91.5	92.3	93.1	93.2	93.4	93.5	93.5	93.4	93.5	93.8	94.5	95.0	95.2	95.0
–15	86.8	89.7	90.7	91.5	92.2	92.3	92.5	92.6	92.6	92.5	92.6	92.9	93.6	94.7	95.8	95.5
–20	85.9	88.8	89.8	90.6	91.3	91.4	91.6	91.7	91.7	91.6	91.7	92.0	92.7	93.8	94.9	94.5
–25	85.1	88.0	88.9	89.7	90.4	90.5	90.7	90.8	90.8	90.7	90.8	91.1	91.8	92.8	93.9	93.6
–30	84.2	87.1	88.0	88.8	89.5	89.6	89.8	89.9	89.9	89.8	89.9	90.2	90.8	91.9	93.0	92.6
–35	83.3	86.2	87.1	87.8	88.6	88.7	88.8	88.9	88.9	88.9	89.0	89.3	89.9	91.0	92.0	91.7
–40	82.4	85.3	86.2	86.9	87.6	87.7	87.9	88.0	88.0	87.9	88.0	88.3	89.0	90.0	91.0	90.7

UNCONTROLLED IF DOWNLOADED OR PRINTED
DRAFT

ALTERNATE MODE EEC
ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
280 KIAS
%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	0.4	–0.7	–0.7	–0.7	–0.6	–0.4	–0.3	–0.3	–0.3	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.5	–0.8	–0.9	–0.9	–0.8	–0.7	–0.5	–0.6	–0.5	–0.5	–0.5	–0.5	–0.4	–0.4	–0.5	–0.5
ENGINE & WING**	–0.6	–1.0	–1.0	–1.1	–1.1	–0.9	–0.8	–0.8	–0.8	–0.8	–0.8	–0.8	–0.8	–0.7	–0.9	–1.0

**Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

240 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	92.1	91.9	91.9	91.8	91.8	90.7	89.4	89.4	90.0	90.4	90.5	90.3	90.3	90.6	91.1	91.6
25	92.8	92.9	92.8	92.4	92.4	91.5	90.4	89.8	89.5	89.6	89.7	89.6	89.6	89.8	90.3	90.8
20	92.3	93.8	93.7	93.4	93.1	92.2	91.2	90.6	90.3	90.1	89.4	88.8	88.8	89.0	89.6	90.0
15	91.5	94.4	94.7	94.5	94.3	93.2	91.9	91.3	90.9	90.8	90.0	89.2	88.5	88.3	88.8	89.3
10	90.7	93.6	94.9	95.6	95.6	94.5	93.1	92.1	91.5	91.4	90.4	89.6	89.1	88.8	88.7	89.1
5	89.9	92.7	94.0	95.1	96.4	95.9	94.6	93.3	92.4	92.1	90.9	89.9	89.5	89.4	89.4	89.8
0	89.1	91.9	93.2	94.3	95.5	96.0	95.9	94.6	93.5	93.1	91.7	90.5	89.8	89.9	90.0	90.4
–5	88.3	91.1	92.3	93.4	94.6	95.1	95.2	95.1	94.7	94.3	92.7	91.4	90.6	90.6	90.6	91.1
–10	87.4	90.2	91.4	92.5	93.7	94.2	94.3	94.3	94.4	94.5	93.9	92.5	91.5	91.6	91.6	92.3
–15	86.6	89.4	90.6	91.7	92.8	93.3	93.4	93.4	93.5	93.6	93.3	93.0	92.8	92.8	92.8	93.4
–20	85.8	88.5	89.7	90.8	91.9	92.4	92.5	92.4	92.6	92.7	92.4	92.1	92.3	93.5	94.1	94.8
–25	84.9	87.6	88.8	89.9	91.0	91.5	91.6	91.5	91.6	91.8	91.4	91.2	91.4	92.5	93.7	94.6
–30	84.1	86.7	87.9	89.0	90.1	90.5	90.6	90.6	90.7	90.8	90.5	90.3	90.5	91.6	92.7	93.6
–35	83.2	85.8	87.0	88.0	89.2	89.6	89.7	89.7	89.8	89.9	89.6	89.4	89.5	90.6	91.7	92.7
–40	82.3	84.9	86.1	87.1	88.2	88.7	88.8	88.7	88.8	89.0	88.6	88.4	88.6	89.7	90.8	91.7

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.4	–0.7	–0.7	–0.7	–0.6	–0.5	–0.3	–0.3	–0.3	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.5	–0.8	–0.9	–0.9	–0.8	–0.7	–0.5	–0.6	–0.6	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.6
ENGINE & WING**	–0.6	–1.0	–1.0	–1.2	–1.1	–1.0	–0.8	–0.9	–0.9	–0.8	–0.8	–0.8	–0.9	–0.9	–0.9	–1.0

**Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

UNCONTROLLED IF DOWNLOADED OR PRINTED
DRAFT

ALTERNATE MODE EEC
ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
200 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	91.6	90.6	90.3	89.8	89.4	88.2	87.9	88.7	89.3	89.6	89.3	89.2	89.3	89.7	89.9	90.4
25	92.4	91.4	90.9	90.4	90.1	89.1	87.8	87.9	88.6	88.9	88.6	88.5	88.6	89.0	89.1	89.7
20	92.7	92.3	91.8	91.1	90.7	89.9	88.9	88.4	87.9	88.1	87.8	87.7	87.9	88.2	88.4	88.9
15	91.9	93.2	92.7	92.1	91.5	90.5	89.8	89.3	88.8	88.6	87.3	87.0	87.1	87.5	87.6	88.2
10	91.1	93.2	93.6	93.0	92.5	91.6	90.6	90.0	89.5	89.3	88.2	87.1	86.3	86.7	86.8	87.4
5	90.3	92.4	93.2	93.9	93.6	92.7	91.8	90.9	90.1	89.9	88.8	87.8	86.9	86.6	86.1	86.6
0	89.4	91.6	92.3	93.0	93.9	94.0	93.2	92.1	91.1	90.6	89.3	88.3	87.4	87.3	86.8	87.1
–5	88.6	90.7	91.5	92.2	93.1	93.6	94.3	93.5	92.3	91.7	90.2	88.9	87.8	87.8	87.5	87.8
–10	87.8	89.9	90.6	91.3	92.2	92.8	93.4	93.8	93.6	93.0	91.3	89.8	88.5	88.3	88.0	88.4
–15	87.0	89.0	89.7	90.4	91.3	91.9	92.5	92.9	93.2	93.3	92.6	90.8	89.4	89.2	88.9	89.3
–20	86.1	88.1	88.9	89.6	90.4	91.0	91.6	92.0	92.3	92.4	92.1	91.7	90.6	90.3	90.0	90.5
–25	85.3	87.3	88.0	88.7	89.5	90.1	90.7	91.1	91.4	91.5	91.1	90.8	90.5	91.6	91.3	91.8
–30	84.4	86.4	87.1	87.8	88.6	89.2	89.8	90.2	90.4	90.5	90.2	89.9	89.6	90.7	91.7	92.6
–35	83.5	85.5	86.2	86.9	87.7	88.3	88.8	89.2	89.5	89.6	89.3	89.0	88.7	89.7	90.7	91.6
–40	82.6	84.6	85.3	86.0	86.8	87.3	87.9	88.3	88.6	88.7	88.3	88.0	87.8	88.8	89.8	90.6

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.4	–0.7	–0.7	–0.7	–0.6	–0.5	–0.3	–0.3	–0.3	–0.2	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.5	–0.8	–0.9	–0.9	–0.9	–0.7	–0.5	–0.6	–0.5	–0.5	–0.6	–0.5	–0.5	–0.5	–0.6	–0.6
ENGINE & WING**	–0.6	–1.0	–1.1	–1.1	–1.1	–1.0	–0.8	–0.9	–0.9	–0.8	–0.9	–0.9	–0.9	–1.0	–1.0	–1.0

**Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

UNCONTROLLED IF DOWNLOADED OR PRINTED

GEAR DOWN

220 KIAS Max Climb EPR

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)														
	0	5	10	12	14	16	18	20	22	24	26	28	30	32	34
55	1.187	1.185	1.206	1.210	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
50	1.204	1.199	1.206	1.210	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
45	1.223	1.219	1.206	1.210	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
40	1.243	1.239	1.229	1.218	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
35	1.264	1.262	1.253	1.243	1.233	1.223	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
30	1.280	1.286	1.276	1.268	1.259	1.250	1.243	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
25	1.280	1.311	1.303	1.293	1.284	1.276	1.271	1.267	1.259	1.262	1.260	1.251	1.246	1.235	1.225
20	1.280	1.323	1.331	1.321	1.312	1.304	1.299	1.296	1.290	1.280	1.260	1.251	1.246	1.235	1.225
15	1.280	1.323	1.360	1.350	1.342	1.334	1.329	1.326	1.321	1.313	1.293	1.264	1.246	1.235	1.225
10	1.280	1.323	1.366	1.377	1.373	1.366	1.362	1.359	1.352	1.345	1.325	1.295	1.270	1.246	1.225
5	1.280	1.323	1.366	1.377	1.391	1.399	1.396	1.394	1.389	1.380	1.359	1.326	1.298	1.276	1.256
0	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.431	1.426	1.419	1.397	1.359	1.325	1.306	1.292
–5	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.468	1.461	1.439	1.401	1.363	1.337	1.327
–10	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.474	1.495	1.484	1.444	1.406	1.381	1.369
–15	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.474	1.495	1.501	1.491	1.454	1.427	1.417
–20	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.474	1.495	1.501	1.491	1.480	1.480	1.469

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)							
	0	5	10	15	20	25	30	35
ENGINE ONLY	–0.008	–0.010	–0.015	–0.014	–0.006	–0.005	–0.003	–0.003
ENGINE AND WING*	–0.010	–0.012	–0.018	–0.019	–0.012	–0.012	–0.011	–0.013
ENGINE AND WING**	–0.012	–0.014	–0.021	–0.024	–0.018	–0.019	–0.020	–0.023

**Wing anti-ice on, packs on.
**Wing anti-ice on, single bleed source and both packs off.

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GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
300	13000	10400	7300
280	16200	13700	11000
260	19500	17200	14600
240	22500	20500	18200
220	25300	23600	21700
200	27300	26100	25000
180	29400	28200	27100
160	32100	30500	29300
140	35700	34000	32300

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GEAR DOWN

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
300	EPR	1.240									
	MACH	.488									
	KIAS	270									
	FF/ENG	7412									
280	EPR	1.216	1.292	1.334							
	MACH	.474	.518	.538							
	KIAS	262	261	261							
	FF/ENG	6899	6901	6969							
260	EPR	1.192	1.261	1.295	1.338						
	MACH	.458	.501	.519	.540						
	KIAS	253	252	252	252						
	FF/ENG	6367	6344	6363	6431						
240	EPR	1.169	1.231	1.261	1.296	1.340	1.395				
	MACH	.441	.484	.501	.520	.541	.563				
	KIAS	244	243	243	242	242	242				
	FF/ENG	5839	5818	5811	5829	5893	5962				
220	EPR	1.147	1.202	1.229	1.259	1.295	1.339	1.394			
	MACH	.422	.465	.482	.500	.519	.541	.563			
	KIAS	233	234	233	233	232	232	232			
	FF/ENG	5304	5300	5291	5283	5299	5356	5419			
200	EPR	1.127	1.174	1.197	1.224	1.255	1.290	1.334	1.389		
	MACH	.402	.445	.462	.480	.498	.517	.538	.561		
	KIAS	222	223	223	223	222	222	222	222		
	FF/ENG	4772	4784	4779	4771	4763	4773	4820	4879		
180	EPR	1.110	1.147	1.167	1.190	1.218	1.247	1.281	1.324	1.378	
	MACH	.387	.422	.439	.457	.475	.493	.512	.534	.557	
	KIAS	213	212	212	212	212	211	211	211	211	
	FF/ENG	4327	4262	4268	4264	4257	4249	4252	4286	4341	
160	EPR	1.094	1.125	1.141	1.160	1.185	1.211	1.240	1.275	1.317	1.369
	MACH	.372	.403	.419	.436	.454	.472	.492	.513	.535	.558
	KIAS	205	202	202	202	202	202	202	202	202	202
	FF/ENG	3925	3818	3812	3805	3799	3797	3802	3815	3845	3887
140	EPR	1.079	1.106	1.120	1.136	1.157	1.180	1.205	1.233	1.267	1.308
	MACH	.352	.387	.403	.419	.436	.454	.473	.493	.515	.537
	KIAS	194	194	194	194	194	194	194	194	194	194
	FF/ENG	3474	3496	3491	3486	3475	3468	3407	3409	3419	3444

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GEAR DOWN

Long Range Cruise Enroute 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
324	290	260	236	217	200	189	179	170	161	154
656	584	523	474	435	400	378	357	339	323	308
991	882	788	714	653	600	567	536	509	484	462
1329	1181	1053	953	871	800	755	714	677	644	615
1670	1482	1320	1193	1090	1000	943	892	845	804	767
2014	1785	1589	1434	1309	1200	1132	1070	1014	964	919
2362	2091	1859	1676	1528	1400	1320	1248	1182	1123	1071
2715	2400	2130	1919	1748	1600	1508	1425	1349	1282	1223
3073	2711	2403	2163	1968	1800	1696	1602	1517	1441	1373
3434	3026	2678	2407	2189	2000	1884	1779	1684	1599	1524
3799	3343	2954	2652	2410	2200	2072	1955	1850	1756	1674
4169	3662	3232	2898	2631	2400	2259	2132	2016	1914	1824
4542	3984	3511	3145	2853	2600	2447	2308	2183	2071	1974
4921	4309	3792	3393	3075	2800	2635	2485	2349	2229	2123
5303	4637	4074	3641	3297	3000	2822	2661	2515	2386	2272
5689	4968	4358	3890	3519	3200	3010	2837	2681	2542	2421
6081	5301	4643	4140	3742	3400	3197	3012	2846	2698	2569
6477	5638	4930	4391	3966	3600	3384	3188	3011	2854	2717
6877	5977	5220	4643	4190	3800	3571	3363	3176	3010	2865
7283	6320	5510	4896	4414	4000	3758	3538	3340	3165	3012

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	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	6.7	0:49	6.1	0:47	5.3	0:44	4.8	0:42	4.4	0:40
400	13.9	1:37	12.9	1:31	11.5	1:24	10.7	1:20	10.1	1:16
600	21.0	2:25	19.5	2:17	17.5	2:06	16.4	1:59	15.6	1:53
800	27.9	3:15	26.0	3:04	23.4	2:48	22.0	2:39	20.9	2:30
1000	34.7	4:04	32.4	3:51	29.3	3:30	27.5	3:19	26.2	3:07
1200	41.3	4:55	38.6	4:40	35.0	4:14	32.9	3:59	31.3	3:45
1400	47.8	5:46	44.7	5:28	40.6	4:58	38.2	4:40	36.3	4:23
1600	54.2	6:38	50.8	6:17	46.2	5:42	43.4	5:22	41.3	5:02
1800	60.5	7:31	56.7	7:07	51.7	6:27	48.5	6:03	46.1	5:41
2000	66.7	8:24	62.6	7:57	57.2	7:12	53.6	6:45	51.0	6:20
2200	72.9	9:19	68.3	8:48	62.4	7:58	58.5	7:28	55.6	7:00
2400	79.0	10:14	74.0	9:39	67.7	8:44	63.4	8:11	60.2	7:39
2600	85.1	11:10	79.5	10:31	72.8	9:31	68.2	8:54	64.8	8:20
2800	91.0	12:07	85.0	11:24	77.8	10:18	73.0	9:38	69.2	9:01
3000	96.9	13:04	90.4	12:17	82.8	11:06	77.7	10:22	73.6	9:41
3200	102.5	14:03	95.7	13:12	87.6	11:54	82.3	11:07	77.9	10:23
3400	108.1	15:02	101.0	14:06	92.4	12:43	86.8	11:53	82.2	11:05
3600	113.6	16:02	106.2	15:02	97.1	13:33	91.3	12:38	86.4	11:47
3800	119.0	17:04	111.3	15:58	101.7	14:23	95.6	13:24	90.5	12:30
4000	124.4	18:05	116.4	16:54	106.3	15:13	100.0	14:11	94.7	13:13

UNCONTROLLED IF DOWNLOADED OR PRINTED

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)							
	160	180	200	220	240	260	280	300
10	–1.4	–0.7	0.0	0.8	2.0	3.5	5.4	7.6
20	–2.1	–1.1	0.0	1.6	3.7	6.3	9.4	13.1
30	–2.9	–1.5	0.0	2.3	5.3	8.9	13.2	18.1
40	–3.7	–1.9	0.0	3.0	6.8	11.4	16.6	22.7
50	–4.6	–2.4	0.0	3.7	8.2	13.6	19.8	26.8
60	–5.4	–2.8	0.0	4.3	9.5	15.6	22.6	30.5
70	–6.3	–3.3	0.0	4.9	10.7	17.5	25.1	33.7
80	–7.2	–3.7	0.0	5.5	11.8	19.1	27.4	36.5
90	–8.1	–4.2	0.0	6.0	12.8	20.6	29.3	38.8
100	–9.1	–4.7	0.0	6.4	13.7	21.9	30.9	40.7
110	–10.1	–5.1	0.0	6.9	14.5	22.9	32.1	42.1
120	–11.1	–5.6	0.0	7.3	15.2	23.8	33.1	43.1
130	–12.1	–6.1	0.0	7.6	15.8	24.5	33.8	43.6

Based on Long Range Cruise and VREF30 + 80 descent.

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GEAR DOWN

Descent at VREF 30+80

PRESSURE ALT (1000 FT)	17	19	21	23	25	27	29	31	33	35
DISTANCE (NM)	41	45	49	53	57	61	65	69	73	78
TIME (MINUTES)	12	12	13	14	15	16	16	17	18	18

UNCONTROLLED IF DOWNLOADED OR PRINTED

GEAR DOWN

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
300	EPR	1.138	1.167	1.227	1.313			
	KIAS	244	244	244	244			
	FF/ENG	7090	7090	7110	7210			
280	EPR	1.123	1.150	1.203	1.278			
	KIAS	239	239	239	239			
	FF/ENG	6610	6620	6620	6670			
260	EPR	1.110	1.134	1.179	1.247	1.345		
	KIAS	234	234	234	234	234		
	FF/ENG	6160	6150	6150	6180	6300		
240	EPR	1.097	1.119	1.158	1.217	1.302		
	KIAS	228	228	228	228	228		
	FF/ENG	5720	5690	5690	5690	5750		
220	EPR	1.086	1.104	1.140	1.190	1.263	1.376	
	KIAS	222	222	222	222	222	222	
	FF/ENG	5290	5260	5240	5230	5250	5390	
200	EPR	1.076	1.092	1.123	1.166	1.230	1.322	
	KIAS	215	215	215	215	215	215	
	FF/ENG	5000	4840	4810	4790	4800	4860	
180	EPR	1.067	1.081	1.106	1.144	1.199	1.277	1.402
	KIAS	208	208	208	208	208	208	208
	FF/ENG	4600	4440	4390	4380	4370	4390	4510
160	EPR	1.059	1.071	1.093	1.126	1.173	1.242	1.345
	KIAS	203	203	203	203	203	203	203
	FF/ENG	4270	4220	4060	4040	4030	4030	4100
140	EPR	1.053	1.064	1.084	1.114	1.157	1.219	1.310
	KIAS	203	203	203	203	203	203	203
	FF/ENG	4110	4060	3900	3870	3910	3830	3870

This table includes 5% additional fuel for holding in a racetrack pattern.

UNCONTROLLED IF DOWNLOADED OR PRINTED
DRAFT

GEAR DOWN

Holding
Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
300	EPR	1.140	1.168	1.225	1.307	
	KIAS	224	224	224	224	
	FF/ENG	6760	6760	6760	6820	
280	EPR	1.126	1.153	1.202	1.276	1.384
	KIAS	219	219	219	219	219
	FF/ENG	6320	6310	6300	6330	6470
260	EPR	1.113	1.137	1.181	1.247	1.342
	KIAS	214	214	214	214	214
	FF/ENG	5890	5870	5860	5880	5960
240	EPR	1.101	1.122	1.161	1.218	1.301
	KIAS	208	208	208	208	208
	FF/ENG	5460	5430	5420	5410	5450
220	EPR	1.090	1.107	1.143	1.191	1.264
	KIAS	202	202	202	202	202
	FF/ENG	5030	4990	4970	4960	4980
200	EPR	1.080	1.095	1.125	1.167	1.229
	KIAS	195	195	195	195	195
	FF/ENG	4730	4570	4530	4530	4530
180	EPR	1.069	1.083	1.107	1.144	1.196
	KIAS	188	188	188	188	188
	FF/ENG	4310	4270	4110	4100	4090
160	EPR	1.059	1.072	1.093	1.125	1.169
	KIAS	183	183	183	183	183
	FF/ENG	3960	3920	3770	3800	3790
140	EPR	1.053	1.064	1.083	1.111	1.151
	KIAS	183	183	183	183	183
	FF/ENG	3770	3720	3640	3600	3580

This table includes 5% additional fuel for holding in a racetrack pattern.

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		VREF + 80 DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFTDOWN	LEVEL OFF		ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
260	246	233	2200		
240	228	227	5600	3300	400
220	210	221	8500	6600	4200
200	191	214	11300	9700	7500
180	172	208	14100	12500	10700
160	153	200	16800	15400	13700
140	134	192	19500	18100	16500

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DRAFT

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
240	3500		
220	6900	4800	1700
200	10100	8100	5800
180	13000	11300	9300
160	15900	14400	12500
140	18700	17200	15700

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)						
		5	7	9	11	13	15	17
240	EPR	1.394						
	MACH	.379						
	KIAS	229						
	FF/ENG	10859						
230	EPR	1.372	1.420					
	MACH	.374	.388					
	KIAS	226	226					
	FF/ENG	10399	10514					
220	EPR	1.350	1.395					
	MACH	.369	.382					
	KIAS	223	223					
	FF/ENG	9949	10039					
210	EPR	1.330	1.371	1.420				
	MACH	.363	.377	.391				
	KIAS	220	220	220				
	FF/ENG	9514	9582	9688				
200	EPR	1.310	1.348	1.393	1.447			
	MACH	.358	.371	.385	.400			
	KIAS	216	216	216	216			
	FF/ENG	9096	9139	9222	9351			
190	EPR	1.291	1.326	1.367	1.417	1.478		
	MACH	.352	.365	.379	.393	.408		
	KIAS	213	213	213	213	213		
	FF/ENG	8689	8712	8774	8870	9037		
180	EPR	1.273	1.305	1.343	1.388	1.442		
	MACH	.346	.359	.373	.387	.402		
	KIAS	209	209	209	209	209		
	FF/ENG	8291	8303	8340	8414	8529		
170	EPR	1.255	1.285	1.320	1.361	1.409	1.470	
	MACH	.340	.353	.366	.380	.395	.410	
	KIAS	206	206	206	206	206	206	
	FF/ENG	7892	7901	7919	7971	8055	8200	
160	EPR	1.238	1.266	1.298	1.335	1.379	1.432	1.500
	MACH	.334	.346	.359	.373	.388	.403	.419
	KIAS	202	202	202	202	202	202	202
	FF/ENG	7496	7504	7513	7541	7605	7701	7882
150	EPR	1.221	1.247	1.276	1.310	1.350	1.397	1.456
	MACH	.327	.340	.353	.366	.380	.395	.411
	KIAS	198	198	198	198	198	198	198
	FF/ENG	7109	7109	7116	7129	7168	7238	7355
140	EPR	1.205	1.228	1.256	1.287	1.323	1.365	1.416
	MACH	.321	.333	.345	.359	.373	.387	.403
	KIAS	194	194	194	194	194	194	194
	FF/ENG	6729	6721	6725	6732	6750	6799	6877

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GEAR DOWN
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
170	150	132	119	109	100	93	88	83	78	75
349	305	269	241	219	200	187	175	164	154	146
529	462	406	363	329	300	279	260	244	230	218
710	620	544	486	440	400	372	347	325	306	290
892	778	681	608	550	500	465	433	406	381	361
1075	936	819	730	660	600	558	520	487	458	433
1259	1096	958	853	771	700	651	606	567	533	504
1444	1256	1097	976	882	800	743	692	647	608	575
1630	1416	1236	1100	992	900	836	778	727	683	646
1817	1577	1375	1223	1103	1000	928	864	808	759	717

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	6		8		10		12		14	
	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)
100	3.3	0:28	3.1	0:27	2.9	0:27	2.7	0:26	2.6	0:26
200	6.9	0:54	6.6	0:53	6.4	0:52	6.1	0:50	5.9	0:49
300	10.5	1:21	10.1	1:19	9.8	1:17	9.5	1:15	9.2	1:13
400	14.1	1:48	13.6	1:45	13.2	1:42	12.8	1:39	12.5	1:36
500	17.6	2:15	17.0	2:11	16.5	2:07	16.1	2:04	15.7	2:00
600	21.1	2:42	20.4	2:37	19.8	2:33	19.3	2:29	18.9	2:24
700	24.6	3:09	23.8	3:04	23.1	2:59	22.5	2:54	22.0	2:49
800	28.0	3:37	27.1	3:31	26.3	3:25	25.6	3:19	25.1	3:13
900	31.3	4:05	30.4	3:58	29.5	3:51	28.8	3:44	28.1	3:37
1000	34.7	4:33	33.6	4:25	32.7	4:17	31.8	4:09	31.2	4:02

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)					
	140	160	180	200	220	240
4	–0.4	–0.2	0.0	0.3	0.8	1.3
6	–0.7	–0.3	0.0	0.5	1.2	2.0
8	–0.9	–0.5	0.0	0.7	1.6	2.7
10	–1.2	–0.6	0.0	0.9	2.0	3.3
12	–1.4	–0.7	0.0	1.0	2.4	4.0
14	–1.7	–0.8	0.0	1.2	2.7	4.6
16	–1.9	–1.0	0.0	1.4	3.1	5.2
18	–2.1	–1.1	0.0	1.5	3.5	5.8
20	–2.4	–1.2	0.0	1.7	3.8	6.4
22	–2.6	–1.3	0.0	1.8	4.1	7.0
24	–2.9	–1.4	0.0	2.0	4.5	7.5
26	–3.1	–1.6	0.0	2.1	4.8	8.0
28	–3.3	–1.7	0.0	2.3	5.1	8.5
30	–3.6	–1.8	0.0	2.4	5.4	9.0
32	–3.8	–1.9	0.0	2.6	5.7	9.5
34	–4.1	–2.0	0.0	2.7	6.0	10.0
36	–4.3	–2.2	0.0	2.8	6.2	10.4

Based on Long Range Cruise and VREF30+80 descent. Includes APU fuel burn.

UNCONTROLLED IF DOWNLOADED OR PRINTED

GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)			
		1500	5000	10000	15000
240	EPR	1.319	1.390		
	KIAS	228	228		
	FF/ENG	11170	11310		
220	EPR	1.285	1.347		
	KIAS	222	222		
	FF/ENG	10300	10360		
200	EPR	1.253	1.307	1.414	
	KIAS	215	215	215	
	FF/ENG	9440	9470	9650	
180	EPR	1.223	1.270	1.360	
	KIAS	208	208	208	
	FF/ENG	8620	8620	8700	
160	EPR	1.199	1.240	1.319	1.437
	KIAS	203	203	203	203
	FF/ENG	7950	7940	7970	8170
140	EPR	1.185	1.222	1.295	1.401
	KIAS	203	203	203	203
	FF/ENG	7590	7570	7590	7720

This table includes 5% additional fuel for holding in a racetrack pattern.

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Performance Inflight — Chapter PI
Text — Section 28

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer. 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

FMC Takeoff Speeds

FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Clearway and Stopway V1 Adjustments

Takeoff speed corrections are to be applied to V1 when using takeoff weights based on the use of clearway and stopway.

Adjust V1 by the amount shown in the table. The adjusted V1 must not exceed VR. If V1 is greater than VR, VR may be increased to equal V1. The resultant V2 will be increased by the same amount that VR was increased.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF Speeds

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

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Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver 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/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/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.

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 13 mm (0.5 inches) 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 dry field/obstacle limit weight for the takeoff flap setting
2. enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude
3. adjust field length available for temperature by amount shown on chart
4. enter the V1(MCG) Limit Weight table with the field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

1. determine takeoff speeds V1, VR and V2 for actual brake release weight using Takeoff Speeds from the Performance Dispatch chapter or from the FMC
2. if V1(MCG) limited, set V1 = V1(MCG). If not limited by V1(MCG) considerations, enter 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 V1(MCG), set V1 = V1(MCG).

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Slippery Runway

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. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on 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.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Go-Around EPR

To find Go-Around EPR based on normal engine bleed for packs on and anti-ice off, enter the Go-Around EPR table with airport pressure altitude and reported OAT or TAT and read EPR. EPR adjustments are shown for engine bleeds for various conditions.

Max Climb EPR

This table shows Max Climb EPR for a 310/.84 climb speed schedule, normal engine bleed for 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.

Flight with Unreliable Airspeed/Turbulent Air Penetration

Body 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 may also cause unreliable airspeed/Mach indications. Climb, cruise and descent information is based on the recommended turbulent air penetration speed schedule: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and

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above; maintain a minimum speed of 15 knots above the minimum maneuvering speed when below 0.82 Mach. This schedule provides ample protection from stall and high speed buffet, while also providing protection from exceeding structural limits. The Climb, Cruise and Descent tables 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 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. Note that these tables consider 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 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5 g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43,100 ft.

Long Range Cruise Control

These tables provide target EPR, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude, .84 Mach approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

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 .84/310/250 descent. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

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

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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 at .84/310/250

Distance and time for descent are shown for a .84/310/250 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 30 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 is based on VREF30 + 60 speed schedule. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read EPR, IAS and fuel flow per engine.

Advisory Information

Reported Braking Action

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. A table is provided that correlates runway condition code to runway surface condition description and reported braking action that can then be used to determine the appropriate Normal Configuration Landing Distance or Non-Normal Configuration Landing Distance.

Normal Configuration Operational Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and runways with good, good-to-medium, medium, medium-to-poor, and poor reported braking action. Landing distances (reference distances plus adjustments) are 115% of the actual landing distance. The Normal

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Configuration Landing Distance tables should be used enroute to make a landing distance assessment for time of arrival.

The reference landing distance is the distance from threshold to complete stop. It includes an air distance allowance of 1,500 ft from threshold to touchdown. The reference distance is based on a reference landing weight and speed at sea level, standard day, zero wind, zero slope, two-engine maximum reverse thrust, and auto speedbrakes

To use these tables, determine the reference landing distance for the selected braking configuration and reported braking action. Adjust this reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers. Each correction is applied independently to the reference landing distance. A correction for use of manual speedbrakes is provided in the table notes.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" reported 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 appropriate 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. Landing distances and adjustments are provided for dry runways and runways with good, good-to-medium, medium, medium-to-poor, and poor reported braking action. Landing distances (reference distances plus adjustments) are representative of the actual landing distance, and are not factored. The Non-Normal Configuration Landing Distance tables should be used enroute to make a landing distance assessment for time of arrival.

The reference landing distance is the distance from threshold to complete stop. It includes an air distance allowance of 1,500 ft from threshold to touchdown. The reference distance is based on a reference landing weight and speed at sea level, standard day, zero wind, zero slope, and maximum available reverse thrust.

Tables for Non-Normal Configuration Landing Distance in this section are similar in format and used in the same manner as tables for the Normal Configuration Landing Distance previously described.

For an engine inoperative landing, check the rate of climb capability shown in Gear Down Landing Rate of Climb Available tables to ensure adequate climb performance.

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Landing Climb Limit Weight

In the event an overweight landing is necessary and the fuel dump system is unavailable, landing climb limits should be checked if a Flaps 25 or 30 landing is planned. Enter the table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required. At weights exceeding those shown, plan a Flaps 20 landing.

The table "Landing Climb Limit Weight" presents the data which are the more limiting of Approach Climb Limit Weight and Landing Climb Limit Weight.

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 appropriate Event Adjusted Brake Energy Table (No Reverse Thrust or 2 Engine Reverse) with the reference brake energy per brake and the type of braking used during landing (Max Manual, Max Auto, or Autobrake). 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 5.0 or higher on the EICAS indication and disappear as the hottest brake cools with an EICAS indication of 3.5. Note that even without an EICAS advisory message, brake cooling is recommended.

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Engine Inoperative

Initial Max Continuous EPR

The Initial Max Continuous EPR setting for use following an engine failure is shown. The table is based on the typical all engine cruise Mach number of .84 to provide a target EPR setting at the start of driftdown. Once driftdown is established, the Max Continuous EPR table should be used to determine EPR for the given conditions.

Max Continuous EPR

Power setting is based on one engine operating with one bleed source for pack(s) operating and all anti-ice bleeds off. Enter the table for appropriate pressure altitude with IAS or Mach and TAT to read Max Continuous EPR. Apply the anti-ice corrections below the table as required.

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 considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/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. If altitudes other than the level off altitude is used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

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Long Range Cruise Altitude Capability

Table show the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on LRC speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target EPR, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (KG/HR) GROSS WEIGHT (1000 KG)				
	300	260	220	180	140
43				160	140
39			180	160	145
35		200	190	170	140
31	230	220	195	165	140
25	230	220	195	175	155
20	235	230	205	185	165
15	235	235	215	200	185
10	240	240	230	220	200
5	270	270	255	240	220

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 single engine Long Range Cruise speed and .84/310/250 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 off reference fuel corrections table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down Landing Rate of Climb Available

Rate of climb data is provided as guidance information in the event an engine inoperative landing is planned. The tables show gear down rate of climb available for Flaps 20 and Flaps 30. Enter the table with TAT and pressure altitude to read rate of climb available. Apply adjustments shown to correct for weight.

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Alternate Mode EEC

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, net level off and landing climb weights. To determine limit weights for operations with the EEC in the ALTERNATE mode, enter the table with the limit weights for PRIMARY mode EEC operation and read the associated limit weight for each performance condition. 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—Digital Performance Information may yield less restrictive limit weights.

Takeoff Speed Adjustment

Takeoff speeds for the reduced weight should be increased by the amount shown in the Takeoff Speeds Adjustments Table. The adjusted V1 should not exceed the adjusted VR.

Note: The FMC does incorporate ALTERNATE Mode EEC performance in its takeoff speeds calculations.

Max Takeoff %N1

Takeoff power settings are presented for normal air condition bleed. Max Takeoff %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode 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.

Max Climb %N1

This table shows Max Climb %N1 for a 310/.84 climb speed schedule with anti-ice off. Enter the table with pressure altitude and TAT to read Max Climb %N1. Apply bleed adjustments as required.

Max Cruise %N1

Maximum Cruise %N1 is presented for .84M, which approximates Long Range Cruise speed. Enter the table with pressure altitude and TAT to read Max Cruise %N1. Appropriate bleed adjustments are shown.

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Go-Around %N1

Go-Around power setting for ALTERNATE MODE EEC operation is presented for normal engine bleed for packs on. Go-Around %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode 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.

Alternate Mode EEC, Engine Inoperative

Initial Max Continuous %N1

Initial Max Continuous %N1 settings for use following an engine failure are presented. The table is based on the typical all engine cruise Mach number of .84 to provide a target %N1 setting at the start of driftdown. Appropriate bleed adjustments are shown. Once driftdown is established, the Max Continuous %N1 table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Max Continuous %N1 settings are presented as a function of pressure altitude and TAT for engine inoperative speeds of 320, 280, 240, and 200 KIAS. Power settings may be interpolated for intermediate airspeeds. Apply bleed adjustments as required.

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 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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Long Range Cruise Maximum Operating Altitude PI.31.1

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Gear Down, Engine INOP PI.37

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Maximum Allowable Clearway

FIELD LENGTH (M)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (M)
1500	150
2000	180
2500	210
3000	230
3500	260
4000	280
4500	310

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Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (M)	NORMAL V1 (KIAS)			
	DRY RUNWAY			
	100	120	140	160
200	–3	–3	–2	–2
100	–2	–1	–1	–1
0	0	0	0	0
–100	4	3	3	2
–200	6	6	5	3
–300	6	8	7	5
Use of clearway not allowed on wet runway.				

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VREF

WEIGHT (1000 KG)	FLAPS		
	30	25	20
300	169	174	183
290	165	172	181
280	162	169	177
270	159	166	174
260	156	163	171
250	153	160	168
240	150	157	165
230	147	153	161
220	144	150	158
210	140	146	154
200	137	143	150
190	133	139	146
180	129	135	142
170	125	131	138
160	121	127	134

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Flap Maneuver Speed

FLAP POSITION	MANEUVER SPEED
FLAPS 0	VREF30 + 80
FLAPS 1	VREF30 + 60
FLAPS 5	VREF30 + 40
FLAPS 15	VREF30 + 20
FLAPS 20	VREF30 + 20
FLAPS 25	VREF25
FLAPS 30	VREF30

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ADVISORY INFORMATION

Slush/Standing Water Takeoff
Maximum Reverse Thrust
Weight Adjustment (1000 KG)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	–32.8	–37.4	–41.9	–37.8	–42.4	–46.9	–49.1	–53.6	–58.2
300	–31.6	–36.1	–40.6	–36.4	–40.9	–45.4	–46.8	–51.4	–55.9
280	–29.8	–34.4	–38.9	–34.3	–38.8	–43.4	–43.8	–48.3	–52.9
260	–27.6	–32.1	–36.7	–31.6	–36.1	–40.7	–40.0	–44.6	–49.1
240	–24.8	–29.4	–33.9	–28.3	–32.8	–37.4	–35.5	–40.0	–44.6
220	–21.6	–26.2	–30.7	–24.4	–28.9	–33.4	–30.2	–34.8	–39.3
200	–17.9	–22.5	–27.0	–19.8	–24.4	–28.9	–24.2	–28.8	–33.3
180	–13.8	–18.3	–22.8	–14.7	–19.2	–23.8	–17.5	–22.0	–26.5

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
1700							157.0		
1800	141.4			157.7			185.2	147.6	
1900	171.5			187.3	147.7		215.5	175.4	
2000	202.6	161.2		218.8	177.1		248.7	204.9	165.9
2100	235.5	191.8	151.0	252.4	207.9	167.0	285.7	237.1	194.6
2200	270.4	224.1	181.3	288.7	240.7	197.2	328.0	272.6	225.8
2300	307.8	258.3	212.9	328.2	276.0	229.2		313.1	260.1
2400	347.1	294.8	246.4		314.5	263.7		357.0	298.6
2500		333.7	282.1		354.9	300.9			342.1
2600			320.3			341.2			
2700			359.7						

1. Enter Weight Adjustment table with slush/standing water depth and field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by –40 m/+40 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
300	–19	–15	–11	–15	–11	–7	–6	–2	2
280	–21	–17	–13	–16	–12	–8	–7	–3	1
260	–23	–19	–15	–18	–14	–10	–8	–4	0
240	–25	–21	–17	–20	–16	–12	–10	–6	–2
220	–26	–22	–18	–22	–18	–14	–13	–9	–5
200	–27	–23	–19	–24	–20	–16	–16	–12	–8
180	–27	–23	–19	–25	–21	–17	–18	–14	–10
160	–28	–24	–20	–25	–21	–17	–20	–16	–12

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

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ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
Weight Adjustment (1000 KG)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
320	–43.5	–48.4	–53.3	–51.5	–56.4	–61.3	–65.0	–69.9	–74.8
300	–41.1	–46.0	–50.9	–48.3	–53.2	–58.1	–60.4	–65.3	–70.2
280	–38.3	–43.2	–48.1	–44.8	–49.7	–54.6	–55.4	–60.3	–65.2
260	–35.2	–40.1	–45.0	–40.8	–45.7	–50.6	–49.9	–54.8	–59.7
240	–31.7	–36.6	–41.5	–36.4	–41.3	–46.2	–44.0	–48.9	–53.8
220	–27.8	–32.7	–37.6	–31.7	–36.6	–41.5	–37.6	–42.5	–47.4
200	–23.5	–28.4	–33.3	–26.5	–31.4	–36.3	–30.8	–35.7	–40.6
180	–18.9	–23.8	–28.7	–20.9	–25.8	–30.7	–23.6	–28.5	–33.4
160	–13.9	–18.8	–23.7	–14.9	–19.8	–24.7	–16.0	–20.9	–25.8

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2400							170.5	131.9	
2600				151.0			255.2	212.6	172.4
2800	176.8	121.1		254.8	201.9	153.3	351.2	303.0	257.3
3000	308.7	240.1	179.6		316.7	257.5			353.6
3200			312.4						

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water adjustment.
2. Adjust field length available by –55 m/+50 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
300	–32	–26	–20	–24	–18	–12	–11	–5	0
280	–34	–28	–22	–27	–21	–15	–13	–7	–1
260	–36	–30	–24	–30	–24	–18	–16	–10	–4
240	–39	–33	–27	–33	–27	–21	–19	–13	–7
220	–41	–35	–29	–36	–30	–24	–23	–17	–11
200	–43	–37	–31	–39	–33	–27	–28	–22	–16
180	–44	–38	–32	–41	–35	–29	–32	–26	–20
160	–45	–39	–33	–42	–36	–30	–37	–31	–25

1. Obtain V1, VR and V2 for the actual weight.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

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ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
Weight Adjustments (1000 KG)

DRY 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
320	0.0	–2.0	–4.0	–14.5	–16.5	–18.5	–30.5	–32.5	–34.5
300	0.0	–2.0	–4.0	–16.3	–18.3	–20.3	–31.1	–33.1	–35.1
280	–1.0	–3.0	–5.0	–17.3	–19.3	–21.3	–30.9	–32.9	–34.9
260	–2.6	–4.6	–6.6	–17.6	–19.6	–21.6	–29.9	–31.9	–33.9
240	–3.6	–5.6	–7.6	–17.2	–19.2	–21.2	–28.1	–30.1	–32.1
220	–3.9	–5.9	–7.9	–16.0	–18.0	–20.0	–25.4	–27.4	–29.4
200	–3.7	–5.7	–7.7	–14.1	–16.1	–18.1	–21.9	–23.9	–25.9
180	–2.9	–4.9	–6.9	–11.5	–13.5	–15.5	–17.6	–19.6	–21.6

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	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
1300	161.5								
1400	225.5	180.3							
1500	283.0	242.2	198.3						
1600	335.8	298.1	258.4						
1700		350.4	312.9	144.5					
1800				186.3	141.2				
1900				229.1	182.9				
2000				273.4	225.7	179.5			
2100				319.2	269.8	222.2			
2200					315.5	266.2			
2300						311.8	157.4		
2400						358.2	180.8		
2500							205.4	162.0	
2600							231.4	185.6	143.6
2700							259.1	210.5	166.6
2800							288.9	236.8	190.5
2900							321.2	264.9	215.6
3000							354.4	295.1	242.3
3100								327.8	270.7
3200									301.4
3300									334.5

1. Enter Weight Adjustment table with reported braking action and field/obstacle limit weight to obtain slippery runway weight adjustment.

2. Adjust “Good” field length available by –20m/+20m for every 5 deg. C above/below 4 deg. C.
   Adjust “Medium” field length available by –30m/+30m for every 5 deg. C above/below 4 deg. C.
   Adjust “Poor” field length available by –40m/+40m for every 5 deg. C above/below 4 deg. C.

3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.

4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

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ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
V1 Adjustments (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
300	–4	–2	0	–14	–12	–10	–27	–25	–23
280	–5	–3	–1	–16	–14	–12	–30	–28	–26
260	–7	–5	–3	–19	–17	–15	–34	–32	–30
240	–9	–7	–5	–21	–19	–17	–37	–35	–33
220	–10	–8	–6	–24	–22	–20	–40	–38	–36
200	–12	–10	–8	–26	–24	–22	–42	–40	–38
180	–13	–11	–9	–27	–25	–23	–44	–42	–40
160	–13	–11	–9	–28	–26	–24	–45	–43	–41

1. Obtain V1, VR and V2 for the actual weight.

2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

No Reverse Thrust
Weight Adjustment (1000 KG)

DRY 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
320	–1.4	–2.7	–4.0	–23.9	–25.1	–26.4	–43.6	–44.8	–46.1
300	–4.3	–5.6	–6.9	–25.2	–26.5	–27.8	–42.2	–43.5	–44.8
280	–6.6	–7.9	–9.1	–25.8	–27.1	–28.4	–40.5	–41.8	–43.0
260	–8.2	–9.4	–10.7	–25.7	–26.9	–28.2	–38.4	–39.6	–40.9
240	–9.1	–10.4	–11.6	–24.8	–26.0	–27.3	–35.8	–37.1	–38.3
220	–9.3	–10.6	–11.9	–23.1	–24.4	–25.6	–32.8	–34.1	–35.4
200	–8.9	–10.2	–11.4	–20.7	–22.0	–23.2	–29.4	–30.7	–32.0
180	–7.8	–9.1	–10.3	–17.5	–18.8	–20.1	–25.7	–26.9	–28.2
160	–6.0	–7.3	–8.6	–13.6	–14.9	–16.1	–21.4	–22.7	–24.0

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	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
1600	245.7	178.6							
1800		353.0	322.7						
2400				260.0	163.1				
2600						306.4			
3800							319.0	248.0	
4000								344.9	289.3

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.

2. Adjust “Good” field length available by –25 m/+20 m for every 5 deg. C above/below 4 deg. C.
Adjust “Medium” field length available by –40 m/+35 m for every 5 deg. C above/below 4 deg. C.
Adjust “Poor” field length available by –60 m/+55 m for every 5 deg. C above/below 4 deg. C.

3. Find V1(MCG) limited weight for adjusted field length and pressure altitude.

4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

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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
300	–7	–1	0	–21	–15	–9	–42	–36	–30
280	–9	–3	0	–24	–18	–12	–47	–41	–35
260	–11	–5	0	–28	–22	–16	–51	–45	–39
240	–13	–7	–1	–32	–26	–20	–56	–50	–44
220	–16	–10	–4	–35	–29	–23	–61	–55	–49
200	–18	–12	–6	–39	–33	–27	–66	–60	–54
180	–20	–14	–8	–42	–36	–30	–71	–65	–59
160	–22	–16	–10	–45	–39	–33	–77	–71	–65

1. Obtain V1, VR and V2 for the actual weight.

2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

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Minimum Control Speeds
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)					
		0		4000		8000	
deg. C	deg. F	V1(MCG)	Min VR	V1(MCG)	Min VR	V1(MCG)	Min VR
60	140	98	102	94	100		
50	122	100	105	94	100	90	96
40	104	106	110	97	102	90	96
30	86	109	114	101	106	93	98
20	68	110	114	103	108	95	100
–60	–76	111	114	104	108	97	102

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Go-around EPR

Based on engine bleed for packs on and anti-ice off

REPORTED OAT		TAT (deg. C)	AIRPORT PRESSURE ALTITUDE (FT)											
deg. C	deg. F		–2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
66	150	70	1.269	1.282	1.284	1.287	1.289	1.290	1.290	1.289	1.287	1.284	1.281	1.278
56	133	60	1.316	1.324	1.328	1.332	1.335	1.337	1.339	1.339	1.338	1.336	1.334	1.332
51	124	55	1.347	1.356	1.356	1.355	1.359	1.361	1.363	1.365	1.364	1.362	1.361	1.359
46	115	50	1.380	1.390	1.392	1.392	1.388	1.387	1.388	1.390	1.389	1.388	1.388	1.387
41	106	45	1.406	1.429	1.428	1.428	1.421	1.416	1.416	1.416	1.415	1.414	1.414	1.414
36	97	40	1.431	1.461	1.461	1.460	1.453	1.446	1.445	1.445	1.444	1.443	1.442	1.441
31	88	35	1.443	1.492	1.491	1.491	1.483	1.477	1.475	1.474	1.473	1.473	1.472	1.471
26	79	30	1.443	1.498	1.511	1.518	1.512	1.505	1.506	1.505	1.504	1.504	1.502	1.502
21	70	25	1.443	1.498	1.511	1.521	1.526	1.531	1.527	1.529	1.528	1.527	1.525	1.525
17	62	20	1.443	1.498	1.511	1.521	1.526	1.531	1.535	1.539	1.545	1.546	1.541	1.539
12	53	15	1.443	1.498	1.511	1.521	1.526	1.531	1.535	1.539	1.547	1.555	1.563	1.561
8 & BELOW	46 & BELOW	12 & BELOW	1.443	1.498	1.511	1.521	1.526	1.531	1.535	1.539	1.547	1.555	1.563	1.571

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)						
	–1000	0	2000	4000	6000	8000	10000
PACKS OFF	0.003	0.003	0.003	0.003	0.004	0.004	0.005
1 PACK ON—2 BLEED SOURCES	–0.003	–0.003	–0.003	–0.003	–0.004	–0.004	–0.004
1 PACK ON—1 BLEED SOURCE	–0.003	–0.003	–0.003	–0.003	–0.004	–0.004	–0.004
WING ANTI-ICE ON	–0.001	–0.001	–0.001	–0.002	–0.002	–0.002	–0.002

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Max Climb EPR

Based on engine bleed for packs on and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)/SPEED (IAS OR MACH)									
	0	5	10	15	20	25	30	35	40	43
	310	310	310	310	310	310	310	0.84	0.84	0.84
60	1.132	1.122	1.127	1.146	1.166	1.159	1.152	1.174	1.178	1.170
50	1.168	1.161	1.147	1.146	1.166	1.159	1.152	1.174	1.178	1.170
40	1.209	1.205	1.191	1.184	1.173	1.159	1.152	1.174	1.178	1.170
30	1.217	1.253	1.243	1.237	1.228	1.196	1.157	1.174	1.178	1.170
20	1.217	1.253	1.284	1.298	1.292	1.259	1.228	1.191	1.178	1.170
10	1.217	1.253	1.284	1.329	1.364	1.337	1.307	1.273	1.260	1.257
0	1.217	1.253	1.284	1.329	1.374	1.399	1.402	1.367	1.351	1.348
–10	1.217	1.253	1.284	1.329	1.374	1.399	1.434	1.482	1.468	1.465
–15 & BELOW	1.217	1.253	1.284	1.329	1.374	1.399	1.434	1.506	1.521	1.518

EPR Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)									
	0	5	10	15	20	25	30	35	40	43
ENGINE ONLY	–0.008	–0.010	–0.015	–0.015	–0.006	–0.005	–0.003	–0.003	–0.004	–0.005
ENGINE & WING 1	–0.010	–0.012	–0.018	–0.020	–0.012	–0.012	–0.011	–0.014	–0.017	–0.019
ENGINE & WING 2	–0.012	–0.014	–0.021	–0.025	–0.018	–0.019	–0.020	–0.024	–0.029	–0.033

Wing 1: Wing anti-ice on, packs on.
Wing 2: Wing anti-ice on, single bleed source and both packs off.

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Flight With Unreliable Airspeed/Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		160	200	240	280	320
40000 (.82M)	PITCH ATT V/S (FT/MIN)	3.5 1400	3.5 700			
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	4.5 2200	4.0 1600	4.0 1100	4.0 700	
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	7.0 3600	6.5 2700	6.5 2000	6.5 1500	6.5 1100
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	9.5 4400	8.5 3400	8.0 2600	7.5 2100	8.0 1600
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	12.0 5000	10.5 3900	9.5 3100	9.0 2500	9.0 2000

Cruise

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		160	200	240	280	320
40000 (.82M)	PITCH ATT EPR (Alt Mode %N1)	2.0 1.152 (82.1)	2.5 1.269 (86.1)			
35000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 1.081 (79.5)	2.0 1.136 (81.8)	2.5 1.214 (84.8)	3.0 1.362 (89.5)	
30000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 1.038 (76.4)	2.0 1.075 (78.3)	2.5 1.127 (80.8)	3.5 1.204 (84.2)	
25000 (280 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 1.010 (73.1)	2.0 1.038 (75.0)	3.0 1.077 (77.3)	3.5 1.130 (80.1)	4.0 1.202 (83.8)
20000 (270 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 0.995 (68.7)	2.5 1.017 (71.0)	3.0 1.047 (73.6)	4.0 1.088 (76.5)	5.0 1.142 (79.8)
15000 (270 KIAS)	PITCH ATT EPR (Alt Mode %N1)	1.5 0.983 (64.6)	2.5 1.001 (67.3)	3.0 1.024 (69.9)	4.0 1.053 (72.9)	5.0 1.091 (76.1)

Descent

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		160	200	240	280	320
40000 (.82M)	PITCH ATT V/S (FT/MIN)	–1.5 –2600	–0.5 –2500			
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –2200	–0.5 –2000	0.5 –1900	1.0 –1900	
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	–1.0 –1900	0.0 –1700	0.5 –1600	1.5 –1600	2.5 –1600
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –1700	–0.5 –1500	0.5 –1400	1.5 –1400	2.0 –1400
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	–2.0 –1500	–0.5 –1300	0.5 –1300	1.0 –1200	2.0 –1200

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Flight With Unreliable Airspeed/Turbulent Air Penetration
Altitude and/or vertical speed indications may also be unreliable.
Holding
Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		160	200	240	280	320
10000	PITCH ATT	4.0	4.5	5.0	5.0	4.5
	EPR	1.008	1.021	1.033	1.044	1.056
	(Alt Mode %N1)	(53.7)	(60.2)	(64.7)	(68.7)	(72.4)
	KIAS	201	217	234	253	272
5000	PITCH ATT	4.0	4.5	5.0	5.0	5.0
	EPR	1.003	1.013	1.022	1.030	1.038
	(Alt Mode %N1)	(49.7)	(55.1)	(60.8)	(64.7)	(68.3)
	KIAS	201	217	233	251	269

Terminal Area (5000 FT)
Set Thrust for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		160	200	240	280	320
FLAPS UP (GEAR UP) (VREF 30+80)	PITCH ATT	4.0	4.5	5.0	5.5	5.5
	EPR	1.002	1.012	1.024	1.039	1.052
	(Alt Mode %N1)	(49.4)	(54.9)	(60.8)	(65.0)	(68.7)
	KIAS	201	217	230	242	255
FLAPS 1 (GEAR UP) (VREF 30+60)	PITCH ATT	5.5	6.0	6.5	7.0	7.0
	EPR	1.018	1.030	1.046	1.063	1.080
	(Alt Mode %N1)	(50.4)	(56.6)	(62.3)	(66.7)	(70.5)
	KIAS	181	197	210	222	235
FLAPS 5 (GEAR UP) (VREF 30+40)	PITCH ATT	5.0	5.0	5.5	6.0	6.0
	EPR	1.029	1.046	1.065	1.084	1.103
	(Alt Mode %N1)	(50.8)	(58.1)	(63.4)	(67.9)	(71.6)
	KIAS	161	177	190	202	215
FLAPS 15 (GEAR UP) (VREF 30+20)	PITCH ATT	6.0	6.0	6.0	6.5	6.5
	EPR	1.044	1.064	1.088	1.113	1.135
	(Alt Mode %N1)	(52.6)	(60.1)	(65.6)	(70.1)	(73.8)
	KIAS	141	157	170	182	195
FLAPS 20 (GEAR DOWN) (VREF 30+20)	PITCH ATT	4.5	5.0	5.0	5.5	5.5
	EPR	1.072	1.101	1.133	1.168	1.202
	(Alt Mode %N1)	(60.4)	(66.9)	(72.0)	(76.2)	(79.8)
	KIAS	141	157	170	182	195

Final Approach (1500 FT)
Gear Down, Set Thrust for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		160	200	240	280	320
FLAPS 20 (VREF 20+10)	PITCH ATT	1.0	1.5	1.5	1.5	1.5
	EPR	1.006	1.010	1.015	1.022	1.028
	(Alt Mode %N1)	(39.4)	(43.6)	(47.6)	(51.3)	(54.6)
	KIAS	143	160	174	187	199
FLAPS 25 (VREF 25+10)	PITCH ATT	1.0	1.0	1.0	1.0	1.5
	EPR	1.031	1.042	1.056	1.072	1.088
	(Alt Mode %N1)	(47.6)	(53.0)	(58.8)	(63.3)	(67.1)
	KIAS	136	152	166	178	190
FLAPS 30 (VREF 30+10)	PITCH ATT	0.5	0.5	0.5	0.5	0.5
	EPR	1.051	1.069	1.089	1.109	1.134
	(Alt Mode %N1)	(53.0)	(60.2)	(65.1)	(69.2)	(73.3)
	KIAS	131	147	160	172	185

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Flight With Unreliable Airspeed/Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Go-Around

Flaps 20, Gear Up, Set Go-Around Thrust

Normal Mode

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		160	200	240	280	320
10000	PITCH ATT	16.5	13.0	10.5	9.5	7.5
	V/S (FT/MIN)	3600	2800	2200	1700	1300
	KIAS	141	157	170	182	198
5000	PITCH ATT	19.5	15.5	13.0	11.0	9.5
	V/S (FT/MIN)	4200	3400	2700	2200	1800
	KIAS	141	157	170	182	196
SEA LEVEL	PITCH ATT	23.0	18.0	15.0	13.0	11.0
	V/S (FT/MIN)	4800	3900	3200	2700	2200
	KIAS	141	157	170	182	195

Alternate Mode EEC

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		160	200	240	280	320
10000	PITCH ATT	16.5	13.0	10.5	9.5	7.5
	V/S (FT/MIN)	3600	2800	2200	1700	1300
	KIAS	141	157	170	182	198
5000	PITCH ATT	19.5	15.5	13.0	11.0	9.5
	V/S (FT/MIN)	4200	3400	2700	2200	1800
	KIAS	141	157	170	182	196
SEA LEVEL	PITCH ATT	23.0	18.0	15.0	13.0	11.0
	V/S (FT/MIN)	4800	3900	3200	2700	2200
	KIAS	141	157	170	182	195

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 10 deg. C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20(33°)	1.25(36°)	1.30(39°)	1.40(44°)	1.50(48°)
300	29700	0	33500*	33500*	33500*	33500*	32100
290	30500	–2	34300*	34300*	34300*	34300	32900
280	31200	–4	35200*	35200*	35200*	35100	33600
270	32000	–5	36100*	36100*	36100*	35800	34400
260	32800	–7	36700*	36700*	36700*	36600	35200
250	33700	–9	37500*	37500*	37500*	37400	36000
240	34500	–11	38300*	38300*	38300*	38300	36800
230	35400	–13	39100*	39100*	39100*	39100*	37700
220	36400	–15	40000*	40000*	40000*	40000*	38700
210	37300	–15	41000*	41000*	41000*	41000	39600
200	38300	–15	41900*	41900*	41900*	41900*	40600
190	39400	–15	42900*	42900*	42900*	42900*	41700
180	40500	–15	43100	43100	43100	43100	42800
170	41700	–15	43100	43100	43100	43100	43100
160	43000	–15	43100	43100	43100	43100	43100

ISA + 15 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20(33°)	1.25(36°)	1.30(39°)	1.40(44°)	1.50(48°)
300	29700	5	32400*	32400*	32400*	32400*	32100
290	30500	4	33300*	33300*	33300*	33300*	32900
280	31200	2	34200*	34200*	34200*	34200*	33600
270	32000	0	35100*	35100*	35100*	35100*	34400
260	32800	–2	36100*	36100*	36100*	36100*	35200
250	33700	–3	36700*	36700*	36700*	36700*	36000
240	34500	–5	37500*	37500*	37500*	37500*	36800
230	35400	–7	38300*	38300*	38300*	38300*	37700
220	36400	–9	39200*	39200*	39200*	39200*	38700
210	37300	–9	40100*	40100*	40100*	40100*	39600
200	38300	–9	41100*	41100*	41100*	41100*	40600
190	39400	–9	42100*	42100*	42100*	42100*	41700
180	40500	–9	43100	43100	43100	43100	42800
170	41700	–9	43100	43100	43100	43100	43100
160	43000	–9	43100	43100	43100	43100	43100

*Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust
ISA + 20 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20(33°)	1.25(36°)	1.30(39°)	1.40(44°)	1.50(48°)
300	29700	11	30900*	30900*	30900*	30900*	30900*
290	30500	9	31900*	31900*	31900*	31900*	31900*
280	31200	8	32900*	32900*	32900*	32900*	32900*
270	32000	6	33800*	33800*	33800*	33800*	33800*
260	32800	4	34800*	34800*	34800*	34800*	34800*
250	33700	2	35800*	35800*	35800*	35800*	35800*
240	34500	0	36500*	36500*	36500*	36500*	36500*
230	35400	–2	37400*	37400*	37400*	37400*	37400*
220	36400	–3	38200*	38200*	38200*	38200*	38200*
210	37300	–3	39100*	39100*	39100*	39100*	39100*
200	38300	–3	40000*	40000*	40000*	40000*	40000*
190	39400	–3	41000*	41000*	41000*	41000*	41000*
180	40500	–3	42100*	42100*	42100*	42100*	42100*
170	41700	–3	43100	43100	43100	43100	43100
160	43000	–3	43100	43100	43100	43100	43100

***Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.**

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Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		25	27	29	31	33	35	37	39	41	43
300	EPR	1.112	1.138	**1.173**	**1.235**	1.329					
	MACH	.772	.802	**.834**	**.838**	.837					
	KIAS	325	325	**325**	**313**	299					
	FF/ENG	4494	4550	**4631**	**4638**	4719					
280	EPR	1.092	1.116	1.147	**1.189**	**1.257**	1.370				
	MACH	.772	.802	.827	**.838**	**.838**	.836				
	KIAS	325	325	322	**313**	**299**	286				
	FF/ENG	4291	4359	4377	**4329**	**4323**	4451				
260	EPR	1.075	1.096	1.122	1.156	**1.203**	1.279	1.415			
	MACH	.767	.790	.813	.830	**.839**	.837	.836			
	KIAS	322	319	316	310	**300**	286	273			
	FF/ENG	4089	4074	4085	4047	**4007**	4014	4216			
240	EPR	1.060	1.079	1.101	1.129	**1.164**	**1.216**	1.300			
	MACH	.744	.769	.792	.815	**.832**	**.839**	.837			
	KIAS	312	310	307	304	**297**	**287**	273			
	FF/ENG	3789	3763	3757	3760	**3721**	**3688**	3729			
220	EPR	1.048	1.063	1.082	1.105	1.133	**1.170**	**1.226**	1.316		
	MACH	.718	.745	.769	.794	.817	**.833**	**.839**	.837		
	KIAS	301	300	298	295	291	**284**	**274**	261		
	FF/ENG	3482	3465	3441	3440	3436	**3399**	**3392**	3462		
200	EPR	1.036	1.049	1.064	1.083	1.107	1.136	**1.174**	**1.232**	1.322	
	MACH	.689	.716	.743	.768	.793	.816	**.833**	**.839**	.837	
	KIAS	288	287	286	284	282	278	**272**	**261**	249	
	FF/ENG	3168	3159	3143	3122	3121	3116	**3102**	**3116**	3181	
180	EPR	1.024	1.036	1.049	1.064	1.083	1.107	1.136	**1.175**	**1.231**	1.319
	MACH	.660	.684	.711	.739	.765	.790	.814	**.832**	**.839**	.837
	KIAS	275	274	273	273	271	268	265	**259**	**250**	238
	FF/ENG	2918	2900	2888	2825	2806	2802	2816	**2826**	**2837**	2888
160	EPR	1.013	1.023	1.035	1.048	1.063	1.081	1.105	1.134	**1.172**	**1.222**
	MACH	.627	.652	.676	.703	.731	.759	.784	.809	**.828**	**.838**
	KIAS	260	260	259	258	258	256	254	251	**246**	**238**
	FF/ENG	2614	2596	2577	2518	2508	2493	2500	2535	**2550**	**2553**

Boldface area approximates optimum altitude.

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Long Range Cruise Enroute Fuel and Time—Low Altitude
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
287	265	245	228	213	200	190	181	173	166	160
572	528	489	455	426	400	382	365	349	335	322
858	792	733	683	639	600	573	548	525	503	484
1146	1057	978	911	852	800	764	731	700	672	646
1434	1322	1223	1139	1066	1000	955	914	875	840	808
1723	1588	1468	1367	1279	1200	1146	1096	1049	1007	969
2013	1855	1715	1596	1492	1400	1337	1278	1225	1176	1131
2305	2123	1962	1825	1706	1600	1528	1460	1399	1343	1292
2597	2391	2209	2054	1920	1800	1719	1643	1574	1511	1453
2891	2661	2456	2283	2134	2000	1909	1825	1748	1678	1614

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	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	3.8	0:40	3.2	0:38	2.7	0:36	2.3	0:35	2.1	0:34
400	7.8	1:16	6.8	1:12	6.0	1:08	5.4	1:05	5.0	1:02
600	11.8	1:52	10.5	1:47	9.4	1:39	8.5	1:35	7.8	1:30
800	15.7	2:28	14.3	2:21	12.7	2:11	11.6	2:04	10.7	1:58
1000	19.7	3:05	18.0	2:56	15.9	2:43	14.7	2:35	13.5	2:27
1200	23.7	3:42	21.6	3:31	19.2	3:15	17.7	3:05	16.3	2:55
1400	27.6	4:19	25.3	4:06	22.4	3:48	20.7	3:35	19.1	3:24
1600	31.5	4:57	28.9	4:42	25.6	4:20	23.7	4:06	21.9	3:53
1800	35.4	5:35	32.4	5:18	28.7	4:53	26.7	4:37	24.7	4:22
2000	39.2	6:13	36.0	5:55	31.8	5:26	29.6	5:08	27.4	4:51

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)			
	150	200	250	300
5	–0.4	0.0	0.5	1.1
10	–0.8	0.0	1.2	2.6
15	–1.3	0.0	1.9	4.0
20	–1.8	0.0	2.6	5.5
25	–2.3	0.0	3.2	6.9
30	–2.9	0.0	3.8	8.2
35	–3.5	0.0	4.3	9.6
40	–4.1	0.0	4.9	10.9
45	–4.7	0.0	5.4	12.2
50	–5.3	0.0	5.9	13.5

Based on Long Range Cruise and .84/310/250 descent.

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Long Range Cruise Enroute Fuel and Time—High Altitude
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
1307	1232	1165	1104	1050	1000	959	921	886	853	823
1961	1849	1746	1656	1575	1500	1439	1382	1329	1280	1235
2618	2468	2330	2209	2100	2000	1918	1842	1771	1706	1647
3278	3088	2916	2763	2626	2500	2398	2303	2215	2133	2058
3943	3713	3504	3319	3152	3000	2877	2762	2656	2558	2469
4611	4340	4093	3875	3679	3500	3356	3222	3098	2983	2878
5282	4969	4684	4432	4207	4000	3835	3681	3538	3407	3287
5958	5601	5277	4991	4734	4500	4313	4139	3978	3830	3694
6638	6236	5871	5550	5263	5000	4792	4598	4418	4252	4101
7323	6875	6469	6111	5792	5500	5270	5055	4857	4673	4506
8012	7517	7068	6673	6321	6000	5747	5512	5294	5094	4911
8707	8163	7670	7237	6852	6500	6224	5968	5731	5513	5314
9407	8813	8275	7803	7383	7000	6702	6424	6167	5931	5716
10113	9466	8881	8369	7914	7500	7178	6879	6602	6348	6116
10824	10124	9491	8938	8447	8000	7654	7333	7036	6763	6515

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)
1000	13.2	2:24	12.7	2:21	12.3	2:18	12.0	2:15	11.8	2:13
1500	20.0	3:35	19.3	3:29	18.8	3:25	18.4	3:20	17.9	3:17
2000	26.9	4:46	25.8	4:39	25.1	4:32	24.5	4:26	24.0	4:21
2500	33.5	5:59	32.2	5:49	31.2	5:41	30.5	5:33	29.9	5:26
3000	40.1	7:13	38.4	7:01	37.3	6:50	36.4	6:41	35.7	6:32
3500	46.5	8:29	44.5	8:14	43.2	8:00	42.1	7:49	41.3	7:38
4000	52.8	9:46	50.5	9:28	49.0	9:12	47.8	8:58	46.8	8:45
4500	58.9	11:04	56.5	10:43	54.8	10:25	53.3	10:09	52.2	9:53
5000	64.9	12:23	62.3	12:00	60.5	11:39	58.8	11:20	57.5	11:02
5500	70.8	13:45	68.1	13:18	66.0	12:54	64.2	12:32	62.8	12:12
6000	76.5	15:07	73.7	14:37	71.5	14:11	69.5	13:46	67.9	13:23
6500	82.2	16:32	79.2	15:58	76.8	15:29	74.7	15:01	73.0	14:34
7000	87.8	17:58	84.5	17:21	82.0	16:48	79.8	16:18	77.9	15:48
7500	93.3	19:26	89.8	18:45	87.1	18:09	84.7	17:35	82.8	17:02
8000	98.7	20:56	95.0	20:11	92.1	19:31	89.6	18:55	87.5	18:18

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)			
	150	200	250	300
10	–1.1	0.0	2.2	8.7
20	–2.5	0.0	4.2	13.7
30	–3.8	0.0	6.2	18.3
40	–5.2	0.0	8.0	22.5
50	–6.5	0.0	9.6	26.3
60	–7.9	0.0	11.2	29.6
70	–9.3	0.0	12.7	32.5
80	–10.7	0.0	14.1	35.0
90	–12.1	0.0	15.4	37.1
100	–13.5	0.0	16.5	38.8
110	–14.9	0.0	17.6	40.0

Based on Long Range Cruise and .84/310/250 descent.

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Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)							
	300	280	260	240	220	200	180	160
43						38	10	0
41					37	11	0	3
39				34	11	0	2	12
37		59	29	10	0	1	9	25
35	46	22	7	0	1	8	21	39
33	16	5	0	2	8	20	36	55
31	3	0	2	9	20	34	51	70
29	0	3	10	20	33	48	66	85
27	5	12	21	33	47	63	80	99
25	14	23	35	47	62	78	94	112

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.**

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Descent at .84/310/250

PRESSURE ALT (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	94	101	109	116	122	127	133	139	144	149
TIME (MINUTES)	20	21	22	23	23	24	25	25	26	27

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Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
300	EPR	1.026	1.034	1.050	1.064	1.080	1.127	1.201			
	KIAS	260	260	262	277	302	306	311			
	FF/ENG	4340	4300	4200	4220	4410	4500	4700			
280	EPR	1.023	1.030	1.044	1.061	1.073	1.113	1.174	1.362		
	KIAS	251	251	253	261	286	295	299	279		
	FF/ENG	4060	4020	3920	3900	4040	4150	4300	4540		
260	EPR	1.020	1.026	1.038	1.058	1.070	1.099	1.152	1.276		
	KIAS	242	242	243	246	266	283	287	279		
	FF/ENG	3790	3740	3720	3590	3680	3820	3940	4090		
240	EPR	1.017	1.022	1.033	1.050	1.067	1.082	1.132	1.214		
	KIAS	232	233	234	235	247	272	275	279		
	FF/ENG	3590	3460	3500	3370	3400	3490	3570	3750		
220	EPR	1.013	1.018	1.028	1.042	1.063	1.075	1.114	1.178	1.374	
	KIAS	224	224	224	224	230	251	262	266	249	
	FF/ENG	3320	3270	3220	3090	3090	3120	3230	3340	3630	
200	EPR	1.009	1.013	1.021	1.033	1.054	1.071	1.095	1.150	1.269	
	KIAS	217	217	217	217	217	229	249	253	249	
	FF/ENG	3050	3000	2950	2890	2800	2840	2900	2990	3190	
180	EPR	1.005	1.008	1.014	1.024	1.040	1.066	1.080	1.125	1.203	1.312
	KIAS	209	209	209	209	209	209	230	239	242	232
	FF/ENG	2860	2740	2690	2620	2590	2520	2550	2630	2820	2940
160	EPR	1.001	1.003	1.008	1.016	1.028	1.048	1.073	1.102	1.163	1.222
	KIAS	201	201	201	201	201	201	206	224	227	229
	FF/ENG	2610	2550	2440	2360	2320	2240	2260	2350	2490	2570

This table includes 5% additional fuel for holding in a racetrack pattern.

Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)				
		1500	5000	10000	15000	20000
300	EPR	1.058	1.071	1.098	1.137	1.195
	KIAS	229	229	229	229	229
	FF/ENG	4640	4490	4520	4500	4530
280	EPR	1.052	1.063	1.086	1.122	1.173
	KIAS	222	222	222	222	222
	FF/ENG	4320	4280	4190	4170	4180
260	EPR	1.044	1.055	1.074	1.105	1.149
	KIAS	216	216	216	216	216
	FF/ENG	4010	3960	3860	3830	3840
240	EPR	1.037	1.046	1.062	1.088	1.126
	KIAS	210	210	210	210	210
	FF/ENG	3700	3650	3630	3560	3570
220	EPR	1.030	1.038	1.052	1.073	1.106
	KIAS	204	204	204	204	204
	FF/ENG	3460	3420	3390	3250	3250
200	EPR	1.024	1.031	1.043	1.060	1.087
	KIAS	197	197	197	197	197
	FF/ENG	3160	3120	3080	2950	2930
180	EPR	1.019	1.024	1.035	1.048	1.069
	KIAS	189	189	189	189	189
	FF/ENG	2870	2820	2790	2720	2630
160	EPR	1.014	1.018	1.026	1.038	1.054
	KIAS	181	181	181	181	181
	FF/ENG	2650	2600	2500	2430	2400

This table includes 5% additional fuel for holding in a racetrack pattern.

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Reported Braking Action

RUNWAY CONDITION CODE	RUNWAY DESCRIPTION	REPORTED BRAKING ACTION
6	Dry	Dry
5	Wet (Smooth, Grooved or PFC) or Frost 3 mm (0.12 inches) or less of: Water, Slush, Dry Snow or Wet Snow	Good
4	Compacted Snow at or below –15 deg. C OAT	Good to Medium
3	Wet (Slippery), Dry Snow or Wet Snow (any depth) over Compacted Snow Greater than 3 mm (0.12 inches) of : Dry Snow or Wet Snow Compacted Snow at OAT warmer than –15 deg. C	Medium
2	Greater than 3 mm (0.12 inches) of: Water or Slush	Medium to Poor
1	Ice	Poor
0	Wet Ice, Water on top of Compacted Snow, Dry Snow or Wet Snow over Ice	Nil

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Normal Configuration Operational Landing Distance
Flaps 30

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF 30	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1375	30/–15	30	–45/165	15/–15	30/–30	45	15	40
AUTOBRAKE MAX	1740	25/–25	35	–65/220	0/0	40/–40	80	0	0
AUTOBRAKE 4	2130	35/–35	50	–90/305	5/–5	50/–50	100	0	0
AUTOBRAKE 3	2520	40/–40	65	–110/380	10/–10	65/–70	120	0	0
AUTOBRAKE 2	2820	45/–45	75	–130/445	15/–40	75/–75	120	5	5
AUTOBRAKE 1	3040	50/–50	85	–145/500	50/–75	80/–80	110	115	115
Good Reported Braking Action									
MAX MANUAL	1805	25/–25	40	–75/270	40/–35	40/–40	65	70	160
AUTOBRAKE MAX	1910	30/–30	45	–80/280	35/–35	40/–40	75	75	175
AUTOBRAKE 4	2135	35/–35	50	–90/310	10/–10	50/–50	100	5	30
AUTOBRAKE 3	2520	40/–40	65	–110/380	10/–10	65/–70	120	0	0
AUTOBRAKE 2	2820	45/–45	75	–130/445	15/–40	75/–75	120	5	5
AUTOBRAKE 1	3040	50/–50	85	–145/500	50/–75	80/–80	110	115	115
Good To Medium Reported Braking Action									
MAX MANUAL	2100	30/–30	55	–100/355	70/–60	50/–50	70	140	330
AUTOBRAKE MAX	2165	35/–35	60	–100/360	65/–55	50/–50	85	140	330
AUTOBRAKE 4	2290	35/–35	60	–105/375	60/–45	55/–55	90	110	270
AUTOBRAKE 3	2585	45/–40	65	–120/425	40/–25	65/–70	120	55	180
AUTOBRAKE 2	2850	45/–45	80	–140/470	35/–50	75/–75	120	35	115
AUTOBRAKE 1	3055	50/–55	90	–145/520	70/–80	80/–80	110	130	175
Medium Reported Braking Action									
MAX MANUAL	2400	40/–40	70	–120/445	105/–80	60/–60	80	205	500
AUTOBRAKE MAX	2420	40/–40	70	–120/445	100/–75	60/–60	90	200	490
AUTOBRAKE 4	2440	40/–40	70	–120/445	110/–80	60/–60	85	215	510
AUTOBRAKE 3	2650	45/–40	70	–130/465	70/–40	70/–70	120	110	355
AUTOBRAKE 2	2885	45/–45	80	–145/500	60/–60	75/–75	120	65	225
AUTOBRAKE 1	3075	50/–60	90	–150/535	85/–85	80/–80	110	145	235
Medium To Poor Reported Braking Action									
MAX MANUAL	2735	50/–50	85	–150/565	175/–120	70/–70	85	330	845
AUTOBRAKE MAX	2745	50/–50	85	–150/565	175/–120	70/–70	90	325	840
AUTOBRAKE 4	2765	50/–50	85	–150/570	180/–125	70/–70	90	335	855
AUTOBRAKE 3	2880	50/–50	85	–160/580	160/–90	75/–75	115	280	775
AUTOBRAKE 2	3055	50/–50	90	–165/605	135/–100	80/–80	120	205	650
AUTOBRAKE 1	3205	60/–60	100	–170/630	155/–120	85/–85	110	265	620
Poor Reported Braking Action									
MAX MANUAL	3070	60/–60	100	–180/690	245/–160	80/–80	90	450	1190
AUTOBRAKE MAX	3075	60/–60	100	–180/690	245/–165	80/–80	90	450	1190
AUTOBRAKE 4	3090	60/–60	100	–185/695	245/–165	80/–80	90	455	1200
AUTOBRAKE 3	3115	60/–60	100	–185/695	245/–145	80/–80	110	450	1195
AUTOBRAKE 2	3230	60/–60	100	–185/705	215/–140	85/–85	120	345	1075
AUTOBRAKE 1	3340	65/–65	105	–190/725	225/–155	85/–85	110	385	1005

Reference distance is based on sea level, standard day, no wind or slope, VREF 30 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 70 m.
For autobrake and manual speedbrakes, increase reference landing distance by 60 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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Normal Configuration Operational Landing Distance
Flaps 25

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF 25	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1445	35/–15	30	–50/175	15/–15	30/–30	45	25	50
AUTOBRAKE MAX	1830	25/–25	40	–70/225	0/0	40/–40	80	0	0
AUTOBRAKE 4	2265	35/–35	60	–90/315	5/–5	60/–60	105	0	0
AUTOBRAKE 3	2690	40/–45	70	–115/395	10/–10	70/–70	125	0	0
AUTOBRAKE 2	2985	50/–50	85	–130/460	30/–50	80/–80	120	30	30
AUTOBRAKE 1	3200	60/–60	100	–150/510	65/–80	85/–85	110	175	180
Good Reported Braking Action									
MAX MANUAL	1870	30/–30	45	–80/270	45/–40	40/–40	65	85	190
AUTOBRAKE MAX	1990	30/–30	45	–80/280	40/–35	45/–45	75	85	200
AUTOBRAKE 4	2270	35/–35	60	–90/320	10/–10	60/–60	105	5	30
AUTOBRAKE 3	2690	40/–45	70	–115/395	10/–10	70/–70	125	0	0
AUTOBRAKE 2	2985	50/–50	85	–130/460	30/–50	80/–80	120	30	30
AUTOBRAKE 1	3200	60/–60	100	–150/510	65/–80	85/–85	110	175	180
Good To Medium Reported Braking Action									
MAX MANUAL	2180	35/–35	60	–100/360	75/–65	50/–50	70	160	385
AUTOBRAKE MAX	2255	35/–35	60	–105/365	70/–55	55/–55	85	160	385
AUTOBRAKE 4	2405	35/–35	65	–110/390	60/–40	60/–60	100	120	310
AUTOBRAKE 3	2745	45/–45	70	–125/440	40/–25	70/–70	125	55	195
AUTOBRAKE 2	3020	50/–50	85	–140/490	50/–60	80/–80	120	55	145
AUTOBRAKE 1	3215	60/–60	100	–150/530	80/–90	85/–85	110	185	240
Medium Reported Braking Action									
MAX MANUAL	2495	40/–40	70	–120/450	105/–85	65/–65	80	235	580
AUTOBRAKE MAX	2520	40/–40	75	–125/450	100/–75	65/–65	90	230	570
AUTOBRAKE 4	2545	40/–40	75	–125/455	105/–70	65/–65	100	235	590
AUTOBRAKE 3	2805	45/–45	75	–130/485	70/–40	75/–75	125	110	390
AUTOBRAKE 2	3055	50/–50	85	–145/520	70/–70	80/–80	120	80	265
AUTOBRAKE 1	3230	60/–60	100	–155/545	100/–100	85/–85	110	200	305
Medium To Poor Reported Braking Action									
MAX MANUAL	2835	50/–50	85	–150/575	175/–125	70/–70	85	370	980
AUTOBRAKE MAX	2855	50/–50	90	–155/575	175/–120	70/–70	90	370	980
AUTOBRAKE 4	2875	50/–50	90	–155/580	175/–120	70/–70	95	375	995
AUTOBRAKE 3	3025	50/–50	90	–160/595	155/–90	80/–80	125	295	885
AUTOBRAKE 2	3220	60/–60	95	–165/620	145/–110	85/–85	120	235	750
AUTOBRAKE 1	3360	60/–60	105	–175/640	165/–130	90/–90	110	325	740
Poor Reported Braking Action									
MAX MANUAL	3175	60/–60	105	–185/700	245/–160	80/–80	90	505	1380
AUTOBRAKE MAX	3190	60/–60	105	–185/700	255/–165	80/–80	90	505	1385
AUTOBRAKE 4	3205	60/–60	105	–185/700	245/–165	80/–80	90	510	1395
AUTOBRAKE 3	3245	60/–60	105	–185/705	240/–140	85/–85	120	485	1375
AUTOBRAKE 2	3385	65/–65	105	–190/720	220/–150	85/–85	115	385	1230
AUTOBRAKE 1	3485	65/–65	110	–195/735	230/–160	90/–90	110	450	1175

Reference distance is based on sea level, standard day, no wind or slope, VREF 25 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 75 m.
For autobrake and manual speedbrakes, increase reference landing distance by 65 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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Normal Configuration Operational Landing Distance
Flaps 20

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF 20	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1540	40/–25	35	–50/180	15/–15	30/–30	50	30	65
AUTOBRAKE MAX	1950	30/–30	45	–70/235	0/0	45/–45	80	0	0
AUTOBRAKE 4	2440	35/–40	65	–100/330	0/–5	65/–65	110	0	0
AUTOBRAKE 3	2920	45/–45	80	–120/415	10/–15	80/–80	130	0	0
AUTOBRAKE 2	3245	60/–60	90	–145/475	30/–50	85/–85	125	40	40
AUTOBRAKE 1	3475	65/–65	110	–160/535	70/–85	100/–100	120	195	200
Good Reported Braking Action									
MAX MANUAL	2000	30/–30	50	–80/280	45/–40	45/–45	65	100	230
AUTOBRAKE MAX	2120	30/–35	50	–85/295	40/–35	45/–50	75	105	240
AUTOBRAKE 4	2445	35/–40	65	–100/340	5/–10	65/–65	110	5	35
AUTOBRAKE 3	2920	45/–45	80	–120/415	10/–15	80/–80	130	0	0
AUTOBRAKE 2	3245	60/–60	90	–145/475	30/–50	85/–85	125	40	40
AUTOBRAKE 1	3475	65/–65	110	–160/535	70/–85	100/–100	120	195	200
Good To Medium Reported Braking Action									
MAX MANUAL	2345	35/–35	65	–105/375	80/–65	60/–60	75	190	465
AUTOBRAKE MAX	2410	35/–40	65	–105/380	75/–60	60/–60	85	185	465
AUTOBRAKE 4	2595	40/–45	70	–115/405	60/–45	65/–65	105	140	370
AUTOBRAKE 3	2975	50/–50	85	–130/455	40/–30	80/–80	130	65	235
AUTOBRAKE 2	3275	60/–60	95	–150/510	50/–65	90/–90	125	70	180
AUTOBRAKE 1	3490	65/–65	110	–165/550	85/–95	100/–100	120	210	275
Medium Reported Braking Action									
MAX MANUAL	2690	45/–45	80	–125/465	115/–90	70/–70	85	280	700
AUTOBRAKE MAX	2700	45/–45	80	–125/465	110/–80	70/–70	100	270	690
AUTOBRAKE 4	2740	45/–45	80	–130/470	110/–75	70/–70	105	275	700
AUTOBRAKE 3	3035	50/–50	85	–145/500	70/–45	80/–80	130	125	470
AUTOBRAKE 2	3310	60/–60	100	–155/540	75/–75	90/–90	125	100	315
AUTOBRAKE 1	3505	65/–65	110	–165/570	105/–105	100/–100	120	225	345
Medium To Poor Reported Braking Action									
MAX MANUAL	3060	55/–55	100	–160/595	190/–135	80/–80	90	440	1185
AUTOBRAKE MAX	3070	60/–55	100	–160/595	190/–130	80/–80	100	435	1180
AUTOBRAKE 4	3100	60/–55	100	–160/600	185/–125	80/–80	100	440	1195
AUTOBRAKE 3	3270	60/–60	100	–170/615	160/–100	85/–85	130	345	1060
AUTOBRAKE 2	3485	65/–65	105	–180/645	150/–115	95/–95	125	275	905
AUTOBRAKE 1	3640	65/–65	115	–185/665	175/–135	100/–100	120	370	875
Poor Reported Braking Action									
MAX MANUAL	3435	65/–65	115	–190/725	265/–180	85/–85	100	600	1670
AUTOBRAKE MAX	3435	70/–65	115	–190/725	270/–180	85/–85	100	600	1675
AUTOBRAKE 4	3460	70/–65	115	–190/725	265/–180	90/–90	100	605	1685
AUTOBRAKE 3	3510	70/–65	115	–195/730	255/–150	90/–90	125	565	1650
AUTOBRAKE 2	3660	70/–70	115	–200/750	230/–155	100/–100	125	450	1495
AUTOBRAKE 1	3775	70/–70	120	–205/765	240/–165	100/–100	120	510	1405

Reference distance is based on sea level, standard day, no wind or slope, VREF 20 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 75 m.
For autobrake and manual speedbrakes, increase reference landing distance by 70 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
Airspeed Unreliable (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1535	40/–20	35	–50/170	20/–20	35/–35	N/A	35	75
AUTOBRAKE MAX	1840	25/–25	45	–65/215	0/0	45/–45	N/A	0	0
AUTOBRAKE 2	3165	50/–55	90	–135/445	0/–30	90/–90	N/A	5	5
Good Reported Braking Action									
MAX MANUAL	2105	30/–30	55	–80/280	55/–50	50/–50	N/A	135	310
AUTOBRAKE MAX	2125	30/–35	55	–85/285	50/–45	50/–50	N/A	130	310
AUTOBRAKE 2	3165	50/–55	90	–135/445	0/–30	90/–90	N/A	5	5
Good To Medium Reported Braking Action									
MAX MANUAL	2455	40/–40	70	–105/365	95/–75	60/–60	N/A	245	620
AUTOBRAKE MAX	2465	40/–45	70	–105/370	95/–80	65/–65	N/A	245	615
AUTOBRAKE 2	3200	50/–55	90	–140/475	30/–40	90/–90	N/A	50	270
Medium Reported Braking Action									
MAX MANUAL	2800	50/–50	85	–125/450	130/–100	70/–70	N/A	355	925
AUTOBRAKE MAX	2800	50/–50	85	–125/450	135/–110	75/–75	N/A	355	920
AUTOBRAKE 3	2955	50/–50	85	–135/465	95/–45	80/–80	N/A	235	815
Medium To Poor Reported Braking Action									
MAX MANUAL	3170	60/–60	105	–155/570	205/–145	85/–85	N/A	540	1530
AUTOBRAKE MAX	3175	60/–60	105	–155/570	215/–155	85/–85	N/A	540	1535
AUTOBRAKE 3	3265	60/–60	105	–160/580	190/–110	90/–90	N/A	480	1480
Poor Reported Braking Action									
MAX MANUAL	3535	70/–65	120	–185/685	280/–190	95/–95	N/A	720	2135
AUTOBRAKE MAX	3550	70/–65	125	–185/690	290/–195	95/–95	N/A	725	2145
AUTOBRAKE 3	3570	70/–65	125	–185/690	280/–175	95/–95	N/A	720	2145

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	2170	35/–35	60	–105/390	90/–75	55/–55	70	205	505
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2170	35/–35	60	–105/390	90/–75	55/–55	70	205	505
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2465	45/–45	75	–135/500	155/–110	65/–65	75	325	855
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2760	50/–50	90	–160/610	215/–140	70/–70	80	440	1200
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	3265	65/–65	110	–220/915	495/–245	85/–85	85	800	2715
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3770	80/–75	130	–280/1215	775/–345	95/–95	90	1160	4225
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	2085	35/–35	60	–105/385	90/–70	50/–50	70	180	435
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2085	35/–35	60	–105/385	90/–70	50/–50	70	180	435
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2375	45/–45	75	–130/495	155/–105	60/–60	75	285	735
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2665	50/–50	85	–155/600	215/–140	70/–70	80	390	1035
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	**3160**	**65/–60**	**105**	**–215/905**	**490/–240**	**85/–85**	**85**	**725**	**2380**
AUTOBRAKE MAX	**Autobrake inoperative**								
AUTOBRAKE 3	**Autobrake inoperative**								
Medium To Poor Reported Braking Action									
MAX MANUAL	3160	65/–60	105	–215/905	490/–240	85/–85	85	725	2380
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3655	75/–70	125	–275/1205	765/–340	95/–95	90	1060	3720
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG SHUTDOWN L, R (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1355	35/–20	30	–45/160	20/–15	30/–30	45	0	30
AUTOBRAKE MAX	1695	25/–25	40	–60/205	0/0	40/–40	70	0	0
AUTOBRAKE 2	2845	45/–50	80	–125/420	10/–10	80/–80	135	0	0
Good Reported Braking Action									
MAX MANUAL	1805	25/–25	45	–75/260	50/–40	45/–45	60	0	105
AUTOBRAKE MAX	1920	30/–30	50	–80/270	40/–35	45/–45	70	0	115
AUTOBRAKE 2	2845	45/–50	80	–125/420	10/–10	80/–80	135	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2170	35/–35	60	–100/350	90/–70	55/–55	75	0	225
AUTOBRAKE MAX	2235	40/–40	65	–105/355	85/–65	60/–60	85	0	230
AUTOBRAKE 2	2890	50/–50	85	–135/455	45/–25	80/–80	135	0	85
Medium Reported Braking Action									
MAX MANUAL	2535	45/–45	75	–125/440	130/–100	65/–65	85	0	345
AUTOBRAKE MAX	2550	45/–45	75	–125/440	125/–90	70/–70	95	0	340
AUTOBRAKE 3	2720	45/–45	75	–130/455	100/–60	75/–75	115	0	275
Medium To Poor Reported Braking Action									
MAX MANUAL	2975	55/–55	95	–160/575	230/–155	80/–80	95	0	605
AUTOBRAKE MAX	2980	55/–55	95	–160/575	230/–155	85/–85	100	0	600
AUTOBRAKE 3	3085	55/–55	95	–165/585	220/–140	85/–85	110	0	575
Poor Reported Braking Action									
MAX MANUAL	3410	65/–65	110	–190/710	330/–210	95/–95	100	0	860
AUTOBRAKE MAX	3410	65/–65	110	–190/710	335/–215	95/–95	100	0	860
AUTOBRAKE 3	3450	65/–65	110	–195/715	335/–215	95/–95	100	0	870

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG SHUTDOWN L, R (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1205	30/–15	25	–40/145	15/–15	25/–25	40	0	20
AUTOBRAKE MAX	1510	20/–20	30	–55/190	0/0	35/–35	70	0	0
AUTOBRAKE 2	2450	40/–40	65	–115/385	10/–10	65/–65	125	0	0
Good Reported Braking Action									
MAX MANUAL	1610	25/–25	40	–70/245	40/–35	35/–35	55	0	75
AUTOBRAKE MAX	1715	25/–25	40	–75/255	35/–30	40/–40	70	0	80
AUTOBRAKE 2	2450	40/–40	65	–115/385	10/–10	65/–65	125	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1920	30/–30	50	–95/330	80/–65	45/–45	65	0	160
AUTOBRAKE MAX	1980	35/–35	55	–95/335	75/–55	50/–50	80	0	160
AUTOBRAKE 2	2495	45/–45	70	–120/415	40/–25	70/–70	125	0	65
Medium Reported Braking Action									
MAX MANUAL	2230	35/–35	60	–115/410	115/–90	55/–55	75	0	240
AUTOBRAKE MAX	2245	40/–40	65	–115/415	110/–80	60/–60	90	0	235
AUTOBRAKE 3	2365	40/–40	65	–120/425	90/–55	65/–65	105	0	195
Medium To Poor Reported Braking Action									
MAX MANUAL	2600	45/–45	75	–145/540	205/–140	70/–70	85	0	415
AUTOBRAKE MAX	2610	50/–50	80	–150/545	205/–135	70/–70	90	0	415
AUTOBRAKE 3	2685	50/–50	80	–150/550	195/–120	75/–75	100	0	400
Poor Reported Braking Action									
MAX MANUAL	2970	55/–55	90	–175/665	290/–185	80/–80	90	0	590
AUTOBRAKE MAX	2975	55/–55	90	–180/670	295/–185	80/–80	90	0	590
AUTOBRAKE 3	3005	55/–55	90	–180/670	295/–185	80/–80	90	0	600

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAP/SLAT CONTROL (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1330	30/–20	30	–45/155	15/–15	25/–25	40	25	55
AUTOBRAKE MAX	1695	25/–25	40	–60/205	0/0	40/–40	70	0	0
AUTOBRAKE 2	2800	50/–50	80	–125/415	30/–50	75/–75	100	45	45
Good Reported Braking Action									
MAX MANUAL	1720	25/–25	45	–70/245	40/–35	40/–40	55	85	190
AUTOBRAKE MAX	1830	25/–25	45	–75/255	35/–30	40/–40	65	90	200
AUTOBRAKE 2	2800	50/–50	80	–125/415	30/–50	75/–75	100	45	45
Good To Medium Reported Braking Action									
MAX MANUAL	2010	35/–35	55	–90/325	70/–60	50/–50	65	160	385
AUTOBRAKE MAX	2080	35/–35	60	–95/330	65/–50	50/–50	75	160	385
AUTOBRAKE 2	2830	50/–50	80	–130/440	50/–60	75/–75	100	70	160
Medium Reported Braking Action									
MAX MANUAL	2300	40/–40	65	–110/400	95/–80	55/–55	70	235	580
AUTOBRAKE MAX	2325	40/–40	70	–110/400	90/–70	60/–60	80	230	570
AUTOBRAKE 3	2625	45/–45	75	–120/435	60/–40	70/–70	110	100	370
Medium To Poor Reported Braking Action									
MAX MANUAL	2620	50/–50	80	–140/515	160/–115	65/–65	75	365	980
AUTOBRAKE MAX	2635	50/–50	85	–140/515	160/–110	70/–70	85	365	975
AUTOBRAKE 3	2820	50/–50	85	–145/535	135/–85	75/–75	110	280	860
Poor Reported Braking Action									
MAX MANUAL	2935	55/–55	95	–165/625	225/–150	75/–75	80	495	1375
AUTOBRAKE MAX	2940	55/–55	95	–165/625	225/–150	75/–75	85	495	1375
AUTOBRAKE 3	3015	55/–55	95	–165/630	210/–125	80/–80	110	455	1345

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (Flaps ≤ 5)
VREF 30+40

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1620	50/–30	40	–55/205	25/–20	35/–35	50	55	120
AUTOBRAKE MAX	2085	30/–25	50	–70/235	5/0	50/–50	80	5	15
AUTOBRAKE 2	3515	55/–65	110	–140/470	45/–75	100/–100	120	160	160
Good Reported Braking Action									
MAX MANUAL	1990	25/–30	50	–75/260	45/–40	50/–50	55	125	300
AUTOBRAKE MAX	2165	30/–30	55	–80/275	20/–15	55/–55	80	90	275
AUTOBRAKE 2	3515	55/–65	110	–140/470	45/–75	100/–100	120	160	160
Good To Medium Reported Braking Action									
MAX MANUAL	2355	35/–40	70	–100/345	80/–65	60/–60	65	245	630
AUTOBRAKE MAX	2450	40/–40	70	–100/355	60/–50	65/–65	85	220	605
AUTOBRAKE 2	3545	55/–65	110	–145/495	60/–85	100/–100	120	185	315
Medium Reported Braking Action									
MAX MANUAL	2720	45/–45	85	–120/430	110/–85	70/–70	75	360	955
AUTOBRAKE MAX	2735	45/–45	85	–120/430	100/–80	70/–70	85	350	930
AUTOBRAKE 3	3315	45/–55	95	–140/485	50/–60	90/–90	125	125	535
Medium To Poor Reported Braking Action									
MAX MANUAL	3110	55/–55	105	–150/550	180/–130	80/–80	85	565	1655
AUTOBRAKE MAX	3120	55/–55	105	–150/550	175/–125	80/–80	90	560	1640
AUTOBRAKE 3	3505	55/–60	110	–165/585	135/–100	95/–95	125	375	1385
Poor Reported Braking Action									
MAX MANUAL	3500	65/–65	120	–180/665	245/–170	90/–90	90	765	2355
AUTOBRAKE MAX	3500	65/–65	120	–180/665	250/–170	90/–90	90	765	2350
AUTOBRAKE 3	3690	65/–65	120	–185/680	215/–140	100/–100	120	625	2235

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (5 < Flaps < 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1405	35/–20	30	–50/165	20/–15	30/–30	45	35	75
AUTOBRAKE MAX	1775	25/–25	40	–65/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	2990	50/–50	90	–130/430	25/–50	85/–85	115	50	50
Good Reported Braking Action									
MAX MANUAL	1810	25/–25	45	–75/250	40/–35	40/–40	60	105	240
AUTOBRAKE MAX	1905	25/–25	50	–75/260	35/–30	45/–45	70	110	250
AUTOBRAKE 2	2990	50/–50	90	–130/430	25/–50	85/–85	115	50	50
Good To Medium Reported Braking Action									
MAX MANUAL	2130	35/–35	60	–95/330	75/–60	50/–50	70	200	500
AUTOBRAKE MAX	2175	35/–35	65	–95/335	70/–55	55/–55	75	195	500
AUTOBRAKE 2	3020	50/–55	90	–135/455	45/–60	85/–85	115	75	200
Medium Reported Braking Action									
MAX MANUAL	2445	40/–40	75	–115/410	105/–85	60/–60	75	290	755
AUTOBRAKE MAX	2445	40/–40	75	–115/410	100/–75	60/–60	80	280	745
AUTOBRAKE 3	2795	45/–45	75	–125/450	50/–40	75/–75	120	115	505
Medium To Poor Reported Braking Action									
MAX MANUAL	2785	50/–50	90	–145/525	170/–125	70/–70	85	455	1290
AUTOBRAKE MAX	2785	50/–50	90	–145/525	170/–120	70/–70	85	450	1285
AUTOBRAKE 3	3005	55/–50	90	–150/550	135/–90	80/–80	115	345	1150
Poor Reported Braking Action									
MAX MANUAL	3125	60/–55	105	–170/640	235/–160	80/–80	90	620	1825
AUTOBRAKE MAX	3125	60/–55	105	–170/640	240/–160	80/–80	90	620	1825
AUTOBRAKE 3	3210	60/–55	105	–175/650	215/–135	85/–85	110	575	1795

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (Flaps ≥ 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1335	35/–20	30	–45/155	15/–15	25/–25	40	25	55
AUTOBRAKE MAX	1695	25/–25	40	–60/205	0/0	40/–40	70	0	0
AUTOBRAKE 2	2820	50/–50	80	–125/415	25/–45	75/–75	110	35	35
Good Reported Braking Action									
MAX MANUAL	1735	25/–25	55	–70/245	40/–35	40/–40	55	85	200
AUTOBRAKE MAX	1840	25/–30	45	–75/255	35/–30	40/–45	65	90	210
AUTOBRAKE 2	2820	50/–50	80	–125/415	25/–45	75/–75	110	35	35
Good To Medium Reported Braking Action									
MAX MANUAL	2035	35/–35	60	–90/325	70/–60	50/–50	65	165	405
AUTOBRAKE MAX	2095	35/–35	60	–95/330	65/–50	50/–55	75	165	405
AUTOBRAKE 2	2850	50/–50	85	–130/445	45/–55	80/–80	110	60	155
Medium Reported Braking Action									
MAX MANUAL	2335	40/–40	70	–110/405	100/–80	60/–60	75	245	610
AUTOBRAKE MAX	2345	40/–40	70	–110/405	95/–70	60/–60	85	235	600
AUTOBRAKE 3	2635	45/–45	75	–125/435	60/–40	70/–70	115	110	410
Medium To Poor Reported Braking Action									
MAX MANUAL	2660	50/–50	85	–140/520	165/–120	70/–70	80	385	1030
AUTOBRAKE MAX	2665	50/–50	85	–140/520	165/–115	70/–70	85	380	1030
AUTOBRAKE 3	2845	55/–50	90	–150/535	140/–85	75/–75	115	300	925
Poor Reported Braking Action									
MAX MANUAL	2985	55/–55	100	–165/630	230/–155	75/–75	85	520	1450
AUTOBRAKE MAX	2985	60/–55	100	–165/630	235/–155	75/–75	85	520	1455
AUTOBRAKE 3	3050	60/–55	100	–170/635	220/–130	80/–80	110	490	1435

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS PRIMARY FAIL (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1415	35/–20	30	–45/160	15/–15	30/–30	45	25	55
AUTOBRAKE MAX	1695	25/–25	40	–60/205	0/0	40/–40	70	0	0
AUTOBRAKE 2	2875	45/–50	80	–125/420	0/–25	80/–80	130	5	5
Good Reported Braking Action									
MAX MANUAL	1900	30/–30	50	–75/265	45/–40	45/–45	65	105	240
AUTOBRAKE MAX	1925	30/–30	50	–75/265	45/–40	45/–45	75	105	240
AUTOBRAKE 2	2875	45/–50	80	–125/420	0/–25	80/–80	130	5	5
Good To Medium Reported Braking Action									
MAX MANUAL	2215	40/–40	65	–100/345	80/–65	55/–55	75	195	485
AUTOBRAKE MAX	2225	40/–40	65	–100/345	85/–70	55/–55	80	195	485
AUTOBRAKE 2	2905	50/–50	80	–130/450	25/–35	80/–80	130	40	190
Medium Reported Braking Action									
MAX MANUAL	2525	45/–45	75	–120/425	110/–90	65/–65	85	285	730
AUTOBRAKE MAX	2520	45/–45	75	–120/425	120/–95	65/–65	85	285	725
AUTOBRAKE 3	2685	45/–45	75	–125/445	75/–40	70/–70	120	170	615
Medium To Poor Reported Braking Action									
MAX MANUAL	2860	55/–55	90	–150/540	180/–130	75/–75	90	445	1230
AUTOBRAKE MAX	2865	55/–55	95	–150/540	190/–135	75/–75	95	445	1230
AUTOBRAKE 3	2960	55/–55	90	–150/555	165/–100	80/–80	115	385	1175
Poor Reported Braking Action									
MAX MANUAL	3195	60/–60	105	–175/655	250/–170	80/–80	95	600	1725
AUTOBRAKE MAX	3210	65/–60	110	–175/655	260/–175	85/–85	100	600	1730
AUTOBRAKE 3	3230	65/–60	105	–175/660	250/–160	85/–85	105	595	1735

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLIGHT CONTROL MODE (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1440	35/–20	30	–50/160	20/–15	30/–30	50	30	60
AUTOBRAKE MAX	1695	25/–25	40	–60/205	0/0	40/–40	70	0	0
AUTOBRAKE 2	2875	45/–50	80	–125/420	0/–10	80/–80	145	0	0
Good Reported Braking Action									
MAX MANUAL	1960	30/–30	50	–80/270	50/–45	45/–45	75	115	270
AUTOBRAKE MAX	1960	30/–30	50	–80/270	45/–40	45/–45	80	115	265
AUTOBRAKE 2	2875	45/–50	80	–125/420	0/–10	80/–80	145	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2290	40/–40	65	–105/355	85/–70	55/–55	85	220	550
AUTOBRAKE MAX	2285	40/–40	65	–100/355	90/–75	55/–55	90	220	545
AUTOBRAKE 2	2915	50/–50	80	–130/450	30/–25	80/–80	145	45	265
Medium Reported Braking Action									
MAX MANUAL	2615	45/–45	80	–125/435	120/–95	65/–65	90	320	830
AUTOBRAKE MAX	2610	45/–45	80	–120/435	130/–105	65/–65	95	320	825
AUTOBRAKE 3	2715	45/–45	80	–125/445	95/–45	70/–70	120	245	765
Medium To Poor Reported Braking Action									
MAX MANUAL	2970	55/–55	100	–155/555	195/–140	75/–75	100	495	1410
AUTOBRAKE MAX	2975	55/–55	100	–150/555	205/–150	75/–75	100	495	1410
AUTOBRAKE 3	3030	55/–55	100	–155/560	185/–110	80/–80	120	460	1380
Poor Reported Braking Action									
MAX MANUAL	3320	65/–65	115	–180/670	270/–180	85/–85	105	670	1985
AUTOBRAKE MAX	3335	65/–65	115	–180/670	280/–190	85/–85	105	670	1990
AUTOBRAKE 3	3340	65/–65	115	–180/670	275/–175	90/–90	115	675	1995

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLIGHT CONTROLS (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1540	30/–20	35	–50/170	25/–25	35/–35	70	45	100
AUTOBRAKE MAX	1775	25/–25	40	–65/210	0/0	40/–40	75	0	10
AUTOBRAKE 2	3045	45/–50	85	–130/435	0/–15	85/–85	145	0	0
Good Reported Braking Action									
MAX MANUAL	2130	30/–35	60	–85/285	65/–55	50/–50	90	165	395
AUTOBRAKE MAX	2120	35/–35	60	–85/285	65/–50	55/–55	90	155	380
AUTOBRAKE 2	3045	45/–50	85	–130/435	0/–15	85/–85	145	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2475	40/–45	75	–110/370	105/–85	65/–65	100	290	750
AUTOBRAKE MAX	2470	45/–45	75	–110/370	110/–85	65/–65	100	285	745
AUTOBRAKE 2	3085	50/–50	85	–135/465	35/–30	85/–90	145	80	420
Medium Reported Braking Action									
MAX MANUAL	2820	50/–50	90	–130/455	145/–115	75/–75	105	415	1105
AUTOBRAKE MAX	2820	50/–50	90	–130/455	150/–115	75/–75	110	410	1105
AUTOBRAKE 3	2905	50/–45	90	–130/465	110/–60	80/–80	125	360	1065
Medium To Poor Reported Braking Action									
MAX MANUAL	3185	60/–60	110	–160/575	225/–160	85/–85	110	610	1780
AUTOBRAKE MAX	3185	60/–60	110	–160/575	230/–160	85/–85	115	610	1785
AUTOBRAKE 3	3230	60/–55	110	–160/580	210/–125	90/–90	125	585	1765
Poor Reported Braking Action									
MAX MANUAL	3545	70/–65	125	–190/695	300/–200	95/–95	115	800	2455
AUTOBRAKE MAX	3550	70/–65	125	–190/695	305/–205	95/–95	120	805	2460
AUTOBRAKE 3	3550	70/–65	125	–190/695	305/–190	95/–95	120	805	2460

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS C (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1415	35/–20	30	–45/160	15/–15	30/–30	45	25	55
AUTOBRAKE MAX	1695	25/–25	40	–60/205	0/0	40/–40	70	0	0
AUTOBRAKE 2	2875	45/–50	80	–125/420	0/–25	80/–80	130	5	5
Good Reported Braking Action									
MAX MANUAL	1900	30/–30	50	–75/265	45/–40	45/–45	65	105	240
AUTOBRAKE MAX	1925	30/–30	50	–75/265	45/–40	45/–45	75	105	240
AUTOBRAKE 2	2875	45/–50	80	–125/420	0/–25	80/–80	130	5	5
Good To Medium Reported Braking Action									
MAX MANUAL	2215	40/–40	65	–100/345	80/–65	55/–55	75	195	485
AUTOBRAKE MAX	2225	40/–40	65	–100/345	85/–70	55/–55	80	195	485
AUTOBRAKE 2	2905	50/–50	80	–130/450	25/–35	80/–80	130	40	190
Medium Reported Braking Action									
MAX MANUAL	2525	45/–45	75	–120/425	110/–90	65/–65	85	285	730
AUTOBRAKE MAX	2520	45/–45	75	–120/425	120/–95	65/–65	85	285	725
AUTOBRAKE 3	2685	45/–45	75	–125/445	75/–40	70/–70	120	170	615
Medium To Poor Reported Braking Action									
MAX MANUAL	2860	55/–55	90	–150/540	180/–130	75/–75	90	445	1230
AUTOBRAKE MAX	2865	55/–55	95	–150/540	190/–135	75/–75	95	445	1230
AUTOBRAKE 3	2960	55/–55	90	–150/555	165/–100	80/–80	115	385	1175
Poor Reported Braking Action									
MAX MANUAL	3195	60/–60	105	–175/655	250/–170	80/–80	95	600	1725
AUTOBRAKE MAX	3210	65/–60	110	–175/655	260/–175	85/–85	100	600	1730
AUTOBRAKE 3	3230	65/–60	105	–175/660	250/–160	85/–85	105	595	1735

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1290	30/–15	25	–45/150	20/–15	25/–25	45	0	25
AUTOBRAKE MAX	1590	20/–20	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2645	40/–45	70	–120/405	5/–10	75/–75	130	0	0
Good Reported Braking Action									
MAX MANUAL	1795	25/–25	45	–75/265	50/–45	45/–45	70	0	110
AUTOBRAKE MAX	1865	25/–30	45	–80/270	45/–40	45/–45	75	0	115
AUTOBRAKE 2	2645	40/–45	70	–120/405	5/–10	75/–75	130	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2165	35/–35	60	–100/360	100/–80	55/–55	80	0	240
AUTOBRAKE MAX	2200	35/–40	60	–105/365	95/–75	55/–55	85	0	240
AUTOBRAKE 2	2710	45/–45	75	–130/445	50/–30	75/–75	130	0	120
Medium Reported Braking Action									
MAX MANUAL	2530	40/–45	70	–125/455	145/–110	65/–65	90	0	365
AUTOBRAKE MAX	2530	45/–45	75	–125/455	145/–110	65/–65	90	0	365
AUTOBRAKE 3	2610	45/–45	75	–130/460	135/–80	70/–70	110	0	365
Medium To Poor Reported Braking Action									
MAX MANUAL	2980	55/–55	90	–165/605	265/–170	80/–80	100	0	645
AUTOBRAKE MAX	2985	55/–55	95	–165/605	265/–175	80/–80	100	0	650
AUTOBRAKE 3	3045	55/–55	95	–170/610	260/–160	85/–85	110	0	655
Poor Reported Braking Action									
MAX MANUAL	3430	65/–60	110	–200/755	380/–230	95/–95	110	0	925
AUTOBRAKE MAX	3440	65/–60	110	–200/755	385/–235	95/–95	110	0	930
AUTOBRAKE 3	3475	65/–65	110	–205/760	380/–240	95/–95	110	0	940

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1230	30/–15	25	–45/145	15/–15	25/–25	45	0	20
AUTOBRAKE MAX	1505	20/–20	30	–55/190	0/0	35/–35	70	0	0
AUTOBRAKE 2	2480	40/–40	65	–115/390	0/–10	70/–70	125	0	0
Good Reported Braking Action									
MAX MANUAL	1725	25/–25	40	–75/260	50/–45	40/–40	70	0	95
AUTOBRAKE MAX	1790	25/–25	45	–75/265	45/–35	45/–45	75	0	95
AUTOBRAKE 2	2480	40/–40	65	–115/390	0/–10	70/–70	125	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2080	35/–35	55	–100/355	95/–75	55/–55	80	0	205
AUTOBRAKE MAX	2115	35/–35	60	–100/355	95/–75	55/–55	85	0	205
AUTOBRAKE 2	2545	45/–45	70	–125/430	50/–35	70/–70	125	0	115
Medium Reported Braking Action									
MAX MANUAL	2430	40/–40	70	–125/445	140/–105	65/–65	90	0	315
AUTOBRAKE MAX	2435	40/–40	70	–125/445	145/–110	65/–65	90	0	315
AUTOBRAKE 3	2500	40/–40	70	–125/455	140/–85	65/–65	100	0	330
Medium To Poor Reported Braking Action									
MAX MANUAL	2870	50/–50	85	–165/595	260/–170	80/–80	100	0	565
AUTOBRAKE MAX	2880	50/–50	90	–165/600	265/–175	80/–80	100	0	565
AUTOBRAKE 3	2925	50/–50	90	–165/605	260/–160	80/–80	105	0	575
Poor Reported Braking Action									
MAX MANUAL	3310	60/–60	100	–200/745	380/–230	90/–90	110	0	810
AUTOBRAKE MAX	3320	60/–60	105	–200/750	385/–235	90/–90	110	0	810
AUTOBRAKE 3	3350	60/–60	105	–200/750	380/–235	95/–95	110	0	820

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L+C (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1550	40/–20	35	–50/175	25/–20	35/–35	60	0	40
AUTOBRAKE MAX	1775	25/–25	40	–65/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	3045	45/–50	85	–130/435	0/0	85/–85	150	0	0
Good Reported Braking Action									
MAX MANUAL	2210	30/–35	60	–90/305	70/–60	55/–55	90	0	180
AUTOBRAKE MAX	2205	30/–35	60	–90/305	65/–55	55/–55	95	0	175
AUTOBRAKE 2	3045	45/–50	85	–130/435	0/0	85/–85	150	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2670	40/–45	80	–120/410	130/–105	70/–70	105	0	380
AUTOBRAKE MAX	2665	45/–45	80	–120/410	135/–105	70/–70	110	0	380
AUTOBRAKE 2	3135	50/–55	90	–140/480	80/–35	90/–90	150	0	260
Medium Reported Braking Action									
MAX MANUAL	3130	50/–50	95	–145/515	190/–145	85/–85	115	0	580
AUTOBRAKE MAX	3125	55/–55	95	–145/515	200/–150	85/–85	120	0	580
AUTOBRAKE 3	3160	55/–55	95	–150/515	195/–130	85/–85	120	0	590
Medium To Poor Reported Braking Action									
MAX MANUAL	3685	65/–65	120	–190/680	340/–225	105/–105	130	0	1025
AUTOBRAKE MAX	3690	70/–70	120	–190/680	355/–230	105/–105	130	0	1025
AUTOBRAKE 3	3715	70/–70	120	–190/680	350/–220	105/–105	135	0	1035
Poor Reported Braking Action									
MAX MANUAL	4240	80/–75	140	–230/840	490/–300	120/–120	140	0	1465
AUTOBRAKE MAX	4255	80/–80	140	–230/845	505/–310	120/–120	140	0	1470
AUTOBRAKE 3	4265	80/–80	140	–230/845	500/–305	120/–120	145	0	1475

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L+R (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1785	25/–25	40	–65/225	45/–40	45/–45	75	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2750	40/–40	75	–120/415	150/–115	75/–75	115	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	3495	55/–55	100	–170/590	320/–215	105/–105	135	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	4240	65/–65	120	–220/760	485/–310	130/–130	155	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	5320	85/–80	150	–305/1085	1250/–530	165/–165	175	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	6400	100/–95	175	–385/1410	2010/–750	200/–200	190	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1460	20/–20	35	–55/190	25/–25	30/–30	35	0	50
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	**2065**	**30/–35**	**55**	**–95/330**	**80/–65**	**50/–50**	**75**	**0**	**190**
AUTOBRAKE MAX	**Autobrake inoperative**								
AUTOBRAKE 2	**Autobrake inoperative**								
Good Reported Braking Action									
MAX MANUAL	2065	30/–35	55	–95/330	80/–65	50/–50	75	0	190
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2460	40/–45	70	–125/445	145/–110	65/–65	85	0	365
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2855	50/–50	85	–155/555	210/–150	75/–75	95	0	535
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	3315	60/–60	105	–200/740	400/–225	90/–90	105	0	885
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3775	70/–70	120	–240/920	590/–295	105/–105	110	0	1235
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1400	20/–20	30	–55/185	25/–25	30/–30	55	0	40
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1960	30/–30	50	–90/320	75/–60	50/–50	75	0	155
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2330	40/–40	65	–120/430	140/–100	60/–60	85	0	295
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2695	45/–45	80	–150/540	200/–140	70/–70	95	0	435
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	3125	55/–55	95	–190/720	380/–210	85/–85	100	0	720
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3555	65/–65	110	–230/895	560/–280	100/–100	105	0	1005
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R+C (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1910	25/–25	45	–70/240	45/–40	45/–45	80	0	100
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2715	40/–45	75	–120/405	125/–100	70/–70	110	0	370
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	3230	55/–55	100	–155/540	225/–160	90/–90	125	0	690
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	3745	65/–65	120	–190/670	320/–220	105/–105	135	0	1010
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	4330	80/–80	145	–240/880	605/–325	125/–125	145	0	1645
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	4915	95/–90	170	–290/1090	890/–425	140/–140	150	0	2280
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH DOWN AUTHORITY (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1410	30/–20	25	–50/165	20/–15	25/–25	50	15	35
AUTOBRAKE MAX	1590	25/–20	35	–60/195	5/0	35/–35	75	0	0
AUTOBRAKE 2	2650	45/–45	70	–120/405	0/–20	70/–70	125	5	5
Good Reported Braking Action									
MAX MANUAL	1780	25/–25	40	–75/250	40/–35	40/–40	60	65	145
AUTOBRAKE MAX	1805	25/–25	45	–75/255	40/–35	40/–40	70	65	150
AUTOBRAKE 2	2655	45/–45	75	–120/405	5/–25	70/–70	125	5	5
Good To Medium Reported Braking Action									
MAX MANUAL	2055	30/–30	55	–95/330	70/–55	50/–50	70	130	310
AUTOBRAKE MAX	2070	35/–35	55	–95/330	70/–60	50/–50	75	130	315
AUTOBRAKE 2	2695	45/–45	75	–125/430	30/–35	75/–75	125	30	110
Medium Reported Braking Action									
MAX MANUAL	2325	35/–35	65	–110/405	95/–75	55/–55	75	195	475
AUTOBRAKE MAX	2330	40/–40	65	–110/405	100/–80	55/–55	80	195	475
AUTOBRAKE 3	2490	40/–40	65	–120/425	65/–30	65/–65	120	95	340
Medium To Poor Reported Braking Action									
MAX MANUAL	2625	45/–45	80	–140/515	160/–110	65/–65	80	310	820
AUTOBRAKE MAX	2635	50/–45	80	–140/515	165/–115	65/–65	85	310	820
AUTOBRAKE 3	2720	50/–45	80	–145/525	145/–85	70/–70	110	255	750
Poor Reported Braking Action									
MAX MANUAL	2920	50/–50	90	–165/625	220/–145	70/–70	85	425	1160
AUTOBRAKE MAX	2935	55/–50	90	–165/625	225/–150	75/–75	85	425	1165
AUTOBRAKE 3	2945	55/–50	90	–165/625	220/–135	75/–75	100	415	1155

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH DOWN AUTHORITY (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1345	30/–15	25	–45/160	15/–15	25/–25	50	15	30
AUTOBRAKE MAX	1510	25/–20	30	–55/190	5/0	35/–35	70	0	0
AUTOBRAKE 2	2485	40/–40	65	–115/390	0/–10	70/–70	125	0	0
Good Reported Braking Action									
MAX MANUAL	1710	25/–25	40	–70/250	40/–35	35/–35	60	55	125
AUTOBRAKE MAX	1730	25/–25	40	–70/250	40/–35	40/–40	70	60	130
AUTOBRAKE 2	2495	40/–40	65	–115/390	5/–10	70/–70	130	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1970	30/–30	50	–90/325	70/–55	45/–45	70	115	265
AUTOBRAKE MAX	1985	30/–30	50	–90/325	70/–55	50/–50	75	115	270
AUTOBRAKE 2	2535	40/–45	70	–120/415	30/–25	70/–70	130	25	95
Medium Reported Braking Action									
MAX MANUAL	2230	35/–35	60	–110/400	95/–75	55/–55	75	170	405
AUTOBRAKE MAX	2235	35/–35	60	–110/400	100/–75	55/–55	80	170	405
AUTOBRAKE 3	2350	40/–40	65	–115/410	65/–30	60/–60	115	95	310
Medium To Poor Reported Braking Action									
MAX MANUAL	2520	45/–45	75	–135/510	155/–110	65/–65	80	275	700
AUTOBRAKE MAX	2530	45/–45	75	–135/510	165/–115	65/–65	85	275	705
AUTOBRAKE 3	2590	45/–45	75	–140/515	145/–90	65/–65	105	235	655
Poor Reported Braking Action									
MAX MANUAL	2805	50/–50	85	–160/615	215/–145	70/–70	85	375	995
AUTOBRAKE MAX	2820	50/–50	85	–160/615	225/–150	70/–70	85	375	1000
AUTOBRAKE 3	2825	50/–50	85	–160/615	225/–145	70/–70	90	375	1000

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH UP AUTHORITY (Flaps ≤ 15)
VREF 30+40

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1585	45/–25	40	–55/190	20/–20	35/–35	50	45	100
AUTOBRAKE MAX	2080	30/–25	50	–70/235	0/0	50/–50	80	0	0
AUTOBRAKE 2	3375	55/–60	105	–135/455	70/–80	95/–95	100	235	250
Good Reported Braking Action									
MAX MANUAL	1970	25/–30	50	–75/260	45/–40	45/–45	55	115	260
AUTOBRAKE MAX	2180	30/–30	55	–80/280	25/–20	55/–55	80	75	230
AUTOBRAKE 2	3375	55/–60	105	–135/455	70/–80	95/–95	100	235	250
Good To Medium Reported Braking Action									
MAX MANUAL	2310	35/–40	65	–100/340	75/–65	60/–60	65	215	525
AUTOBRAKE MAX	2450	40/–40	70	–100/355	60/–50	65/–65	80	195	510
AUTOBRAKE 2	3405	55/–60	105	–140/480	90/–90	95/–95	100	260	370
Medium Reported Braking Action									
MAX MANUAL	2650	45/–45	80	–120/420	105/–85	70/–70	70	310	785
AUTOBRAKE MAX	2715	45/–45	80	–120/425	95/–75	70/–70	80	310	790
AUTOBRAKE 3	3235	50/–55	95	–140/480	75/–70	90/–90	105	145	450
Medium To Poor Reported Braking Action									
MAX MANUAL	3010	55/–55	100	–150/535	170/–125	80/–80	80	475	1310
AUTOBRAKE MAX	3050	55/–55	100	–150/540	165/–120	80/–80	85	470	1310
AUTOBRAKE 3	3415	55/–60	105	–160/575	145/–110	95/–95	105	325	1065
Poor Reported Braking Action									
MAX MANUAL	3370	60/–60	115	–175/650	235/–160	90/–90	85	635	1835
AUTOBRAKE MAX	3380	60/–60	115	–175/650	235/–160	90/–90	90	630	1830
AUTOBRAKE 3	3595	60/–65	115	–180/670	215/–145	100/–100	105	505	1675

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH UP AUTHORITY (Flaps ≥ 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1380	35/–20	30	–50/165	20/–15	30/–30	45	30	60
AUTOBRAKE MAX	1780	25/–25	40	–65/210	5/0	40/–40	75	0	0
AUTOBRAKE 2	2905	50/–50	85	–125/425	45/–60	80/–80	95	90	90
Good Reported Braking Action									
MAX MANUAL	1745	25/–25	45	–70/245	40/–35	40/–40	50	80	190
AUTOBRAKE MAX	1890	25/–25	45	–75/260	30/–20	45/–45	75	80	195
AUTOBRAKE 2	2905	50/–50	85	–125/425	45/–60	80/–80	95	90	90
Good To Medium Reported Braking Action									
MAX MANUAL	2045	35/–35	60	–90/325	70/–55	50/–50	60	160	385
AUTOBRAKE MAX	2140	35/–35	60	–95/335	60/–45	55/–55	80	155	385
AUTOBRAKE 2	2935	50/–50	85	–130/450	60/–70	80/–80	95	115	190
Medium Reported Braking Action									
MAX MANUAL	2345	40/–40	70	–110/400	95/–75	60/–60	70	235	575
AUTOBRAKE MAX	2390	40/–40	70	–115/405	85/–70	60/–60	80	230	575
AUTOBRAKE 3	2750	40/–45	75	–125/445	60/–45	75/–75	110	95	335
Medium To Poor Reported Braking Action									
MAX MANUAL	2670	50/–50	85	–140/515	160/–115	70/–70	75	365	970
AUTOBRAKE MAX	2695	50/–50	85	–140/515	155/–110	70/–70	85	365	970
AUTOBRAKE 3	2935	50/–50	90	–150/545	130/–85	80/–80	110	255	815
Poor Reported Braking Action									
MAX MANUAL	2995	55/–55	95	–165/625	220/–150	80/–80	80	495	1365
AUTOBRAKE MAX	2995	55/–55	100	–165/625	225/–145	80/–80	85	495	1365
AUTOBRAKE 3	3120	55/–55	100	–170/640	195/–125	85/–85	110	410	1290

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PRI FLIGHT COMPUTERS (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1440	35/–20	30	–50/160	20/–15	30/–30	50	30	60
AUTOBRAKE MAX	1695	25/–25	40	–60/205	0/0	40/–40	70	0	0
AUTOBRAKE 2	2875	45/–50	80	–125/420	0/–10	80/–80	145	0	0
Good Reported Braking Action									
MAX MANUAL	1960	30/–30	50	–80/270	50/–45	45/–45	75	115	270
AUTOBRAKE MAX	1960	30/–30	50	–80/270	45/–40	45/–45	80	115	265
AUTOBRAKE 2	2875	45/–50	80	–125/420	0/–10	80/–80	145	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2290	40/–40	65	–105/355	85/–70	55/–55	85	220	550
AUTOBRAKE MAX	2285	40/–40	65	–100/355	90/–75	55/–55	90	220	545
AUTOBRAKE 2	2915	50/–50	80	–130/450	30/–25	80/–80	145	45	265
Medium Reported Braking Action									
MAX MANUAL	2615	45/–45	80	–125/435	120/–95	65/–65	90	320	830
AUTOBRAKE MAX	2610	45/–45	80	–120/435	130/–105	65/–65	95	320	825
AUTOBRAKE 3	2715	45/–45	80	–125/445	95/–45	70/–70	120	245	765
Medium To Poor Reported Braking Action									
MAX MANUAL	2970	55/–55	100	–155/555	195/–140	75/–75	100	495	1410
AUTOBRAKE MAX	2975	55/–55	100	–150/555	205/–150	75/–75	100	495	1410
AUTOBRAKE 3	3030	55/–55	100	–155/560	185/–110	80/–80	120	460	1380
Poor Reported Braking Action									
MAX MANUAL	3320	65/–65	115	–180/670	270/–180	85/–85	105	670	1985
AUTOBRAKE MAX	3335	65/–65	115	–180/670	280/–190	85/–85	105	670	1990
AUTOBRAKE 3	3340	65/–65	115	–180/670	275/–175	90/–90	115	675	1995

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SLATS DRIVE (Flaps 20)
VREF 30+30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1475	40/–20	30	–50/165	20/–20	30/–30	45	35	70
AUTOBRAKE MAX	1925	25/–25	45	–65/220	5/0	45/–45	80	0	0
AUTOBRAKE 2	3180	50/–55	95	–135/445	50/–70	90/–90	100	125	125
Good Reported Braking Action									
MAX MANUAL	1940	25/–30	50	–75/265	45/–40	45/–45	60	105	245
AUTOBRAKE MAX	2070	30/–30	55	–80/275	40/–30	50/–50	75	115	260
AUTOBRAKE 2	3180	50/–55	95	–135/445	50/–70	90/–90	100	125	125
Good To Medium Reported Braking Action									
MAX MANUAL	2270	35/–40	65	–100/345	80/–65	55/–55	70	195	485
AUTOBRAKE MAX	2350	40/–40	70	–100/350	70/–55	60/–60	80	200	485
AUTOBRAKE 2	3210	55/–55	95	–140/470	70/–80	90/–90	100	150	255
Medium Reported Braking Action									
MAX MANUAL	2595	45/–45	80	–120/425	110/–90	65/–65	75	285	720
AUTOBRAKE MAX	2630	45/–45	80	–120/425	100/–80	70/–70	85	285	710
AUTOBRAKE 3	3015	45/–50	85	–135/465	70/–55	85/–85	115	125	440
Medium To Poor Reported Braking Action									
MAX MANUAL	2940	55/–55	95	–150/540	180/–130	75/–75	80	435	1180
AUTOBRAKE MAX	2960	55/–55	95	–150/540	175/–125	80/–80	90	435	1175
AUTOBRAKE 3	3220	55/–55	100	–160/565	145/–100	90/–90	115	310	1000
Poor Reported Braking Action									
MAX MANUAL	3285	60/–60	110	–175/655	245/–165	85/–85	85	585	1635
AUTOBRAKE MAX	3290	60/–60	110	–175/655	245/–165	90/–90	90	585	1640
AUTOBRAKE 3	3420	60/–60	110	–180/665	220/–145	95/–95	110	490	1555

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SPOILERS (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1260	30/–15	25	–45/145	15/–15	25/–25	40	20	45
AUTOBRAKE MAX	1590	20/–20	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2625	45/–45	75	–120/400	15/–35	70/–70	115	10	10
Good Reported Braking Action									
MAX MANUAL	1685	25/–25	40	–70/245	40/–35	40/–40	60	85	190
AUTOBRAKE MAX	1765	25/–25	45	–75/250	35/–30	40/–40	70	85	195
AUTOBRAKE 2	2625	45/–45	75	–120/400	15/–35	70/–70	115	10	10
Good To Medium Reported Braking Action									
MAX MANUAL	1970	35/–35	55	–90/325	70/–60	50/–50	70	160	385
AUTOBRAKE MAX	2010	35/–35	55	–95/325	70/–55	50/–50	75	155	385
AUTOBRAKE 2	2660	45/–45	75	–125/430	35/–45	70/–70	115	40	145
Medium Reported Braking Action									
MAX MANUAL	2250	40/–40	65	–110/400	100/–80	55/–55	75	230	575
AUTOBRAKE MAX	2255	40/–40	65	–110/400	100/–75	55/–55	80	225	575
AUTOBRAKE 3	2460	40/–40	70	–120/420	65/–40	65/–65	110	120	445
Medium To Poor Reported Braking Action									
MAX MANUAL	2555	50/–45	80	–140/510	165/–115	65/–65	80	360	965
AUTOBRAKE MAX	2565	50/–50	80	–140/510	170/–115	65/–65	85	360	970
AUTOBRAKE 3	2685	50/–45	85	–145/525	145/–90	70/–70	105	305	905
Poor Reported Braking Action									
MAX MANUAL	2860	55/–50	95	–165/620	230/–150	75/–75	85	485	1355
AUTOBRAKE MAX	2870	55/–55	95	–165/620	235/–155	75/–75	85	490	1360
AUTOBRAKE 3	2905	55/–50	95	–165/625	225/–140	75/–75	95	485	1365

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SPOILERS (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1205	30/–15	25	–45/140	15/–15	25/–25	40	15	35
AUTOBRAKE MAX	1505	20/–20	30	–55/190	0/0	35/–35	70	0	0
AUTOBRAKE 2	2470	40/–40	65	–115/385	10/–25	65/–65	115	0	0
Good Reported Braking Action									
MAX MANUAL	1625	25/–25	40	–70/240	40/–35	35/–35	60	70	160
AUTOBRAKE MAX	1695	25/–25	40	–70/250	35/–30	40/–40	70	75	165
AUTOBRAKE 2	2470	40/–40	65	–115/385	10/–25	65/–65	115	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1895	30/–30	50	–90/320	70/–60	45/–45	70	135	330
AUTOBRAKE MAX	1930	35/–30	50	–90/325	70/–55	50/–50	75	140	330
AUTOBRAKE 2	2500	40/–40	70	–120/415	30/–35	70/–70	115	30	125
Medium Reported Braking Action									
MAX MANUAL	2165	35/–35	60	–110/395	100/–80	55/–55	75	200	495
AUTOBRAKE MAX	2165	40/–35	60	–110/395	100/–75	55/–55	80	200	490
AUTOBRAKE 3	2325	40/–35	65	–115/410	70/–40	60/–60	105	120	410
Medium To Poor Reported Braking Action									
MAX MANUAL	2465	45/–45	75	–135/505	165/–115	65/–65	80	315	830
AUTOBRAKE MAX	2465	50/–45	75	–135/505	165/–115	65/–65	85	320	830
AUTOBRAKE 3	2560	50/–45	80	–140/515	150/–95	65/–65	100	280	795
Poor Reported Braking Action									
MAX MANUAL	2760	55/–50	90	–160/615	230/–150	70/–70	85	430	1160
AUTOBRAKE MAX	2765	55/–50	90	–160/615	230/–155	70/–70	85	435	1165
AUTOBRAKE 3	2795	55/–50	90	–165/620	230/–145	70/–70	90	435	1175

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
STABILIZER (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	240000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 240000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1385	35/–20	30	–45/160	20/–15	30/–30	45	30	60
AUTOBRAKE MAX	1775	25/–25	40	–65/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	2950	50/–50	85	–125/425	35/–55	80/–80	105	60	60
Good Reported Braking Action									
MAX MANUAL	1815	25/–25	45	–75/255	45/–40	45/–45	60	95	220
AUTOBRAKE MAX	1925	25/–30	50	–75/265	40/–30	45/–45	70	100	230
AUTOBRAKE 2	2950	50/–50	85	–125/425	35/–55	80/–80	105	60	60
Good To Medium Reported Braking Action									
MAX MANUAL	2125	35/–35	60	–95/335	75/–65	55/–55	70	180	440
AUTOBRAKE MAX	2190	35/–35	65	–95/340	70/–55	55/–55	80	180	435
AUTOBRAKE 2	2980	50/–50	90	–130/455	55/–65	80/–80	105	85	185
Medium Reported Braking Action									
MAX MANUAL	2430	40/–40	70	–115/410	105/–85	60/–60	75	260	655
AUTOBRAKE MAX	2450	40/–40	75	–115/415	100/–75	65/–65	85	255	640
AUTOBRAKE 3	2770	45/–45	75	–125/450	65/–45	75/–75	115	115	425
Medium To Poor Reported Braking Action									
MAX MANUAL	2760	50/–50	85	–145/525	170/–125	70/–70	80	405	1090
AUTOBRAKE MAX	2775	50/–50	90	–145/530	170/–120	75/–75	85	400	1080
AUTOBRAKE 3	2975	55/–50	90	–150/550	145/–90	80/–80	115	305	955
Poor Reported Braking Action									
MAX MANUAL	3090	60/–55	100	–170/640	235/–160	80/–80	85	545	1520
AUTOBRAKE MAX	3095	60/–55	105	–170/640	240/–160	80/–80	85	545	1520
AUTOBRAKE 3	3175	60/–55	100	–170/645	220/–130	85/–85	115	495	1485

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 25 or 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG)					
		AIRPORT PRESSURE ALTITUDE (FT)					
deg. C	deg. F	–2000	0	2000	4000	6000	8000
54	129	257.7	242.6				
52	126	263.7	248.6				
50	122	269.7	254.4	235.2			
48	118	275.8	260.1	241.0			
46	115	281.9	265.7	246.5	226.7		
44	111	287.9	271.6	252.0	231.1		
42	108	292.3	277.9	257.4	235.4	218.6	
40	104	296.6	283.9	262.6	239.8	222.3	
38	100	300.9	288.9	267.7	243.9	225.7	208.8
36	97	304.9	293.8	272.7	248.1	229.2	212.0
34	93	308.9	298.7	276.8	252.2	232.6	215.1
32	90	309.0	303.1	280.8	256.0	236.1	218.3
30	86	309.0	306.4	284.7	259.8	239.8	221.4
28	82	309.1	307.4	288.4	263.5	243.4	224.7
26	79	309.2	307.5	291.5	266.9	247.0	228.1
24	75	309.2	307.5	292.7	270.0	250.4	231.0
22	72	309.3	307.6	292.8	272.5	252.5	232.9
20	68	309.3	307.6	292.8	273.5	253.6	234.4
18	64	309.4	307.7	292.9	273.6	254.7	236.1
16	61	309.4	307.7	292.9	273.6	255.2	237.8
14	57	309.4	307.8	293.0	273.7	255.2	239.1
12	54	309.4	307.8	293.0	273.7	255.3	239.5
10	50	309.5	307.9	293.1	273.7	255.3	239.6
–40	–40	310.6	309.3	294.4	275.0	256.4	240.6

Based on engine bleed for 2 packs on, engine anti-ice on or off and wing anti-ice off.
With engine bleed for packs off, increase weight by 950 kg.
With engine and wing anti-ice on, decrease weight by 1,450 kg.
When operating in icing conditions during any part of the flight with forecast landing temperature below 10 deg. C, decrease weight by 20,450 kg.

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ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Reference Brake Energy (Millions of Foot Pounds)

WEIGHT (1000 KG)	OAT (deg. C)	BRAKES ON SPEED (KIAS) 80			100			120			140			160			180		
		PRESSURE ALTITUDE (1000 FT) 0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8
300	0	17.1	18.9	21.1	25.8	28.8	32.4	35.9	40.3	45.6	47.3	53.3	60.4	59.6	67.3	76.3	72.3	81.5	92.0
	10	17.7	19.5	21.8	26.6	29.7	33.5	37.1	41.7	47.1	48.8	55.0	62.4	61.6	69.5	78.7	74.6	84.0	94.8
	15	18.0	19.9	22.2	27.1	30.3	34.0	37.8	42.4	47.9	49.7	56.0	63.4	62.7	70.7	80.0	75.9	85.4	96.4
	20	18.3	20.2	22.5	27.6	30.8	34.6	38.4	43.1	48.8	50.5	57.0	64.5	63.7	71.9	81.3	77.1	86.7	97.8
	30	18.7	20.7	23.1	28.3	31.6	35.6	39.5	44.4	50.2	52.0	58.6	66.4	65.6	73.9	83.6	79.3	89.1	100
	40	19.0	21.0	23.5	28.8	32.2	36.3	40.3	45.3	51.3	53.2	60.0	68.0	67.2	75.7	85.6	81.2	91.2	103
280	0	16.2	17.9	19.9	24.4	27.2	30.5	33.9	38.0	42.9	44.5	50.1	56.8	56.1	63.3	71.8	68.2	76.9	87.1
	10	16.7	18.4	20.5	25.1	28.0	31.5	35.0	39.2	44.3	46.0	51.8	58.7	58.0	65.4	74.1	70.4	79.3	89.7
	15	17.0	18.8	20.9	25.6	28.5	32.1	35.6	39.9	45.1	46.8	52.7	59.7	59.0	66.6	75.4	71.6	80.6	91.1
	20	17.3	19.1	21.3	26.0	29.0	32.6	36.2	40.6	45.9	47.6	53.6	60.7	60.0	67.7	76.6	72.7	81.9	92.4
	30	17.7	19.6	21.8	26.7	29.8	33.5	37.2	41.8	47.2	49.0	55.2	62.5	61.7	69.6	78.8	74.9	84.2	94.9
	40	18.0	19.8	22.2	27.2	30.4	34.2	38.0	42.7	48.3	50.1	56.4	64.0	63.2	71.3	80.7	76.7	86.2	97.2
260	0	15.3	16.8	18.8	22.9	25.5	28.6	31.8	35.6	40.2	41.7	46.9	53.1	52.5	59.3	67.2	63.9	72.1	81.7
	10	15.8	17.4	19.3	23.7	26.3	29.6	32.8	36.8	41.5	43.1	48.5	54.9	54.3	61.2	69.4	66.0	74.4	84.2
	15	16.1	17.7	19.7	24.1	26.8	30.1	33.4	37.5	42.2	43.9	49.4	55.9	55.3	62.3	70.6	67.1	75.7	85.6
	20	16.3	18.0	20.0	24.5	27.2	30.6	34.0	38.1	43.0	44.6	50.2	56.8	56.2	63.3	71.7	68.2	76.9	86.9
	30	16.7	18.4	20.5	25.1	28.0	31.4	34.9	39.1	44.2	45.9	51.6	58.5	57.8	65.2	73.8	70.2	79.1	89.3
	40	16.9	18.7	20.8	25.6	28.5	32.0	35.6	40.0	45.2	46.9	52.8	59.8	59.2	66.8	75.6	71.9	81.0	91.4
240	0	14.4	15.8	17.6	21.5	23.9	26.8	29.7	33.2	37.4	38.9	43.7	49.4	48.9	55.1	62.5	59.5	67.1	76.1
	10	14.8	16.3	18.1	22.1	24.6	27.6	30.6	34.3	38.7	40.1	45.1	51.1	50.5	56.9	64.5	61.4	69.3	78.5
	15	15.1	16.6	18.4	22.5	25.1	28.1	31.2	34.9	39.3	40.8	45.9	52.0	51.4	57.9	65.6	62.5	70.5	79.8
	20	15.3	16.8	18.7	22.9	25.5	28.6	31.7	35.5	40.0	41.5	46.7	52.9	52.3	58.9	66.7	63.6	71.7	81.1
	30	15.7	17.3	19.2	23.5	26.2	29.4	32.6	36.5	41.2	42.7	48.1	54.4	53.8	60.7	68.7	65.4	73.8	83.4
	40	15.9	17.5	19.5	23.9	26.6	29.9	33.2	37.2	42.0	43.6	49.1	55.7	55.0	62.1	70.3	67.0	75.5	85.4
220	0	13.5	14.8	16.4	20.0	22.2	24.9	27.6	30.8	34.7	36.0	40.4	45.7	45.2	50.9	57.6	54.9	62.0	70.3
	10	13.9	15.2	16.9	20.6	22.9	25.6	28.4	31.8	35.8	37.1	41.7	47.2	46.6	52.6	59.6	56.7	64.0	72.6
	15	14.1	15.5	17.2	21.0	23.3	26.1	28.9	32.4	36.4	37.8	42.5	48.0	47.5	53.5	60.6	57.7	65.1	73.8
	20	14.3	15.8	17.5	21.4	23.7	26.5	29.4	32.9	37.1	38.5	43.2	48.8	48.3	54.4	61.6	58.7	66.2	75.0
	30	14.7	16.1	17.9	21.9	24.3	27.3	30.3	33.8	38.1	39.6	44.4	50.3	49.7	56.0	63.4	60.5	68.2	77.2
	40	14.9	16.3	18.2	22.3	24.7	27.7	30.8	34.5	38.9	40.4	45.4	51.4	50.8	57.3	64.9	61.9	69.8	79.0
200	0	12.6	13.8	15.2	18.6	20.5	23.0	25.4	28.4	31.9	33.1	37.1	41.9	41.4	46.6	52.7	50.2	56.7	64.3
	10	12.9	14.2	15.7	19.1	21.2	23.7	26.2	29.3	32.9	34.1	38.3	43.2	42.7	48.1	54.5	51.9	58.5	66.4
	15	13.2	14.5	16.0	19.5	21.6	24.1	26.7	29.8	33.5	34.7	39.0	44.0	43.5	49.0	55.4	52.8	59.6	67.5
	20	13.4	14.7	16.2	19.8	21.9	24.5	27.2	30.3	34.1	35.3	39.6	44.8	44.2	49.8	56.4	53.7	60.6	68.6
	30	13.7	15.0	16.6	20.3	22.5	25.2	27.9	31.1	35.0	36.3	40.8	46.1	45.5	51.2	58.0	55.3	62.4	70.6
	40	13.8	15.2	16.9	20.6	22.8	25.6	28.4	31.7	35.7	37.1	41.6	47.1	46.5	52.4	59.4	56.6	63.8	72.3
180	0	11.7	12.7	14.1	17.1	18.9	21.1	23.3	25.9	29.1	30.1	33.7	38.0	37.5	42.2	47.7	45.4	51.2	58.0
	10	12.0	13.1	14.5	17.6	19.5	21.7	24.0	26.7	30.0	31.1	34.8	39.2	38.7	43.5	49.3	46.9	52.9	59.9
	15	12.2	13.4	14.8	17.9	19.8	22.1	24.4	27.2	30.5	31.7	35.4	39.9	39.4	44.3	50.1	47.8	53.8	60.9
	20	12.4	13.6	15.0	18.2	20.1	22.5	24.8	27.6	31.1	32.2	36.0	40.6	40.1	45.1	51.0	48.6	54.7	62.0
	30	12.7	13.9	15.4	18.7	20.6	23.1	25.5	28.4	31.9	33.1	37.0	41.8	41.3	46.4	52.5	50.0	56.3	63.8
	40	12.8	14.0	15.6	18.9	21.0	23.4	25.9	28.9	32.5	33.7	37.8	42.7	42.1	47.4	53.7	51.1	57.6	65.3

***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 and enter table with sea level, 15 deg. C.**

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ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Event Adjusted Brake Energy (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	100
RTO MAX MAN		10	20	30	40	50	60	70	80	90	100
LANDING	MAX MAN	7.0	16.1	25.2	34.4	43.5	52.7	62.0	71.3	80.8	90.4
	MAX AUTO	6.8	14.9	23.1	31.6	40.3	49.3	58.5	68.1	77.9	88.0
	AUTOBRAKE 4	6.6	14.0	21.5	29.3	37.3	45.7	54.4	63.5	73.0	83.1
	AUTOBRAKE 3	6.2	13.0	19.9	27.0	34.4	42.0	49.9	58.3	67.1	76.4
	AUTOBRAKE 2	5.9	12.1	18.4	24.9	31.5	38.4	45.6	53.1	61.1	69.5
	AUTOBRAKE 1	5.7	11.3	17.0	22.8	28.9	35.2	41.7	48.6	55.8	63.4

2 Engine Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)									
EVENT		10	20	30	40	50	60	70	80	90	100
RTO MAX MAN		10	20	30	40	50	60	70	80	90	100
LANDING	MAX MAN	6.3	15.1	23.8	32.3	40.7	49.1	57.5	66.0	74.5	83.2
	MAX AUTO	4.9	12.0	19.2	26.6	34.3	42.2	50.5	59.1	68.1	77.5
	AUTOBRAKE 4	4.0	9.4	15.1	21.2	27.6	34.4	41.7	49.5	57.9	66.8
	AUTOBRAKE 3	2.7	6.7	11.1	15.9	21.1	26.6	32.6	39.1	46.1	53.5
	AUTOBRAKE 2	1.5	4.4	7.7	11.3	15.2	19.5	24.2	29.2	34.7	40.5
	AUTOBRAKE 1	1.0	3.0	5.3	7.8	10.6	13.8	17.4	21.3	25.7	30.6

Cooling Time (Minutes)

	EVENT ADJUSTED BRAKE ENERGY (MILLIONS OF FOOT POUNDS)									
	16 & BELOW	17	18	20	24	28	32	35	36 TO 44	45 & ABOVE
GEAR DOWN INFLIGHT	NO SPECIAL PROCEDURE REQUIRED	1	1	2	4	5	7	7	CAUTION	FUSE PLUG MELT ZONE
GROUND		10	13	23	40	53	66	73		
BTMS	UP TO 2.4	2.4	2.5	2.9	3.4	4.0	4.4	4.9	5.0 TO 6.3	6.3 & 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 10 percent.

For two brakes deactivated, increase brake energy by 20 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. (Inflight gear extended, the BTMS indications may vary between individual brakes, due to airstream effects, gear tilt, and position of the gear temperature probes.)

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ENGINE INOP

Initial Max Continuous EPR
Based on .84 M, engine bleed for one pack on and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20 & ABOVE	1.243	1.234	1.226	1.211	1.192	1.183	1.181	1.175	1.170
15	1.284	1.275	1.263	1.250	1.232	1.222	1.220	1.216	1.212
10	1.327	1.319	1.307	1.288	1.273	1.264	1.262	1.259	1.257
5	1.364	1.366	1.354	1.337	1.314	1.306	1.304	1.302	1.300
0	1.364	1.402	1.406	1.388	1.368	1.355	1.354	1.351	1.349
–5	1.364	1.402	1.439	1.444	1.424	1.412	1.411	1.408	1.406
–10	1.364	1.402	1.439	1.473	1.482	1.471	1.469	1.467	1.465
–15	1.364	1.402	1.439	1.473	1.506	1.523	1.523	1.521	1.518
–20 & BELOW	1.364	1.402	1.439	1.473	1.506	1.523	1.523	1.521	1.518

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ENGINE INOP

Max Continuous EPR
Based on engine bleed for packs on or off and anti-ice off
37000 FT to 27000 FT Pressure Altitudes

37000 FT PRESS ALT		TAT (deg. C)											
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
200	.63	1.531	1.531	1.531	1.531	1.531	1.489	1.436	1.385	1.341	1.302	1.263	1.233
240	.74	1.534	1.534	1.534	1.534	1.534	1.534	1.517	1.455	1.402	1.349	1.308	1.268
280	.86	1.506	1.506	1.506	1.506	1.506	1.506	1.506	1.506	1.469	1.413	1.356	1.304
35000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
200	.60	1.517	1.517	1.517	1.517	1.517	1.486	1.433	1.385	1.341	1.304	1.267	1.234
240	.71	1.514	1.514	1.514	1.514	1.514	1.514	1.502	1.444	1.394	1.344	1.305	1.266
280	.82	1.519	1.519	1.519	1.519	1.519	1.519	1.519	1.519	1.476	1.417	1.362	1.311
33000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
200	.58	1.499	1.499	1.499	1.499	1.499	1.499	1.447	1.401	1.358	1.323	1.290	1.257
240	.68	1.491	1.491	1.491	1.491	1.491	1.491	1.491	1.452	1.402	1.355	1.314	1.278
280	.79	1.489	1.489	1.489	1.489	1.489	1.489	1.489	1.489	1.472	1.414	1.363	1.314
320	.89	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.389	1.338
31000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10
200	.55	1.480	1.480	1.480	1.480	1.480	1.461	1.414	1.372	1.332	1.303	1.274	1.245
240	.66	1.471	1.471	1.471	1.471	1.471	1.471	1.461	1.410	1.365	1.322	1.291	1.260
280	.76	1.459	1.459	1.459	1.459	1.459	1.459	1.459	1.459	1.415	1.366	1.321	1.281
320	.85	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.426	1.406	1.353	1.306
29000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10	15
200	.53	1.493	1.493	1.493	1.493	1.493	1.454	1.411	1.369	1.334	1.302	1.270	1.252
240	.63	1.475	1.475	1.475	1.475	1.475	1.475	1.441	1.395	1.352	1.315	1.286	1.255
280	.73	1.446	1.446	1.446	1.446	1.446	1.446	1.446	1.426	1.378	1.334	1.293	1.259
320	.82	1.413	1.413	1.413	1.413	1.413	1.413	1.413	1.413	1.413	1.362	1.317	1.273
360	.91	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.351	1.330	1.284
27000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10	15
200	.51	1.507	1.507	1.507	1.507	1.507	1.499	1.452	1.409	1.368	1.336	1.302	1.268
240	.60	1.488	1.488	1.488	1.488	1.488	1.488	1.483	1.434	1.391	1.349	1.317	1.286
280	.70	1.443	1.443	1.443	1.443	1.443	1.443	1.443	1.443	1.398	1.355	1.314	1.279
320	.79	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.395	1.368	1.323	1.282
360	.88	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.330	1.325	1.281

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	37	35	33	31	29	27
ENGINE ANTI-ICE ON	–0.004	–0.003	–0.003	–0.003	–0.003	–0.004
ENGINE & WING ANTI-ICE*	–0.015	–0.014	–0.013	–0.012	–0.012	–0.012
ENGINE & WING ANTI-ICE**	–0.026	–0.024	–0.022	–0.021	–0.020	–0.019

***Wing anti-ice on, packs on.**
****Wing anti-ice on, packs off.**

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ENGINE INOP

Max Continuous EPR
Based on engine bleed for packs on or off and anti-ice off
25000 FT to 18000 FT Pressure Altitudes

25000 FT PRESS ALT		TAT (deg. C)											
KIAS	M	–35	–30	–25	–20	–15	–10	–5	0	5	10	15	20
200	.49	1.521	1.521	1.521	1.521	1.521	1.496	1.450	1.407	1.369	1.337	1.303	1.278
240	.58	1.502	1.502	1.502	1.502	1.502	1.502	1.477	1.431	1.389	1.350	1.316	1.282
280	.67	1.450	1.450	1.450	1.450	1.450	1.450	1.450	1.430	1.384	1.344	1.305	1.273
320	.76	1.386	1.389	1.389	1.389	1.389	1.389	1.389	1.389	1.380	1.335	1.296	1.257
360	.85	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.319	1.288	1.249
24000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–35	–30	–25	–20	–15	–10	–5	0	5	10	15	20
200	.48	1.523	1.523	1.523	1.523	1.523	1.512	1.465	1.420	1.379	1.346	1.312	1.278
240	.57	1.502	1.502	1.502	1.502	1.502	1.502	1.490	1.443	1.399	1.357	1.324	1.289
280	.66	1.455	1.455	1.455	1.455	1.455	1.455	1.455	1.447	1.400	1.358	1.316	1.283
320	.75	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.350	1.309	1.269
360	.83	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.324	1.300	1.259
22000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–30	–25	–20	–15	–10	–5	0	5	10	15	20	25
200	.46	1.523	1.523	1.523	1.523	1.523	1.496	1.449	1.404	1.364	1.330	1.295	1.271
240	.55	1.505	1.505	1.505	1.505	1.505	1.505	1.473	1.426	1.380	1.341	1.307	1.273
280	.63	1.463	1.463	1.463	1.463	1.463	1.463	1.463	1.433	1.387	1.342	1.302	1.269
320	.72	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.385	1.340	1.297	1.255
360	.80	1.336	1.336	1.336	1.336	1.336	1.336	1.336	1.336	1.336	1.329	1.287	1.246
20000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–30	–25	–20	–15	–10	–5	0	5	10	15	20	25
200	.44	1.519	1.519	1.519	1.519	1.519	1.519	1.477	1.429	1.383	1.346	1.311	1.275
240	.53	1.512	1.512	1.512	1.512	1.512	1.512	1.509	1.461	1.413	1.366	1.329	1.294
280	.61	1.469	1.469	1.469	1.469	1.469	1.469	1.469	1.465	1.417	1.368	1.321	1.287
320	.69	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.376	1.329	1.283
360	.77	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.350	1.317	1.274
18000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–25	–20	–15	–10	–5	0	5	10	15	20	25	30
200	.42	1.511	1.511	1.511	1.511	1.511	1.500	1.455	1.411	1.369	1.337	1.305	1.275
240	.51	1.515	1.515	1.515	1.515	1.515	1.515	1.495	1.449	1.403	1.362	1.328	1.293
280	.59	1.472	1.472	1.472	1.472	1.472	1.472	1.472	1.447	1.400	1.354	1.313	1.282
320	.67	1.424	1.424	1.424	1.424	1.424	1.424	1.424	1.424	1.402	1.356	1.311	1.269
360	.75	1.362	1.362	1.362	1.362	1.362	1.362	1.362	1.362	1.362	1.349	1.305	1.262

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	25	24	22	20	18
ENGINE ANTI-ICE ON	–0.005	–0.006	–0.007	–0.006	–0.010
ENGINE & WING ANTI-ICE*	–0.012	–0.012	–0.013	–0.012	–0.015
ENGINE & WING ANTI-ICE**	–0.019	–0.019	–0.019	–0.018	–0.020

***Wing anti-ice on, packs on.**
****Wing anti-ice on, packs off.**

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ENGINE INOP

Max Continuous EPR
Based on engine bleed for packs on or off and anti-ice off
16000 FT to 5000 FT Pressure Altitudes

16000 FT PRESS ALT		TAT (deg. C)											
KIAS	M	–25	–20	–15	–10	–5	0	5	10	15	20	25	30
200	.41	1.504	1.504	1.504	1.504	1.504	1.504	1.479	1.438	1.396	1.360	1.332	1.304
240	.49	1.511	1.511	1.511	1.511	1.511	1.511	1.511	1.477	1.432	1.389	1.354	1.322
280	.57	1.474	1.474	1.474	1.474	1.474	1.474	1.474	1.474	1.432	1.387	1.344	1.310
320	.64	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.427	1.384	1.340	1.296
360	.72	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.372	1.337	1.294
14000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–20	–15	–10	–5	0	5	10	15	20	25	30	35
200	.39	1.488	1.488	1.488	1.488	1.488	1.488	1.452	1.413	1.373	1.343	1.315	1.288
240	.47	1.491	1.491	1.491	1.491	1.491	1.491	1.484	1.444	1.402	1.361	1.330	1.298
280	.54	1.463	1.463	1.463	1.463	1.463	1.463	1.463	1.449	1.407	1.365	1.324	1.293
320	.62	1.417	1.417	1.417	1.417	1.417	1.417	1.417	1.417	1.400	1.357	1.315	1.275
360	.69	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.368	1.354	1.313	1.272
12000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–15	–10	–5	0	5	10	15	20	25	30	35	40
200	.38	1.475	1.475	1.475	1.475	1.475	1.468	1.431	1.393	1.355	1.329	1.302	1.276
240	.45	1.473	1.473	1.473	1.473	1.473	1.473	1.453	1.415	1.375	1.339	1.308	1.277
280	.52	1.452	1.452	1.452	1.452	1.452	1.452	1.452	1.424	1.385	1.344	1.308	1.275
320	.60	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.407	1.373	1.333	1.292	1.257
360	.67	1.359	1.359	1.359	1.359	1.359	1.359	1.359	1.359	1.359	1.327	1.288	1.248
10000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–15	–10	–5	0	5	10	15	20	25	30	35	40
200	.36	1.462	1.462	1.462	1.462	1.462	1.462	1.444	1.408	1.371	1.338	1.311	1.284
240	.43	1.452	1.452	1.452	1.452	1.452	1.452	1.452	1.421	1.383	1.345	1.313	1.283
280	.51	1.438	1.438	1.438	1.438	1.438	1.438	1.438	1.433	1.397	1.358	1.318	1.286
320	.58	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.392	1.382	1.344	1.305	1.265
360	.65	1.344	1.344	1.344	1.344	1.344	1.344	1.344	1.344	1.344	1.332	1.295	1.258
5000 FT PRESS ALT		**TAT (deg. C)**											
KIAS	M	–10	–5	0	5	10	15	20	25	30	35	40	45
200	.33	1.422	1.422	1.422	1.422	1.422	1.422	1.422	1.399	1.367	1.334	1.306	1.282
240	.40	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.394	1.361	1.328	1.295	1.269
280	.46	1.382	1.382	1.382	1.382	1.382	1.382	1.382	1.382	1.365	1.330	1.295	1.263
320	.53	1.349	1.349	1.349	1.349	1.349	1.349	1.349	1.349	1.349	1.323	1.288	1.253
360	.59	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.303	1.270	1.237

EPR Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	16	14	12	10	5
ENGINE ANTI-ICE ON	–0.013	–0.015	–0.015	–0.015	–0.010
ENGINE & WING ANTI-ICE*	–0.018	–0.019	–0.019	–0.018	–0.012
ENGINE & WING ANTI-ICE**	–0.024	–0.024	–0.023	–0.022	–0.014

***Wing anti-ice on, packs on.**
****Wing anti-ice on, packs off.**

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ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFTDOWN	LEVEL OFF		ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
300	290	282	17000	15600	13900
280	271	273	18800	17500	15900
260	252	263	20700	19400	17900
240	232	253	22600	21400	19900
220	213	243	24700	23400	22000
200	194	232	26600	25500	24300
180	174	220	28700	27500	26400
160	154	208	31000	29700	28600

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MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability
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
133	125	117	111	105	100	95	91	87	84	80
272	254	238	224	211	200	190	181	173	165	158
410	382	358	336	317	300	285	271	258	247	236
547	510	477	448	423	400	380	361	344	329	315
683	637	596	560	528	500	475	452	431	412	394
818	763	714	672	634	600	570	542	517	495	474
952	888	832	783	739	700	665	633	604	578	554
1085	1013	950	894	844	800	760	724	691	661	634
1218	1138	1067	1005	950	900	855	815	778	745	714
1350	1262	1184	1116	1055	1000	951	906	865	828	794
1482	1386	1301	1227	1160	1100	1046	997	953	912	874
1614	1510	1418	1337	1265	1200	1141	1088	1040	996	955
1746	1634	1536	1448	1370	1300	1237	1179	1127	1079	1035
1879	1759	1653	1559	1475	1400	1332	1270	1214	1163	1116
2011	1883	1770	1670	1580	1500	1427	1362	1301	1246	1196
2145	2008	1888	1781	1686	1600	1523	1452	1388	1330	1276
2278	2133	2006	1892	1791	1700	1618	1543	1475	1413	1356
2413	2259	2124	2004	1896	1800	1713	1634	1562	1496	1435

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG) WEIGHT AT START OF DRIFTDOWN (1000 KG)								TIME (HR:MIN)
	160	180	200	220	240	260	280	300	
100	0.9	1.0	1.1	1.1	1.3	1.3	1.5	1.5	0:15
200	2.1	2.2	2.5	2.7	3.0	3.1	3.4	3.5	0:32
300	3.4	3.7	4.1	4.4	4.9	5.1	5.6	5.9	0:48
400	4.8	5.2	5.8	6.3	6.9	7.3	7.9	8.3	1:05
500	6.1	6.7	7.4	8.0	8.8	9.4	10.1	10.7	1:20
600	7.4	8.1	9.0	9.7	10.6	11.3	12.2	12.9	1:36
700	8.7	9.5	10.5	11.4	12.4	13.3	14.3	15.2	1:51
800	9.9	10.9	12.0	13.0	14.2	15.2	16.4	17.4	2:06
900	11.2	12.3	13.6	14.7	16.0	17.1	18.4	19.6	2:21
1000	12.4	13.7	15.1	16.3	17.8	19.1	20.5	21.7	2:36
1100	13.7	15.0	16.6	18.0	19.6	21.0	22.5	23.9	2:50
1200	14.9	16.4	18.1	19.6	21.3	22.9	24.6	26.1	3:05
1300	16.1	17.8	19.6	21.2	23.1	24.8	26.6	28.3	3:19
1400	17.3	19.1	21.0	22.8	24.9	26.6	28.6	30.4	3:34
1500	18.5	20.4	22.5	24.4	26.6	28.5	30.6	32.5	3:49
1600	19.7	21.8	24.0	26.0	28.3	30.4	32.6	34.7	4:04
1700	20.9	23.1	25.4	27.6	30.0	32.2	34.6	36.8	4:19
1800	22.0	24.4	26.9	29.2	31.7	34.0	36.5	38.9	4:34

Includes APU fuel burn.
Driftdown at optimum driftdown speed and cruise at LRC speed.

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MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
300	14000	11800	9200
290	14800	12500	10200
280	15500	13300	10900
270	16000	14100	11600
260	16900	15200	12900
250	18000	16300	14400
240	19100	17500	15700
230	20200	18600	16800
220	21300	19800	18000
210	22400	21000	19200
200	23500	22200	20500
190	24700	23400	21900
180	25900	24700	23300
170	27200	25900	24800
160	28500	27200	26000

With engine anti-ice on, decrease altitude capability by 1,000 ft.
With engine and wing anti-ice on, decrease altitude capability by 1,400 ft.

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MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)							
		10	15	17	19	21	23	25	27
300	EPR	1.273	1.385						
	MACH	.585	.641						
	KIAS	325	325						
	FF/ENG	9022	9176						
280	EPR	1.252	1.355	1.409					
	MACH	.585	.641	.665					
	KIAS	325	325	325					
	FF/ENG	8669	8800	8901					
260	EPR	1.228	1.322	1.372					
	MACH	.574	.632	.658					
	KIAS	319	320	322					
	FF/ENG	8132	8318	8412					
240	EPR	1.202	1.283	1.326	1.378				
	MACH	.552	.608	.632	.659				
	KIAS	306	308	308	310				
	FF/ENG	7456	7591	7660	7752				
220	EPR	1.177	1.246	1.283	1.327	1.380			
	MACH	.529	.583	.606	.631	.658			
	KIAS	293	295	295	296	297			
	FF/ENG	6782	6875	6937	6998	7090			
200	EPR	1.154	1.213	1.244	1.281	1.325	1.378		
	MACH	.506	.556	.579	.603	.627	.654		
	KIAS	280	281	282	282	283	284		
	FF/ENG	6138	6161	6224	6280	6339	6422		
180	EPR	1.131	1.182	1.208	1.239	1.274	1.318	1.371	1.438
	MACH	.483	.529	.550	.573	.597	.621	.648	.677
	KIAS	267	266	267	268	268	269	270	271
	FF/ENG	5517	5458	5513	5572	5627	5681	5742	5882
160	EPR	1.109	1.153	1.174	1.200	1.229	1.264	1.306	1.357
	MACH	.459	.500	.520	.540	.563	.587	.612	.639
	KIAS	254	252	252	252	252	253	254	254
	FF/ENG	4921	4822	4826	4859	4921	4975	5017	5064

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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
290	266	245	228	213	200	191	182	174	167	161
581	534	492	457	427	400	382	366	351	337	324
873	802	739	686	641	600	574	549	526	506	487
1167	1072	987	916	855	800	765	732	702	675	650
1462	1342	1235	1146	1069	1000	956	916	878	844	813
1758	1612	1484	1376	1283	1200	1148	1099	1054	1013	975
2055	1884	1733	1606	1497	1400	1339	1282	1229	1181	1137
2354	2157	1983	1837	1712	1600	1530	1465	1405	1349	1299
2654	2431	2234	2068	1926	1800	1720	1647	1579	1516	1460

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	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	3.5	0:40	3.0	0:38	2.7	0:37	2.4	0:35	2.2	0:34
400	7.3	1:18	6.6	1:14	6.2	1:10	5.7	1:06	5.4	1:03
600	11.1	1:56	10.2	1:50	9.6	1:43	9.0	1:38	8.6	1:32
800	14.9	2:34	13.7	2:25	12.9	2:17	12.2	2:09	11.7	2:01
1000	18.6	3:13	17.2	3:02	16.3	2:51	15.4	2:41	14.8	2:31
1200	22.3	3:51	20.6	3:38	19.6	3:25	18.5	3:13	17.8	3:01
1400	25.9	4:31	24.0	4:15	22.8	4:00	21.7	3:45	20.8	3:31
1600	29.5	5:10	27.4	4:53	26.1	4:35	24.7	4:18	23.8	4:01
1800	33.1	5:50	30.7	5:30	29.2	5:10	27.8	4:51	26.7	4:32

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)			
	150	200	250	300
2	–0.2	0.0	0.2	0.4
4	–0.5	0.0	0.6	1.2
6	–0.7	0.0	1.1	2.0
8	–1.0	0.0	1.5	2.8
10	–1.3	0.0	2.0	3.6
12	–1.6	0.0	2.4	4.4
14	–1.9	0.0	2.9	5.2
16	–2.2	0.0	3.4	6.0
18	–2.4	0.0	3.8	6.8
20	–2.7	0.0	4.3	7.6
22	–3.0	0.0	4.8	8.5
24	–3.3	0.0	5.2	9.3
26	–3.6	0.0	5.7	10.1
28	–3.9	0.0	6.2	10.9
30	–4.1	0.0	6.6	11.7
32	–4.4	0.0	7.1	12.5
34	–4.7	0.0	7.6	13.3

Based on Long Range Cruise and .84/310/250 descent.

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ENGINE INOP

MAX CONTINUOUS THRUST

Holding
Flaps up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
300	EPR	1.167	1.205	1.277	1.374		
	KIAS	260	260	262	277		
	FF/ENG	8010	8020	8190	8560		
280	EPR	1.152	1.184	1.250	1.338		
	KIAS	251	251	253	261		
	FF/ENG	7450	7440	7560	7810		
260	EPR	1.137	1.165	1.223	1.305	1.422	
	KIAS	242	242	243	246	266	
	FF/ENG	6890	6880	6950	7090	7540	
240	EPR	1.123	1.148	1.198	1.270	1.371	
	KIAS	232	233	234	235	247	
	FF/ENG	6340	6330	6370	6440	6740	
220	EPR	1.107	1.131	1.173	1.237	1.327	1.473
	KIAS	224	224	224	224	230	251
	FF/ENG	5800	5790	5820	5810	6000	6520
200	EPR	1.093	1.113	1.150	1.204	1.283	1.397
	KIAS	217	217	217	217	217	229
	FF/ENG	5290	5270	5290	5230	5340	5630
180	EPR	1.080	1.096	1.128	1.173	1.240	1.338
	KIAS	209	209	209	209	209	209
	FF/ENG	4910	4760	4770	4710	4760	4890
160	EPR	1.068	1.082	1.107	1.145	1.200	1.281
	KIAS	201	201	201	201	201	201
	FF/ENG	4410	4260	4260	4200	4200	4300

This table includes 5% additional fuel for holding in a racetrack pattern.

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ENGINE INOP

ADVISORY INFORMATION

Gear Down Landing Rate of Climb Available
Flaps 20

TAT (deg. C)	RATE OF CLIMB (FT/MIN) PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
52	490	390				
50	540	440	300			
48	590	480	350			
46	640	530	400	240		
44	680	580	440	280		
42	720	630	490	310	170	
40	750	680	530	350	200	
38	790	720	570	380	230	90
36	820	750	600	410	260	120
34	860	790	630	450	290	150
32	860	830	670	480	320	170
30	860	860	700	510	350	200
20	880	880	770	630	470	310
10	900	890	780	640	490	360
0	910	910	800	650	500	370
–20	950	950	830	680	520	390
–40	990	990	870	710	540	400

Rate of climb capability shown is valid for 200,000 kg, gear down at VREF20 + 5.
Decrease rate of climb 40 ft/min per 5,000 kg greater than 200000 kg.
Increase rate of climb 60 ft/min per 5,000 kg less than 200000 kg.

Flaps 30

TAT (deg. C)	RATE OF CLIMB (FT/MIN) PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
52	–10	–110				
50	30	–70	–210			
48	70	–30	–160			
46	120	10	–120	–270		
44	160	60	–80	–240		
42	190	100	–40	–210	–350	
40	220	150	–10	–180	–320	
38	250	180	30	–150	–290	–440
36	280	210	60	–120	–270	–410
34	310	240	90	–100	–240	–390
32	310	270	120	–70	–220	–370
30	310	300	140	–40	–190	–340
20	320	310	200	60	–100	–250
10	330	320	200	60	–90	–220
0	330	320	200	60	–90	–220
–20	350	340	210	60	–90	–230
–40	360	360	220	70	–90	–240

Rate of climb capability shown is valid for 200,000 kg, gear down at VREF30 + 5.
Decrease rate of climb 40 ft/min per 5,000 kg greater than 200,000 kg.
Increase rate of climb 60 ft/min per 5,000 kg less than 200,000 kg.

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ALTERNATE MODE EEC

Limit Weight

PERFORMANCE LIMIT	ALTERNATE MODE EEC LIMIT WEIGHT (1000 KG)								
	PRIMARY MODE PERFORMANCE LIMIT WEIGHT (1000 KG)								
	160	180	200	220	240	260	280	300	320
FIELD	154.6	173.9	193.2	212.6	231.9	251.2	270.5	289.9	309.2
CLIMB	142.7	161.9	181.1	200.4	219.6	238.8	258.1	277.3	296.5
OBSTACLE	149.1	167.3	185.4	203.6	221.8	240.0	258.1	276.3	294.5
NET LEVEL OFF WEIGHT	151.0	168.7	186.4	204.2	221.9	239.6	257.3	275.1	292.8
LANDING CLIMB	140.9	160.4	180.0	199.6	219.1	238.7	258.3	277.9	297.4

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ALTERNATE MODE EEC

Takeoff Speed Adjustment

TAKEOFF SPEEDS	TAKEOFF SPEED ADJUSTMENT (KTS)
V1	+1
VR	+1
V2	0

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ALTERNATE MODE EEC

Max Takeoff %N1

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)										
deg. C	deg. F	–2000	0	1000	2000	3000	4000	5000	6000	7000	8000	8400
55	131	92.4	92.7	92.9	93.1	93.3	93.4	93.4	93.4	93.3	93.2	93.1
50	122	93.4	93.9	93.9	93.9	93.9	94.0	94.1	94.1	94.0	94.0	93.9
45	113	94.4	95.0	95.0	95.0	94.8	94.7	94.7	94.7	94.7	94.6	94.6
40	104	94.9	96.3	96.1	96.1	95.7	95.4	95.3	95.3	95.3	95.3	95.2
35	95	95.4	96.9	97.0	96.9	96.5	96.1	96.1	96.0	96.0	96.0	96.0
30	86	94.9	98.0	97.8	97.8	97.4	97.0	96.9	96.9	96.8	96.8	96.7
25	77	94.1	97.4	97.8	98.2	97.9	97.6	97.8	97.7	97.6	97.6	97.6
20	68	93.3	96.6	97.0	97.4	97.6	97.8	97.7	97.8	97.9	97.8	97.8
15	59	92.5	95.7	96.1	96.6	96.8	96.9	97.2	97.4	97.8	98.0	97.9
10	50	91.7	94.9	95.3	95.7	95.9	96.1	96.3	96.5	96.9	97.3	97.5
5	41	90.9	94.0	94.4	94.9	95.1	95.2	95.5	95.7	96.1	96.5	96.6
0	32	90.1	93.2	93.6	94.0	94.2	94.4	94.6	94.8	95.2	95.6	95.8
–10	14	88.4	91.5	91.9	92.3	92.5	92.6	92.9	93.1	93.5	93.8	94.0
–20	–4	86.7	89.7	90.1	90.5	90.7	90.9	91.1	91.3	91.7	92.0	92.2
–30	–22	85.0	87.9	88.3	88.7	88.9	89.0	89.3	89.5	89.8	90.2	90.3
–40	–40	83.2	86.1	86.5	86.9	87.0	87.2	87.4	87.6	88.0	88.3	88.5
–50	–58	81.4	84.2	84.6	85.0	85.1	85.3	85.5	85.7	86.1	86.4	86.5

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
PACKS OFF	0.1	0.2	0.2	0.2	0.2	0.2
WING ANTI-ICE ON	–0.1	–0.2	–0.2	–0.3	–0.3	–0.3

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ALTERNATE MODE EEC

Max Climb %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (FT)/SPEED (KIAS OR MACH)									
	0	5000	10000	15000	20000	25000	30000	35000	40000	43000
	310	310	310	310	310	310	310	.84	.84	.84
60	83.9	84.6	86.7	89.4	92.2	93.4	94.5	96.1	96.3	96.0
50	85.4	86.2	86.7	88.1	90.8	92.0	93.1	94.7	94.9	94.5
40	86.8	87.5	88.0	88.9	89.8	90.6	91.6	93.2	93.4	93.1
30	85.9	88.8	89.4	90.2	91.0	90.8	90.5	91.7	91.9	91.6
20	84.5	87.3	89.8	91.3	92.1	91.8	91.9	90.9	90.3	90.0
15	83.7	86.6	89.1	91.7	92.6	92.5	92.3	91.5	91.1	90.9
10	83.0	85.8	88.3	90.9	93.2	93.1	92.9	92.1	91.7	91.5
5	82.3	85.1	87.5	90.1	92.8	93.9	93.6	92.5	92.2	92.1
0	81.5	84.3	86.7	89.3	92.0	93.9	94.5	93.3	92.8	92.7
–5	80.8	83.5	85.9	88.5	91.1	93.0	94.6	94.3	93.8	93.7
–10	80.0	82.7	85.1	87.7	90.3	92.1	93.7	95.4	94.9	94.8
–15	79.3	81.9	84.3	86.8	89.4	91.2	92.9	95.4	96.0	95.9
–20	78.5	81.1	83.5	86.0	88.5	90.4	91.9	94.5	95.0	94.9
–25	77.7	80.3	82.7	85.1	87.7	89.5	91.0	93.5	94.1	94.0
–30	76.9	79.5	81.8	84.3	86.8	88.5	90.1	92.6	93.1	93.0
–35	76.1	78.7	81.0	83.4	85.9	87.6	89.2	91.6	92.2	92.1
–40	75.3	77.9	80.1	82.5	85.0	86.7	88.2	90.7	91.2	91.1

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)									
	0	5000	10000	15000	20000	25000	30000	35000	40000	43000
ENGINE ANTI-ICE ON	–0.4	–0.5	–0.7	–0.6	–0.3	–0.2	–.01	–0.1	–0.1	–0.2
ENGINE & WING ANTI-ICE ON	–0.5	–0.6	–0.8	–0.8	–0.5	–0.5	–0.4	–0.5	–0.6	–0.7

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ALTERNATE MODE EEC

Max Cruise %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (FT)									
	25000	27000	29000	31000	33000	35000	37000	39000	41000	43000
25	89.6	89.4	89.5	89.9	89.2	89.3	89.6	89.5	89.3	89.1
20	90.1	90.0	90.1	90.4	89.9	89.2	88.9	88.8	88.6	88.4
15	90.7	90.5	90.6	90.9	90.5	89.9	89.5	89.5	89.3	89.2
10	91.1	91.0	91.1	91.4	90.9	90.4	90.1	90.1	90.0	89.9
5	91.7	91.5	91.6	91.9	91.4	90.8	90.6	90.5	90.5	90.4
0	91.5	91.9	92.2	92.5	92.0	91.4	91.1	91.0	91.0	90.9
–5	90.7	91.1	91.8	92.6	92.7	92.1	91.8	91.7	91.7	91.6
–10	89.8	90.2	91.0	91.7	92.6	92.9	92.6	92.5	92.5	92.4
–15	89.0	89.4	90.1	90.8	91.7	92.7	93.2	93.1	93.1	93.0
–20	88.1	88.5	89.2	89.9	90.8	91.8	92.2	92.2	92.2	92.1
–25	87.2	87.6	88.3	89.0	89.9	90.9	91.3	91.3	91.3	91.2
–30	86.3	86.7	87.5	88.1	89.0	89.9	90.4	90.4	90.3	90.3
–35	85.4	85.8	86.5	87.2	88.1	89.0	89.5	89.4	89.4	89.3

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)				
	25000	30000	35000	40000	43000
ENGINE ANTI-ICE ON	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING ANTI-ICE ON	–0.4	–0.4	–0.5	–0.5	–0.6

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ALTERNATE MODE EEC

Go-Around %N1

Based on engine bleed for packs on, engine anti-ice on or off, wing anti-ice off

AIRPORT OAT		TAT	PRESSURE ALTITUDE (FT)											
deg. C	deg. F	(deg. C)	–2000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
51	124	55	93.4	93.9	93.9	93.8	94.0	94.2	94.3	94.3	94.3	94.2	94.1	94.1
46	115	50	94.4	95.0	95.1	95.1	94.9	94.8	94.9	95.0	94.9	94.9	94.9	94.8
41	106	45	95.1	96.2	96.1	96.1	95.8	95.6	95.6	95.6	95.5	95.5	95.5	95.5
36	97	40	95.5	97.0	97.0	96.9	93.6	96.2	96.2	96.2	96.1	96.1	96.0	96.0
31	88	35	95.3	97.7	97.7	97.7	97.3	97.0	96.9	96.9	96.8	96.8	96.8	96.7
26	79	30	94.6	97.3	98.0	98.4	98.0	97.7	97.7	97.6	97.6	97.6	97.5	97.5
21	70	25	93.8	96.5	97.2	97.8	98.1	98.3	98.1	98.2	98.2	98.1	98.0	98.0
17	62	20	93.0	95.7	96.4	97.0	97.2	97.5	97.8	98.0	98.3	98.3	98.1	97.9
12	53	15	92.2	94.9	95.5	96.1	96.4	96.7	96.9	97.1	97.6	98.0	98.3	98.3
7	45	10	91.4	94.0	94.7	95.3	95.6	95.9	96.1	96.3	96.7	97.1	97.5	97.9
2	36	5	90.6	93.2	93.9	94.4	94.7	95.0	95.2	95.4	95.9	96.3	96.6	97.0
–3	27	0	89.8	92.4	93.0	93.6	93.9	94.1	94.4	94.6	95.0	95.4	95.8	96.1
–13	9	–10	88.1	90.7	91.3	91.9	92.1	92.4	92.6	92.8	93.3	93.6	94.0	94.3
–23	–9	–20	86.4	88.9	89.5	90.1	90.4	90.6	90.8	91.0	91.5	91.8	92.2	92.5
–33	–27	–30	84.7	87.1	87.8	88.3	88.6	88.8	89.0	89.2	89.6	90.0	90.3	90.7
–43	–45	–40	82.9	85.3	85.9	86.5	86.7	87.0	87.2	87.4	87.8	88.1	88.5	88.8
–53	–63	–50	81.1	83.5	84.1	84.6	84.8	85.1	85.3	85.5	85.9	86.2	86.5	86.9

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)						
	–2000	0	2000	4000	6000	8000	10000
PACKS OFF	0.1	0.1	0.2	0.2	0.2	0.2	0.2
1 PACK ON	–0.1	–0.1	–0.2	–0.2	–0.2	–0.2	–0.2
WING ANTI-ICE ON	–0.1	–0.2	–0.2	–0.3	–0.3	–0.3	–0.3

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ALTERNATE MODE EEC
ENGINE INOP

Initial Max Continuous %N1
Based on .84M, engine bleed for one pack on or off and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	92.7	92.4	92.1	91.6	90.9	90.5	90.5	90.2	90.0
15	93.2	92.9	92.5	92.1	91.5	91.2	91.1	91.0	90.9
10	93.7	93.5	93.1	92.5	92.1	91.8	91.7	91.6	91.5
5	94.1	94.1	93.7	93.2	92.5	92.3	92.2	92.1	92.1
0	93.2	94.4	94.6	94.0	93.3	92.9	92.9	92.8	92.8
–5	92.4	93.6	94.8	94.9	94.3	93.9	93.9	93.8	93.7
–10	91.5	92.7	93.9	95.1	95.4	95.0	95.0	94.9	94.8
–15	90.6	91.8	93.0	94.2	95.4	96.0	96.0	95.9	95.9
–20	89.7	90.9	92.1	93.3	94.5	95.1	95.1	95.0	94.9
–25	88.9	90.0	91.2	92.3	93.6	94.1	94.1	94.1	94.0
–30	88.0	89.1	90.3	91.4	92.6	93.2	93.2	93.1	93.0
–35	87.0	88.2	89.3	90.5	91.6	92.2	92.2	92.1	92.1
–40	86.1	87.2	88.4	89.5	90.7	91.3	91.2	91.2	91.1

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
ENGINE ONLY	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.1	–0.2	–0.2
ENGINE & WING*	–0.4	–0.4	–0.4	–0.4	–0.5	–0.5	–0.6	–0.6	–0.7
ENGINE & WING**	–0.6	–0.6	–0.7	–0.8	–0.9	–0.9	–1.0	–1.1	–1.2

*Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

UNCONTROLLED IF DOWNLOADED OR PRINTED
DRAFT

ALTERNATE MODE EEC
ENGINE INOP

Max Continuous %N1
Based on engine bleed for one pack on or off and anti-ice off
320 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	93.6	94.2	94.1	93.7	93.4	92.7	92.1	91.6	91.2	91.1	90.9	91.0	91.0	90.5	90.8	91.9
25	92.9	95.0	95.0	94.6	94.3	93.5	92.9	92.2	91.7	91.6	91.6	91.7	91.7	91.3	91.5	92.3
20	92.1	94.6	95.6	95.6	95.3	94.5	93.8	93.0	92.3	92.1	92.0	92.2	92.2	91.8	92.0	92.7
15	91.3	93.8	94.8	95.5	96.3	95.6	94.9	93.8	93.0	92.7	92.6	92.7	92.7	92.3	92.5	93.2
10	90.5	93.0	94.0	94.7	95.5	95.7	96.0	94.8	93.7	93.3	93.2	93.3	93.2	92.9	93.0	93.8
5	89.7	92.2	93.1	93.9	94.6	94.9	95.1	94.8	94.5	94.1	94.0	94.0	93.8	93.5	93.7	94.6
0	88.9	91.3	92.3	93.0	93.8	94.0	94.3	93.9	93.6	93.5	94.1	94.8	94.6	94.3	94.5	95.4
–5	88.1	90.5	91.4	92.2	92.9	93.1	93.4	93.1	92.8	92.7	93.2	93.9	94.4	94.7	95.5	95.9
–10	87.2	89.6	90.6	91.3	92.0	92.3	92.5	92.2	91.9	91.8	92.3	93.0	93.5	93.8	94.6	95.0
–15	86.4	88.8	89.7	90.4	91.2	91.4	91.7	91.3	91.0	90.9	91.4	92.2	92.6	92.9	93.7	94.1
–20	85.6	87.9	88.8	89.6	90.3	90.5	90.8	90.4	90.1	90.0	90.6	91.3	91.7	92.0	92.8	93.2
–25	84.7	87.1	88.0	88.7	89.4	89.6	89.9	89.5	89.2	89.1	89.7	90.4	90.8	91.1	91.9	92.2
–30	83.9	86.2	87.1	87.8	88.5	88.7	89.0	88.6	88.3	88.2	88.7	89.4	89.9	90.2	91.0	91.3
–35	83.0	85.3	86.2	86.9	87.6	87.8	88.0	87.7	87.4	87.3	87.8	88.5	89.0	89.2	90.0	90.4
–40	82.1	84.4	85.3	85.9	86.6	86.8	87.1	86.8	86.5	86.4	86.9	87.6	88.0	88.3	89.1	89.4

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.4	–0.6	–0.6	–0.6	–0.6	–0.4	–0.3	–0.3	–0.2	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.5	–0.8	–0.8	–0.8	–0.8	–0.6	–0.5	–0.5	–0.5	–0.4	–0.4	–0.4	–0.4	–0.4	–0.5	–0.4
ENGINE & WING**	–0.6	–0.9	–1.0	–1.0	–1.0	–0.9	–0.8	–0.8	–0.7	–0.7	–0.7	–0.7	–0.7	–0.8	–0.8	–0.8

*Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

280 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	93.2	93.6	93.4	92.9	92.6	91.8	91.1	90.7	90.3	90.1	89.9	90.0	90.4	91.1	91.8	91.8
25	93.2	94.5	94.3	93.8	93.2	92.3	91.7	91.4	91.1	90.8	90.1	89.6	89.6	90.3	91.1	91.0
20	92.4	95.4	95.3	94.8	94.3	93.2	92.2	91.9	91.5	91.4	90.8	90.3	90.2	90.4	90.5	90.6
15	91.7	94.8	95.8	95.9	95.5	94.3	93.3	92.6	92.0	91.8	91.2	90.9	90.8	91.0	91.2	91.3
10	90.9	94.0	94.9	95.8	96.6	95.6	94.6	93.6	92.8	92.5	91.8	91.3	91.3	91.6	91.8	91.9
5	90.0	93.1	94.1	94.9	95.7	95.8	95.8	94.8	93.7	93.3	92.5	92.0	91.9	92.1	92.3	92.3
0	89.2	92.3	93.3	94.1	94.8	95.0	95.2	95.2	94.9	94.3	93.4	92.9	92.7	92.9	93.1	93.0
–5	88.4	91.4	92.4	93.2	94.0	94.1	94.3	94.4	94.4	94.3	94.4	93.9	93.7	93.9	94.1	94.0
–10	87.6	90.6	91.5	92.3	93.1	93.2	93.4	93.5	93.5	93.4	93.5	93.8	94.5	95.0	95.2	95.0
–15	86.8	89.7	90.7	91.5	92.2	92.3	92.5	92.6	92.6	92.5	92.6	92.9	93.6	94.7	95.8	95.5
–20	85.9	88.8	89.8	90.6	91.3	91.4	91.6	91.7	91.7	91.6	91.7	92.0	92.7	93.8	94.9	94.5
–25	85.1	88.0	88.9	89.7	90.4	90.5	90.7	90.8	90.8	90.7	90.8	91.1	91.8	92.8	93.9	93.6
–30	84.2	87.1	88.0	88.8	89.5	89.6	89.8	89.9	89.9	89.8	89.9	90.2	90.8	91.9	93.0	92.6
–35	83.3	86.2	87.1	87.8	88.6	88.7	88.8	88.9	88.9	88.9	89.0	89.3	89.9	91.0	92.0	91.7
–40	82.4	85.3	86.2	86.9	87.6	87.7	87.9	88.0	88.0	87.9	88.0	88.3	89.0	90.0	91.0	90.7

UNCONTROLLED IF DOWNLOADED OR PRINTED
DRAFT

ALTERNATE MODE EEC
ENGINE INOP

Max Continuous %N1
Based on engine bleed for one pack on or off and anti-ice off
280 KIAS
%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)																
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.4	–0.7	–0.7	–0.7	–0.6	–0.4	–0.3	–0.3	–0.3	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.5	–0.8	–0.9	–0.9	–0.8	–0.7	–0.5	–0.6	–0.5	–0.5	–0.5	–0.5	–0.4	–0.4	–0.5	–0.5
ENGINE & WING**	–0.6	–1.0	–1.0	–1.1	–1.1	–0.9	–0.8	–0.8	–0.8	–0.8	–0.8	–0.8	–0.8	–0.7	–0.9	–1.0

**Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

240 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	92.1	91.9	91.9	91.8	91.8	90.7	89.4	89.4	90.0	90.4	90.5	90.3	90.9	90.6	91.1	91.6
25	92.8	92.9	92.8	92.4	92.4	91.5	90.4	89.8	89.5	89.6	89.7	89.6	89.6	89.8	90.3	90.8
20	92.3	93.8	93.7	93.4	93.1	92.2	91.2	90.6	90.3	90.1	89.4	88.8	88.8	89.0	89.6	90.0
15	91.5	94.4	94.7	94.5	94.3	93.2	91.9	91.3	90.9	90.8	90.0	89.2	88.5	88.3	88.8	89.3
10	90.7	93.6	94.9	95.6	95.6	94.5	93.1	92.1	91.5	91.4	90.4	89.6	89.1	88.8	88.7	89.1
5	89.9	92.7	94.0	95.1	96.4	95.9	94.6	93.3	92.4	92.1	90.9	89.9	89.5	89.4	89.4	89.8
0	89.1	91.9	93.2	94.3	95.5	96.0	95.9	94.6	93.5	93.1	91.7	90.5	89.8	89.9	90.0	90.4
–5	88.3	91.1	92.3	93.4	94.6	95.1	95.2	95.1	94.7	94.3	92.7	91.4	90.6	90.6	90.6	91.1
–10	87.4	90.2	91.4	92.5	93.7	94.2	94.3	94.3	94.4	94.5	93.9	92.5	91.5	91.6	91.6	92.3
–15	86.6	89.4	90.6	91.7	92.8	93.3	93.4	93.4	93.5	93.6	93.3	93.0	92.8	92.8	92.8	93.4
–20	85.8	88.5	89.7	90.8	91.9	92.4	92.5	92.4	92.6	92.7	92.4	92.1	92.3	93.5	94.1	94.8
–25	84.9	87.6	88.8	89.9	91.0	91.5	91.6	91.5	91.6	91.8.	91.4	91.2	91.4	92.5	93.7	94.6
–30	84.1	86.7	87.9	89.0	90.1	90.5	90.6	90.6	90.7	90.8	90.5	90.3	90.5	91.6	92.7	93.6
–35	83.2	85.8	87.0	88.0	89.2	89.6	89.7	89.7	89.8	89.9	89.6	89.4	89.5	90.6	91.7	92.7
–40	82.3	84.9	86.1	87.7	88.2	88.7	88.8	88.7	88.8	89.0	88.6	88.4	88.6	89.7	90.8	91.7

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)																
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.4	–0.7	–0.7	–0.7	–0.6	–0.5	–0.3	–0.3	–0.3	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.5	–0.8	–0.9	–0.9	–0.8	–0.7	–0.5	–0.6	–0.6	–0.5	–0.5	–0.5	–0.5	–0.5	–0.5	–0.6
ENGINE & WING**	–0.6	–1.0	–1.0	–1.2	–1.1	–1.0	–0.8	–0.9	–0.9	–0.8	–0.8	–0.8	–0.9	–0.9	–0.9	–1.0

**Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

UNCONTROLLED IF DOWNLOADED OR PRINTED
DRAFT

ALTERNATE MODE EEC
ENGINE INOP

Max Continuous %N1
Based on engine bleed for one pack on or off and anti-ice off
200 KIAS

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
30	91.6	90.6	90.3	89.8	89.4	88.2	87.9	88.7	89.3	89.6	89.3	89.2	89.3	89.7	89.9	90.4
25	92.4	91.4	90.9	90.4	90.1	89.1	87.8	87.9	88.6	88.9	88.6	88.5	88.6	89.0	89.1	89.7
20	92.7	92.3	91.8	91.1	90.7	89.9	88.9	88.4	87.9	88.1	87.8	87.7	87.9	88.2	88.4	88.9
15	91.9	93.2	92.7	92.1	91.5	90.5	89.8	89.3	88.8	88.6	87.3	87.0	87.1	87.5	87.6	88.2
10	91.1	93.2	93.6	93.0	92.5	91.6	90.6	90.0	89.5	89.3	88.2	87.1	86.3	86.7	86.8	87.4
5	90.3	92.4	93.2	93.9	93.6	92.7	91.8	90.9	90.1	89.9	88.8	87.8	86.9	86.6	86.1	86.6
0	89.4	91.6	92.3	93.0	93.9	94.0	93.2	92.1	91.1	90.6	89.3	88.3	87.4	87.3	86.8	87.1
–5	88.6	90.7	91.5	92.2	93.1	93.6	94.3	93.5	92.3	91.7	90.2	88.9	87.8	87.8	87.5	87.8
–10	87.8	89.9	90.6	91.3	92.2	92.8	93.4	93.8	93.6	93.0	91.3	89.8	88.5	88.3	88.0	88.4
–15	87.0	89.0	89.7	90.4	91.3	91.9	92.5	92.9	93.2	93.3	92.6	90.8	89.4	89.2	88.9	89.3
–20	86.1	88.1	88.9	89.6	90.4	91.0	91.6	92.0	92.3	92.4	92.1	91.7	90.6	90.3	90.0	90.5
–25	85.3	87.3	88.0	88.7	89.5	90.1	90.7	91.1	91.4	91.5	91.1	90.8	90.5	91.6	91.3	91.8
–30	84.4	86.4	87.1	87.8	88.6	89.2	89.8	90.2	90.4	90.5	90.2	89.9	89.6	90.7	91.7	92.6
–35	83.5	85.5	86.2	86.9	87.7	88.3	88.8	89.2	89.5	89.6	89.3	89.0	88.7	89.7	90.7	91.6
–40	82.6	84.6	85.3	86.0	86.8	87.3	87.9	88.3	88.6	88.7	88.3	88.0	87.8	88.8	89.8	90.6

%N1 Adjustments for Engine Bleed

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)															
	5	10	12	14	16	18	20	22	24	25	27	29	31	33	35	37
ENGINE ONLY	–0.4	–0.7	–0.7	–0.7	–0.6	–0.5	–0.3	–0.3	–0.3	–0.2	–0.2	–0.2	–0.1	–0.1	–0.1	–0.1
ENGINE & WING*	–0.5	–0.8	–0.9	–0.9	–0.9	–0.7	–0.5	–0.6	–0.5	–0.5	–0.6	–0.5	–0.5	–0.5	–0.6	–0.6
ENGINE & WING**	–0.6	–1.0	–1.0	–1.1	–1.1	–1.0	–0.8	–0.9	–0.9	–0.8	–0.9	–0.9	–0.9	–1.0	–1.0	–1.0

*Wing anti-ice on, packs on.
**Wing anti-ice on, packs off.

UNCONTROLLED IF DOWNLOADED OR PRINTED

GEAR DOWN

220 KIAS Max Climb EPR

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)														
	0	5	10	12	14	16	18	20	22	24	26	28	30	32	34
55	1.187	1.185	1.206	1.210	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
50	1.204	1.199	1.206	1.210	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
45	1.223	1.219	1.206	1.210	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
40	1.243	1.239	1.229	1.218	1.216	1.222	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
35	1.264	1.262	1.253	1.243	1.233	1.223	1.232	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
30	1.280	1.286	1.276	1.268	1.259	1.250	1.243	1.244	1.254	1.262	1.260	1.251	1.246	1.235	1.225
25	1.280	1.311	1.303	1.293	1.284	1.276	1.271	1.267	1.259	1.262	1.260	1.251	1.246	1.235	1.225
20	1.280	1.323	1.331	1.321	1.312	1.304	1.299	1.296	1.290	1.280	1.260	1.251	1.246	1.235	1.225
15	1.280	1.323	1.360	1.350	1.342	1.334	1.329	1.326	1.321	1.313	1.293	1.264	1.246	1.235	1.225
10	1.280	1.323	1.366	1.377	1.373	1.366	1.362	1.359	1.352	1.345	1.325	1.295	1.270	1.246	1.225
5	1.280	1.323	1.366	1.377	1.391	1.399	1.396	1.394	1.389	1.380	1.359	1.326	1.298	1.276	1.256
0	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.431	1.426	1.419	1.397	1.359	1.325	1.306	1.292
−5	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.468	1.461	1.439	1.401	1.363	1.337	1.327
−10	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.474	1.495	1.484	1.444	1.406	1.381	1.369
−15	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.474	1.495	1.501	1.491	1.454	1.427	1.417
−20	1.280	1.323	1.366	1.377	1.391	1.406	1.428	1.452	1.474	1.495	1.501	1.491	1.480	1.480	1.469

Anti-Ice Adjustment

ANTI-ICE CONFIGURATION	PRESSURE ALTITUDE (1000 FT)							
	0	5	10	15	20	25	30	35
ENGINE ONLY	−0.008	−0.010	−0.015	−0.015	−0.006	−0.005	−0.003	−0.003
ENGINE AND WING 1	−0.010	−0.012	−0.018	−0.019	−0.012	−0.012	−0.011	−0.013
ENGINE AND WING 2	−0.012	−0.014	−0.021	−0.024	−0.018	−0.019	−0.020	−0.023

Wing 1: Wing anti-ice on, packs on.
Wing 2: Wing anti-ice on, single bleed source and both packs off.

UNCONTROLLED IF DOWNLOADED OR PRINTED

GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
300	12900	10300	6800
290	14400	11900	8900
280	16000	13500	10800
270	17600	15100	12500
260	19200	16800	14300
250	20700	18500	16100
240	22100	20200	17900
230	23500	21700	19700
220	25000	23200	21300
210	25900	24800	22900
200	26900	25800	24500
190	28000	26800	25700
180	29000	27900	26800
170	30200	29000	27800
160	31500	30200	29000

UNCONTROLLED IF DOWNLOADED OR PRINTED

GEAR DOWN

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)								
		10	15	17	19	21	23	25	27	29
300	EPR	1.242								
	MACH	.484								
	KIAS	268								
	FF/ENG	7343								
280	EPR	1.218	1.296	1.338						
	MACH	.470	.512	.531						
	KIAS	260	258	258						
	FF/ENG	6801	6858	6918						
260	EPR	1.195	1.264	1.300	1.344					
	MACH	.455	.496	.514	.533					
	KIAS	251	249	249	249					
	FF/ENG	6293	6307	6337	6396					
240	EPR	1.173	1.235	1.265	1.302	1.347	1.403			
	MACH	.439	.479	.496	.514	.534	.556			
	KIAS	242	241	240	239	239	239			
	FF/ENG	5797	5762	5788	5818	5870	5939			
220	EPR	1.152	1.206	1.233	1.264	1.301	1.347	1.404		
	MACH	.422	.461	.477	.495	.514	.534	.556		
	KIAS	233	232	231	230	230	229	229		
	FF/ENG	5309	5217	5247	5272	5296	5343	5411		
200	EPR	1.132	1.178	1.202	1.229	1.261	1.298	1.343	1.400	
	MACH	.404	.442	.458	.475	.492	.511	.532	.554	
	KIAS	223	222	221	220	220	219	219	219	
	FF/ENG	4820	4725	4712	4732	4763	4776	4819	4879	
180	EPR	1.114	1.152	1.173	1.196	1.224	1.255	1.291	1.337	1.393
	MACH	.385	.421	.437	.453	.470	.489	.509	.531	.553
	KIAS	212	211	211	210	210	209	209	209	209
	FF/ENG	4334	4249	4227	4213	4226	4272	4286	4329	4384
160	EPR	1.096	1.130	1.147	1.166	1.192	1.219	1.249	1.285	1.330
	MACH	.365	.401	.417	.434	.452	.470	.490	.511	.533
	KIAS	201	201	201	201	201	201	201	201	201
	FF/ENG	3859	3799	3792	3781	3778	3798	3848	3860	3896

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GEAR DOWN

Long Range Cruise Enroute 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
328	293	262	238	217	200	188	177	168	160	153
660	587	525	476	435	400	377	356	337	321	307
995	885	790	715	653	600	566	534	506	481	459
1336	1185	1056	955	872	800	754	712	675	641	612
1680	1488	1324	1196	1091	1000	943	890	843	801	764
2029	1795	1595	1438	1310	1200	1131	1068	1011	960	916
2382	2104	1866	1680	1530	1400	1319	1245	1179	1119	1067
2739	2415	2139	1924	1750	1600	1507	1422	1346	1278	1219
3099	2729	2413	2168	1971	1800	1695	1599	1513	1437	1370
3464	3045	2689	2413	2192	2000	1883	1776	1680	1595	1520
3833	3364	2967	2659	2413	2200	2071	1953	1847	1752	1670
4206	3686	3246	2906	2634	2400	2258	2129	2013	1910	1819
4583	4011	3526	3153	2856	2600	2446	2305	2179	2067	1969
4965	4338	3808	3402	3078	2800	2633	2482	2345	2224	2117
5352	4669	4092	3651	3301	3000	2821	2657	2511	2380	2266
5744	5003	4378	3901	3524	3200	3008	2833	2676	2536	2414
6141	5341	4666	4152	3748	3400	3195	3008	2841	2692	2562
6544	5681	4956	4405	3972	3600	3382	3183	3005	2847	2710
6951	6025	5247	4658	4196	3800	3568	3358	3169	3002	2857
7364	6372	5540	4912	4421	4000	3755	3533	3333	3157	3003

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	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	7.5	0:47	6.7	0:45	5.9	0:43	5.4	0:41	5.1	0:40
400	14.4	1:37	13.2	1:32	11.9	1:26	11.1	1:21	10.5	1:17
600	21.3	2:27	19.7	2:19	17.8	2:08	16.8	2:01	15.9	1:55
800	28.2	3:16	26.1	3:06	23.7	2:51	22.4	2:41	21.4	2:32
1000	35.2	4:06	32.6	3:52	29.6	3:33	28.1	3:21	26.8	3:09
1200	41.7	4:58	38.7	4:41	35.2	4:17	33.5	4:02	31.9	3:48
1400	48.3	5:50	44.9	5:29	40.8	5:01	38.9	4:43	37.1	4:26
1600	54.7	6:43	50.9	6:19	46.4	5:45	44.2	5:25	42.1	5:05
1800	60.9	7:36	56.8	7:09	51.9	6:31	49.3	6:07	47.0	5:44
2000	67.2	8:30	62.7	7:59	57.3	7:16	54.4	6:49	51.9	6:23
2200	73.4	9:26	68.3	8:51	62.6	8:02	59.3	7:32	56.6	7:03
2400	79.6	10:22	74.0	9:43	67.8	8:49	64.1	8:15	61.3	7:43
2600	85.6	11:18	79.6	10:35	72.9	9:36	68.9	8:59	65.8	8:24
2800	91.5	12:16	85.0	11:29	77.9	10:24	73.6	9:44	70.3	9:06
3000	97.4	13:14	90.4	12:22	82.9	11:12	78.4	10:28	74.8	9:47
3200	103.1	14:14	95.7	13:18	87.7	12:01	82.9	11:14	79.0	10:29
3400	108.7	15:14	100.9	14:13	92.5	12:50	87.4	11:59	83.3	11:11
3600	114.2	16:15	106.1	15:09	97.1	13:40	91.9	12:46	87.5	11:54
3800	119.5	17:17	111.1	16:06	101.7	14:31	96.2	13:33	91.6	12:38
4000	124.9	18:19	116.2	17:04	106.3	15:22	100.5	14:20	95.7	13:21

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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)				
	160	180	200	220	240
10	–1.3	–0.6	0.0	0.9	1.8
20	–2.1	–1.1	0.0	1.7	3.4
30	–2.9	–1.5	0.0	2.4	5.0
40	–3.7	–1.9	0.0	3.1	6.5
50	–4.6	–2.4	0.0	3.8	7.9
60	–5.5	–2.8	0.0	4.5	9.3
70	–6.4	–3.3	0.0	5.1	10.6
80	–7.3	–3.8	0.0	5.7	11.8
90	–8.3	–4.2	0.0	6.3	12.9
100	–9.2	–4.7	0.0	6.8	14.0
110	–10.3	–5.2	0.0	7.3	15.0
120	–11.3	–5.7	0.0	7.7	15.9
130	–12.4	–6.2	0.0	8.2	16.7

Based on Long Range Cruise and VREF30 + 80 descent.

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GEAR DOWN

Descent at VREF 30+80

PRESSURE ALT (1000 FT)	10	15	17	19	21	23	25	27	29
DISTANCE (NM)	20	30	34	38	42	46	50	54	58
TIME (MINUTES)	8	10	10	11	12	13	14	14	15

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GEAR DOWN

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
300	EPR	1.138	1.168	1.228	1.313			
	KIAS	249	249	249	249			
	FF/ENG	7060	7040	7110	7250			
280	EPR	1.125	1.152	1.204	1.280			
	KIAS	242	242	242	242			
	FF/ENG	6570	6560	6600	6690			
260	EPR	1.113	1.137	1.183	1.251	1.351		
	KIAS	236	236	236	236	236		
	FF/ENG	6150	6130	6160	6200	6370		
240	EPR	1.101	1.123	1.164	1.224	1.310		
	KIAS	230	230	230	230	230		
	FF/ENG	5740	5720	5740	5710	5850		
220	EPR	1.090	1.110	1.146	1.198	1.274	1.393	
	KIAS	224	224	224	224	224	224	
	FF/ENG	5340	5300	5320	5260	5370	5520	
200	EPR	1.081	1.096	1.129	1.174	1.241	1.339	
	KIAS	217	217	217	217	217	217	
	FF/ENG	4930	4890	4890	4830	4890	5000	
180	EPR	1.071	1.085	1.112	1.151	1.209	1.291	
	KIAS	209	209	209	209	209	209	
	FF/ENG	4640	4470	4470	4410	4400	4500	
160	EPR	1.061	1.074	1.096	1.130	1.178	1.249	1.357
	KIAS	201	201	201	201	201	201	201
	FF/ENG	4230	4170	4050	3990	3970	4040	4120

This table includes 5% additional fuel for holding in a racetrack pattern.

Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
300	EPR	1.142	1.172	1.230	1.314	
	KIAS	229	229	229	229	
	FF/ENG	6780	6770	6830	6920	
280	EPR	1.128	1.155	1.207	1.281	
	KIAS	222	222	222	222	
	FF/ENG	6290	6280	6330	6370	
260	EPR	1.115	1.140	1.185	1.251	1.349
	KIAS	216	216	216	216	216
	FF/ENG	5860	5840	5870	5890	6020
240	EPR	1.103	1.125	1.165	1.223	1.308
	KIAS	210	210	210	210	210
	FF/ENG	5440	5410	5440	5410	5510
220	EPR	1.092	1.110	1.146	1.196	1.270
	KIAS	204	204	204	204	204
	FF/ENG	5020	4980	5000	4950	5020
200	EPR	1.081	1.097	1.128	1.171	1.235
	KIAS	197	197	197	197	197
	FF/ENG	4720	4560	4560	4510	4540
180	EPR	1.071	1.085	1.110	1.148	1.201
	KIAS	189	189	189	189	189
	FF/ENG	4300	4250	4130	4080	4070
160	EPR	1.060	1.073	1.094	1.126	1.170
	KIAS	181	181	181	181	181
	FF/ENG	3870	3830	3710	3710	3700

This table includes 5% additional fuel for holding in a racetrack pattern.

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		VREF 30 + 80 DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFTDOWN	LEVEL OFF		ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
240	228	228	4700	2100	
220	210	222	7700	5700	3100
200	191	215	10600	8800	6600
180	172	207	13400	11800	10000
160	154	199	16200	14800	13000

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
240	1000		
230	3600		
220	5900	3100	
210	7700	5600	2400
200	9300	7200	4900
190	10800	9000	6700
180	12300	10600	8500
170	13800	12200	10300
160	15300	13800	11900

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MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)					
		5	7	9	11	13	15
220	EPR	1.366	1.411				
	MACH	.372	.385				
	KIAS	225	225				
	FF/ENG	10159	10225				
200	EPR	1.321	1.361	1.407			
	MACH	.359	.372	.386			
	KIAS	217	217	217			
	FF/ENG	9200	9261	9354			
180	EPR	1.282	1.316	1.355	1.401	1.458	
	MACH	.346	.359	.372	.387	.402	
	KIAS	209	209	209	209	209	
	FF/ENG	8353	8379	8430	8508	8617	
160	EPR	1.245	1.274	1.307	1.345	1.391	1.446
	MACH	.333	.345	.358	.372	.386	.401
	KIAS	201	201	201	201	201	201
	FF/ENG	7494	7538	7559	7594	7657	7751

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GEAR DOWN
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
342	301	267	240	219	200	187	174	164	155	147
518	455	402	361	328	300	280	261	245	231	220
694	610	538	483	438	400	373	348	327	308	292
871	764	674	604	548	500	466	435	408	384	364
1049	920	810	726	658	600	559	522	489	460	436
1228	1076	947	848	768	700	652	608	570	537	508
1408	1233	1084	970	879	800	744	695	651	612	580
1590	1390	1222	1092	989	900	837	781	731	688	652
1772	1548	1360	1214	1099	1000	930	868	812	764	723
1955	1707	1498	1337	1210	1100	1023	954	893	840	795
2139	1866	1636	1460	1320	1200	1116	1040	974	916	866

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	6		8		10		12		14	
	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	7.5	0:52	7.2	0:51	6.9	0:50	6.7	0:49	6.5	0:47
300	11.3	1:18	10.9	1:16	10.6	1:14	10.3	1:12	10.1	1:10
400	15.1	1:44	14.7	1:41	14.3	1:39	13.9	1:36	13.7	1:33
500	18.9	2:10	18.4	2:07	17.9	2:03	17.5	2:00	17.2	1:56
600	22.6	2:37	22.0	2:32	21.5	2:28	21.0	2:24	20.7	2:20
700	26.3	3:03	25.6	2:58	25.0	2:53	24.4	2:48	24.1	2:43
800	30.0	3:30	29.2	3:24	28.5	3:18	27.9	3:12	27.5	3:07
900	33.6	3:57	32.7	3:50	31.9	3:43	31.2	3:37	30.7	3:30
1000	37.1	4:24	36.2	4:16	35.3	4:09	34.6	4:01	34.0	3:54
1100	40.6	4:51	39.6	4:43	38.6	4:34	37.8	4:26	37.2	4:18
1200	44.1	5:19	43.0	5:09	42.0	5:00	41.1	4:51	40.4	4:43

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)			
	160	200	240	280
5	–0.5	0.0	0.7	1.4
10	–1.1	0.0	1.6	3.1
15	–1.7	0.0	2.4	4.8
20	–2.4	0.0	3.3	6.4
25	–3.0	0.0	4.1	8.1
30	–3.6	0.0	4.9	9.7
35	–4.2	0.0	5.7	11.4
40	–4.8	0.0	6.4	13.0
45	–5.4	0.0	7.2	14.6

Based on Long Range Cruise and VREF30 + 80 descent. Includes APU fuel burn.

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)			
		1500	5000	10000	15000
240	EPR	1.332			
	KIAS	230			
	FF/ENG	11360			
220	EPR	1.298	1.362		
	KIAS	224	224		
	FF/ENG	10480	10580		
200	EPR	1.265	1.321	1.434	
	KIAS	217	217	217	
	FF/ENG	9610	9660	9880	
180	EPR	1.233	1.282	1.377	
	KIAS	209	209	209	
	FF/ENG	8690	8770	8890	
160	EPR	1.203	1.245	1.325	1.446
	KIAS	201	201	201	201
	FF/ENG	7830	7870	7950	8140
This table includes 5% additional fuel for holding in a racetrack pattern.					

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Introduction

This chapter contains information to supplement performance data from the Flight Management Computer. 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

FMC Takeoff Speeds

FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Clearway and Stopway V1 Adjustments

Takeoff speed corrections are to be applied to V1 when using takeoff weights based on the use of clearway and stopway.

Adjust V1 by the amount shown in the table. The adjusted V1 must not exceed VR. If V1 is greater than VR, VR may be increased to equal V1. The resultant V2 will be increased by the same amount that VR was increased.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF Speeds

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

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Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver 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/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/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.

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 13mm (0.5 inches) 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 dry field/obstacle limit weight for the takeoff flap setting
2. enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude
3. adjust field length available for temperature by amount shown on chart
4. enter the V1(MCG) Limit Weight table with the field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

1. determine takeoff speeds V1, VR and V2 for actual brake release weight using Takeoff Speeds from the Performance Dispatch chapter or from the FMC
2. if V1(MCG) limited, set V1 = V1(MCG). If not limited by V1(MCG) considerations, enter 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 V1(MCG), set V1 = V1(MCG).

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Slippery Runway

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. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on 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.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Go-Around EPR

To find Go-Around EPR based on normal engine bleed for packs on and anti-ice off, enter the Go-Around EPR table with airport pressure altitude and reported OAT or TAT and read EPR. EPR adjustments are shown for engine bleeds for various conditions.

Max Climb EPR

This table shows Max Climb EPR for a 310/.84 climb speed schedule, normal engine bleed for 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.

Flight with Unreliable Airspeed/Turbulent Air Penetration

Body 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 may also cause unreliable airspeed/Mach indications. Climb, cruise and descent information is based on the recommended turbulent air penetration speed schedule: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and

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above; maintain a minimum speed of 15 knots above the minimum maneuvering speed when below 0.82 Mach. This schedule provides ample protection from stall and high speed buffet, while also providing protection from exceeding structural limits. The Climb, Cruise and Descent tables 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 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. Note that these tables consider 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 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of 1.5 g (48° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43,100 ft.

Long Range Cruise Control

These tables provide target EPR, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude, .84 Mach approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

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 .84/310/250 descent. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

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

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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 at .84/310/250

Distance and time for descent are shown for a .84/310/250 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 30 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 is based on VREF30 + 60 speed schedule. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read EPR, IAS and fuel flow per engine.

Advisory Information

Reported Braking Action

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. A table is provided that correlates runway condition code to runway surface condition description and reported braking action that can then be used to determine the appropriate Normal Configuration Landing Distance or Non-Normal Configuration Landing Distance.

Normal Configuration Operational Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and runways with good, good-to-medium, medium, medium-to-poor, and poor reported braking action. Landing distances (reference distances plus adjustments) are 115% of the actual landing distance. The Normal

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Configuration Landing Distance tables should be used enroute to make a landing distance assessment for time of arrival.

The reference landing distance is the distance from threshold to complete stop. It includes an air distance allowance of 1,500 ft from threshold to touchdown. The reference distance is based on a reference landing weight and speed at sea level, standard day, zero wind, zero slope, two-engine maximum reverse thrust, and auto speedbrakes.

To use these tables, determine the reference landing distance for the selected braking configuration and reported braking action. Adjust this reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers. Each correction is applied independently to the reference landing distance. A correction for use of manual speedbrakes is provided in the table notes.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" reported 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 appropriate 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. Landing distances and adjustments are provided for dry runways and runways with good, good-to-medium, medium, medium-to-poor, and poor reported braking action. Landing distances (reference distances plus adjustments) are representative of the actual landing distance, and are not factored. The Non-Normal Configuration Landing Distance tables should be used enroute to make a landing distance assessment for time of arrival.

The reference landing distance is the distance from threshold to complete stop. It includes an air distance allowance of 1,500 ft from threshold to touchdown. The reference distance is based on a reference landing weight and speed at sea level, standard day, zero wind, zero slope, and maximum available reverse thrust.

Tables for Non-Normal Configuration Landing Distance in this section are similar in format and used in the same manner as tables for the Normal Configuration Landing Distance previously described.

For an engine inoperative landing, check the rate of climb capability shown in Gear Down Landing Rate of Climb Available tables to ensure adequate climb performance.

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Landing Climb Limit Weight

In the event an overweight landing is necessary and the fuel dump system is unavailable, landing climb limits should be checked if a Flaps 30 landing is planned. Enter the table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required. At weights exceeding those shown, plan a Flaps 20 landing.

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 appropriate Event Adjusted Brake Energy Table (No Reverse Thrust or 2 Engine Reverse) with the reference brake energy per brake and the type of braking used during landing (Max Manual, Max Auto, or Autobrake). 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 5.0 or higher on the EICAS indication and disappear as the hottest brake cools with an EICAS indication of 3.5. Note that even without an EICAS advisory message, brake cooling is recommended.

Engine Inoperative

Initial Max Continuous EPR

The Initial Max Continuous EPR setting for use following an engine failure is shown. The table is based on the typical all engine cruise Mach number of .84

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to provide a target EPR setting at the start of driftdown. Once driftdown is established, the Max Continuous EPR table should be used to determine EPR for the given conditions.

Max Continuous EPR

Power setting is based on one engine operating with one bleed source for pack(s) operating and all anti-ice bleeds off. Enter the table for appropriate pressure altitude with IAS or Mach and TAT to read Max Continuous EPR. Apply the anti-ice corrections below the table as required.

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 considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/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. If altitudes other than the level off altitude is used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

Table show the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on LRC speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

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Long Range Cruise Control

The table provides target EPR, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (KG/HR)				
	GROSS WEIGHT (1000 KG)				
	300	260	220	180	140
43				160	140
39			180	160	145
35		200	190	170	140
31	230	220	195	165	140
25	230	220	195	175	155
20	235	230	205	185	165
15	235	235	215	200	185
10	240	240	230	220	200
5	270	270	255	240	220

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 single engine Long Range Cruise speed and .84/310/250 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 off reference fuel corrections table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down Landing Rate of Climb Available

Rate of climb data is provided as guidance information in the event an engine inoperative landing is planned. The tables show gear down rate of climb available for Flaps 20 and Flaps 30. Enter the table with TAT and pressure altitude to read rate of climb available. Apply adjustments shown to correct for weight.

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Alternate Mode EEC

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, net level off and landing climb weights. To determine limit weights for operations with the EEC in the ALTERNATE mode, enter the table with the limit weights for PRIMARY mode EEC operation and read the associated limit weight for each performance condition. 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—Digital Performance Information may yield less restrictive limit weights.

Takeoff Speed Adjustment

Takeoff speeds for the reduced weight should be increased by the amount shown in the Takeoff Speeds Adjustments Table. The adjusted V1 should not exceed the adjusted VR.

Note: The FMC does incorporate ALTERNATE Mode EEC performance in its takeoff speeds calculations.

Max Takeoff %N1

Takeoff power settings are presented for normal air condition bleed. Max Takeoff %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode 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.

Max Climb %N1

This table shows Max Climb %N1 for a 310/.84 climb speed schedule with anti-ice off. Enter the table with pressure altitude and TAT to read Max Climb %N1. Apply bleed adjustments as required.

Max Cruise %N1

Maximum Cruise %N1 is presented for .84M, which approximates Long Range Cruise speed. Enter the table with pressure altitude and TAT to read Max Cruise %N1. Appropriate bleed adjustments are shown.

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Go-Around %N1

Go-Around power setting for ALTERNATE MODE EEC operation is presented for normal engine bleed for packs on. Go-Around %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode 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.

Alternate Mode EEC, Engine Inoperative

Initial Max Continuous %N1

Initial Max Continuous %N1 settings for use following an engine failure are presented. The table is based on the typical all engine cruise Mach number of .84 to provide a target %N1 setting at the start of driftdown. Appropriate bleed adjustments are shown. Once driftdown is established, the Max Continuous %N1 table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Max Continuous %N1 settings are presented as a function of pressure altitude and TAT for engine inoperative speeds of 320, 280, 240, and 200 KIAS. Power settings may be interpolated for intermediate airspeeds. Apply bleed adjustments as required.

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 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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Maximum Allowable Clearway PI.40.1

Clearway and Stopway V1 Adjustments PI.40.2

VREF PI.40.3

Flap Maneuver Speed PI.40.4

Slush/Standing Water Takeoff PI.40.5

Slippery Runway Takeoff PI.40.8

Minimum Control Speeds PI.40.11

Go-around %N1 . . . . . PI.40.12

Max Climb %N1 . . . . . PI.40.13

Flight With Unreliable Airspeed/Turbulent Air Penetration PI.40.14

All Engine PI.41

Long Range Cruise Maximum Operating Altitude PI.41.1

Long Range Cruise Control PI.41.4

Long Range Cruise Enroute Fuel and Time—Low Altitude PI.41.5

Long Range Cruise Enroute Fuel and Time—High Altitude PI.41.6

Long Range Cruise Wind-Altitude Trade PI.41.8

Descent at .84M/310/250 . . . . . PI.41.9

Holding PI.41.10

Advisory Information PI.42

Reported Braking Action PI.42.1

Normal Configuration Operational Landing Distance PI.42.2

Non-Normal Configuration Landing Distance PI.42.5

Landing Climb Limit Weight PI.42.34

Recommended Brake Cooling Schedule PI.42.36

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Engine Inoperative PI.43

Initial Max Continuous %N1 ..... PI.43.1

Max Continuous %N1 ..... PI.43.2

Driftdown Speed/Level Off Altitude PI.43.5

Driftdown/LRC Cruise Range Capability PI.43.6

Long Range Cruise Altitude Capability PI.43.7

Long Range Cruise Control PI.43.8

Long Range Cruise Diversion Fuel and Time PI.43.9

Holding PI.43.10

Gear Down Landing Rate of Climb Available PI.43.11

Alternate Mode EEC PI.44

Alternate Mode EEC Max Takeoff %N1 ..... PI.44.1

Gear Down PI.45

220 KIAS Max Climb %N1 ..... PI.45.1

Long Range Cruise Altitude Capability PI.45.2

Long Range Cruise Control PI.45.3

Long Range Cruise Enroute Fuel and Time PI.45.4

Descent at VREF 30+80 ..... PI.45.6

Holding PI.45.7

Gear Down, Engine INOP PI.46

Driftdown Speed/Level Off Altitude PI.46.1

Long Range Cruise Altitude Capability PI.46.2

Long Range Cruise Control PI.46.3

Long Range Cruise Diversion Fuel and Time PI.46.4

Holding PI.46.5

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Maximum Allowable Clearway

FIELD LENGTH (M)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (M)
1500	140
2000	180
2500	210
3000	230
3500	250
4000	280
4500	310

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Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (M)	NORMAL V1 (KIAS)														
	DRY RUNWAY					WET RUNWAY					WET SKID-RESISTANT				
	100	120	140	160	180	100	120	140	160	180	100	120	140	160	180
300	–3	–3	–3	–3	–3										
200	–3	–3	–3	–2	–2										
100	–2	–2	–1	–1	–1										
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
–100	4	4	4	3	2	3	3	2	1	1	3	3	2	1	1
–200	8	7	5	3	3	5	4	2	2	2	4	4	2	2	2
–300	8	8	5	3	3	7	7	4	3	3	4	4	2	2	2

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VREF

WEIGHT (1000 KG)	FLAPS		
	30	25	20
360	184	186	199
340	180	183	196
320	173	177	190
300	164	172	184
280	158	166	178
260	152	160	172
240	146	154	165
220	140	148	158
200	134	141	151
180	126	133	143
160	119	125	134

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Flap Maneuver Speed

FLAP POSITION	MANEUVER SPEED
FLAPS UP	VREF30 + 80
FLAPS 1	VREF30 + 60
FLAPS 5	VREF30 + 40
FLAPS 15	VREF30 + 20
FLAPS 20	VREF30 + 20
FLAPS 25	VREF25
FLAPS 30	VREF30

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ADVISORY INFORMATION

Slush/Standing Water Takeoff
Maximum Reverse Thrust
Weight Adjustment (1000 KG)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	–39.2	–44.3	–49.4	–46.7	–51.8	–56.9	–59.3	–64.3	–69.4
380	–37.7	–42.8	–47.9	–44.7	–49.8	–54.9	–56.3	–61.4	–66.5
360	–36.3	–41.3	–46.4	–42.7	–47.8	–52.9	–53.3	–58.4	–63.5
340	–34.6	–39.7	–44.8	–40.6	–45.6	–50.7	–50.2	–55.3	–60.4
320	–32.6	–37.7	–42.8	–38.0	–43.1	–48.2	–46.6	–51.7	–56.8
300	–30.3	–35.4	–40.4	–35.1	–40.1	–45.2	–42.7	–47.8	–52.8
280	–27.5	–32.6	–37.7	–31.7	–36.8	–41.9	–38.3	–43.3	–48.4
260	–24.4	–29.5	–34.6	–28.0	–33.1	–38.1	–33.4	–38.5	–43.6
240	–20.9	–26.0	–31.1	–23.8	–28.9	–34.0	–28.2	–33.2	–38.3
220	–17.1	–22.2	–27.2	–19.3	–24.4	–29.4	–22.5	–27.6	–32.6
200	–12.8	–17.9	–23.0	–14.3	–19.4	–24.5	–16.4	–21.5	–26.5
180	–8.2	–13.3	–18.4	–9.0	–14.1	–19.2	–9.8	–14.9	–20.0
160	–3.5	–8.6	–13.7	–3.5	–8.6	–13.7	–3.1	–8.2	–13.3

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
2000				141.8			163.2		
2200	169.0			181.8			204.0	156.8	
2400	209.0	162.8		222.7	175.5		246.2	197.5	150.4
2600	251.0	202.6	156.5	265.7	216.1	169.2	290.3	239.4	191.0
2800	295.6	244.2	196.2	311.1	258.8	209.6	336.6	283.2	232.7
3000	343.2	288.4	237.5	359.4	303.8	251.9	384.9	329.1	276.2
3200	393.6	335.5	281.2		351.5	296.5		377.2	321.7
3400		385.6	327.8			343.8			369.5
3600			377.6			393.4			

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by –55 m/+50 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

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ADVISORY INFORMATION

Slush/Standing Water Takeoff
Maximum Reverse Thrust
V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	–26	–24	–22	–21	–19	–17	–14	–12	–10
340	–28	–26	–24	–24	–22	–20	–15	–13	–11
320	–30	–28	–26	–25	–23	–21	–17	–15	–13
300	–30	–28	–26	–27	–25	–23	–18	–16	–14
280	–31	–29	–27	–27	–25	–23	–20	–18	–16
260	–31	–29	–27	–28	–26	–24	–21	–19	–17
240	–31	–29	–27	–28	–26	–24	–22	–20	–18
220	–30	–28	–26	–28	–26	–24	–23	–21	–19
200	–29	–27	–25	–28	–26	–24	–24	–22	–20
180	–28	–26	–24	–27	–25	–23	–24	–22	–20
160	–28	–26	–24	–26	–24	–22	–24	–22	–20

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.

2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

No Reverse Thrust
Weight Adjustment (1000 KG)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
400	–54.8	–60.4	–66.0	–64.0	–69.6	–75.2	–79.3	–84.9	–90.5
380	–52.2	–57.8	–63.5	–60.7	–66.3	–71.9	–74.5	–80.1	–85.7
360	–49.7	–55.3	–60.9	–57.4	–63.0	–68.6	–69.7	–75.3	–81.0
340	–47.0	–52.6	–58.3	–53.9	–59.6	–65.2	–64.8	–70.5	–76.1
320	–44.0	–49.6	–55.3	–50.2	–55.8	–61.4	–59.7	–65.3	–70.9
300	–40.7	–46.3	–51.9	–46.1	–51.7	–57.4	–54.2	–59.8	–65.5
280	–37.0	–42.7	–48.3	–41.7	–47.3	–53.0	–48.5	–54.1	–59.7
260	–33.1	–38.7	–44.3	–37.0	–42.6	–48.2	–42.5	–48.1	–53.7
240	–28.7	–34.4	–40.0	–32.0	–37.6	–43.2	–36.2	–41.8	–47.5
220	–24.1	–29.7	–35.4	–26.6	–32.2	–37.9	–29.6	–35.3	–40.9
200	–19.1	–24.8	–30.4	–20.9	–26.6	–32.2	–22.8	–28.4	–34.0
180	–13.9	–19.5	–25.1	–14.9	–20.6	–26.2	–15.7	–21.3	–26.9
160	–8.4	–14.1	–19.7	–8.8	–14.5	–20.1	–8.4	–14.1	–19.7

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ADVISORY INFORMATION

Slush/Standing Water Takeoff
No Reverse Thrust
V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (m)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
3000							168.9		
3200				126.7			217.0	167.2	
3400				177.0	124.9		267.2	215.2	165.5
3600	165.9			228.7	175.2	123.0	320.1	265.4	213.5
3800	219.2	164.0		284.3	226.8	173.4	375.9	318.2	263.5
4000	277.6	217.2	162.1	344.8	282.2	224.9		373.8	316.2
4200	343.4	275.3	215.2	409.4	342.5	280.1			371.8
4400	415.8	340.8	273.1		407.0	340.2			
4600		413.2	338.3			404.7			

1. Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.
2. Adjust field length available by –85 m/+85 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.

V1 Adjustment (KIAS)

WEIGHT (1000 KG)	SLUSH/STANDING WATER DEPTH								
	3 mm (0.12 INCHES)			6 mm (0.25 INCHES)			13 mm (0.50 INCHES)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
360	–42	–38	–34	–36	–32	–28	–24	–20	–16
340	–44	–40	–36	–38	–34	–30	–26	–22	–18
320	–45	–41	–37	–40	–36	–32	–28	–24	–20
300	–46	–42	–38	–42	–38	–34	–30	–26	–22
280	–47	–43	–39	–43	–39	–35	–33	–29	–25
260	–47	–43	–39	–44	–40	–36	–35	–31	–27
240	–47	–43	–39	–44	–40	–36	–37	–33	–29
220	–47	–43	–39	–44	–40	–36	–39	–35	–31
200	–46	–42	–38	–44	–40	–36	–40	–36	–32
180	–45	–41	–37	–44	–40	–36	–40	–36	–32
160	–45	–41	–37	–43	–39	–35	–41	–37	–33

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

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ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
Weight Adjustments (1000 KG)

DRY 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	–1.5	–2.9	–20.1	–21.6	–23.0	–39.9	–41.3	–42.8
380	0.0	–1.5	–2.9	–20.6	–22.1	–23.5	–38.8	–40.2	–41.7
360	0.0	–1.5	–2.9	–21.1	–22.6	–24.0	–37.7	–39.1	–40.6
340	–1.8	–3.2	–4.7	–21.5	–23.0	–24.4	–36.5	–37.9	–39.4
320	–4.2	–5.6	–7.1	–21.7	–23.1	–24.6	–35.2	–36.6	–38.1
300	–5.6	–7.1	–8.5	–21.5	–23.0	–24.4	–33.7	–35.2	–36.6
280	–6.2	–7.7	–9.1	–21.0	–22.4	–23.9	–31.9	–33.4	–34.8
260	–6.3	–7.7	–9.2	–19.7	–21.1	–22.6	–29.4	–30.8	–32.3
240	–5.8	–7.3	–8.7	–17.7	–19.1	–20.6	–26.1	–27.5	–29.0
220	–4.8	–6.3	–7.7	–15.0	–16.4	–17.9	–22.0	–23.4	–24.9
200	–3.3	–4.8	–6.2	–11.5	–13.0	–14.4	–17.1	–18.6	–20.0
180	–1.3	–2.7	–4.2	–7.3	–8.8	–10.2	–11.5	–13.0	–14.4
160	0.0	–0.5	–2.0	–2.8	–4.3	–5.7	–5.6	–7.1	–8.5

V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	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
1400	125.7								
1600	212.9	159.7							
1800	299.1	246.6	193.7						
2000	384.4	332.5	280.3	174.3	126.3				
2200		417.5	365.7	232.1	182.7	134.7			
2400				294.0	240.9	191.1	150.3		
2600				361.2	303.6	249.9	184.5	138.6	
2800					371.6	313.3	219.9	172.9	127.0
3000						382.0	257.6	207.6	161.2
3200							298.1	244.5	195.6
3400							342.2	284.0	231.7
3600							389.8	326.7	270.2
3800								373.5	311.8
4000									357.3

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.

2. Adjust “Good” field length available by –30 m/+25 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Medium” field length available by –40 m/+35 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Poor” field length available by –60 m/+55 m for every 5 deg. C above/below 4 deg. C.

3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.

4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

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ADVISORY INFORMATION

Slippery Runway Takeoff
Maximum Reverse Thrust
V1 Adjustments (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
360	–7	–5	–3	–19	–17	–15	–33	–31	–29
340	–9	–7	–5	–21	–19	–17	–35	–33	–31
320	–11	–9	–7	–23	–21	–19	–38	–36	–34
300	–12	–10	–8	–25	–23	–21	–39	–37	–35
280	–12	–10	–8	–26	–24	–22	–40	–38	–36
260	–13	–11	–9	–26	–24	–22	–41	–39	–37
240	–13	–11	–9	–27	–25	–23	–42	–40	–38
220	–13	–11	–9	–27	–25	–23	–42	–40	–38
200	–14	–12	–10	–27	–25	–23	–42	–40	–38
180	–14	–12	–10	–28	–26	–24	–42	–40	–38
160	–15	–13	–11	–29	–27	–25	–41	–39	–37

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.

2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

No Reverse Thrust
Weight Adjustment (1000 KG)

DRY 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	–0.5	–0.5	–0.5	–34.3	–34.3	–34.3	–59.7	–59.7	–59.7
380	–3.0	–3.0	–3.0	–33.8	–33.8	–33.8	–57.1	–57.1	–57.1
360	–5.6	–5.6	–5.6	–33.2	–33.2	–33.2	–54.5	–54.5	–54.5
340	–7.9	–7.9	–7.9	–32.7	–32.7	–32.7	–51.9	–51.9	–51.9
320	–9.9	–9.9	–9.9	–32.3	–32.3	–32.3	–49.7	–49.7	–49.7
300	–11.4	–11.4	–11.4	–32.0	–32.0	–32.0	–47.7	–47.7	–47.7
280	–12.4	–12.4	–12.4	–31.4	–31.4	–31.4	–45.7	–45.7	–45.7
260	–12.6	–12.6	–12.6	–29.9	–29.9	–29.9	–42.7	–42.7	–42.7
240	–12.0	–12.0	–12.0	–27.4	–27.4	–27.4	–38.9	–38.9	–38.9
220	–10.7	–10.7	–10.7	–23.8	–23.8	–23.8	–34.1	–34.1	–34.1
200	–8.6	–8.6	–8.6	–19.2	–19.2	–19.2	–28.4	–28.4	–28.4
180	–5.7	–5.7	–5.7	–13.5	–13.5	–13.5	–21.7	–21.7	–21.7
160	–2.1	–2.1	–2.1	–6.8	–6.8	–6.8	–14.1	–14.1	–14.1

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ADVISORY INFORMATION

Slippery Runway Takeoff
No Reverse Thrust
V1(MCG) Limit Weight (1000 KG)

ADJUSTED FIELD LENGTH (M)	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
1800	149.2								
2000	300.8	237.4	153.9						
2200	405.7	356.5	303.6						
2400			408.1						
3000				287.0	184.8				
3200				400.6	327.4	239.5			
3400					436.1	364.0			
...									
4800							246.9		
5000							368.0	292.4	188.8
5200								402.3	331.8
5400									436.6

1. Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.
2. Adjust “Good” field length available by –30 m/+30 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Medium” field length available by –50 m/+45 m for every 5 deg. C above/below 4 deg. C.
   Adjust “Poor” field length available by –85 m/+80 m for every 5 deg. C above/below 4 deg. C.
3. Find V1(MCG) limit weight for adjusted field length and pressure altitude.
4. Max allowable slippery runway limited weight is lesser of weights from 1 and 3.

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
360	–10	–6	–2	–27	–23	–19	–52	–48	–44
340	–13	–9	–5	–30	–26	–22	–56	–52	–48
320	–15	–11	–7	–33	–29	–25	–59	–55	–51
300	–16	–12	–8	–35	–31	–27	–63	–59	–55
280	–17	–13	–9	–37	–33	–29	–66	–62	–58
260	–18	–14	–10	–39	–35	–31	–68	–64	–60
240	–19	–15	–11	–41	–37	–33	–70	–66	–62
220	–20	–16	–12	–42	–38	–34	–71	–67	–63
200	–21	–17	–13	–44	–40	–36	–71	–67	–63
180	–22	–18	–14	–46	–42	–38	–71	–67	–63
160	–23	–19	–15	–48	–44	–40	–71	–67	–63

1. Obtain V1, VR and V2 for the actual weight using the Dry Runway Takeoff Speeds table.
2. If V1(MCG) limited, set V1 = V1(MCG). If not V1(MCG) limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than V1(MCG), set V1 = V1(MCG). V1 not to exceed VR.

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Minimum Control Speeds
V1(MCG), Minimum VR
Max Takeoff Thrust

TEMP		PRESSURE ALTITUDE (FT)											
		–2000		0		2000		4000		6000		8000	
deg. C	deg. F	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR	V1 (MCG)	Min VR
60	140	116	118	113	115	111	113	109	111				
50	122	119	121	116	118	111	113	109	111	106	109	103	106
40	104	126	127	123	124	118	120	113	115	108	111	103	106
30	86	128	130	128	130	123	125	118	120	112	115	106	109
20	68	129	130	129	130	125	126	120	122	116	118	110	113
–60	–76	130	130	130	130	126	126	121	122	117	118	112	114

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Go-around %N1

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off

REPORTED OAT		TAT (deg. C)	AIRPORT PRESSURE ALTITUDE (1000 FT)												
deg. C	deg. F		–2	–1	0	1	2	3	4	5	6	7	8	9	10
66	150	70	93.7	93.8	94.1	93.9	93.8	93.7	93.6	93.4	93.3	92.6	91.5	90.5	89.6
56	133	60	96.5	96.6	96.9	96.7	96.6	96.5	96.4	96.2	96.1	95.4	94.3	93.4	92.5
51	124	55	97.8	98.0	98.3	98.1	97.9	97.9	97.7	97.6	97.4	96.7	95.7	94.7	93.9
46	115	50	99.1	99.3	99.6	99.4	99.3	99.2	99.1	98.9	98.7	98.0	97.0	96.1	95.2
41	106	45	100.2	100.7	101.1	101.0	100.9	100.7	100.5	100.4	100.0	99.3	98.3	97.3	96.5
36	97	40	101.5	102.4	103.2	103.2	102.8	102.6	102.3	102.0	101.4	100.5	99.5	98.6	97.8
31	88	35	101.2	103.9	105.8	105.4	105.1	104.7	104.3	103.8	102.7	101.7	100.6	99.7	98.9
26	79	30	100.4	103.1	105.9	106.8	107.3	106.8	106.6	106.4	105.0	103.4	101.9	100.8	100.0
21	70	25	99.5	102.2	105.0	105.9	106.5	107.0	107.4	107.4	106.8	105.7	104.0	102.3	101.3
16	61	20	98.7	101.4	104.1	105.0	105.6	106.1	106.5	107.0	106.8	106.3	105.2	104.2	103.3
11	53	15	97.9	100.5	103.2	104.1	104.7	105.2	105.6	106.1	105.9	105.5	104.9	104.4	104.0
7	44	10	97.0	99.6	102.3	103.2	103.8	104.3	104.7	105.1	105.0	104.6	104.0	103.5	103.4
2	35	5	96.1	98.7	101.4	102.3	102.9	103.4	103.8	104.2	104.1	103.7	103.1	102.6	102.5
–3	26	0	95.3	97.8	100.5	101.4	102.0	102.4	102.8	103.3	103.1	102.7	102.2	101.7	101.6
–13	8	–10	93.5	96.0	98.6	99.5	100.1	100.5	100.9	101.4	101.2	100.8	100.3	99.8	99.7
–23	–10	–20	91.7	94.2	96.7	97.6	98.2	98.6	99.0	99.4	99.3	98.9	98.3	97.9	97.8
–33	–27	–30	89.9	92.3	94.8	95.6	96.2	96.6	97.0	97.4	97.3	96.9	96.4	95.9	95.8
–43	–45	–40	88.0	90.4	92.8	93.6	94.2	94.6	95.0	95.4	95.3	94.9	94.4	93.9	93.9
–53	–63	–50	86.1	88.4	90.8	91.6	92.2	92.6	93.0	93.3	93.2	92.9	92.3	91.9	91.8

%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
PACKS OFF	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3
1 PACK ON	–0.2	–0.2	–0.3	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4	–0.3	–0.3	–0.3	–0.3
WING ANTI-ICE ON	–0.2	–0.3	–0.4	–0.5	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4

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Max Climb %N1

Based on engine bleed for packs on or off and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)/SPEED (KIAS OR MACH)									
	0	5	10	15	20	25	30	35	40	43
	310	310	310	310	310	310	310	0.84	0.84	0.84
60	88.3	88.1	90.3	91.0	93.1	96.7	99.6	101.7	101.8	101.3
50	90.6	90.4	90.2	89.6	91.7	95.3	98.0	100.1	100.2	99.7
40	92.5	92.4	92.4	92.2	90.5	93.8	96.5	98.6	98.7	98.2
30	91.6	94.1	94.2	94.0	93.1	94.2	95.2	97.0	97.1	96.6
20	90.1	92.5	95.1	95.8	95.9	95.9	96.9	95.9	95.5	95.0
15	89.3	91.7	94.3	96.9	96.9	96.9	97.8	96.6	95.8	95.4
10	88.6	90.9	93.5	96.1	98.4	98.1	98.8	97.2	96.5	96.0
5	87.8	90.1	92.7	95.2	98.1	99.6	100.1	98.1	97.2	96.8
0	87.0	89.3	91.8	94.4	97.3	99.9	101.5	99.3	98.1	97.6
–5	86.2	88.5	91.0	93.5	96.4	99.0	101.9	100.5	99.5	98.8
–10	85.4	87.7	90.1	92.6	95.5	98.1	100.9	101.3	100.5	100.0
–15	84.6	86.8	89.3	91.7	94.5	97.1	100.0	101.0	100.9	100.5
–20	83.7	86.0	88.4	90.8	93.6	96.2	99.0	100.1	99.9	99.5
–25	82.9	85.1	87.5	89.9	92.7	95.2	98.0	99.1	98.9	98.5
–30	82.1	84.3	86.7	89.0	91.8	94.3	97.0	98.1	97.9	97.5
–35	81.2	83.4	85.8	88.1	90.8	93.3	96.0	97.0	96.9	96.5
–40	80.4	82.5	84.9	87.2	89.8	92.3	95.0	96.0	95.9	95.5

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)									
	0	5	10	15	20	25	30	35	40	43
2 PACKS ON - 1 BLEED SOURCE	–0.4	–0.5	–0.4	–0.3	–0.2	–0.3	–0.3	–0.4	–0.4	–0.5
1 PACK ON - 1 OR 2 BLEED SOURCES	–0.4	–0.5	–0.4	–0.3	–0.2	–0.3	–0.3	–0.4	–0.4	–0.5
ENGINE ANTI-ICE ON	–0.3	–0.5	–0.4	–0.3	–0.1	–0.2	–0.2	–0.2	–0.2	–0.2
ENGINE & WING ANTI-ICE ON*	–0.6	–0.8	–0.7	–0.5	–0.2	–0.3	–0.3	–0.4	–0.4	–0.4
ENGINE & WING ANTI-ICE ON**	–1.1	–0.9	–0.9	–0.6	–0.3	–0.4	–0.5	–0.5	–0.6	–0.6

***Packs on or of with 2 bleed sources.**
****Packs off with 1 bleed source.**

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Flight With Unreliable Airspeed/Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		160	**210**	**260**	**310**	**360**
40000 (.82M)	PITCH ATT V/S (FT/MIN)	4.5 2200	**4.0** **800**			
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	6.0 3300	5.0 2300	5.0 1600	**4.5** **1200**	**4.0** **800**
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	9.0 4700	8.0 3400	7.5 2500	7.5 1900	**7.0** **1300**
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	13.0 6200	10.5 4500	10.0 3500	9.5 2700	**9.0** **2100**
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	16.5 7200	13.5 5300	12.0 4100	11.5 3300	**11.0** **2700**

In boldface areas, data reflects the minimum speed limitation of 15 knots above minimum maneuvering speed.

Cruise

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		160	**210**	**260**	**310**	**360**
40000 (.82M)	PITCH ATT %N1	2.0 80.2	3.0 84.8			
35000 (280 KIAS)	PITCH ATT %N1	1.5 77.7	2.0 80.4	2.5 84.1	**3.5** **90.4**	
30000 (280 KIAS)	PITCH ATT %N1	1.5 73.5	2.0 76.0	3.0 79.8	**3.0** **84.2**	**3.0** **88.5**
25000 (280 KIAS)	PITCH ATT %N1	1.5 69.6	2.5 72.1	3.0 75.2	**3.5** **79.3**	**3.5** **83.4**
20000 (270 KIAS)	PITCH ATT %N1	1.5 64.7	2.5 67.3	3.5 70.5	**4.0** **74.6**	**4.0** **78.7**
15000 (270 KIAS)	PITCH ATT %N1	1.5 60.9	2.5 63.3	3.5 66.4	4.5 69.7	**4.5** **74.1**

In boldface areas, data reflects the minimum speed limitation of 15 knots above minimum maneuvering speed.

Descent

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT) (SPEED)		WEIGHT (1000 KG)				
		160	**210**	**260**	**310**	**360**
40000 (.82M)	PITCH ATT V/S (FT/MIN)	–1.5 –2900	–0.5 –2600			
30000 (280 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –2400	–0.5 –2000	0.5 –1900	**0.5** **–2100**	**0.5** **–2500**
20000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –1900	0.0 –1700	1.0 –1600	2.0 –1500	**1.5** **–1600**
10000 (270 KIAS)	PITCH ATT V/S (FT/MIN)	–1.5 –1700	0.0 –1500	1.0 –1400	2.0 –1400	**2.5** **–1400**
SEA LEVEL (270 KIAS)	PITCH ATT V/S (FT/MIN)	–2.0 –1600	–0.5 –1300	1.0 –1200	2.0 –1200	**2.5** **–1200**

In boldface areas, data reflects the minimum speed limitation of 15 knots above minimum maneuvering speed.

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Flight With Unreliable Airspeed/Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Holding

Flaps Up, Set Thrust for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		160	210	260	310	360
10000	PITCH ATT	4.0	5.0	5.5	5.5	5.5
	%N1	50.4	55.8	60.8	65.5	69.5
	KIAS	199	217	233	255	275
5000	PITCH ATT	4.0	5.0	5.5	5.5	5.5
	%N1	46.7	52.3	56.9	61.3	65.4
	KIAS	199	217	232	253	273

Terminal Area (5000 FT)

Set Thrust for Level Flight

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		160	210	260	310	360
FLAPS UP	PITCH ATT	4.5	5.5	6.0	6.0	6.5
GEAR UP	%N1	46.9	52.6	57.4	61.9	66.2
(VREF 30+80)	KIAS	201	217	232	248	264
FLAPS 1	PITCH ATT	6.0	7.0	7.5	7.5	8.0
GEAR UP	%N1	47.7	53.6	58.7	63.6	67.8
(VREF 30+60)	KIAS	181	197	212	228	244
FLAPS 5	PITCH ATT	5.5	6.0	6.5	6.5	6.5
GEAR UP	%N1	48.3	54.3	59.8	64.5	68.9
(VREF 30+40)	KIAS	161	177	192	208	224
FLAPS 15	PITCH ATT	6.0	6.5	7.0	7.0	7.0
GEAR UP	%N1	49.2	55.6	61.5	66.3	70.9
(VREF 30+20)	KIAS	141	157	172	188	204
FLAPS 20	PITCH ATT	4.5	5.0	5.5	5.5	5.5
GEAR DOWN	%N1	54.9	61.7	67.8	73.2	77.9
(VREF 30+20)	KIAS	141	157	172	188	204

Final Approach (1500 FT)

Gear Down, Set Thrust for 3° Glideslope

FLAP POSITION (VREF + INCREMENT)		WEIGHT (1000 KG)				
		160	210	260	310	360
FLAPS 20 (VREF 20+10)	PITCH ATT	1.0	1.0	1.5	1.5	2.0
	%N1	37.7	42.4	46.8	50.6	53.7
	KIAS	144	164	181	196	208
FLAPS 25 (VREF 25+10)	PITCH ATT	1.5	1.5	2.0	2.0	2.0
	%N1	47.6	53.0	57.5	61.6	64.5
	KIAS	135	154	170	184	195
FLAPS 30 (VREF 30+10)	PITCH ATT	1.0	1.0	1.5	1.0	1.0
	%N1	52.5	57.7	62.6	68.2	73.3
	KIAS	131	147	162	178	194

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Flight With Unreliable Airspeed/Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Go-Around

Flaps 20, Gear Up, Set Go-Around Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 KG)				
		160	210	260	310	360
10000	PITCH ATT	20.5	15.5	13.0	10.5	9.0
	V/S (FT/MIN)	4600	3500	2600	2100	1600
	KIAS	139	157	172	189	204
5000	PITCH ATT	26.0	19.5	16.0	13.0	11.0
	V/S (FT/MIN)	5700	4400	3400	2800	2300
	KIAS	139	157	172	189	204
SEA LEVEL	PITCH ATT	30.5	23.0	18.5	15.5	13.0
	V/S (FT/MIN)	6500	5100	4100	3400	2800
	KIAS	141	157	172	188	204

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust, Forward C.G. (7.5% MAC - FMC Default)
ISA + 10 deg. C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (°deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	4	30400	28700	27200
350	28500	3	31000	29400	27800
340	29200	1	31600	30000	28500
330	29800	0	32100	30500	29000
320	30500	–2	32600	31000	29500
310	31200	–3	33200	31600	30000
300	31900	–5	33700	32100	30600
290	32600	–7	34300	32700	31200
280	33400	–8	34900	33300	31800
270	34100	–10	35500	33900	32400
260	34900	–12	36100	34500	33100
250	35800	–14	36800	35200	33800
240	36600	–15	37500	35900	34500
230	37500	–15	38200	36600	35200
220	38400	–15	39000	37400	36000
210	39400	–15	39700	38200	36800
200	40400	–15	40600	39100	37700
190	41500	–15	41500	39900	38600
180	42600	–15	42400	40900	39600
170	43100	–15	43100	42100	40800
160	43100	–15	43100	43100	42100

ISA + 15 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	10	30400	28700	27200
350	28500	8	31000	29400	27800
340	29200	7	31600	30000	28500
330	29800	5	32100	30500	29000
320	30500	4	32600	31000	29500
310	31200	2	33200	31600	30000
300	31900	1	33700	32100	30600
290	32600	–1	34300	32700	31200
280	33400	–3	34900	33300	31800
270	34100	–4	35500	33900	32400
260	34900	–6	36100	34500	33100
250	35800	–8	36800	35200	33800
240	36600	–9	37500	35900	34500
230	37500	–9	38200	36600	35200
220	38400	–9	39000	37400	36000
210	39400	–9	39700	38200	36800
200	40400	–9	40600	39100	37700
190	41500	–9	41500	39900	38600
180	42600	–9	42400	40900	39600
170	43100	–9	43100	42100	40800
160	43100	–9	43100	43100	42100

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust, Forward C.G. (7.5% MAC - FMC Default)
ISA + 20 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	15	30400	28700	27200
350	28500	14	31000	29400	27800
340	29200	13	31600	30000	28500
330	29800	11	32100	30500	29000
320	30500	10	32600	31000	29500
310	31200	8	33200	31600	30000
300	31900	6	33700	32100	30600
290	32600	5	34300	32700	31200
280	33400	3	34900	33300	31800
270	34100	1	35500	33900	32400
260	34900	–1	36100	34500	33100
250	35800	–2	36800	35200	33800
240	36600	–3	37500	35900	34500
230	37500	–3	38200	36600	35200
220	38400	–3	39000	37400	36000
210	39400	–3	39700	38200	36800
200	40400	–3	40600	39100	37700
190	41500	–3	41500	39900	38600
180	42600	–3	42400	40900	39600
170	43100	–3	43100	42100	40800
160	43100	–3	43100	43100	42100

Max Climb Thrust, Mid C.G. (30% MAC)
ISA + 10 deg. C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	4	31400	29800	28300
350	28500	3	32000	30400	28900
340	29200	1	32700	31000	29500
330	29800	0	33200	31500	30000
320	30500	–2	33700	32100	30500
310	31200	–3	34200	32600	31100
300	31900	–5	34700	33100	31600
290	32600	–7	35300	33700	32200
280	33400	–8	35900	34300	32800
270	34100	–10	36500	34900	33400
260	34900	–12	37100	35500	34100
250	35800	–14	37800	36200	34800
240	36600	–15	38500	36900	35500
230	37500	–15	39200	37600	36200
220	38400	–15	40000	38400	37000
210	39400	–15	40700	39200	37800
200	40400	–15	41600	40000	38600
190	41500	–15	42500	40900	39500
180	42600	–15	43100	41900	40500
170	43100	–15	43100	43100	41700
160	43100	–15	43100	43100	43000

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Long Range Cruise Maximum Operating Altitude
Max Climb Thrust, Mid C.G. (30% MAC)
ISA + 15 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	10	31400	29800	28300
350	28500	8	32000	30400	28900
340	29200	7	32700	31000	29500
330	29800	5	33200	31500	30000
320	30500	4	33700	32100	30500
310	31200	2	34200	32600	31100
300	31900	1	34700	33100	31600
290	32600	–1	35300	33700	32200
280	33400	–3	35900	34300	32800
270	34100	–4	36500	34900	33400
260	34900	–6	37100	35500	34100
250	35800	–8	37800	36200	34800
240	36600	–9	38500	36900	35500
230	37500	–9	39200	37600	36200
220	38400	–9	40000	38400	37000
210	39400	–9	40700	39200	37800
200	40400	–9	41600	40000	38600
190	41500	–9	42500	40900	39500
180	42600	–9	43100	41900	40500
170	43100	–9	43100	43100	41700
160	43100	–9	43100	43100	43000

ISA + 20 deg. C

WEIGHT (1000 KG)	OPTIMUM ALT (FT)	TAT (deg. C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)		
			1.30 (39°)	1.40 (44°)	1.50 (48°)
360	27900	15	31400	29800	28300
350	28500	14	32000	30400	28900
340	29200	13	32700	31000	29500
330	29800	11	33200	31500	30000
320	30500	10	33700	32100	30500
310	31200	8	34200	32600	31100
300	31900	6	34700	33100	31600
290	32600	5	35300	33700	32200
280	33400	3	35900	34300	32800
270	34100	1	36500	34900	33400
260	34900	–1	37100	35500	34100
250	35800	–2	37800	36200	34800
240	36600	–3	38500	36900	35500
230	37500	–3	39200	37600	36200
220	38400	–3	40000	38400	37000
210	39400	–3	40700	39200	37800
200	40400	–3	41600	40000	38600
190	41500	–3	42500	40900	39500
180	42600	–3	43100	41900	40500
170	43100	–3	43100	43100	41700
160	43100	–3	43100	43100	43000

Denotes altitude thrust limited in level flight, 300 fpm residual rate of climb.

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Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		25	27	29	31	33	35	37	39	41	43
360	%N1	84.5	**86.2**	**87.7**	90.3						
	MACH	.819	**.840**	**.839**	.837						
	KIAS	346	**342**	**327**	313						
	FF/ENG	5246	**5242**	**5185**	5376						
340	%N1	83.6	85.1	**86.2**	**88.2**	91.3					
	MACH	.819	.838	**.840**	**.839**	.836					
	KIAS	346	341	**328**	**313**	299					
	FF/ENG	5069	5026	**4892**	**4942**	5189					
320	%N1	82.7	83.8	**85.1**	**86.3**	88.6					
	MACH	.814	.832	**.839**	**.840**	.838					
	KIAS	344	338	**327**	**314**	299					
	FF/ENG	4864	4799	**4667**	**4581**	4709					
300	%N1	81.0	82.6	83.8	**84.9**	**86.4**	89.2				
	MACH	.796	.820	.835	**.840**	**.839**	.837				
	KIAS	336	333	326	**314**	**300**	286				
	FF/ENG	4551	4537	4449	**4332**	**4312**	4474				
280	%N1	79.2	81.0	82.4	83.7	**84.8**	**86.6**				
	MACH	.773	.802	.824	.837	**.840**	**.839**				
	KIAS	325	325	321	313	**300**	**287**				
	FF/ENG	4216	4238	4205	4115	**4019**	**4052**				
260	%N1	77.3	79.1	80.9	82.1	83.4	**84.6**	87.0			
	MACH	.747	.778	.806	.828	.838	**.840**	.838			
	KIAS	313	314	313	309	300	**287**	274			
	FF/ENG	3870	3915	3919	3885	3799	**3718**	3802			
240	%N1	75.5	77.0	78.8	80.6	81.8	**83.1**	**84.7**	87.8		
	MACH	.723	.749	.781	.809	.830	**.839**	**.840**	.838		
	KIAS	303	302	303	301	296	**287**	**274**	261		
	FF/ENG	3566	3573	3608	3608	3576	**3490**	**3442**	3570		
220	%N1	73.8	75.0	76.6	78.4	80.1	81.4	**83.0**	**85.1**	88.3	
	MACH	.703	.723	.750	.783	.810	.831	**.839**	**.840**	.838	
	KIAS	294	290	290	290	289	284	**274**	**262**	249	
	FF/ENG	3309	3267	3274	3304	3306	3269	**3204**	**3192**	3321	
200	%N1	71.9	73.2	74.4	75.9	77.8	79.5	81.3	**83.2**	**85.3**	
	MACH	.681	.701	.721	.749	.782	.810	.831	**.839**	**.840**	
	KIAS	284	281	277	277	277	276	271	**262**	**250**	
	FF/ENG	3057	3011	2971	2976	3003	3003	2983	**2947**	**2935**	
180	%N1	69.5	71.1	72.4	73.6	75.2	77.0	79.2	81.3	**83.3**	**85.2**
	MACH	.652	.677	.698	.718	.745	.778	.808	.830	**.839**	**.840**
	KIAS	271	270	268	264	263	264	262	258	**250**	**239**
	FF/ENG	2782	2757	2717	2682	2680	2699	2713	2721	**2690**	**2659**
160	%N1	66.8	68.4	70.0	71.5	72.7	74.1	76.3	78.9	81.1	**83.1**
	MACH	.616	.643	.669	.692	.712	.737	.770	.801	.826	**.838**
	KIAS	255	256	256	254	250	248	249	248	245	**238**
	FF/ENG	2490	2483	2460	2432	2399	2382	2404	2441	2457	**2423**

Boldface area approximates optimum altitude.

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Long Range Cruise Enroute Fuel and Time—Low Altitude
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
282	261	242	226	213	200	191	182	174	167	160
561	520	484	452	425	400	382	366	351	337	325
840	779	725	678	637	600	574	550	528	508	489
1120	1039	966	904	849	800	766	734	705	678	653
1401	1299	1208	1130	1062	1000	957	918	881	848	817
1683	1560	1451	1357	1274	1200	1149	1101	1057	1017	980
1966	1822	1694	1583	1487	1400	1340	1285	1234	1187	1144
2250	2085	1937	1811	1700	1600	1532	1469	1410	1356	1307
2535	2348	2181	2038	1913	1800	1723	1652	1586	1525	1470
2820	2611	2425	2265	2126	2000	1915	1835	1762	1695	1633

Reference Fuel And Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	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	4.0	0:38	3.5	0:37	2.9	0:35	2.5	0:34	2.3	0:34
400	8.2	1:12	7.5	1:08	6.5	1:04	5.9	1:02	5.5	1:00
600	12.4	1:46	11.4	1:40	10.1	1:33	9.3	1:30	8.7	1:26
800	16.5	2:20	15.4	2:12	13.6	2:02	12.6	1:58	11.9	1:52
1000	20.7	2:55	19.3	2:45	17.2	2:31	15.9	2:26	15.0	2:19
1200	24.7	3:30	23.1	3:17	20.7	3:00	19.2	2:54	18.1	2:45
1400	28.8	4:05	27.0	3:50	24.2	3:30	22.5	3:22	21.2	3:12
1600	32.8	4:41	30.8	4:24	27.6	4:00	25.7	3:50	24.3	3:39
1800	36.8	5:16	34.5	4:57	31.1	4:30	28.9	4:19	27.3	4:06
2000	40.8	5:52	38.3	5:31	34.5	5:00	32.1	4:48	30.3	4:34

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)									
	170	190	210	230	250	270	290	310	330	350
5	–0.6	–0.5	–0.3	–0.2	0.0	0.2	0.4	0.6	0.8	1.0
10	–1.3	–1.0	–0.7	–0.3	0.0	0.4	0.9	1.3	1.8	2.2
15	–2.0	–1.5	–1.0	–0.5	0.0	0.7	1.4	2.1	2.8	3.4
20	–2.7	–2.1	–1.4	–0.7	0.0	1.0	1.9	2.9	3.8	4.7
25	–3.4	–2.6	–1.8	–0.9	0.0	1.2	2.4	3.6	4.8	5.9
30	–4.1	–3.1	–2.1	–1.1	0.0	1.5	3.0	4.4	5.8	7.2
35	–4.8	–3.7	–2.5	–1.2	0.0	1.8	3.5	5.2	6.9	8.5
40	–5.5	–4.2	–2.8	–1.4	0.0	2.1	4.1	6.0	7.9	9.7
45	–6.2	–4.7	–3.2	–1.6	0.0	2.3	4.6	6.8	9.0	11.0

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Long Range Cruise Enroute Fuel and Time—High Altitude
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
1032	976	925	879	838	800	767	736	708	682	657
1543	1460	1385	1317	1256	1200	1151	1106	1063	1024	989
2056	1946	1846	1756	1675	1600	1535	1475	1419	1367	1320
2571	2433	2308	2195	2094	2000	1920	1845	1775	1710	1651
3088	2922	2771	2635	2513	2400	2304	2214	2131	2053	1982
3606	3412	3235	3076	2932	2800	2688	2583	2486	2396	2313
4126	3904	3699	3517	3352	3200	3072	2953	2842	2739	2645
4649	4396	4165	3959	3772	3600	3456	3322	3197	3082	2976
5172	4890	4631	4400	4192	4000	3840	3691	3552	3424	3307
5697	5384	5098	4843	4612	4400	4224	4060	3908	3767	3637
6223	5880	5565	5285	5033	4800	4608	4429	4263	4109	3967
6751	6376	6034	5729	5453	5200	4992	4798	4617	4450	4297
7281	6874	6503	6172	5874	5600	5375	5166	4971	4791	4626
7812	7373	6973	6616	6295	6000	5759	5534	5324	5131	4954
8345	7874	7444	7061	6716	6400	6142	5901	5678	5471	5282
8880	8376	7915	7506	7138	6800	6525	6269	6030	5811	5610
9418	8880	8388	7952	7560	7200	6908	6636	6383	6150	5936
9959	9385	8863	8399	7982	7600	7291	7002	6735	6488	6262
10502	9893	9338	8846	8405	8000	7674	7369	7086	6826	6587

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)
800	11.8	1:50	11.4	1:48	11.0	1:47	10.7	1:47	10.7	1:48
1200	17.8	2:43	17.3	2:40	16.8	2:37	16.4	2:37	16.2	2:38
1600	23.9	3:36	23.2	3:31	22.6	3:28	22.0	3:27	21.7	3:27
2000	29.9	4:30	29.1	4:22	28.4	4:18	27.6	4:17	27.2	4:17
2400	35.7	5:24	34.8	5:15	33.9	5:09	33.0	5:07	32.5	5:07
2800	41.5	6:19	40.5	6:08	39.5	6:00	38.4	5:57	37.8	5:57
3200	47.2	7:15	46.0	7:02	44.9	6:52	43.8	6:48	43.0	6:47
3600	52.8	8:11	51.5	7:56	50.2	7:45	49.0	7:39	48.1	7:37
4000	58.4	9:07	56.9	8:51	55.6	8:37	54.2	8:30	53.2	8:27
4400	63.7	10:05	62.2	9:47	60.7	9:32	59.2	9:22	58.0	9:18
4800	69.1	11:02	67.4	10:43	65.8	10:26	64.2	10:15	62.9	10:09
5200	74.3	12:00	72.5	11:40	70.8	11:21	69.1	11:08	67.7	11:00
5600	79.5	12:59	77.5	12:37	75.7	12:17	73.9	12:01	72.4	11:52
6000	84.7	13:58	82.5	13:35	80.6	13:13	78.7	12:55	77.1	12:44
6400	89.7	14:59	87.4	14:34	85.3	14:10	83.3	13:51	81.6	13:37
6800	94.6	15:59	92.2	15:33	90.0	15:07	87.9	14:46	86.1	14:30
7200	99.5	17:01	97.0	16:32	94.7	16:06	92.4	15:42	90.5	15:24
7600	104.3	18:04	101.6	17:33	99.2	17:04	96.8	16:40	94.8	16:19
8000	109.2	19:07	106.3	18:33	103.7	18:03	101.2	17:37	99.1	17:14

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Long Range Cruise Enroute Fuel and Time—High Altitude
Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)									
	170	190	210	230	250	270	290	310	330	350
10	–1.8	–1.3	–0.8	–0.4	0.0	0.7	2.4	4.9	8.4	12.7
20	–3.6	–2.8	–1.9	–0.9	0.0	1.4	4.0	7.7	12.5	18.5
30	–5.5	–4.3	–2.9	–1.5	0.0	2.1	5.5	10.2	16.3	23.7
40	–7.3	–5.7	–3.9	–2.0	0.0	2.7	6.9	12.5	19.7	28.3
50	–9.1	–7.1	–4.9	–2.5	0.0	3.3	8.2	14.6	22.7	32.3
60	–10.9	–8.5	–5.8	–2.9	0.0	3.9	9.4	16.5	25.3	35.7
70	–12.6	–9.8	–6.7	–3.4	0.0	4.4	10.5	18.2	27.5	38.6
80	–14.3	–11.0	–7.5	–3.8	0.0	4.9	11.4	19.6	29.4	40.8
90	–15.9	–12.2	–8.3	–4.2	0.0	5.4	12.3	20.8	30.9	42.5
100	–17.6	–13.3	–9.0	–4.6	0.0	5.8	13.1	21.8	32.0	43.6
110	–19.2	–14.4	–9.7	–5.0	0.0	6.3	13.8	22.6	32.7	44.1
120	–20.8	–15.4	–10.4	–5.3	0.0	6.7	14.4	23.2	33.1	44.0

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Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 KG)										
	360	340	320	300	280	260	240	220	200	180	160
43							156	68	18	1	6
41						136	61	18	1	3	19
39						51	15	1	3	15	34
37			156	85	38	11	1	3	14	31	49
35		114	61	26	7	0	3	14	29	46	62
33	79	40	16	3	0	5	15	29	44	59	72
31	24	8	1	1	7	17	30	44	58	70	78
29	3	0	3	10	20	32	45	57	68	77	81
27	1	5	13	23	34	46	58	68	76	80	81
25	9	17	27	37	48	59	68	75	80	82	79

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.**

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Descent at .84M/310/250

PRESSURE ALT (1000 FT)	25	27	29	31	33	35	37	39	41	43
DISTANCE (NM)	96	104	111	118	124	129	135	140	145	150
TIME (MINUTES)	20	21	22	23	24	24	25	26	26	27

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Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		1500	5000	10000	15000	20000	25000	30000	35000	40000	43000
360	%N1	62.4	65.4	69.5	74.3	78.9	83.5	88.5			
	KIAS	272	273	275	298	313	317	312			
	FF/ENG	4740	4690	4650	4800	4960	5140	5380			
340	%N1	60.9	63.8	67.9	72.3	77.3	82.1	86.6			
	KIAS	264	266	267	282	303	307	312			
	FF/ENG	4480	4440	4380	4450	4660	4800	4980			
320	%N1	59.4	62.1	66.3	70.4	75.7	80.3	85.0			
	KIAS	257	257	259	265	294	297	302			
	FF/ENG	4220	4180	4120	4130	4360	4460	4600			
300	%N1	57.8	60.4	64.6	68.6	73.8	78.5	83.2			
	KIAS	249	249	251	252	277	287	291			
	FF/ENG	3960	3920	3870	3850	4020	4130	4270			
280	%N1	56.2	58.7	62.8	66.8	71.6	76.6	81.3			
	KIAS	240	241	242	243	258	277	280			
	FF/ENG	3710	3670	3610	3590	3670	3830	3950			
260	%N1	54.4	56.9	60.8	64.9	69.3	74.6	79.3	84.1		
	KIAS	232	232	233	234	240	266	269	274		
	FF/ENG	3470	3420	3360	3330	3340	3540	3620	3750		
240	%N1	52.7	55.1	58.8	62.9	67.2	72.3	77.1	82.0		
	KIAS	226	226	226	226	226	248	258	262		
	FF/ENG	3250	3180	3110	3070	3070	3200	3310	3410		
220	%N1	50.9	53.2	56.8	60.7	64.9	69.6	74.7	79.6		
	KIAS	220	220	220	220	220	226	246	249		
	FF/ENG	3040	2960	2870	2830	2820	2850	3000	3090		
200	%N1	48.8	51.3	54.8	58.4	62.7	67.0	72.3	77.2	83.5	
	KIAS	213	213	213	213	213	213	233	237	241	
	FF/ENG	2830	2750	2650	2610	2580	2580	2690	2770	2930	
180	%N1	46.6	49.2	52.6	56.1	60.2	64.5	69.1	74.3	80.8	
	KIAS	206	206	206	206	206	206	208	224	227	
	FF/ENG	2640	2550	2450	2410	2360	2390	2350	2470	2590	
160	%N1	44.3	46.7	50.4	53.8	57.5	62.0	66.1	71.3	77.7	81.8
	KIAS	199	199	199	199	199	199	199	210	213	215
	FF/ENG	2500	2420	2320	2260	2210	2170	2160	2180	2270	2340

This table includes 5% additional fuel for holding in a racetrack pattern.

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Holding
Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
360	%N1	65.0	67.8	72.4	76.9	81.9
	KIAS	242	242	242	242	242
	FF/ENG	5180	5170	5150	5190	5300
340	%N1	63.3	66.1	70.5	75.0	80.0
	KIAS	240	240	240	240	240
	FF/ENG	4870	4840	4810	4840	4940
320	%N1	61.6	64.5	68.6	73.2	78.2
	KIAS	233	233	233	233	233
	FF/ENG	4570	4540	4510	4520	4610
300	%N1	59.8	62.7	66.8	71.5	76.3
	KIAS	224	224	224	224	224
	FF/ENG	4280	4250	4210	4210	4280
280	%N1	58.0	60.8	64.9	69.3	74.1
	KIAS	218	218	218	218	218
	FF/ENG	3990	3960	3910	3910	3950
260	%N1	56.2	58.7	62.9	67.0	71.8
	KIAS	212	212	212	212	212
	FF/ENG	3710	3670	3620	3610	3630
240	%N1	54.3	56.7	60.7	64.8	69.5
	KIAS	206	206	206	206	206
	FF/ENG	3450	3390	3330	3320	3330
220	%N1	52.3	54.7	58.4	62.5	66.8
	KIAS	200	200	200	200	200
	FF/ENG	3200	3130	3060	3030	3030
200	%N1	50.2	52.5	56.0	60.0	64.2
	KIAS	193	193	193	193	193
	FF/ENG	2960	2880	2790	2750	2740
180	%N1	47.8	50.2	53.6	57.2	61.5
	KIAS	186	186	186	186	186
	FF/ENG	2730	2640	2550	2500	2470
160	%N1	45.1	47.6	51.0	54.5	58.4
	KIAS	179	179	179	179	179
	FF/ENG	2560	2470	2370	2310	2280

This table includes 5% additional fuel for holding in a racetrack pattern.

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ADVISORY INFORMATION

Reported Braking Action

RUNWAY CONDITION CODE	RUNWAY DESCRIPTION	REPORTED BRAKING ACTION
6	Dry	Dry
5	Wet (Smooth, Grooved or PFC) or Frost 3 mm (0.12 inches) or less of: Water, Slush, Dry Snow or Wet Snow	Good
4	Compacted Snow at or below –15 deg. C OAT	Good to Medium
3	Wet (Slippery), Dry Snow or Wet Snow (any depth) over Compacted Snow Greater than 3 mm (0.12 inches) of : Dry Snow or Wet Snow Compacted Snow at OAT warmer than –15 deg. C	Medium
2	Greater than 3 mm (0.12 inches) of: Water or Slush	Medium to Poor
1	Ice	Poor
0	Wet Ice, Water on top of Compacted Snow, Dry Snow or Wet Snow over Ice	Nil

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Normal Configuration Operational Landing Distance
Flaps 30

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF 30	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1300	30/–10	25	–45/150	10/–10	25/–25	40	25	60
AUTOBRAKE MAX	1705	30/–25	35	–65/220	0/0	40/–40	75	0	0
AUTOBRAKE 4	2175	40/–30	50	–90/310	0/0	50/–60	110	0	0
AUTOBRAKE 3	2545	45/–40	70	–115/385	0/–10	70/–70	120	0	0
AUTOBRAKE 2	2805	50/–45	80	–130/445	35/–60	75/–75	100	75	75
AUTOBRAKE 1	3035	65/–50	100	–150/520	85/–90	80/–80	100	295	370
Good Reported Braking Action									
MAX MANUAL	1775	30/–25	40	–75/265	40/–35	40/–40	60	105	245
AUTOBRAKE MAX	1835	30/–25	45	–75/270	35/–30	40/–40	70	110	260
AUTOBRAKE 4	2180	40/–30	50	–90/315	10/–5	60/–60	110	5	45
AUTOBRAKE 3	2545	45/–40	70	–115/385	5/–10	70/–70	120	0	0
AUTOBRAKE 2	2805	50/–45	80	–130/445	35/–60	75/–75	100	75	75
AUTOBRAKE 1	3035	65/–50	100	–150/520	85/–90	80/–80	100	295	370
Good To Medium Reported Braking Action									
MAX MANUAL	2045	35/–30	55	–95/340	65/–55	50/–50	65	195	485
AUTOBRAKE MAX	2080	35/–30	60	–95/345	65/–50	50/–50	75	195	485
AUTOBRAKE 4	2290	45/–30	60	–105/375	45/–25	60/–60	110	130	375
AUTOBRAKE 3	2595	50/–40	70	–120/425	25/–25	70/–70	120	60	240
AUTOBRAKE 2	2830	50/–45	80	–135/470	50/–70	75/–75	100	105	225
AUTOBRAKE 1	3040	65/–50	100	–150/525	100/–95	80/–80	100	305	430
Medium Reported Braking Action									
MAX MANUAL	2320	40/–35	70	–115/420	90/–75	60/–60	75	280	720
AUTOBRAKE MAX	2320	45/–35	70	–115/420	100/–75	60/–60	80	275	715
AUTOBRAKE 4	2395	45/–35	70	–120/430	75/–45	60/–65	110	260	705
AUTOBRAKE 3	2650	50/–40	70	–125/460	45/–40	70/–70	120	120	485
AUTOBRAKE 2	2860	50/–45	80	–140/495	70/–80	75/–75	100	140	375
AUTOBRAKE 1	3045	65/–50	100	–150/530	110/–100	80/–80	100	315	495
Medium To Poor Reported Braking Action									
MAX MANUAL	2610	50/–45	80	–140/530	145/–105	65/–65	80	430	1215
AUTOBRAKE MAX	2610	50/–45	80	–140/530	150/–110	65/–65	85	430	1210
AUTOBRAKE 4	2650	55/–45	80	–145/540	140/–90	65/–70	105	420	1210
AUTOBRAKE 3	2820	60/–45	80	–150/560	110/–80	75/–75	120	320	1070
AUTOBRAKE 2	2985	60/–50	90	–160/580	125/–110	80/–80	100	300	965
AUTOBRAKE 1	3135	65/–55	100	–165/610	155/–125	85/–85	100	430	990
Poor Reported Braking Action									
MAX MANUAL	2895	60/–50	90	–165/645	200/–140	75/–75	85	580	1710
AUTOBRAKE MAX	2900	60/–50	90	–165/645	205/–145	75/–75	85	580	1710
AUTOBRAKE 4	2900	65/–50	90	–165/645	205/–130	75/–75	100	580	1710
AUTOBRAKE 3	2995	65/–50	90	–175/655	175/–115	80/–80	120	525	1655
AUTOBRAKE 2	3115	65/–50	100	–180/665	180/–140	80/–80	100	465	1555
AUTOBRAKE 1	3225	65/–60	105	–185/690	200/–150	85/–85	100	545	1490

Reference distance is based on sea level, standard day, no wind or slope, VREF 30 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 75 m.
For autobrake and manual speedbrakes, increase reference landing distance by 60 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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ADVISORY INFORMATION

Normal Configuration Operational Landing Distance
Flaps 25

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF 25	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1360	30/–15	30	–45/155	15/–10	30/–30	40	30	65
AUTOBRAKE MAX	1820	25/–25	40	–70/225	0/0	40/–40	80	0	0
AUTOBRAKE 4	2335	30/–35	60	–100/320	0/0	60/–60	115	0	0
AUTOBRAKE 3	2745	40/–45	75	–120/405	0/–25	75/–75	120	5	5
AUTOBRAKE 2	3005	45/–50	90	–140/460	40/–70	80/–80	105	115	115
AUTOBRAKE 1	3240	60/–60	105	–155/535	100/–100	85/–90	105	350	455
Good Reported Braking Action									
MAX MANUAL	1865	25/–25	45	–75/270	40/–35	40/–40	65	115	270
AUTOBRAKE MAX	1935	25/–30	45	–80/275	35/–25	45/–45	80	120	290
AUTOBRAKE 4	2350	30/–35	60	–100/335	10/–5	60/–65	115	5	45
AUTOBRAKE 3	2745	40/–45	75	–120/405	5/–25	75/–75	120	5	5
AUTOBRAKE 2	3005	45/–50	90	–140/460	40/–70	80/–80	105	115	115
AUTOBRAKE 1	3240	60/–60	105	–155/535	100/–100	85/–90	105	350	455
Good To Medium Reported Braking Action									
MAX MANUAL	2160	30/–30	60	–100/350	70/–60	50/–50	70	215	535
AUTOBRAKE MAX	2195	30/–35	60	–100/355	65/–50	55/–55	85	215	545
AUTOBRAKE 4	2455	35/–35	65	–110/390	40/–25	60/–65	115	130	405
AUTOBRAKE 3	2800	40/–45	80	–125/440	25/–35	75/–75	120	65	260
AUTOBRAKE 2	3030	45/–50	90	–140/485	60/–80	80/–80	105	145	275
AUTOBRAKE 1	3245	60/–60	105	–155/545	110/–100	90/–90	105	360	520
Medium Reported Braking Action									
MAX MANUAL	2450	40/–40	75	–120/430	100/–80	65/–65	75	310	800
AUTOBRAKE MAX	2450	40/–40	75	–120/430	100/–75	65/–65	85	310	800
AUTOBRAKE 4	2560	40/–40	75	–120/445	70/–45	65/–65	115	260	765
AUTOBRAKE 3	2855	40/–45	80	–130/475	45/–50	75/–75	120	125	510
AUTOBRAKE 2	3055	45/–50	90	–145/510	80/–85	80/–80	105	180	430
AUTOBRAKE 1	3250	60/–60	105	–155/550	120/–105	90/–90	105	375	585
Medium To Poor Reported Braking Action									
MAX MANUAL	2760	50/–45	90	–145/545	155/–115	70/–70	85	475	1350
AUTOBRAKE MAX	2765	50/–45	90	–145/545	160/–110	70/–70	90	475	1350
AUTOBRAKE 4	2815	50/–45	90	–145/550	140/–90	70/–70	105	450	1335
AUTOBRAKE 3	3025	50/–50	90	–155/575	110/–90	80/–80	120	340	1165
AUTOBRAKE 2	3185	50/–55	100	–165/600	140/–115	85/–85	100	355	1080
AUTOBRAKE 1	3345	60/–60	110	–175/630	165/–130	90/–90	105	495	1130
Poor Reported Braking Action									
MAX MANUAL	3070	60/–50	105	–175/660	215/–150	80/–80	90	640	1905
AUTOBRAKE MAX	3075	60/–50	105	–175/660	220/–150	80/–80	90	645	1905
AUTOBRAKE 4	3075	60/–50	105	–175/660	215/–140	80/–80	100	645	1910
AUTOBRAKE 3	3200	60/–60	105	–180/675	180/–125	85/–85	120	550	1825
AUTOBRAKE 2	3315	60/–60	110	–185/690	195/–145	85/–85	100	530	1725
AUTOBRAKE 1	3435	65/–65	115	–190/705	215/–155	90/–90	105	615	1675

Reference distance is based on sea level, standard day, no wind or slope, VREF 25 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 80 m.
For autobrake and manual speedbrakes, increase reference landing distance by 65 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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ADVISORY INFORMATION

Normal Configuration Operational Landing Distance
Flaps 20

	OPERATIONAL LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF 20	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1465	35/–15	30	–45/160	15/–15	30/–30	45	35	75
AUTOBRAKE MAX	2000	25/–30	45	–70/240	0/0	45/–45	85	0	0
AUTOBRAKE 4	2590	35/–40	70	–105/345	0/0	70/–70	120	0	0
AUTOBRAKE 3	3050	45/–50	85	–125/425	5/–30	85/–85	130	10	10
AUTOBRAKE 2	3340	50/–60	105	–145/490	50/–75	90/–90	110	150	150
AUTOBRAKE 1	3595	65/–70	120	–165/565	110/–115	105/–105	110	425	560
Good Reported Braking Action									
MAX MANUAL	2035	30/–30	50	–80/280	45/–40	45/–45	65	140	330
AUTOBRAKE MAX	2115	30/–30	50	–85/295	40/–25	50/–50	85	140	340
AUTOBRAKE 4	2595	35/–40	70	–105/350	10/0	70/–70	120	5	50
AUTOBRAKE 3	3050	45/–50	85	–125/425	5/30	85/–85	130	10	10
AUTOBRAKE 2	3340	50/–60	105	–145/490	50/–75	90/–90	110	150	150
AUTOBRAKE 1	3595	65/–70	120	–165/565	110/–115	105/–105	110	425	560
Good To Medium Reported Braking Action									
MAX MANUAL	2365	35/–35	65	–105/370	80/–65	60/–60	70	255	645
AUTOBRAKE MAX	2400	35/–35	65	–105/375	75/–50	60/–60	90	250	645
AUTOBRAKE 4	2710	40/–45	75	–120/410	45/–25	70/–70	120	150	475
AUTOBRAKE 3	3100	45/–50	90	–135/465	30/–45	85/–85	130	80	310
AUTOBRAKE 2	3365	55/–60	105	–150/515	70/–85	90/–90	110	185	335
AUTOBRAKE 1	3600	65/–70	120	–165/570	120/–120	105/–105	110	440	635
Medium Reported Braking Action									
MAX MANUAL	2695	45/–45	80	–125/455	110/–85	70/–70	80	370	960
AUTOBRAKE MAX	2690	45/–45	80	–125/455	110/–80	70/–70	90	360	955
AUTOBRAKE 4	2820	45/–45	80	–130/465	75/–50	75/–75	120	295	905
AUTOBRAKE 3	3155	45/–50	90	–145/505	60/–60	85/–85	125	150	610
AUTOBRAKE 2	3390	60/–60	105	–155/540	85/–90	90/–90	110	225	525
AUTOBRAKE 1	3610	65/–70	120	–165/580	130/–120	105/–105	110	455	705
Medium To Poor Reported Braking Action									
MAX MANUAL	3035	55/–55	100	–155/570	170/–125	80/–80	85	560	1615
AUTOBRAKE MAX	3035	55/–55	100	–155/570	175/–125	80/–80	95	560	1615
AUTOBRAKE 4	3100	55/–55	100	–160/580	155/–100	85/–85	115	525	1590
AUTOBRAKE 3	3340	55/–60	105	–165/605	125/–100	90/–90	125	395	1390
AUTOBRAKE 2	3525	60/–65	110	–175/630	145/–125	95/–95	110	425	1290
AUTOBRAKE 1	3700	65/–70	125	–185/660	180/–145	105/–105	110	590	1350
Poor Reported Braking Action									
MAX MANUAL	3370	65/–65	115	–185/690	230/–160	85/–85	90	755	2270
AUTOBRAKE MAX	3380	65/–65	115	–185/690	235/–165	90/–90	100	755	2270
AUTOBRAKE 4	3380	65/–65	115	–185/690	235/–150	90/–90	110	755	2275
AUTOBRAKE 3	3530	65/–65	115	–190/700	190/–140	100/–100	125	640	2170
AUTOBRAKE 2	3660	65/–70	120	–195/720	205/–160	100/–100	110	620	2060
AUTOBRAKE 1	3790	70/–70	125	–200/740	230/–175	105/–105	110	725	1995

Reference distance is based on sea level, standard day, no wind or slope, VREF 20 approach speed, two-engine maximum reverse thrust, and auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 85 m.
For autobrake and manual speedbrakes, increase reference landing distance by 70 m.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
All reference distances and adjustments shown have been increased by 15%.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
Airspeed Unreliable (Flaps 20)
VREF 20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1550	30/–20	35	–50/165	20/–20	35/–35	N/A	45	105
AUTOBRAKE MAX	1880	25/–25	45	–65/220	0/0	45/–45	N/A	0	0
AUTOBRAKE 2	3260	50/–55	100	–135/455	35/–55	95/–95	N/A	80	80
Good Reported Braking Action									
MAX MANUAL	2130	30/–30	60	–80/280	55/–45	50/–50	N/A	180	430
AUTOBRAKE MAX	2120	30/–30	60	–80/280	50/–45	55/–55	N/A	175	430
AUTOBRAKE 2	3260	50/–55	100	–135/455	35/–35	95/–95	N/A	80	80
Good To Medium Reported Braking Action									
MAX MANUAL	2455	40/–40	75	–105/360	90/–70	60/–60	N/A	310	815
AUTOBRAKE MAX	2445	40/–40	75	–105/360	90/–75	65/–65	N/A	310	815
AUTOBRAKE 2	3290	50/–55	100	–140/480	60/–65	95/–95	N/A	125	390
Medium Reported Braking Action									
MAX MANUAL	2775	45/–45	90	–125/435	120/–95	70/–70	N/A	440	1200
AUTOBRAKE MAX	2765	45/–45	90	–125/435	125/–100	75/–75	N/A	440	1195
AUTOBRAKE 3	3050	45/–50	90	–135/465	65/–50	85/–85	N/A	205	945
Medium To Poor Reported Braking Action									
MAX MANUAL	3100	55/–55	105	–150/545	180/–135	80/–80	N/A	650	1970
AUTOBRAKE MAX	3100	55/–55	110	–150/545	190/–140	85/–85	N/A	650	1970
AUTOBRAKE 3	3275	55/–55	105	–155/560	145/–100	90/–90	N/A	500	1815
Poor Reported Braking Action									
MAX MANUAL	3425	65/–65	120	–175/650	240/–170	90/–90	N/A	860	2740
AUTOBRAKE MAX	3430	65/–65	125	–175/650	250/–175	95/–95	N/A	860	2745
AUTOBRAKE 3	3495	60/–60	120	–175/655	225/–150	95/–95	N/A	795	2680

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID (Flaps 25)
VREF 25

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	2130	35/–35	65	–105/375	85/–70	55/–55	65	270	695
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2130	35/–35	65	–105/375	85/–70	55/–55	65	270	695
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2400	45/–40	80	–130/475	135/–100	65/–65	70	415	1175
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2665	50/–45	90	–150/575	185/–130	70/–70	75	555	1655
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	3080	60/–60	110	–200/815	625/–205	80/–80	80	1010	2210
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3490	70/–70	125	–245/1055	1065/–280	90/–90	85	1460	2765
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ANTISKID (Flaps 30)
VREF 30

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	2015	35/–30	60	–100/365	80/–65	50/–50	65	245	625
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2015	35/–30	60	–100/365	80/–65	50/–50	65	245	625
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2265	45/–40	70	–125/465	130/–95	60/–60	70	375	1055
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2515	50/–45	80	–145/560	175/–120	65/–65	75	505	1485
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	2905	65/–55	100	–195/800	605/–195	75/–75	80	930	2220
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3295	75/–65	115	–240/1035	1030/–265	85/–85	85	1350	2955
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG SHUTDOWN L, R (Flaps 20)
VREF 20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1285	35/–15	25	–45/145	15/–15	25/–25	40	0	35
AUTOBRAKE MAX	1735	25/–25	40	–60/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	3010	45/–50	85	–130/435	10/–35	85/–85	130	0	0
Good Reported Braking Action									
MAX MANUAL	1850	25/–25	50	–75/260	50/–40	45/–45	60	0	155
AUTOBRAKE MAX	1925	25/–30	50	–80/270	45/–40	45/–45	70	0	165
AUTOBRAKE 2	3010	45/–50	85	–130/435	10/–35	85/–85	130	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2215	35/–35	65	–100/350	90/–70	60/–60	70	0	315
AUTOBRAKE MAX	2255	35/–40	65	–105/355	85/–70	60/–60	80	0	320
AUTOBRAKE 2	3050	45/–50	90	–135/465	45/–50	90/–90	130	0	110
Medium Reported Braking Action									
MAX MANUAL	2575	40/–45	75	–125/440	130/–100	70/–70	80	0	475
AUTOBRAKE MAX	2580	40/–45	80	–125/440	125/–95	70/–70	90	0	470
AUTOBRAKE 3	2830	45/–45	85	–130/465	85/–60	80/–80	120	0	340
Medium To Poor Reported Braking Action									
MAX MANUAL	2995	50/–55	95	–160/570	220/–155	85/–85	90	0	815
AUTOBRAKE MAX	3000	50/–55	100	–160/570	220/–155	85/–85	95	0	810
AUTOBRAKE 3	3145	55/–55	100	–160/585	195/–125	90/–90	120	0	755
Poor Reported Braking Action									
MAX MANUAL	3415	60/–60	115	–190/700	310/–205	95/–95	100	0	1150
AUTOBRAKE MAX	3415	60/–65	115	–190/700	315/–210	95/–95	100	0	1150
AUTOBRAKE 3	3460	65/–65	115	–190/700	305/–190	100/–100	115	0	1165

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
ENG SHUTDOWN L, R (Flaps 30)
VREF 30

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1140	25/–15	20	–40/135	15/–10	20/–20	40	0	25
AUTOBRAKE MAX	1480	25/–20	30	–55/190	0/0	35/–35	65	0	0
AUTOBRAKE 2	2485	45/–40	65	–115/390	10/–20	70/–70	120	0	0
Good Reported Braking Action									
MAX MANUAL	1600	25/–20	40	–70/240	40/–35	35/–35	55	0	115
AUTOBRAKE MAX	1665	30/–25	40	–70/245	35/–30	40/–40	65	0	120
AUTOBRAKE 2	2485	45/–40	65	–115/390	10/–20	70/–70	120	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	1895	35/–30	50	–90/325	75/–60	45/–45	65	0	235
AUTOBRAKE MAX	1930	35/–30	55	–90/325	75/–55	50/–50	75	0	235
AUTOBRAKE 2	2520	50/–40	70	–120/420	40/–35	70/–70	120	0	85
Medium Reported Braking Action									
MAX MANUAL	2185	40/–35	60	–110/405	110/–85	55/–55	75	0	350
AUTOBRAKE MAX	2190	40/–35	65	–110/405	110/–80	55/–55	85	0	345
AUTOBRAKE 3	2370	45/–35	65	–120/425	75/–55	65/–65	105	0	265
Medium To Poor Reported Braking Action									
MAX MANUAL	2530	50/–45	75	–140/525	190/–130	70/–70	85	0	595
AUTOBRAKE MAX	2535	50/–45	80	–140/525	190/–130	70/–70	90	0	595
AUTOBRAKE 3	2640	55/–45	80	–145/535	170/–110	75/–75	100	0	560
Poor Reported Braking Action									
MAX MANUAL	2870	60/–50	90	–170/645	265/–170	80/–80	90	0	840
AUTOBRAKE MAX	2875	60/–50	90	–170/645	265/–175	80/–80	90	0	845
AUTOBRAKE 3	2910	60/–50	95	–170/645	260/–165	80/–80	95	0	855

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAP/SLAT CONTROL (Flaps 20)
VREF 20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1270	30/–15	25	–40/140	15/–15	25/–25	40	30	65
AUTOBRAKE MAX	1735	20/–25	40	–60/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	2900	45/–50	90	–125/425	45/–65	80/–80	95	130	130
Good Reported Braking Action									
MAX MANUAL	1765	25/–25	45	–70/245	40/–35	40/–40	55	120	285
AUTOBRAKE MAX	1835	25/–25	45	–75/255	35/–20	45/–45	75	120	295
AUTOBRAKE 2	2900	45/–50	90	–125/425	45/–65	80/–80	95	130	130
Good To Medium Reported Braking Action									
MAX MANUAL	2055	35/–35	60	–90/320	70/–55	50/–50	65	220	560
AUTOBRAKE MAX	2085	35/–35	60	–95/325	65/–45	55/–55	75	220	565
AUTOBRAKE 2	2925	50/–50	90	–130/450	60/–75	80/–80	95	165	295
Medium Reported Braking Action									
MAX MANUAL	2340	40/–40	70	–110/395	95/–75	60/–60	70	320	835
AUTOBRAKE MAX	2335	40/–40	70	–110/395	95/–70	60/–60	75	315	830
AUTOBRAKE 3	2740	40/–45	80	–125/440	50/–50	75/–75	110	130	530
Medium To Poor Reported Braking Action									
MAX MANUAL	2635	50/–50	85	–135/500	150/–110	70/–70	75	490	1405
AUTOBRAKE MAX	2635	50/–50	85	–135/500	150/–110	70/–70	80	485	1405
AUTOBRAKE 3	2905	50/–50	90	–145/525	110/–85	80/–80	110	345	1210
Poor Reported Braking Action									
MAX MANUAL	2930	55/–55	100	–160/600	200/–140	75/–75	80	655	1975
AUTOBRAKE MAX	2935	55/–55	100	–160/600	205/–145	80/–80	80	655	1975
AUTOBRAKE 3	3065	55/–55	100	–165/610	165/–120	85/–85	110	555	1885

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (Flaps ≤ 5)
VREF 30+40

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1410	50/–15	40	–45/190	15/–15	35/–30	50	45	115
AUTOBRAKE MAX	2055	30/–25	50	–70/230	0/0	50/–50	80	0	0
AUTOBRAKE 2	3440	65/–60	115	–140/465	60/–80	100/–100	110	270	270
Good Reported Braking Action									
MAX MANUAL	1965	30/–25	55	–75/260	40/–35	50/–50	55	160	390
AUTOBRAKE MAX	2125	30/–25	55	–80/270	20/–15	55/–55	80	95	330
AUTOBRAKE 2	3440	65/–60	115	–140/465	60/–80	100/–100	110	270	270
Good To Medium Reported Braking Action									
MAX MANUAL	2305	40/–35	70	–95/340	70/–60	60/–60	65	300	795
AUTOBRAKE MAX	2380	40/–35	70	–100/345	60/–45	65/–65	80	265	760
AUTOBRAKE 2	3465	65/–60	115	–145/490	75/–85	100/–100	110	300	470
Medium Reported Braking Action									
MAX MANUAL	2645	45/–40	85	–115/415	100/–80	70/–70	70	435	1200
AUTOBRAKE MAX	2635	45/–40	85	–115/415	100/–75	70/–70	80	430	1190
AUTOBRAKE 3	3255	55/–50	100	–135/475	55/–60	90/–80	115	175	710
Medium To Poor Reported Braking Action									
MAX MANUAL	3000	55/–50	105	–145/520	160/–115	80/–80	80	665	2090
AUTOBRAKE MAX	2990	55/–50	105	–145/520	160/–115	80/–80	85	665	2085
AUTOBRAKE 3	3405	65/–55	110	–155/560	120/–95	95/–95	115	440	1750
Poor Reported Braking Action									
MAX MANUAL	3350	65/–60	120	–170/625	215/–150	90/–90	85	895	2980
AUTOBRAKE MAX	3345	65/–60	120	–170/625	220/–155	90/–90	85	895	2975
AUTOBRAKE 3	3555	70/–60	120	–175/645	185/–125	100/–100	115	705	2790

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (5 < Flaps < 20)
VREF 30+20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1280	40/–15	25	–40/140	15/–15	25/–25	40	30	70
AUTOBRAKE MAX	1750	25/–20	40	–65/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	2960	55/–50	90	–130/430	40/–55	85/–85	110	110	110
Good Reported Braking Action									
MAX MANUAL	1785	30/–25	45	–70/250	40/–35	40/–40	55	135	320
AUTOBRAKE MAX	1840	30/–25	50	–75/255	35/–20	45/–45	70	130	325
AUTOBRAKE 2	2960	55/–50	90	–130/430	40/–55	85/–85	110	110	110
Good To Medium Reported Braking Action									
MAX MANUAL	2085	40/–30	60	–90/325	70/–60	50/–50	65	245	640
AUTOBRAKE MAX	2110	40/–30	65	–95/330	70/–50	55/–55	75	245	640
AUTOBRAKE 2	2985	55/–50	95	–135/455	55/–65	85/–85	110	140	300
Medium Reported Braking Action									
MAX MANUAL	2380	45/–35	75	–110/400	95/–80	60/–60	75	355	960
AUTOBRAKE MAX	2375	45/–35	75	–110/400	100/–80	60/–60	75	355	955
AUTOBRAKE 3	2775	50/–40	80	–125/440	45/–40	75/–75	120	130	635
Medium To Poor Reported Braking Action									
MAX MANUAL	2690	55/–45	90	–135/505	150/–115	70/–70	80	545	1650
AUTOBRAKE MAX	2690	55/–45	90	–135/505	155/–115	70/–70	80	545	1650
AUTOBRAKE 3	2940	55/–45	90	–145/530	115/–75	80/–80	120	385	1440
Poor Reported Braking Action									
MAX MANUAL	3000	60/–50	105	–160/605	205/–145	80/–80	85	735	2335
AUTOBRAKE MAX	3000	60/–50	105	–160/605	210/–145	80/–80	85	735	2340
AUTOBRAKE 3	3100	60/–50	100	–165/615	180/–110	85/–85	115	640	2245

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS DRIVE (Flaps ≥ 20)
VREF 20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1270	30/–15	25	–40/140	15/–15	25/–25	40	30	65
AUTOBRAKE MAX	1735	20/–25	40	–60/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	2900	45/–50	90	–125/425	45/–65	80/–80	95	130	130
Good Reported Braking Action									
MAX MANUAL	1765	25/–25	45	–70/245	40/–35	40/–40	55	120	285
AUTOBRAKE MAX	1825	25/–25	45	–75/250	35/–20	45/–45	75	120	295
AUTOBRAKE 2	2900	45/–50	90	–125/425	45/–65	80/–80	95	130	130
Good To Medium Reported Braking Action									
MAX MANUAL	2055	35/–35	60	–90/320	70/–55	50/–50	65	220	560
AUTOBRAKE MAX	2080	35/–35	60	–95/325	65/–45	55/–55	75	220	565
AUTOBRAKE 2	2920	50/–50	90	–130/450	60/–75	80/–80	95	160	295
Medium Reported Braking Action									
MAX MANUAL	2340	40/–40	70	–110/395	95/–75	60/–60	70	320	835
AUTOBRAKE MAX	2335	40/–40	70	–110/395	95/–70	60/–60	75	315	830
AUTOBRAKE 3	2735	40/–45	80	–125/440	50/–50	75/–75	110	130	530
Medium To Poor Reported Braking Action									
MAX MANUAL	2635	50/–50	85	–135/500	150/–110	70/–70	75	490	1405
AUTOBRAKE MAX	2635	50/–50	85	–135/500	150/–110	70/–70	80	485	1405
AUTOBRAKE 3	2900	50/–50	90	–145/525	110/–85	80/–80	110	345	1210
Poor Reported Braking Action									
MAX MANUAL	2930	55/–55	100	–160/600	200/–140	75/–75	80	655	1975
AUTOBRAKE MAX	2935	55/–55	100	–160/600	205/–145	80/–80	80	655	1975
AUTOBRAKE 3	3065	55/–55	100	–165/610	165/–120	85/–85	110	555	1885

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLAPS PRIMARY FAIL (Flaps 20)
VREF 20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1430	30/–15	30	–45/155	15/–15	30/–30	50	40	85
AUTOBRAKE MAX	1735	20/–25	40	–60/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	2985	45/–50	90	–130/435	25/–45	85/–85	120	50	50
Good Reported Braking Action									
MAX MANUAL	1955	25/–30	50	–75/265	45/–40	45/–45	70	150	355
AUTOBRAKE MAX	1945	30/–30	50	–75/265	45/–40	45/–45	75	150	355
AUTOBRAKE 2	2985	45/–50	90	–130/435	25/–45	85/–85	120	50	50
Good To Medium Reported Braking Action									
MAX MANUAL	2255	35/–35	65	–100/345	75/–65	55/–55	80	265	690
AUTOBRAKE MAX	2245	35/–35	65	–95/340	80/–65	55/–55	80	265	685
AUTOBRAKE 2	3010	50/–50	90	–135/460	50/–55	85/–85	120	90	310
Medium Reported Braking Action									
MAX MANUAL	2550	40/–40	80	–120/420	105/–85	65/–65	85	380	1020
AUTOBRAKE MAX	2540	40/–40	80	–115/415	115/–90	65/–65	85	375	1010
AUTOBRAKE 3	2785	40/–45	80	–125/445	60/–45	75/–75	125	180	800
Medium To Poor Reported Braking Action									
MAX MANUAL	2855	50/–50	95	–145/525	165/–120	75/–75	90	570	1695
AUTOBRAKE MAX	2850	50/–50	95	–145/520	175/–125	75/–75	90	565	1695
AUTOBRAKE 3	2995	50/–50	95	–150/540	140/–90	80/–80	120	445	1565
Poor Reported Braking Action									
MAX MANUAL	3155	60/–60	110	–165/625	225/–155	85/–85	95	755	2370
AUTOBRAKE MAX	3160	60/–60	110	–170/625	230/–160	85/–85	95	755	2375
AUTOBRAKE 3	3205	60/–55	110	–170/630	215/–135	85/–85	115	710	2330

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLIGHT CONTROL MODE (Flaps 20)
VREF 20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1445	30/–15	30	–45/160	20/–15	30/–30	50	40	90
AUTOBRAKE MAX	1735	20/–25	40	–60/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	3005	45/–50	90	–125/435	15/–40	85/–85	130	30	30
Good Reported Braking Action									
MAX MANUAL	1985	30/–30	55	–80/270	50/–45	45/–45	70	155	380
AUTOBRAKE MAX	1970	30/–30	55	–80/270	50/–40	50/–50	75	155	375
AUTOBRAKE 2	3005	45/–50	90	–130/435	15/–40	85/–85	130	30	30
Good To Medium Reported Braking Action									
MAX MANUAL	2295	40/–40	70	–100/350	80/–70	55/–55	80	280	740
AUTOBRAKE MAX	2280	40/–40	70	–100/350	85/–70	60/–60	85	280	735
AUTOBRAKE 2	3035	50/–50	90	–135/460	40/–50	85/–85	130	75	345
Medium Reported Braking Action									
MAX MANUAL	2600	45/–45	80	–120/425	110/–90	65/–65	90	400	1095
AUTOBRAKE MAX	2590	45/–45	85	–120/425	120/–95	65/–65	90	400	1090
AUTOBRAKE 3	2795	45/–45	80	–125/445	65/–40	75/–75	130	220	910
Medium To Poor Reported Braking Action									
MAX MANUAL	2915	55/–55	100	–145/530	170/–125	75/–75	95	605	1835
AUTOBRAKE MAX	2910	55/–55	100	–145/530	180/–135	75/–75	95	605	1835
AUTOBRAKE 3	3030	55/–55	95	–150/540	145/–95	85/–85	125	500	1730
Poor Reported Braking Action									
MAX MANUAL	3225	60/–60	115	–170/635	230/–160	85/–85	100	805	2575
AUTOBRAKE MAX	3230	60/–60	115	–170/635	240/–170	85/–85	100	805	2580
AUTOBRAKE 3	3260	60/–60	110	–170/635	225/–145	90/–90	115	775	2550

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
FLIGHT CONTROLS (Flaps 20)
VREF 30+20

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1495	30/–15	35	–50/165	25/–20	35/–35	65	60	130
AUTOBRAKE MAX	1750	25/–20	40	–65/210	0/0	40/–40	75	0	10
AUTOBRAKE 2	3055	55/–50	90	–130/440	10/–35	85/–85	135	20	20
Good Reported Braking Action									
MAX MANUAL	2080	35/–30	60	–80/280	60/–50	50/–50	85	210	520
AUTOBRAKE MAX	2065	35/–30	60	–80/280	65/–55	50/–50	85	205	505
AUTOBRAKE 2	3055	55/–50	90	–130/440	10/–35	85/–85	135	20	20
Good To Medium Reported Braking Action									
MAX MANUAL	2400	45/–40	75	–105/360	95/–80	60/–60	95	355	965
AUTOBRAKE MAX	2390	45/–40	75	–105/360	100/–80	60/–60	95	350	955
AUTOBRAKE 2	3085	55/–50	90	–135/465	35/–45	90/–90	135	90	520
Medium Reported Braking Action									
MAX MANUAL	2720	50/–45	90	–125/440	130/–105	70/–70	100	495	1405
AUTOBRAKE MAX	2715	50/–45	90	–125/440	135/–105	70/–70	100	495	1400
AUTOBRAKE 3	2835	50/–40	85	–130/450	95/–45	80/–80	125	370	1275
Medium To Poor Reported Braking Action									
MAX MANUAL	3040	60/–55	110	–150/545	195/–145	80/–80	105	720	2285
AUTOBRAKE MAX	3040	60/–55	110	–150/545	200/–145	80/–80	105	720	2280
AUTOBRAKE 3	3105	60/–50	105	–155/550	175/–105	85/–85	125	655	2215
Poor Reported Braking Action									
MAX MANUAL	3355	70/–60	125	–175/650	255/–180	90/–90	110	945	3160
AUTOBRAKE MAX	3360	70/–60	125	–175/650	260/–180	90/–90	110	945	3160
AUTOBRAKE 3	3370	70/–60	125	–175/650	255/–160	90/–90	120	935	3150

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS C (Flaps 20)
VREF 20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1430	30/–15	30	–45/155	15/–15	30/–30	50	40	85
AUTOBRAKE MAX	1735	20/–25	40	–60/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	2985	45/–50	90	–130/435	25/–45	85/–85	120	50	50
Good Reported Braking Action									
MAX MANUAL	1955	25/–30	50	–75/265	45/–40	45/–45	70	150	355
AUTOBRAKE MAX	1945	30/–30	50	–75/265	45/–40	45/–45	75	150	355
AUTOBRAKE 2	2985	45/–50	90	–130/435	25/–45	85/–85	120	50	50
Good To Medium Reported Braking Action									
MAX MANUAL	2255	35/–35	65	–100/345	75/–65	55/–55	80	265	690
AUTOBRAKE MAX	2245	35/–35	65	–95/340	80/–65	55/–55	80	265	685
AUTOBRAKE 2	3010	50/–50	90	–135/460	50/–55	85/–85	120	90	310
Medium Reported Braking Action									
MAX MANUAL	2550	40/–40	80	–120/420	105/–85	65/–65	85	380	1020
AUTOBRAKE MAX	2540	40/–40	80	–115/415	115/–90	65/–65	85	375	1010
AUTOBRAKE 3	2785	40/–45	80	–125/445	60/–45	75/–75	125	180	800
Medium To Poor Reported Braking Action									
MAX MANUAL	2855	50/–50	95	–145/525	165/–120	75/–75	90	570	1695
AUTOBRAKE MAX	2850	50/–50	95	–145/520	175/–125	75/–75	90	565	1695
AUTOBRAKE 3	2995	50/–50	95	–150/540	140/–90	80/–80	120	445	1565
Poor Reported Braking Action									
MAX MANUAL	3155	60/–60	110	–165/625	225/–155	85/–85	95	755	2370
AUTOBRAKE MAX	3160	60/–60	110	–170/625	230/–160	85/–85	95	755	2375
AUTOBRAKE 3	3205	60/–55	110	–170/630	215/–135	85/–85	115	710	2330

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L (Flaps 25)
VREF 25

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1265	25/–15	25	–45/145	15/–15	25/–25	45	0	35
AUTOBRAKE MAX	1580	20/–20	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2715	40/–45	75	–120/410	0/0	75/–75	145	0	0
Good Reported Braking Action									
MAX MANUAL	1825	25/–25	45	–80/270	55/–45	45/–45	70	0	165
AUTOBRAKE MAX	1860	25/–25	50	–80/270	50/–40	45/–45	75	0	170
AUTOBRAKE 2	2715	40/–45	75	–120/410	0/0	75/–75	145	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2195	35/–35	60	–105/365	100/–80	60/–60	80	0	345
AUTOBRAKE MAX	2210	35/–35	65	–105/365	100/–80	60/–60	85	0	345
AUTOBRAKE 2	2775	45/–45	80	–130/450	40/–25	80/–80	145	0	165
Medium Reported Braking Action									
MAX MANUAL	2560	40/–40	75	–130/460	145/–110	70/–70	90	0	520
AUTOBRAKE MAX	2555	40/–40	80	–130/460	145/–115	70/–70	90	0	520
AUTOBRAKE 3	2635	40/–40	80	–130/465	120/–65	70/–70	120	0	500
Medium To Poor Reported Braking Action									
MAX MANUAL	3005	50/–50	95	–170/615	265/–170	85/–85	100	0	925
AUTOBRAKE MAX	3005	50/–50	100	–170/615	265/–175	85/–85	100	0	925
AUTOBRAKE 3	3045	50/–50	100	–170/615	255/–145	85/–85	120	0	915
Poor Reported Braking Action									
MAX MANUAL	3445	60/–60	115	–205/765	380/–230	95/–95	105	0	1330
AUTOBRAKE MAX	3455	60/–60	115	–205/765	385/–235	95/–95	105	0	1330
AUTOBRAKE 3	3455	60/–60	115	–205/765	385/–225	95/–95	115	0	1330

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L (Flaps 30)
VREF 30

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1210	25/–15	25	–40/145	15/–15	25/–25	45	0	30
AUTOBRAKE MAX	1480	25/–20	30	–55/190	0/0	35/–35	65	0	0
AUTOBRAKE 2	2505	50/–40	70	–115/395	0/0	70/–70	135	0	0
Good Reported Braking Action									
MAX MANUAL	1730	30/–25	45	–75/260	50/–45	40/–40	70	0	150
AUTOBRAKE MAX	1760	30/–25	45	–75/265	45/–40	40/–40	75	0	155
AUTOBRAKE 2	2505	50/–40	70	–115/395	0/0	70/–70	135	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2075	40/–30	60	–100/355	95/–75	55/–55	80	0	310
AUTOBRAKE MAX	2090	40/–35	60	–100/360	95/–75	55/–55	85	0	315
AUTOBRAKE 2	2570	50/–40	75	–125/435	45/–20	70/–70	135	0	170
Medium Reported Braking Action									
MAX MANUAL	2420	45/–35	70	–125/450	140/–105	65/–65	90	0	470
AUTOBRAKE MAX	2420	45/–40	70	–125/450	140/–110	65/–65	90	0	470
AUTOBRAKE 3	2465	50/–40	75	–125/450	130/–70	65/–65	115	0	475
Medium To Poor Reported Braking Action									
MAX MANUAL	2840	55/–45	90	–160/600	255/–165	80/–80	100	0	845
AUTOBRAKE MAX	2845	55/–50	90	–165/600	255/–170	80/–80	100	0	845
AUTOBRAKE 3	2870	60/–50	95	–165/600	250/–145	80/–80	115	0	850
Poor Reported Braking Action									
MAX MANUAL	3260	65/–55	110	–195/750	365/–220	90/–90	105	0	1215
AUTOBRAKE MAX	3270	65/–55	110	–200/750	370/–225	90/–90	105	0	1220
AUTOBRAKE 3	3270	65/–55	110	–200/750	370/–220	90/–90	110	0	1220

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L+C (Flaps 20)
VREF 30+20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1560	35/–15	35	–50/175	25/–20	35/–35	65	0	60
AUTOBRAKE MAX	1750	25/–20	40	–60/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	3070	55/–45	85	–130/440	0/0	90/–90	155	0	0
Good Reported Braking Action									
MAX MANUAL	2250	35/–30	60	–90/310	75/–60	55/–55	90	0	260
AUTOBRAKE MAX	2210	35/–30	60	–90/305	80/–60	55/–55	95	0	250
AUTOBRAKE 2	3070	55/–45	85	–130/440	0/0	90/–90	155	0	0
Good To Medium Reported Braking Action									
MAX MANUAL	2690	45/–40	80	–120/415	135/–105	70/–70	105	0	520
AUTOBRAKE MAX	2665	45/–40	80	–120/410	140/–105	70/–70	105	0	515
AUTOBRAKE 2	3160	60/–50	95	–140/485	75/–30	95/–95	155	0	340
Medium Reported Braking Action									
MAX MANUAL	3130	55/–50	100	–145/515	190/–145	85/–85	115	0	780
AUTOBRAKE MAX	3115	55/–50	100	–145/515	200/–150	85/–85	115	0	775
AUTOBRAKE 3	3125	60/–50	100	–145/515	195/–130	85/–85	120	0	780
Medium To Poor Reported Braking Action									
MAX MANUAL	3650	70/–60	125	–190/680	335/–200	105/–105	125	0	1360
AUTOBRAKE MAX	3650	70/–60	125	–190/680	345/–225	105/–105	125	0	1360
AUTOBRAKE 3	3655	75/–60	125	–190/680	340/–215	105/–105	130	0	1360
Poor Reported Braking Action									
MAX MANUAL	4170	80/–70	145	–230/840	475/–290	120/–120	135	0	1940
AUTOBRAKE MAX	4180	85/–70	150	–230/840	485/–300	120/–120	135	0	1940
AUTOBRAKE 3	4180	85/–70	150	–230/840	485/–300	120/–120	135	0	1940

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS L+R (Flaps 20)
VREF 30+20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1680	35/–20	40	–60/205	35/–30	40/–40	70	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2675	40/–35	75	–115/395	135/–105	75/–75	110	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	3445	55/–45	100	–165/570	300/–205	100/–100	135	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	4210	65/–55	125	–215/745	465/–305	125/–125	155	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	5415	85/–65	170	–310/1115	1370/–555	170/–170	175	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	6620	100/–75	210	–400/1480	2270/–800	210/–210	190	0	0
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R (Flaps 25)
VREF 25

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1380	20/–15	30	–50/170	20/–20	30/–30	50	0	55
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1985	25/–30	55	–90/310	70/–55	50/–50	75	0	225
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2365	35/–40	70	–120/415	125/–95	65/–65	85	0	440
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2745	45/–45	85	–145/520	180/–130	75/–75	95	0	650
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	3190	55/–55	105	–185/690	335/–200	90/–90	105	0	1120
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3635	65/–65	125	–225/860	485/–265	100/–100	110	0	1590
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R (Flaps 30)
VREF 30

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1310	20/–15	30	–50/165	20/–20	25/–25	50	0	45
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	1865	30/–25	50	–85/295	65/–55	45/–45	70	0	195
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	2210	40/–35	65	–110/400	115/–90	60/–60	80	0	380
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	2550	50/–40	75	–135/500	165/–120	70/–70	90	0	560
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	2955	60/–50	95	–175/665	310/–185	85/–85	95	0	960
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	3360	65/–55	115	–215/830	450/–245	95/–95	100	0	1360
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
HYD PRESS SYS R+C (Flaps 20)
VREF 30+20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1890	30/–25	45	–70/235	45/–40	45/–45	80	0	135
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good Reported Braking Action									
MAX MANUAL	2710	45/–40	80	–120/405	125/–100	70/–70	110	0	490
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Good To Medium Reported Braking Action									
MAX MANUAL	3200	60/–50	105	–155/540	220/–160	90/–90	120	0	900
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 2	Autobrake inoperative								
Medium Reported Braking Action									
MAX MANUAL	3690	70/–60	125	–185/670	310/–215	105/–105	130	0	1310
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Medium To Poor Reported Braking Action									
MAX MANUAL	4240	85/–75	150	–235/880	585/–310	125/–125	140	0	2190
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								
Poor Reported Braking Action									
MAX MANUAL	4790	95/–85	175	–285/1090	860/–405	140/–140	145	0	3065
AUTOBRAKE MAX	Autobrake inoperative								
AUTOBRAKE 3	Autobrake inoperative								

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH DOWN AUTHORITY (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1345	25/–15	25	–45/150	15/–15	25/–25	45	20	40
AUTOBRAKE MAX	1580	20/–20	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2670	40/–45	75	–120/405	20/–40	70/–75	110	45	45
Good Reported Braking Action									
MAX MANUAL	1785	20/–25	45	–70/250	40/–35	40/–40	60	90	215
AUTOBRAKE MAX	1780	20/–25	45	–70/250	45/–35	40/–40	65	90	210
AUTOBRAKE 2	2670	40/–45	75	–120/405	25/–40	70/–75	110	45	45
Good To Medium Reported Braking Action									
MAX MANUAL	2045	30/–30	55	–90/325	65/–55	50/–50	70	175	435
AUTOBRAKE MAX	2040	30/–30	55	–90/325	70/–55	50/–50	70	175	435
AUTOBRAKE 2	2715	40/–45	80	–125/430	45/–55	75/–75	110	75	185
Medium Reported Braking Action									
MAX MANUAL	2300	35/–35	65	–110/395	90/–70	55/–55	75	255	655
AUTOBRAKE MAX	2300	35/–35	65	–110/395	95/–75	55/–55	75	255	655
AUTOBRAKE 3	2535	35/–40	70	–120/420	55/–40	65/–65	120	110	440
Medium To Poor Reported Braking Action									
MAX MANUAL	2570	45/–45	80	–135/495	140/–100	65/–65	80	400	1130
AUTOBRAKE MAX	2575	45/–45	80	–135/495	145/–110	65/–65	80	400	1130
AUTOBRAKE 3	2725	45/–45	80	–140/510	115/–80	70/–70	115	295	995
Poor Reported Braking Action									
MAX MANUAL	2835	50/–50	90	–155/590	190/–130	70/–70	85	540	1600
AUTOBRAKE MAX	2850	50/–50	90	–155/590	195/–140	70/–70	85	540	1600
AUTOBRAKE 3	2910	50/–45	90	–160/595	175/–115	75/–75	105	480	1545

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH DOWN AUTHORITY (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1285	25/–15	25	–45/145	15/–15	25/–25	45	15	35
AUTOBRAKE MAX	1480	25/–20	30	–55/190	5/0	35/–35	70	0	0
AUTOBRAKE 2	2485	45/–40	70	–115/390	10/–30	65/–65	110	20	20
Good Reported Braking Action									
MAX MANUAL	1695	25/–20	40	–70/245	35/–35	35/–35	60	80	190
AUTOBRAKE MAX	1690	25/–20	40	–70/245	40/–35	35/–35	65	80	185
AUTOBRAKE 2	2485	45/–40	70	–115/390	15/–30	65/–65	110	20	20
Good To Medium Reported Braking Action									
MAX MANUAL	1935	30/–25	50	–90/315	60/–55	45/–45	65	155	390
AUTOBRAKE MAX	1935	35/–25	50	–90/315	65/–55	45/–45	70	155	385
AUTOBRAKE 2	2525	45/–40	70	–120/415	40/–45	65/–70	110	50	155
Medium Reported Braking Action									
MAX MANUAL	2175	35/–30	60	–105/385	85/–70	50/–50	70	230	585
AUTOBRAKE MAX	2175	40/–30	60	–105/385	90/–70	50/–50	75	225	580
AUTOBRAKE 3	2355	40/–35	65	–115/405	60/–40	60/–60	115	105	415
Medium To Poor Reported Braking Action									
MAX MANUAL	2425	45/–40	75	–130/480	135/–100	60/–60	75	360	1010
AUTOBRAKE MAX	2430	45/–40	75	–130/480	140/–100	60/–60	80	360	1005
AUTOBRAKE 3	2540	45/–40	75	–135/495	120/–75	65/–65	110	280	910
Poor Reported Braking Action									
MAX MANUAL	2675	50/–45	85	–150/575	180/–125	65/–65	80	485	1430
AUTOBRAKE MAX	2685	50/–45	85	–150/575	190/–130	65/–65	80	490	1430
AUTOBRAKE 3	2720	50/–45	85	–155/580	175/–110	70/–70	105	455	1400

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH UP AUTHORITY (Flaps ≤ 15)
VREF 30+40

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1425	45/–15	30	–45/150	15/–15	30/–30	40	40	90
AUTOBRAKE MAX	1990	30/–25	50	–70/225	0/0	50/–50	80	0	0
AUTOBRAKE 2	3280	60/–55	105	–135/450	70/–80	90/–90	95	280	285
Good Reported Braking Action									
MAX MANUAL	2000	30/–25	55	–75/260	45/–40	50/–50	55	160	380
AUTOBRAKE MAX	2080	30/–25	55	–80/270	25/–20	50/–55	80	115	340
AUTOBRAKE 2	3280	60/–55	105	–135/450	70/–80	90/–90	95	280	285
Good To Medium Reported Braking Action									
MAX MANUAL	2325	40/–35	70	–95/340	75/–65	60/–60	65	280	730
AUTOBRAKE MAX	2340	40/–35	70	–100/340	65/–50	65/–65	80	255	695
AUTOBRAKE 2	3300	60/–55	105	–140/475	85/–90	95/–95	95	310	465
Medium Reported Braking Action									
MAX MANUAL	2645	45/–40	85	–115/415	100/–85	70/–70	70	400	1075
AUTOBRAKE MAX	2600	45/–40	80	–115/410	100/–75	70/–70	75	390	1050
AUTOBRAKE 3	3135	55/–50	95	–135/470	65/–70	85/–85	100	195	650
Medium To Poor Reported Braking Action									
MAX MANUAL	2975	55/–50	100	–140/520	155/–120	80/–80	80	600	1785
AUTOBRAKE MAX	2920	55/–50	100	–140/515	160/–115	80/–80	80	585	1750
AUTOBRAKE 3	3295	60/–55	105	–155/555	125/–105	90/–90	100	415	1475
Poor Reported Braking Action									
MAX MANUAL	3300	65/–55	115	–165/625	210/–150	90/–90	85	800	2495
AUTOBRAKE MAX	3240	65/–55	115	–165/620	215/–150	85/–90	80	780	2450
AUTOBRAKE 3	3450	65/–60	115	–170/640	180/–140	95/–95	100	630	2300

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PITCH UP AUTHORITY (Flaps ≥ 20)
VREF 30+20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1290	35/–15	25	–40/145	15/–15	25/–25	40	30	70
AUTOBRAKE MAX	1750	25/–20	40	–65/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	2910	55/–50	90	–125/425	50/–65	80/–80	95	150	150
Good Reported Braking Action									
MAX MANUAL	1785	30/–25	45	–70/250	40/–35	40/–40	55	125	295
AUTOBRAKE MAX	1855	30/–25	50	–75/255	35/–20	45/–45	75	125	305
AUTOBRAKE 2	2910	55/–50	90	–125/425	50/–65	80/–80	95	150	150
Good To Medium Reported Braking Action									
MAX MANUAL	2070	40/–30	60	–90/325	70/–55	50/–50	65	225	570
AUTOBRAKE MAX	2105	40/–30	60	–95/325	65/–45	55/–55	80	225	575
AUTOBRAKE 2	2935	55/–50	90	–130/450	65/–75	80/–80	95	180	315
Medium Reported Braking Action									
MAX MANUAL	2355	45/–35	70	–110/395	95/–75	60/–60	70	325	845
AUTOBRAKE MAX	2355	45/–35	70	–110/395	95/–70	60/–60	80	320	840
AUTOBRAKE 3	2765	50/–45	80	–125/440	50/–55	75/–75	105	140	535
Medium To Poor Reported Braking Action									
MAX MANUAL	2650	55/–45	85	–135/500	150/–110	70/–70	75	490	1410
AUTOBRAKE MAX	2655	55/–45	85	–135/500	150/–110	70/–70	80	490	1410
AUTOBRAKE 3	2930	55/–50	90	–145/530	110/–90	80/–80	105	345	1210
Poor Reported Braking Action									
MAX MANUAL	2945	60/–50	100	–160/600	200/–140	80/–80	80	655	1970
AUTOBRAKE MAX	2950	60/–50	100	–160/600	205/–145	80/–80	80	655	1975
AUTOBRAKE 3	3090	60/–50	100	–165/615	170/–125	85/–85	105	550	1880

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
PRI FLIGHT COMPUTERS (Flaps 20)
VREF 20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1445	30/–15	30	–45/160	20/–15	30/–30	50	40	90
AUTOBRAKE MAX	1735	20/–25	40	–60/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	3005	45/–50	90	–130/435	15/–40	85/–85	130	30	30
Good Reported Braking Action									
MAX MANUAL	1985	30/–30	55	–80/270	50/–45	45/–45	70	155	380
AUTOBRAKE MAX	1970	30/–30	55	–80/270	50/–40	50/–50	75	155	375
AUTOBRAKE 2	3005	45/–50	90	–130/435	15/–40	85/–85	130	30	30
Good To Medium Reported Braking Action									
MAX MANUAL	2295	40/–40	70	–100/350	80/–70	55/–55	80	280	740
AUTOBRAKE MAX	2280	40/–40	70	–100/350	85/–70	60/–60	85	280	735
AUTOBRAKE 2	3035	50/–50	90	–135/460	40/–50	85/–85	130	75	345
Medium Reported Braking Action									
MAX MANUAL	2600	45/–45	80	–120/425	110/–90	65/–65	90	400	1095
AUTOBRAKE MAX	2590	45/–45	85	–120/425	120/–95	65/–65	90	400	1090
AUTOBRAKE 3	2795	45/–45	80	–125/445	65/–40	75/–75	130	220	910
Medium To Poor Reported Braking Action									
MAX MANUAL	2915	55/–55	100	–145/530	170/–125	75/–75	95	605	1835
AUTOBRAKE MAX	2910	55/–55	100	–145/530	180/–135	75/–75	95	605	1835
AUTOBRAKE 3	3030	55/–55	95	–150/540	145/–95	85/–85	125	500	1730
Poor Reported Braking Action									
MAX MANUAL	3225	60/–60	115	–170/635	230/–160	85/–85	100	805	2575
AUTOBRAKE MAX	3230	60/–60	115	–170/635	240/–170	85/–85	100	805	2580
AUTOBRAKE 3	3260	60/–60	110	–170/635	225/–145	90/–90	115	775	2550

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SLATS DRIVE (Flaps 20)
VREF 30+30

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1370	40/–15	30	–45/150	15/–15	30/–30	40	35	80
AUTOBRAKE MAX	1900	30/–25	45	–65/220	0/0	45/–45	80	0	0
AUTOBRAKE 2	3125	55/–50	100	–130/440	65/–75	90/–90	95	225	225
Good Reported Braking Action									
MAX MANUAL	1910	30/–25	50	–75/260	45/–40	45/–45	60	140	330
AUTOBRAKE MAX	2005	30/–25	50	–75/265	30/–20	50/–50	80	130	330
AUTOBRAKE 2	3125	55/–50	100	–130/440	65/–75	90/–90	95	225	225
Good To Medium Reported Braking Action									
MAX MANUAL	2215	40/–35	65	–95/335	75/–60	55/–55	65	250	635
AUTOBRAKE MAX	2270	40/–35	65	–95/340	65/–50	60/–60	80	245	630
AUTOBRAKE 2	3150	55/–50	100	–135/465	85/–85	90/–90	95	255	395
Medium Reported Braking Action									
MAX MANUAL	2520	45/–40	80	–115/410	100/–80	65/–65	70	355	935
AUTOBRAKE MAX	2530	45/–40	80	–115/410	100/–75	65/–65	80	355	930
AUTOBRAKE 3	3000	50/–45	90	–130/460	65/–70	80/–80	100	175	590
Medium To Poor Reported Braking Action									
MAX MANUAL	2830	55/–50	95	–140/515	155/–115	75/–75	75	535	1540
AUTOBRAKE MAX	2840	55/–50	95	–140/515	160/–115	75/–75	85	535	1540
AUTOBRAKE 3	3165	60/–50	100	–150/545	125/–105	85/–85	100	380	1310
Poor Reported Braking Action									
MAX MANUAL	3140	60/–55	110	–165/615	210/–150	85/–85	80	710	2145
AUTOBRAKE MAX	3145	60/–55	110	–165/615	215/–150	85/–85	85	710	2145
AUTOBRAKE 3	3325	65/–55	110	–170/630	180/–140	90/–90	95	580	2025

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SPOILERS (Flaps 25)
VREF 25

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1220	25/–15	25	–40/140	15/–15	25/–25	40	30	60
AUTOBRAKE MAX	1580	20/–20	35	–60/195	0/0	35/–35	70	0	0
AUTOBRAKE 2	2655	40/–45	80	–120/405	25/–50	70/–70	100	65	65
Good Reported Braking Action									
MAX MANUAL	1680	25/–25	45	–70/240	40/–35	40/–40	60	115	270
AUTOBRAKE MAX	1720	25/–25	45	–70/245	35/–30	40/–40	65	120	285
AUTOBRAKE 2	2655	40/–45	80	–120/405	25/–50	70/–70	100	65	65
Good To Medium Reported Braking Action									
MAX MANUAL	1945	30/–30	55	–90/315	65/–55	50/–50	70	210	530
AUTOBRAKE MAX	1965	30/–30	55	–90/315	65/–55	50/–50	70	210	535
AUTOBRAKE 2	2680	40/–45	80	–125/430	45/–60	75/–75	100	95	240
Medium Reported Braking Action									
MAX MANUAL	2205	35/–35	65	–105/385	90/–75	55/–55	75	300	790
AUTOBRAKE MAX	2205	35/–35	65	–105/385	95/–75	55/–55	75	300	785
AUTOBRAKE 3	2485	35/–40	70	–120/420	45/–35	65/–65	115	130	575
Medium To Poor Reported Braking Action									
MAX MANUAL	2480	45/–45	80	–130/485	145/–105	65/–65	80	455	1325
AUTOBRAKE MAX	2485	45/–45	80	–130/485	150/–110	65/–65	80	460	1320
AUTOBRAKE 3	2650	45/–45	80	–140/505	115/–70	70/–70	115	350	1195
Poor Reported Braking Action									
MAX MANUAL	2755	50/–50	95	–155/585	195/–135	70/–70	85	610	1855
AUTOBRAKE MAX	2760	50/–50	95	–155/585	200/–140	70/–70	85	615	1855
AUTOBRAKE 3	2815	50/–50	90	–155/590	180/–105	75/–75	115	565	1815

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
SPOILERS (Flaps 30)
VREF 30

	LANDING DISTANCES AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	APP SPD ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1170	25/–15	25	–40/135	15/–10	20/–20	40	25	55
AUTOBRAKE MAX	1480	20/–20	30	–55/190	0/0	35/–35	65	0	0
AUTOBRAKE 2	2470	45/–40	70	–115/390	20/–45	65/–65	100	40	40
Good Reported Braking Action									
MAX MANUAL	1595	25/–20	40	–65/235	40/–35	35/–35	55	105	245
AUTOBRAKE MAX	1630	25/–25	40	–70/240	35/–30	35/–35	65	105	250
AUTOBRAKE 2	2470	45/–40	70	–115/390	20/–45	65/–65	100	40	40
Good To Medium Reported Braking Action									
MAX MANUAL	1840	35/–30	50	–85/305	65/–55	45/–45	65	190	475
AUTOBRAKE MAX	1860	35/–30	50	–90/310	65/–55	45/–45	70	190	475
AUTOBRAKE 2	2495	45/–40	70	–120/415	35/–55	65/–65	100	70	205
Medium Reported Braking Action									
MAX MANUAL	2085	40/–35	60	–105/375	90/–70	50/–50	70	270	705
AUTOBRAKE MAX	2085	40/–35	60	–105/375	90/–75	50/–50	70	270	700
AUTOBRAKE 3	2310	40/–35	65	–115/405	45/–30	60/–60	115	130	540
Medium To Poor Reported Braking Action									
MAX MANUAL	2340	50/–40	75	–130/475	140/–100	60/–60	75	415	1180
AUTOBRAKE MAX	2345	50/–40	75	–130/475	140/–105	60/–60	75	415	1180
AUTOBRAKE 3	2475	50/–40	75	–135/490	110/–65	65/–65	115	330	1090
Poor Reported Braking Action									
MAX MANUAL	2595	55/–45	85	–150/570	190/–130	65/–65	80	555	1655
AUTOBRAKE MAX	2600	55/–45	85	–150/570	190/–130	65/–65	80	555	1655
AUTOBRAKE 3	2635	55/–45	85	–150/575	175/–100	70/–70	110	530	1635

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Non-Normal Configuration Landing Distance
STABILIZER (Flaps 20)
VREF 30+20

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	250000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 250000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10 deg. C ABV/ BLW ISA	PER 5 KTS ABOVE VREF	ONE REV	NO REV
Dry Runway									
MAX MANUAL	1290	35/–15	25	–40/145	15/–15	25/–25	40	30	70
AUTOBRAKE MAX	1750	25/–20	40	–65/210	0/0	40/–40	75	0	0
AUTOBRAKE 2	2910	55/–50	90	–125/425	50/–65	80/–80	95	150	150
Good Reported Braking Action									
MAX MANUAL	1785	30/–25	45	–70/250	40/–35	40/–40	55	125	295
AUTOBRAKE MAX	1855	30/–25	50	–75/255	35/–20	45/–45	75	125	305
AUTOBRAKE 2	2910	55/–50	90	–125/425	50/–65	80/–80	95	150	150
Good To Medium Reported Braking Action									
MAX MANUAL	2070	40/–30	60	–90/325	70/–55	50/–50	65	225	570
AUTOBRAKE MAX	2105	40/–30	60	–95/325	65/–45	55/–55	80	225	575
AUTOBRAKE 2	2935	55/–50	90	–130/450	65/–75	80/–80	95	180	315
Medium Reported Braking Action									
MAX MANUAL	2355	45/–35	70	–110/395	95/–75	60/–60	70	325	845
AUTOBRAKE MAX	2355	45/–35	70	–110/395	95/–70	60/–60	80	320	840
AUTOBRAKE 3	2765	50/–45	80	–125/440	50/–55	75/–75	105	140	535
Medium To Poor Reported Braking Action									
MAX MANUAL	2650	55/–45	85	–135/500	150/–110	70/–70	75	490	1410
AUTOBRAKE MAX	2655	55/–45	85	–135/500	150/–110	70/–70	80	490	1410
AUTOBRAKE 3	2930	55/–50	90	–145/530	110/–90	80/–80	105	345	1210
Poor Reported Braking Action									
MAX MANUAL	2945	60/–50	100	–160/600	200/–140	80/–80	80	655	1970
AUTOBRAKE MAX	2950	60/–50	100	–160/600	205/–145	80/–80	80	655	1975
AUTOBRAKE 3	3090	60/–50	100	–165/615	170/–125	85/–85	105	550	1880

Reference distance is based on sea level, standard day, no wind or slope, and maximum available reverse thrust.
MAX MANUAL assumes maximum achievable manual braking.
Reference Distance includes an air distance allowance of 455 m from threshold to touchdown.
Actual (unfactored) distances are shown.

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ADVISORY INFORMATION

Landing Climb Limit Weight
Valid for approach with flaps 20 and landing with flaps 30

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG) AIRPORT PRESSURE ALTITUDE (FT)					
deg. C	deg. F	–2000	0	2000	4000	6000	8000
54	129	304.9	284.8				
52	126	313.0	291.7				
50	122	321.0	299.0	274.7			
48	118	329.1	307.4	281.2			
46	115	337.3	315.9	288.2	265.3		
44	111	345.2	323.9	295.9	272.2		
42	108	352.5	332.1	304.6	278.8	255.6	
40	104	359.7	340.5	312.9	285.6	261.5	
38	100	366.9	349.0	320.7	292.2	267.2	237.5
36	97	373.4	356.3	327.9	298.5	272.1	242.3
34	93	378.7	363.3	335.4	304.7	276.5	247.0
32	90	378.7	370.4	341.7	310.6	280.5	251.3
30	86	378.7	376.6	347.1	317.1	284.8	255.1
28	82	378.7	376.7	351.7	322.0	289.4	258.9
26	79	378.7	376.8	357.1	325.9	294.0	262.5
24	75	378.7	376.9	357.2	329.0	298.9	266.5
22	72	378.7	377.0	357.3	332.2	302.2	270.7
20	68	378.7	377.1	357.3	332.3	304.3	274.3
18	64	378.7	377.2	357.4	332.4	306.4	276.8
16	61	378.7	377.3	357.5	332.4	306.4	278.6
14	57	378.7	377.3	357.6	332.5	306.5	280.1
12	54	378.7	377.4	357.7	332.6	306.5	280.2
10	50	378.7	377.4	357.7	332.7	306.6	280.3
8	46	378.7	377.5	357.8	332.7	306.6	280.3
6	43	378.7	377.5	357.8	332.8	306.6	280.2
4	40	378.7	377.5	354.6	320.5	293.0	258.9
2	36	378.7	377.6	354.6	320.5	293.0	258.9
0	32	378.7	377.6	354.7	320.6	293.0	259.0
–40	–40	378.7	377.7	354.6	320.6	293.0	259.0

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.
With engine bleed for packs off, increase weight by 1,350 kg.
With engine and wing anti-ice on, decrease weight by 2,200 kg.
When operating in icing conditions during any part of the flight with forecast landing temperature below 10 deg. C, decrease weight by 21,950 kg.

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ADVISORY INFORMATION

Landing Climb Limit Weight

Valid for approach with flaps 20 and landing with flaps 25

AIRPORT OAT		LANDING CLIMB LIMIT WEIGHT (1000 KG) AIRPORT PRESSURE ALTITUDE (FT)					
deg. C	deg. F	–2000	0	2000	4000	6000	8000
54	129	308.4	289.3				
52	126	315.6	296.4				
50	122	323.1	303.4	279.2			
48	118	330.8	310.6	285.8			
46	115	338.7	318.2	292.8	269.5		
44	111	346.3	325.7	300.4	276.4		
42	108	353.7	333.6	308.1	283.2	259.8	
40	104	360.8	341.6	315.5	290.1	265.8	
38	100	368.1	350.1	322.9	297.3	271.8	241.8
36	97	374.8	357.4	329.8	303.3	277.2	246.6
34	93	378.7	364.4	337.1	309.0	281.6	251.3
32	90	378.7	371.7	343.0	314.0	285.9	256.0
30	86	378.7	377.9	348.2	319.8	290.2	259.9
28	82	378.7	378.0	352.9	324.4	295.0	263.8
26	79	378.7	378.2	358.5	328.1	299.6	267.5
24	75	378.7	378.3	358.5	331.1	304.0	271.5
22	72	378.7	378.4	358.6	331.1	307.0	275.9
20	68	378.7	378.5	358.7	334.2	308.7	279.6
18	64	378.7	378.5	358.8	334.3	310.5	282.2
16	61	378.7	378.6	358.8	334.4	310.5	284.1
14	57	378.7	378.7	358.9	334.4	310.6	285.7
12	54	378.7	378.7	359.0	334.5	310.7	285.7
10	50	378.7	378.7	359.1	334.6	310.7	285.8
8	46	378.7	378.7	359.1	334.7	310.7	285.8
6	43	378.7	378.7	359.2	334.7	310.8	285.8
4	40	378.7	378.7	359.2	334.8	310.8	280.7
2	36	378.7	378.7	359.3	334.8	310.8	280.7
0	32	378.7	378.7	359.3	334.8	310.9	280.7
–40	–40	378.7	378.7	359.4	334.9	311.0	280.9

Based on engine bleed for packs on, engine anti-ice on or off and wing anti-ice off.
With engine bleed for packs off, increase weight by 1,450 kg.
With engine and wing anti-ice on, decrease weight by 1,800 kg.
When operating in icing conditions during any part of the flight with forecast landing temperature below 10 deg. C, decrease weight by 22,250 kg.

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ADVISORY INFORMATION

Recommended Brake Cooling Schedule
Reference Brake Energy (Millions of Foot Pounds)

WEIGHT (1000 KG)	OAT (deg. C)	BRAKES ON SPEED (KIAS)																	
		80			100			120			140			160			180		
		PRESSURE ALTITUDE (1000 FT)																	
		0	4	8	0	4	8	0	4	8	0	4	8	0	4	8	0	4	8
360	0	22.1	24.1	26.5	32.9	36.3	40.3	46.1	51.3	57.3	60.4	67.5	75.8	75.7	84.9	95.4	91.6	102.6	115.1
	10	22.7	24.8	27.2	33.9	37.4	41.5	47.5	52.9	59.1	62.3	69.7	78.2	78.1	87.6	98.4	94.4	105.7	118.4
	15	23.2	25.3	27.8	34.5	38.1	42.3	48.4	53.9	60.2	63.4	70.9	79.6	79.5	89.1	100.0	96.0	107.5	120.3
	20	23.6	25.7	28.2	35.1	38.8	43.0	49.3	54.8	61.2	64.5	72.1	80.9	80.8	90.6	101.7	97.6	109.2	122.2
	30	24.1	26.3	28.9	36.0	39.8	44.1	50.5	56.3	62.9	66.3	74.1	83.2	83.1	93.1	104.4	100.3	112.1	125.4
	40	24.3	26.5	29.2	36.4	40.3	44.7	51.3	57.2	64.0	67.4	75.5	84.8	84.7	94.9	106.5	102.3	114.3	127.7
340	0	21.2	23.1	25.3	31.4	34.7	38.4	43.9	48.8	54.5	57.5	64.2	72.0	72.1	80.8	90.8	87.3	97.9	109.9
	10	21.7	23.7	26.0	32.4	35.7	39.5	45.3	50.4	56.2	59.3	66.3	74.3	74.4	83.4	93.7	90.0	100.9	113.1
	15	22.1	24.1	26.5	33.0	36.3	40.3	46.1	51.3	57.3	60.4	67.5	75.7	75.7	84.8	95.3	91.6	102.6	115.0
	20	22.5	24.6	26.9	33.6	37.0	41.0	46.9	52.2	58.3	61.4	68.6	77.0	77.0	86.3	96.8	93.1	104.2	116.8
	30	23.1	25.1	27.6	34.4	37.9	42.0	48.2	53.6	59.8	63.1	70.5	79.1	79.1	88.7	99.5	95.7	107.1	119.9
	40	23.2	25.3	27.8	34.8	38.4	42.6	48.9	54.4	60.8	64.2	71.8	80.6	80.6	90.4	101.5	97.6	109.2	122.2
320	0	20.2	22.0	24.1	30.0	33.0	36.5	41.8	46.4	51.7	54.6	60.9	68.3	68.4	76.7	86.1	82.9	93.0	104.4
	10	20.8	22.6	24.8	30.8	33.9	37.6	43.1	47.8	53.3	56.3	62.9	70.4	70.6	79.1	88.9	85.5	95.9	107.6
	15	21.2	23.0	25.2	31.4	34.6	38.3	43.8	48.7	54.3	57.3	64.0	71.7	71.9	80.5	90.4	87.0	97.5	109.4
	20	21.5	23.4	25.7	32.0	35.2	38.9	44.6	49.5	55.3	58.3	65.1	72.9	73.1	81.9	91.9	88.5	99.1	111.1
	30	22.0	24.0	26.3	32.7	36.1	39.9	45.8	50.9	56.7	59.9	66.9	74.9	75.1	84.1	94.4	90.9	101.8	114.1
	40	22.1	24.1	26.5	33.1	36.5	40.4	46.4	51.6	57.7	60.9	68.1	76.3	76.5	85.8	96.3	92.7	103.9	116.3
300	0	19.3	20.9	22.9	28.5	31.3	34.6	39.6	43.9	48.9	51.6	57.6	64.5	64.7	72.5	81.4	78.4	88.0	98.8
	10	19.8	21.5	23.5	29.3	32.2	35.6	40.8	45.3	50.4	53.2	59.4	66.5	66.8	74.8	84.0	80.9	90.7	101.9
	15	20.2	21.9	24.0	29.8	32.8	36.3	41.6	46.1	51.4	54.2	60.5	67.7	68.0	76.1	85.4	82.3	92.3	103.6
	20	20.5	22.3	24.4	30.4	33.4	36.9	42.3	46.9	52.3	55.1	61.5	68.9	69.1	77.4	86.9	83.7	93.8	105.3
	30	21.0	22.8	25.0	31.1	34.2	37.8	43.4	48.1	53.6	56.6	63.2	70.8	71.0	79.5	89.3	86.1	96.4	108.1
	40	21.1	22.9	25.1	31.4	34.6	38.3	44.0	48.8	54.5	57.5	64.3	72.1	72.3	81.1	91.0	87.7	98.3	110.3
260	0	17.4	18.9	20.6	25.5	28.0	30.8	35.3	39.0	43.3	45.7	50.8	56.8	57.1	63.8	71.6	69.2	77.5	87.1
	10	17.9	19.4	21.2	26.3	28.8	31.7	36.3	40.1	44.6	47.1	52.4	58.6	58.9	65.8	73.8	71.4	80.0	89.8
	15	18.2	19.8	21.6	26.7	29.3	32.3	37.0	40.9	45.4	48.0	53.4	59.6	60.0	67.0	75.2	72.6	81.4	91.4
	20	18.6	20.1	21.9	27.2	29.8	32.9	37.6	41.6	46.2	48.8	54.3	60.7	61.0	68.2	76.4	73.9	82.7	92.9
	30	19.0	20.6	22.4	27.9	30.5	33.7	38.6	42.7	47.4	50.1	55.7	62.3	62.7	70.1	78.6	75.9	85.0	95.4
	40	19.0	20.7	22.6	28.1	30.8	34.0	39.0	43.2	48.1	50.8	56.6	63.4	63.7	71.3	80.0	77.3	86.7	97.3
220	0	15.7	16.9	18.4	22.6	24.7	27.1	30.9	34.0	37.6	39.7	44.0	49.0	49.3	54.9	61.4	59.4	66.5	74.6
	10	16.1	17.4	18.9	23.2	25.4	27.9	31.8	35.0	38.8	40.9	45.3	50.5	50.8	56.6	63.4	61.3	68.6	77.0
	15	16.4	17.7	19.2	23.7	25.8	28.4	32.4	35.6	39.5	41.6	46.2	51.4	51.7	57.6	64.5	62.4	69.8	78.3
	20	16.7	18.0	19.6	24.1	26.3	28.9	32.9	36.3	40.2	42.3	47.0	52.3	52.6	58.6	65.6	63.5	71.0	79.7
	30	17.0	18.4	20.0	24.6	26.9	29.6	33.7	37.2	41.2	43.4	48.2	53.7	54.0	60.2	67.4	65.2	73.0	81.9
	40	17.1	18.4	20.1	24.8	27.1	29.9	34.1	37.6	41.7	44.0	48.9	54.6	54.9	61.2	68.6	66.4	74.3	83.4
180	0	13.9	15.0	16.2	19.7	21.4	23.4	26.5	29.0	32.0	33.6	37.0	41.1	41.2	45.7	50.9	49.3	54.9	61.5
	10	14.3	15.4	16.6	20.2	22.0	24.1	27.2	29.9	32.9	34.5	38.1	42.3	42.4	47.1	52.5	50.8	56.7	63.4
	15	14.6	15.7	16.9	20.6	22.4	24.5	27.7	30.4	33.6	35.2	38.8	43.1	43.2	48.0	53.5	51.8	57.7	64.5
	20	14.8	15.9	17.2	21.0	22.8	25.0	28.2	30.9	34.1	35.8	39.5	43.9	44.0	48.8	54.4	52.7	58.7	65.7
	30	15.1	16.3	17.6	21.5	23.3	25.5	28.9	31.7	35.0	36.7	40.5	45.0	45.1	50.1	55.9	52.7	60.3	67.5
	40	15.1	16.3	17.7	21.6	23.5	25.7	29.1	32.0	35.4	37.1	41.1	45.6	45.7	50.9	56.8	54.9	61.3	68.7

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 and enter table with sea level, 15 deg. C.

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ADVISORY INFORMATION

Recommended Brake Cooling Schedule

Event Adjusted Brake Energy (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	100	110	120
RTO MAX MAN		10	20	30	40	50	60	70	80	90	100	110	120
LANDING	MAX MAN	4.4	14.1	23.7	33.2	42.6	51.9	61.2	70.5	79.9	89.3	98.9	108.7
	MAX AUTO	4.4	13.1	21.7	30.2	38.7	47.3	56.0	65.0	74.3	83.9	94.0	104.6
	AUTOBRAKE 4	4.3	12.5	20.4	28.1	35.7	43.4	51.2	59.3	67.7	76.6	86.1	96.4
	AUTOBRAKE 3	4.2	11.9	19.2	26.3	33.3	40.3	47.4	54.8	62.6	70.8	79.7	89.3
	AUTOBRAKE 2	4.1	11.2	17.9	24.4	30.8	37.2	43.7	50.5	57.6	65.1	73.2	81.9
	AUTOBRAKE 1	4.0	10.3	16.3	22.1	27.8	33.4	39.1	45.1	51.3	58.0	65.1	72.9

2 Engine Reverse Thrust

		REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)											
EVENT		10	20	30	40	50	60	70	80	90	100	110	120
RTO MAX MAN		10	20	30	40	50	60	70	80	90	100	110	120
LANDING	MAX MAN	3.3	12.0	21.0	30.0	38.9	47.5	56.1	64.5	72.8	81.0	89.2	97.5
	MAX AUTO	2.0	8.7	15.5	22.3	29.3	36.4	43.8	51.5	59.6	68.3	77.5	87.4
	AUTOBRAKE 4	1.4	5.6	10.4	15.6	20.9	26.4	32.2	38.3	44.8	51.9	59.6	68.0
	AUTOBRAKE 3	0.9	3.2	6.4	10.3	14.3	18.5	23.0	27.9	33.2	39.0	45.4	52.4
	AUTOBRAKE 2	0.3	1.8	4.0	6.5	9.3	12.3	15.6	19.2	23.3	27.9	33.0	38.7
	AUTOBRAKE 1	0.2	1.2	2.6	4.3	6.1	8.1	10.3	12.8	15.6	18.8	22.3	26.4

Cooling Time (Minutes)

	EVENT ADJUSTED BRAKE ENERGY (MILLIONS OF FOOT POUNDS)									
	16 & BELOW	17	18	20	24	28	32	35	36 TO 44	45 & ABOVE
GEAR DOWN INFLIGHT	NO SPECIAL PROCEDURE REQUIRED	1	2	3	4	6	7	7	CAUTION	FUSE PLUG MELT ZONE
GROUND		11	18	26	42	55	66	73		
BTMS	UP TO 2.4	2.4	2.6	2.9	3.4	4.0	4.5	4.9	5.0 TO 6.3	6.3 & 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 10 percent.

For two brakes deactivated, increase brake energy by 20 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. (When inflight with gear extended, the BTMS indications may vary between individual brakes, due to airstream effects.)

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ENGINE INOP

Initial Max Continuous %N1
Based on .84M, engine bleed for one pack on and anti-ice off

TAT (deg. C)	PRESSURE ALTITUDE (1000 FT)								
	27	29	31	33	35	37	39	41	43
20	97.4	97.0	96.7	96.3	95.9	95.9	95.6	95.3	95.0
15	98.2	97.8	97.3	97.0	96.6	96.3	96.0	95.7	95.4
10	99.2	98.9	98.3	97.7	97.2	97.0	96.6	96.3	96.0
5	100.2	100.1	99.7	98.8	98.1	97.8	97.4	97.1	96.8
0	99.3	100.9	101.0	99.9	99.3	98.8	98.3	97.9	97.6
–5	98.4	99.9	101.2	101.3	100.5	100.2	99.7	99.3	98.8
–10	97.4	99.0	100.3	101.6	101.3	101.3	100.7	100.3	100.0
–15	96.5	98.1	99.3	100.6	101.0	102.0	101.1	100.8	100.5
–20	95.6	97.1	98.3	99.6	100.1	101.0	100.1	99.8	99.5
–25	94.6	96.1	97.4	98.6	99.1	100.0	99.1	98.8	98.5
–30	93.7	95.2	96.4	97.6	98.1	99.0	98.1	97.8	97.5
–35	92.7	94.2	95.4	96.6	97.0	97.9	97.1	96.8	96.5
–40	91.7	93.2	94.4	95.6	96.0	96.9	96.1	95.8	95.5

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ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
37000 FT to 27000 FT Pressure Altitudes

37000 FT PRESS ALT						TAT (deg. C)							
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
280	0.86	94.3	95.4	96.4	97.4	98.4	99.5	100.5	101.4	101.2	100.2	98.9	97.7
240	0.74	96.1	97.2	98.3	99.3	100.4	101.4	102.1	101.9	100.9	99.5	98.1	97.1
200	0.63	95.7	96.7	97.8	98.8	99.9	100.8	101.4	100.9	100.0	98.5	97.0	96.3
35000 FT PRESS ALT						**TAT (deg. C)**							
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
280	0.82	94.6	95.6	96.6	97.7	98.7	99.7	100.7	101.7	101.4	100.4	99.2	98.1
240	0.71	95.1	96.2	97.2	98.3	99.3	100.3	101.3	101.8	100.9	99.8	98.3	97.2
200	0.60	94.8	95.8	96.9	97.9	98.9	99.9	100.9	101.0	100.2	98.8	97.1	96.1
33000 FT PRESS ALT						**TAT (deg. C)**							
KIAS	M	–50	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5
320	0.89	91.4	92.4	93.4	94.4	95.4	96.4	97.4	98.3	99.3	100.2	99.8	98.8
280	0.79	95.0	96.0	97.1	98.1	99.2	100.2	101.2	102.2	102.4	101.0	100.0	98.7
240	0.68	95.6	96.7	97.8	98.8	99.8	100.9	101.9	102.4	101.8	100.2	98.9	97.5
200	0.58	95.9	97.0	98.0	99.1	100.1	101.1	101.6	101.6	101.0	99.3	97.9	96.4
31000 FT PRESS ALT						**TAT (deg. C)**							
KIAS	M	–45	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10
320	0.85	92.7	93.8	94.8	95.7	96.7	97.7	98.7	99.6	100.5	100.8	99.7	98.4
280	0.76	96.3	97.4	98.4	99.5	100.5	101.5	102.5	103.5	102.0	100.6	99.1	98.0
240	0.66	97.4	98.4	99.5	100.5	101.5	102.6	103.3	103.0	101.0	99.5	98.1	96.9
200	0.55	97.6	98.7	99.7	100.8	101.8	102.6	102.8	102.0	100.7	98.7	97.2	96.1
29000 FT PRESS ALT						**TAT (deg. C)**							
KIAS	M	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10	15
320	0.82	93.8	94.8	95.8	96.8	97.8	98.7	99.7	100.6	101.6	100.1	98.9	97.8
280	0.73	96.6	97.6	98.6	99.6	100.6	101.6	102.6	102.5	101.0	99.5	98.1	97.1
240	0.63	98.1	99.2	100.2	101.3	102.3	103.3	103.1	101.6	99.8	98.4	97.1	96.0
200	0.53	98.6	99.7	100.7	101.7	102.7	103.2	102.7	101.2	99.4	97.7	96.3	96.2
27000 FT PRESS ALT						**TAT (deg. C)**							
KIAS	M	–40	–35	–30	–25	–20	–15	–10	–5	0	5	10	15
360	0.88	90.2	91.2	92.1	93.0	94.0	94.9	95.8	96.7	97.6	98.5	99.2	98.1
320	0.79	93.4	94.4	95.3	96.3	97.3	98.2	99.2	100.1	101.1	100.6	99.2	98.1
280	0.70	95.4	96.4	97.4	98.4	99.4	100.4	101.3	102.3	101.3	99.7	98.2	97.1
240	0.60	97.2	98.2	99.2	100.3	101.3	102.3	103.0	102.0	99.9	98.5	97.2	96.2
200	0.51	98.4	99.4	100.4	101.5	102.5	103.2	102.7	101.8	99.9	98.1	96.5	95.6

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)					
	37	35	33	31	29	27
ENGINE A/I ON	–0.2	–0.2	–0.2	–0.2	–0.2	–0.2
WING A/I ON - PACKS ON	–0.4	–0.4	–0.4	–0.3	–0.3	–0.3
WING A/I ON - PACKS OFF	–0.6	–0.5	–0.5	–0.5	–0.5	–0.4

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ENGINE INOP

Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
25000 FT to 18000 FT Pressure Altitudes

25000 FT PRESS ALT								TAT (deg. C)					
KIAS	M	–35	–30	–25	–20	–15	–10	–5	0	5	10	15	20
360	0.85	91.2	92.2	93.1	94.1	95.0	95.9	96.8	97.7	98.6	99.5	98.9	98.1
320	0.76	93.9	94.8	95.8	96.8	97.7	98.7	99.6	100.5	101.1	99.6	98.5	97.6
280	0.67	95.5	96.5	97.5	98.5	99.4	100.4	101.3	101.5	100.4	98.8	97.5	96.7
240	0.58	97.4	98.5	99.5	100.5	101.5	102.4	102.3	100.9	99.3	97.8	96.7	95.9
200	0.49	99.3	100.3	101.4	102.4	103.4	103.1	102.0	100.6	98.5	97.1	96.1	95.9
24000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–35	–30	–25	–20	–15	–10	–5	0	5	10	15	20
360	0.83	91.3	92.3	93.2	94.2	95.1	96.0	96.9	97.8	98.7	99.6	99.4	98.4
320	0.75	93.6	94.6	95.6	96.5	97.5	98.4	99.4	100.3	101.2	100.0	98.8	97.8
280	0.66	95.4	96.4	97.4	98.3	99.3	100.3	101.2	101.8	100.7	99.1	97.8	96.9
240	0.57	97.3	98.3	99.3	100.3	101.3	102.2	102.6	101.4	99.8	98.3	97.1	96.2
200	0.48	98.8	99.9	100.9	101.9	102.9	103.4	102.3	101.0	98.9	97.4	96.3	95.6
22000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–30	–25	–20	–15	–10	–5	0	5	10	15	20	25
360	0.80	92.1	93.0	94.0	94.9	95.8	96.7	97.6	98.5	99.4	100.0	99.0	98.3
320	0.72	94.3	95.3	96.3	97.2	98.1	99.1	100.0	100.9	100.7	99.3	98.2	97.5
280	0.63	96.1	97.1	98.1	99.0	100.0	100.9	101.9	101.3	99.8	98.4	97.3	96.6
240	0.55	97.7	98.7	99.7	100.7	101.7	102.7	102.3	100.9	99.3	97.7	96.8	96.1
200	0.46	99.5	100.5	101.5	102.5	103.5	103.0	101.5	99.9	97.9	96.8	95.9	95.8
20000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–30	–25	–20	–15	–10	–5	0	5	10	15	20	25
360	0.77	93.7	94.6	95.6	96.5	97.4	98.4	99.3	100.2	101.1	102.0	101.3	100.1
320	0.69	95.9	96.9	97.8	98.8	99.7	100.7	101.6	102.6	103.5	101.8	100.4	99.1
280	0.61	97.7	98.7	99.6	100.6	101.6	102.6	103.5	104.3	102.8	100.9	99.4	98.3
240	0.53	98.5	99.5	100.5	101.5	102.4	103.4	104.3	104.1	102.4	100.7	98.7	97.2
200	0.44	98.0	99.0	99.9	100.9	101.9	102.9	103.8	102.6	100.5	98.0	96.2	95.3
18000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–25	–20	–15	–10	–5	0	5	10	15	20	25	30
360	0.75	94.4	95.4	96.3	97.2	98.2	99.1	100.0	100.9	101.8	102.0	100.6	99.4
320	0.67	96.7	97.7	98.6	99.6	100.5	101.4	102.4	103.3	102.9	101.2	99.7	98.6
280	0.59	98.5	99.5	100.5	101.5	102.4	103.4	104.3	104.0	102.3	100.4	98.9	97.8
240	0.51	99.6	100.6	101.6	102.6	103.6	104.5	104.9	103.9	101.9	100.0	98.4	97.2
200	0.42	97.2	98.2	99.2	100.1	101.1	101.9	102.0	100.8	98.8	97.3	95.8	94.4

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	25	24	22	20	18
ENGINE A/I ON	–0.2	–0.2	–0.2	–0.2	–0.2
WING A/I ON - PACKS ON	–0.3	–0.3	–0.3	–0.2	–0.3
WING A/I ON - PACKS OFF	–0.4	–0.4	–0.4	–0.3	–0.5

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Max Continuous %N1
Based on engine bleed for packs on or off and anti-ice off
16000 FT to 5000 FT Pressure Altitudes

16000 FT PRESS ALT								TAT (deg. C)					
KIAS	M	–25	–20	–15	–10	–5	0	5	10	15	20	25	30
360	0.72	94.8	95.8	96.7	97.6	98.6	99.5	100.4	101.3	102.2	103.1	101.7	100.2
320	0.64	96.9	97.9	98.8	99.8	100.7	101.7	102.6	103.5	104.4	102.7	100.9	99.4
280	0.57	98.7	99.7	100.7	101.6	102.6	103.5	104.5	105.4	104.1	102.2	100.3	98.8
240	0.49	99.1	100.1	101.1	102.0	103.0	104.0	104.9	104.5	103.0	100.9	99.2	97.9
200	0.41	96.2	97.2	98.1	99.1	100.0	100.9	101.5	101.3	99.8	98.3	97.0	95.4
14000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–20	–15	–10	–5	0	5	10	15	20	25	30	35
360	0.69	94.9	95.9	96.8	97.7	98.6	99.5	100.4	101.3	102.2	102.2	100.8	99.5
320	0.62	97.1	98.1	99.0	99.9	100.9	101.8	102.7	103.6	103.4	101.5	100.0	98.9
280	0.54	99.2	100.1	101.1	102.1	103.0	103.9	104.9	104.9	103.0	101.0	99.5	98.4
240	0.47	97.3	98.2	99.2	100.1	101.1	102.0	102.8	102.5	100.6	99.0	97.8	96.7
200	0.39	96.1	97.0	98.0	98.9	99.8	100.7	101.4	100.7	99.0	97.6	96.5	95.6
12000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–15	–10	–5	0	5	10	15	20	25	30	35	40
360	0.67	95.4	96.3	97.2	98.1	99.0	99.9	100.8	101.6	102.5	101.3	100.0	99.0
320	0.60	97.3	98.2	99.2	100.1	101.0	101.9	102.8	103.7	102.3	100.6	99.4	98.4
280	0.52	99.7	100.6	101.6	102.5	103.5	104.4	105.3	104.0	102.0	100.2	99.1	98.1
240	0.45	96.5	97.4	98.3	99.3	100.2	101.1	101.4	100.6	99.2	98.0	96.9	96.0
200	0.38	96.7	97.7	98.6	99.5	100.4	101.2	101.3	100.2	98.7	97.4	96.4	95.8
10000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–15	–10	–5	0	5	10	15	20	25	30	35	40
360	0.65	94.2	95.2	96.1	96.9	97.8	98.7	99.6	100.4	101.3	101.5	100.2	99.1
320	0.58	96.1	97.1	98.0	98.9	99.8	100.7	101.6	102.4	102.6	101.0	99.7	98.6
280	0.51	98.5	99.4	100.4	101.3	102.2	103.1	104.0	104.6	102.3	100.5	99.4	98.4
240	0.43	95.6	96.6	97.5	98.4	99.3	100.2	101.0	101.1	100.3	99.1	97.8	96.9
200	0.36	96.6	97.5	98.4	99.3	100.2	101.1	101.6	101.2	100.1	98.5	97.5	96.6
5000 FT PRESS ALT								**TAT (deg. C)**					
KIAS	M	–10	–5	0	5	10	15	20	25	30	35	40	45
360	0.59	92.6	93.5	94.3	95.2	96.0	96.9	97.7	98.5	99.4	100.2	99.3	98.5
320	0.53	94.0	94.9	95.8	96.7	97.5	98.4	99.2	100.1	100.9	100.1	99.1	98.2
280	0.46	95.0	95.9	96.8	97.6	98.5	99.4	100.2	101.1	100.9	99.8	98.8	97.8
240	0.40	95.7	96.6	97.5	98.4	99.3	100.2	101.0	101.6	100.5	99.4	98.3	97.4
200	0.33	97.0	97.9	98.8	99.7	100.6	101.5	102.4	101.7	100.3	99.1	98.1	97.3

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)				
	16	14	12	10	5
ENGINE A/I ON	–0.3	–0.2	–0.4	–0.5	–0.5
WING A/I ON - PACKS ON	–0.4	–0.5	–0.6	–0.7	–0.8
WING A/I ON - PACKS OFF	–0.6	–0.7	–0.8	–0.9	–1.1

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MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF PRESSURE ALTITUDE (FT)		
START DRIFTDOWN	LEVEL OFF		ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
360	350	300	17500	16300	15100
340	330	292	19000	17800	16600
320	311	284	20400	19400	18300
300	292	275	21600	20800	19900
280	272	266	23300	22300	21300
260	252	257	25300	24400	23100
240	232	247	27500	26700	25300
220	214	237	29900	29200	27900
200	194	226	31700	31300	30500
180	175	215	33600	33400	33000
160	155	203	35800	35700	35600

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MAX CONTINUOUS THRUST

Driftdown/LRC Cruise Range Capability
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
134	126	118	111	105	100	95	90	86	82	79
269	251	236	222	210	200	190	181	173	165	159
403	377	354	334	316	300	285	272	260	248	238
536	502	472	445	421	400	380	362	346	332	318
670	627	589	556	526	500	475	453	433	415	398
803	752	707	667	632	600	571	544	520	498	478
936	877	824	778	737	700	666	635	607	582	558
1068	1001	942	889	842	800	761	726	695	665	639
1201	1126	1059	1000	947	900	856	817	782	749	719
1333	1250	1176	1111	1052	1000	952	908	869	833	799
1466	1374	1293	1222	1157	1100	1047	1000	956	916	880
1598	1499	1411	1332	1262	1200	1142	1091	1043	1000	960
1731	1623	1528	1443	1368	1300	1238	1182	1131	1084	1040
1863	1747	1645	1554	1473	1400	1333	1273	1218	1167	1121
1996	1872	1762	1665	1578	1500	1428	1364	1305	1251	1201
2129	1997	1880	1776	1683	1600	1524	1455	1392	1334	1281
2262	2121	1997	1887	1788	1700	1619	1546	1479	1418	1361
2395	2246	2115	1998	1894	1800	1714	1637	1566	1501	1441

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 KG) WEIGHT AT START OF DRIFTDOWN (1000 KG)											TIME (HR:MIN)
	160	180	200	220	240	260	280	300	320	340	360	
100	1.1	1.1	1.2	1.3	1.5	1.6	1.7	1.8	1.8	1.9	2.0	0:16
200	2.4	2.5	2.8	3.1	3.3	3.5	3.7	3.9	4.1	4.3	4.6	0:31
300	3.7	4.1	4.5	4.9	5.3	5.6	6.0	6.3	6.6	7.0	7.4	0:46
400	5.1	5.6	6.2	6.8	7.3	7.8	8.2	8.7	9.2	9.7	10.3	1:01
500	6.4	7.0	7.8	8.5	9.2	9.8	10.4	11.0	11.6	12.3	13.0	1:16
600	7.7	8.4	9.3	10.1	11.0	11.7	12.5	13.2	13.9	14.8	15.6	1:31
700	8.9	9.8	10.8	11.8	12.8	13.7	14.5	15.4	16.2	17.2	18.2	1:46
800	10.1	11.2	12.3	13.4	14.5	15.6	16.5	17.5	18.5	19.6	20.8	2:01
900	11.3	12.5	13.8	15.1	16.3	17.4	18.5	19.6	20.7	22.0	23.3	2:15
1000	12.6	13.9	15.3	16.7	18.0	19.3	20.5	21.8	23.0	24.4	25.9	2:30
1100	13.8	15.2	16.8	18.3	19.8	21.2	22.5	23.9	25.2	26.8	28.4	2:45
1200	14.9	16.6	18.2	19.9	21.5	23.0	24.5	26.0	27.4	29.2	30.9	2:59
1300	16.1	17.9	19.7	21.5	23.2	24.8	26.4	28.0	29.7	31.5	33.4	3:14
1400	17.3	19.2	21.1	23.0	24.9	26.6	28.4	30.1	31.8	33.8	35.8	3:29
1500	18.5	20.5	22.5	24.6	26.5	28.4	30.3	32.2	34.0	36.1	38.3	3:43
1600	19.6	21.7	23.9	26.1	28.2	30.2	32.2	34.2	36.2	38.4	40.7	3:58
1700	20.8	23.0	25.3	27.6	29.8	32.0	34.1	36.2	38.3	40.7	43.1	4:13
1800	21.9	24.3	26.7	29.1	31.5	33.8	36.0	38.2	40.5	43.0	45.5	4:28

Includes APU fuel burn.
Driftdown at optimum driftdown speed and cruise at LRC speed.

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ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
360	15000	13600	12000
350	15500	14200	12600
340	16400	14900	13100
330	17200	15700	13900
320	18100	16600	14900
310	19000	17500	15800
300	19900	18400	16700
290	20600	19400	17800
280	21200	20200	18800
270	21900	20900	19900
260	22800	21600	20600
250	23800	22500	21400
240	24900	23700	22100
230	26200	24900	23400
220	27600	26300	24600
210	29100	27700	26000
200	30400	29100	27600
190	31400	30500	29100
180	32400	31700	30600
170	33400	33000	32000
160	34600	34400	33500

With engine anti-ice on, no altitude capability adjustment is required.
With engine and wing anti-ice on, decrease altitude capability by 300 ft.

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MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
360	%N1	91.6	97.3								
	MACH	.602	.664								
	KIAS	334	337								
	FF/ENG	10335	11118								
340	%N1	90.6	95.5	98.6							
	MACH	.602	.662	.681							
	KIAS	334	337	333							
	FF/ENG	9977	10586	10771							
320	%N1	89.7	93.7	95.9	99.2						
	MACH	.602	.650	.667	.686						
	KIAS	334	330	326	323						
	FF/ENG	9633	9884	9949	10098						
300	%N1	87.7	92.0	93.7	96.1						
	MACH	.584	.637	.653	.671						
	KIAS	324	323	319	316						
	FF/ENG	8949	9222	9239	9287						
280	%N1	85.7	90.1	91.8	93.5	96.3					
	MACH	.566	.619	.640	.656	.674					
	KIAS	314	314	312	308	305					
	FF/ENG	8313	8533	8592	8583	8659					
260	%N1	83.8	88.1	89.8	91.5	93.2	96.3				
	MACH	.548	.599	.621	.642	.658	.677				
	KIAS	304	303	303	301	297	294				
	FF/ENG	7698	7830	7916	7948	7953	8065				
240	%N1	81.5	85.7	87.6	89.3	91.0	92.9	96.0			
	MACH	.529	.577	.599	.622	.643	.659	.678			
	KIAS	293	292	292	292	290	286	283			
	FF/ENG	7105	7147	7227	7288	7324	7345	7467			
220	%N1	79.3	83.3	85.1	86.9	88.7	90.4	92.3	95.4	99.4	
	MACH	.510	.555	.576	.598	.621	.642	.659	.679	.701	
	KIAS	282	280	280	280	280	278	274	271	269	
	FF/ENG	6519	6489	6557	6617	6672	6717	6737	6844	7112	
200	%N1	76.7	80.6	82.5	84.2	86.1	87.8	89.6	91.5	94.5	98.6
	MACH	.490	.532	.552	.572	.594	.618	.640	.658	.677	.700
	KIAS	271	269	268	267	267	267	266	262	259	257
	FF/ENG	5935	5852	5910	5967	6007	6064	6109	6120	6208	6468
180	%N1	74.1	77.8	79.6	81.5	83.1	85.0	86.7	88.5	90.3	93.3
	MACH	.470	.509	.527	.546	.567	.589	.613	.636	.654	.674
	KIAS	260	256	255	255	254	254	254	253	250	247
	FF/ENG	5363	5237	5285	5340	5374	5402	5453	5494	5502	5567
160	%N1	71.2	74.8	76.6	78.3	80.1	81.7	83.6	85.3	87.1	88.9
	MACH	.449	.485	.501	.519	.538	.559	.581	.605	.629	.649
	KIAS	248	244	243	242	241	241	240	240	240	237
	FF/ENG	4809	4648	4682	4735	4758	4774	4797	4837	4878	4892

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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
286	264	244	227	213	200	190	181	173	166	159
569	525	487	454	425	400	381	364	348	333	320
853	788	730	681	638	600	572	546	522	501	482
1138	1051	974	908	851	800	763	729	698	669	643
1424	1316	1219	1136	1064	1000	954	911	872	836	803
1711	1580	1464	1364	1278	1200	1144	1093	1046	1003	964
1999	1846	1709	1592	1491	1400	1335	1275	1220	1170	1124
2288	2111	1954	1820	1704	1600	1526	1457	1394	1337	1285
2578	2378	2201	2049	1918	1800	1717	1639	1568	1504	1445
2869	2646	2447	2278	2132	2000	1907	1821	1742	1670	1605

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	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	4.0	0:39	3.5	0:38	3.2	0:36	2.8	0:36	2.6	0:35
400	8.4	1:15	7.6	1:11	7.1	1:08	6.7	1:06	6.4	1:03
1:03	12.7	1:50	11.7	1:45	11.1	1:40	10.4	1:36	10.2	1:32
800	16.9	2:26	15.7	2:19	14.9	2:11	14.2	2:06	13.9	2:02
1000	21.1	3:02	19.7	2:53	18.8	2:44	17.9	2:37	17.6	2:31
1200	25.3	3:38	23.7	3:27	22.6	3:16	21.5	3:07	21.2	3:00
1400	29.4	4:15	27.6	4:02	26.3	3:49	25.1	3:38	24.7	3:30
1600	33.5	4:52	31.4	4:37	30.1	4:21	28.7	4:09	28.2	4:00
1800	37.6	5:29	35.2	5:12	33.8	4:55	32.3	4:40	31.6	4:29
2000	41.6	6:07	39.0	5:47	37.4	5:28	35.8	5:11	35.0	5:00

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)									
	170	190	210	230	250	270	290	310	330	350
5	–0.8	–0.6	–0.4	–0.2	0.0	0.3	0.7	1.2	1.7	2.3
10	–1.8	–1.3	–0.9	–0.4	0.0	0.8	1.6	2.6	3.7	4.9
15	–2.7	–2.0	–1.3	–0.7	0.0	1.2	2.5	4.0	5.6	7.4
20	–3.7	–2.7	–1.8	–0.9	0.0	1.6	3.3	5.3	7.5	9.8
25	–4.6	–3.4	–2.3	–1.1	0.0	2.0	4.2	6.6	9.3	12.2
30	–5.6	–4.2	–2.7	–1.4	0.0	2.3	4.9	7.8	11.0	14.4
35	–6.5	–4.9	–3.2	–1.6	0.0	2.7	5.7	9.0	12.6	16.6
40	–7.5	–5.6	–3.7	–1.8	0.0	3.1	6.4	10.2	14.2	18.6
45	–8.5	–6.3	–4.2	–2.1	0.0	3.4	7.1	11.3	15.8	20.6

Includes APU fuel burn.

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MAX CONTINUOUS THRUST

Holding
Flaps up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
360	%N1	81.1	84.5	89.2	94.5			
	KIAS	272	273	275	298			
	FF/ENG	9270	9350	9640	10310			
340	%N1	79.3	82.6	87.4	92.2			
	KIAS	264	266	267	282			
	FF/ENG	8720	8760	8990	9410			
320	%N1	77.6	80.6	85.4	90.1	98.4		
	KIAS	257	257	259	265	294		
	FF/ENG	8170	8190	8350	8590	9780		
300	%N1	75.6	78.6	83.4	88.1	94.5		
	KIAS	249	249	251	252	277		
	FF/ENG	7640	7640	7740	7890	8730		
280	%N1	73.7	76.6	81.1	86.0	91.3		
	KIAS	240	241	242	243	258		
	FF/ENG	7120	7090	7150	7250	7830		
260	%N1	71.6	74.5	78.8	83.7	88.8	97.3	
	KIAS	232	232	233	234	240	266	
	FF/ENG	6600	6570	6570	6640	7030	7980	
240	%N1	69.3	72.3	76.5	81.3	86.3	92.6	
	KIAS	226	226	226	226	226	248	
	FF/ENG	6090	6060	6040	6080	6360	6920	
220	%N1	67.0	69.9	74.1	78.6	83.8	88.8	99.1
	KIAS	220	220	220	220	220	226	246
	FF/ENG	5600	5570	5530	5540	5750	6060	7020
200	%N1	64.7	67.4	71.6	76.0	80.9	85.8	93.5
	KIAS	213	213	213	213	213	213	233
	FF/ENG	5130	5090	5030	5040	5180	5360	5950
180	%N1	62.2	64.8	68.9	73.2	77.9	83.0	88.0
	KIAS	206	206	206	206	206	206	208
	FF/ENG	4670	4620	4560	4560	4640	4780	5000
160	%N1	59.5	62.1	65.9	70.3	74.7	79.8	84.5
	KIAS	199	199	199	199	199	199	199
	FF/ENG	4230	4170	4110	4100	4150	4230	4360

This table includes 5% additional fuel for holding in a racetrack pattern.

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ADVISORY INFORMATION

Gear Down Landing Rate of Climb Available
Flaps 20

TAT (deg. C)	RATE OF CLIMB (FT/MIN) PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
52	450	340				
50	500	390	230			
48	550	440	290			
46	590	490	340	180		
44	640	550	390	230		
42	690	590	430	270	110	
40	730	640	480	310	140	
38	760	690	530	350	170	
36	760	730	560	390	200	–10
34	760	780	600	420	230	20
32	770	780	630	460	260	50
30	770	790	660	480	300	70
20	790	800	670	530	370	190
10	810	820	620	440	280	140
0	830	830	610	380	150	–90
–20	860	870	630	390	150	–90
–40	900	900	660	410	160	–100

Rate of climb capability shown is valid for 225,000 kg, gear down at VREF 20+5.
Decrease rate of climb 40 ft/min per 5000 kg greater than 225,000 kg.
Increase rate of climb 50 ft/min per 5000 kg less than 225,000 kg.

Flaps 30

TAT (deg. C)	RATE OF CLIMB (FT/MIN) PRESSURE ALTITUDE (FT)					
	–2000	0	2000	4000	6000	8000
52	–120	–230				
50	–80	–190	–340			
48	–40	–140	–300			
46	10	–100	–250	–400		
44	50	–50	–200	–360		
42	90	–10	–160	–320	–480	
40	120	40	–130	–290	–450	
38	160	80	–90	–260	–430	
36	160	120	–50	–230	–400	–600
34	160	150	–20	–190	–380	–580
32	160	170	10	–160	–350	–560
30	160	170	30	–140	–320	–530
20	170	170	40	–100	–250	–440
10	180	180	20	–130	–280	–640
0	180	180	–30	–250	–480	–710
–20	190	190	–40	–260	–490	–730
–40	200	190	–40	–280	–510	–760

Rate of climb capability shown is valid for 225,000 kg, gear down at VREF 30+5.
Decrease rate of climb 40 ft/min per 5000 kg greater than 225,000 kg.
Increase rate of climb 50 ft/min per 5000 kg less than 225,000 kg.

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ALTERNATE MODE EEC

Alternate Mode EEC Max Takeoff %N1

Based on engine bleed for packs on, engine anti-ice on or off, and wing anti-ice off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (1000 FT)											
deg. C	deg. F	–2	–1	0	1	2	3	4	5	6	7	8	8.4
55	131	94.3	96.7	97.0	96.7	96.5	96.6	96.4	96.3	96.1	95.5	94.6	94.2
50	122	95.7	98.1	98.6	98.2	97.9	97.9	97.8	97.6	97.4	96.8	95.9	95.6
45	113	97.2	99.6	100.1	99.8	99.4	99.3	99.1	98.9	98.8	98.2	97.3	96.9
40	104	98.9	101.2	101.9	101.4	101.0	100.8	100.6	100.4	100.0	99.4	98.6	98.2
35	95	100.9	102.7	104.7	104.2	103.1	102.6	102.1	101.7	101.1	100.4	99.6	99.3
30	86	100.5	103.7	106.9	106.4	105.6	105.0	104.3	103.7	102.6	101.5	100.7	100.3
25	77	99.7	102.8	106.0	106.7	107.3	107.2	106.7	106.5	105.3	103.8	102.4	101.8
20	68	98.8	101.9	105.1	105.8	106.4	106.8	107.1	107.5	106.8	105.9	104.8	104.3
15	59	98.0	101.1	104.2	104.9	105.5	105.8	106.2	106.5	106.4	106.1	105.6	105.3
10	50	97.1	100.2	103.3	104.0	104.6	104.9	105.3	105.6	105.5	105.2	104.9	104.8
5	41	96.3	99.3	102.4	103.0	103.7	104.0	104.3	104.7	104.5	104.2	104.0	103.8
0	32	95.4	98.4	101.4	102.1	102.7	103.1	103.4	103.7	103.6	103.3	103.0	102.9
–10	14	93.6	96.6	99.6	100.2	100.8	101.2	101.5	101.8	101.7	101.4	101.1	101.0
–20	–4	91.8	94.7	97.7	98.3	98.9	99.2	99.5	99.9	99.7	99.5	99.2	99.0
–30	–22	90.0	92.8	95.7	96.3	96.9	97.2	97.5	97.9	97.7	97.5	97.2	97.1
–40	–40	88.1	90.9	93.7	94.3	94.9	95.2	95.5	95.8	95.7	95.4	95.2	95.0
–50	–58	86.2	88.9	91.7	92.3	92.9	93.1	93.4	93.8	93.6	93.4	93.1	93.0

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (1000 FT)											
	–2	–1	0	1	2	3	4	5	6	7	8	8.4
PACKS OFF	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3
WING ANTI-ICE ON	–0.2	–0.3	–0.4	–0.5	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4	–0.4

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GEAR DOWN

220 KIAS Max Climb %N1

TAT	PRESSURE ALTITUDE (1000 FT)														
(deg. C)	0	5	10	12	14	16	18	20	22	24	26	28	30	32	34
55	88.2	88.3	91.4	91.1	92.1	91.3	94.0	95.2	95.4	98.1	99.9	101.1	102.4	102.9	103.4
50	89.5	88.8	90.7	90.4	91.4	92.1	93.3	94.5	94.7	97.3	99.2	100.3	101.6	102.1	102.6
45	90.5	90.1	90.0	89.7	90.7	91.4	92.6	93.8	93.9	96.6	98.4	99.6	100.8	101.3	101.8
40	91.6	91.2	91.2	89.7	89.9	90.7	91.9	93.0	93.2	95.8	97.6	98.8	100.0	100.5	101.0
35	92.6	92.3	92.2	92.1	90.6	89.9	91.1	92.3	92.5	95.0	96.8	98.0	99.2	99.7	100.2
30	93.0	93.2	93.2	93.0	92.2	91.2	90.9	91.5	91.7	94.3	96.0	97.2	98.4	98.9	99.4
25	92.2	94.2	94.1	94.0	93.7	92.8	92.1	92.0	91.1	93.5	95.2	96.4	97.6	98.0	98.5
20	91.4	94.2	95.1	95.0	94.9	94.4	93.4	93.0	92.8	93.6	94.4	95.6	96.8	97.2	97.7
15	90.7	93.4	96.7	96.4	96.3	96.1	94.8	94.1	94.5	94.8	95.2	95.3	96.0	96.4	96.9
10	89.9	92.6	96.3	97.9	98.1	98.1	96.8	95.5	96.5	96.2	96.4	96.4	96.6	96.1	96.0
5	89.1	91.7	95.4	97.1	98.9	100.3	99.0	97.9	98.2	97.8	97.8	97.9	97.9	97.3	96.8
0	88.3	90.9	94.6	96.2	98.0	100.1	100.8	100.3	100.1	99.7	99.4	99.4	99.5	98.6	98.1
–5	87.4	90.1	93.7	95.3	97.1	99.1	99.9	100.8	101.9	101.5	101.1	101.1	101.1	100.2	99.6
–10	86.6	89.2	92.8	94.4	96.1	98.2	98.9	99.8	101.4	102.8	102.6	102.6	103.0	101.6	100.8
–15	85.8	88.4	91.9	93.5	95.2	97.3	98.0	98.9	100.4	101.8	102.5	103.2	103.8	102.5	101.4
–20	85.0	87.5	91.1	92.6	94.3	96.3	97.0	97.9	99.4	100.8	101.5	102.2	103.3	102.4	101.3

%N1 Adjustments for Engine Bleed

BLEED CONFIGURATION	PRESSURE ALTITUDE (1000 FT)							
	0	5	10	15	20	25	30	35
2 PACKS ON - 1 BLEED SOURCE	–0.4	–0.5	–0.4	–0.3	–0.2	–0.3	–0.3	–0.4
1 PACK ON - 1 OR 2 BLEED SOURCES	–0.4	–0.5	–0.4	–0.3	–0.2	–0.3	–0.3	–0.4
ENGINE ANTI-ICE ON	–0.3	–0.5	–0.4	–0.3	–0.1	–0.2	–0.2	–0.2
ENGINE & WING ANTI-ICE ON*	–0.6	–0.8	–0.7	–0.5	–0.2	–0.3	–0.3	–0.4
ENGINE & WING ANTI-ICE ON**	–1.1	–0.9	–0.9	–0.6	–0.3	–0.4	–0.5	–0.5

*** Packs on or off with 2 bleed sources.**
**** Packs off with 1 bleed source.**

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GEAR DOWN

Long Range Cruise Altitude Capability
Max Climb Thrust, 300 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
360	18200	16100	13700
350	18800	16900	14400
340	19400	17600	15100
330	20000	18200	15800
320	20700	19100	16800
310	21800	20300	18000
300	22800	21400	19300
290	24000	22500	20600
280	25100	23700	22000
270	26200	24800	23300
260	27300	26100	24600
250	28500	27500	26000
240	29700	28900	27400
230	30600	30200	28900
220	31400	31100	30300
210	32300	32000	31400
200	33200	33000	32500
190	34100	34000	33700
180	35000	34900	34800
170	36000	36000	35800
160	37000	37000	36800

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Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)									
		10	15	17	19	21	23	25	27	29	31
360	%N1	84.7	89.1	91.1	93.6						
	MACH	.488	.535	.556	.578						
	KIAS	270	270	270	270						
	FF/ENG	7616	7771	7912	8126						
340	%N1	83.8	88.1	90.0	92.2						
	MACH	.488	.535	.556	.578						
	KIAS	270	270	270	270						
	FF/ENG	7360	7485	7589	7762						
320	%N1	82.6	86.9	88.8	90.8	93.3					
	MACH	.483	.531	.552	.574	.597					
	KIAS	267	268	268	268	269					
	FF/ENG	7053	7156	7240	7378	7571					
300	%N1	80.5	84.9	87.0	88.8	90.8	93.8				
	MACH	.468	.514	.535	.556	.579	.603				
	KIAS	259	259	259	260	260	260				
	FF/ENG	6575	6634	6706	6789	6934	7132				
280	%N1	78.4	82.9	85.0	86.8	88.6	90.7	94.0			
	MACH	.453	.498	.517	.538	.560	.584	.609			
	KIAS	250	251	251	251	251	252	252			
	FF/ENG	6101	6136	6179	6258	6335	6478	6688			
260	%N1	76.2	80.7	82.7	84.7	86.4	88.3	90.4	94.0		
	MACH	.437	.481	.500	.520	.541	.563	.587	.613		
	KIAS	242	242	242	242	242	242	243	243		
	FF/ENG	5630	5659	5680	5728	5802	5878	6014	6228		
240	%N1	73.8	78.3	80.3	82.3	84.2	85.9	87.8	90.0	93.8	
	MACH	.421	.463	.481	.500	.520	.542	.565	.589	.615	
	KIAS	233	232	233	233	233	233	233	234	234	
	FF/ENG	5171	5184	5206	5227	5275	5340	5416	5541	5751	
220	%N1	71.4	75.8	77.7	79.7	81.6	83.5	85.3	87.1	89.4	93.4
	MACH	.404	.444	.461	.480	.499	.520	.542	.565	.590	.617
	KIAS	223	223	223	223	223	223	223	224	224	225
	FF/ENG	4720	4715	4736	4756	4775	4819	4878	4949	5062	5264
200	%N1	68.7	73.1	75.0	76.9	78.9	80.8	82.7	84.4	86.3	88.6
	MACH	.387	.425	.442	.460	.479	.498	.519	.541	.564	.589
	KIAS	213	213	213	213	213	213	213	213	213	214
	FF/ENG	4284	4281	4290	4310	4323	4339	4375	4426	4480	4578
180	%N1	66.3	70.8	72.6	74.5	76.5	78.5	80.2	82.2	83.9	85.7
	MACH	.374	.412	.428	.445	.463	.482	.503	.524	.546	.570
	KIAS	206	206	206	206	206	206	206	206	206	206
	FF/ENG	3937	3935	3933	3945	3959	3969	3984	4021	4066	4112
160	%N1	64.0	68.2	70.1	71.9	74.0	75.9	77.7	79.5	81.4	83.1
	MACH	.361	.397	.413	.429	.447	.465	.485	.505	.527	.550
	KIAS	199	199	199	199	199	199	199	199	199	199
	FF/ENG	3592	3585	3584	3585	3591	3602	3612	3628	3663	3702

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GEAR DOWN

Long Range Cruise Enroute 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
316	284	257	235	216	200	189	180	171	162	155
634	570	515	470	433	400	379	359	341	326	312
956	859	774	706	650	600	568	539	512	489	468
1282	1149	1035	943	867	800	757	718	683	651	623
1610	1442	1297	1180	1084	1000	947	898	853	813	778
1942	1737	1560	1419	1302	1200	1136	1077	1024	976	933
2276	2034	1825	1658	1520	1400	1325	1256	1193	1137	1087
2614	2333	2091	1898	1739	1600	1514	1434	1362	1298	1241
2954	2634	2358	2138	1958	1800	1702	1613	1531	1459	1394
3297	2936	2626	2379	2176	2000	1891	1791	1701	1619	1547
3642	3240	2894	2620	2396	2200	2080	1969	1869	1780	1700
3991	3546	3164	2862	2615	2400	2268	2147	2037	1939	1852
4342	3853	3435	3104	2835	2600	2456	2324	2205	2098	2004
4697	4164	3707	3347	3055	2800	2644	2502	2373	2258	2156
5054	4476	3981	3591	3275	3000	2832	2679	2541	2416	2307
5414	4789	4255	3836	3495	3200	3020	2856	2708	2575	2458
5778	5105	4531	4081	3716	3400	3208	3033	2875	2734	2609
6146	5424	4808	4326	3937	3600	3396	3210	3041	2891	2759
6516	5744	5086	4572	4159	3800	3584	3386	3208	3049	2909
6889	6066	5365	4819	4380	4000	3772	3564	3375	3207	3059

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	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	7.4	0:47	6.7	0:45	5.9	0:42	5.5	0:40	5.2	0:39
400	15.0	1:32	13.9	1:27	12.6	1:21	11.9	1:16	11.5	1:12
600	22.6	2:17	21.1	2:10	19.3	1:59	18.3	1:52	17.7	1:46
800	29.9	3:04	28.1	2:53	25.7	2:39	24.5	2:29	23.7	2:20
1000	37.3	3:50	35.0	3:37	32.1	3:18	30.6	3:06	29.7	2:55
1200	44.3	4:38	41.7	4:22	38.3	3:59	36.6	3:44	35.4	3:30
1400	51.4	5:27	48.4	5:07	44.5	4:40	42.5	4:22	41.2	4:06
1600	58.2	6:16	54.8	5:53	50.5	5:21	48.2	5:01	46.7	4:42
1800	65.0	7:05	61.3	6:39	56.5	6:03	53.9	5:40	52.2	5:19
2000	71.6	7:55	67.5	7:26	62.3	6:46	59.5	6:20	57.5	5:56
2200	78.1	8:46	73.8	8:14	68.1	7:28	65.0	7:00	62.8	6:33
2400	84.5	9:37	79.8	9:02	73.8	8:11	70.3	7:40	68.0	7:10
2600	90.8	10:29	85.9	9:50	79.4	8:55	75.7	8:20	73.1	7:48
2800	97.0	11:22	91.7	10:39	84.8	9:39	80.9	9:02	78.1	8:26
3000	103.1	12:15	97.5	11:28	90.2	10:23	86.1	9:43	83.0	9:05
3200	109.0	13:09	103.2	12:18	95.5	11:08	91.1	10:25	87.8	9:44
3400	114.9	14:03	108.8	13:09	100.8	11:53	96.1	11:07	92.7	10:23
3600	120.6	14:58	114.3	14:00	105.9	12:39	101.0	11:49	97.3	11:02
3800	126.4	15:53	119.7	14:51	111.0	13:25	105.8	12:32	102.0	11:42
4000	132.0	16:50	125.0	15:44	115.9	14:12	110.6	13:15	106.5	12:22

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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)									
	170	190	210	230	250	270	290	310	330	350
10	–1.7	–1.3	–0.9	–0.4	0.0	1.0	2.0	3.1	4.2	5.5
20	–3.6	–2.7	–1.8	–0.9	0.0	1.7	3.7	5.8	8.1	10.7
30	–5.5	–4.1	–2.8	–1.4	0.0	2.5	5.3	8.4	11.8	15.5
40	–7.3	–5.5	–3.7	–1.8	0.0	3.2	6.7	10.7	15.1	19.9
50	–9.1	–6.9	–4.6	–2.3	0.0	3.8	8.1	12.9	18.2	24.0
60	–10.8	–8.2	–5.5	–2.8	0.0	4.4	9.4	14.9	21.0	27.6
70	–12.5	–9.5	–6.4	–3.2	0.0	5.0	10.5	16.7	23.5	30.9
80	–14.2	–10.8	–7.3	–3.7	0.0	5.5	11.6	18.3	25.7	33.7
90	–15.9	–12.1	–8.1	–4.1	0.0	5.9	12.5	19.7	27.6	36.2
100	–17.5	–13.3	–9.0	–4.5	0.0	6.3	13.3	21.0	29.3	38.3
110	–19.1	–14.6	–9.8	–4.9	0.0	6.7	14.0	22.0	30.7	40.0
120	–20.6	–15.8	–10.7	–5.4	0.0	7.0	14.6	22.9	31.8	41.4
130	–22.1	–16.9	–11.5	–5.8	0.0	7.2	15.1	23.5	32.6	42.3
140	–23.5	–18.1	–12.3	–6.2	0.0	7.4	15.5	24.0	33.2	42.9

Based on Long Range Cruise and VREF30 + 80 descent.

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GEAR DOWN

Descent at VREF 30+80

PRESSURE ALT (1000 FT)	17	19	21	23	25	27	29	31	33	35
DISTANCE (NM)	35	39	43	48	52	56	60	64	69	73
TIME (MINUTES)	11	12	12	13	14	15	15	16	17	17

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GEAR DOWN

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
360	%N1	76.2						
	KIAS	262						
	FF/ENG	7790						
340	%N1	75.0	78.1					
	KIAS	260	260					
	FF/ENG	7470	7470					
320	%N1	73.3	76.3					
	KIAS	253	253					
	FF/ENG	7010	7000					
300	%N1	71.2	74.3	78.7				
	KIAS	244	244	244				
	FF/ENG	6510	6490	6470				
280	%N1	69.2	72.5	76.8				
	KIAS	238	238	238				
	FF/ENG	6080	6070	6040				
260	%N1	67.4	70.5	74.9	79.5			
	KIAS	232	232	232	232			
	FF/ENG	5680	5680	5640	5670			
240	%N1	65.6	68.5	72.9	77.5	82.4		
	KIAS	226	226	226	226	226		
	FF/ENG	5300	5290	5250	5270	5320		
220	%N1	63.8	66.5	71.0	75.4	80.3		
	KIAS	220	220	220	220	220		
	FF/ENG	4940	4920	4880	4880	4930		
200	%N1	61.8	64.5	68.7	73.1	77.9	82.7	
	KIAS	213	213	213	213	213	213	
	FF/ENG	4580	4540	4500	4500	4530	4590	
180	%N1	59.6	62.4	66.3	70.8	75.4	80.2	84.8
	KIAS	206	206	206	206	206	206	206
	FF/ENG	4230	4190	4130	4130	4150	4180	4290
160	%N1	57.3	60.0	64.0	68.2	72.8	77.7	82.3
	KIAS	199	199	199	199	199	199	199
	FF/ENG	3880	3830	3770	3760	3770	3790	3870

This table includes 5% additional fuel for holding in a racetrack pattern.

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GEAR DOWN

Holding
Flaps 1

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)				
		1500	5000	10000	15000	20000
360	%N1	75.9	78.9	83.8	88.3	94.3
	KIAS	242	242	242	242	242
	FF/ENG	7650	7690	7680	7800	8180
340	%N1	74.5	77.6	82.2	86.9	92.0
	KIAS	240	240	240	240	240
	FF/ENG	7290	7310	7300	7400	7690
320	%N1	72.7	75.7	80.2	85.1	89.9
	KIAS	233	233	233	233	233
	FF/ENG	6820	6820	6820	6880	7100
300	%N1	70.5	73.6	78.0	83.0	87.8
	KIAS	224	224	224	224	224
	FF/ENG	6310	6310	6300	6360	6490
280	%N1	68.4	71.6	76.0	80.8	85.7
	KIAS	218	218	218	218	218
	FF/ENG	5870	5870	5850	5910	6010
260	%N1	66.4	69.5	73.9	78.6	83.7
	KIAS	212	212	212	212	212
	FF/ENG	5470	5460	5430	5480	5550
240	%N1	64.5	67.3	71.8	76.3	81.4
	KIAS	206	206	206	206	206
	FF/ENG	5070	5050	5020	5060	5110
220	%N1	62.5	65.2	69.6	74.0	79.0
	KIAS	200	200	200	200	200
	FF/ENG	4690	4660	4620	4640	4690
200	%N1	60.2	62.9	67.0	71.5	76.2
	KIAS	193	193	193	193	193
	FF/ENG	4310	4260	4220	4230	4270
180	%N1	57.7	60.5	64.4	68.9	73.5
	KIAS	186	186	186	186	186
	FF/ENG	3940	3890	3830	3830	3860
160	%N1	55.2	57.8	61.8	65.9	70.5
	KIAS	179	179	179	179	179
	FF/ENG	3580	3520	3460	3430	3460

This table includes 5% additional fuel for holding in a racetrack pattern.

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude
100 ft/min residual rate of climb
Includes APU fuel burn

WEIGHT (1000 KG)		VREF 30 + 80 DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE		
START DRIFTDOWN	LEVEL OFF		ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
320	308	254	5000	3700	1300
300	288	246	7100	6100	4500
280	269	238	9200	8500	7400
260	249	231	11200	10500	9400
240	230	225	13200	12600	11500
220	211	219	15200	14800	13700
200	192	213	17500	16900	15900
180	173	206	19900	19700	18600
160	154	198	22300	21700	20900

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Altitude Capability
100 ft/min residual rate of climb

WEIGHT (1000 KG)	PRESSURE ALTITUDE (FT)		
	ISA + 10 deg. C & BELOW	ISA + 15 deg. C	ISA + 20 deg. C
340	200		
330	1700		
320	3200	600	
310	4500	2400	
300	5500	4200	1300
290	6600	5500	3200
280	7800	6800	5000
270	8900	8200	6700
260	10100	9400	8300
250	11200	10500	9400
240	12300	11600	10400
230	13200	12700	11500
220	14300	13800	12600
210	15400	14900	13800
200	16500	16000	15100
190	17800	17100	16200
180	19000	18700	17400
170	20300	20100	19000
160	21600	21100	20400

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ENGINE INOP

MAX CONTINUOUS THRUST

Long Range Cruise Control

WEIGHT (1000 KG)		PRESSURE ALTITUDE (1000 FT)							
		5	7	9	11	13	15	17	19
300	%N1	96.0	99.0						
	MACH	.413	.427						
	KIAS	250	249						
	FF/ENG	12977	13257						
280	%N1	93.5	95.6	98.8					
	MACH	.400	.414	.429					
	KIAS	242	242	241					
	FF/ENG	12015	12091	12444					
260	%N1	91.2	92.9	95.0	98.4				
	MACH	.387	.400	.414	.429				
	KIAS	234	234	233	233				
	FF/ENG	11137	11108	11216	11560				
240	%N1	88.9	90.6	92.3	94.7	98.4			
	MACH	.374	.388	.402	.418	.434			
	KIAS	226	226	226	226	226			
	FF/ENG	10249	10257	10303	10449	10806			
220	%N1	86.7	88.4	90.1	91.9	94.4	98.4		
	MACH	.364	.378	.392	.407	.422	.439		
	KIAS	220	220	220	220	220	220		
	FF/ENG	9466	9490	9517	9591	9723	10067		
200	%N1	84.1	86.0	87.7	89.5	91.4	93.9	98.1	
	MACH	.353	.366	.380	.394	.409	.425	.442	
	KIAS	213	213	213	213	213	213	213	
	FF/ENG	8676	8685	8711	8768	8843	8965	9313	
180	%N1	81.3	83.3	85.1	87.0	88.8	90.6	93.2	97.4
	MACH	.341	.354	.367	.381	.396	.412	.428	.445
	KIAS	206	206	206	206	206	206	206	206
	FF/ENG	7917	7917	7918	7967	8039	8106	8230	8570
160	%N1	78.4	80.3	82.2	84.1	86.1	87.8	89.7	92.2
	MACH	.329	.341	.354	.368	.382	.397	.413	.429
	KIAS	199	199	199	199	199	199	199	199
	FF/ENG	7154	7160	7151	7167	7230	7299	7359	7481

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GEAR DOWN
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
165	145	129	117	108	100	93	87	81	77	73
332	295	263	238	218	200	187	175	165	156	148
500	444	396	358	327	300	281	263	247	234	222
669	593	528	477	436	400	374	350	329	311	295
839	743	662	597	545	500	467	438	411	388	368
1009	894	795	718	655	600	561	525	494	466	442
1180	1044	928	838	764	700	654	612	575	543	515
1351	1196	1063	958	874	800	747	700	657	620	588
1523	1347	1197	1079	983	900	840	787	739	697	661
1696	1499	1331	1199	1093	1000	933	874	820	773	733

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	6		8		10		12		14	
	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)
100	4.1	0:27	3.9	0:26	3.7	0:25	3.5	0:25	3.5	0:24
200	8.3	0:51	8.0	0:50	7.7	0:48	7.5	0:47	7.5	0:46
300	12.5	1:15	12.1	1:13	11.7	1:11	11.5	1:09	11.6	1:08
400	16.7	1:40	16.1	1:37	15.7	1:34	15.4	1:32	15.5	1:29
500	20.9	2:04	20.2	2:01	19.6	1:58	19.3	1:54	19.4	1:51
600	24.9	2:29	24.1	2:25	23.5	2:21	23.2	2:17	23.3	2:13
700	29.0	2:54	28.1	2:49	27.4	2:44	27.0	2:40	27.1	2:35
800	33.0	3:19	32.0	3:13	31.2	3:08	30.7	3:02	30.8	2:57
900	37.0	3:44	35.9	3:38	35.0	3:31	34.4	3:25	34.4	3:20
1000	40.9	4:09	39.7	4:02	38.7	3:55	38.1	3:48	38.0	3:42

Fuel Required Adjustment (1000 KG)

REFERENCE FUEL REQUIRED (1000 KG)	WEIGHT AT CHECK POINT (1000 KG)									
	170	190	210	230	250	270	290	310	330	350
5	–0.9	–0.7	–0.4	–0.2	0.0	0.5	1.0	1.5	1.9	2.4
10	–1.9	–1.4	–0.9	–0.5	0.0	1.1	2.1	3.2	4.2	5.2
15	–2.9	–2.1	–1.4	–0.7	0.0	1.6	3.2	4.8	6.3	7.9
20	–3.8	–2.9	–1.9	–1.0	0.0	2.1	4.2	6.3	8.4	10.5
25	–4.8	–3.6	–2.4	–1.2	0.0	2.6	5.1	7.8	10.4	13.1
30	–5.8	–4.3	–2.9	–1.4	0.0	3.0	6.0	9.2	12.4	15.6
35	–6.8	–5.1	–3.4	–1.7	0.0	3.4	6.8	10.5	14.2	18.1
40	–7.8	–5.8	–3.9	–1.9	0.0	3.7	7.6	11.7	16.0	20.5
45	–8.8	–6.6	–4.4	–2.2	0.0	4.0	8.3	12.9	17.7	22.8

Based on Long Range Cruise and VREF30 + 80 descent. Includes APU fuel burn.

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GEAR DOWN
ENGINE INOP

MAX CONTINUOUS THRUST

Holding
Flaps Up

WEIGHT (1000 KG)		PRESSURE ALTITUDE (FT)			
		1500	5000	10000	15000
340	%N1	96.1			
	KIAS	260			
	FF/ENG	15250			
320	%N1	94.0	98.2		
	KIAS	253	253		
	FF/ENG	14280	14490		
300	%N1	91.8	95.1		
	KIAS	244	244		
	FF/ENG	13280	13280		
280	%N1	89.9	92.9		
	KIAS	238	238		
	FF/ENG	12380	12370		
260	%N1	87.9	90.9	96.3	
	KIAS	232	232	232	
	FF/ENG	11520	11580	11870	
240	%N1	85.6	88.9	93.4	
	KIAS	226	226	226	
	FF/ENG	10680	10760	10880	
220	%N1	83.3	86.7	91.0	98.4
	KIAS	220	220	220	220
	FF/ENG	9870	9940	10020	10570
200	%N1	80.8	84.1	88.6	93.9
	KIAS	213	213	213	213
	FF/ENG	9060	9110	9170	9410
180	%N1	78.2	81.3	86.1	90.6
	KIAS	206	206	206	206
	FF/ENG	8270	8310	8330	8510
160	%N1	75.5	78.4	83.1	87.8
	KIAS	199	199	199	199
	FF/ENG	7490	7510	7510	7660

This table includes 5% additional fuel for holding in a racetrack pattern.

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Performance Inflight — Chapter PI
Text — Section 47

Introduction

This chapter contains information to supplement performance data from the Flight Management Computer. 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

FMC Takeoff Speeds

FMC computed takeoff speeds can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, brake deactivation, improved climb, contaminated runway situations, unbalanced for brake energy or obstacle clearance with unbalanced V1. These speeds may be used for weights less than or equal to the performance limited weight.

The FMC will protect for minimum control speeds by increasing V1, VR and V2 as required. However, the FMC will not compute takeoff speeds for weights where the required speed increase exceeds the maximum certified speed increase. This typically occurs at full rated thrust and light weights. In this case, the message "V SPEEDS UNAVAILABLE" will appear on the FMC scratchpad and the takeoff speed entries will be blank. Takeoff is not permitted in this condition as certified limits have been exceeded. The options are to select a smaller flap setting, select derate thrust and/or add weight (fuel). Selecting derate thrust is the preferred method as this will reduce the minimum control speeds. Note that the assumed temperature method may not help this condition as the minimum control speeds are determined at the actual temperature and therefore are not reduced.

Clearway and Stopway V1 Adjustments

Takeoff speed corrections are to be applied to V1 when using takeoff weights based on the use of clearway and stopway.

Adjust V1 by the amount shown in the table. The adjusted V1 must not exceed VR. If V1 is greater than VR, VR may be increased to equal V1. The resultant V2 will be increased by the same amount that VR was increased.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

VREF Speeds

This table contains flaps 30, 25 and 20 reference speeds for a given weight.

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Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuver 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/extension, movement of the flap to the next position should be initiated when within 20 knots of the recommended speed for that position.

Slush/Standing Water

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/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.

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 13 mm (0.5 inches) 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 dry field/obstacle limit weight for the takeoff flap setting
2. enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude
3. adjust field length available for temperature by amount shown on chart
4. enter the V1(MCG) Limit Weight table with the field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for V1(MCG) speed.

The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 2 and 4.

Takeoff speed determination:

1. determine takeoff speeds V1, VR and V2 for actual brake release weight using Takeoff Speeds from the Performance Dispatch chapter or from the FMC
2. if V1(MCG) limited, set V1 = V1(MCG). If not limited by V1(MCG) considerations, enter 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 V1(MCG), set V1 = V1(MCG).

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Slippery Runway

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. Good reported braking action denotes wet runway conditions or runways covered by compact snow. Similarly, poor braking action denotes runways covered with wet ice. Performance is based on 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.

Minimum Control Speeds

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, V1(MCG), and VR less than minimum VR, (1.05) VMCA. It is therefore necessary to compare the adjusted V1 and VR to V1(MCG) and Minimum VR respectively. To find V1(MCG) and Minimum VR, enter the V1(MCG), Minimum VR table with the airport pressure altitude and actual OAT. If the adjusted V1 is less than V1(MCG), set V1 equal to V1(MCG). If the adjusted VR is less than Min VR, set VR equal to Min VR and determine a new V2 by adding the difference between the normal VR and Min VR to the normal V2. No takeoff weight adjustment is necessary provided that the field length available exceeds the minimum field length shown in the Field and Climb Limit Weight table.

Go-Around %N1

To find Go-Around %N1 based on normal engine bleed for packs on and anti-ice off, enter the Go-Around %N1 table with airport pressure altitude and reported OAT or TAT and read %N1. %N1 adjustments are shown for engine bleeds for various conditions.

Max Climb %N1

This table shows Max Climb %N1 for a 310/.84 climb speed schedule, normal engine bleed for 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.

Flight with Unreliable Airspeed/Turbulent Air Penetration

Body 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 may also cause unreliable airspeed/Mach indications. Climb, cruise and descent information is based on the recommended turbulent air penetration speed schedule: 270 knots below 25,000 feet, 280 knots or 0.82 Mach whichever is lower at 25,000 feet and

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above; maintain a minimum speed of 15 knots above the minimum maneuvering speed when below 0.82 Mach. This schedule provides ample protection from stall and high speed buffet, while also providing protection from exceeding structural limits. The Climb, Cruise and Descent tables 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 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 at two center of gravity positions: 7.5% MAC (FMC default) for use when no center of gravity is entered on the PERF INIT page, and 30% MAC (typical mid cruise center of gravity) for use when 30% MAC is entered. Crews may interpolate between these values to determine the airplane's capability at other specific center of gravity positions. Note that these tables consider 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 300 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 21° may cause the airplane to lose speed and/or altitude.

Note that optimum altitudes shown in the tables result in buffet related maneuver margins of approximately 1.3 g (39° bank) or more. The altitudes shown in the table are limited to the maximum certified altitude of 43,100 ft.

Long Range Cruise Control

These tables provide target %N1, Long Range Cruise Mach number, IAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude, .84 Mach approximates the Long Range Cruise Mach schedule.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the table in the Engine Inoperative text section.

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 .84/310/250 descent. Tables are presented for low altitudes for shorter trip distances and high altitudes for longer trip distances.

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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 at .84/310/250

Distance and time for descent are shown for a .84/310/250 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 30 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 is based on VREF30 + 60 speed schedule. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read %N1, IAS and fuel flow per engine.

Advisory Information

Reported Braking Action

When landing on slippery runways or runways contaminated with ice, snow, slush, or standing water, the reported braking action must be considered. A table is provided that correlates runway condition code to runway surface condition description and reported braking action that can then be used to determine the appropriate Normal Configuration Landing Distance or Non-Normal Configuration Landing Distance.

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Normal Configuration Operational Landing Distance

Tables are provided as advisory information for normal configuration landing distances on dry runways and runways with good, good-to-medium, medium, medium-to-poor, and poor reported braking action. Landing distances (reference distances plus adjustments) are 115% of the actual landing distance. The Normal Configuration Landing Distance tables should be used enroute to make a landing distance assessment for time of arrival.

The reference landing distance is the distance from threshold to complete stop. It includes an air distance allowance of 1,500 ft from threshold to touchdown. The reference distance is based on a reference landing weight and speed at sea level, standard day, zero wind, zero slope, two-engine maximum reverse thrust, and auto speedbrakes.

To use these tables, determine the reference landing distance for the selected braking configuration and reported braking action. Adjust this reference distance for landing weight, altitude, wind, slope, temperature, approach speed, and the number of operative thrust reversers. Each correction is applied independently to the reference landing distance. A correction for use of manual speedbrakes is provided in the table notes.

Use of the autobrake system commands the airplane to a constant deceleration rate. In some conditions, such as a runway with "poor" reported 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 appropriate 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. Landing distances and adjustments are provided for dry runways and runways with good, good-to-medium, medium, medium-to-poor, and poor reported braking action. Landing distances (reference distances plus adjustments) are representative of the actual landing distance, and are not factored. The Non-Normal Configuration Landing Distance tables should be used enroute to make a landing distance assessment for time of arrival.

The reference landing distance is the distance from threshold to complete stop. It includes an air distance allowance of 1,500 ft from threshold to touchdown. The reference distance is based on a reference landing weight and speed at sea level, standard day, zero wind, zero slope, and maximum available reverse thrust.

Tables for Non-Normal Configuration Landing Distance in this section are similar in format and used in the same manner as tables for the Normal Configuration Landing Distance previously described.

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For an engine inoperative landing, check the rate of climb capability shown in Gear Down Landing Rate of Climb Available tables to ensure adequate climb performance.

Landing Climb Limit Weight

In the event an overweight landing is necessary and the fuel dump system is unavailable, landing climb limits should be checked if a Flaps 25 or 30 landing is planned. Enter the table with airport OAT and pressure altitude to read landing climb limit weight. Apply the noted adjustments as required. At weights exceeding those shown, plan a Flaps 20 landing.

The table "Landing Climb Limit Weight" presents the data which are the more limiting of Approach Climb Limit Weight and Landing Climb Limit Weight.

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 appropriate Event Adjusted Brake Energy Table (No Reverse Thrust or 2 Engine Reverse) with the reference brake energy per brake and the type of braking used during landing (Max Manual, Max Auto, or Autobrake). 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 5.0 or higher on the EICAS indication and disappear as the hottest brake cools with an EICAS indication of 3.5. Note that even without an EICAS advisory message, brake cooling is recommended.

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Engine Inoperative

Initial Max Continuous %N1

The Initial Max Continuous %N1 setting for use following an engine failure is shown. The table is based on the typical all engine cruise Mach number of .84 to provide a target %N1 setting at the start of driftdown. Once driftdown is established, the Max Continuous %N1 Table should be used to determine %N1 for the given conditions.

Max Continuous %N1

Power setting is based on one engine operating with engine bleed for packs on or off and all anti-ice bleeds off. Enter the table with pressure altitude and IAS 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 considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/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. If altitudes other than the level off altitude is used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

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Long Range Cruise Altitude Capability

Table show the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on LRC speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target %N1, engine inoperative Long Range Cruise Mach number, IAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn.

APU Operation During Flight

For APU operation during flight, increase fuel flow according to the following table. These increments include the APU fuel flow and the effect of increased drag from the APU door.

PRESSURE ALTITUDE (1000 FT)	APU FUEL FLOW PENALTY (KG/HR) GROSS WEIGHT (1000 KG)				
	300	260	220	180	140
43				160	140
39			180	160	145
35		200	190	170	140
31	230	220	195	165	140
25	230	220	195	175	155
20	235	230	205	185	165
15	235	235	215	200	185
10	240	240	230	220	200
5	270	270	255	240	220

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 single engine Long Range Cruise speed and .84/310/250 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 off reference fuel corrections table with the fuel required for the reference weight and the actual weight at checkpoint. Read fuel and time required for the actual weight.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down Landing Rate of Climb Available

Rate of climb data is provided as guidance information in the event an engine inoperative landing is planned. The tables show gear down rate of climb available for Flaps 20 and Flaps 30. Enter the table with TAT and pressure altitude to read rate of climb available. Apply adjustments shown to correct for weight.

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Alternate Mode EEC

No takeoff speed adjustments or other performance adjustments are required for operation of EEC in the ALTERNATE mode. Power setting adjustments are only required for the takeoff thrust rating.

Max Takeoff %N1

Takeoff power settings are presented for normal air condition bleed. Max Takeoff %N1 may be read directly from the tables for the desired pressure altitude and airport OAT.

The EEC ALTERNATE mode schedule provides equal or greater thrust than the normal mode for the same lever position. Thrust protection is not provided in the ALTERNATE mode 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 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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Operating Procedures — Chapter OP

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Callouts Procedure

Both crewmembers should be aware of altitude, aircraft position and situation.

Avoid casual and nonessential conversation during critical phases of flight, particularly during taxi, takeoff, approach and landing. Unnecessary conversation reduces crew efficiency and alertness and is not recommended when below 10,000 ft MSL/FL100.

PM makes callouts based on instrument indications or observations for the appropriate condition. PF should verify the condition/location from the flight instruments and acknowledge. If PM does not make the required callout, PF should make it.

One of the basic fundamentals of the “Crew Coordination Concept” is that each crewmember must be able to supplement or act as a backup for the other crewmember. Proper adherence to standard callouts is an essential element of a well-managed flight deck. These callouts provide both crewmembers required information about aircraft systems and about the participation of the other crewmember. The absence of a standard callout at the appropriate time may indicate a malfunction of an aircraft system or indication, or indicate the possibility of incapacitation of the other pilot.

PF should acknowledge all GPWS voice callouts during approach except altitude callouts while below minimums (e.g. fifty—forty—thirty—twenty—ten). If the automatic electronic voice callout is not heard by the flight crew, PM should make the callout.

General Rules for FMA Callout

Other than company standard stated in OM-A 8.3 and 8.18, additional standards callouts are given in this section.

In normal situation, PF shall operate the AFDS during automatic flight. He shall call out the new mode selection made by himself as depicted on the FMA e.g. “Heading select”, “LNAV”, “Vertical speed”. The annunciation shall be short and straight to the point without contradicting with FOM standard callouts. PM shall call out for automatic mode switching when a discrepancy from anticipated annunciation or aircraft behavior is detected.

Automatic flight

- If PF operates the AFDS, he shall call out himself to inform PM of his action. PM checks the FMA and calls out “Checked” to confirm PF’s action.

Manual flight

- If PF orders, PM shall call out after performing the action.

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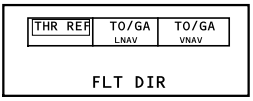
Definition of Terms

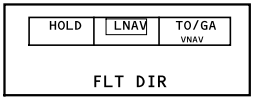
AFDS MODE SWITCHING: Any mode that change the ACFT reaction or flight path. So we can group all modes of B777 by:

A/T	ROLL	PITCH
THR REF	TO/GA	TO/GA
THR	LNAV	VNAV PTH
IDLE	TRK SEL	VNAV SPD
HOLD	HDG SEL	VNAV ALT
SPD	LOC	FLCH SPD
		ALT
		G/S

Any autothrottle mode that normally change or slave to the pitch mode may omit the callout due to master mode has already been called. PM should make any callout if aircraft behavior or any mode is not slave or act erroneous.

Takeoff Phase

FMA ANNUNCIATIONS	LP's CALLOUT	RP's CALLOUT
	"TOGA" Verifies that THR REF display on FMA	"CHECKED"

FMA ANNUNCIATIONS	PM's CALLOUT	PF's CALLOUT
When actual EPR indications meet target EPR reference.	"THRUST SET... (V1 speed)"	Nil
	"L NAV CAPTURED"	"CHECKED"
	"VEE NAV SPEED"	"CHECKED"
CLB (EICAS)	"CLIMB THRUST"	

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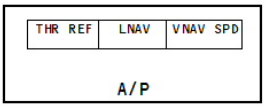
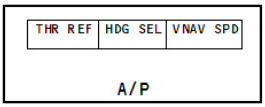
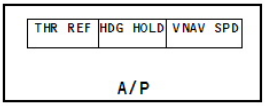
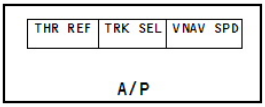
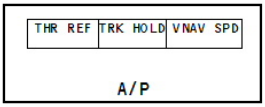
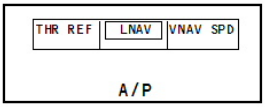
FMA ANNUNCIATIONS	PM's CALLOUT	PF's CALLOUT
CLB 1 (EICAS)	"CLIMB ONE"	
CLB 2 (EICAS)	"CLIMB TWO"	
CON (EICAS)	"CON THRUST"	"CHECKED"

Automatic Flight (Action by PF)

FMA	PF's ACTION/ CALLOUT	PM's CALLOUT
	"AUTOPILOT ENGAGED"	"CHECKED"
	"HEADING SELECT"	"CHECKED"
	"HEADING HOLD"	"CHECKED"
	"TRACK SELECT"	"CHECKED"
	"TRACK HOLD"	"CHECKED"
	"L NAV CAPTURED" (Momentarily White, then Green)	"CHECKED"

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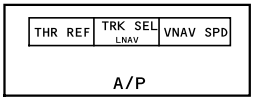
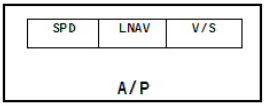
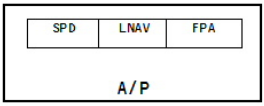
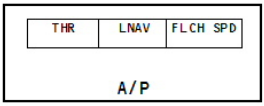
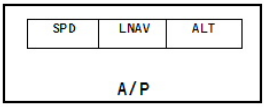
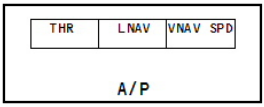
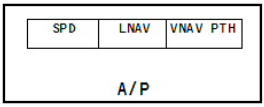
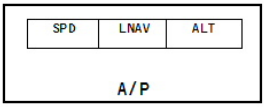
FMA	PF's ACTION/ CALLOUT	PM's CALLOUT
	"L NAV ARMED"	"CHECKED"
	"VERTICAL SPEED"	"CHECKED"
	"FLIGHT PATH ANGLE"	"CHECKED"
	"FLIGHT LEVEL CHANGE"	"CHECKED"
	"ALTITUDE HOLD"	"CHECKED"
	"LEAVING" (Initiate climb) "CHECKED"	"VEE NAV SPEED"
	"CHECKED"	"VEE NAV PATH"
	"CHECKED"	"ALTITUDE CAPTURE"

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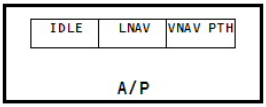
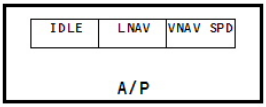
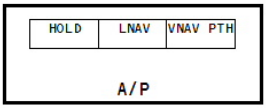
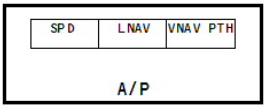
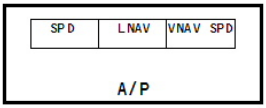
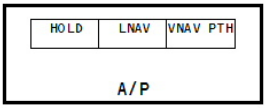
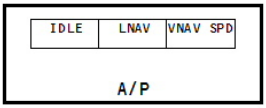
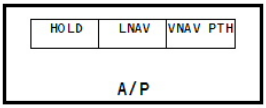
Descent Mode

MODE SELECTION ACTION/CONDITION	PF's ACTION/ CALLOUT	PM's CALLOUT
	"CHECKED"	"IDLE" (Initial Descent)
	"LEAVING" (Initiate early descent) "CHECKED"	"VEE NAV SPEED"
	Nil	Nil
	Nil	Nil
	"MCP SPEED" (Set desired speed on MCP)	"CHECKED"
	"FMC SPEED" (Push speed knob and sets required speed in FMC)	"CHECKED"
	"CHECKED"	"VEE NAV SPEED" (Automatically changes in FMA)
	"CHECKED"	"VEE NAV PATH" (Automatically changes in FMA)

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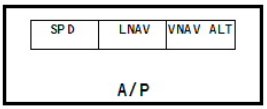
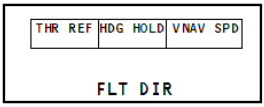
MODE SELECTION ACTION/CONDITION	PF's ACTION/ CALLOUT	PM's CALLOUT
	"CHECKED"	"VEE NAV ALT"

Manual Flight (Ordered by PF and Action by PM)

FMA	PF's ORDER	PM's CALLOUT
	"HEADING SELECT"	"HEADING SELECT"
	"HEADING ONE EIGHT ZERO"	"HEADING ONE EIGHT ZERO"
	"HEADING HOLD"	"HEADING HOLD"
	"TRACK SELECT"	"TRACK SELECT"
	"TRACK HOLD"	"TRACK HOLD"
	"TRACK TWO ONE ZERO"	"TRACK TWO ONE ZERO"
	"ARM L NAV"	"L NAV CAPTURED" (Momentarily White, then Green)

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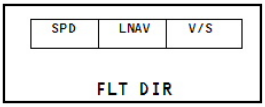
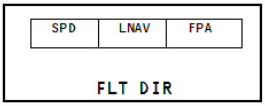
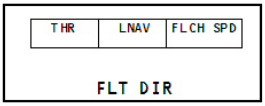
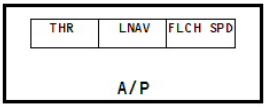
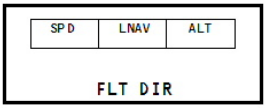
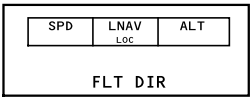
FMA	PF's ORDER	PM's CALLOUT
	"ARM L NAV"	"L NAV ARMED"
	"VERTICAL SPEED UP/DOWN.... (SIX HUNDRED)"	"VERTICAL SPEED UP/DOWN.... (SIX HUNDRED)"
	"FIGHT PATH ANGLE UP/DOWN... (TWO POINT EIGHT)"	"FLIGHT PATH ANGLE UP/DOWN... (TWO POINT EIGHT)"
	"FLIGHT LEVEL CHANGE"	"FLIGHT LEVEL CHANGE"
	"ENGAGE AUTOPILOT"	"AUTOPILOT ENGAGED"
	"ENGAGE AUTOTHROTTLE"	"AUTOTHROTTLE ENGAGED"
	"ALTITUDE HOLD"	"ALTITUDE HOLD"
	"ARM LOCALIZER"	"LOCALIZER ARMED"

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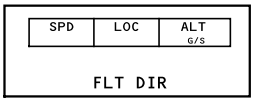
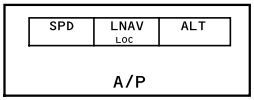
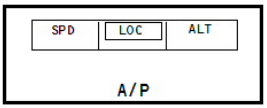
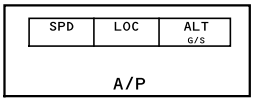
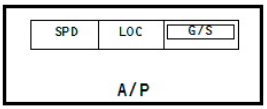
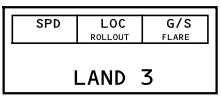
FMA	PF's ORDER	PM's CALLOUT
	"ARM APPROACH"	"APPROACH ARMED"
PM pushes MCP speed knob and sets required speed	"MCP SPEED..."	"MCP SPEED..."
PM sets ordered speed on MCP	"SPEED..."	"SPEED..."
PM enters ordered speed by PF in FMC VNAV page	"FMC SPEED..."	"FMC SPEED..."

Automatic Flight (Auto Pitch/Roll, Auto/Man)

FMA	PF's ACTION/ CALLOUT	PM's CALLOUT
	"LOCALIZER ARMED"	"CHECKED"
	"CHECKED"	"LOCALIZER CAPTURED"
	"APPROACH ARMED"	"CHECKED"
	"CHECKED"	"GLIDESLOPE CAPTURED"
	"CHECKED"	"LAND THREE"

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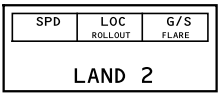
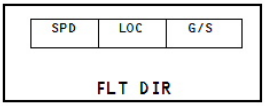
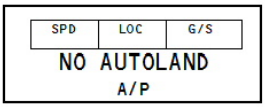
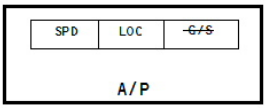
FMA	PF's ACTION/ CALLOUT	PM's CALLOUT
	"CHECKED"	"LAND TWO"
	"AUTOPILOT DISENGAGED" (Intend to disengage AP)	"CHECKED"
For CAT II/III approaches, verify the autoland status at 500 feet radio altimeters	"LAND 2" or "LAND 3" or "NO AUTOLAND"	"FIVE HUNDRED FEET"
For CAT II/IIIB approaches, at 200 feet RA (company alert height)	"CHECKED"	"ALERT HEIGHT" (omit "TWO HUNDRED" callout)
During Autoland and "FLARE" green on FMA display below 60–40 ft RA	NIL	"FLARE"
During Autoland and "IDLE" green on FMA replace "SPD" below 25 ft RA	NIL	"IDLE"
During Autoland and "ROLLOUT" green on FMA replace "LOC" below 2 ft RA	NIL	"ROLLOUT"

Abnormal Callouts

MODE SELECTION ACTION/CONDITION	PF's CALLOUT	PM's CALLOUT
	"CHECKED"	"NO AUTOLAND"
	"CHECKED"	"GLIDESLOPE BAR"

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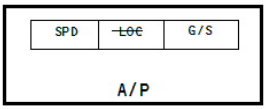
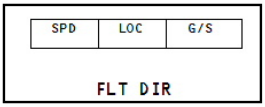
MODE SELECTION ACTION/CONDITION	PF's CALLOUT	PM's CALLOUT
	"CHECKED"	"LOCALIZER BAR"
	"AUTOPILOT DISCONNECT"	"CHECKED"
During Autoland and no "FLARE" green on FMA display below 60–40 ft RA	"CHECKED"	"NO FLARE"
During Autoland and no "IDLE" green on FMA replace "SPD" below 25 ft RA	"CHECKED"	"NO IDLE"
During Autoland and no "ROLLOUT" green on FMA replace "SPD" below 2 ft RA	"CHECKED"	"NO ROLLOUT"

Additional Callouts and Phraseology

Checklist

CONDITION	PM'S CALLOUT	PF'S CONFIRMATION
Some items may be read and not performed (e.g. altimeter setting)	"CHECKLIST TO_____ e.g. ALTIMETERS"	"CHECKED"
After completion of each normal checklist	"_____ CHECKLIST COMPLETE"	"CHECKED"
For the BEFORE TAKEOFF and LANDING checklists	"_____ CHECKLIST COMPLETE"	"CHECKLIST COMPLETE"
After completion of each non-normal checklist	"_____ CHECKLIST COMPLETE"	"CHECKED"
When a non-normal checklist is complete except for the deferred items, and the normal checklist to which the items have been deferred has not yet been done	"_____ CHECKLIST COMPLETE EXCEPT FOR DEFERRED ITEMS"	"CHECKED"

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Change of Controls

CONDITION	CALLOUT
An order used by a pilot, that he intends to take over the maneuvering, or a confirmation by a pilot that he has taken over the maneuvering	“MY CONTROLS”
Used by a pilot to hand over the maneuvering to the other, or by a pilot to confirm that he is handling over the maneuvering to other pilot upon his order “My controls”	“YOUR CONTROLS”
Used by a pilot to hand over/confirm that he has taken over the handling of the communication systems	“YOUR RADIOS”/“MY RADIOS”
Note: The term “Maneuvering” means controls and brakes.	

Before Taxi

LOCATION	CALLOUT
Before taxiing when all obstructions on the right side of the aircraft are removed	RP: “CLEAR RIGHT”
During taxiing before intended turns	PF: e.g., “ALPHA FIRST RIGHT” or “INDIA SECOND LEFT”

Takeoff

CONDITION	CALLOUT
To inform of the P-i-C’s intention to continue the takeoff	“GO”
To inform of the P-i-C’s intention to reject the takeoff	“STOP”
To inform of the P-i-C’s intention to initiate and order an emergency evacuation	“EVACUATE”
“ON GROUND EMERGENCY”	“EVACUATION”

Thrust

CONDITION	CALLOUT
Maximum certified thrust	“FULL THRUST”
Maximum Continuous Thrust	“CON THRUST”
Climb Thrust	“CLIMB THRUST”

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Airspeed

CONDITION	CALLOUT
IAS passing “80” knots during takeoff roll	PM: “Eighty Knots”
IAS passing “60” knots during landing roll	PM: “Sixty Knots”
IAS passing “V1” and no auto callout	PM: “Vee One”
IAS passing “VR” during takeoff roll	PM: 777-200 : “Rotate” 777-300 : “Rotate long body”
Order made by PF to set desired airspeed	PF: “Set ____ Knots” “Set VREF Plus (additive)” “Set Flaps ____ Speed”

Configuration Settings

PF’s ORDER	PM’s ANSWER	PM’s CONFIRMATION
“GEAR UP”	“GEAR UP SELECTED”	“GEAR IS UP”
“GEAR DOWN”	“GEAR DOWN SELECTED”	“___ DOWN AND CHECKED” as in LANDING checklist
“FLAPS UP”	“FLAPS UP SELECTED”	When checked as up, “CLEAN SPEED ___”
“FLAPS ___” (UP, ONE, FIVE, FIFTEEN, TWENTY, TWENTY-FIVE, THIRTY)	“FLAPS ___ SELECTED”	Confirm FLAPS indicator displays as ordered

Approach

CONDITION/LOCATION	CALLOUT (PM, unless noted)
Radio altimeter passing 2,500 ft during letdown, and check of adequate terrain clearance and actual altimeter setting.	“RADIO HEIGHT” and actual altimeter setting PF: Actual altimeter setting
Localizer bar moving from full deflection.	“LOCALIZER ALIVE”
AP or FD has captured localizer.	“LOCALIZER CAPTURED”
Glideslope bar moving from full deflection.	“GLIDESLOPE ALIVE”
AP or FD has captured glideslope.	“GLIDESLOPE CAPTURED”

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CONDITION/LOCATION	CALLOUT (PM, unless noted)
Flightpath deviates from ILS glideslope by more than one dot.	"GLIDESLOPE"
Outer marker or equivalent position plus actual crossing altitude. **Note:** The term "equivalent position' means the fix/point defined to check the crossing altitude.	PF: "OUTER MARKER (OR EQUIVALENT POSITION) ___ FEET"
Radio altimeter passing 1,000 ft during letdown and actual indicating aircraft sink rate.	"ONE THOUSAND FEET SINK RATE ___"
Rate of descent more than 1,500 ft/min below 2,500 ft AGL. Rate of descent more than 1,000 ft/min below 500 ft AGL.	"SINK RATE"
That desired indicated pattern airspeed is exceeded by more than 10 kt or approach and threshold speed by more than 5 kt.	"SPEED HIGH"
Indicating airspeed below: • pattern speed minus 10 kt, • approach speed minus 5 kt, or • threshold speed minus 0 kt.	"SPEED LOW"
Passing minimum plus 100 ft and "CONTACT" not called by PF.	"PLUS HUNDRED"
Approach lights in sight and "CONTACT" not called by PF (manual/semi-automatic approach).	"APPROACH LIGHTS" plus direction (e.g. TWELVE O'CLOCK)
Runway in sight and "CONTACT" not called by PF (manual/semi-automatic approach).	"RUNWAY" plus direction
Ability to continue approach by visual reference.	PF: "CONTACT"
Actual radio heights, if automatic callouts are not available, in order to assist in assessment of safe threshold crossing and flare.	"Actual radio heights, e.g. "ONE HUNDRED, FIFTY, FORTY, ___"
Reaching DA/DH/MDA.	"MINIMUM"
Time to go-around is expired on non-precision approach and "CONTACT" not called by PF.	"TIME IS UP"
Reaching DA/DH/MDA, and "CONTACT" or "GOING AROUND" not called by PF.	"GO AROUND"
Starting a go-around.	PF: "GOING AROUND"

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CONDITION/LOCATION	CALLOUT (PM, unless noted)
The latest point at which the missed approach procedure must be established.	“MISSED APPROACH POINT”

Non-Normal Situation

CONDITION	CALLOUT
To inform PM of the PF’s intention to execute the stall recovery, when the aircraft enters a stall or a stall warning device is actuated when airborne.	“STALL—FULL THRUST”
To inform PM of the PF’s intention to execute the pullup as described in the terrain avoidance procedure, when the GPWS modes command requiring a pullup.	“PULLING UP—FULL THRUST”
To inform PM of the PF’s intention to execute the windshear recovery, when windshear is encountered in flight.	“WINDSHEAR—GOING AROUND”

Others

CONDITION	CALLOUT
A warning given by PM calling out at 1,000 ft before reaching a cleared altitude/flight level. If for some reasons the callout cannot be made by PM, then it shall be made by PF.	“Prelevel”

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General

Definition

The Extended Range Operations for twin-engine aircraft (ETOPS) is defined by airworthiness authority as follows:

Note: ETOPS are those operations intended to be or actually conducted over a route that contains a point further than sixty-min flight time with one engine cruise speed at ISA conditions on still air from and adequate airport.

Approval

According to the rules, to conduct an ETOPS flight, airframe, power plant and operator must all comply with the requirement and be approved by the airworthiness authority.

Definition of Airport

Adequate Airport

An adequate airport is an airport which, at the anticipated time of use,:

- will be available and equipped with necessary ancillary services, such as ATC, sufficient lighting, communications, weather reporting, navaids, and safety cover, and
- will have at least one let-down aid (ground radar would qualify) available for an instrument approach.

Suitable Airport

A suitable airport is an adequate airport where, at the anticipated time of use, weather reports, or forecasts, or any combination thereof, indicate that the weather conditions are very likely to be at or above the normal operating minima at the time of the intended operation. The expected runway conditions at the time of the intended operation also have to be taken into consideration.

Suitable airport = adequate airport plus weather requirements.

ETOPS En Route Alternate

An ETOPS en route alternate is an airport to be available in the event of an engine and/or system failure which requires a diversion from the originally planned route. This airport must have the capabilities, services and facilities to safety support a particular aircraft involved in a specific ETOPS route. It must have weather and field conditions which give a high assurance that an approach and landing can safely be completed with one engine inoperative.

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Such en route alternatives have to be listed on the TAFS.

All normal destination and destination alternate aerodromes can be used as ETOPS en route alternates in addition to those specifically chosen by Flight Standards and published in the Route Manual.

Dispatch Consideration

MEL

The MEL will be most probably adapted to each ETOPS route and the determining parameters will be:

- the maximum and the average diversion time en route
- the equipment of the en route alternates
- the navigation and communications means
- the average meteorological conditions.

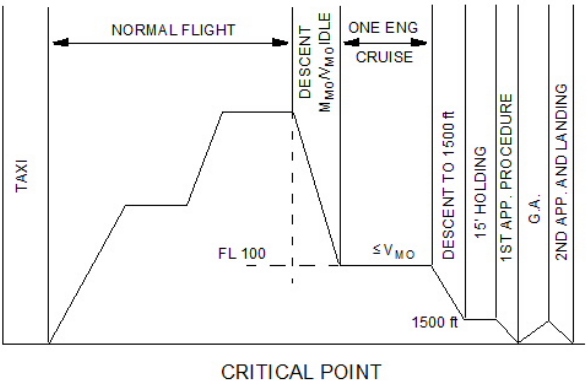
Fuel and Oil Supply

Fuel and oil supply will be calculated, taking into account engine failure and/or pressurization failure at the most critical point on the route. Forecast wind and temperature conditions as well as icing conditions must be considered.

Two critical scenarios must be considered and compared to the normal fuel calculation.

The two scenarios are:

1. pressurization failure + engine failure



2. pressurization failure.

Same flight profile but with two engines operative. In this case long range cruise at FL 100 can be considered.

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Note: Descent and cruise data corresponding to the chosen speed schedule at the chosen FL for best TAS and obstacle clearance.

Critical scenario, fuel reserve

The critical fuel scenario must include:

- a contingency figure of five percent added to the calculated fuel burn from the critical point to take into account errors in wind forecasts,
- a five-percent penalty in fuel mileage (or an established value for the inservice deterioration in cruise fuel mileage),
- any configuration deviated items, and
- both airframe and engine anti-icing and account for ice accumulation on unheated surfaces if the aircraft is likely to enter icing conditions during the diversion.

Eight-percent fuel penalty due to drag effect on unheated surfaces is to be considered for severe icing conditions during diversion flight. This figure can be proportionally decreased for shorter probable exposure time and divided by two for moderate icing conditions.

Note: Fuel reserves must include the most critical failure scenario with the use of minimum diversion time procedure. However, in case of pressurization failure with two engines operative, a cruise at FL 100 and LRC speed can be assumed.

If the use of APU is necessary, consider its fuel consumption during the applicable phase(s) of the flight.

APU fuel consumption

If APU is used as power source, consider diversion flight at FL 100 (most critical scenario).

Weather Minima

Dispatch is not permitted unless the meteorological forecasts, at en route alternate airports for a period starting one hour before the earliest expected time-of-landing and ending one hour after the latest expected time-of-landing, meet these weather minima. For weather minima, refer to OM-A 8.4.

Area of Operation

The maximum distance from an adequate airport must be determined for ISA and no wind conditions, taking into account aircraft performance with one engine inoperative and the other engine at no more than MCT.

To determine the maximum distance from an adequate airport, a diversion strategy must be defined for each ETOPS route.

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The one-engine-inoperative descent and cruise speed law must be selected so that the related net flightpath is above the en route obstacles with the appropriate margin.

The maximum distance from an adequate airport must be based on a diversion speed schedule compatible with obstacle clearance.

When the diversion strategy is selected, the maximum distance for a diversion airport can be found using the tables below.

The area of possible ETOPS operation can be found on navigation charts.

-200

Speed (M/KIAS)	Weight at Diversion (T)	Diversion Distance (Nm)								
		Time (min)								
		60	70	80	90	100	110	120	130	140
.84/260	260	371	429	487	546	604	662	720	778	836
	240	382	442	502	562	622	682	742	802	862
	220	393	456	518	580	643	705	767	830	892
	200	403	467	531	595	659	723	787	851	915
	180	412	478	543	609	674	740	805	871	936
	160	419	486	553	620	687	754	821	888	955
	140	425	493	561	630	698	766	834	903	971
.84/280	260	394	456	517	579	640	701	763	824	885
	240	405	468	532	595	658	722	785	849	912
	220	415	481	546	612	678	743	809	875	940
	200	423	491	559	626	694	762	830	897	965
	180	431	500	569	638	707	776	845	914	983
	160	436	506	576	646	716	786	856	926	996
	140	440	511	582	653	724	795	866	937	1,008
.84/300	260	412	476	540	604	667	731	795	858	922
	240	422	488	554	619	685	751	816	882	948
	220	430	498	566	634	701	769	837	904	972
	200	439	508	578	648	718	787	857	927	996
	180	445	517	588	659	731	802	874	945	1,016
	160	448	521	593	666	738	810	883	955	1,028
	140	451	524	597	670	743	817	890	963	1,036
.84/320	260	425	490	556	621	686	751	816	881	946
	240	433	500	567	634	701	767	834	901	968

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Speed (M/KIAS)	Weight at Diversion (T)	Diversion Distance (Nm)								
		Time (min)								
		60	70	80	90	100	110	120	130	140
	220	439	508	577	645	714	782	850	919	987
	200	446	516	586	656	726	796	866	936	1,006
	180	451	523	594	665	737	808	879	950	1,022
	160	454	527	599	671	744	816	889	961	1,034
	140	457	530	603	677	750	823	897	970	1,043
LRC	260	417	481	546	610	674	737	801	865	928
	240	419	485	550	615	680	745	810	875	939
	220	422	488	554	620	686	752	818	883	948
	200	421	488	555	622	688	755	821	887	953
	180	415	481	547	613	678	743	808	873	938
	160	407	472	536	601	665	729	793	857	920
	140	401	465	528	592	655	719	782	845	908

-200ER

Speed (M/KIAS)	Weight at Diversion (T)	Diversion Distance (Nm)								
		Time (min)								
		60	70	80	90	100	110	120	130	140
.84/260	300	363	420	477	535	592	649	707	764	821
	280	372	431	490	549	608	667	726	785	844
	260	382	442	503	564	625	686	747	808	868
	240	392	454	517	580	642	705	767	830	893
	220	403	467	531	596	660	724	789	853	917
	200	414	480	546	612	679	745	811	877	943
	180	425	493	561	629	697	765	833	901	969
	160	437	507	577	647	717	787	857	927	997
.84/280	300	387	448	510	572	633	695	756	818	880
	280	396	459	522	586	649	712	775	839	902
	260	405	470	535	600	665	730	794	859	924
	240	414	481	547	613	680	746	813	879	945
	220	424	492	559	627	695	763	831	899	967
	200	434	503	572	642	711	780	850	919	989
	180	442	513	584	655	725	796	867	938	1,009
	160	450	523	595	667	740	812	885	957	1,029

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Speed (M/KIAS)	Weight at Diversion (T)	Diversion Distance (Nm)								
		Time (min)								
		60	70	80	90	100	110	120	130	140
.84/300	300	409	474	539	605	670	736	801	866	932
	280	417	484	551	617	684	751	818	885	952
	260	425	493	561	630	698	766	834	903	971
	240	433	502	572	641	711	780	850	919	989
	220	441	511	582	653	723	794	865	936	1,006
	200	448	520	591	663	735	807	879	950	1,022
	180	454	527	600	673	746	819	892	965	1,038
	160	460	534	608	682	756	830	904	978	1,053
.84/320	300	427	496	564	633	701	770	838	907	975
	280	435	504	574	644	714	784	853	923	993
	260	441	512	583	655	726	797	868	939	1,010
	240	447	519	591	663	735	807	879	951	1,024
	220	453	526	599	672	745	818	891	964	1,037
	200	458	532	606	680	754	828	901	975	1,049
	180	462	537	612	686	761	836	910	985	1,060
	160	466	542	617	692	768	843	918	994	1,069
LRC	300	439	509	580	649	719	789	858	927	996
	280	439	509	579	649	718	788	857	926	995
	260	438	508	578	648	718	787	856	925	994
	240	436	506	575	645	714	783	852	920	988
	220	434	503	572	641	710	779	847	915	983
	200	432	501	569	638	706	774	842	910	978
	180	429	498	566	635	703	770	838	906	973
	160	428	496	564	632	700	768	835	903	970

-300

Speed (M/KIAS)	Weight at Diversion (T)	Diversion Distance (Nm)								
		Time (min)								
		60	70	80	90	100	110	120	130	140
.84/260	300	361	418	475	532	589	646	703	760	817
	280	370	428	487	545	604	663	721	780	838
	260	379	439	499	559	619	680	740	800	860
	240	388	450	512	574	636	698	760	822	883

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Speed (M/KIAS)	Weight at Diversion (T)	Diversion Distance (Nm)								
		Time (min)								
		60	70	80	90	100	110	120	130	140
	220	398	462	525	589	652	716	779	842	906
	200	408	473	538	603	668	733	798	863	928
	180	419	485	552	618	685	751	818	885	951
	160	428	496	564	632	701	769	837	905	973
.84/280	300	385	446	507	568	629	690	751	813	874
	280	393	455	518	581	643	706	769	831	894
	260	401	466	530	594	658	722	786	850	914
	240	410	476	541	607	672	738	803	869	934
	220	419	486	552	619	686	753	820	887	953
	200	427	496	564	632	700	768	836	904	972
	180	435	504	574	643	712	782	851	920	990
	160	442	512	583	653	724	794	865	936	1,006
.84/300	300	406	471	535	600	665	730	795	859	924
	280	413	479	546	612	678	744	810	876	942
	260	421	489	556	623	691	758	826	893	960
	240	428	497	565	634	702	771	839	908	976
	220	435	504	574	643	713	783	852	922	991
	200	441	512	582	653	723	794	865	935	1,006
	180	446	518	589	661	732	804	875	947	1,018
	160	451	524	596	668	740	812	885	957	1,029
.84/320	300	424	492	559	627	695	763	830	898	966
	280	431	500	569	638	707	775	844	913	982
	260	437	507	577	647	717	787	857	928	998
	240	442	514	585	656	727	798	869	940	1,011
	220	448	520	591	663	735	807	879	951	1,023
	200	452	525	597	670	742	815	887	960	1,033
	180	456	529	603	676	749	822	895	969	1,042
	160	459	532	606	680	754	827	901	975	1,049
LRC	300	437	507	576	646	715	784	853	922	990
	280	436	505	575	644	713	782	851	919	987
	260	434	503	572	642	710	779	848	916	984

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Speed (M/KIAS)	Weight at Diversion (T)	Diversion Distance (Nm)								
		Time (min)								
		60	70	80	90	100	110	120	130	140
	240	432	501	570	638	707	775	843	911	979
	220	429	497	565	633	701	769	837	904	971
	200	426	494	561	629	696	763	830	897	964
	180	422	489	557	624	690	757	823	889	956
	160	419	486	552	618	685	751	816	882	947

-300ER

Speed (M/KIAS)	Weight at Diversion (T)	Diversion Distance (Nm)								
		Time (min)								
		60	75	90	120	138	180	207	240	270
.82/260	360	359	445	531	702	804	1,042	1,195	1,383	1,553
	340	364	451	539	713	818	1,062	1,219	1,411	1,586
	320	372	461	550	728	835	1,085	1,246	1,442	1,620
	300	380	472	563	746	856	1,112	1,276	1,478	1,661
	280	390	484	578	766	879	1,142	1,312	1,519	1,707
	260	400	497	594	788	904	1,175	1,350	1,563	1,757
	240	411	511	612	812	932	1,212	1,392	1,612	1,812
	220	421	524	627	833	956	1,244	1,429	1,655	1,861
	200	431	536	641	850	976	1,271	1,459	1,690	1,900
	180	440	547	654	869	997	1,298	1,491	1,727	1,941
	160	447	557	667	886	1,017	1,324	1,522	1,763	1,982
.84/280	360	382	474	566	751	861	1,119	1,285	1,488	1,672
	340	389	483	577	765	878	1,142	1,311	1,518	1,706
	320	396	492	588	779	894	1,163	1,335	1,546	1,737
	300	404	502	599	795	912	1,186	1,362	1,576	1,772
	280	413	513	613	813	933	1,212	1,392	1,612	1,812
	260	423	525	627	832	955	1,241	1,425	1,650	1,855
	240	433	538	643	853	980	1,274	1,463	1,694	1,904
	220	442	550	658	873	1,003	1,304	1,498	1,735	1,951
	200	450	560	670	890	1,022	1,330	1,528	1,770	1,990
	180	457	569	681	905	1,039	1,352	1,554	1,800	2,024
	160	462	576	690	917	1,054	1,372	1,577	1,827	2,054
.84/300	360	405	503	601	798	916	1,191	1,368	1,584	1,781

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Speed (M/KIAS)	Weight at Diversion (T)	Diversion Distance (Nm)								
		Time (min)								
		60	75	90	120	138	180	207	240	270
	340	412	512	612	812	932	1,212	1,393	1,613	1,813
	320	419	520	622	825	947	1,231	1,413	1,637	1,840
	300	425	528	631	837	960	1,248	1,433	1,660	1,865
	280	433	538	643	852	978	1,271	1,459	1,690	1,899
	260	441	548	654	868	996	1,294	1,486	1,721	1,934
	240	449	558	667	885	1,015	1,320	1,516	1,756	1,973
	220	457	568	679	902	1,035	1,346	1,547	1,791	2,013
	200	464	577	690	917	1,053	1,370	1,574	1,823	2,049
	180	469	584	699	929	1,067	1,390	1,597	1,850	2,080
	160	472	589	705	938	1,077	1,403	1,612	1,868	2,101
.84/320	360	425	529	632	839	963	1,252	1,438	1,665	1,872
	340	433	538	643	853	979	1,273	1,462	1,693	1,903
	320	439	545	652	865	993	1,291	1,483	1,718	1,931
	300	444	551	659	875	1,004	1,306	1,500	1,736	1,952
	280	450	559	668	885	1,016	1,321	1,517	1,757	1,974
	260	456	566	677	897	1,030	1,339	1,537	1,780	2,001
	240	462	574	686	910	1,044	1,358	1,559	1,806	2,030
	220	467	581	694	922	1,058	1,376	1,580	1,830	2,057
	200	472	587	702	933	1,071	1,393	1,600	1,853	2,083
	180	475	591	708	940	1,079	1,405	1,614	1,870	2,102
	160	477	595	712	946	1,086	1,414	1,625	1,883	2,117
LRC	360	439	545	652	863	989	1,282	1,470	1,697	1,903
	340	438	544	650	861	987	1,279	1,466	1,693	1,898
	320	436	542	647	858	983	1,274	1,460	1,686	1,891
	300	432	536	641	849	973	1,262	1,446	1,670	1,873
	280	430	534	638	845	968	1,255	1,438	1,661	1,862
	260	429	533	636	842	965	1,250	1,432	1,654	1,854
	240	429	533	636	842	965	1,251	1,433	1,655	1,855
	220	427	531	634	840	963	1,248	1,430	1,652	1,851
	200	422	525	627	831	952	1,243	1,414	1,633	1,831
	180	418	520	620	821	941	1,220	1,397	1,613	1,809

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Speed (M/KIAS)	Weight at Diversion (T)	Diversion Distance (Nm)								
		Time (min)								
		60	75	90	120	138	180	207	240	270
	160	412	512	611	810	928	1,203	1,378	1,591	1,784

Critical Fuel Reserves

Regulations require reserve planning to include a “Critical Fuel Scenario” calculation. The information shown is the fuel required to satisfy the flight profile as described on the charts. This information is shown for two engine operation at Long Range Cruise, as well as single engine operation at Long Range Cruise, 260, 280, 300 and 320 KIAS. The fuel required is the higher of the two engine fuel and the single engine fuel for the speed schedule selected. This fuel is compared to the amount of fuel normally on board the aircraft at that point in the route. If the fuel required by the critical fuel reserves exceeds the amount of fuel normally expected, the fuel load must be adjusted accordingly.

The critical fuel reserves charts are computed based on the following:

- emergency descent to 10,000 ft
- level cruise at 10,000 ft
- 250 KIAS descent to 1,500 ft
- 15 minute hold at 1,500 ft
- one missed-approach, approach and land
- 5% allowance for wind errors.

To determine the fuel required, enter the appropriate chart with the desired diversion distance, correct for the anticipated wind, proceed vertically to the weight at critical point and read the fuel required to the right. Apply corrections as necessary.

Corrections

Increase fuel required by 0.8% for each 10 deg. C hotter than ISA conditions.

If icing conditions exist, increase fuel required by 8% to account for engine and wing anti-ice on and ice accumulation on unheated surfaces.

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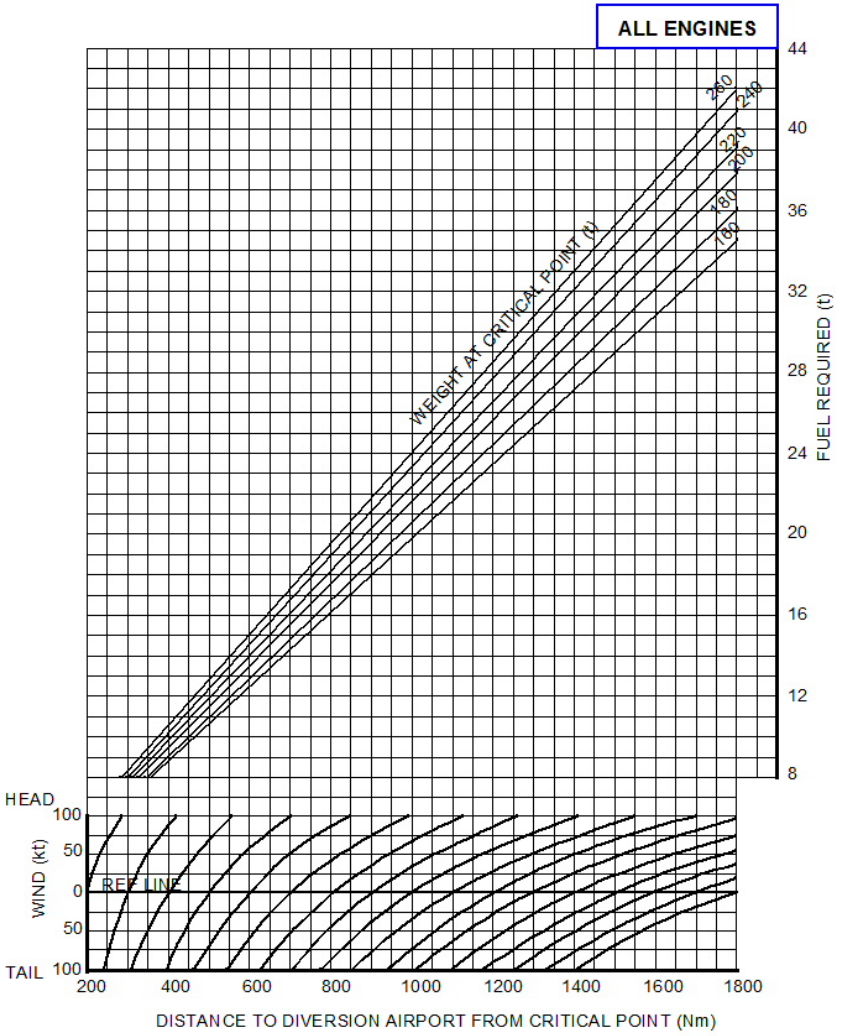
Critical Fuel Reserves Charts

-200

Long range cruise critical fuel reserves—777-200



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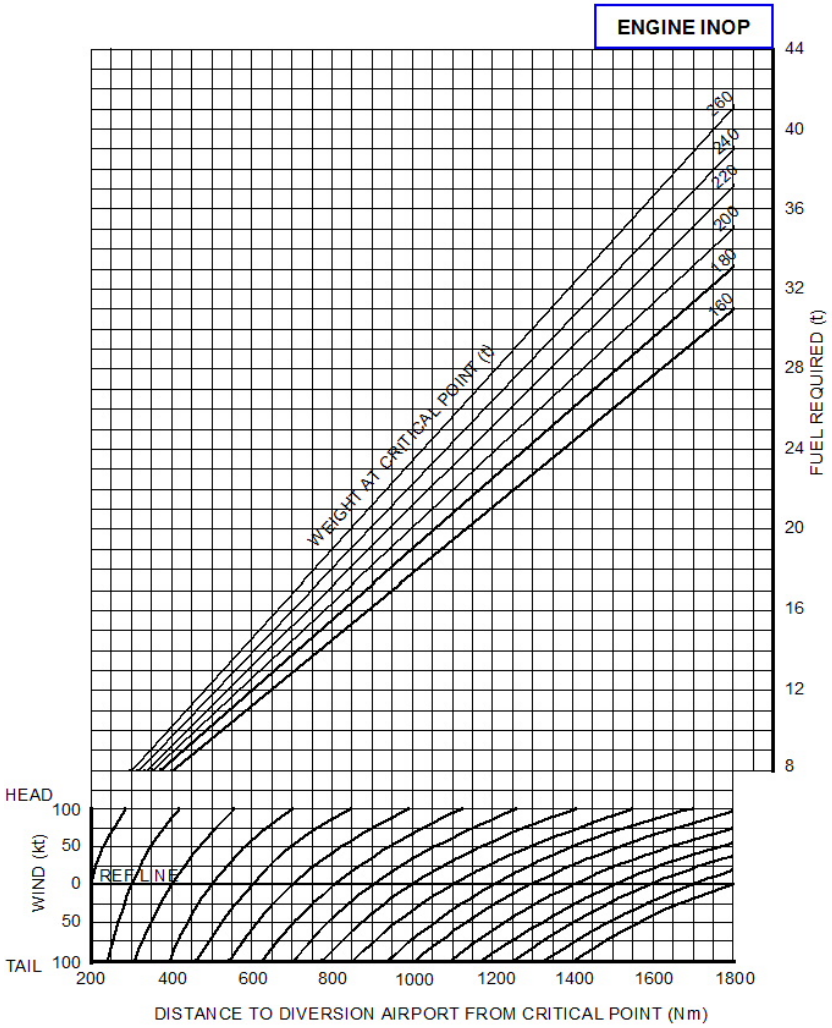
-200 ***Long range cruise critical fuel reserves—777-200***



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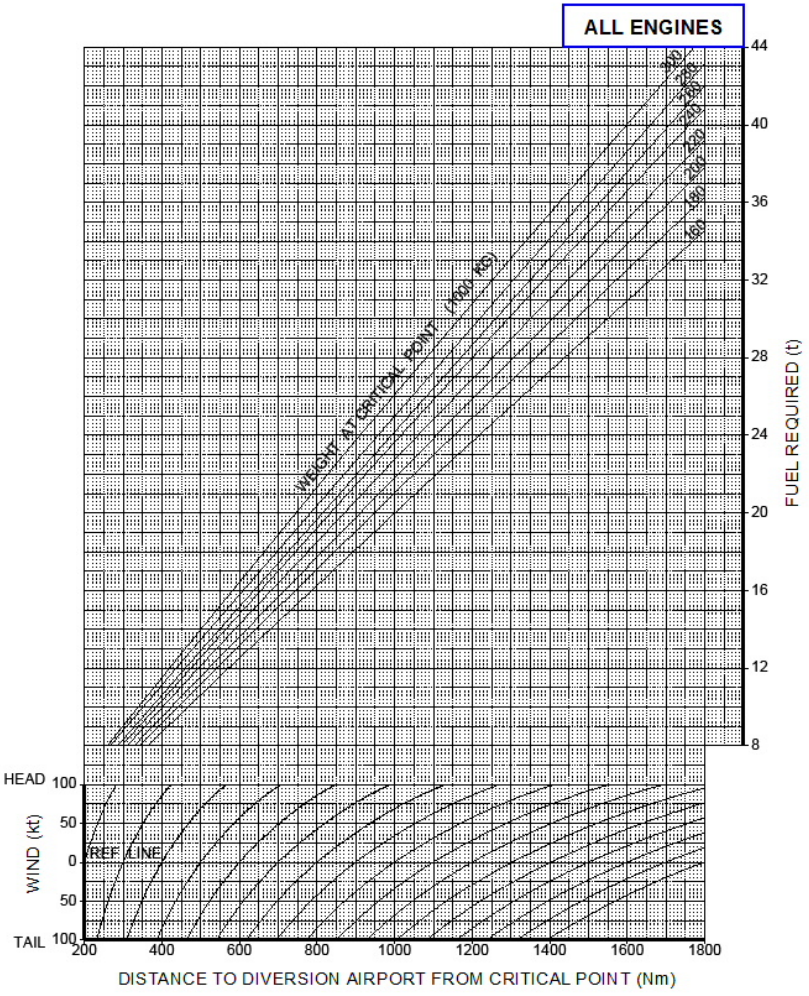
Long range cruise critical fuel reserves—777-200ER

-200ER



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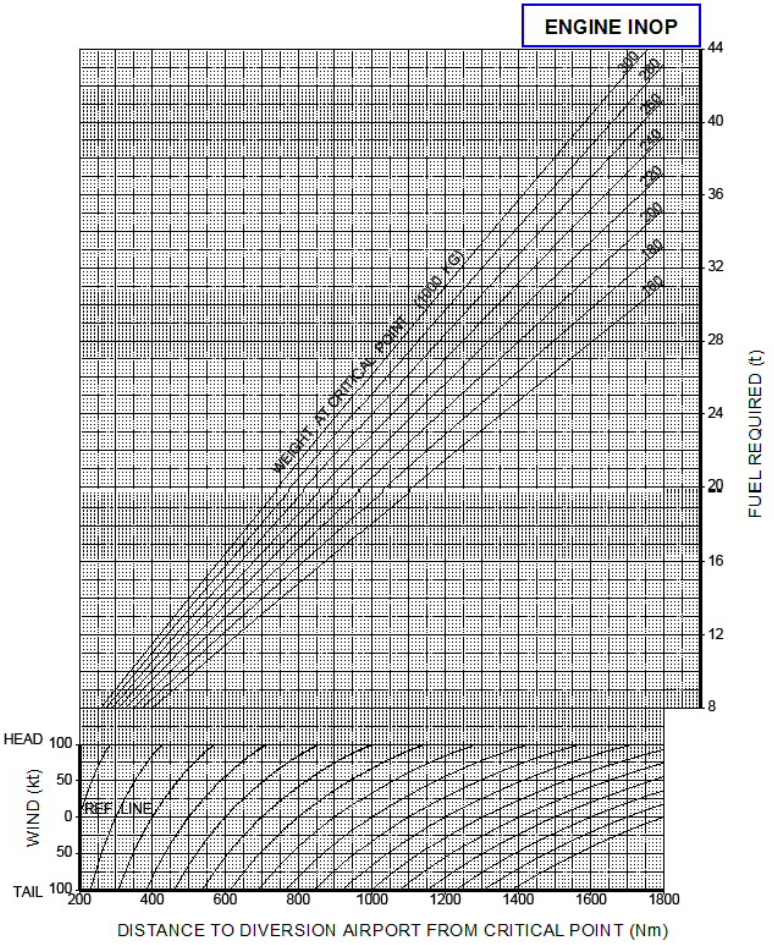
-200ER

Long range cruise critical fuel reserves—777-200ER



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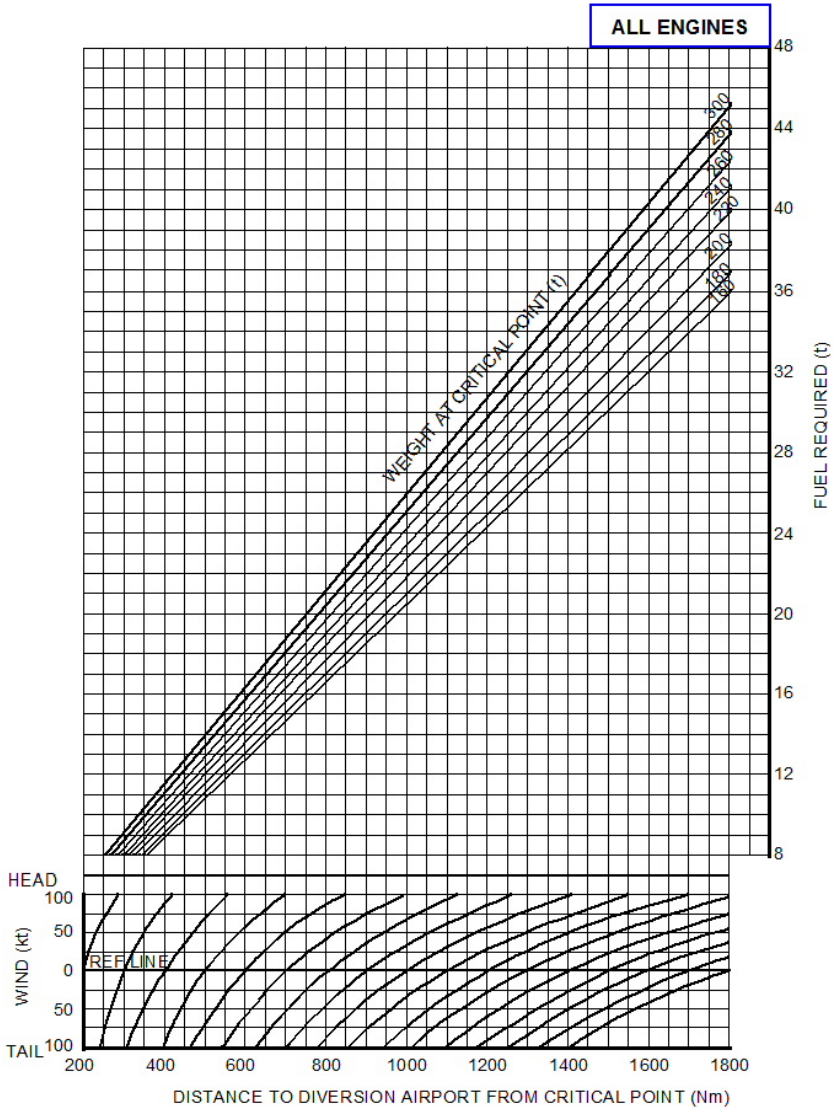
Long range cruise critical fuel reserves—777-300

-300



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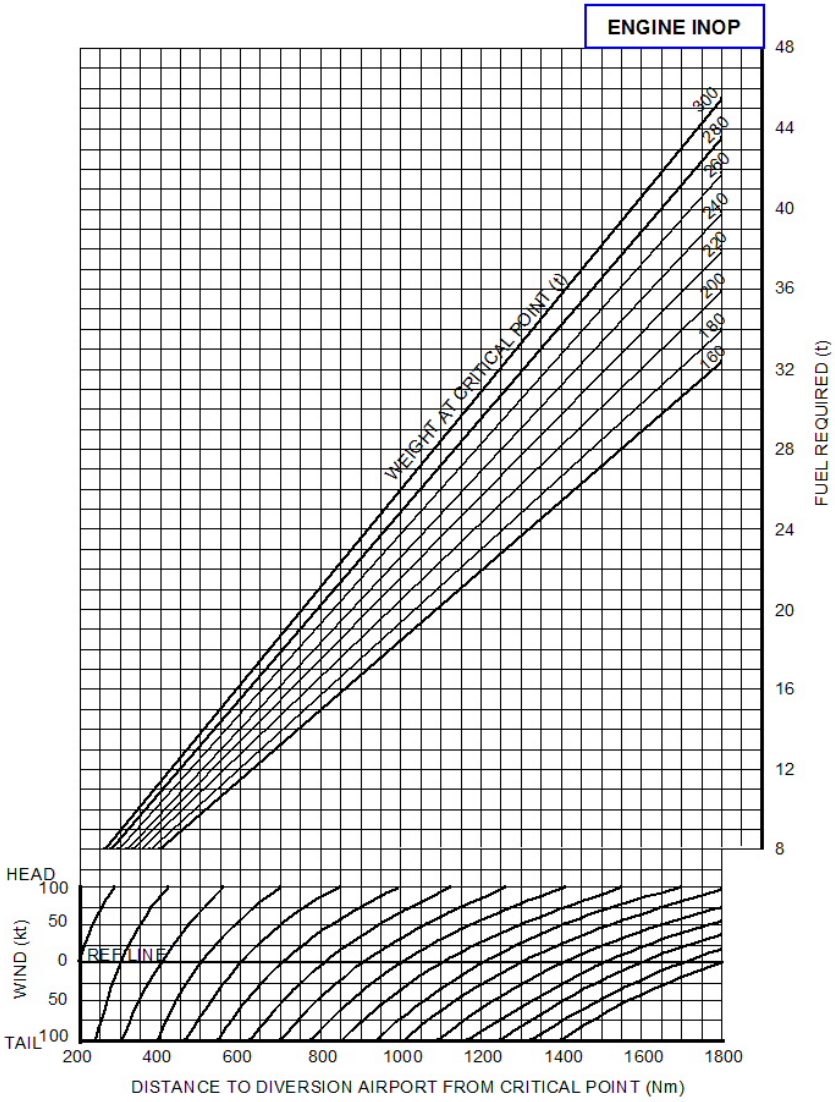
-300 ***Long range cruise critical fuel reserves—777-300***



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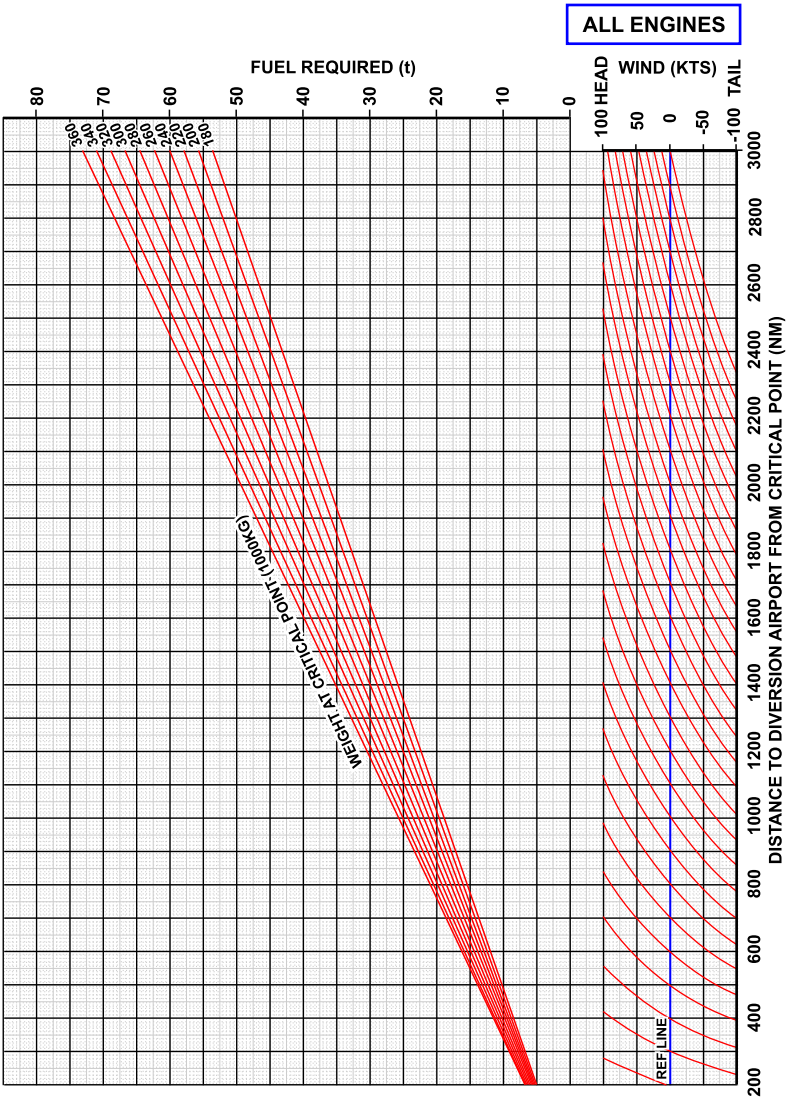
Long range cruise critical fuel reserves—777-300ER

-300ER



-300ER

Based on: Emergency descent to 10,000 ft, level cruise at 10,000 ft, 250 KIAS descent to 1,500 ft, 15 minutes hold at 1,500 ft, approach and land. Allowance for performance deterioration not included.

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Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required by 0.7% per 10 deg. C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (3%) for the total forecast time or engine and wing anti-ice on and ice drag (8%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

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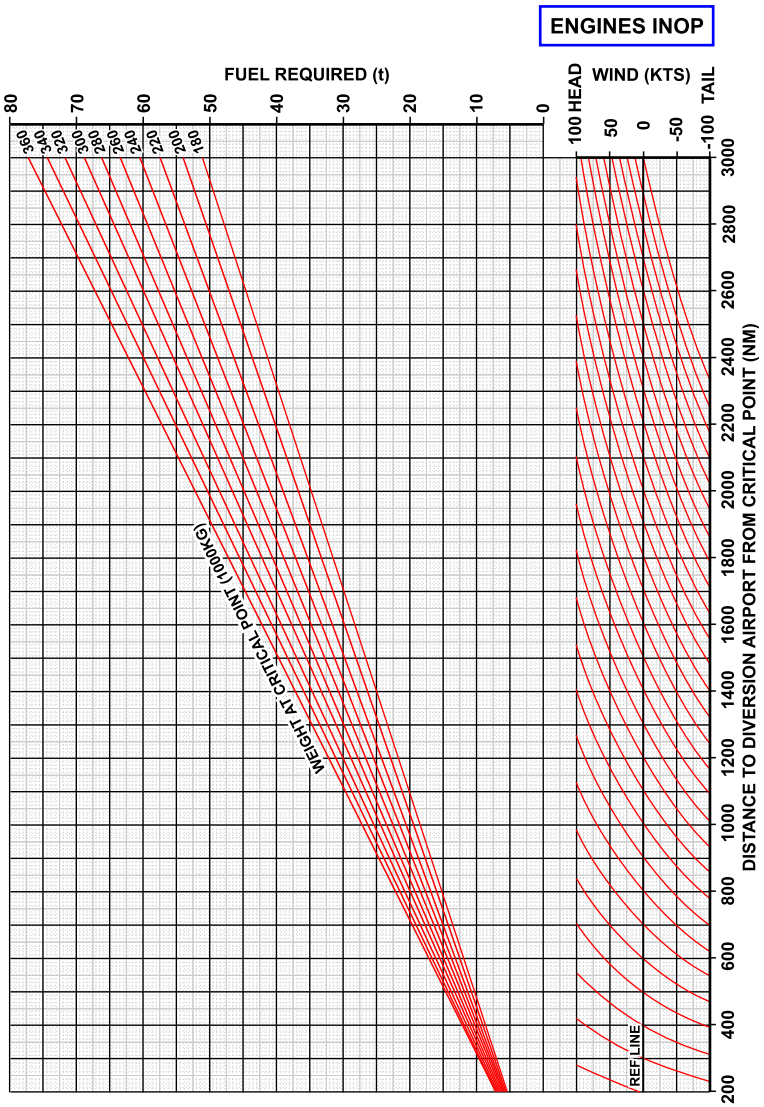
Long range cruise critical fuel reserves—777-300ER

-300ER



-300ER

Based on: Emergency descent to 10,000 ft, level cruise at 10,000 ft, 250 KIAS descent to 1,500 ft, 15 minutes hold at 1,500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

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Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required by 0.7% per 10 deg. C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (10%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

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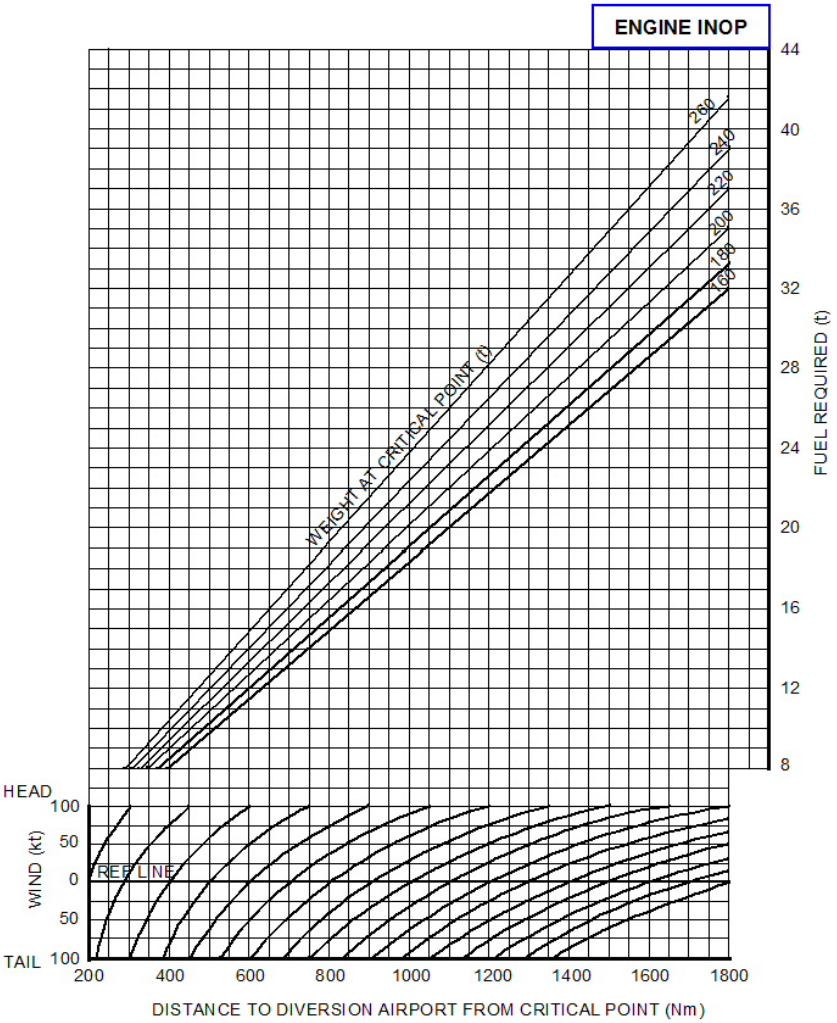
260 KIAS cruise critical fuel reserves—777-200

-200



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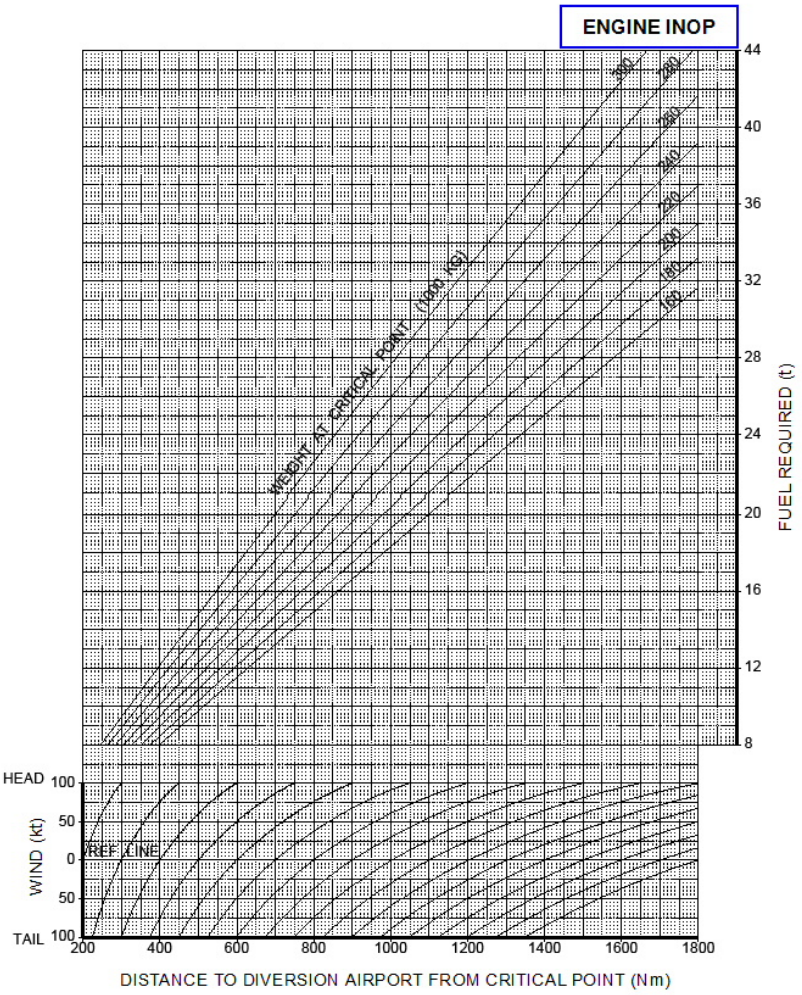
-200ER

260 KIAS cruise critical fuel reserves—777-200ER



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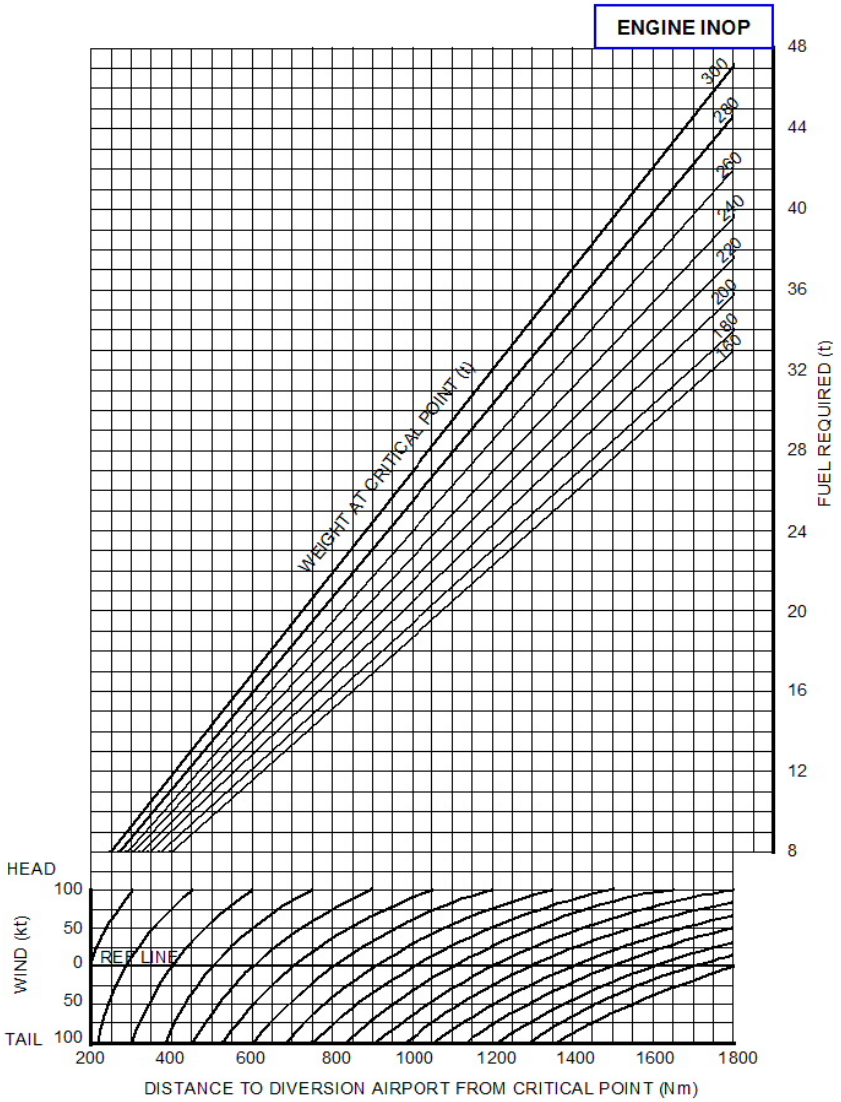
260 KIAS cruise critical fuel reserves—777-300

-300



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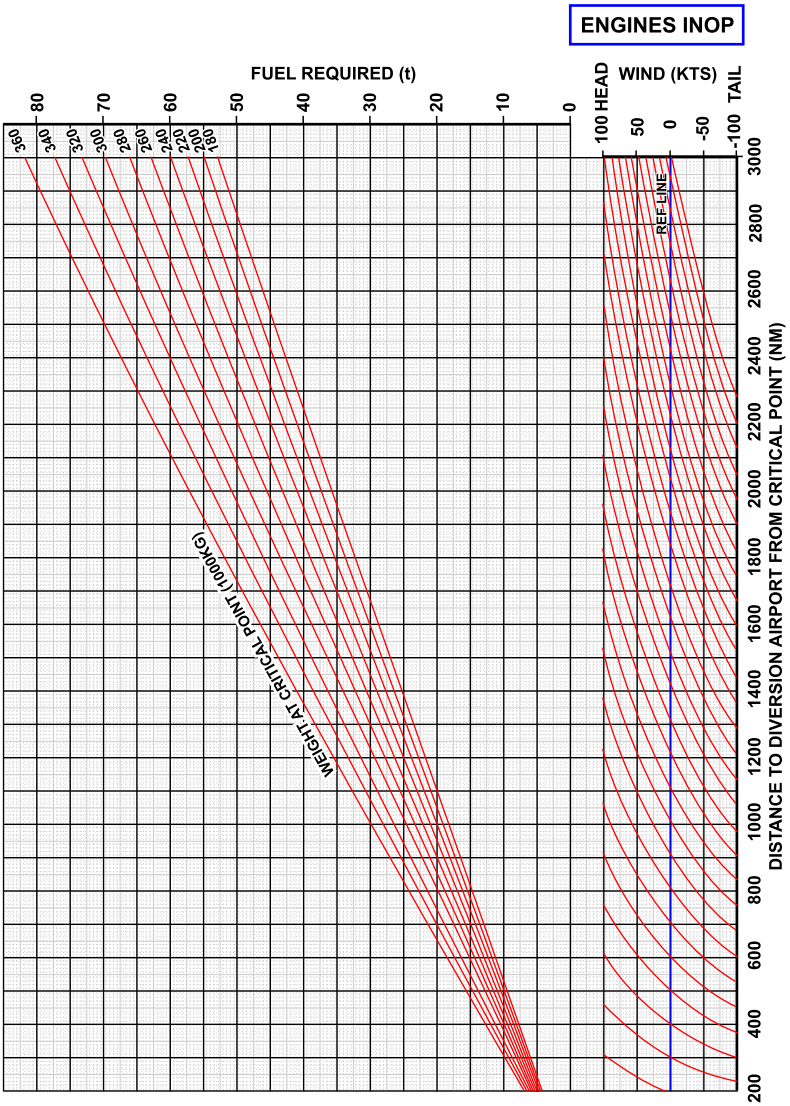
-300ER

260 KIAS cruise critical fuel reserves—777-300ER



-300ER

Based on: Emergency descent to 10,000 ft, level cruise at 10,000 ft, 250 KIAS descent to 1,500 ft, 15 minutes hold at 1,500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

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Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required by 0.7% per 10 deg. C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (10%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

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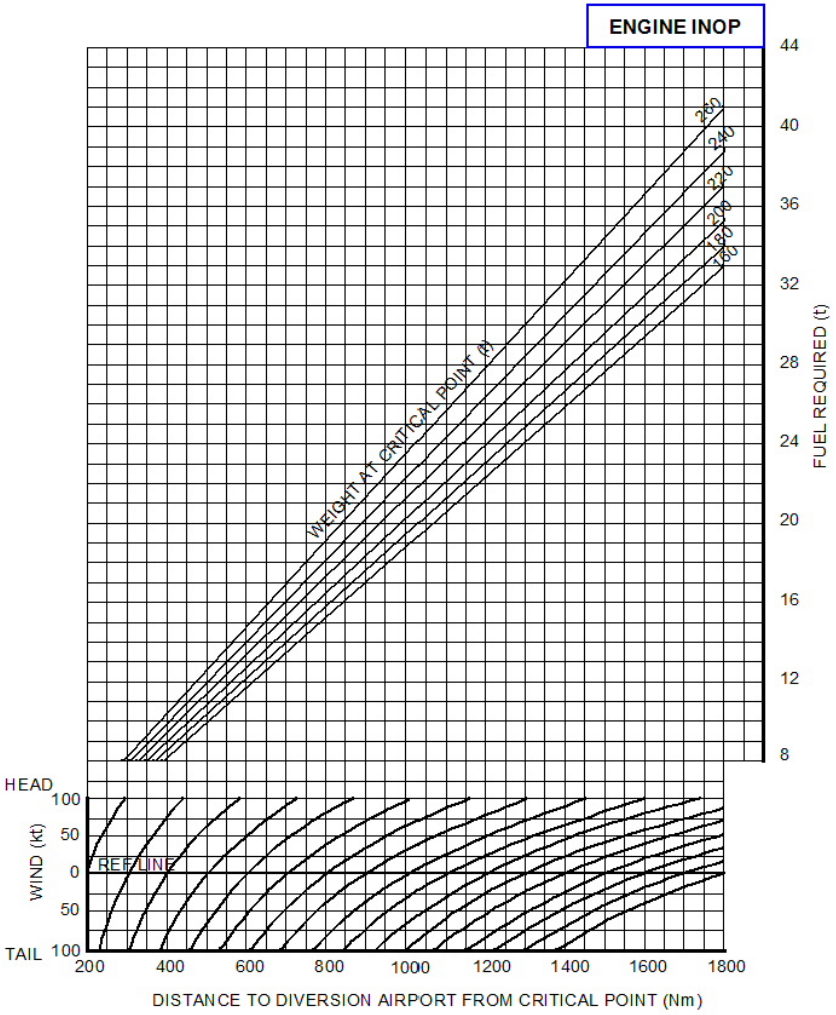
-200 ***280 KIAS cruise critical fuel reserves—777-200***



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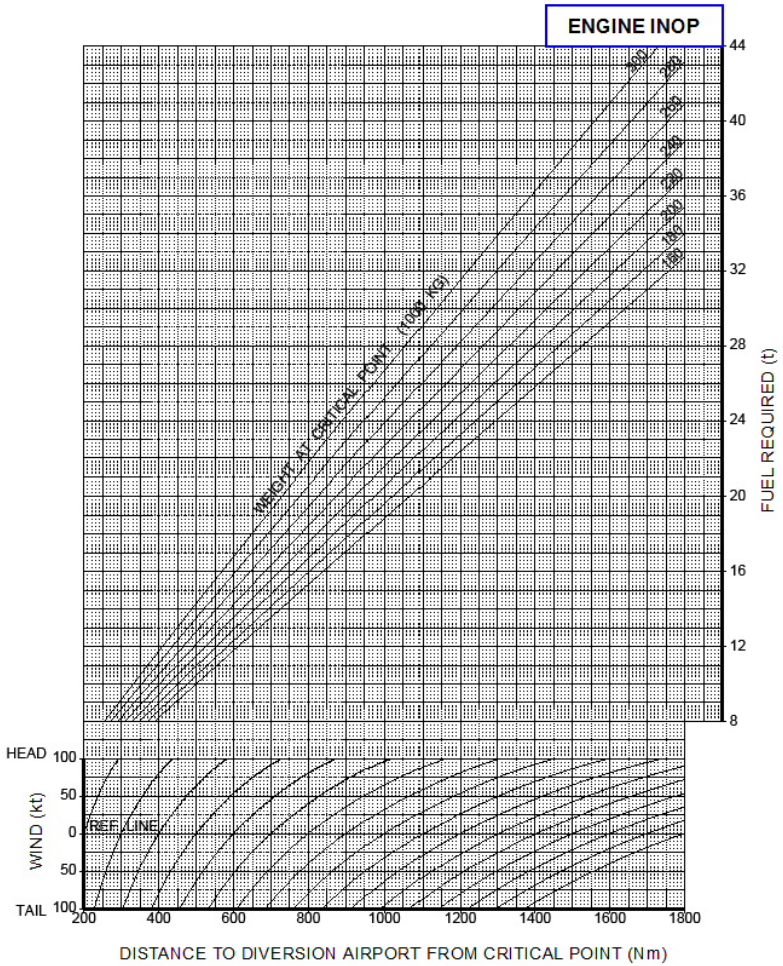
280 KIAS cruise critical fuel reserves—777-200ER

-200ER



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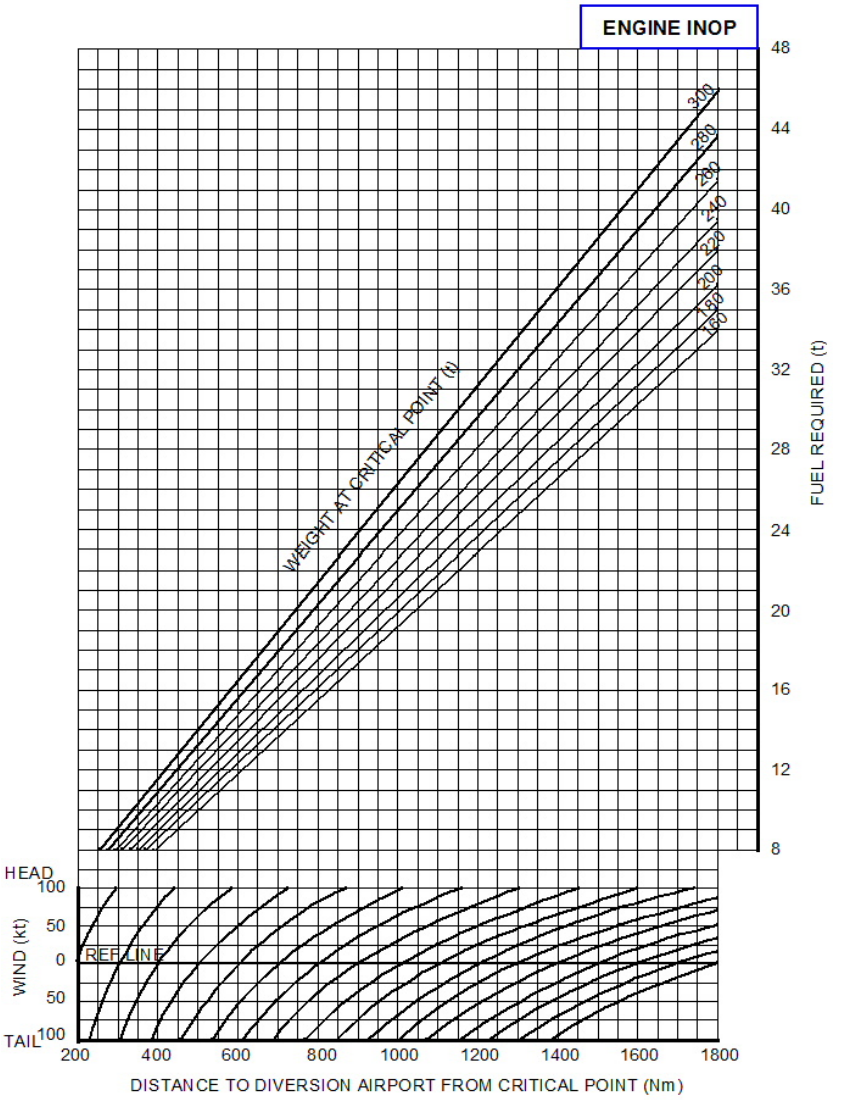
-300 ***280 KIAS cruise critical fuel reserves—777-300***



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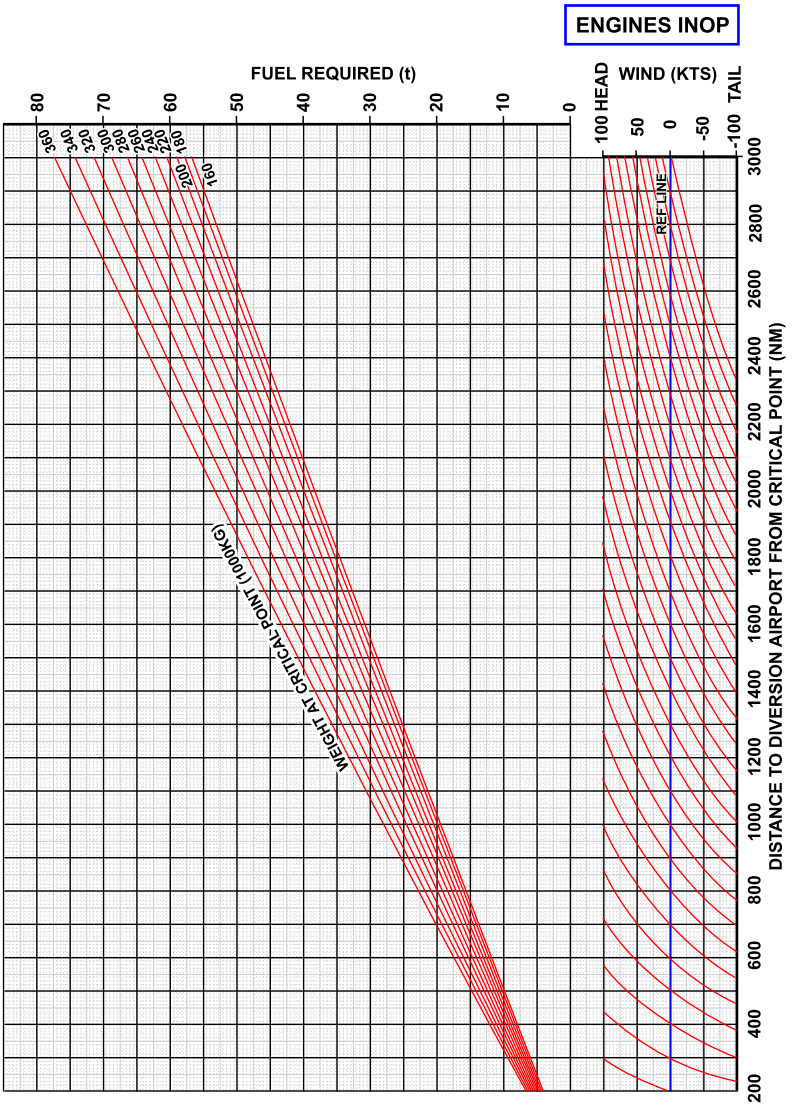
280 KIAS cruise critical fuel reserves—777-300ER

-300ER



-300ER

Based on: Emergency descent to 10,000 ft, level cruise at 10,000 ft, 250 KIAS descent to 1,500 ft, 15 minutes hold at 1,500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

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Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required by 0.7% per 10 deg. C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (10%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

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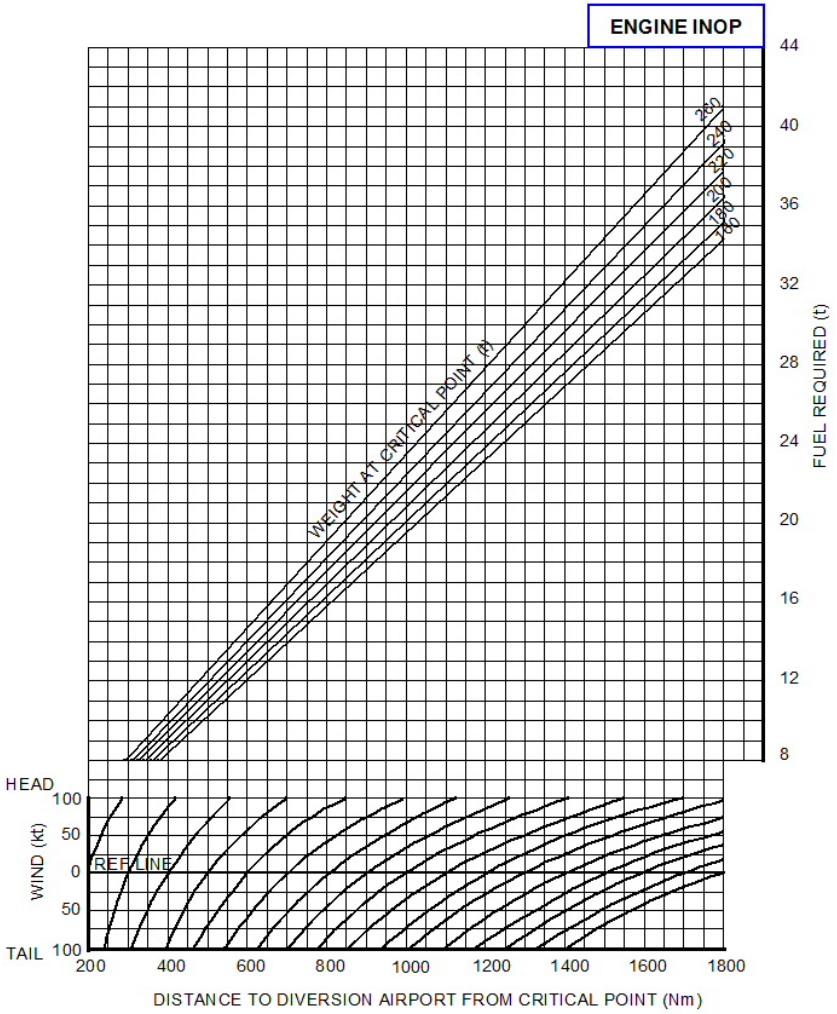
300 KIAS cruise critical fuel reserves—777-200

-200



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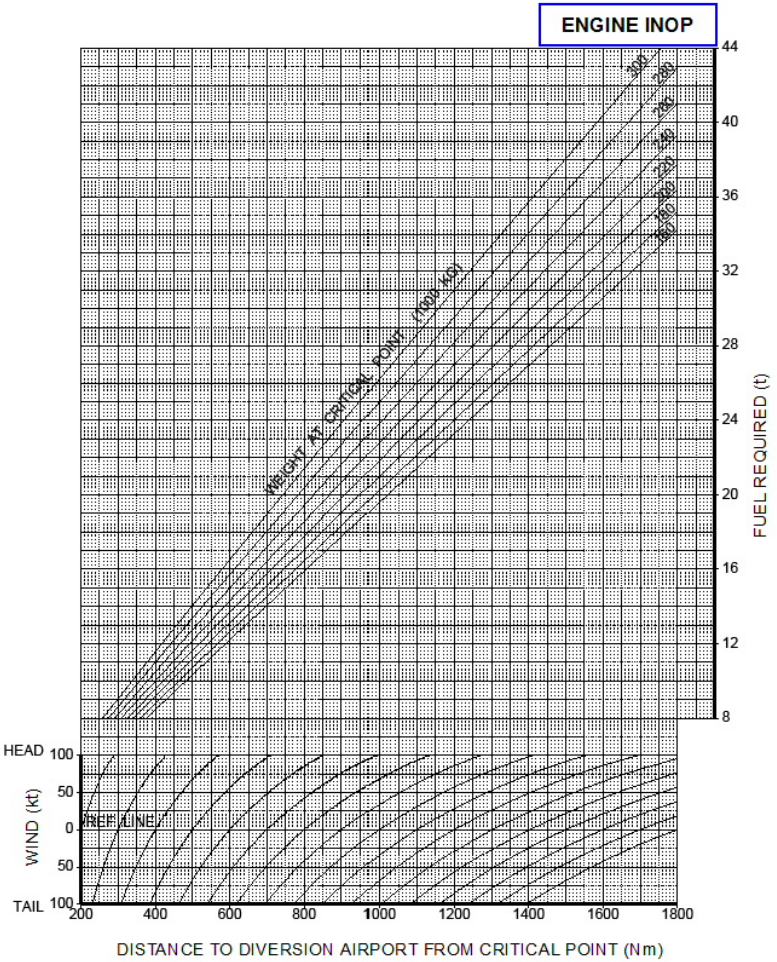
-200ER

300 KIAS cruise critical fuel reserves—777-200ER



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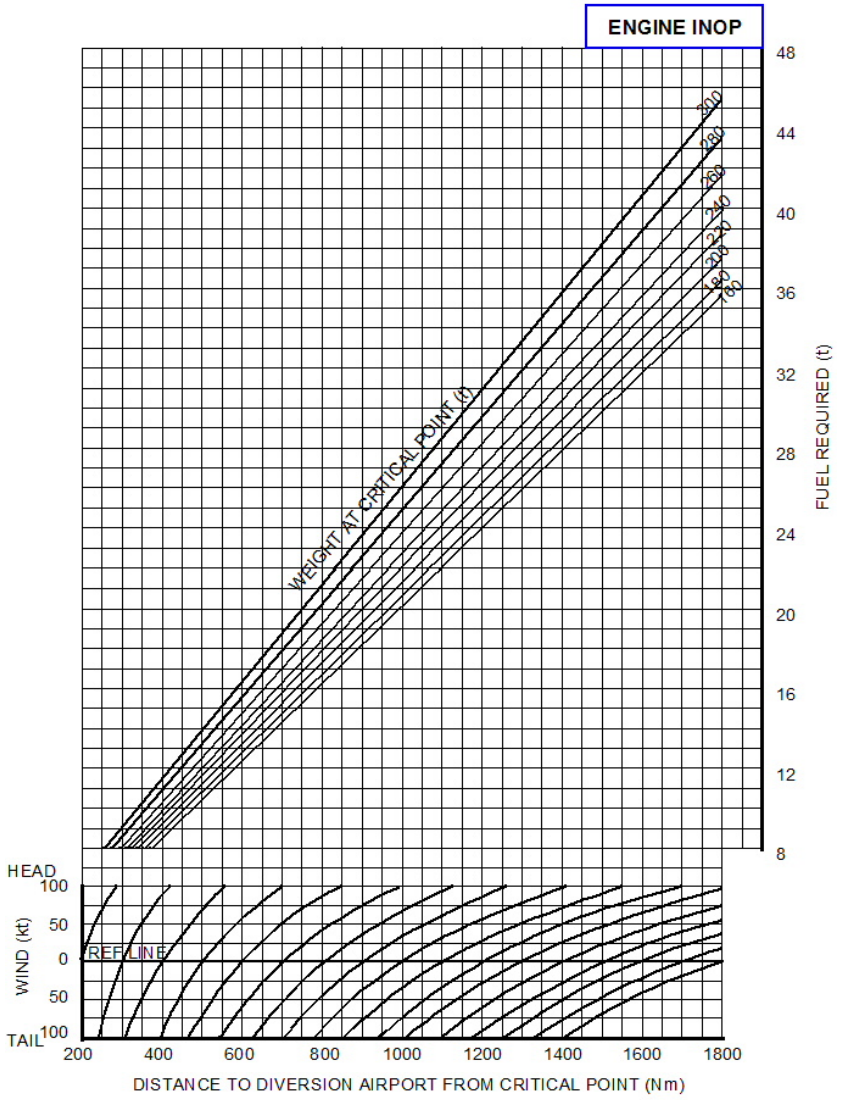
300 KIAS cruise critical fuel reserves—777-300

-300



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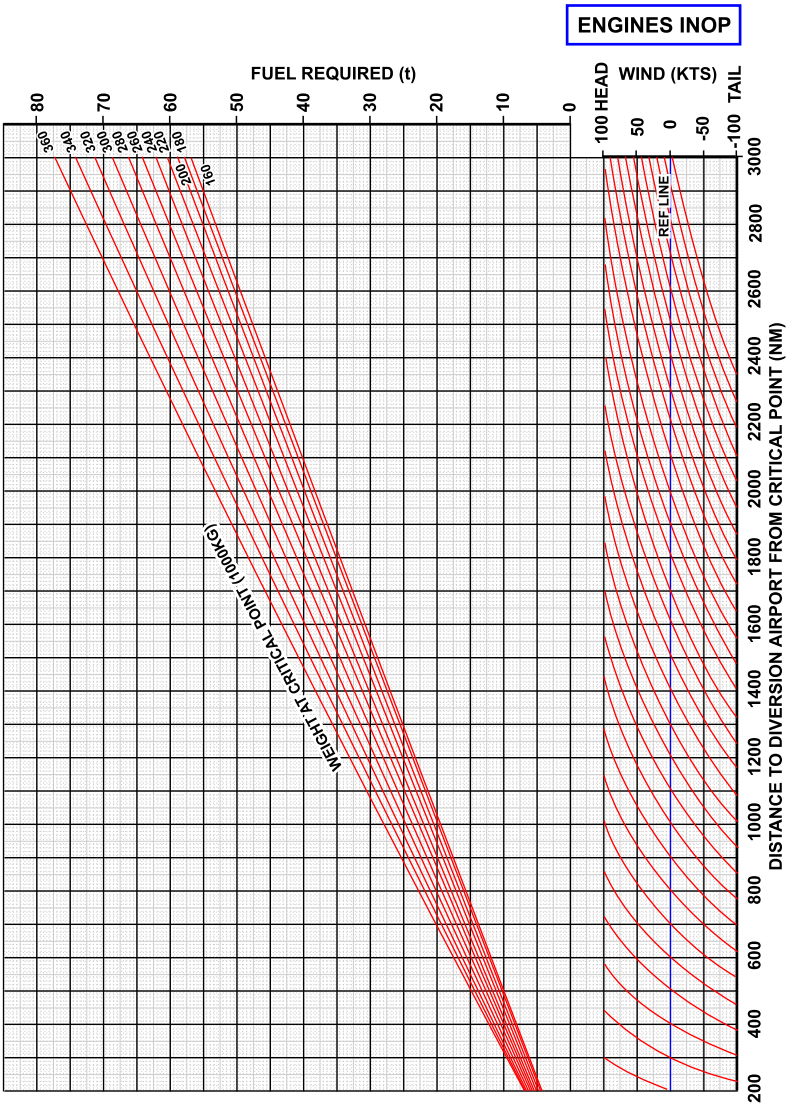
-300ER

300 KIAS cruise critical fuel reserves—777-300ER



-300ER

Based on: Emergency descent to 10,000 ft, level cruise at 10,000 ft, 250 KIAS descent to 1,500 ft, 15 minutes hold at 1,500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

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Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required by 0.7% per 10 deg. C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (10%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

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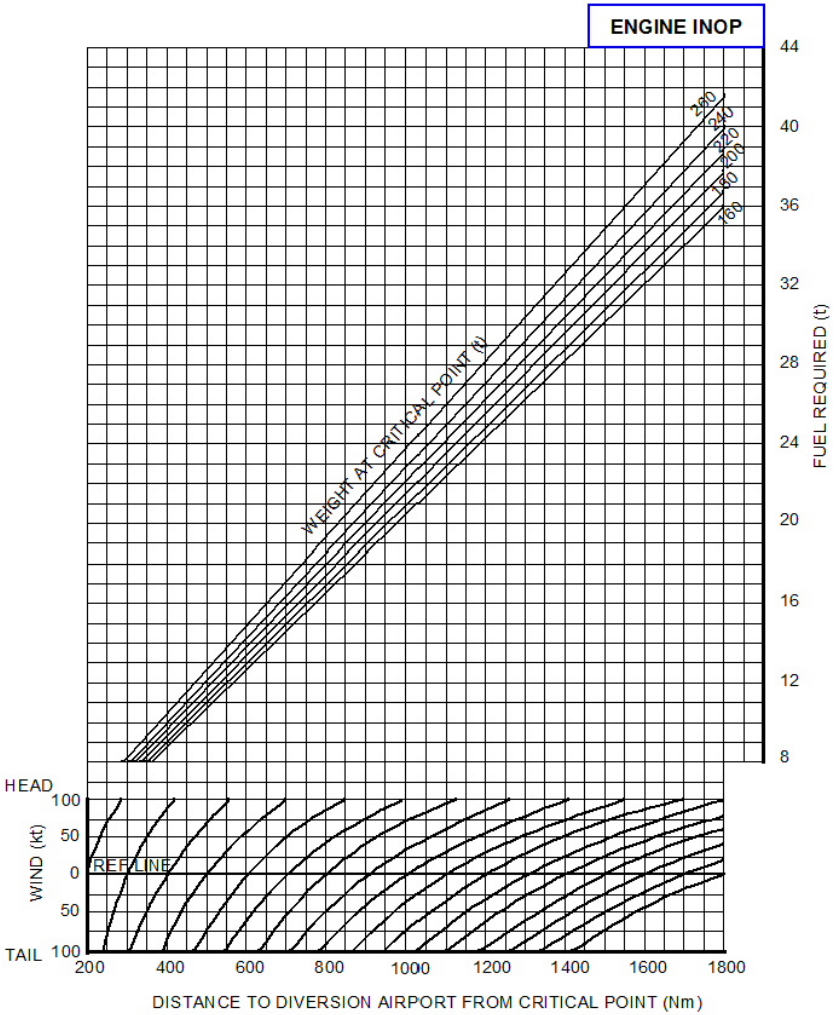
-200 ***320 KIAS cruise critical fuel reserves—777-200***



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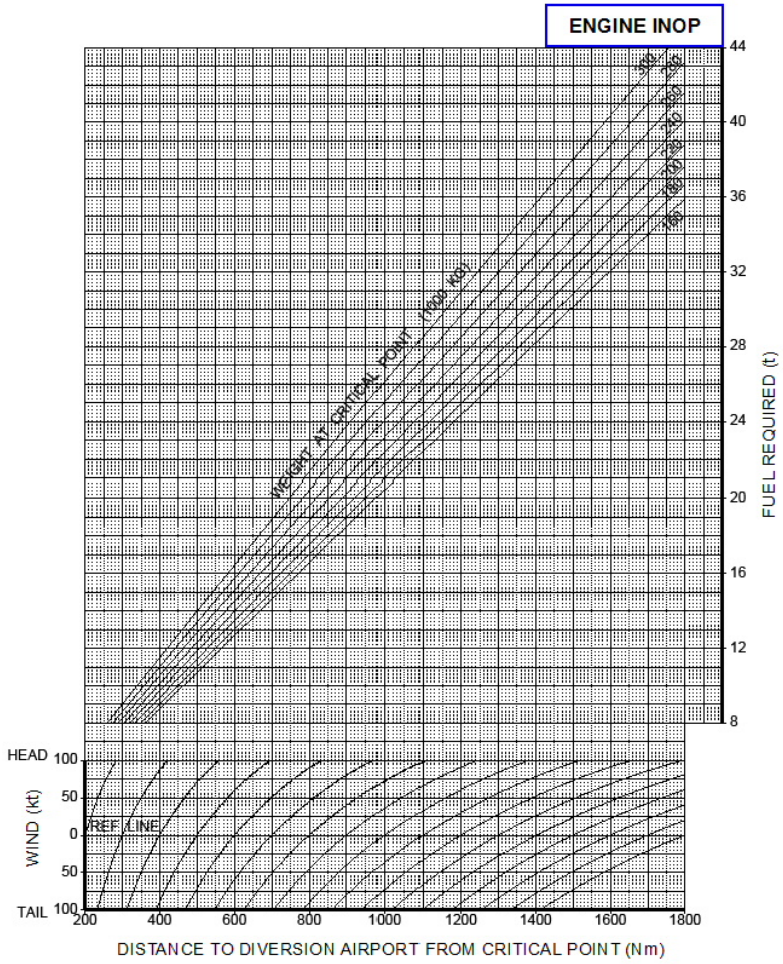
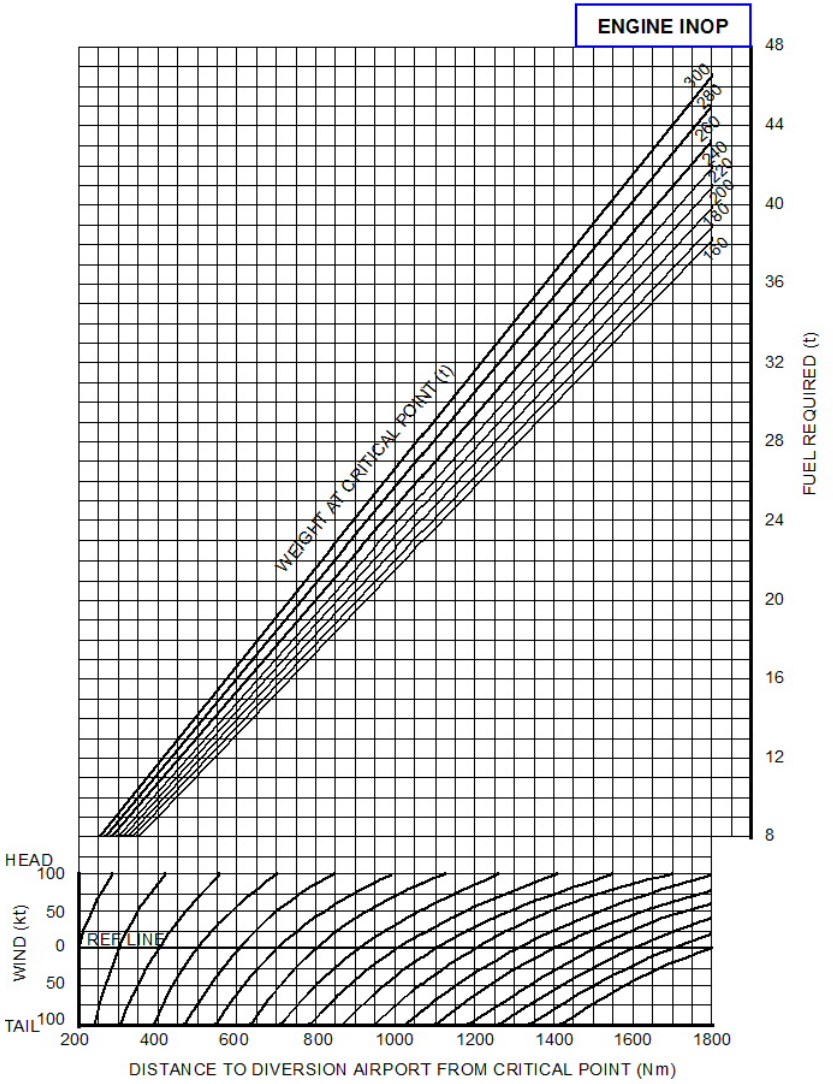
320 KIAS cruise critical fuel reserves—777-200ER

-200ER



UNCONTROLLED IF DOWNLOADED OR PRINTED

-300 ***320 KIAS cruise critical fuel reserves—777-300***



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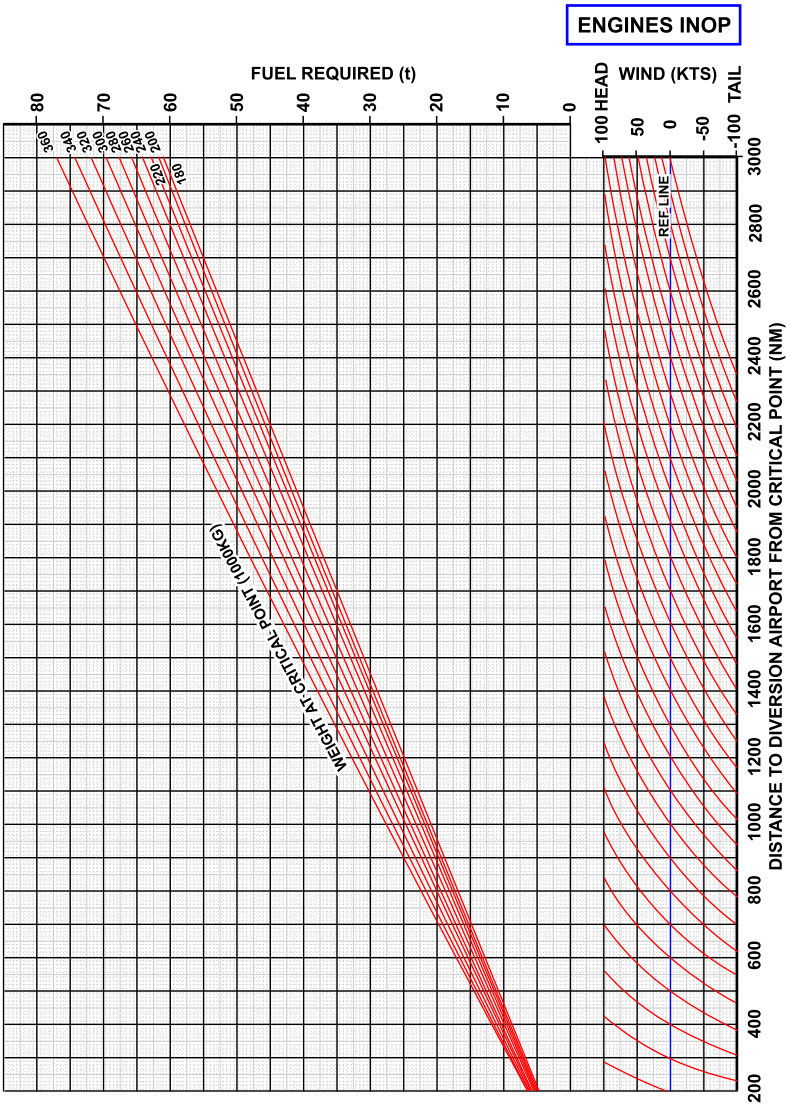
320 KIAS cruise critical fuel reserves—777-300ER

-300ER



-300ER

Based on: Emergency descent to 10,000 ft, level cruise at 10,000 ft, 250 KIAS descent to 1,500 ft, 15 minutes hold at 1,500 ft, approach and land. Allowance for performance deterioration not included. Includes APU fuel burn.

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Adjustments:

- Increase forecast headwind or decrease forecast tailwind by 5% if an acceptable wind forecasting model is used; otherwise, increase diversion fuel by 5% to account for wind errors.
- Increase fuel required by 0.7% per 10 deg. C above ISA.
- When icing conditions are forecast, use the greater of engine and wing anti-ice on (1%) for the total forecast time or engine and wing anti-ice on and ice drag (10%) for 10% of the forecast time.

Compare the critical fuel reserves required for all engines cruise, engine inoperative cruise, and engine inoperative driftdown and use the higher of the three.

Net Level Off Weight

These charts are used to determine the maximum weight for terrain clearance based on net engine inoperative performance for the speed schedules shown and is for planning purposes only. Regulations require terrain clearance flight planning based on net performance which is the gross (actual) gradients performance degraded by 1.1%.

Net level off weight is determined by entering the appropriate chart at the left with the desired level off pressure-altitude, correcting for anti-ice as shown, proceeding across to the correct ISA deviation line and reading the allowable weight at the bottom. The net level off altitude may be obtained by entering the chart with weight and proceeding up to the correct ISA deviation line and reading across to the altitude on the left.

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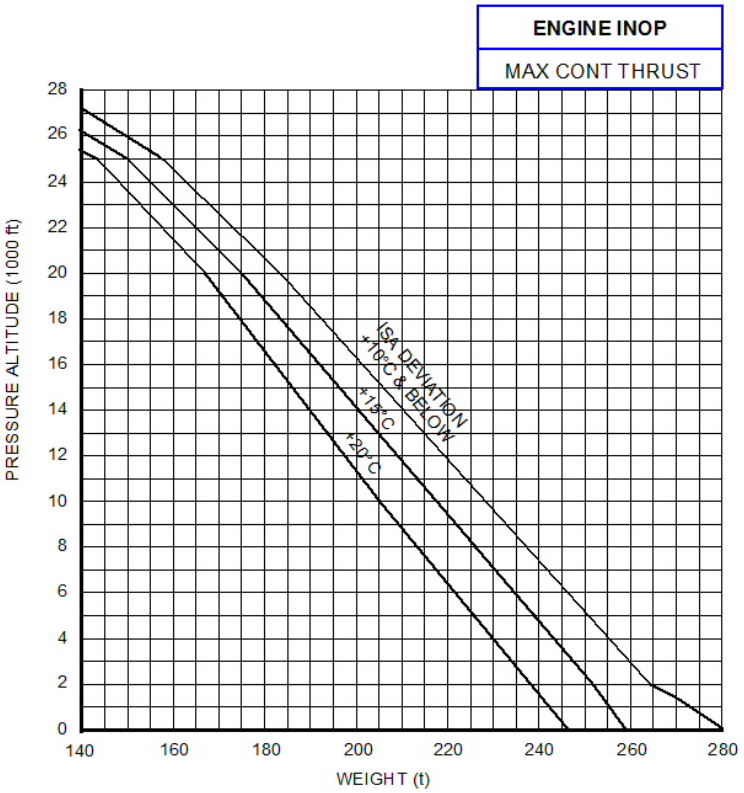
Net Level Off Weights Charts

-200

Long range cruise net level off weight—777-200



-200

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)											
	Pressure Altitude (1,000 ft)											
	2	4	6	8	10	12	14	16	18	20	22	24
Engine Only	–5.5	–5.0	–5.1	–5.5	–5.9	–5.3	–4.8	–3.8	–2.5	–1.3	–1.1	–1.0
Engine and Wing	–6.7	–6.4	–6.5	–6.9	–7.4	–6.9	–6.5	–5.5	–4.1	–2.9	–2.8	–2.7

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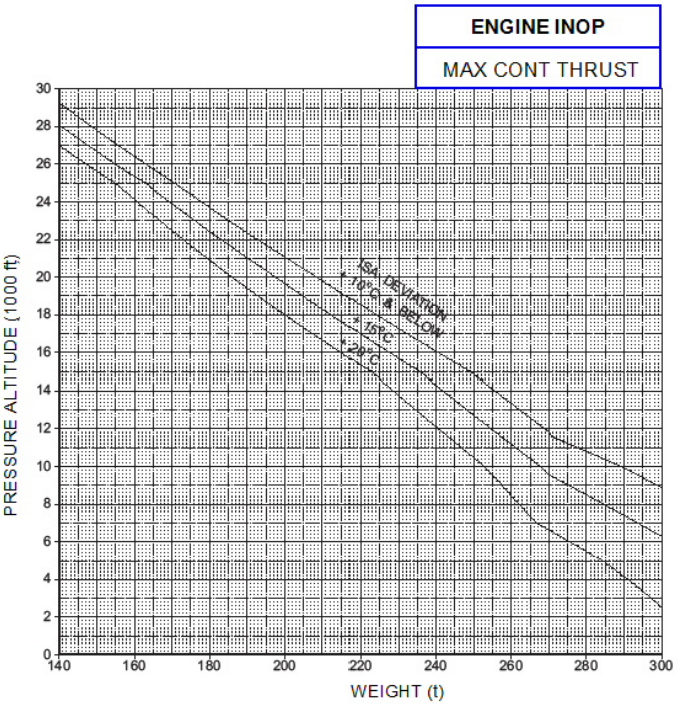
-200ER

Long range cruise net level off weight—777-200ER



-200ER

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)									
	Pressure Altitude (1,000 ft)									
	10	12	14	16	18	20	22	24	26	28
Engine Only	0.0	–1.0	–0.4	–0.4	–1.2	–1.3	–1.1	–1.2	–1.0	–0.7
Engine and Wing	–1.2	–0.7	–1.7	–1.6	–2.4	–2.7	–2.4	–2.5	–2.3	–1.9

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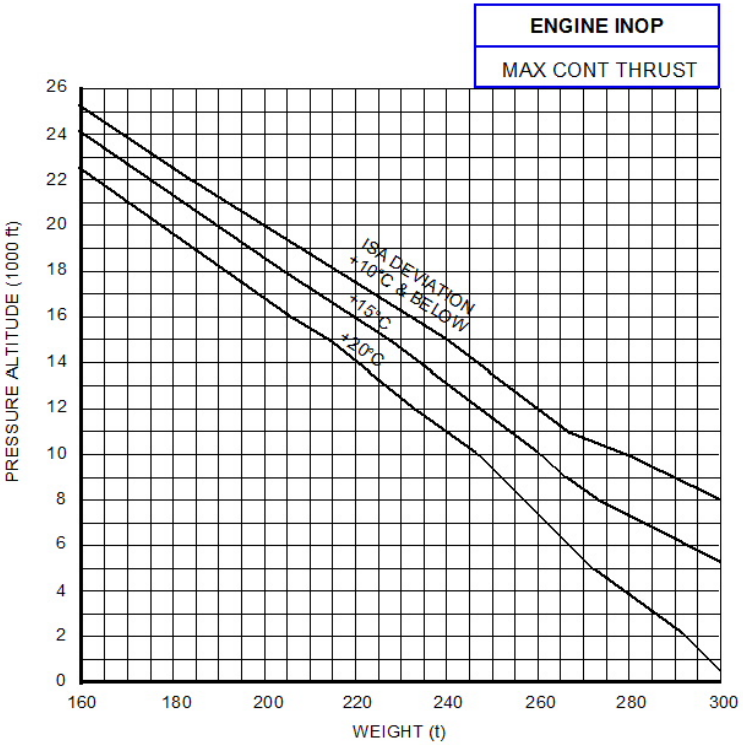
Long range cruise net level off weight—777-300

-300



-300

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)								
	Pressure Altitude (1,000 ft)								
	8	10	12	14	16	18	20	22	24
Engine Only	–7.7	–9.2	–4.3	–3.9	–3.1	–2.1	–1.2	–1.0	–0.8
Engine and Wing	–9.8	–10.5	–5.8	–5.4	–4.7	–3.6	–2.7	–2.6	–2.1

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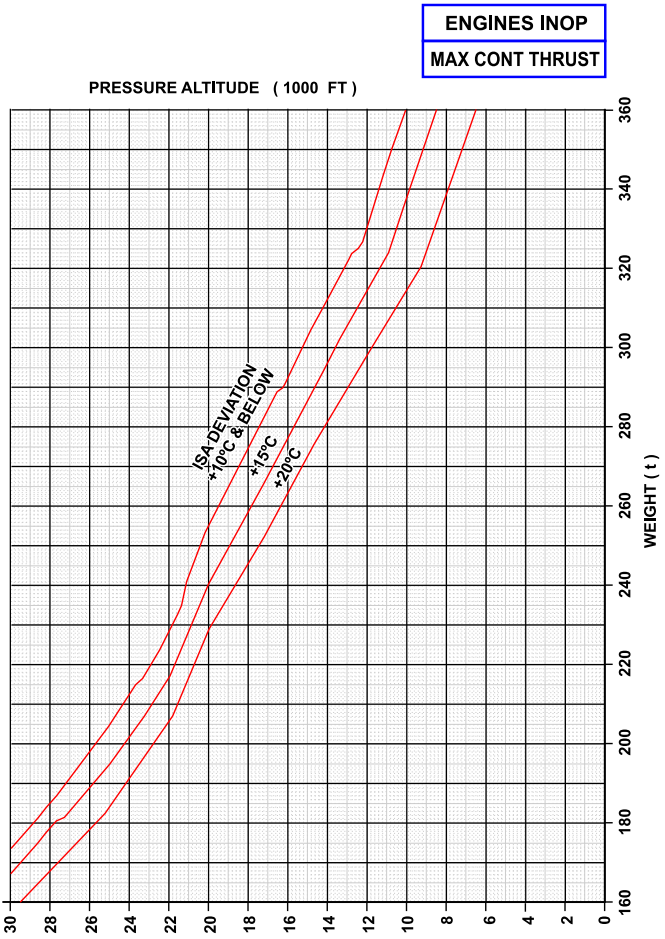
-300ER

Long range cruise net level off weight—777-300ER



-300ER

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t) Pressure Altitude (1,000 ft)							
	12	14	16	18	20	22	24	26
Engine Only	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engine and Wing	–2.7	–2.2	–2.1	–1.7	–1.3	–1.5	–1.5	–1.5

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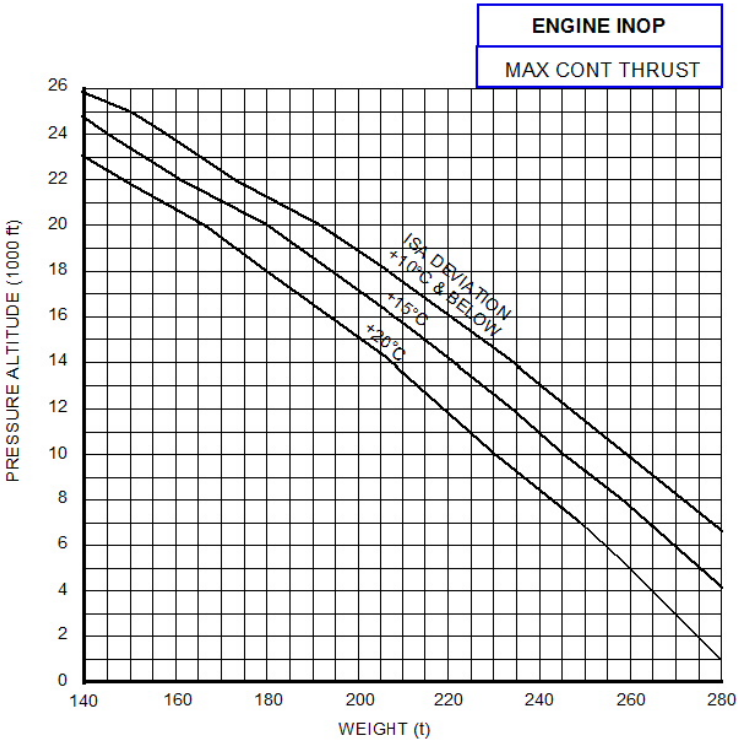
260 KIAS net level off weight—777-200

-200



-200

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)												
	Pressure Altitude (1,000 ft)												
	2	4	6	8	10	12	14	16	18	20	22	24	26
Engine Only	–6.2	–6.3	–6.9	–7.5	–8.5	–7.5	–7.4	–5.8	–4.1	–2.1	–2.0	–1.9	–1.7
Engine and Wing	–7.7	–7.9	–8.7	–9.5	–10.6	–10.0	–10.0	–8.5	–6.9	–4.7	–4.8	–4.9	–5.0

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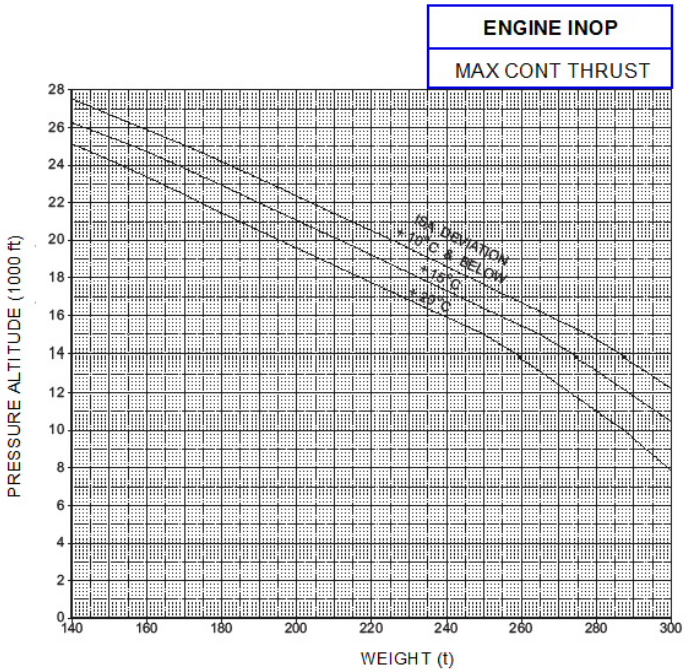
-200ER

260 KIAS net level off weight—777-200ER



-200ER

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)						
	Pressure Altitude (1,000 ft)						
	14	16	18	20	22	24	26
Engine Only	–0.5	–1.2	–1.4	–1.8	–1.9	–1.8	–1.5
Engine and Wing	–1.7	–2.5	–2.7	–3.6	–4.1	–4.1	–3.8

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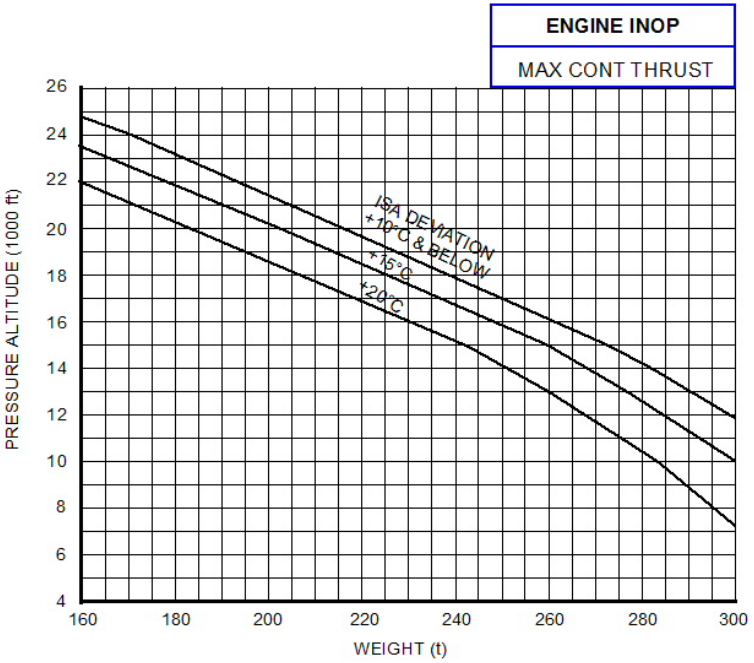
260 KIAS net level off weight—777-300

-300



-300

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)							
	Pressure Altitude (1,000 ft)							
	10	12	14	16	18	20	22	24
Engine Only	–6.6	–6.0	–5.5	–4.7	–3.4	–2.1	–2.0	–1.2
Engine and Wing	–8.5	–8.1	–7.8	–7.1	–5.9	–4.8	–4.8	–3.5

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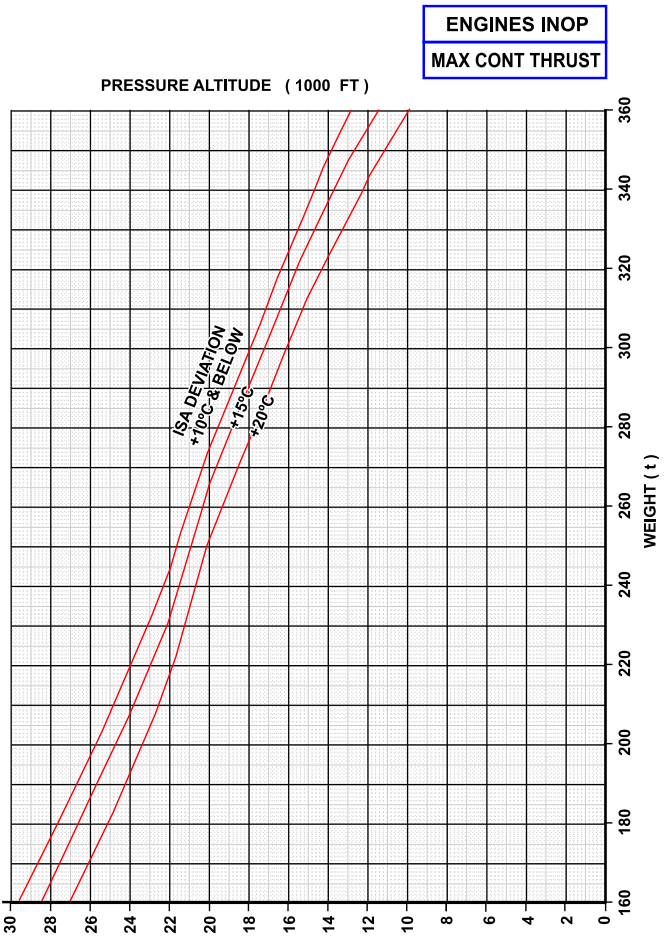
-300ER

260 KIAS net level off weight—777-300ER



-300ER

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t) Pressure Altitude (1,000 ft)					
	14	16	18	20	22	24
Engine Only	–0.0	–0.0	–0.0	–0.0	–0.0	–0.0
Engine and Wing	–2.0	–2.0	–1.7	–1.4	–1.9	–2.2

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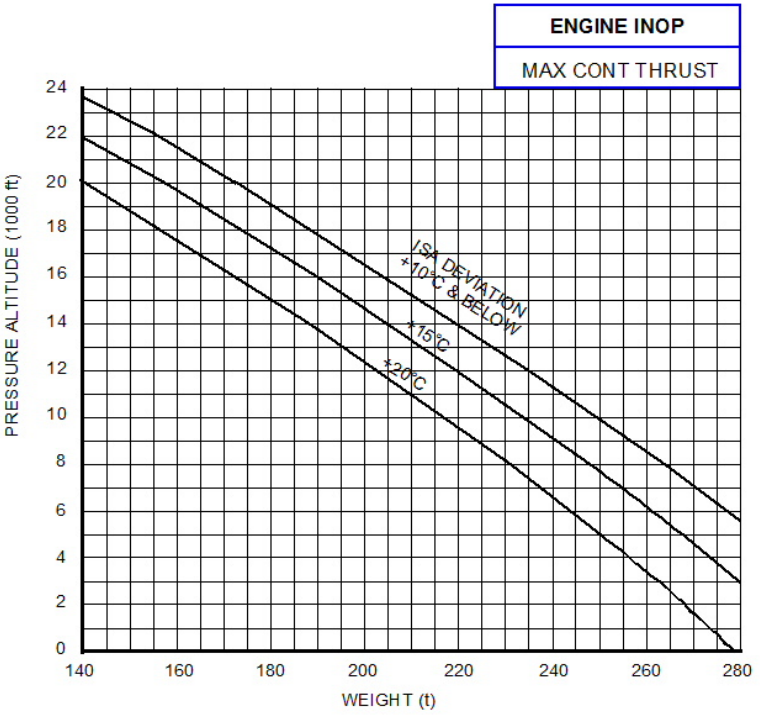
280 KIAS net level off weight—777-200

-200



-200

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)											
	Pressure Altitude (1,000 ft)											
	2	4	6	8	10	12	14	16	18	20	22	24
Engine Only	–7.2	–7.2	–8.3	–8.9	–10.2	–9.1	–9.1	–7.1	–5.1	–2.6	–2.6	–2.2
Engine and Wing	–9.1	–9.1	–10.5	–11.1	–12.8	–11.9	–12.3	–10.3	–8.4	–5.8	–6.0	–5.9

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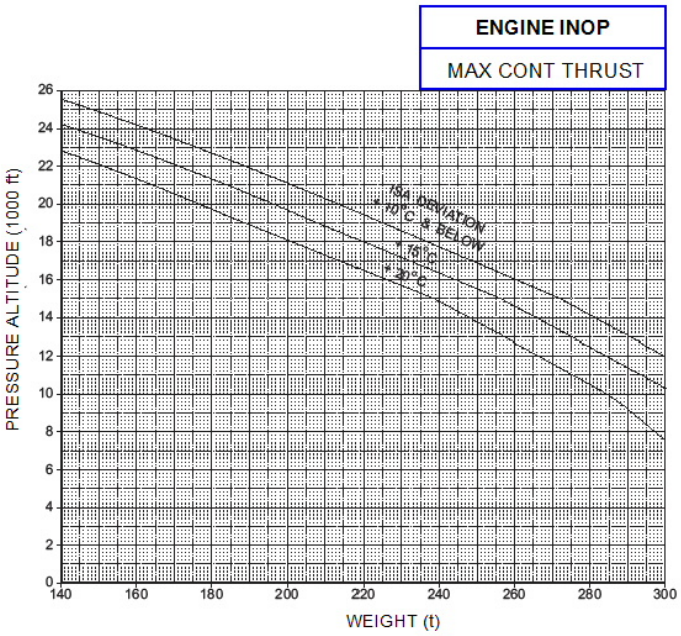
-200ER

280 KIAS net level off weight—777-200ER



-200ER

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)						
	Pressure Altitude (1,000 ft)						
	12	14	16	18	20	22	24
Engine Only	–0.8	–0.6	–0.6	–1.6	–2.2	–2.1	–2.3
Engine and Wing	–2.1	–2.0	–2.1	–3.3	–4.4	–4.4	–5.1

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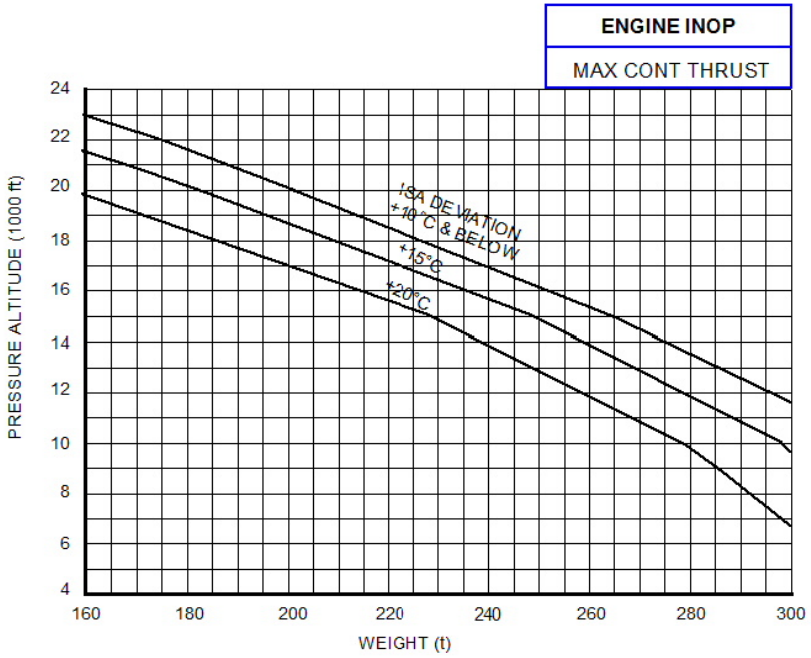
280 KIAS net level off weight—777-300

-300



-300

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)						
	Pressure Altitude (1,000 ft)						
	10	12	14	16	18	20	22
Engine Only	–7.3	–6.9	–6.6	–5.7	–4.2	–2.1	–1.7
Engine and Wing	–9.5	–9.3	–9.3	–8.6	–7.3	–4.9	–4.2

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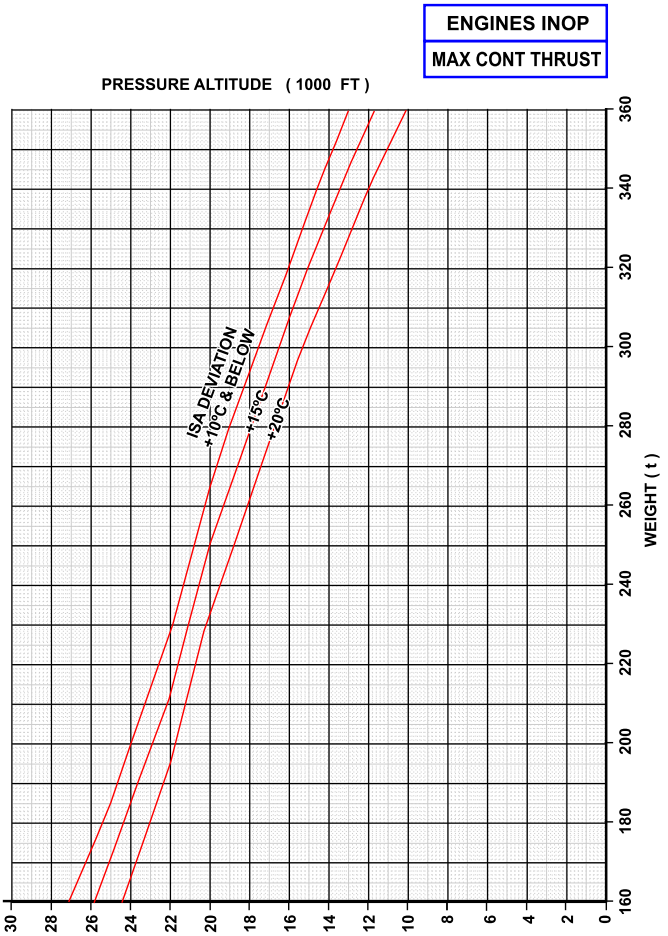
-300ER

280 KIAS net level off weight—777-300ER



-300ER

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)				
	Pressure Altitude (1,000 ft)				
	14	16	18	20	22
Engine Only	0.0	0.0	0.0	0.0	0.0
Engine and Wing	–2.3	–2.3	–2.1	–1.7	–2.5

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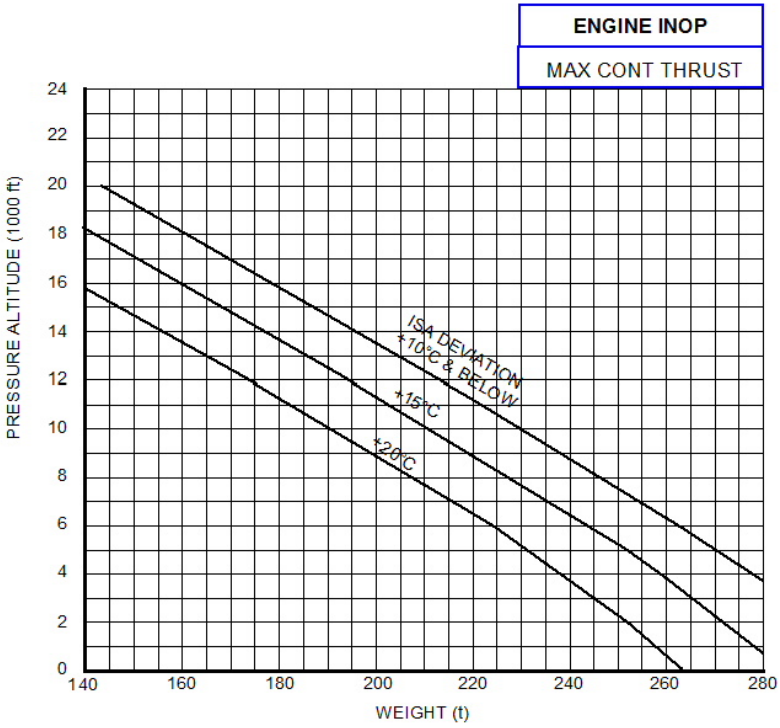
300 KIAS net level off weight—777-200

-200



-200

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)									
	Pressure Altitude (1,000 ft)									
	2	4	6	8	10	12	14	16	18	20
Engine Only	–8.5	–8.6	–9.7	–10.8	–12.4	–11.4	–11.1	–9.0	–6.6	–3.5
Engine and Wing	–11.0	–10.9	–12.3	–13.7	–15.8	–15.0	–15.2	–12.9	–10.8	–7.6

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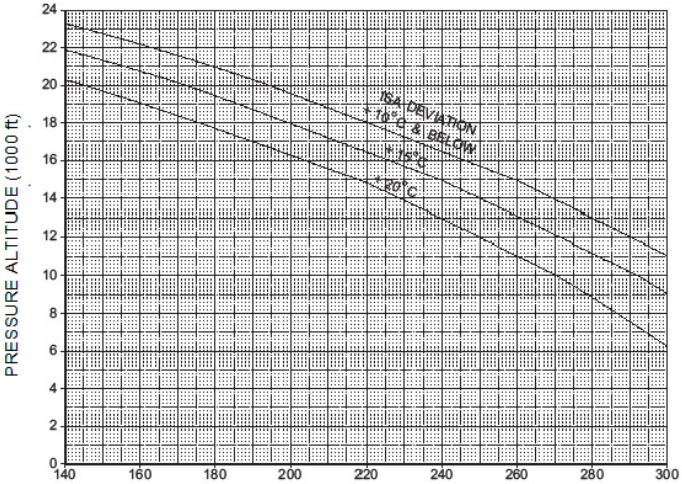
-200ER

300 KIAS net level off weight—777-200ER



-200ER

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)					
	Pressure Altitude (1,000 ft)					
	12	14	16	18	20	24
Engine Only	–0.8	–0.7	–0.6	–2.1	–2.1	–2.3
Engine and Wing	–2.3	–2.5	–2.6	–4.1	–4.4	–5.0

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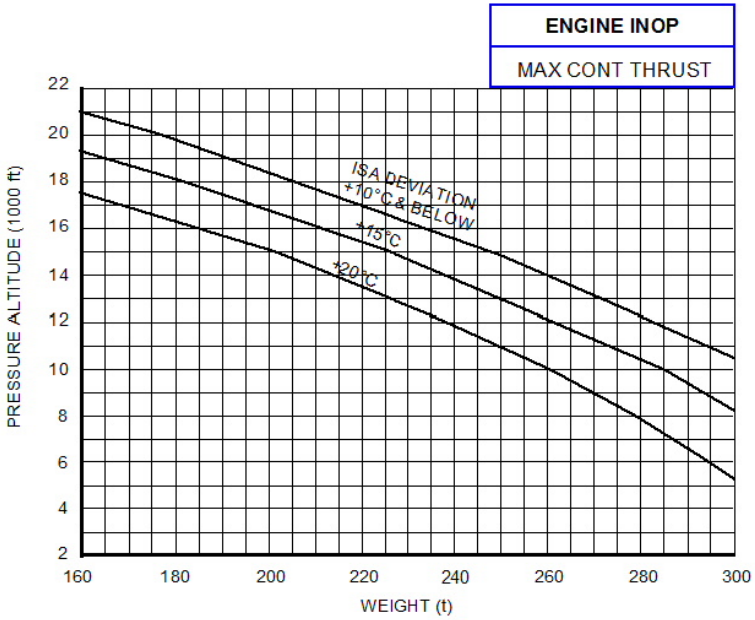
300 KIAS net level off weight—777-300

-300



-300

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)					
	Pressure Altitude (1,000 ft)					
	10	12	14	16	18	20
Engine Only	–8.7	–8.3	–8.1	–7.3	–4.6	–2.3
Engine and Wing	–11.2	–11.1	–11.3	–11.0	–7.9	–5.3

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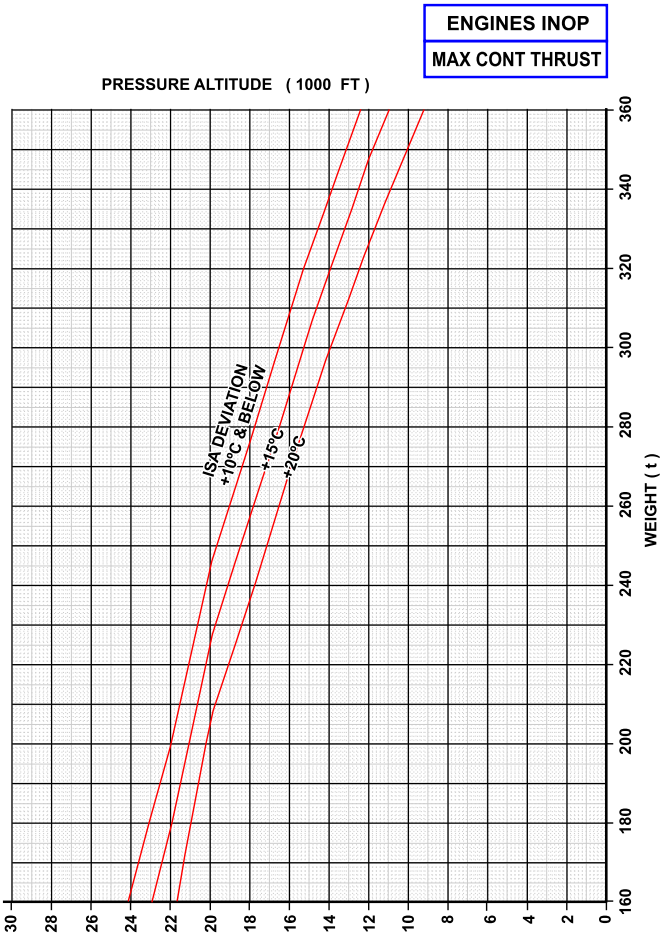
-300ER

300 KIAS net level off weight—777-300ER



-300ER

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)				
	Pressure Altitude (1,000 ft)				
	14	16	18	20	22
Engine Only	0.0	0.0	0.0	0.0	0.0
Engine and Wing	–2.8	–2.7	–2.4	–1.9	–3.0

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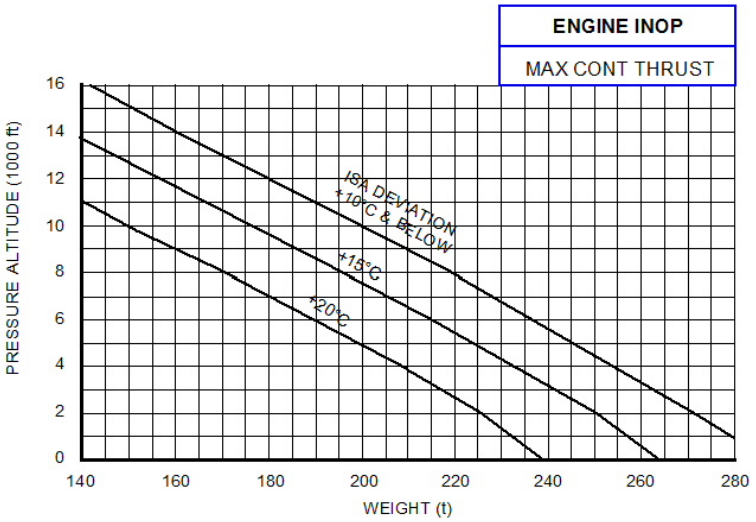
320 KIAS net level off weight—777-200

-200



-200

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)							
	Pressure Altitude (1,000 ft)							
	2	4	6	8	10	12	14	16
Engine Only	–9.4	–10.4	–11.0	–13.4	–15.2	–14.7	–13.1	–10.4
Engine and Wing	–12.6	–13.6	–14.6	–17.3	–19.7	–19.3	–17.7	–14.9

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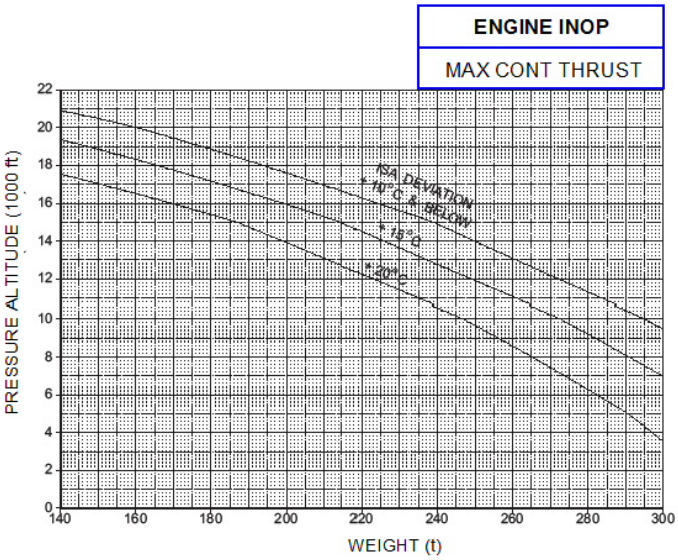
-200ER

320 KIAS net level off weight—777-200ER



-200ER

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)					
	Pressure Altitude (1,000 ft)					
	10	12	14	16	18	20
Engine Only	0.0	–0.8	–0.7	–0.6	–0.6	–0.5
Engine and Wing	–1.2	–2.7	–2.8	–3.0	–3.3	–3.7

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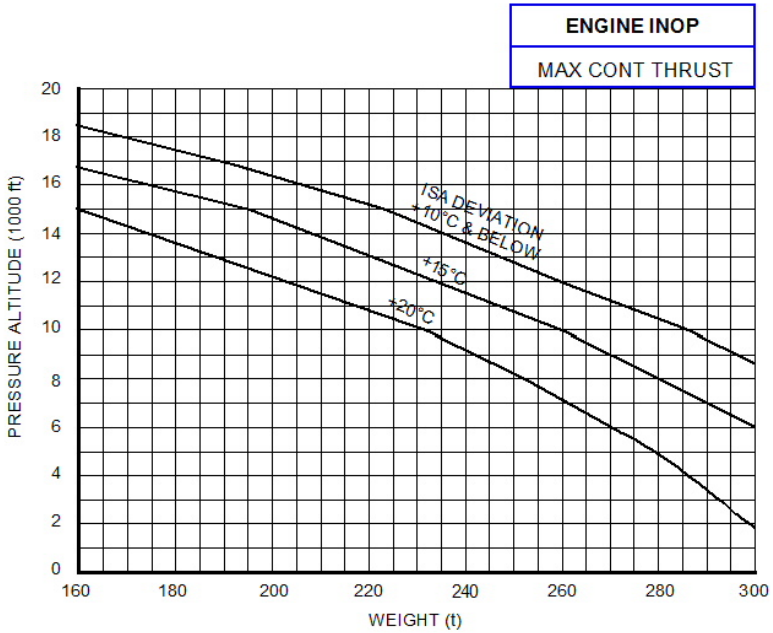
320 KIAS net level off weight—777-300

-300



-300

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)					
	Pressure Altitude (1,000 ft)					
	10	12	14	16	18	20
Engine Only	–7.3	–10.7	–10.7	–11.3	–8.5	–5.3
Engine and Wing	–9.4	–13.6	–14.3	–15.8	–12.6	–9.1

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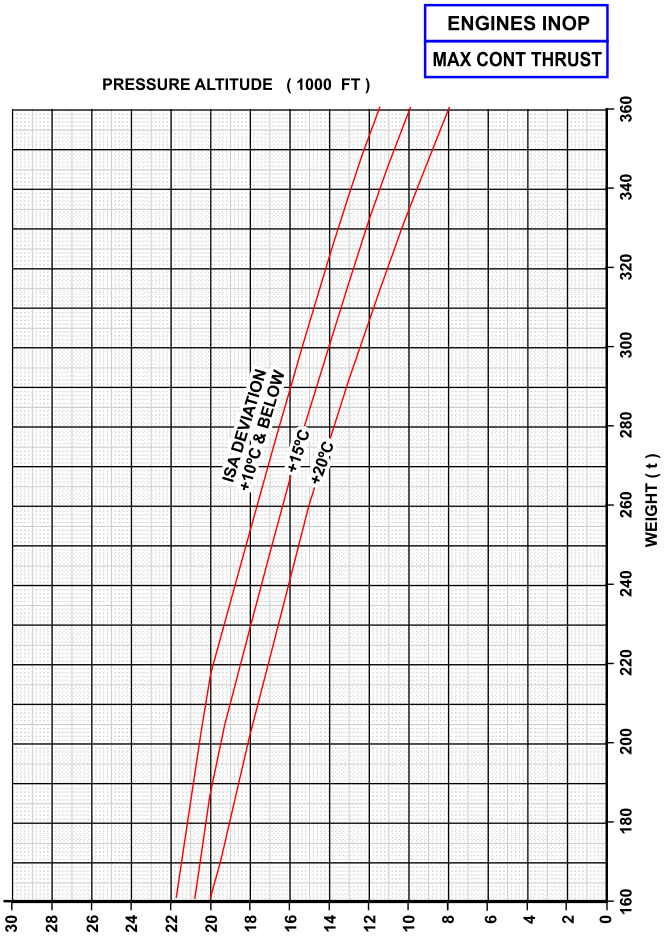
-300ER

320 KIAS net level off weight—777-300ER



-300ER

Anti-ice Adjustments

Anti-ice Configuration	Level Off Weight Adjustment (t)				
	Pressure Altitude (1,000 ft)				
	14	16	18	20	22
Engine Only	0.0	0.0	0.0	0.0	0.0
Engine and Wing	–2.9	–3.1	–3.0	–2.6	–2.5

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Driftdown/Cruise Range Capibility

This chart shows range capability from the start of driftdown/cruise when the driftdown/cruise procedure outlined in this section is followed. Charts are shown for each of the speed schedules discussed previously.

To determine the fuel required, enter with the desired ground distance, correct for the anticipated wind, and proceed vertically to the start of driftdown weight and read the fuel required to the right. The time required is read to the left from the single weight line on top. The chart may be used in reverse to determine the range capability knowing the fuel remaining from the start of driftdown.

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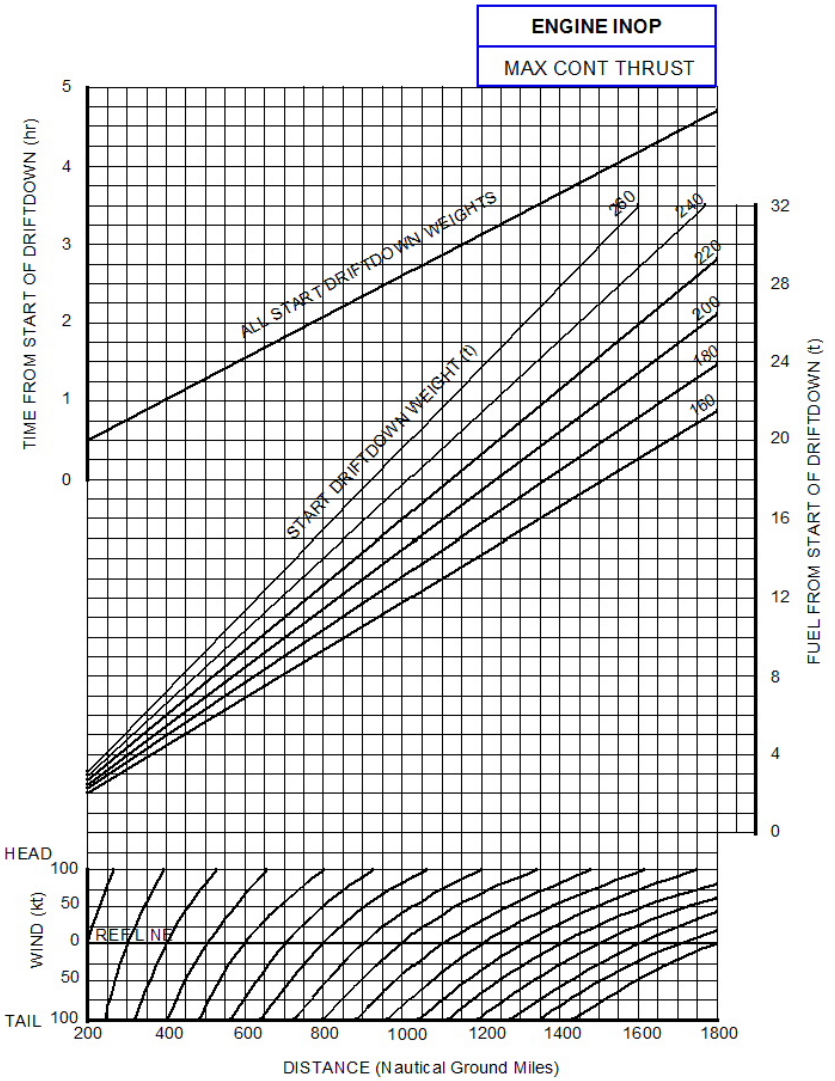
Driftdown/Cruise Range Capibility Charts

-200

Long range cruise driftdown/Cruise range capability (includes APU fuel burn)—777-200



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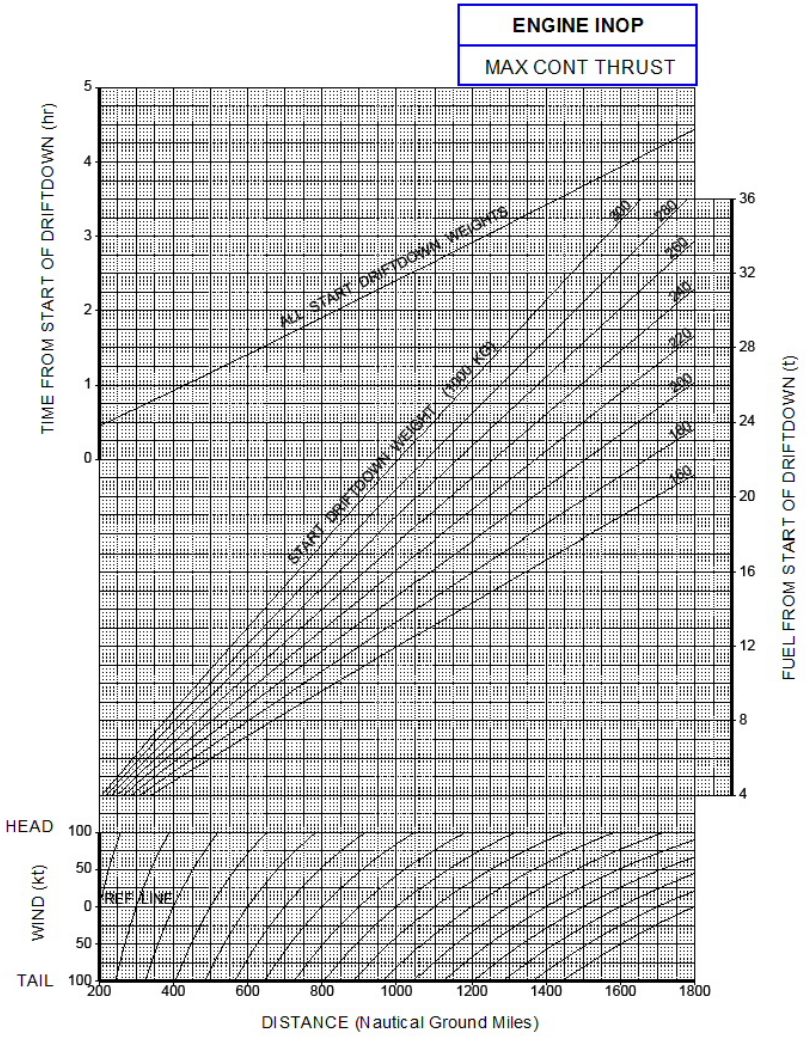
Long range cruise driftdown/Cruise range capability (includes APU fuel burn)—777-200ER -200ER



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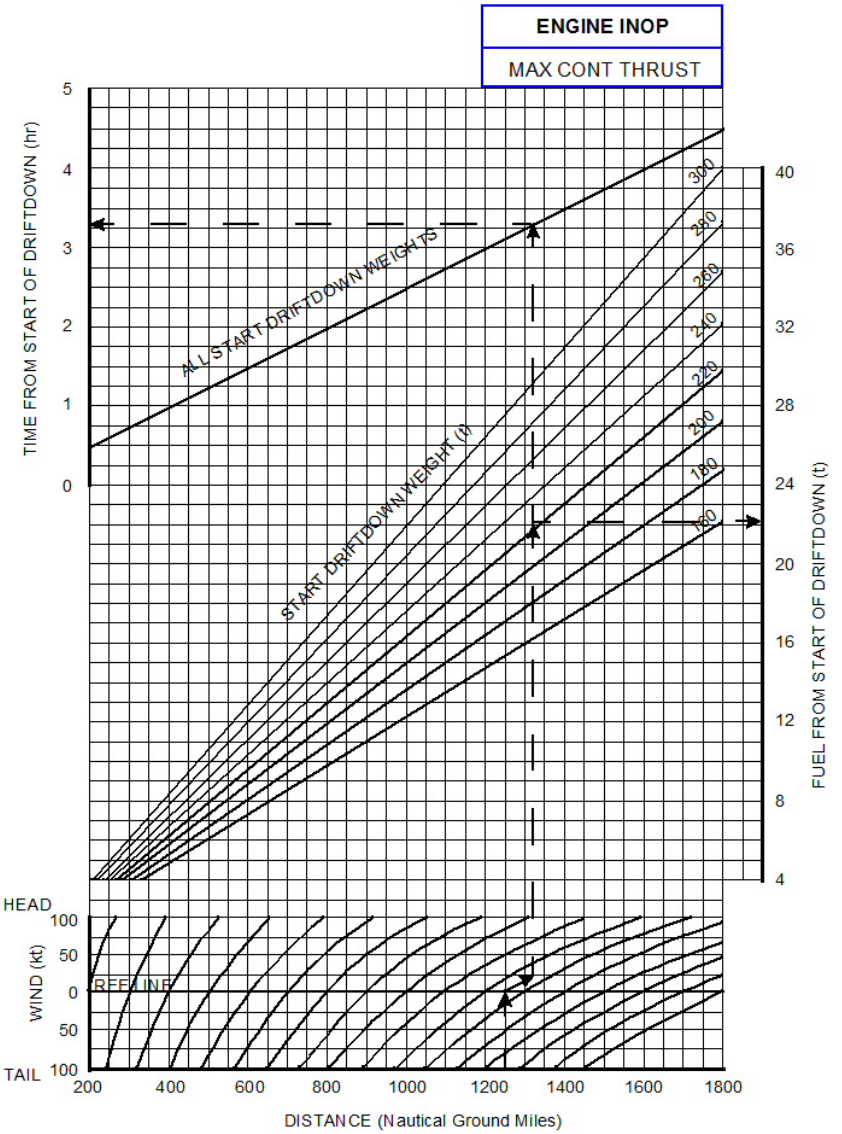
-300 ***Long range cruise driftdown/Cruise range capability (includes APU fuel burn)—777-300***



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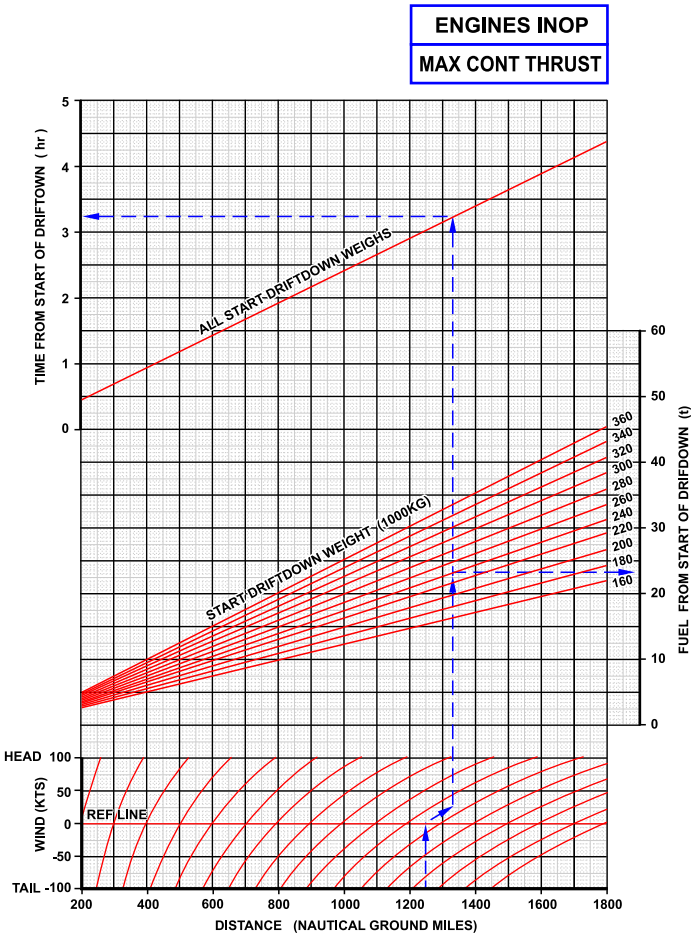
Long range cruise driftdown/Cruise range capability (includes APU fuel burn)—777-300ER -300ER



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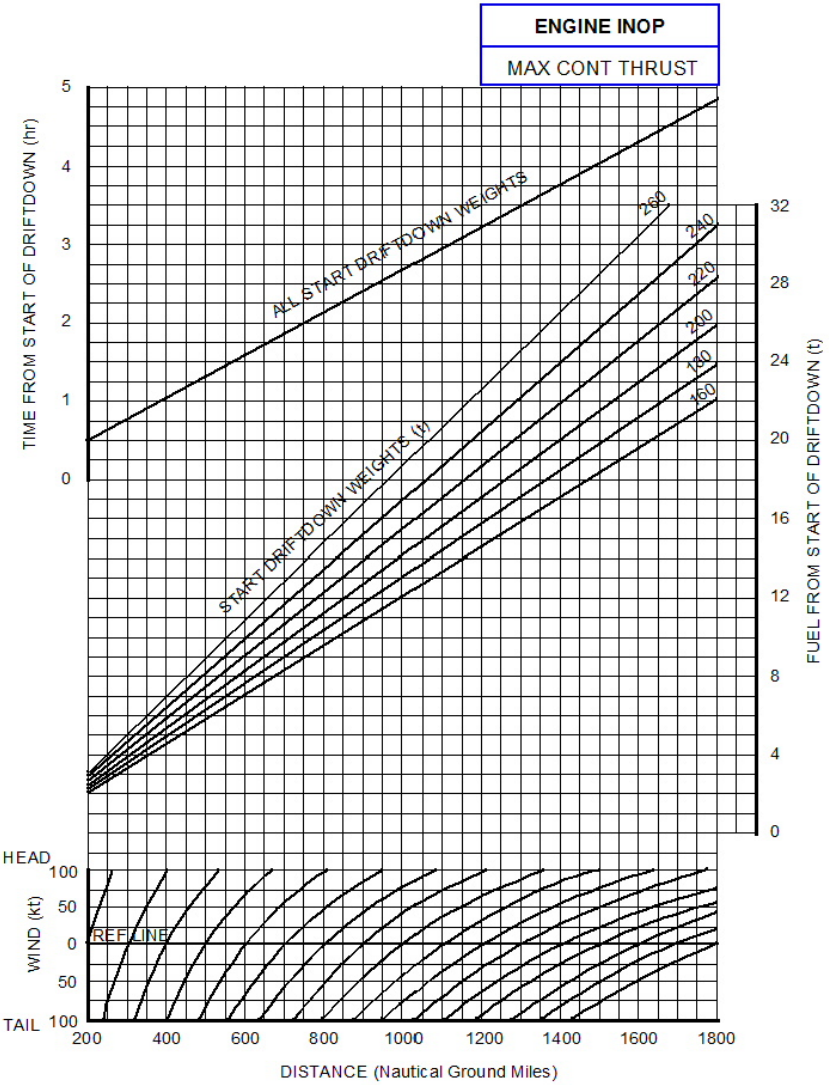
-200 ***.84 M/260 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-200***



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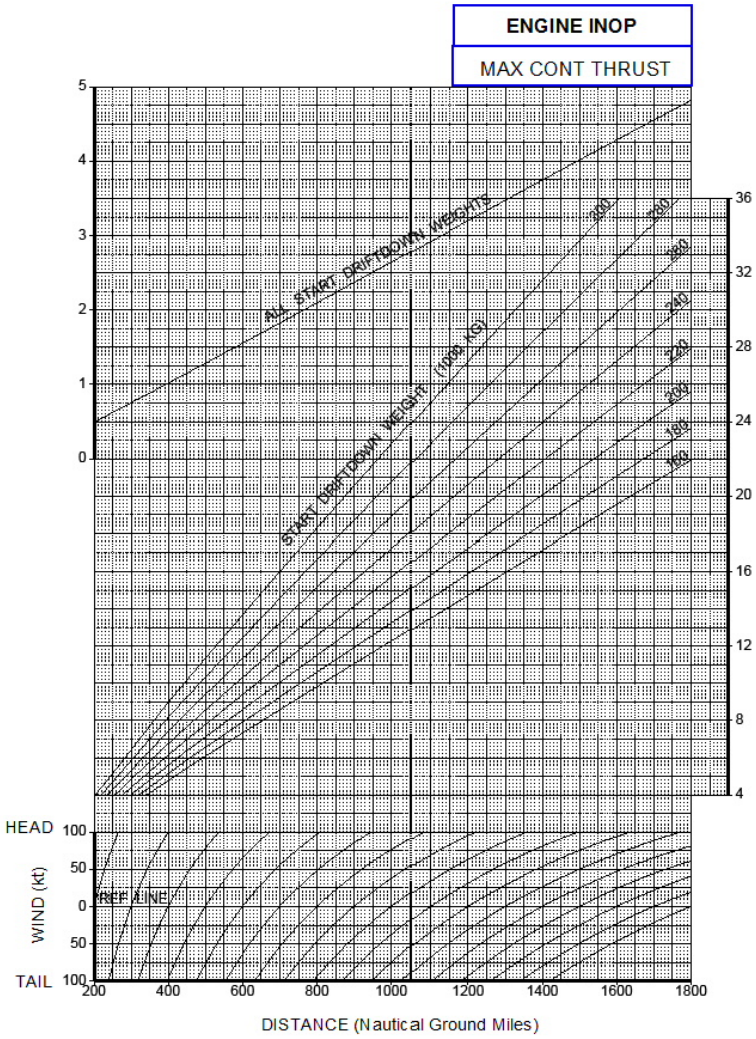
.84 M/260 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-200ER -200ER



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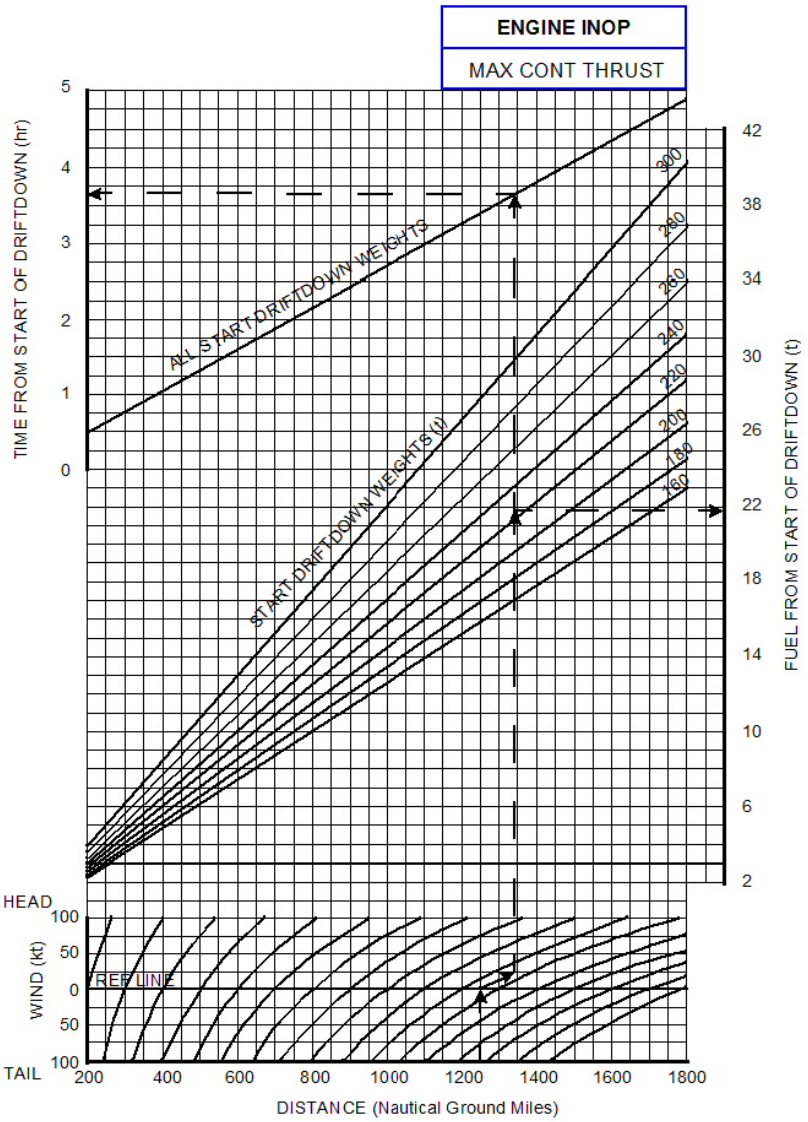
-300 ***.84 M/260 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-300***



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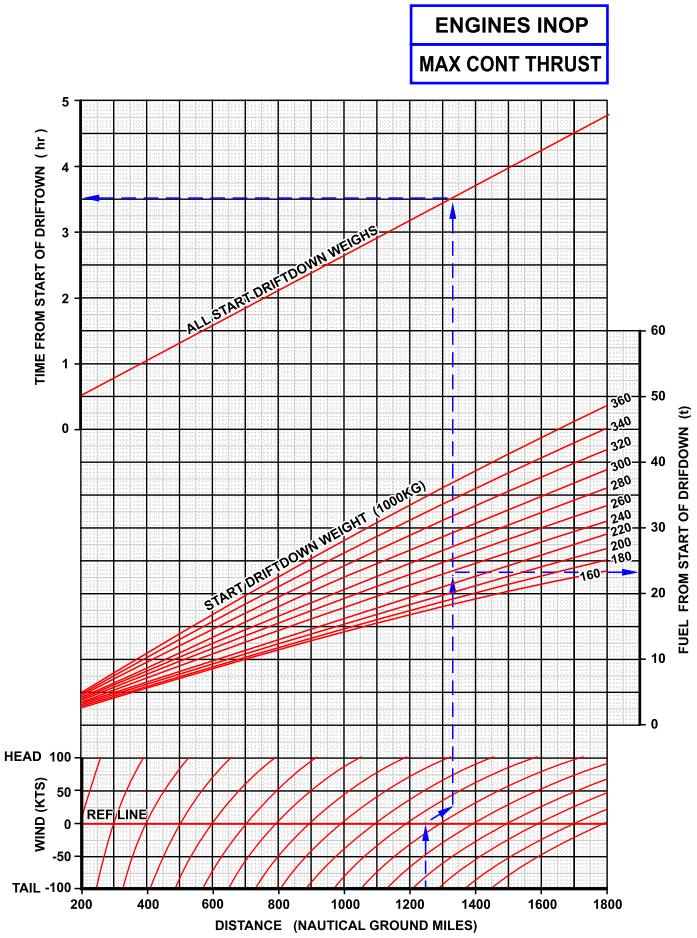
.84 M/260 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-300ER

-300ER



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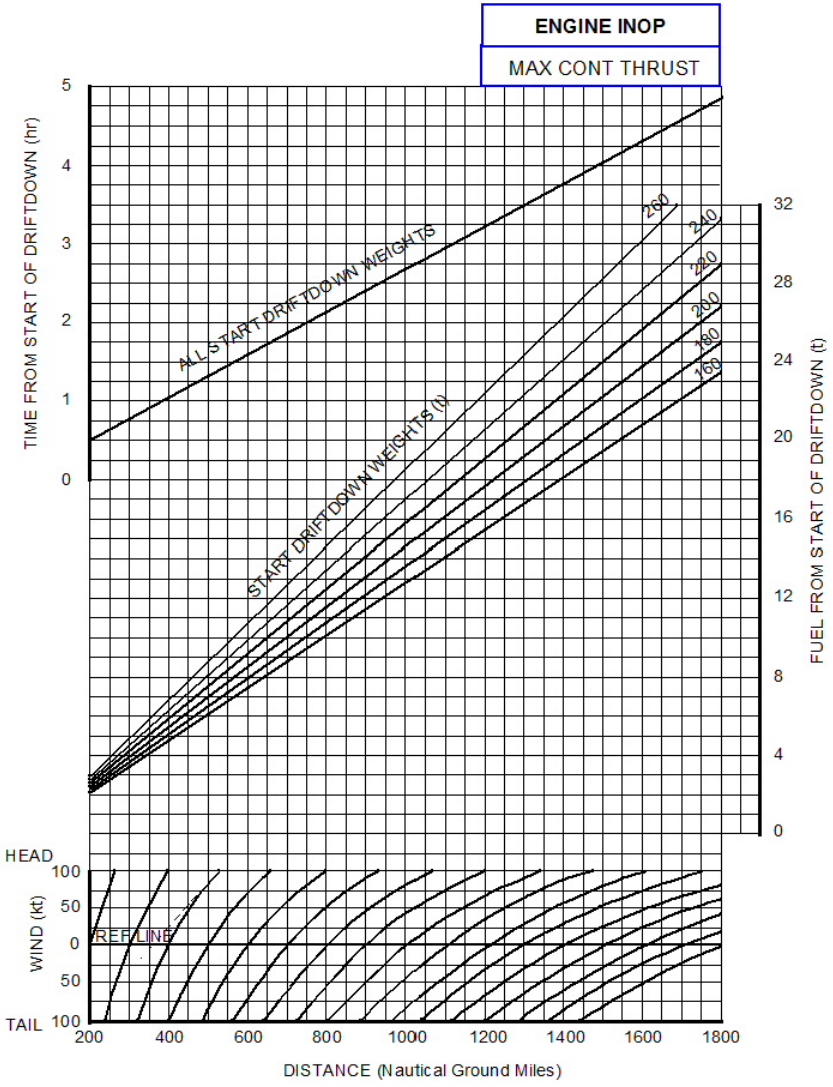

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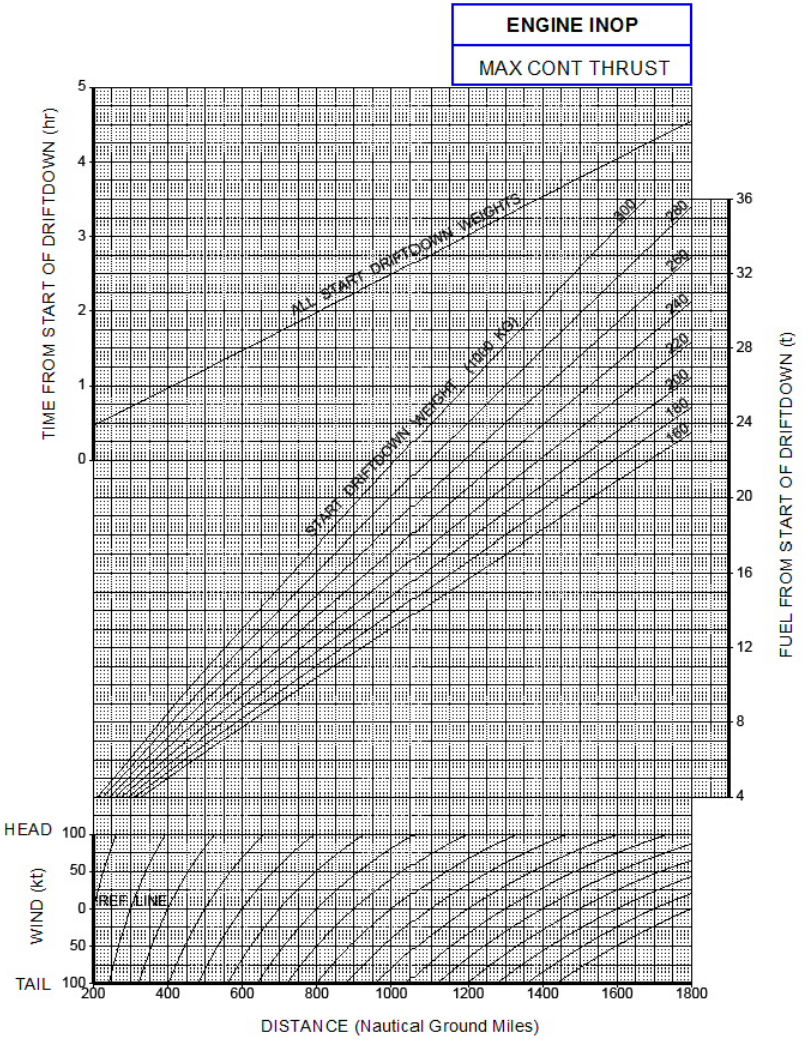
.84 M/280 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-200ER -200ER



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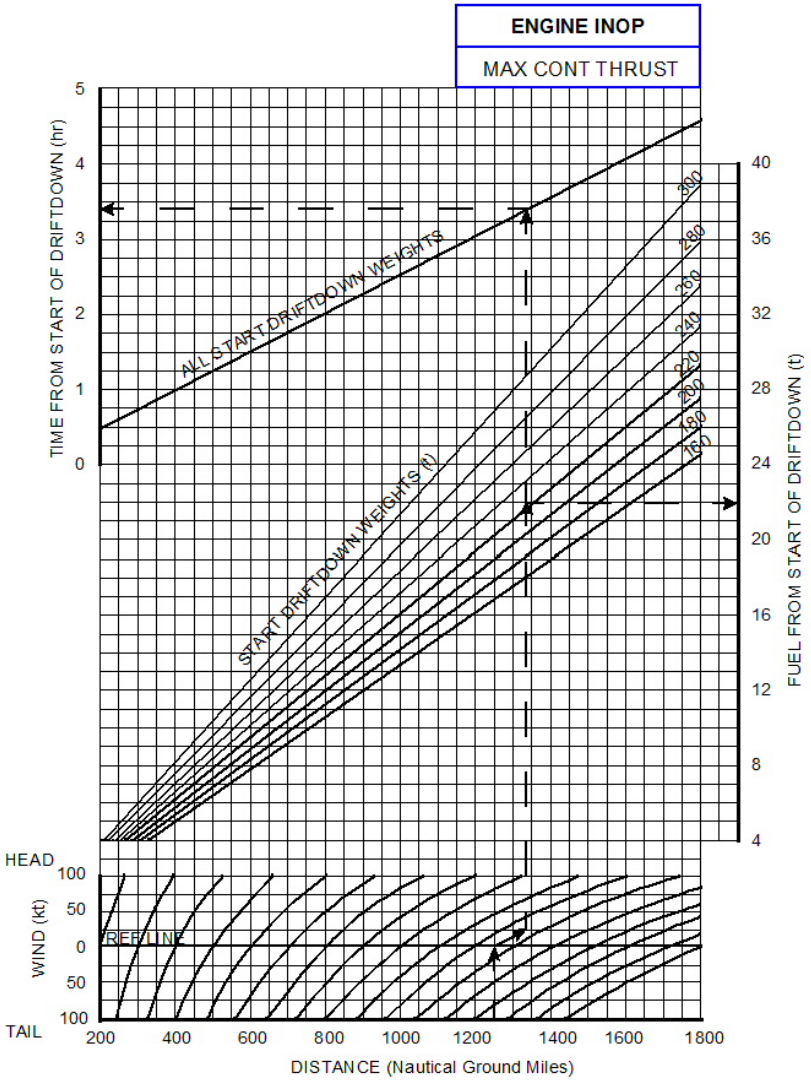
-300 ***.84 M/280 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-300***



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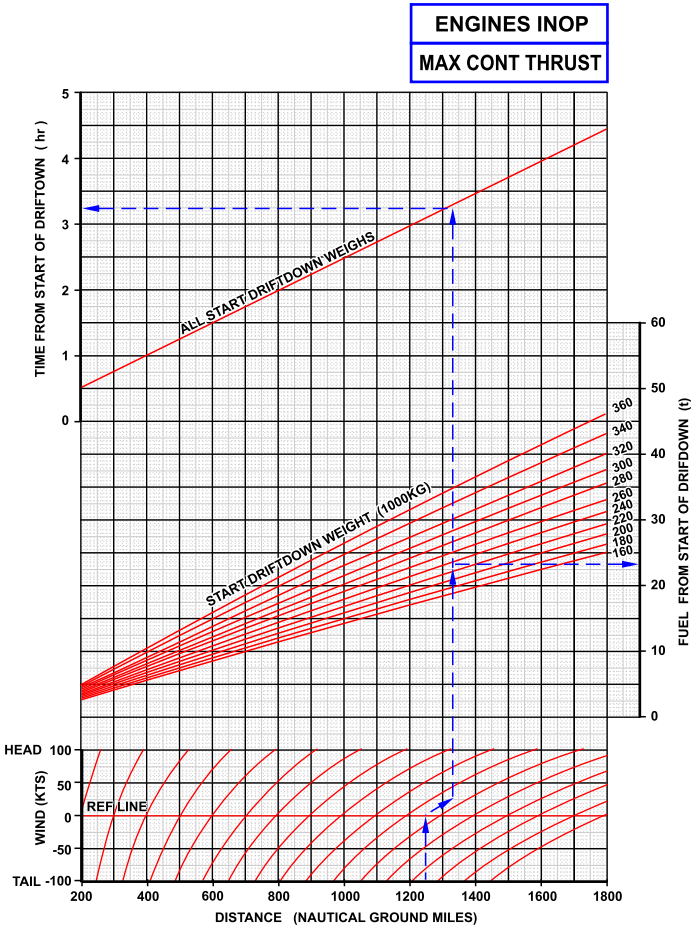
.84 M/280 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-300ER -300ER



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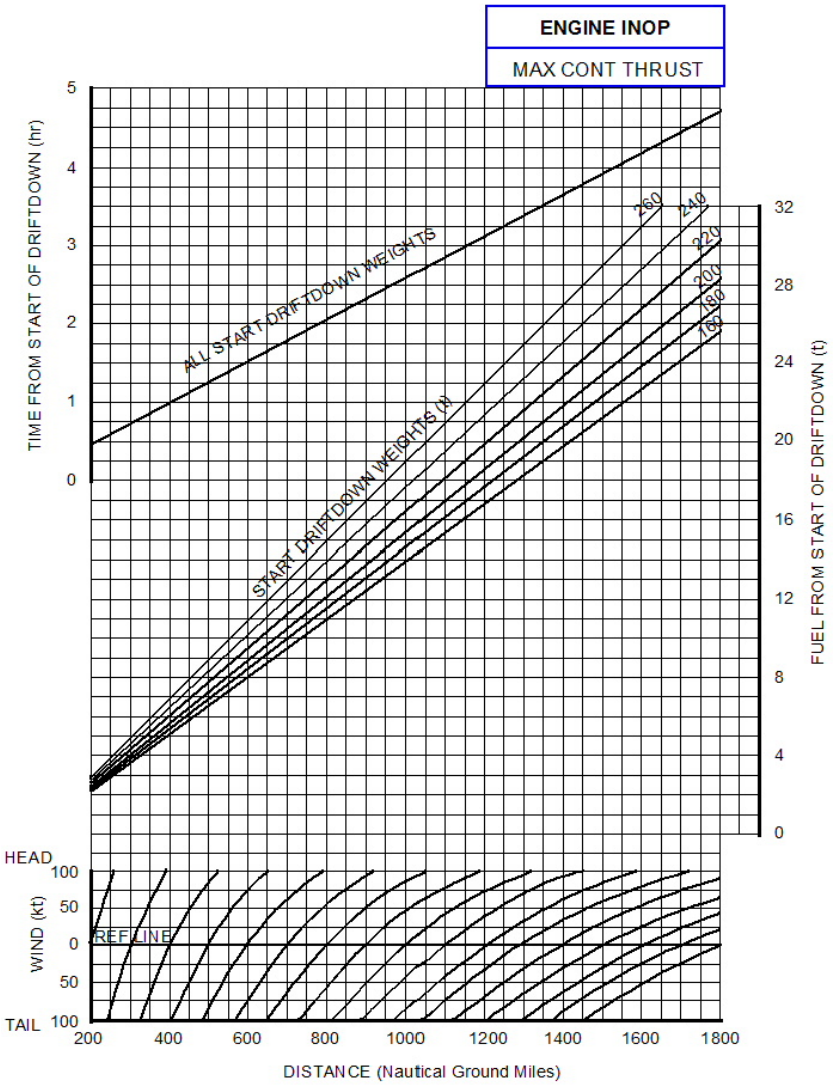
-200 ***.84 M/300 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-200***



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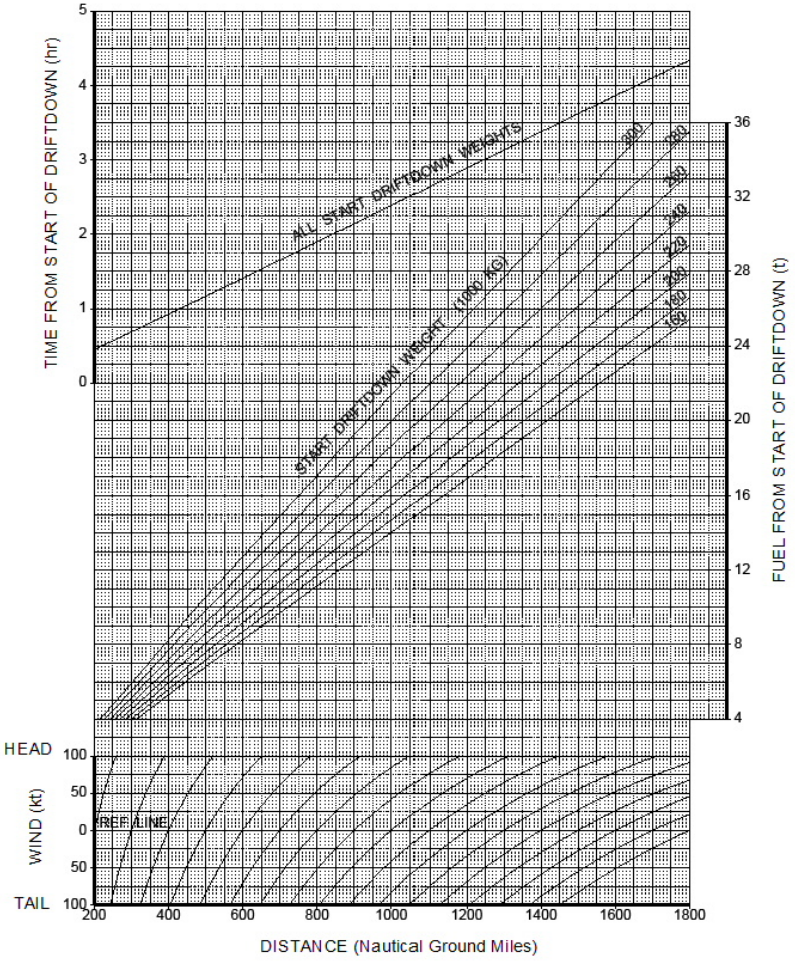
.84 M/300 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-200ER

-200ER



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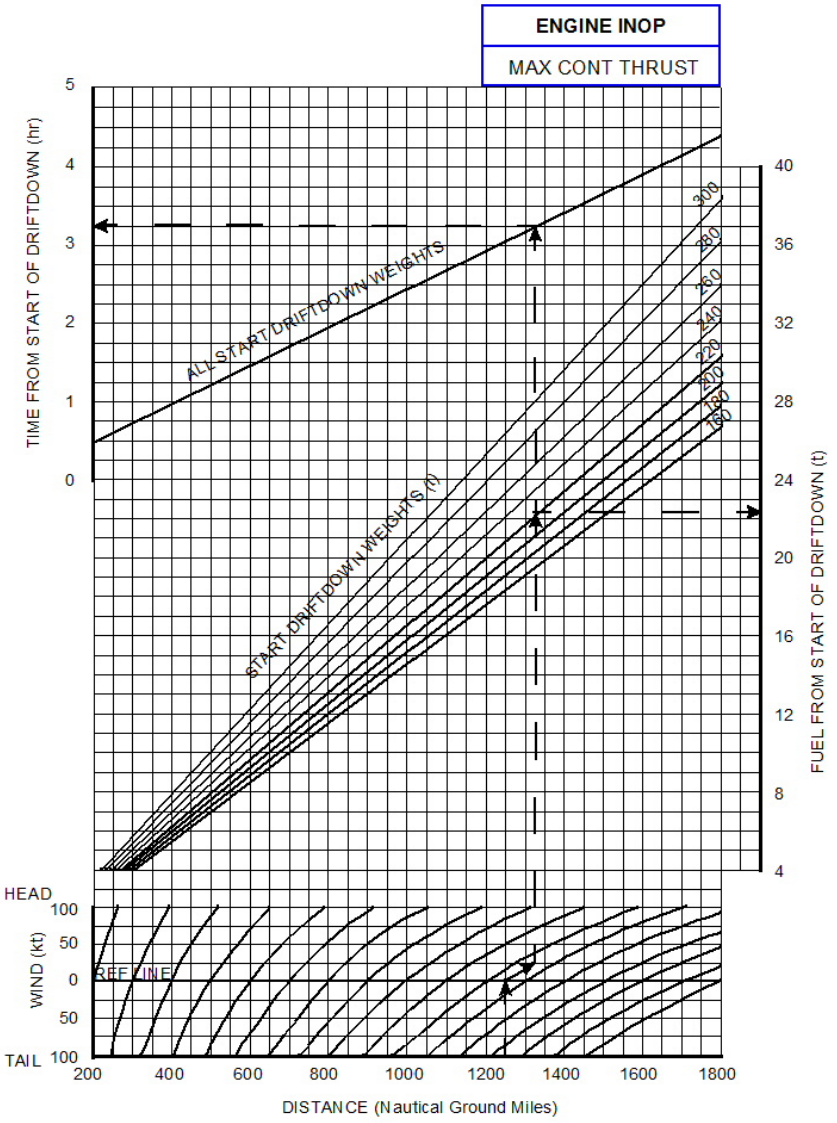
-300 ***.84 M/300 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-300***



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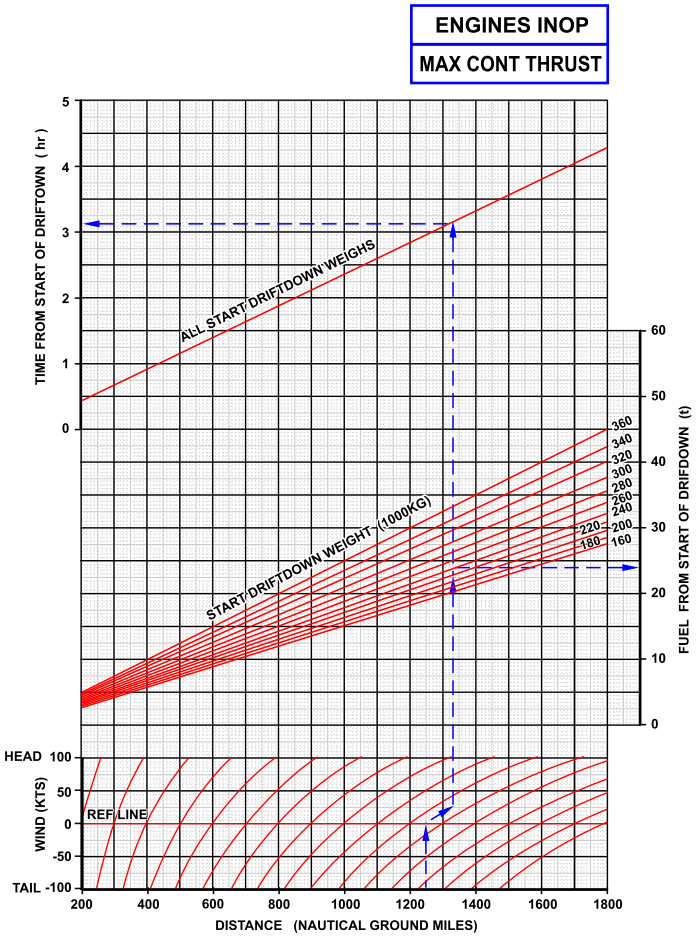
.84 M/300 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-300ER -300ER



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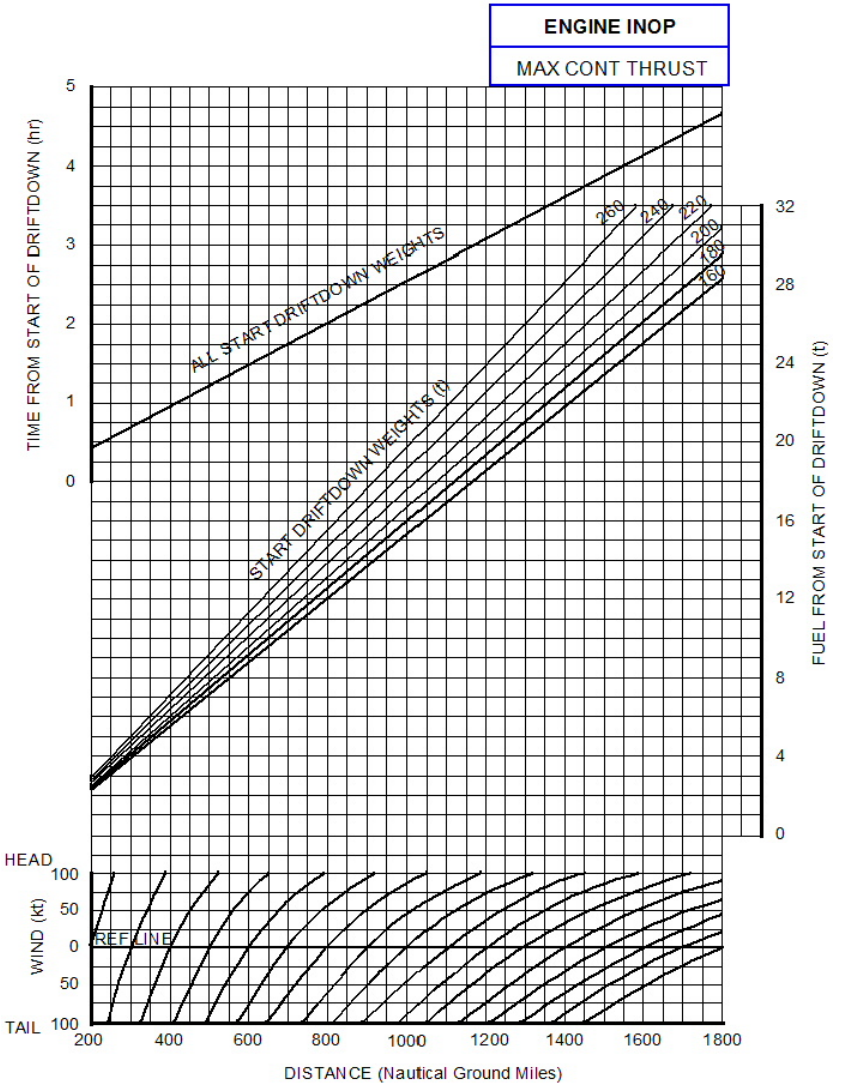
-200 ***.84 M/320 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-200***



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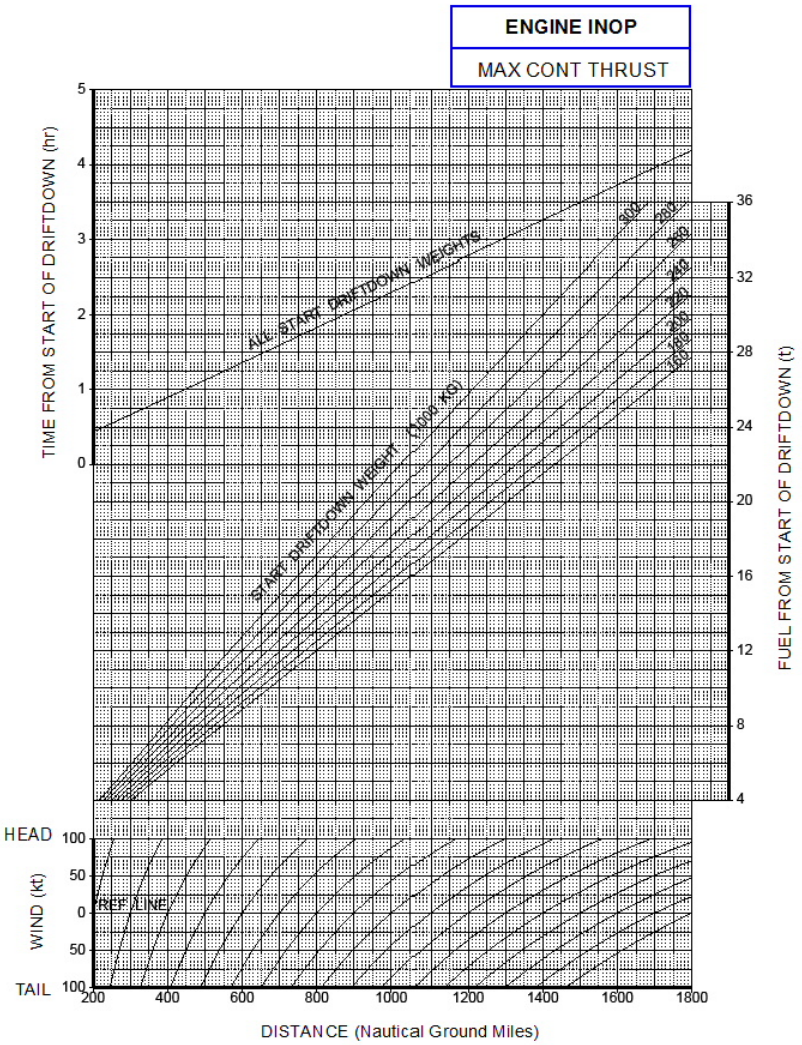
.84 M/320 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-200ER -200ER



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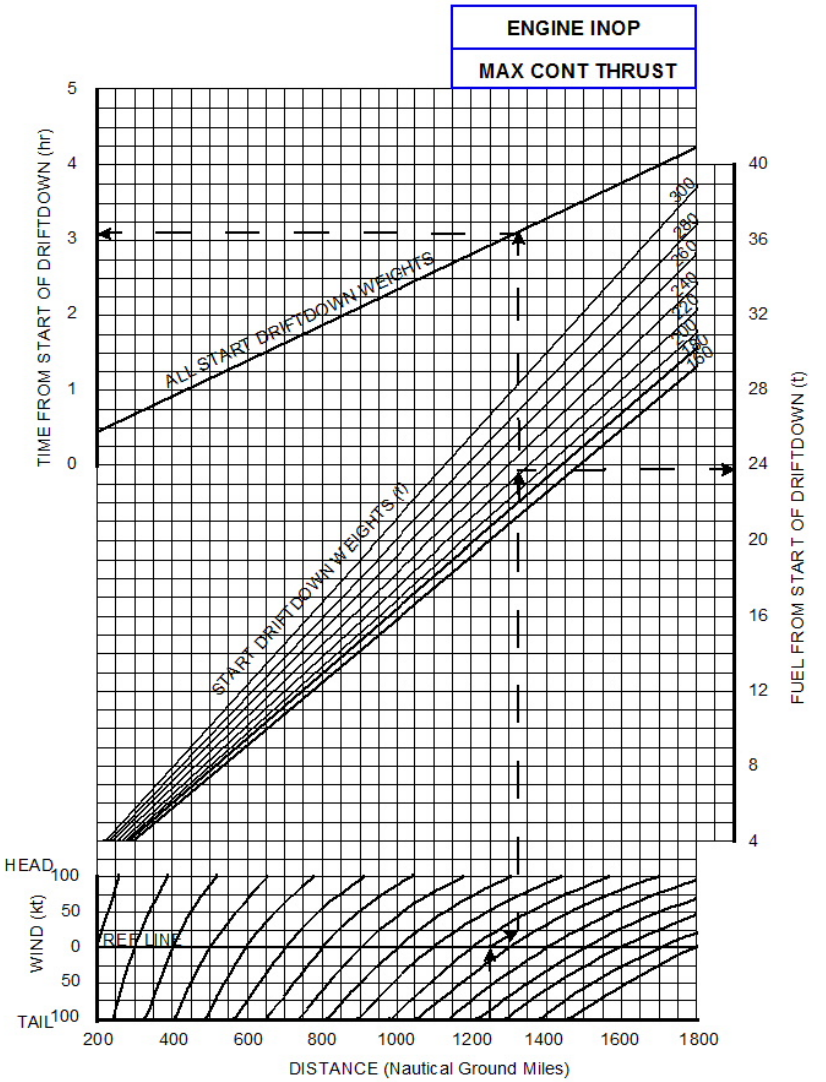
-300 ***.84 M/320 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-300***



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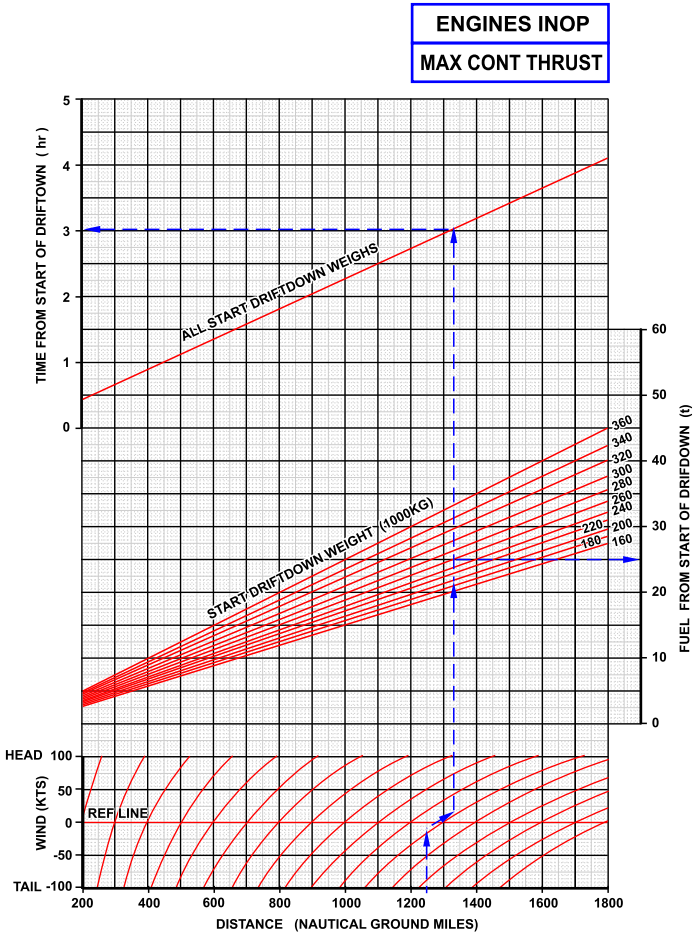
.84 M/320 KIAS driftdown/Cruise range capability (includes APU fuel burn)—777-300ER -300ER



Verification Flight

When an ETOPS significant system has been rectified by maintenance action but there is no effective means on ground to verify that the system operates normally by BITE, ground check per the Fault Isolation Manual (FIM) or the Aircraft Maintenance Manual (AMM), it may be necessary to verify the success of the maintenance action during an actual flight. Such inflight verification is also required when some other maintenance action is done on the aircraft, for

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example an engine change. The need for inflight verification is determined by Maintenance Control Center (LC).

Verification Flight Definition

Verification flight is a revenue or non-revenue flight where flight crew is asked to assist maintenance in determining that an ETOPS significant system is confirmed to be operating normally, or that an ETOPS significant problem has been resolved. A verification flight may be conducted on a non-ETOPS flight or during the first 60 minutes of a validated ETOPS revenue flight (i.e., prior to entry into the ETOPS portion of the flight).

Verification Flight Procedures

When the need for a verification flight occurs, departments involved will make necessary preparation for flight and inform flight crew accordingly. The aircraft log will include the statement “ETOPS VERIFICATION FLIGHT REQUIRED” under the ETOPS status sequence. Maintenance will also inform flight crew of the concerned remark.

Within the first 60 minutes of flight or the minimum duration specified by the Departing Line Station or LC, prior to ETOPS entry point, if communication is available, flight crew will indicate the confirmation or failure of the system correction either through ACARS or radio contact with LC.

If during the verification flight, the problem recurs, the flight crew will contact LC and dispatch for resolution. If the problem does not recur but associated flight deck or associated airframe sensory indications are experienced, flight crew will contact Maintenance Control Center (LC) and Dispatch for resolution and whether flight continuation or turnback should be made. The final decision is determined by the P-i-C.

At flight completion, an entry in a new A/C log sequence should be made with the statement “ETOPS VERIFICATION FLIGHT PERFORMED SATISFACTORY” when that system fulfilled the ETOPS requirement.

APU Inflight Start Reliability

The Monthly APU Start Form in the aircraft logbook is provided for APU inflight start data collection. The data will be used for APU inflight start reliability monitoring as part of ETOPS requirements to ensure the APU has adequate reliability and capability for inflight operations.

APU in-flight starts should be made subjected to the following conditions:

- the APU in-flight start should be initiated before top of descent, or at such time that will ensure 2-hour cold soak at altitude before the start attempt,
- the start attempt should be initiated prior to top-of-descent,
- up to three start attempts may be performed,
- the APU may be left running until the aircraft arrives at the gate.

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All necessary information should be entered in the Monthly APU Start Form.

For a successful start, enter in the ACFT Log:

- “APU IN-FLIGHT START SUCCESSFUL”.

In case APU failed to start or APU automatically shut down after start, enter the following note in ACFT Log as appropriate:

- “APU IN-FLIGHT START FAILED”, or
- “APU IN-FLIGHT SHUTDOWN AFTER STARTED”.

In case of a failed APU start, after maintenance actions are done, a statement “APU INFLIGHT START REQUIRED” will be included in the log sequence indicating that the APU inflight start is again required. Flight crew should then attempt to start the APU within the next return-leg to BKK to make sure that corrective actions have been taken. If the problem recurs flight crew should contact Maintenance Control Center (LC) to withdraw the aircraft from ETOPS operation.

The initial APU inflight start program requires that the inflight APU start be performed once a month for every ETOPS aircraft. The program will be carried out to determine if the APU achieves the expected level of reliability. At the successful completion of the program, the APU inflight start sampling quantity/ interval will then be reestablished based on system performance. Any necessary corrective actions/fleet upgrades, etc. will be performed to ensure that the APU sustains inherent reliability.

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Emergency — Chapter EM
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Introduction

This instruction explains the vital actions which have to be taken in connection with any emergency situation.

Since it is a well-established fact that the unexpected emergencies cause most of the injuries to passengers and crew, and sudden emergency situation requiring immediate evacuation of the airplane may arise in connection with takeoff, landing, taxiing or even while stationary on the tarmac, it is of utmost importance that the crew know the operation of doors, slides, ramps, life rafts and slides/rafts as well as evacuation duties by heart.

The most important duties of the crew will always be to:

- have the occupants well prepared for quick evacuation,
- provide the best crash protection for all occupants,
- supervise the evacuation after landing, and
- help the passengers as necessary after the evacuation.

Crew Duties

The crew duties during emergency are summarized in the Cabin Emergency Checklist.

Extra flight deck and cabin crew are used for assisting disabled or injured passengers, passengers coming down the slide on ground and giving any assistance when required.

Takeoff and Landing Preparation

Cabin Ready for Takeoff

After boarding completed and IM/purser have complied with all items stated in OM-A 8.3.15 Cabin Safety Requirements, he/she, when all passengers seated, cabin safety performed and min CA ready to take their seats, will order CA's through PA systems " Cabin Crew Arm the doors." CA must immediately obey this order. After ensure all door slides armed, IM/AP shall report "CABIN CLEAR/ CABIN READY" to flight deck crew accordingly.

In case of any malfunctions in the door mode, IM/purser must inform the P-i-C immediately.

Takeoff shall not be commenced, if the emergency demonstration has not been completed.

Cabin Ready For Landing

No reporting is required before landing.

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As soon as the FASTEN SEAT BELT sign is ON before landing, the IM/purser shall check the cabin in accordance with CABIN TAKEOFF AND LANDING CHECKLIST.

Communication—Summary of the Cabin Calls

Normal Calls

From	To	Communication method	Remarks
"Cabin crew, arm the doors"			
IM/AP	Cabin	PA system	Then IM/AP shall report "CABIN CLEAR"/"CABIN READY" to Flight deck.
"Cabin crew, at your station"			
IM/AP	Cabin	PA system	Given when final cabin safety check is performed during pushback or descent for landing.
"Cabin crew, disarm the door"			
IM/AP	Cabin	PA system	Given when the airplane come to a complete stop and seat belt sign has been switched off.
Takeoff imminent			
Flight deck	Cabin	2 × chimes with SEAT BELTS selector	Given before entering the runway, approx 30–60 sec before takeoff. IM/Purser immediately make an announcement through PA "CABIN CREW PREPARE FOR TAKEOFF." All cabin crew immediately return to assigned seats and fasten seat belt.
Landing imminent			
Flight deck	Cabin	2 × chimes with SEAT BELTS selector **Note:** If passenger oxygen is deployed, use PA system to make an announcement.	Given at approx 2,500 ft/3 min before landing. IM/Purser immediately make an announcement through PA "CABIN CREW PREPARE FOR LANDING." All cabin crew immediately return to

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From	To	Communication method	Remarks
			assigned seats and fasten seat belt.

Emergency Calls

From	To	Communication method	Remarks
Urgency call			
Flight deck	Cabin	Service interphone **ALL CALL (CDU)**, press 6 times or more, or PA system **"IM/PURSER, REPORT TO FLIGHT DECK"**, or **6 × FASTEN SEAT BELT**	IM/purser must immediately answer by the nearest interphone. If no reply, he must proceed to flight deck.
Cabin	Flight deck	Interphone, press ****** (Pilot priority)	Any CA can make this call. Flight deck crew must reply. If no reply he/she must proceed to flight deck.
Cabin	Cabin	Interphone, press **54** (ATTN ALL)	
Cabin emergency alert			
Flight deck	Cabin	PA system	Brief announcement, in case of short time for preparation. If given on ground, cabin crew shall immediately go to their stations.
"Emergency stations"			
Flight deck	Cabin	PA system	All CA's must immediately proceed to their emergency stations.
Brace for impact			
Flight deck	Cabin	PA system: **"BRACE, BRACE "**(repeatedly)	Given approx 1 min before landing.

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From	To	Communication method	Remarks
		and/or Repeatedly flashing FASTEN SEAT BELT	
Cabin	Passengers	PA system: **HEAD DOWN/** **"กัมหัวลง"**	Cabin crew shall order passengers after receiving BRACE FOR IMPACT signal.
Evacuation not required			
Flight deck	Cabin	PA system: **REMAIN SEATED, REMAIN SEATED**	
Initiating evacuation			
Flight deck	Cabin	Press EVAC SIGNAL or PA system: **"EVACUATE"**	
Cabin	Cabin	Emergency Evacuation Signaling system or PA system: **"EVACUATE."**	If no order is received from flight deck (pilots might be injured) and the necessity of an immediate evacuation is evident, cabin crew shall initiate the evacuation.
Cabin	Passengers	Order: **"RELEASE SEAT BELT AND GET OUT"**	Cabin crew shall order passengers after receiving evacuation order from flight deck or cabin.

When Emergency Declared

During, and immediately after the declaration of an emergency, the P-i-C or a selected flight deck crew will briefly inform the cabin crew, and when practicable also the passengers, about the impending emergency and the P-i-C's intentions. The detailed passenger-briefing should then be made by the purser or suitable cabin crew over the PA system in accordance with the EMERGENCY ANNOUNCEMENT.

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Strict supervision of all passengers is necessary during an emergency to avoid panic and confusion. Look out for passengers who tend to panic; they are a danger to the morale of all. Calm them gently at first but forcibly if necessary. Never forget to let them know that the rescue is close at hand if you have any reason to believe it to be so since this will make the emergency more bearable to them.

The cabin crew shall be kept well-informed about the emergency so that they can give further details to the passengers if necessary. As soon as the emergency situation arises, the cabin crew shall be ordered to start preparation according to CABIN EMERGENCY CHECKLIST.

Preparation—Emergency Landing/Ditching

Briefing Passengers

When ordered by the P-i-C, brief passengers according to the EMERGENCY ANNOUNCEMENT form.

Demonstrating Life Vest/Brace for Impact

In case of ditching, on completion of briefing and if time permits, demonstrate wearing of the life vest. The purser shall read the EMERGENCY ANNOUNCEMENT while the other cabin crew demonstrate.

If time permits, demonstrate brace for impact position and explain the signals; otherwise, order “HEAD DOWN” when order to brace is given.

Securing the Passengers and the Cabin

While the IM/purser brief the passengers, the other cabin crew shall do the following:

1. Make sure that the seatbacks are in upright position, footrests/legrests folded, tables folded, seat belts fastened.
2. Secure passengers, cabin and galleys.
3. Store hard objects in the stowage and the toilets and secure toilet doors by sliding toilet sign to OCCUPIED.
4. Report to the P-i-C that the cabin is secured. Check with the P-i-C which exits can or cannot be used for evacuation.

Preparing Survival Equipment

Prepare and secure the ELT (emergency locator transmitter) and suitable survival equipment as shown in the CABIN EMERGENCY CHECKLIST.

Selecting Able-Bodied Passengers

In prepared and unprepared emergency, select (reseat and brief if time permits) the suitable passengers to:

- help children and disabled or injured passengers,

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- help remove and operate survival equipment,
- guard unsafe exits or damaged evacuation slide,
- help passengers come down the slide.

Crash Protection

Protection of Infants

Whenever an emergency landing or ditching is expected, infants must secured as follows:

1. Hold the infant in your lap, or between your legs.
2. Support his head with one hand.
3. Put the other hand around his waist.
4. Push seatback forward.
5. Bend down.

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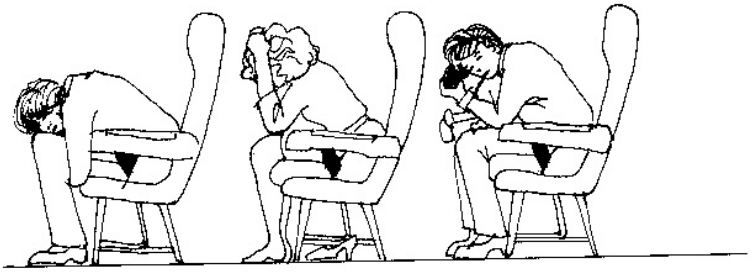
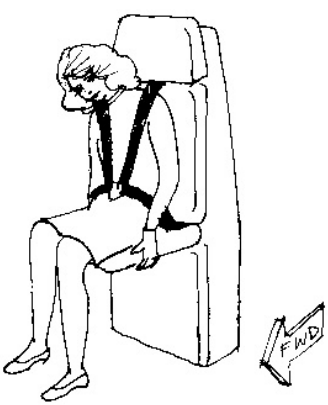
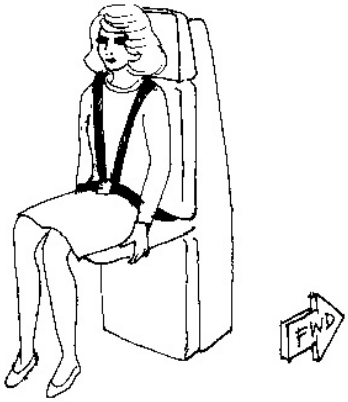
Brace for Impact—Seating Position



Passenger Seats



CA FWD Facing Seat



CA AFT Facing Seat

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Brace-for-Impact Signals

One minute before the estimated touchdown, the flight deck crew will order “BRACE BRACE” over the PA system and/or repeatedly flash the FASTEN SEAT BELT sign. Whenever possible the “BRACE” order should be repeated immediately before the impact.

Flight deck crew should instruct the passengers to remain in brace position until the airplane has come to a stop and warn that two or more impact shocks may occur before the airplane stops.

Evacuation

Evacuation Signal/Order

In case an evacuation is necessary, the P-i-C shall make an order to start evacuation by switching on the EVAC SIGNAL or using the PA system.

If the P-i-C decides that evacuation is not required, he shall immediately make an appropriate PA announcement and also disarm the evacuation signaling system.

Initial Evacuation Stage

On Ground

As soon as the airplane comes to a stop, EVAC signal/order is given, IM/purser opens seat belt, stands up and orders: “RELEASE SEAT BELTS, HIGH-HEELED SHOES OFF, STAND BACK, FORM TWO LINES, GET OUT.” Repeat the order if necessary.

Check through door window, if it is OK outside or if no danger and airplane is stationary, open the door in AUTOMATIC mode. If the door does not open automatically, push the door to fully OPEN position using constant pressure.

Check that the slide and slide/raft are properly inflated and safe for sliding. If the slide, slide/raft or ramps fails to inflate automatically, pull the manual inflation handle.

When the slide or slide/raft are in order, instruct passengers to form double line and start immediate evacuation/boarding by ordering: “JUMP, JUMP.”

If a passenger hesitates, order: “PUSH HIM/HER OUT.”

- At the exit with the double lane slide/raft, order: “FORM TWO LINES.”
- If passengers sit down on the doorsill, order: “STAY ON YOUR FEET.”

In Water

As soon as the airplane comes to a stop, EVAC signal/order is given, IM/purser opens seat belt, stands up and orders: “RELEASE SEAT BELTS, PUT LIFE VESTS ON, HIGH-HEELED SHOES OFF, STAND BACK, FORM TWO LINES, GET OUT.” Repeat the order if necessary.

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Check through door window, if it is OK outside or if no danger and airplane is stationary, open the door in AUTOMATIC mode. If the door does not open automatically, push the door to fully OPEN position using constant pressure.

Check that the slide and slide/raft are properly inflated and safe for sliding if the slide, slide/raft or ramps fails to inflate automatically, pull the manual inflation handle.

- Doors 1 2 3 4

  After opening the door in AUTOMATIC/ARMED mode, pull manual inflation handle. Do not wait for automatic inflation.
- Doors 1 2 4 5

  After opening the door in AUTOMATIC/ARMED mode, pull manual inflation handle. Do not wait for automatic inflation.
- Overwing door (Door 3)

  Select door mode selector to MANUAL/DISARMED, do not open the door, direct passengers to FWD/AFT door on the same side of cabin.

When the slide/raft are in order, instruct passengers to form double line and start immediate boarding by ordering: “GET OUT, PUT LIFE VESTS ON (unprepared emergency), GET INTO SLIDE/RAFT, INFLATE LIFE VESTS, HURRY LET’S GO.”

If a passenger hesitates, order: “PUSH HIM/HER OUT.”

- At the exit with the double lane slide/raft, order: “FORM TWO LINES.”
- If passengers sit down on the doorsill, order: “STAY ON YOUR FEET.”

Redirecting Passengers

If it is impossible to open the door or if slide or slide/raft are damaged or because of any other danger, the IM/purser should redirect passengers to the other doors. Use the able-bodied passengers to guard the unsafe doors. Face passengers, give orders: “GO THAT WAY—DOOR JAMMED” or “FIRE OUTSIDE” or “NO SLIDE/NO SLIDE/RAFT.” Instruct passengers to go to other doors in these priorities:

- the door DIRECTLY ACROSS the cabin,
- the door FWD/AFT on the SAME SIDE of the cabin,
- the door FWD/AFT on the OPPOSITE SIDE of the cabin,
- the OTHER/NEAREST door.

Slide/Raft Portability

Under ditching conditions, the CA must assess outside conditions before opening a door. Sea state conditions may not be suitable for deploying a slide/raft at the door on which it is installed. The slide/raft may be repositioned to an alternate doorway for deployment as indicated below.

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Slide/raft alternate deployment positions and instructions are printed on placards on each slide/raft.

-200,-200ER

Move from	Reposition and deploy at:
1L or R	• Opposite door 1 • Door 2L or R
2L	• Door 1L or R • Door 3R
2R	• Door 1L or R • Door 3L
3L	• Door 1L or R • Door 2R
3R	• Door 1L or R • Door 2L
4L or R	• Opposite door 4 • Door 1L or R • Door 2L or R

-300,-300ER

Move from	Reposition and deploy at:
1L or R	• Opposite door 1 • Door 2L or R
2L or R	• Opposite door 2 • Door 1L or R
4L or R	• Door 1L or R • Door 2L or R
5L or R	• Opposite door 5 • Door 1L or R • Door 2L or R

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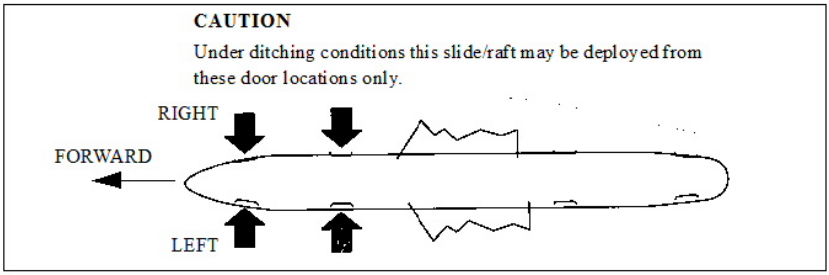
Alternative Exit Identification Placard



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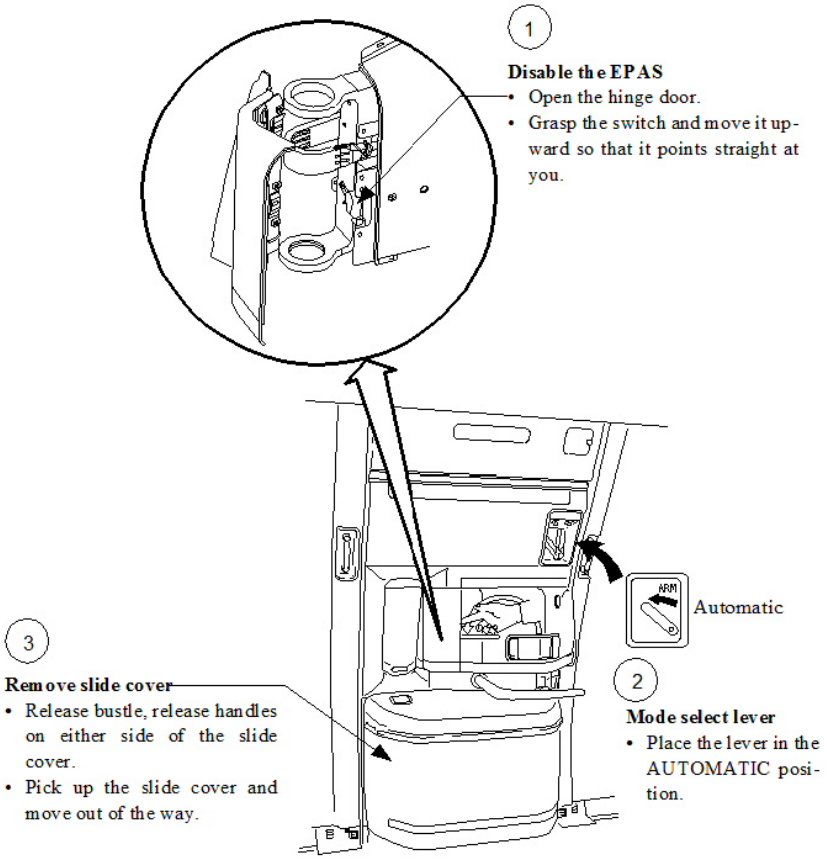
Slide/Raft Portability Procedures

These are instructions for portability of the slide/raft during ditching operations when the slide/raft is removed from an unusable door for use at another exit.



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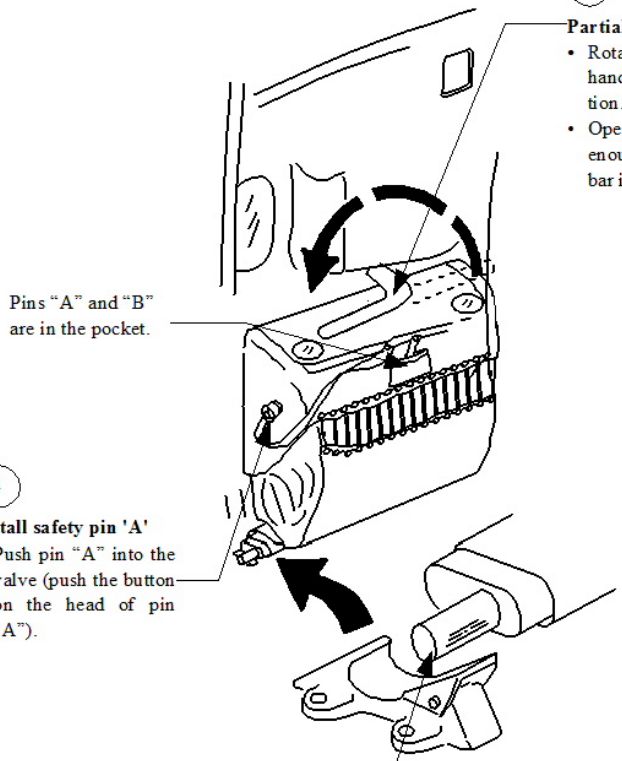

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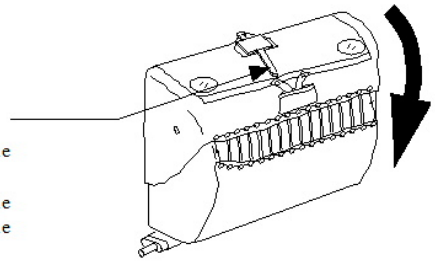
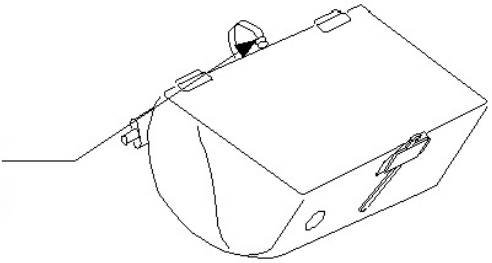


8

Remove slide/raft from door

- Push the handle found on top of the pack forward.
- Rotate the pack inboard onto the floor to remove the pack from the door.
  (See additional instructions on packboard back.)



9

Install safety pin "B" and secure girt bar

- Route pin "B" strap (both legs) through center slit in girt and install pin "B" into hole in latch
- Wrap short leg of strap around the girt bar and join snaps together (2 places).

10

Carry the pack to the alternative door

- Position 1 person on each side of the pack.

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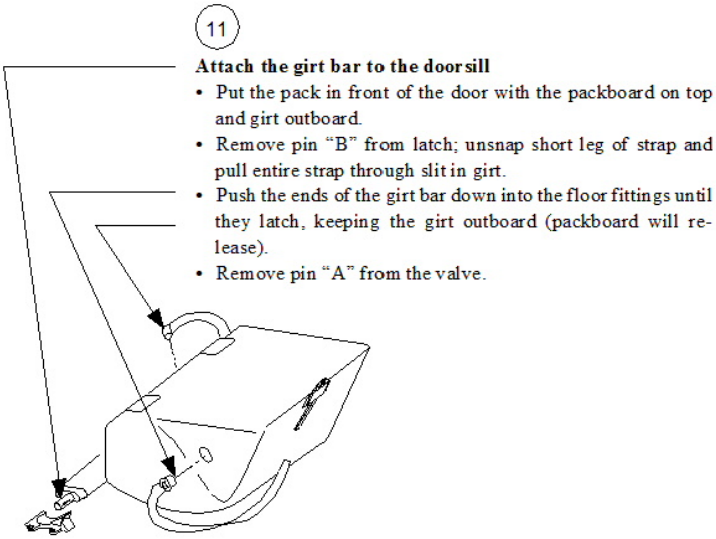

11

Attach the girt bar to the doorsill

- Put the pack in front of the door with the packboard on top and girt outboard.
- Remove pin "B" from latch; unsnap short leg of strap and pull entire strap through slit in girt.
- Push the ends of the girt bar down into the floor fittings until they latch, keeping the girt outboard (packboard will release).
- Remove pin "A" from the valve.

12

Deploy the slide

- Pull the packboard up, away from the slide/raft pack.
- Rotate/push the pack out through the door.
- Pull the red manual inflation handle.

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Unprepared Emergency

Since it is well-established fact that it is the unexpected emergencies which cause most of the injuries to passengers and crew, it is of the utmost importance that the crew know by heart other operation of the doors slide, slide/rafts and ramps as well as the seating plan and evacuation and boarding duties.

A sudden emergency situation requiring immediate evacuation may arise in connection with takeoff, landing taxiing or even while the airplane is stationary on the tarmac.

Evacuation

Evacuation procedures for the unprepared emergency are the same as those previously explained for the prepared emergency.

On Ground Fires

Since the flight deck crew might not be on board, the CA shall initiate the immediate evacuation as previously stated.

However, if there is a fire during engine starting and taxiing:

1. CA shall wait for instructions from the P-i-C.
2. The evacuation shall start when signaled/ordered by P-i-C.
3. Whenever smoke, fire or other abnormal conditions are observed, the P-i-C must be informed immediately.

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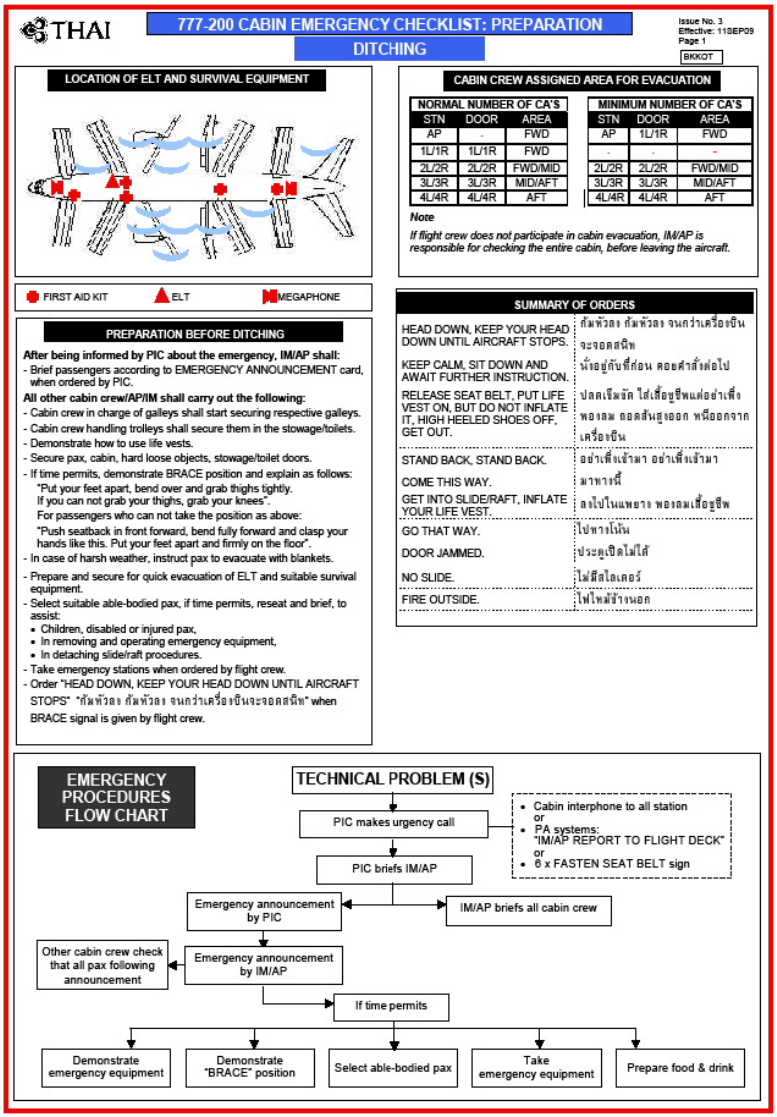
Examples of Cabin Emergency Checklist

This is an example of Cabin Emergency Checklist and is not kept up-to-date. The actual Cabin Emergency Checklist can be found in flight deck, and in PilotDocs OH website.



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777-200 CABIN EMERGENCY CHECKLIST: PREPARATION

DITCHING

Issue No. 3
Effective: 11SEP09
Page 1
BKKOT

LOCATION OF ELT AND SURVIVAL EQUIPMENT

FIRST AID KIT ELT MEGAPHONE

CABIN CREW ASSIGNED AREA FOR EVACUATION

NORMAL NUMBER OF CA'S		
STN	DOOR	AREA
AP	-	FWD
1L/1R	1L/1R	FWD
2L/2R	2L/2R	FWD/MID
3L/3R	3L/3R	MID/AFT
4L/4R	4L/4R	AFT

MINIMUM NUMBER OF CA'S		
STN	DOOR	AREA
AP	1L/1R	FWD
-	-	-
2L/2R	2L/2R	FWD/MID
3L/3R	3L/3R	MID/AFT
4L/4R	4L/4R	AFT

Note

If flight crew does not participate in cabin evacuation, IM/AP is responsible for checking the entire cabin, before leaving the aircraft.

PREPARATION BEFORE DITCHING

After being informed by PIC about the emergency, IM/AP shall:
- Brief passengers according to EMERGENCY ANNOUNCEMENT card, when ordered by PIC.

All other cabin crew/AP/IM shall carry out the following:
- Cabin crew in charge of galleys shall start securing respective galleys.
- Cabin crew handling trolleys shall secure them in the stowage/toilets.
- Demonstrate how to use life vests.
- Secure pax, cabin, hard loose objects, stowage/toilet doors.
- If time permits, demonstrate BRACE position and explain as follows:
  "Put your feet apart, bend over and grab thighs tightly. If you can not grab your thighs, grab your knees".
  For passengers who can not take the position as above:
  "Push seatback in front forward, bend fully forward and clasp your hands like this. Put your feet apart and firmly on the floor".
- In case of harsh weather, instruct pax to evacuate with blankets.
- Prepare and secure for quick evacuation of ELT and suitable survival equipment.
- Select suitable able-bodied pax, if time permits, reseat and brief, to assist:
  - Children, disabled or injured pax,
  - In removing and operating emergency equipment,
  - In detaching slide/raft procedures.
- Take emergency stations when ordered by flight crew.
- Order "HEAD DOWN, KEEP YOUR HEAD DOWN UNTIL AIRCRAFT STOPS" "ก้มหัวลง ก้มหัวลง จนกว่าเครื่องบินจะจอดสนิท" when BRACE signal is given by flight crew.

SUMMARY OF ORDERS

HEAD DOWN, KEEP YOUR HEAD DOWN UNTIL AIRCRAFT STOPS.	ก้มหัวลง ก้มหัวลง จนกว่าเครื่องบินจะจอดสนิท
KEEP CALM, SIT DOWN AND AWAIT FURTHER INSTRUCTION.	นั่งอยู่กับที่ก่อน คอยคำสั่งต่อไป
RELEASE SEAT BELT, PUT LIFE VEST ON, BUT DO NOT INFLATE IT, HIGH HEELED SHOES OFF, GET OUT.	ปลดเข็มขัด ใส่เสื้อชูชีพแต่อย่าเพิ่งพองลม ถอดส้นสูงออก หนีออกจากเครื่องบิน
STAND BACK, STAND BACK.	อย่าเพิ่งเข้ามา อย่าเพิ่งเข้ามา
COME THIS WAY.	มาทางนี้
GET INTO SLIDE/RAFT, INFLATE YOUR LIFE VEST.	ลงไปในแพยาง พองลมเสื้อชูชีพ
GO THAT WAY.	ไปทางโน้น
DOOR JAMMED.	ประตูเปิดไม่ได้
NO SLIDE.	ไม่มีสไลเดอร์
FIRE OUTSIDE.	ไฟไหม้ข้างนอก

EMERGENCY PROCEDURES FLOW CHART

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777-200 CABIN EMERGENCY CHECKLIST: EVACUATION

Issue No. 3
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BKKOT

DITCHING

PIC

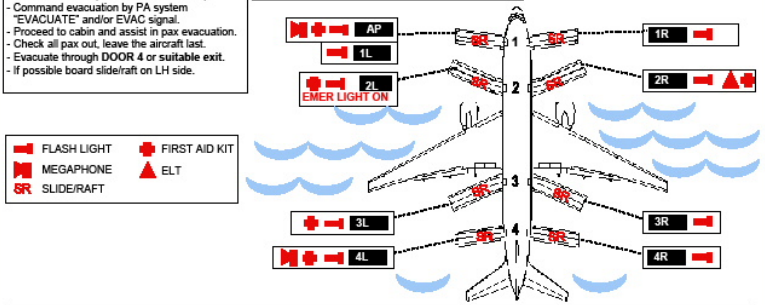
- When aircraft completely stopped, announce "CABIN CREW AT YOUR STATIONS".
- If an evacuation is about to take place on one or both sides, announce "CABIN CREW PREPARE ON (LEFT/RIGHT/BOTH) SIDE".
- Command evacuation by PA system "EVACUATE" and/or EVAC signal.
- Proceed to cabin and assist in pax evacuation.
- Check all pax out, leave the aircraft last.
- Evacuate through **DOOR 4 or suitable exit**.
- If possible board slide/raft on LH side.

COPILOT

- Proceed to cabin and check that ELT has been taken from the area near door 2R.
- Check pax out from fwd/mid/aft cabin.
- Evacuate through **DOOR 4 or suitable exit**.
- If possible board slide/raft on RH side.

If it is NOT POSSIBLE to reach the cabin:

- **Flight crew shall evacuate through windows using escape ropes.**



FLASH LIGHT
MEGAPHONE
SR SLIDE/RAFT
FIRST AID KIT
ELT

CABIN CREW RESPONSIBLE FOR ALL DOORS

- When received "CABIN CREW PREPARE ON (LEFT/RIGHT/BOTH) SIDE" from flight crew, clear evacuation path on the safe side commanded by flight crew, guard the unsafe side.
- When received evacuation command/signal from flight crew, stand up and shout "RELEASE SEAT BELT, PUT LIFE VEST ON, BUT DO NOT INFLATE IT, HIGH HEELED SHOES OFF, GET OUT".
- Assess conditions to determine if aircraft is sinking or floating.
- **If aircraft is sinking rapidly:**
  - Open usable exit.
  - Direct pax out of any opening.
  - Direct pax to support themselves on any debris, which will keep them afloat.
  - Activate available floatation equipment as time permits.
- **If aircraft is floating:**
  - Open usable exit.
  - Pull Manual Inflation Handle. Do not wait for automatic inflation.
  - Command "COME THIS WAY", repeat as necessary.
- **If water level is close to doorsill:**
  - Board pax into slide/raft, shout "GET INTO SLIDE/RAFT, INFLATE YOUR LIFE VEST".
  - Last crew member disconnects slide/raft from aircraft.
- **If water level too far from doorsill:**
  - Disconnect slide raft from doorsill,
  - Hold mooring line close to doorsill,
  - Board pax into slide/raft, shout "GET INTO SLIDE/RAFT, INFLATE YOUR LIFE VEST".
- Last crew member cuts/detaches mooring line/lanyard.
- Try to keep pax out of water.
- Move away from aircraft.

EMERGENCY PROCEDURES FLOW CHART

"EMERGENCY STATION" by PIC

All cabin crew proceed to their stations

1 minute before impact, PA "BRACE, BRACE" and/or flashing FASTEN SEAT BELT sign

Cabin crew and pax in BRACE position

Cabin crew order "HEAD DOWN, KEEP YOUR HEAD DOWN UNTIL AIRCRAFT STOPS"

Aircraft stops completely and EVACUATION required

"CABIN CREW AT YOUR STATIONS" by PIC

"CABIN CREW PREPARE ON (LEFT/RIGHT/BOTH) SIDE" by PIC

PIC gives EVACUATION order/signal

IM/AP gives EVACUATION order/signal

No order/signal from flight crew

IM/AP proceeds to flight deck

Flight crew busy

Flight crew seriously injured

IM/AP waits and asks for PIC's decision

IM/AP gives EVACUATION order/signal

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777-200 CABIN EMERGENCY CHECKLIST: PREPARATION
LANDING IN REMOTE AREA

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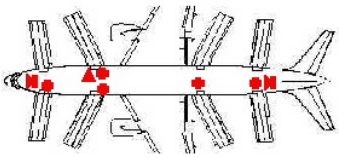
LOCATION OF ELT AND SURVIVAL EQUIPMENT



FIRST AID KIT ELT MEGAPHONE

CABIN CREW ASSIGNED AREA FOR EVACUATION

NORMAL NUMBER OF CA'S		
STN	DOOR	AREA
AP	.	FWD
1L/1R	1L/1R	FWD
2L/2R	2L/2R	FWD/MID
3L/3R	3L/3R	MID/AFT
4L/4R	4L/4R	AFT

MINIMUM NUMBER OF CA'S		
STN	DOOR	AREA
AP	1L/1R	FWD
.	.	FWD
2L/2R	2L/2R	FWD/MID
3L/3R	3L/3R	MID/AFT
4L/4R	4L/4R	AFT

Note

If flight crew does not participate in cabin evacuation, IM/AP is responsible for checking the entire cabin, before leaving the aircraft.

PREPARATION BEFORE EMERGENCY LANDING

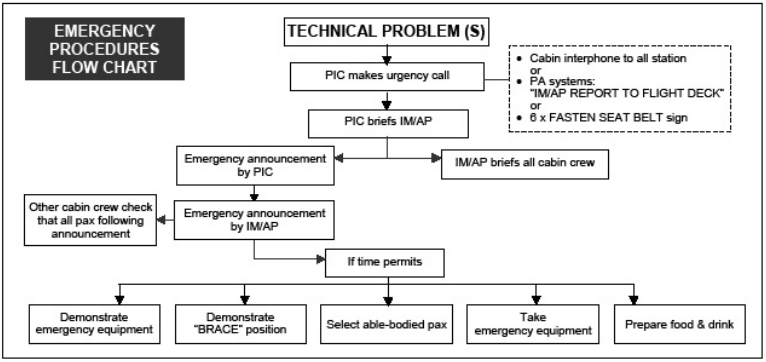
After being informed by PIC about the emergency, IM/AP shall:
- Brief passengers according to EMERGENCY ANNOUNCEMENT card when ordered by PIC.

All other cabin crew/AP/IM shall carry out the following:
- Cabin crew in charge of galleys shall start securing respective galleys.
- Cabin crew handling trolleys shall secure them in the stowage/toilets.
- Secure pax, cabin, hard loose objects, stowage/toilet doors.
- If time permits, demonstrate BRACE position and explain as follows:
  "Put your feet apart, bend over and grab thighs tightly.
  If you can not grab your thighs, grab your knees".
  For passengers who can not take the position as above:
  "Push seatback in front forward, bend fully forward and clasp your hands like this. Put your feet apart and firmly on the floor".
- In case of landing in wilderness, instruct pax to evacuate with blankets.
- Prepare and secure for quick evacuation of ELT and suitable survival equipment.
- Select suitable able-bodied pax, if time permits, reseat and brief, to assist:
  - Children, disabled or injured pax,
  - In removing and operating emergency equipment,
  - Pax in coming down the slide.
- Take emergency stations when ordered by flight crew.
- Order "HEAD DOWN, KEEP YOUR HEAD DOWN UNTIL AIRCRAFT STOPS" "ก้มหัวลง ก้มหัวลง จนกว่าเครื่องบินจะจอดสนิท" when BRACE signal is given by flight crew.

SUMMARY OF ORDERS

HEAD DOWN, KEEP YOUR HEAD DOWN UNTIL AIRCRAFT STOPS.	ก้มหัวลง ก้มหัวลง จนกว่าเครื่องบินจะจอดสนิท
KEEP CALM, SIT DOWN AND AWAIT FURTHER INSTRUCTION.	นั่งอยู่กับที่ก่อน คอยคำสั่งต่อไป
RELEASE SEAT BELT, HIGH HEELED SHOES OFF. LEAVE YOUR BELONGINGS AND GET OUT.	ปลดเข็มขัด ถอดส้นสูงออก ทิ้งของไว้ รีบออกจากเครื่องบิน
STAND BACK, STAND BACK.	อย่าเพิ่งเข้ามา อย่าเพิ่งเข้ามา
COME THIS WAY.	มาทางนี้
FORM TWO LINES.	เรียงเป็นสองแถว
JUMP JUMP GO GO.	กระโดด กระโดด
FASTER FASTER.	เร็ว เร็ว
GO THAT WAY.	ไปทางโน้น
DOOR JAMMED.	ประตูเปิดไม่ได้
NO SLIDE.	ไม่มีสไลเดอร์
FIRE OUTSIDE.	ไฟไหม้ข้างนอก

EMERGENCY PROCEDURES FLOW CHART



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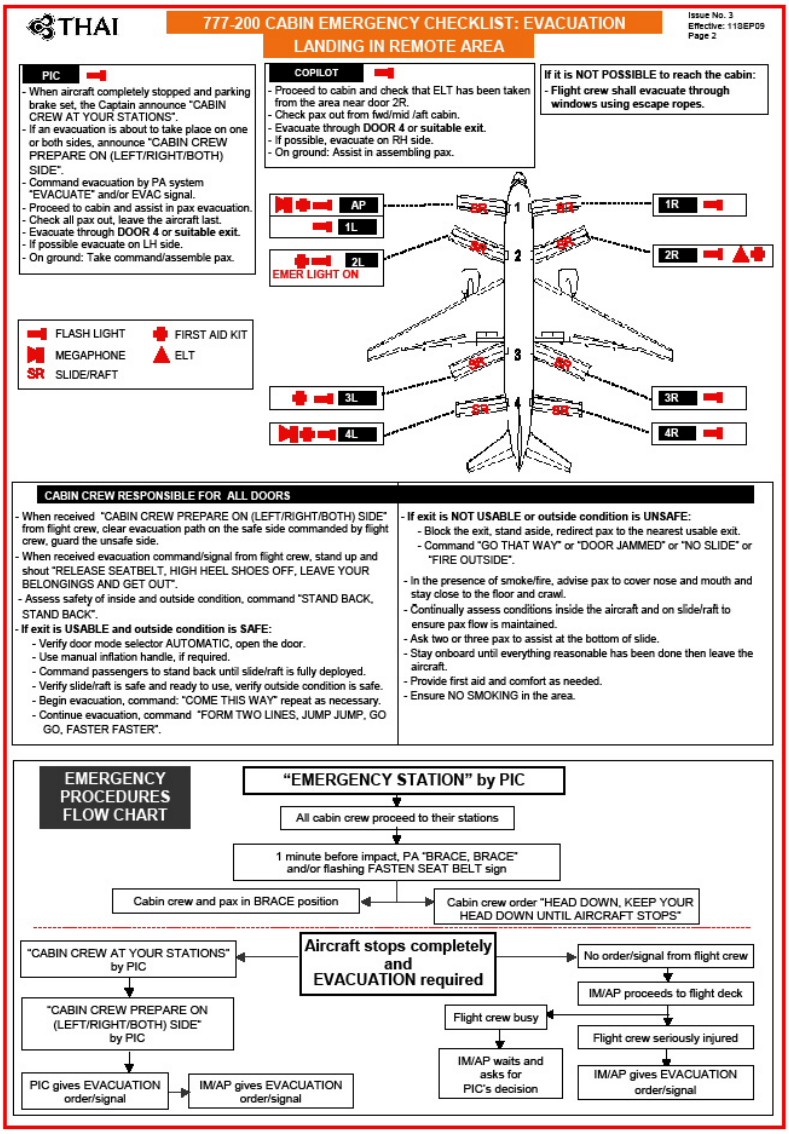

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777-200 CABIN EMERGENCY CHECKLIST: EVACUATION
LANDING IN REMOTE AREA

Issue No. 3
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Page 2

PIC

- When aircraft completely stopped and parking brake set, the Captain announce "CABIN CREW AT YOUR STATIONS".
- If an evacuation is about to take place on one or both sides, announce "CABIN CREW PREPARE ON (LEFT/RIGHT/BOTH) SIDE".
- Command evacuation by PA system "EVACUATE" and/or EVAC signal.
- Proceed to cabin and assist in pax evacuation.
- Check all pax out, leave the aircraft last.
- Evacuate through **DOOR 4 or suitable exit.**
- If possible evacuate on LH side.
- On ground: Take command/assemble pax.

COPILOT

- Proceed to cabin and check that ELT has been taken from the area near door 2R.
- Check pax out from fwd/mid /aft cabin.
- Evacuate through **DOOR 4 or suitable exit.**
- If possible, evacuate on RH side.
- On ground: Assist in assembling pax.

If it is NOT POSSIBLE to reach the cabin:

- **Flight crew shall evacuate through windows using escape ropes.**

AP
1L
2L
EMER LIGHT ON
1R
2R
3L
4L
3R
4R
SR
1
2
3
4

FLASH LIGHT
MEGAPHONE
SR SLIDE/RAFT
FIRST AID KIT
ELT

CABIN CREW RESPONSIBLE FOR ALL DOORS

- When received "CABIN CREW PREPARE ON (LEFT/RIGHT/BOTH) SIDE" from flight crew, clear evacuation path on the safe side commanded by flight crew, guard the unsafe side.
- When received evacuation command/signal from flight crew, stand up and shout "RELEASE SEATBELT, HIGH HEEL SHOES OFF, LEAVE YOUR BELONGINGS AND GET OUT".
- Assess safety of inside and outside condition, command "STAND BACK, STAND BACK".
- **If exit is USABLE and outside condition is SAFE:**
  - Verify door mode selector AUTOMATIC, open the door.
  - Use manual inflation handle, if required.
  - Command passengers to stand back until slide/raft is fully deployed.
  - Verify slide/raft is safe and ready to use, verify outside condition is safe.
  - Begin evacuation, command: "COME THIS WAY" repeat as necessary.
  - Continue evacuation, command "FORM TWO LINES, JUMP JUMP, GO GO, FASTER FASTER".
- **If exit is NOT USABLE or outside condition is UNSAFE:**
  - Block the exit, stand aside, redirect pax to the nearest usable exit.
  - Command "GO THAT WAY" or "DOOR JAMMED" or "NO SLIDE" or "FIRE OUTSIDE".
- In the presence of smoke/fire, advise pax to cover nose and mouth and stay close to the floor and crawl.
- Continually assess conditions inside the aircraft and on slide/raft to ensure pax flow is maintained.
- Ask two or three pax to assist at the bottom of slide.
- Stay onboard until everything reasonable has been done then leave the aircraft.
- Provide first aid and comfort as needed.
- Ensure NO SMOKING in the area.

EMERGENCY PROCEDURES FLOW CHART

"EMERGENCY STATION" by PIC
All cabin crew proceed to their stations
1 minute before impact, PA "BRACE, BRACE" and/or flashing FASTEN SEAT BELT sign
Cabin crew and pax in BRACE position
Cabin crew order "HEAD DOWN, KEEP YOUR HEAD DOWN UNTIL AIRCRAFT STOPS"
Aircraft stops completely and EVACUATION required
"CABIN CREW AT YOUR STATIONS" by PIC
"CABIN CREW PREPARE ON (LEFT/RIGHT/BOTH) SIDE" by PIC
PIC gives EVACUATION order/signal
IM/AP gives EVACUATION order/signal
No order/signal from flight crew
IM/AP proceeds to flight deck
Flight crew busy
Flight crew seriously injured
IM/AP waits and asks for PIC's decision
IM/AP gives EVACUATION order/signal

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777-200 CABIN EMERGENCY CHECKLIST: PREPARATION
AT TERMINAL AREA

Issue No. 3
Effective: 11SEP09
Page 1
BKKOT

PREPARATION BEFORE EMERGENCY LANDING

After being informed by PIC about the emergency, IM/AP shall:

- Brief passengers according to EMERGENCY ANNOUNCEMENT card when ordered by PIC.

All other cabin crew/AP/IM shall carry out the following:

- Cabin crew in charge of galleys shall start securing respective galleys.
- Cabin crew handling trolleys shall secure them in the stowage/toilets.
- Secure pax, cabin, hard loose objects, stowage/toilet doors.
- If time permits, demonstrate BRACE position and explain as follows:
  "Put your feet apart, bend over and grab thighs tightly.
  If you can not grab your thighs, grab your knees".
  For passengers who can not take the position as above:
  "Push seatback in front forward, bend fully forward and clasp your hands like this. Put your feet apart and firmly on the floor".
- Select suitable able-bodied pax, if time permits, reseat and brief, to assist:
  - Children, disabled or injured pax,
  - Pax in coming down the slide.
- Take emergency stations when ordered by flight crew.
- Order "HEAD DOWN, KEEP YOUR HEAD DOWN UNTIL AIRCRAFT STOPS" "ก้มหัวลง ก้มหัวลง จนกว่าเครื่องบินจะจอดสนิท" when BRACE signal is given by flight crew.

CABIN CREW ASSIGNED AREA FOR EVACUATION

NORMAL NUMBER OF CA'S

STN	DOOR	AREA
AP	.	FWD
1L/1R	1L/1R	FWD
2L/2R	2L/2R	FWD/MID
3L/3R	3L/3R	MID/AFT
4L/4R	4L/4R	AFT

MINIMUM NUMBER OF CA'S

STN	DOOR	AREA
AP	1L/1R	FWD
.	.	FWD
2L/2R	2L/2R	FWD/MID
3L/3R	3L/3R	MID/AFT
4L/4R	4L/4R	AFT

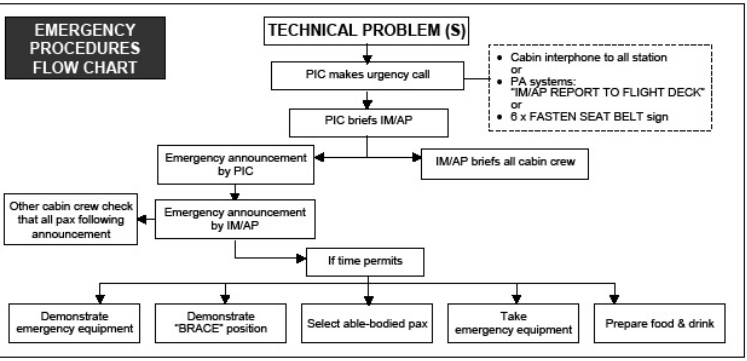
Note

If flight crew does not participate in cabin evacuation, IM/AP is responsible for checking the entire cabin, before leaving the aircraft.

SUMMARY OF ORDERS

HEAD DOWN, KEEP YOUR HEAD DOWN UNTIL AIRCRAFT STOPS.	ก้มหัวลง ก้มหัวลง จนกว่าเครื่องบินจะจอดสนิท
KEEP CALM, SIT DOWN AND AWAIT FURTHER INSTRUCTION.	นั่งอยู่กับที่ก่อน คอยคำสั่งต่อไป
RELEASE SEAT BELT, HIGH HEELED SHOES OFF, LEAVE YOUR BELONGINGS AND GET OUT.	ปลดเข็มขัด ถอดส้นสูงออก ทิ้งของไว้ รีบออกจากเครื่องบิน
STAND BACK, STAND BACK.	อย่าเพิ่งเข้ามา อย่าเพิ่งเข้ามา
COME THIS WAY.	มาทางนี้
FORM TWO LINES.	เรียงเป็นสองแถว
JUMP JUMP GO GO.	กระโดด กระโดด
FASTER FASTER.	เร็ว เร็ว
GO THAT WAY.	ไปทางโน้น
DOOR JAMMED.	ประตูเปิดไม่ได้
NO SLIDE.	ไม่มีสไลเดอร์
FIRE OUTSIDE.	ไฟไหม้ข้างนอก

EMERGENCY PROCEDURES FLOW CHART



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777-200 CABIN EMERGENCY CHECKLIST: EVACUATION AT TERMINAL AREA

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PIC

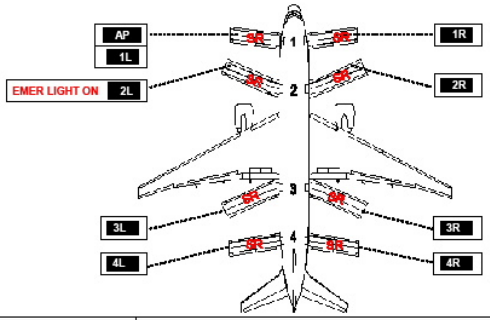
- When aircraft completely stopped and parking brake set, the Captain announce "CABIN CREW AT YOUR STATIONS".
- If an evacuation is not required the Captain announce "Remain seated, resume normal duties".
- If an evacuation is about to take place on one or both sides, announce "CABIN CREW PREPARE ON (LEFT/RIGHT/BOTH) SIDE".
- Command evacuation by PA system "EVACUATE" and/or EVAC signal.
- Proceed to cabin and assist in pax evacuation.
- Check all pax out, leave the aircraft last.
- Evacuate through **suitable exit.**
- On ground: Take command/assemble pax.
- Cooperate with Aerodrome Rescue and Fire Fighting.

SR SLIDE/RAFT

COPILOT

- Check all pax out.
- Evacuate through **suitable exit.**
- On ground: Assist in assembling pax.

If it is NOT POSSIBLE to reach the cabin:
- **Flight crew shall evacuate through windows using escape ropes.**

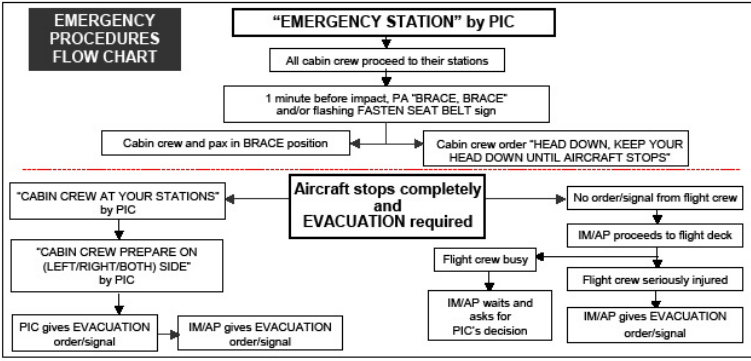


CABIN CREW RESPONSIBLE FOR ALL DOORS

- When received "CABIN CREW PREPARE ON (LEFT/RIGHT/BOTH) SIDE" from flight crew, clear evacuation path on the safe side commanded by flight crew, guard the unsafe side.
- When received evacuation command/signal from flight deck, stand up and shout "RELEASE SEATBELT, HIGH HEEL SHOES OFF, LEAVE YOUR BELONGINGS AND GET OUT".
- Assess safety of inside and outside condition, command "STAND BACK, STAND BACK".
- **If exit is USABLE and outside condition is SAFE:**
  - Verify door mode selector AUTOMATIC, open the door.
  - Use manual inflation handle, if required.
  - Command passengers to stand back until slide/raft is fully deployed.
  - Verify slide/raft is safe and ready to use, verify outside condition is safe.
  - Begin evacuation, command: "COME THIS WAY", repeat as necessary.
  - Continue evacuation, command "FORM TWO LINES", "JUMP JUMP GO GO", "FASTER FASTER".

- **If exit is NOT USABLE or outside condition is UNSAFE:**
  - Block the exit, stand aside, redirect pax to the nearest usable exit.
  - Command "GO THAT WAY" or "DOOR JAMMED" or "NO SLIDE" or "FIRE OUTSIDE".
- In the presence of smoke/fire, advise pax to cover nose and mouth and stay close to the floor and crawl.
- Continually assess conditions inside the aircraft and on slide/raft to ensure pax flow is maintained.
- Ask two or three pax to assist at the bottom of slide.
- Stay onboard until everything reasonable has been done then leave the aircraft.
- Provide first aid and comfort as needed.
- Ensure NO SMOKING in the area.

EMERGENCY PROCEDURES FLOW CHART



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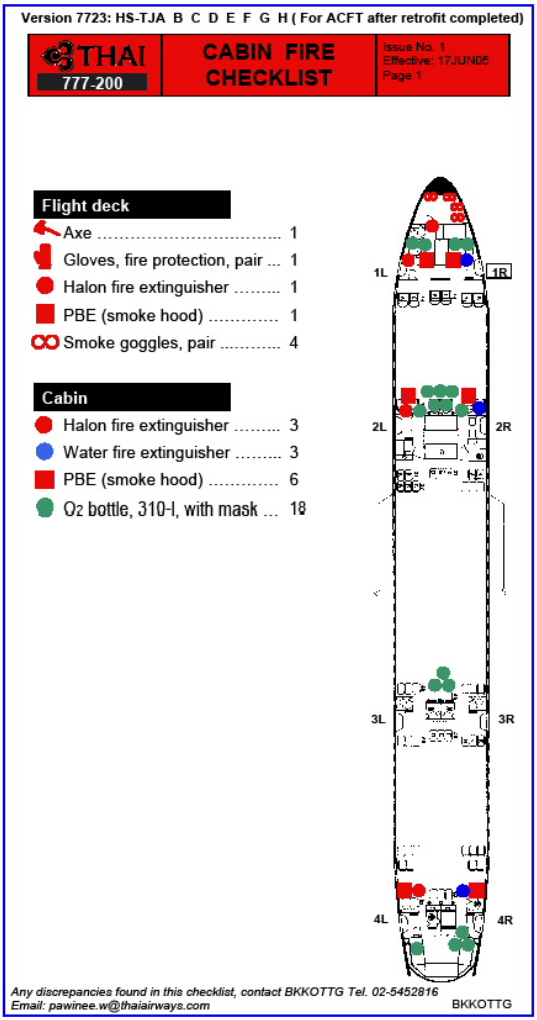
Examples of Cabin Fire Checklist

This is an example of Cabin Fire Checklist and is not kept up-to-date. The actual Cabin Fire Checklist can be found in flight deck, and in PilotDocs OH website.



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Version 7723: HS-TJA B C D E F G H (For ACFT after retrofit completed)

THAI 777-200

CABIN FIRE CHECKLIST

Issue No. 1
Effective: 17JUN05
Page 2

GENERAL

1. CA detecting smoke (either visually or by smoke detecting system) or fire, shall notify any other cabin crew, then begin the fire fighting.
2. Remove oxygen bottles that are located near the fire,
3. One cabin crew notifies PIC and IM/Purser, then assist the fire fighting.
4. Calm passengers, relocate if necessary.
5. Keep PIC informed continuously.

HINT

- *Use PBE (smoke hood) for protection against smoke, fumes and hot air.*
- *Otherwise, place wet paper towel or handkerchief over nose and mouth.*
- *Put on coat / jacket, cap and gloves (made of natural fabrics).*

LAVATORY FIRE

6. Use Halon fire extinguisher. For waste box fire, use water fire extinguisher or any nonflammable liquid.
7. After extinguishing fire, guard the fire area.

GALLEY FIRE

6. Switch off effected electrical equipment.
7. Use Halon fire extinguisher. For waste box fire, use water fire extinguisher or any nonflammable liquid when electrical power is OFF.
8. After extinguishing fire, guard the fire area.

SUSPECTED ELECTRICAL FIRE

6. Switch off effected electrical equipment.
7. Use Halon fire extinguisher.
8. After extinguishing fire, guard the fire area.

FIRE IN TEXTILE

6. Isolate material on fire.
7. Smother with blankets, coats etc.
8. Use water fire extinguisher or any nonflammable liquid
9. After extinguishing fire, guard the fire area.

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Loading — Chapter LD

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Allowable Gross Weights

See Weight Limitations on page L.10.2 for allowable gross weights.

For permissible Takeoff and Landing Weight with regard to flap setting, wind, temperature, runway length, airport elevation, etc., refer to Gross Weight Chart and/or Takeoff or Landing Diagrams.

Mean Aerodynamic Chord and Balance Limits

Mean Aerodynamic Chord (MAC)

The length of MAC is 278.5 inches.

The leading edge of MAC (LEMAC) is located at STA 1174.5.

The nose of the aircraft is located at

- STA 92.5 -200,-200ER
- STA 117.5. -300,-300ER

Balance Limits

The center-of-gravity limits in % MAC vary linearly between gross weights shown.

Forward limit

Gross Weight (kg)	Center of Gravity (% MAC)	
248,115	24.2	-200
243,579	19.0	
201,848	14.0	
130,000	14.0	
Gross Weight (kg)	**Center of Gravity (% MAC)**	-200ER
294,835	21.2	
263,990	16.3	
208,652	14.0	
130,000	14.0	
Gross Weight (kg)	**Center of Gravity (% MAC)**	-300
287,804	13.1	
237,682	8.5	
224,528	7.5	
140,000	7.5	

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Aft Limit

-200

Gross Weight (kg)	Center of Gravity (% MAC)	
	Taxi & Takeoff	Flight & Landing
248,115	37.6	37.6
243,579	44.0	44.0
190,508	44.0	44.0
130,000	39.2	44.0

-200ER

Gross Weight (kg)	Center of Gravity (% MAC)	
	Taxi & Takeoff	Flight & Landing
294,835	29.8	29.8
287,804	38.0	38.0
256,279	44.0	44.0
208,652	44.0	44.0
130,000	44.0	37.8

-300

Gross Weight (kg)	Center of Gravity (% MAC)	
	Taxi & Takeoff	Flight & Landing
287,804	43.8	43.8
287,123	44.0	44.0
230,833	44.0	44.0
140,000	37.2	44.0

-300ER

Gross Weight (kg)	Center of Gravity (% MAC)	
	Taxi & Takeoff	Flight & Landing
343,414	38.1	38.1
304,814	44.0	44.0
279,911	44.0	44.0
224,029	44.0	44.0
158,031	34.1	34.1
130,000	26.9	26.9

The loading and consumption of fuel must be taken into consideration to ensure that the certified limits above are never exceeded during any portion of the flight. The effect of fuel density variation on aircraft balance must also be taken into account.

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Cargo Compartments

Structural Limitations

-200,-200ER

Compartment		Max Linear Load (kg/in)	Max Area Load (kg/sq ft)
FWD	BA 409-899	53.1	90.7
	BA 899-998	78.9	
AFT	BA 1437-1538	78.9	90.7
	BA 1538-1886	53.1	
BULK	BA 1886-1942	30.3	68.0
	BA 1942-2062	Decease linearly from 30.3 to 15.8	

-300,-300ER

Compartment		Max Linear Load (kg/in)	Max Area Load (kg/sq ft)
FWD	BA 199-885	53.1	90.7
	BA 885-998	78.9	
AFT	BA 1437-1546	78.9	90.7
	BA 1546-2075	53.1	
BULK	BA 2075-2131	30.3	68.0
	BA 2131-2251	Decease linearly from 30.3 to 15.8	

Loading Capacity

Maximum weight certified

-200,-200ER

	FWD COMPT	AFT COMPT	BULK
Station	409-998	1437-1886	1886-2062
Maximum Weight (kg)	30,617	22,226	4,082

-300,-300ER

	FWD COMPT	AFT COMPT	BULK
Station	199-998	1437-2075	2075-2251
Maximum Weight (kg)	40,823	31,751	4,082

Crew and Passenger

Crew Member

A maximum of 4 crew members may be carried in the flight deck.

There are 14 jump seats. -200ER

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-200,-300ER There are 16 jump seats.

-300 There are 18 jump seats.

The excess cabin crew must be seated in passenger seat. For location of seats, see Configuration on page LD.2.1.

Maximum Number of Passengers on Board

The actual number of passengers, excluding infants, must not exceed the number of seats with safety belts. For the number of seats available, see Configuration on page LD.2.1 applicable version drawing.

An infant can be seated on an adult's knees. The number of infants that can be carried is, however, limited by the number of available oxygen masks and life vests.

Oxygen limitations

Each outboard seat assembly has an extra mask for use by infants and cabin attendants. In every second seat row–except that equipped with baby cradle–these extra masks are reserved for cabin attendants when walking around in the aisles. The remaining extra masks are for infants seated on adults' knees.

This implies that 3 adults and 1 infant can be seated in every second outboard triple seat assembly. In addition, the positions for all baby cradles can be utilized.

Life vest limitations

When two persons, i.e. one adult and one infant, are carried in the same seat, a spare life vest must be placed in the seat pocket adjacent to that seat.

Disabled Passengers

General rules

The general rules for accepting disabled (incapacitated), i.e., sick or invalid passengers and the conditions for such acceptance are found in PHM 5.5. These rules are governed by Company policy and are usually more restrictive than those stated below.

It is important to note that these restrictions only apply to disabled, i.e., immobilized passengers, as defined below. They do not restrict the transportation of other categories of disabled passengers, e.g., SA1, SB1 and SB2.

For all categories of disabled passengers, the cabin crew must have an individual briefing on safety items before takeoff.

Disabled passengers a person who cannot move himself from his seat to a floor level exit in case of an emergency evacuation.

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	The blind (persons having defective vision) or the deaf (persons having impaired hearing) are not included in the term “disabled passengers”.
Regular flights	scheduled flights or nonscheduled flights (charter flights) where an established max number of disabled passengers may be included in the total number of passengers to be carried.
Special flights	scheduled flights or nonscheduled flights (charter flights) where the number of disabled passengers traveling in groups may exceed the limit stated for regular flights.
Assisting persons	a person trained to help disabled passengers.

Seating

Some seats have been selected as being most suitable for use by disabled passengers. These seats are shown in PHM 7.2.

Before flight, the P-i-C must be informed of the total number of disabled passengers which will be carried and where they and their assisting persons will be seated.

Transportation of disabled passengers on regular flights

The total number of disabled passengers traveling on an individual basis is shown in PHM 7.2. They must be seated in the specific seats mentioned in PHM 7.2.

Transportation of disabled passengers on special flights

Special flights can include:

- flights with a group of disabled passengers together with ordinary passengers. In this case the disabled passengers must be seated as per the applicable version drawing which also shows the maximum number of disabled passengers which can be accepted, or
- flights with passengers including only disabled passengers and person accompanying them, i.e., helpers, nurses, relatives. In this case, the number of disabled passengers carried depends on such factors as length of flight and the disabled passengers’ need for assistance. The seating limitations will, therefore, be established for each separated flight, considering the factors mentioned above.

The conditions below are applied for all special flights:

- Disabled passengers must not be seated in the seat row nearest to an exit.
- There must be at least one assisting person for each group of five disabled passengers which exceeds the max number of disabled passengers on regular flights.

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Assisting person must be seated in close vicinity of the disabled persons.

- The minimum number of cabin attendants stated for the applicable cabin version must be increased by one cabin attendant for each group of 15 disabled persons above the number stated for regular flights.
- The additional cabin attendant may be replaced by an assisting person as long as this person has been specially trained to help disabled passengers in an emergency evacuation and also has knowledge of the applicable equipment and its operation.

Special flights must be arranged in advance.

Dispatch with One Cabin Door Inoperative

According to MEL 52-11-01, passenger seats must be blocked if the aircraft is to be dispatched with one cabin door inoperative.

The following tables show the blocked seat rows (additional blocked seats), the number of blocked seat and the remaining seat capacity of each aircraft version.

TJA,B,C,D,G,H

777-200 v7723			
Inoperative Door	**Blocked Row (Additional Blocked Seats)**	**No. of Blocked Seats**	**Remaining Seat Capacity**
1	11–14	18	12C/279Y
2	15–38 (14ABJK & 39DEF)	89	14C/206Y
3	39–56 (57DEF)	159	30C/120Y
4	58–63 (57ABCHJK)	50	30C/229Y

TJR to TJW

777-200ER v77E1			
Inoperative Door	**Blocked Row (Additional Blocked Seats)**	**No. of Blocked Seats**	**Remaining Seat Capacity**
1	11–14	18	12C/262Y
2	14–38	90	12C/190Y
3	39–56	147	30C/115Y
4	57–61	43	30C/219Y

TKA to TKF

777-300 v7732			
Inoperative Door	**Blocked Row (Additional Blocked Seats)**	**No. of Blocked Seats**	**Remaining Seat Capacity**
1	11–12	13	21C/330Y
2	14–36 (37ABC)	77	13C/274Y

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777-300 v7732			
Inoperative Door	**Blocked Row (Additional Blocked Seats)**	**No. of Blocked Seats**	**Remaining Seat Capacity**
3	38–53 (37DEFHJK)	129	34C/201Y
4	54–65 (66ABC)	95	34C/235Y
5	67–72 (66DEFHJK)	50	34C/280Y

TKK to TKR,
TKU to TKZ

777-300ER v77B1			
Inoperative Door	**Blocked Row (Additional Blocked Seats)**	**No. of Blocked Seats**	**Remaining Seat Capacity**
1	11–14	12	30C/306Y
2	15–22	30	12C/306Y
3	31–47	136	42C/170Y
4	48–66	120	42C/186Y
5	67–72	50	42C/256Y

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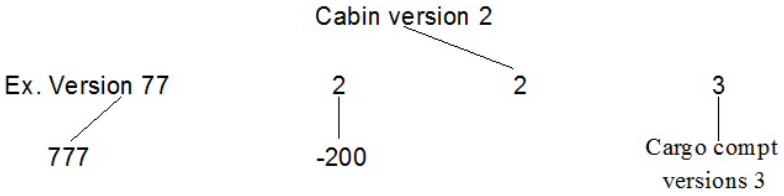
Version Numbering System

The interior version is identified by 5-digit number.

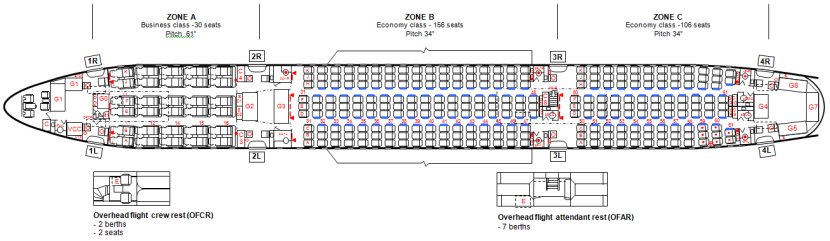
The first two figures in that No. denote aircraft type (77 for 777), the third figure is sub-model (2 for –200), the fourth figure is cabin version, and the last figure, which usually shows the number of pallets, identifies the cargo compartment version.



Note: When identifying interior version on Balance Tables and cabin version plans etc., the cargo compartment version number is usually omitted.

Examples of Interior Configuration

This is an example of Interior Configuration and is not kept up-to-date. The actual Interior Configuration can be found in flight deck, and in PilotDocs OH website.



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Weight Calculation

Definition of Empty Weight

Basic Empty Weight (BEW)

The basic empty weight and its related center of gravity are obtained through weighing the aircraft. Included in the BEW is the weight of the structure, power plant, fixed furnishings and other items of equipment that are considered integral parts of the aircraft. Also included is the weight of unusable fuel, usable manifold, lines and engine fuel, usable and unusable oil to engine, IDG and APU, potable water.

Basic Weight (BW)

Basic Empty Weight (BEW) plus Standard Loose Equipment and Version Equipment.

Dry Operating Weight and Index (DOW, DOI)

Basic Weight plus operational items, such as catering equipment, route equipment and crew (refer to Load Control Manual—LCM).

Calculation on Loadsheet

Refer to PLT/LCM.

Balance Calculation—General

Index Formula

The Index Formula used in the balance calculation reads as follows:

-200,-200ER

$$\text{Index} = \frac{\text{Weight (STA - 1258)}}{181400} + 50$$

-300,-300ER

$$\text{Index} = \frac{\text{Weight (STA - 1258)}}{317000} + 50$$

STA = Center of gravity location expressed in distance (inches) from the reference line (STA = 0).

Balance Aid

The Balance Aid to be used is of a combined graphical-numerical type.

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Balance Table

The Balance Table for applicable version is a means for balance control and must be used for all normal calculations of the aircraft balance condition at zero fuel weight. Instruction on how to use the Balance Table is printed on the back of the table.

The Balance Table is carried on board the aircraft in the Load Control Folder together with actual Load sheet in order to make it possible for the flight deck crew to check the balance calculation.

Center of Gravity and Stabilizer Setting Chart

The purpose of this chart is to determine stabilizer setting for takeoff under actual balance conditions.

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Examples of Balance Table

This is an example of Balance Table and is not kept up-to-date. The actual Balance Table can be found in flight deck, and in PilotDocs OH website.

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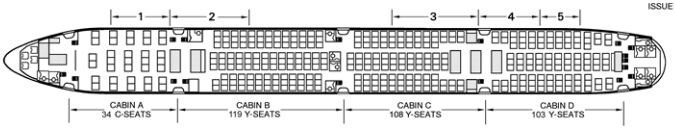
777-300
Balance Table Version 7732

STATION	
FLIGHT	
DATE	

ISSUE NO. 1



FWD COMPT 1		FWD COMPT 2		AFT COMPT 3		AFT COMPT 4		BULK COMPT 5	
	INDEX CORR		INDEX CORR		INDEX CORR		INDEX CORR		INDEX CORR
0 - 170	0	0 - 320	0	0 - 420	0	0 - 230	0	0 - 180	0
171 - 520	- 1	321 - 950	- 1	421 - 1270	1	231 - 700	1	181 - 530	1
521 - 860	- 2	951 - 1580	- 2	1271 - 2120	2	701 - 1170	2	531 - 880	2
861 - 1200	- 3	1581 - 2220	- 3	2121 - 2970	3	1171 - 1640	3	881 - 1240	3
1201 - 1550	- 4	2221 - 2850	- 4	2971 - 3820	4	1641 - 2100	4	1241 - 1590	4
1551 - 1890	- 5	2851 - 3490	- 5	3821 - 4660	5	2101 - 2570	5	1591 - 1950	5
1891 - 2230	- 6	3491 - 4120	- 6	4661 - 5510	6	2571 - 3040	6	1951 - 2300	6
2231 - 2580	- 7	4121 - 4750	- 7	5511 - 6360	7	3041 - 3500	7	2301 - 2650	7
2581 - 2920	- 8	4751 - 5390	- 8	6361 - 7210	8	3501 - 3970	8	2651 - 3010	8
2921 - 3270	- 9	5391 - 6020	- 9	7211 - 8060	9	3971 - 4440	9	3011 - 3360	9
3271 - 3610	- 10	6021 - 6650	- 10	8061 - 8900	10	4441 - 4910	10	3361 - 3720	10
3611 - 3950	- 11	6651 - 7290	- 11	8901 - 9750	11	4911 - 5370	11	3721 - 4082	11
3951 - 4300	- 12	7291 - 7920	- 12	9751 - 10600	12	5371 - 5840	12		
4301 - 4640	- 13	7921 - 8550	- 13	10601 - 11450	13	5841 - 6310	13		
4641 - 4990	- 14	8551 - 9190	- 14	11451 - 12300	14	6311 - 6770	14		
4991 - 5330	- 15	9191 - 9820	- 15	12301 - 13140	15	6771 - 7240	15		
5331 - 5670	- 16	9821 - 10460	- 16	13141 - 13990	16	7241 - 7710	16		
5671 - 6020	- 17	10461 - 11090	- 17	13991 - 14840	17	7711 - 8180	17		
6021 - 6360	- 18	11091 - 11720	- 18	14841 - 15690	18	8181 - 8640	18		
6361 - 6700	- 19	11721 - 12360	- 19	15691 - 16540	19	8641 - 9110	19		
6701 - 7050	- 20	12361 - 12990	- 20	16541 - 17380	20	9111 - 9580	20		
7051 - 7390	- 21	12991 - 13620	- 21	17381 - 18230	21	9581 - 10040	21		
7391 - 7740	- 22	13621 - 14260	- 22	18231 - 19044	22	10041 - 10510	22		
7741 - 8080	- 23	14261 - 14890	- 23			10511 - 10980	23		
8081 - 8420	- 24	14891 - 15530	- 24			10981 - 11450	24		
8421 - 8770	- 25	15531 - 16160	- 25			11451 - 11910	25		
8771 - 9110	- 26	16161 - 16790	- 26			11911 - 12380	26		
9111 - 9450	- 27	16791 - 17430	- 27			12381 - 12696	27		
9451 - 9800	- 28	17431 - 18060	- 28						
9801 - 10140	- 29	18061 - 18690	- 29						
10141 - 10490	- 30	18691 - 19330	- 30						
10491 - 10830	- 31	19331 - 19960	- 31						
10831 - 11170	- 32	19961 - 20590	- 32						
11171 - 11520	- 33	20591 - 21230	- 33						
11521 - 11860	- 34	21231 - 21860	- 34						
11861 - 12200	- 35	21861 - 22500	- 35						
12201 - 12550	- 36	22501 - 23130	- 36						
12551 - 12890	- 37	23131 - 23760	- 37						
12891 - 13240	- 38	23761 - 24400	- 38						
13241 - 13580	- 39	24401 - 25030	- 39						
13581 - 13920	- 40	25031 - 25660	- 40						
13921 - 14270	- 41	25661 - 26300	- 41						
14271 - 14624	- 42	26301 - 26758	- 42						

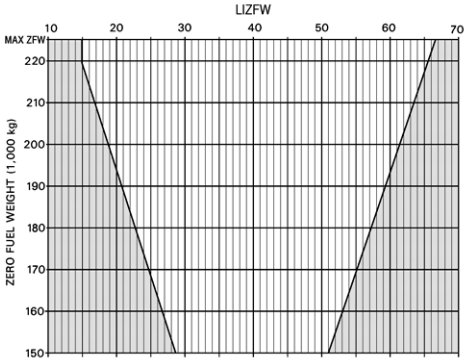
ROYAL EXECUTIVE A		MID ECONOMY C		AFT ECONOMY D	
	INDEX CORR		INDEX CORR		INDEX CORR
0 - 2	0	0 - 14	0	0 - 3	0
3 - 7	- 1	15 - 41	1	4 - 8	1
8 - 11	- 2	42 - 68	2	9 - 14	2
12 - 15	- 3	69 - 96	3	15 - 20	3
16 - 20	- 4	67 - 108	4	21 - 25	4
21 - 24	- 5			26 - 31	5
25 - 28	- 6			32 - 36	6
29 - 33	- 7			37 - 42	7
34	- 8			43 - 47	8
				48 - 53	9
				54 - 59	10
				60 - 64	11
				65 - 70	12
				71 - 75	13
				76 - 81	14
				82 - 87	15
				88 - 92	16
				93 - 98	17
				99 - 103	18

FWD ECONOMY B	
	INDEX CORR
0 - 5	0
6 - 16	- 1
17 - 27	- 2
28 - 38	- 3
39 - 49	- 4
50 - 60	- 5
61 - 71	- 6
72 - 81	- 7
82 - 92	- 8
93 - 103	- 9
104 - 114	- 10
115 - 119	- 11

BALANCE CALCULATION

	−	+	−	+
DOI				
COMPT 1				
COMPT 2				
COMPT 3				
COMPT 4				
COMPT 5				
TOTAL				
DLI				
CABIN A				
CABIN B				
CABIN C				
CABIN D				
TOTAL				
LIZFW				

BALANCE CHECK



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Examples of Center of Gravity and Stabilizer Setting Chart

This is an example of Center of Gravity and Stabilizer Setting Chart and is not kept up-to-date. The actual Center of Gravity and Stabilizer Setting Chart can be found in flight deck, and in PilotDocs OH website.

Flaps 5

THAI 777-300 Stab Setting Chart — Effective 25SEP09, Issue No. 4 — Flap 5

T/O Fuel (t)	LIZFW																																				
127.6-Full	27.9	30.4	32.8	35.3	37.8	40.2	42.7	45.1	47.6	50.1	52.5	55.0	57.4	59.9	62.4	64.8	66.5																				
116.1-127.5	24.9	27.4	29.8	32.3	34.8	37.2	39.7	42.1	44.6	47.1	49.5	52.0	54.4	56.9	59.4	61.8	64.3	66.5																			
104.1-116	20.9	23.4	25.8	28.3	30.8	33.2	35.7	38.1	40.6	43.1	45.5	48.0	50.4	52.9	55.4	57.8	60.3	62.7	65.2	66.5																	
91.1-104	16.4	18.9	21.3	23.8	26.3	28.7	31.2	33.6	36.1	38.6	41.0	43.5	45.9	48.4	50.9	53.3	55.8	58.2	60.7	63.2	65.6	66.5															
78.1-91		15.0	16.8	19.3	21.8	24.2	26.7	29.1	31.6	34.1	36.5	39.0	41.4	43.9	46.4	48.8	51.3	53.7	56.2	58.7	61.1	63.6	66.0	66.5													
65.1-78			15.0	17.2	19.5	21.9	24.3	26.7	29.1	31.4	33.8	36.2	38.6	41.0	43.4	45.7	48.1	50.5	52.9	55.3	57.6	60.0	62.4	64.8	66.5												
53.6-65			15.0	16.4	18.6	20.9	23.2	25.5	27.8	30.0	32.3	34.6	36.9	39.1	41.4	43.7	46.0	48.2	50.5	52.8	55.1	57.3	59.6	61.9	64.2	66.5											
49.1-53.5			15.0	17.0	19.2	21.4	23.6	25.8	28.0	30.2	32.4	34.6	36.8	39.0	41.2	43.4	45.6	47.8	50.1	52.3	54.5	56.7	58.9	61.1	63.3	65.5	66.5										
43.1-49			15.0	17.4	19.5	21.7	23.8	26.0	28.2	30.3	32.5	34.7	36.8	39.0	41.1	43.3	45.5	47.6	49.8	51.9	54.1	56.3	58.4	60.6	62.7	64.9	66.5										
1-43		17.7	19.7	21.8	23.8	25.8	27.8	29.8	31.9	33.9	35.9	37.9	39.9	42.0	44.0	46.0	48.0	50.0	52.1	54.1	56.1	58.1	60.1	62.2	64.2	66.5										
CG (% MAC)	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41									
TOW (t)	Stabilizer Setting																																				
290-Max	8.5	8.25	8.25	8	7.75	7.5	7.25	7	6.75	6.5	6.25	6	5.75	5.5	5.25	5	4.75	4.5	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25								
270-289.9			8	7.75	7.5	7.25	7	6.75	6.5	6.25	6	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2										
250-269.9	8	7.75	7.75	7.5	7.25	7	6.75	6.5	6.25	6	5.75	5.5	5.5	5.25	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2	1.75									
230-249.9	7.75	7.5	7.25	7	6.75	6.5	6.25	6	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2	1.75	1.5										
210-229.9	7.5	7.25	7	6.75	6.5	6.5	6.25	6	5.75	5.5	5.25	5	4.75	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2	1.75	1.5									
190-209.9	7	7	6.75	6.5	6.25	6	5.75	5.5	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2	1.75	1.5											
170-189.9	6.75	6.5	6.25	6	6	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2	1.75	1.5	1.25	1											
150-169.9	6.25	6	6	5.75	5.5	5.25	5	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.5	2.25	2	1.75	1.5	1.25	1											

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Flaps 15–20

THAI 777-300 Stab Setting Chart — Effective 25SEP09, Issue No. 5 — Flaps 15-20

T/O Fuel (t)	LIZFW																															
127.6-Full	27.9	30.4	32.8	35.3	37.8	40.2	42.7	45.1	47.6	50.1	52.5	55.0	57.4	59.9	62.4	64.8	66.5															
116.1-127.5	24.9	27.4	29.8	32.3	34.8	37.2	39.7	42.1	44.6	47.1	49.5	52.0	54.4	56.9	59.4	61.8	64.3	66.5														
104.1-116	20.9	23.4	25.8	28.3	30.8	33.2	35.7	38.1	40.6	43.1	45.5	48.0	50.4	52.9	55.4	57.8	60.3	62.7	65.2	66.5												
91.1-104	16.4	18.9	21.3	23.8	26.3	28.7	31.2	33.6	36.1	38.6	41.0	43.5	45.9	48.4	50.9	53.3	55.8	58.2	60.7	63.2	65.6	66.5										
78.1-91		15.0	16.8	19.3	21.8	24.2	26.7	29.1	31.6	34.1	36.5	39.0	41.4	43.9	46.4	48.8	51.3	53.7	56.2	58.7	61.1	63.6	66.0	66.5								
65.1-78			15.0	17.2	19.5	21.9	24.3	26.7	29.1	31.4	33.8	36.2	38.6	41.0	43.4	45.7	48.1	50.5	52.9	55.3	57.6	60.0	62.4	64.8	66.5							
53.6-65			15.0	16.4	18.6	20.9	23.2	25.5	27.8	30.0	32.3	34.6	36.9	39.1	41.4	43.7	46.0	48.2	50.5	52.8	55.1	57.3	59.6	61.9	64.2	66.5						
49.1-53.5			15.0	17.0	19.2	21.4	23.6	25.8	28.0	30.2	32.4	34.6	36.8	39.0	41.2	43.4	45.6	47.8	50.1	52.3	54.5	56.7	58.9	61.1	63.3	65.5	66.5					
43.1-49			15.0	17.4	19.5	21.7	23.8	26.0	28.2	30.3	32.5	34.7	36.8	39.0	41.1	43.3	45.5	47.6	49.8	51.9	54.1	56.3	58.4	60.6	62.7	64.9	66.5					
1-43		17.7	19.7	21.8	23.8	25.8	27.8	29.8	31.9	33.9	35.9	37.9	39.9	42.0	44.0	46.0	48.0	50.0	52.1	54.1	56.1	58.1	60.1	62.2	64.2	66.5						
CG (% MAC)	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41				
Stabilizer Setting																																
TOW (t)																																
290-Max	9	8.75	8.5	8.25	8	7.75	7.5	7.25	7	6.75	6.5	6.25	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25					
270-289.9	8.75	8.5	8.25	8	7.75	7.5	7.25	7	6.75	6.5	6	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2				
250-269.9	8.5	8.25	8	7.75	7.5	7	6.75	6.5	6.25	6	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.25	3	2.75	2.5	2.25	2	1.75					
230-249.9	8	7.75	7.5	7.25	7	6.75	6.5	6.25	6	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2	1.75	1.5				
210-229.9	7.75	7.5	7.25	7	6.75	6.5	6.25	6	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2.25	2	1.75	1.5	1.5			
190-209.9	7.5	7.25	7	6.75	6.5	6.25	6	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2	1.75	1.5	1.25	1.25				
170-189.9	7	6.75	6.5	6.25	6	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2	1.75	1.75	1.5	1.25	1.25					
150-169.9	6.25	6	6	5.75	5.5	5.25	5	4.75	4.5	4.25	4	3.75	3.5	3.25	3	2.75	2.5	2.25	2	1.75	1.5	1.5	1.25	1.25	1	1	1					

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Fueling Instruction MT.1

Limitations MT.1.1

Fuel Capacity MT.1.1

Fueling Pressure MT.1.1

Fueling, General MT.1.2

Aircraft Preparation for Pressure Fueling MT.1.5

Pressure Fueling MT.1.5

Fuel with Inoperative Refuel Valve MT.1.7

Fueling with Inoperative Quantity Indication MT.1.8

Aircraft Restoration MT.1.8

Quality Control MT.1.8

Water Check After Fueling MT.1.9

Fuel Stick Operation MT.1.9

Fuel Uplift MT.1.10

Reduced Line Check (RLC) MT.2

General MT.2.1

Inspection MT.2.1

After Parking Check MT.2.1

Preflight Check MT.2.3

Maintenance Release MT.2.6

Parking without Aid of Station Engineer MT.3

General MT.3.1

Parking in Strong Wind MT.3.1

Parking for a Longer Period (e.g., Overnight) MT.3.1

RLC—Expanded Procedures MT.4

Introduction MT.4.1

Engine Oil Filling (RLC Expanded) MT.4.1

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Installation of Landing Gear Lock Pins (RLC—Parking) MT.4.3
Tire Inflation (RLC—Parking) MT.4.6
Tire pressures MT.4.6
Tire inflation pressure (psi) MT.4.6
Draining Water System MT.4.8

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Limitations

Fuel Capacity

At density 0.803 kg/liter.

-200

	Tank Capacity		Usable Fuel		Unusable Fuel	
	liter	kg	liter	kg	liter	kg
Left main tank	35,204	28,269	35,204	28,269	47.3	38
Right main tank	35,204	28,269	35,204	28,269	47.3	38
Center tank	46,939	37,692	46,939	37,692	3.4	3
Fuel in manifold	N/A	N/A	235	188	71.5	57
Fuel in feed line	N/A	N/A	45.4	37	44.7	36
Total	117,347	94,230	117,627	94,454	214.2	172

-200ER,-300

	Tank Capacity		Usable Fuel		Unusable Fuel	
	liter	kg	liter	kg	liter	kg
Left main tank	36,188	29,060	36,188	29,060	47.3	38
Right main tank	36,188	29,060	36,188	29,060	47.3	38
Center tank	98,799	79,340	98,799	79,340	11.4	9
Fuel in manifold	N/A	N/A	235	188	71.5	57
Fuel in feed line	N/A	N/A	45.4	37	44.7	36
Total	171,175	137,460	171,455	137,678	222.2	178

-300ER

	Tank Capacity		Usable Fuel		Unusable Fuel	
	liter	kg	liter	kg	liter	kg
Left main tank	38,989	33,171	38,989	33,171	47.3	38
Right main tank	38,989	33,171	38,989	33,171	47.3	38
Center tank	103,303	87,887	103,303	87,887	11.4	9
Fuel in manifold	N/A	N/A	201	161	68.9	55
Fuel in feed line	N/A	N/A	45.4	36	19.7	16
Total	181,281	154,229	181,527	154,426	194.6	156

Fueling Pressure

Minimum: 6 (psi)

Maximum: 55 (psi)

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Fueling, General

Special regulations for fueling with passengers on board are covered in MOM 5.1.3. which is included in SHB/PLT.

At maintenance bases and turnaround stations, the maintenance personnel take care of the fueling operation, quantity check and fuel tank sump draining.

At transit stations, the pilot is normally responsible for making the quantity check, whereas the ground crew take care of the quantity check by means of fuel measuring sticks (fuel sticks) and other duties required on ground in connection with the fueling.

At alternate stations, the pilot is responsible for the entire fueling procedure, and if the aircraft has been fueled with Type A or B fuel, he shall also make a note in the Aircraft Log stating “FUEL TYPE”, “UPLIFT quantity” and total “RAMP FUEL”.

The aircraft is normally fueled by using the pressure fueling method.

Control of the pressure fueling operation is from the left wing fueling control panel.

If APU or external power source is not available, power for pressure fueling control can be obtained from the aircraft battery.

Filler necks are provided for overwing gravity fueling of the main tanks.

Sixteen fuel sticks are installed as a supplementary means of fuel quantity measurement, see Location of Fuel Sticks and Sump Drain Valves on page MT.1.4.

It is the responsibility of the person supervising the fueling to decide if a fuel stick check is required, considering such factors as lack of correspondence in the fueling order, suspect instrument failure, abnormal aircraft attitude or desired accuracy with regard to subsequent flight conditions, etc.

CAUTIONS:

1. **If the total aircraft gages read more than plus 1% of total required ramp fuel, immediately contact the Load Control Supervisor or the Weight and Balance Office to check whether defueling must be performed, or if the loadsheet can be corrected so as to correspond with the actual ramp fuel.**
2. **Do not operate any jettison valves or wing tank jettison pumps during fueling, as this may result in pressure surge causing damage to the fueling receptacle adapters.**

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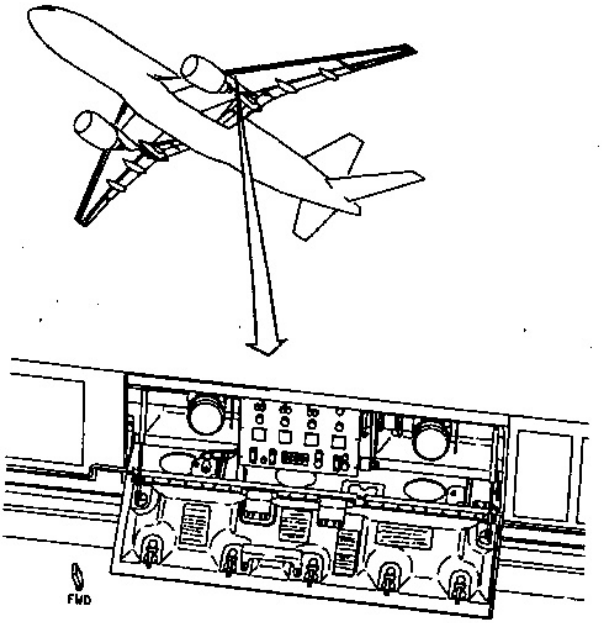
Refuel Station



Refuel station

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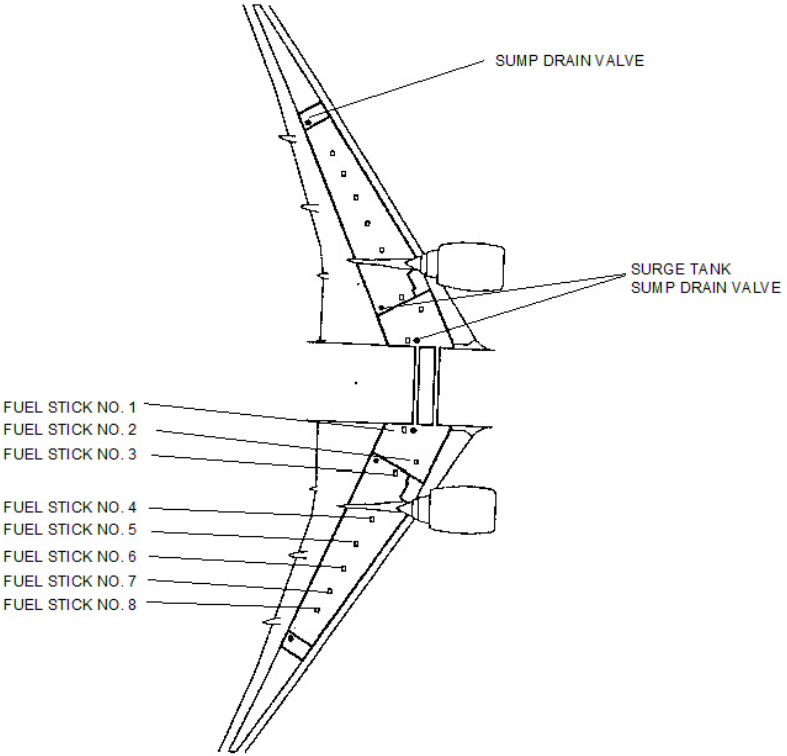
Location of Fuel Sticks and Sump Drain Valves



Location of fuel stick and sump drain valves

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Aircraft Preparation for Pressure Fueling

Apply electrical power.

Install a DO NOT OPERATE tag to the flap control lever.

WARNING: Accidental slat operation could cause damage or injury.

Electrically ground aircraft and fueling source.

WARNINGS:
1. **Failure to ground correctly could cause a fire or explosion.**
2. **Do not operate the HF or weather radar during refueling. A fire or explosion can occur.**

Open fueling station access door.

Connect fueling nozzle to fueling receptacles.

Move POWER switch to NORM or BATT.

Select NORM if AC power is available.

Select BATT if AC power is not available.

Make sure the fuel quantity displays are on.

The FUEL QTY displays will come on within 60 sec after the fueling station doors are open.

Check the FUEL QTY display show the fuel quantity.

Push the TEST IND switch to do a test.

Check that the FUEL QTY and LOAD SEL displays show the test pattern.

Push and release each refuel valve light.

Check lights come on and then go off.

Continue with Pressure Fueling Procedure.

Pressure Fueling

The fuel pressure over 55 psi at fueling nozzle can cause damage to the system component.

Preselect the fuel quantity for each fuel tank:

Use LOAD SELECT QTY thumbwheel switch to set the required quantity.

Push LOAD SELECT SET switch for the applicable tank for one second then release.

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Check the LOAD SEL display of the applicable tank shows the correct fuel quantity.

If you make an error or want to change, push the LOAD SELECT SET switch of the applicable tank to remove the memory and do the procedure again.

Start fueling source.

Open the refuel valves switch of the applicable tank.

Check the blue lights come on,

If blue lights do not come on, see Fuel with Inoperative Refuel Valve on page MT.1.7.

Monitor fuel quantity on the FUEL QTY display.

When the applicable tanks have fuel equal to the preselect quantity or the tank is full, FQIS will automatically close the refuel valves.

Set the refuel valve switch of the tank that is completed to CLOSE position.

Stop the fueling source.

Continue with Aircraft Restoration Procedure.

Preselect the total fuel quantity:

Use LOAD SELECT QTY thumbwheel switch to set the required quantity.

TOTAL/BACKUP display on IRP is set to show the total fuel quantity.

Push LOAD SELECT SET switch of the total fuel indicator for one second then release.

Check the LOAD SEL display of the TOTAL/BACKUP display shows the correct fuel quantity.

If you make an error or want to change, push the LOAD SELECT SET switch of the TOTAL/BACKUP to remove the memory and do the procedure again.

Start fueling source.

Open the refuel valves switch of the applicable tank.

Check the blue lights come on,

If blue lights do not come on, see Fuel with Inoperative Refuel Valve on page MT.1.7.

Monitor fuel quantity on the FUEL QTY display.

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When the applicable tanks have fuel equal to the preselect quantity or the tank is full, FQIS will automatically close the refuel valves.

Set the refuel valve switch of the tank that is completed to CLOSE position.

Stop the fueling source.

Continue with Aircraft Restoration Procedure.

Manual fueling:

Start fueling source.

Open the refuel valves switch of the applicable tank.

Check the blue lights come on,

If blue lights do not come on, see Fuel with Inoperative Refuel Valve on page MT.1.7.

Monitor fuel quantity on the FUEL QTY display.

When the applicable tank have fuel equal to the required quantity, close the refuel valve switch.

Stop the fueling source.

Continue with Aircraft Restoration Procedure.

Fuel with Inoperative Refuel Valve

The inoperative tanks can be fueled by normal fueling procedure.

Make sure that fueling manifold is depressurized.

Remove lockwire from knob of valve override screw.

Open the inoperative refuel valve by turning override screw 10–13 complete revolution in CCW direction.

Make sure that all refuel valve switches are in CLOSE position.

Start fueling source.

Monitor fuel quantity on the FUEL QTY display.

When the applicable tank have fuel equal to the required quantity, stop the fueling source.

Close the inoperative refuel valve by turning overrides screw 10–13 complete revolution in CW direction.

Lockwire knurled knob or valve override screw.

Continue with Aircraft Restoration procedure.

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Fueling with Inoperative Quantity Indication

The tanks with operative quantity indication can be fueled by normal fueling procedure.

The tank with inoperative quantity indication is refueled by using a fuel measuring stick to monitor the fuel quantity.

The volumetric shutoff function is not available, fuel can spill into the surge tanks.

Make sure that FUEL QTY display is inoperative by:

Waiting 60 sec after the access door is opened.

If the FUEL QTY display does not show, pushing the POWER switch to the BATT position.

If one or more display is off, doing next step.

Start fueling source.

If the message PUSH SET shows, push the SET switch to continue refueling.

Open the refuel valve switch.

Check the blue lights go on.

Only one refuel valve of the related tank is open.

Use a fuel measuring stick to monitor the fuel quantity.

Close the refuel valve switch when fuel is equal to the required quantity.

Stop the fueling source.

Continue with Aircraft Restoration Procedure.

Aircraft Restoration

Disconnect fueling nozzles.

Disconnect electrical ground.

If the POWER switch is selected to BATT, switch to NORMAL position.

Close the access door.

Remove DO NOT OPERATE tag from the flap control panel.

Quality Control

At alternate stations without Company or Company-hired ground mechanic, the pilot shall request the fueling Company to make a water and dirt test.

Refer to PLT (MOM 5.1.2).

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Water Check After Fueling

At alternate stations without Company or Company-hired ground mechanic, the pilot shall also do a fuel water check as outlined below:

Drain fuel tank sumps (4) as late as possible after fueling (minimum 5 min) in order to allow water to settle.

For locations of drain valves, see Location of Fuel Sticks and Sump Drain Valves on page MT.1.4.

The drain should be done as follows:

Position tube of drain container against sump drain valve poppet and push upward until fuel flows into container.

Drain each sump until fuel entering container is free of water.

Release upward pressure and allow poppet to close without leakage.

Fuel Stick Operation

The fuel stick assemblies are given as a manual means of measuring the quantity of fuel in the tanks.

The fuel sticks are installed in the lower surface of the wing except the stick in the center tank which is installed in the tank bottom and can be reached through an access door on the wing-to-body fairing. For fuel stick location, see Refuel Station on page MT.1.3.

To unlock fuel stick:

Turn 90° counterclockwise and pull (use a screwdriver or other suitable tool).

Lower the stick past the magnet and then slowly raise it on the fingertip or palm until it is captured by the magnet.

Read the level in line with the outside surface of the wing skin and without touching the stick.

Repeat once to verify first reading and then check against Fuel Distribution Chart value.

If actual fuel stick reading differs more than 1 ½ inches from the published fuel stick reading in the FIH, the cause may be:

- Density of fuel in tank differs from the value given by fuel supplier,
- Incorrect use of Fuel Distribution Chart,
- Incorrect fuel quantity indicator,
- Aircraft not in level attitude, 0.7°±0.25° nose down and 0.0°±0.25° roll.

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To lock the fuel stick:

Push the stick up, apply a slight pressure at its lower end and turn clockwise until it becomes locked in place.

Fuel stick reading charts give reading of fuel quantity for various stick. As aircraft pitch and roll attitude have a direct effect on stick reading. The charts are in Maintenance Manual section 12-11-04.

Fuel Uplift

The Technical Log form (THAI 3634 R2) is bound in a pad containing 50 sets of pages, which includes the Fuel Uplift to be part of this Log.

Refer to A/C Log Handling Procedure in TTPM-LO 1201 which extracted to be parts of SHB.

When the fueling is completed, make sure that the actual FOB is in accordance with the required Ramp Fuel, i.e.:

- individual fuel tank gage readings shall be as close as possible to, but not less than, the requirements except when filled to capacity. In case of faulty gage, use stick reading for affected tank and make a note in the Technical Log.

It is the responsibility of the person supervising the fueling to decide if a fuel stick check is required, considering such factors as lack of correspondence in the Fuel Uplift, suspected instrument failure, abnormal attitude or desired accuracy with regard to subsequent flight conditions, etc.

- A fuel stick check to confirm gage reading is always carried out when fueling in conjunction with a Light Maintenance visit.
- Check that the total airplane gage reading (FOB) roughly agree with total required Ramp Fuel.

CAUTION: **If the total of the airplane gage reading (FOB) more than +1% of total required RAMP FUEL, immediately contact the Load Control Supervisor or the Weight and Balance Officer to check whether defueling must be performed or if the loadsheet can be corrected so as to correspond with the actual Ramp Fuel.**

Note: Check that Uplift quantity comparted to Calculated quantity is within 2%.

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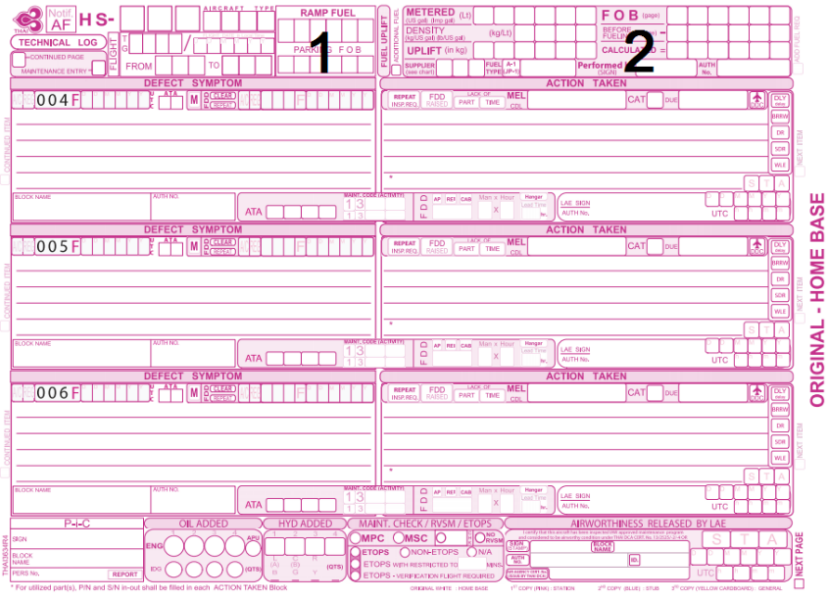

1 Input fields shown at 4 on graphic

RAMP FUEL—P-i-C shall fill in the required fuel quantity in kg. for this flight.

PARKING FOB—P-i-C shall fill in the remained fuel quantity in kg. after arrived Destination.

2 Input fields shown at 5 on graphic

FUEL UPLIFT—LAE shall perform refueling then fill in fuel data on same page of departure flight.

ADDITIONAL FUEL—LAE shall Mark X in case of additional fuel required.

METERED—Fuel uplift in local unit (read from truck) (circle the unit).

S.G.—Specific Gravity = Fuel density in local unit (circle the unit).

UPLIFT in kg.—Fuel uplift in kg. (Conversed from local unit).

SUPPLIER (see chart)—Fuel supplier 3 digit code.

Note: Supplier Code provided on the Log—Inside page.

FUEL TYPE: A-1 (JP-1)—Circle for the preprinted fuel type A-1 (JP-1) type. However, if kerosene-type fuel with a freezing point of –47 deg. C or below is not available (see Engine Fuel System on page L.10.5), fill in the box with uplifted type of fuel.

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F O B (gage)—Final Fuel On Board (read from flight deck gage).

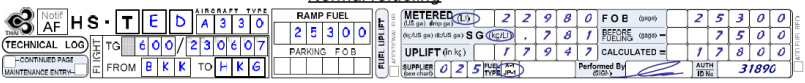
BEFORE FUELING (gage)—Remained fuel before start to refueling (read from flight deck gage).

CALCULATED—FOB minus BEFORE FUELING.

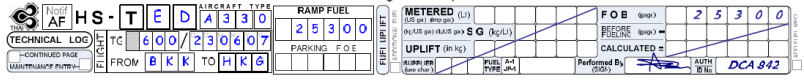
LAE (sign)/AUTH No.—The signature and Authorized No. of LAE.

ADD FUEL REQ—Mark X for the additional fuel required.

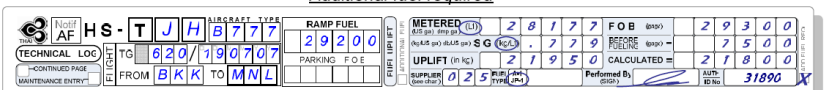
Normal refueling



Refueling not required



Additional fuel required



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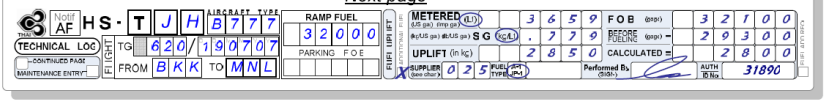

Note: In case the defect occurs after refueling completed, the new page shall be entered and Fuel Uplift data filled in same as 'Refueling Not Required' format.

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General

The Thai Department of Aviation has approved that a Reduced Line Check (RLC) may be carried out by P-i-C in place of the standard Maintenance Preflight Check (MPC). The RLC is performed at a station where, for unforeseen reasons, an authorized licensed engineer is not available (e.g. when landing at an alternate station) provided that the aircraft has a valid maintenance release (MPC, MSC or higher) performed within the last 24 hours.

Since the RLC is based on the MPC, it may not be performed in place of the MSC.

The primary objective of the RLC is to visually inspect the aircraft before flight for external damage or other obvious faults, such as abnormal leaks, etc.

The RLC is divided into:

- the After Parking Check, and
- the Preflight Check.

Inspection

After Parking Check

The After Parking Check shall be performed immediately after the aircraft has been parked.

Engine oil level . . . . . CHECK

WARNINGS:
1. **Do not touch the components of the oil system if the engine is hot. These components stay hotter than other components. Hot components can burn you.**
2. **Do not open the oil system until the pressure goes to zero. The pressure goes to zero approx 5 min after an engine is shutdown. A pressurized oil system can release a spray of hot oil that can burn you.**

The oil shall be filled 5 min after shutdown.

Determine if the airplane will fly for more or less than 6 flight hours on the next flight:

- If the airplane will fly for 6 or more flight hours then examine the oil quantity on oil tank sight glass. If engine oil quantity indicator show less than FULL mark, fully fill the engine oil tank.

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- If the airplane will fly less than 6 flight hours on the next flight, then examine the oil quantity indicator on secondary engine parmeter display. If the oil quantity indicator shows there is less than 17.0 liters of oil in the engine, oil servicing is necessary

Notes: 1. Maximum engine oil consumption for RR engine is 0.66 liters/hour.

2. Maximum engine oil consumption for GE engine is 0.62 liters/hour.

Record refilled oil quantity per engine in the Aircraft Log.

Fuel quantity . . . . . CHECK

Completion of fuel quantities in Aircraft Log and fueling shall be performed according to Fueling Instruction section.

Hydraulic fluid level . . . . . CHECK

Check hydraulic quantity on STATUS page to be more than 0.75.

To get the correct results when you do a check of the hydraulic fluid quantities or fill the reservoirs, the aircraft should be in this condition:

- spoilers retracted,
- landing gear down,
- landing gear doors closed,
- thrust reversers retracted, and
- parking brake accumulator pressure at least 2500 psi.

If level is low, a leak may exist which requires maintenance action.

Record refilled quantity per system in the Aircraft Log.

Oxygen pressure . . . . . CHECK

Minimum crew-oxygen supply-pressure see Crew Oxygen Requirements on page PD.11.8 for 777-200, or page PD.21.8 for 777-200ER, or page PD.31.8 for 777-300 or page PD.41.9 for 777-300ER.

Wheel chocks . . . . . IN PLACE

Check that chocks are installed in front of and behind the nose wheels.

Release parking brakes when chocks are installed.

Landing gear lock pins . . . . . INSTALL

See RLC—Expanded Procedures on page MT.4.1.

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Wheel, tires, and brakes . . . . . CHECK

Check all wheels and tires, presence of bolt nuts for condition and damage.

Check tire pressure visually and tire temperature by hand.

Check brake units, anti-skid transducer drive assembly including hubcaps.

Aircraft exterior . . . . . CHECK

Check the following:

- radome, fuselage, wing skin, and tail section including flight control surfaces for general condition and evidence of fluid leaks
- windshield wiper stops are visible
- oxygen discharge indicator is intact
- slats for aerodynamic cleanliness (dead insects, etc.)
- APU area for evidence of fluid leakage.

Engine and pylons . . . . . CHECK

Check the following:

- pylons and engine cowlings for general condition and evidence of fluid leaks
- engine air intake, spinner, fan blades, fan air exit and exhaust nozzle for general condition, as far as visible from the ground.

When parking for a longer period, e.g. overnight:

Do the additional parking check according to MT.3. Parking Without Aid of Station Engineer.

Preflight Check

The preflight check shall be done immediately, before engine start as a Walk-Around Inspection.

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Nose gear and wheel well . . . . . CHECK

Check the following:

- tires for acceptable condition
- shock strut inner cylinder is visible and no leakage exists
- towing lever not in the TOW position
- torsion links connected, quick disconnect fitting in place
- nose gear and wheel well area are free of fluid leaks and in acceptable condition
- ground lock pin removed.

Nose section . . . . . CHECK

Probes and sensors to be in place and cover removed.

Windshield wiper stops are visible.

Crew oxygen discharge indicator in place.

Right forward fuselage . . . . . CHECK

Check the following:

- cabin and cargo doors that are not in use closed and door handles recessed
- static ports uncovered
- wing illumination light illuminated
- landing light lens clean and unbroken
- radio antenna in acceptable condition
- pack inlet and exit doors full open
- fuselage skin in acceptable condition, no evidence of fluid leaks and all panels closed and fastened.

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Right wing and engine 2 . . . . . CHECK

Check the following:

- inboard wing undersurfaces and slats in acceptable condition, no evidence of fluid leaks, and all panels closed and fastened
- No. 2 engine strut in acceptable condition access panels closed, latches secured and no evidence of fluid leaks
- P20/T20 probe in acceptable condition
- cooling air inlet unobstructed
- exhaust section in acceptable condition and unobstructed
- thrust reverser sleeves fully forward
- fan air exit and inlet cowl in acceptable condition
- engine cowling latches secured, access panels closed and no evidence of excessive fluid accumulation under nacelle
- outboard wing undersurface and slats in acceptable condition, no evidence of fluid leaks, and all panels closed and fastened
- fuel vent outlet unobstructed
- navigation light lens unbroken and light illuminated
- fuel jettison nozzle unobstructed and no fuel leakage
- static dischargers in place
- flaperon and aileron and trailing edge flaps in acceptable condition.

Right landing gear . . . . . CHECK

Check the following:

- tires for acceptable condition
- shock strut inner cylinder visible
- gear and wheel well area free of fluid leaks and in acceptable condition
- ground lock pins removed.

Right aft fuselage . . . . . CHECK

Check the following:

- passenger and cargo doors that are not in use closed and door handles recessed
- fuselage skin in acceptable condition, no evidence of fluid leaks, and all panels closed and fastened.

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Empennage and control surfaces . . . . . CHECK

Check the following:

- all fixed and movable control surfaces in acceptable condition, no evidence of fluid leaks, and panels closed and fastened
- left and right navigation light lens unbroken and lights illuminated
- spoilers retracted
- static dischargers in place
- horizontal stabilizer in approximately neutral position.

Left aft fuselage . . . . . CHECK

Perform same inspection as right aft fuselage.

Aft outflow valve full open and unobstructed.

Left landing gear . . . . . CHECK

Perform same inspection as right landing gear.

Left wing and engine 1 . . . . . CHECK

Perform same inspection as right wing and engine 2.

Left forward fuselage . . . . . CHECK

Perform same inspection as right forward fuselage.

Forward outflow valve full open and unobstructed.

Check cabin positive/negative pressure-relief valve doors closed.

All pulled C/B in main equipment center (if applicable) . . . . . RESET

Maintenance Release

After the RLC has been performed, the necessary entries must be made in the Aircraft Log and a Maintenance Release decided upon.

Enter all complaints found during the RLC.

Evaluate all complaints entered after the previous Maintenance Release.

If any of the complaints is such that corrective action must be taken before flight, or whenever in doubt as to any technical problem, request advice from BKKOPTG, or if more convenient, from a THAI station engineer at a nearby station. (Refer to SHB TTPM LO 1201).

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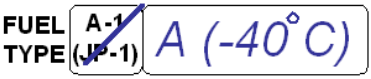
If there are no complaints, or when it has been ascertained that the complaints entered in the log can be accepted without corrective action:

Complete the Aircraft Log by:

- Entering “RLC” on CHK box,
- Marking X for RLC CHK,
- Marking X for NON-ETOPS,
- Signing and naming with Pers. No., station code, date and time in UTC on AIRWORTHINESS RELEASED item.

Remove 1st Copy page (pink) with any notation and hand over to the THAI station representative or handling agent. If there is no THAI representative or handling agent, refer to OM-A 8.1.11—Aircraft Log Handling Procedure.

REDUCE LINE CHECK (RLC) Performed by P-i-C



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General

During normal weather conditions, the aircraft should be parked or headed in a direction that will best facilitate servicing regardless of prevailing winds.

Parking in Strong Wind

If wind gusts are expected to exceed 90 kt, the aircraft should be headed into wind to prevent structural damage to primary control surfaces.

Parking for a Longer Period (e.g., Overnight)

In case there is no station engineer available, e.g., when landing at an alternate airport, the Pilot-in-Command is responsible for the following items to be performed:

Park the aircraft on a level surface.

If no external power is available, keep the APU running until all cargo doors have been closed.

Place wheel chocks both in front of and behind the main gear wheels.

Insert the landing gear lockpins, if required.

Install pitot probe covers.

Make sure that wing flaps, slats, spoilers and engine reversers are retracted.

Install engine inlet cover or engine fan tie-down straps if required due to weather conditions.

Close all cargo compartment doors.

In cold weather, –4 deg. C or below, drain the water from all water and waste system in the aircraft.

Close the air conditioning ram air inlets by running all air conditioning packs to the full hot position.

Close cabin pressure outflow valves.

If APU is used for electrical power, check all cargo doors closed. Shut down the APU. To allow for completion of APU door closing cycle, wait at least 60 sec after APU COOLDOWN status-message disappears before setting the battery switch to OFF.

Close all passenger compartment doors.

Close all exterior access, service and inspection panels.

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Disconnect external power, if used.

Remove stairway(s).

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Introduction

This section gives information and procedures required when performing the Reduced Line Check and Parking Without Aid of Station Engineer which are not available in other chapters of the FCOM.

In several procedures, help and equipment from ground personnel at the local airport is required to correctly perform the actions. The utilized personnel should be experienced to the kind of operation involved, however, not necessarily on 777.

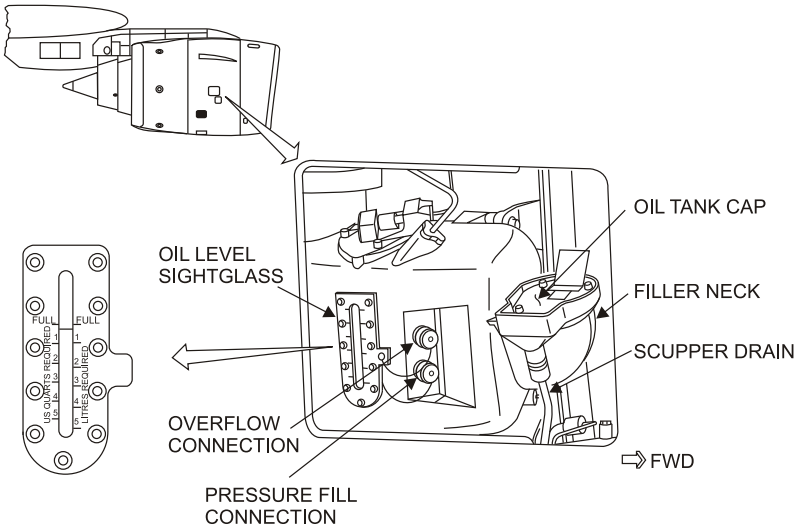
If there is any uncertainty about any action, the nearest THAI station with a station engineer or the Maintenance Base in BKK should be contacted for advice.

Engine Oil Filling (RLC Expanded)

It is assumed that the local oil company can supply the necessary filling equipment as well as with oil of correct quality.

Location of oil tank

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF



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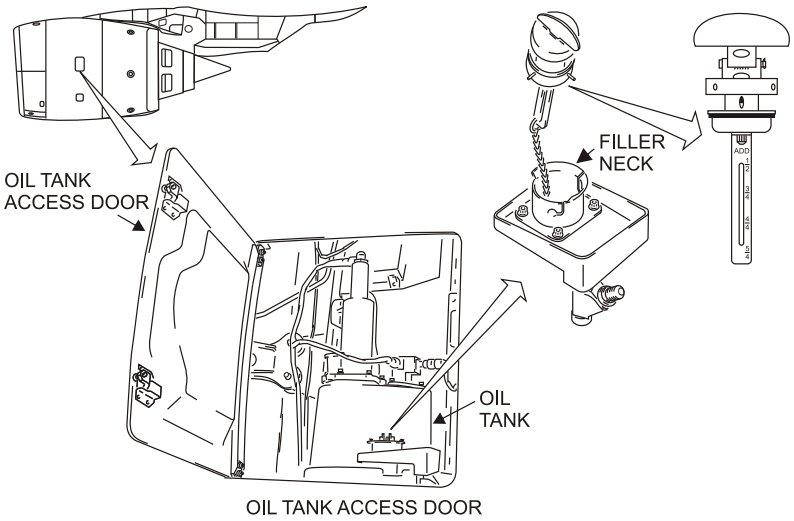
TKK to TKR,
TKU to TKZ



The oil is added to the engine oil tank through the filler neck. Oil replenishment should be accomplished within 30 min after engine shutdown for consistent results.

Note the refilled oil quantity for each engine in Aircraft Log.

Engine Oil Servicing (Gravity Fill):

WARNINGS:
1. **Do not touch the components of the oil system if the engine is hot. These components stay hotter than other components. Hot components can burn you.**
2. **Do not open the oil system until the pressure goes to zero. The pressure goes to zero approx 5 min after an engine is shut down. A pressurized oil system can release a spray of hot oil that can burn you.**

Add oil to the tank through the filler neck until the correct level is seen in the oil level sightglass.

Engine Oil Servicing (Pressure Fill):

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WARNINGS:
1. **Do not touch the components of the oil system if the engine is hot. These components stay hotter than other components. Hot components can burn you.**
2. **Do not open the oil system until the pressure goes to zero. The pressure goes to zero approx 5 min after an engine is shut down. A pressurized oil system can release a spray of hot oil that can burn you.**

Connect a drain hose to the overflow connection first.

Fill the oil tank through the pressure fill connection until oil comes out of the drain hose.

Installation of Landing Gear Lock Pins (RLC—Parking)

Installation of landing gear lock pins is normally not required during routine parking or when the aircraft is towed or pushed with flight crew in the aircraft. However, if aircraft is moved from tarmac to maintenance area or vice versa, lock pins should normally be installed.

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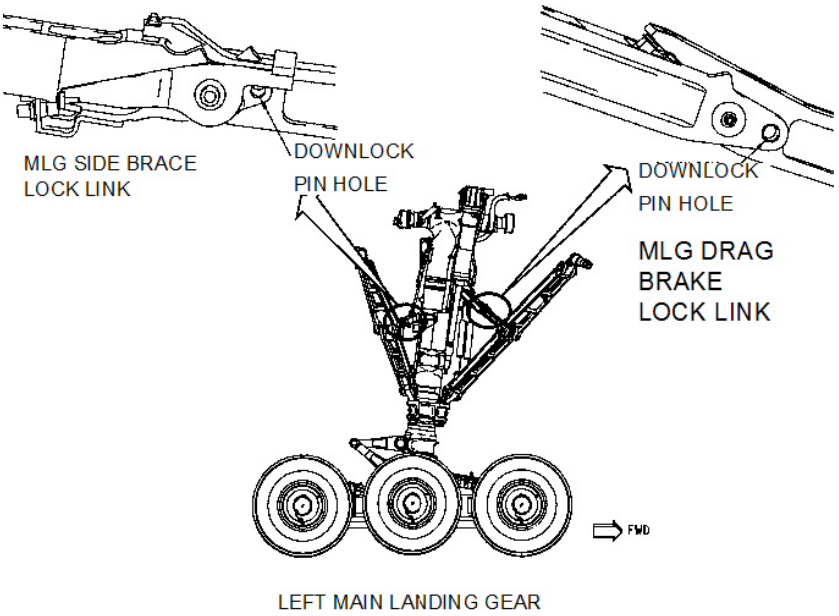

Main gear ground-lock-pin installation

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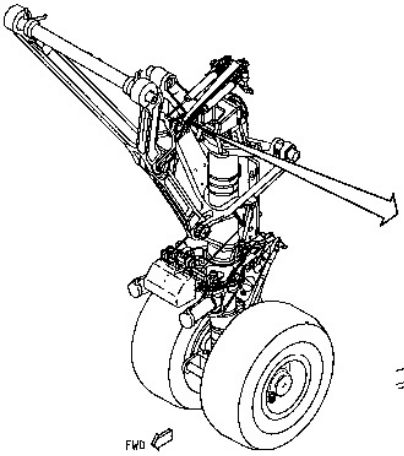
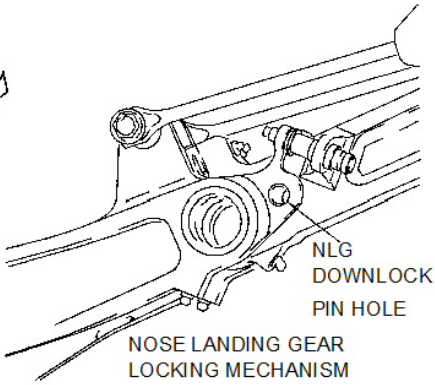


NOSE LANDING GEAR



NOSE LANDING GEAR
LOCKING MECHANISM

Nose gear ground-lock-pin installation

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Tire Inflation (RLC—Parking)

If the RLC results in suspicion of an incorrect pressure in any tire, have the suspected tire(s) checked with a gage.

Tire pressures

To get a valid reading, do not check tire pressure until the temperature of the wheel/tire assy is at ambient temperature.

CAUTION: Never deflate an overinflated tire when the tire temperature is higher than ambient temperature.

Tires should be inflated with nitrogen, BB-N-411, Type I, MIL-P- 27401, Type I.

The table below shows the standard inflation pressure used both for nose and main gear tires.

In case of inflation, the pressure before and after inflation must be written in the Aircraft Log with statement of the wheel position.

CAUTION: Use a direct reading gage to measure the tire pressure when you inflate the tire. Do not use the Tire Pressure Indication System (TPIS) to measure the tire pressure when you inflate the tire. The direct reading gage gives a check to make sure the TPIS is accurate. With this check, the TPIS can give you an incorrect tire pressure. This can cause damage to the tire.

WARNING: Use a regulated pressure source to service the tires. An unregulated pressure source can cause injuries to persons and damage to equipment.

Tire inflation pressure (psi)

-200,-200ER

	Nose gear (psi)	Main gear (psi)
Normal Operation Range (NOR)	175–185	200–210
Inflate to maximum of NOR if pressure is:	171–174	195–199
Inflate to maximum of NOR and measure again after 24 hours if pressure is: [a)]	162–170	185–194
Replace wheel if pressure is:	144–161	164–184
Replace both wheels on same axle if pressure is:	143 or less	163 or less

-300

	Nose gear (psi)	Main gear (psi)
Normal Operation Range (NOR)	195–205	210–220
Inflate to maximum of NOR if pressure is:	190–194	205–209

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	Nose gear (psi)	Main gear (psi)
Inflate to maximum of NOR and measure again after 24 hours if pressure is:[a)]	180–189	194–204
Replace wheel if pressure is:	160–179	172–193
Replace both wheels on same axle if pressure is:	159 or less	171 or less

-300ER

	Nose gear (psi)	Main gear (psi)
Normal Operation Range (NOR)	213–223	216–226
Inflate to maximum of NOR if pressure is:	199–212	210–215
Inflate to maximum of NOR and measure again after 24 hours if pressure is:[a)]	190–198	200-209
Replace wheel if pressure is:	174–189	177–199
Replace both wheels on same axle if pressure is:	173 or less	176 or less

a) Replace the wheel/tire assy if the pressure drops again after 24 hr

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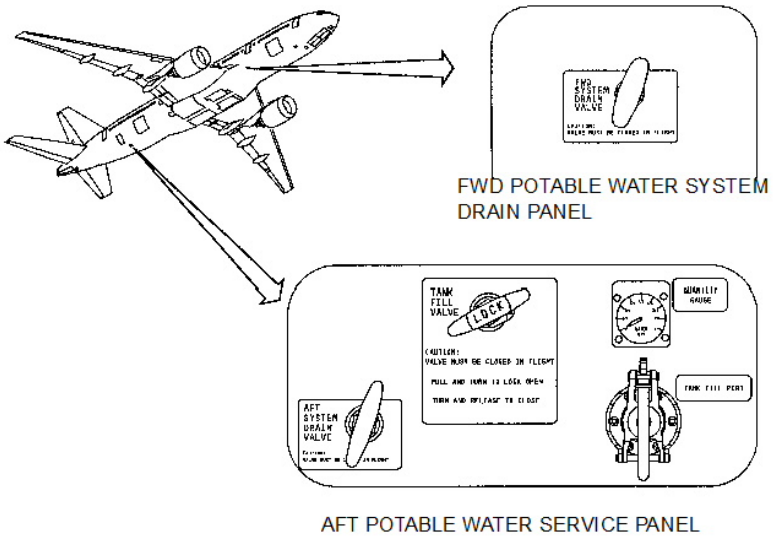
Draining Water System



Draining water system

Make the following preparations:

Open all water heater circuit breakers on panels P110 and P210 in the MEC.

Put the isolation/drain valve (door 2L) in the drain position.

Make sure the isolation valve (door 4L) is in the open position.

Open the distribution drain shutoff-valves (under lavatory sinks).

Pull the forward system drain-valve handle.

Pull the aft system drain handle.

The water flows overboard through these three places:

- forward system drain
- aft system drain
- overflow/tank drain.

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The forward system drain is on the right side of the aircraft and below the leading edge of the wing.

The aft system drain is on the left side of the aircraft, directly across from the aft service panel.

The overflow/tank drain is almost straight aft of the aft service panel.

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

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Principal Dimensions

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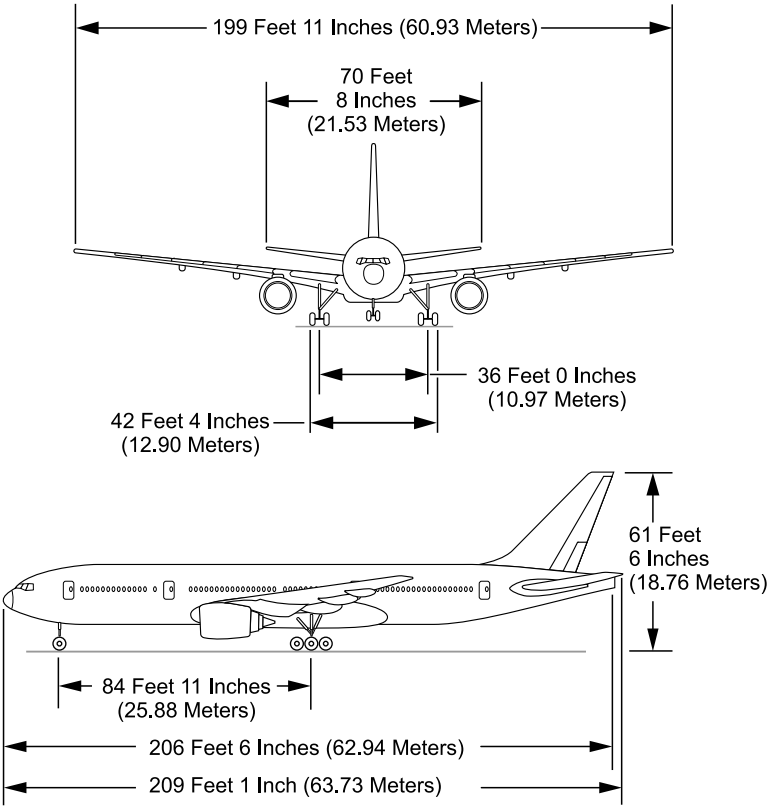

777-200 and 777-200ER

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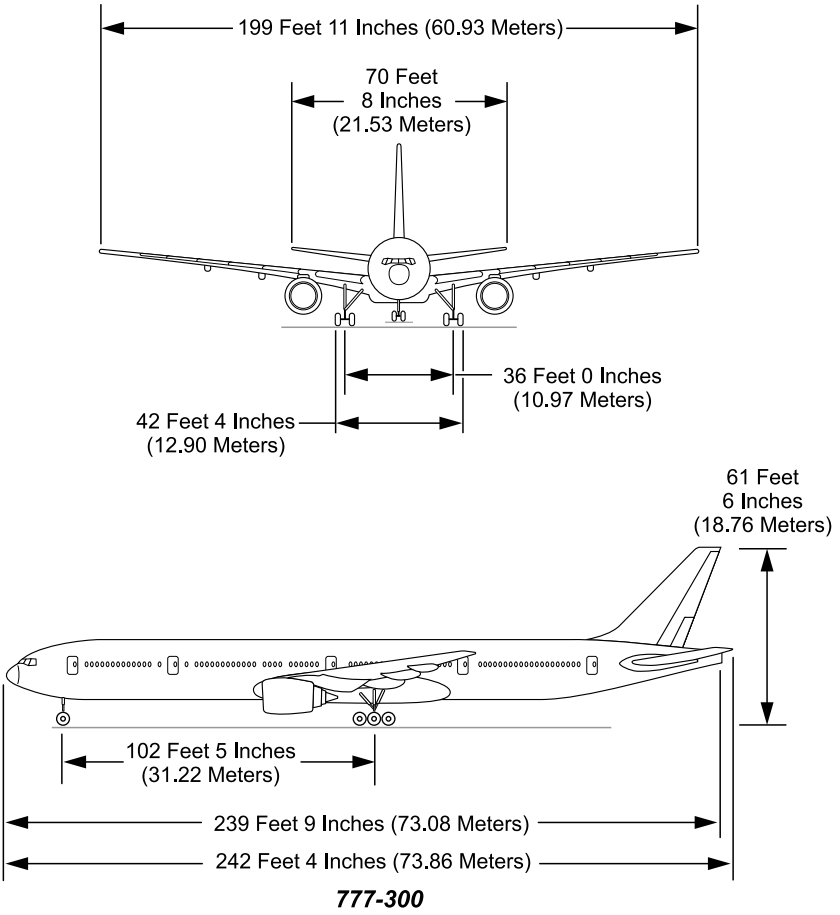
-300



777-300

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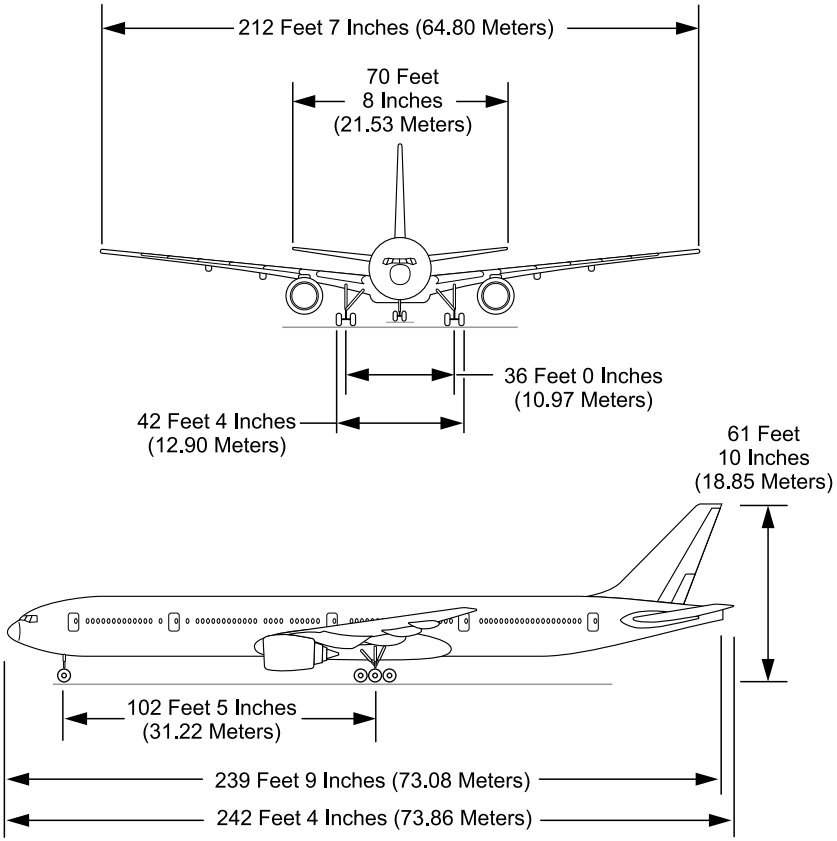
-300ER



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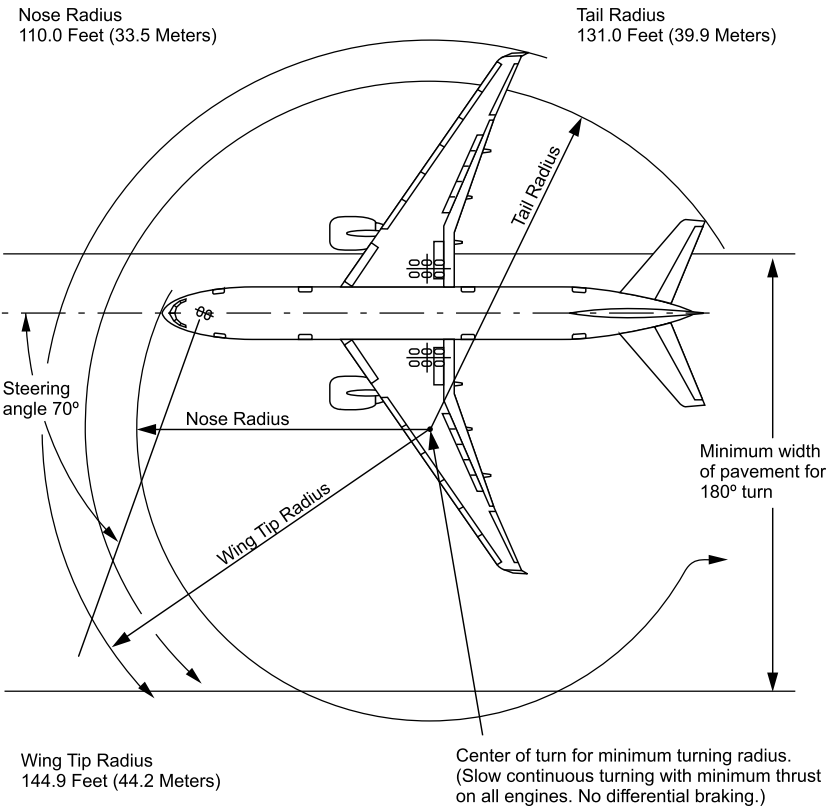
Turning Radius

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.

-200,-200ER



Note: Minimum width of pavement for 180° turn:
155.8 Feet (47.5 Meters)

777-200 and 777-200ER

-200,-200ER **CAUTION: Do not attempt to make a turn away from an obstacle within 15 feet (4.6 m) of the wing tip, or within 50 feet (15.2 m) of the nose.**

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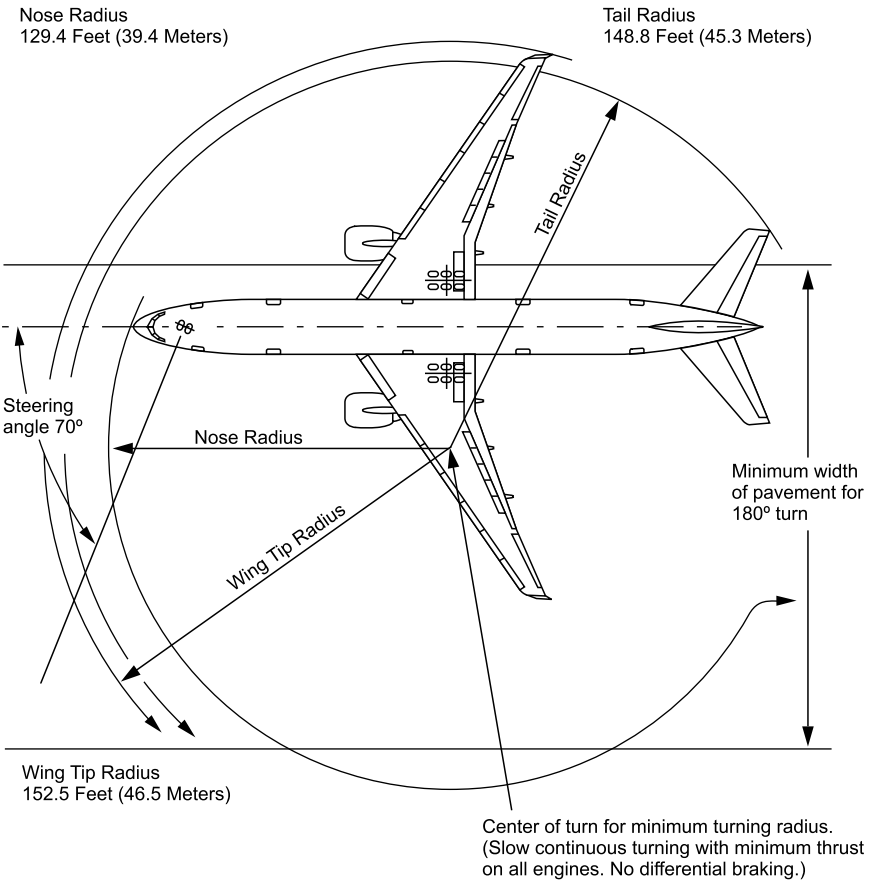
-300



Note: Minimum width of pavement for 180° turn:
183.8 Feet (56.0 Meters)

777-300

-300

CAUTION: Do not attempt to make a turn away from an obstacle within 15 feet (4.6 m) of the wing tip, or within 39 feet (11.9 m) of the nose.

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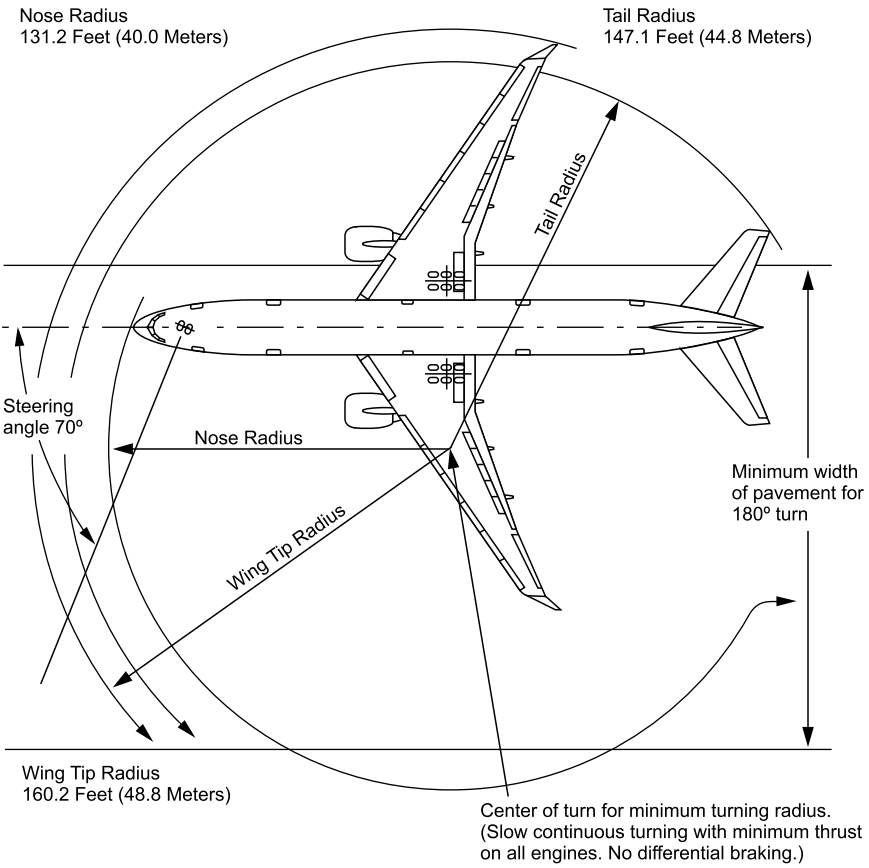
-300ER



Note: Minimum width of pavement for 180° turn:
185.5 Feet (56.5 Meters)

777-300ER

-300ER **CAUTION:** **Do not attempt to make a turn away from an obstacle within 15 feet (4.6 m) of the wing tip, or within 45 feet (13.9 m) of the nose.**

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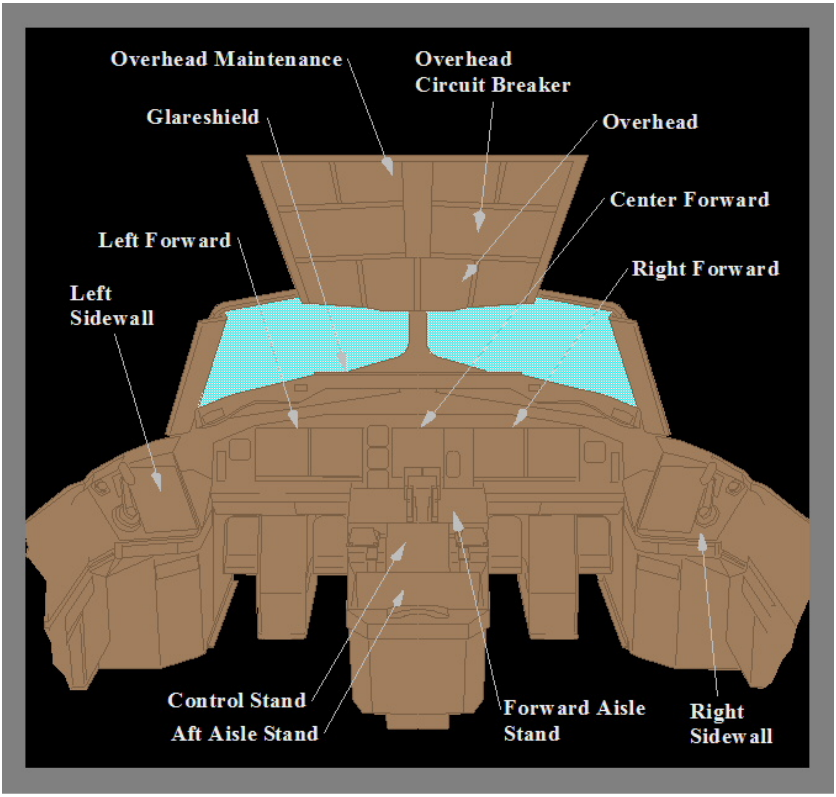
Flight Deck Panels



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.

Note: Do not touch glass displays with bare hands. This can cause damage to the coating.

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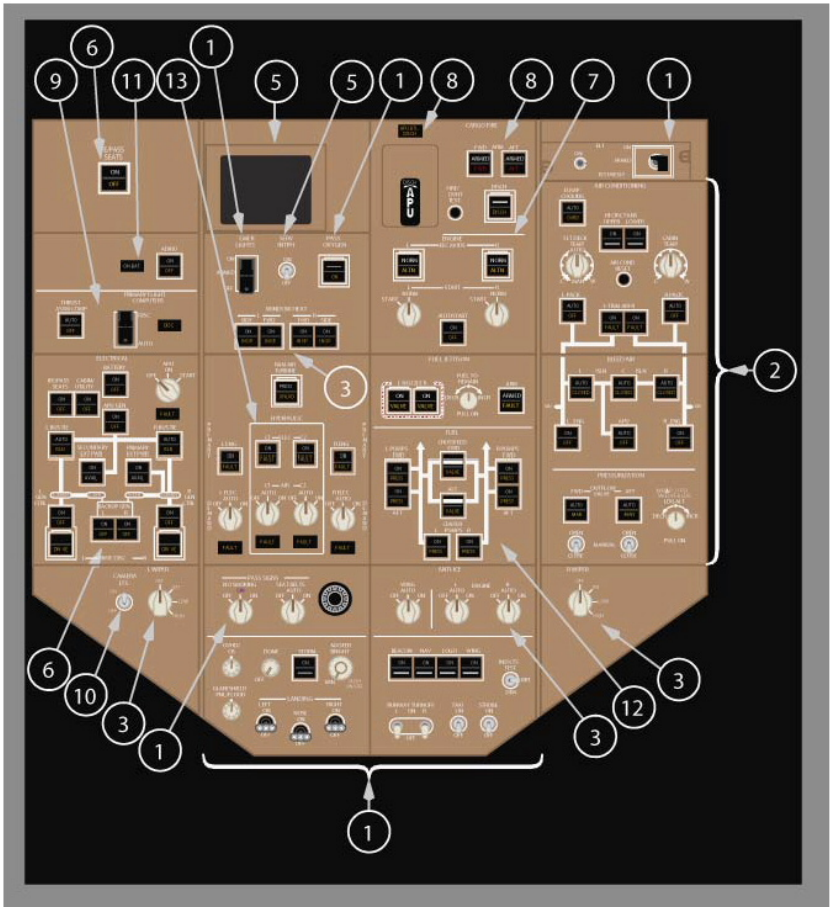
Overhead Panel

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



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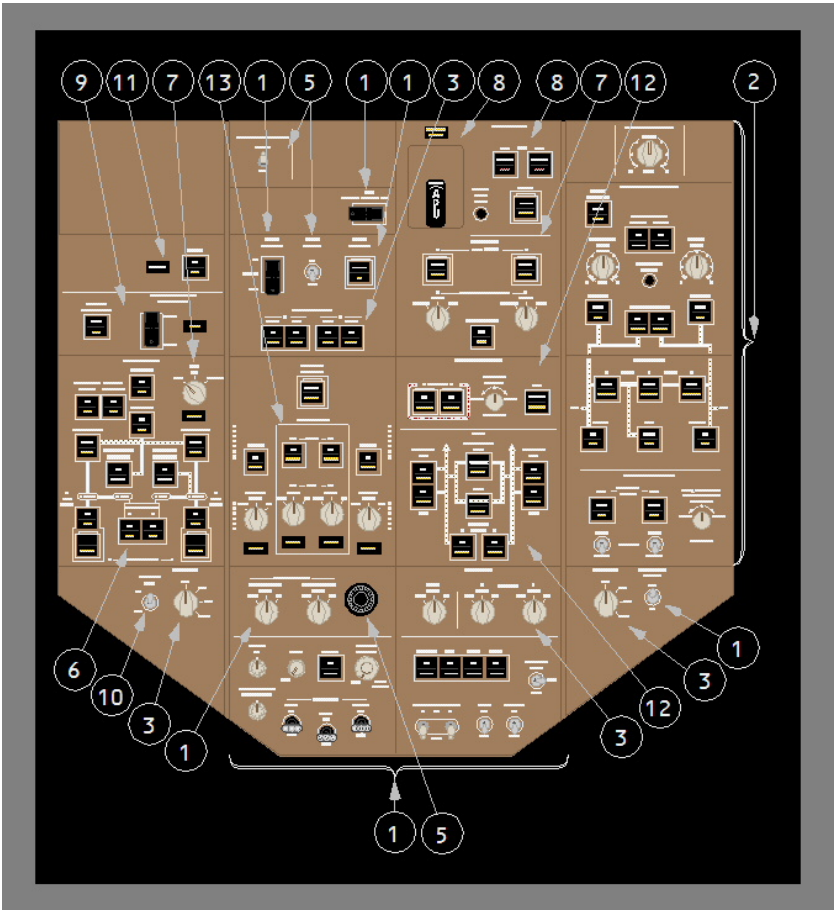
TKK to TKR, TKU to TKZ



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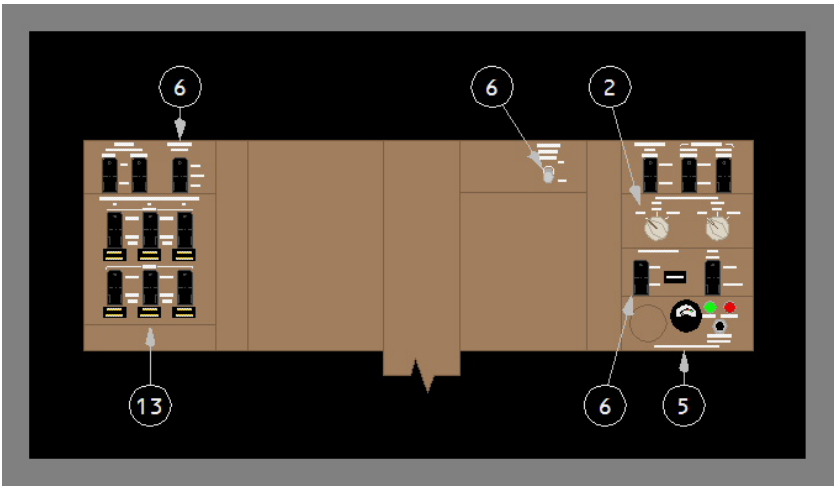
Overhead Maintenance Panel



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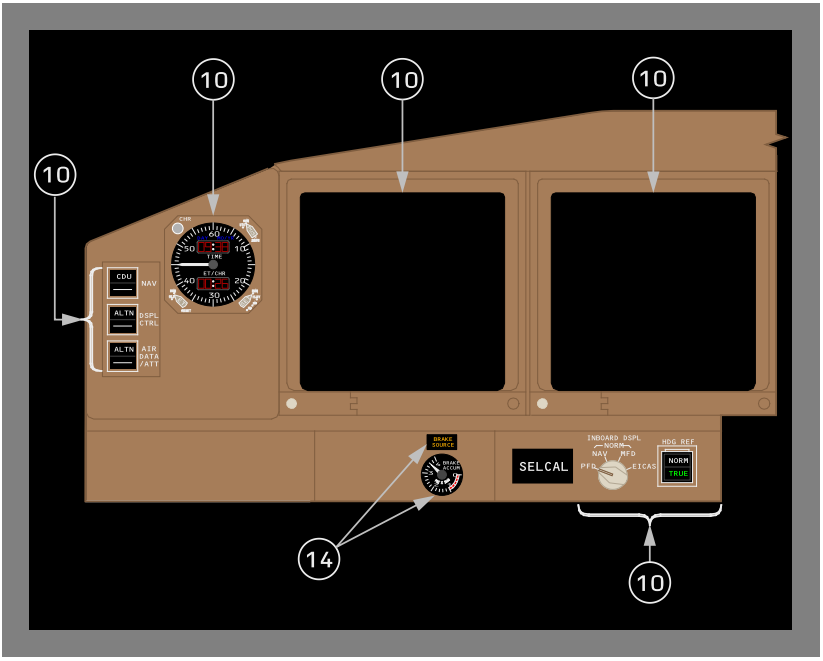
Left Forward Panel

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF,K



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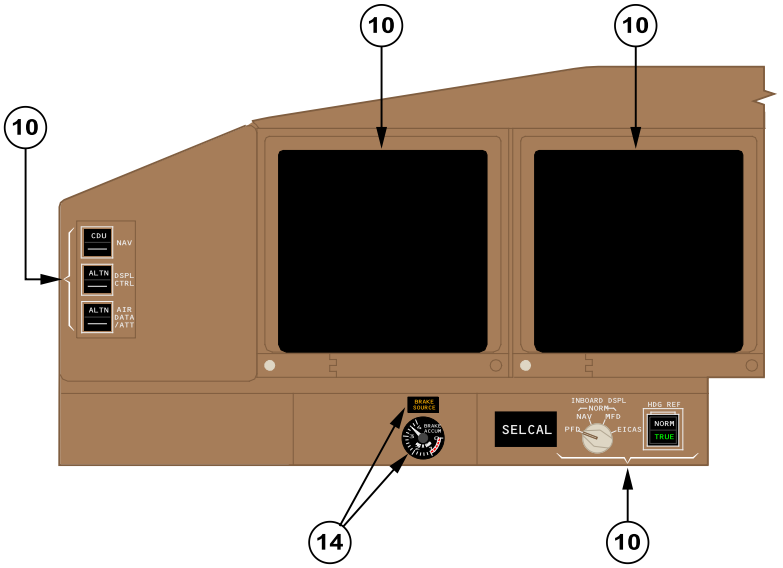
TKL to TKR, TKU to TKZ



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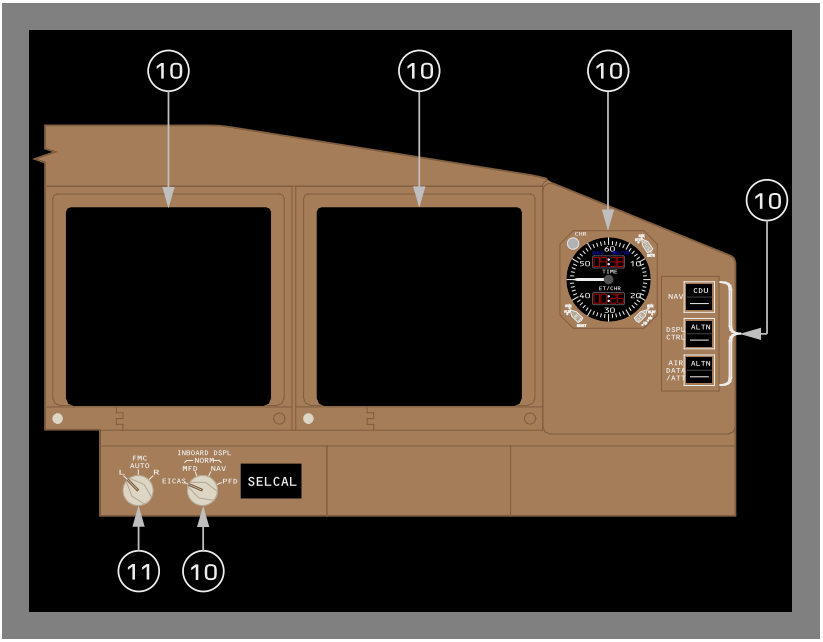
Right Forward Panel

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF,K



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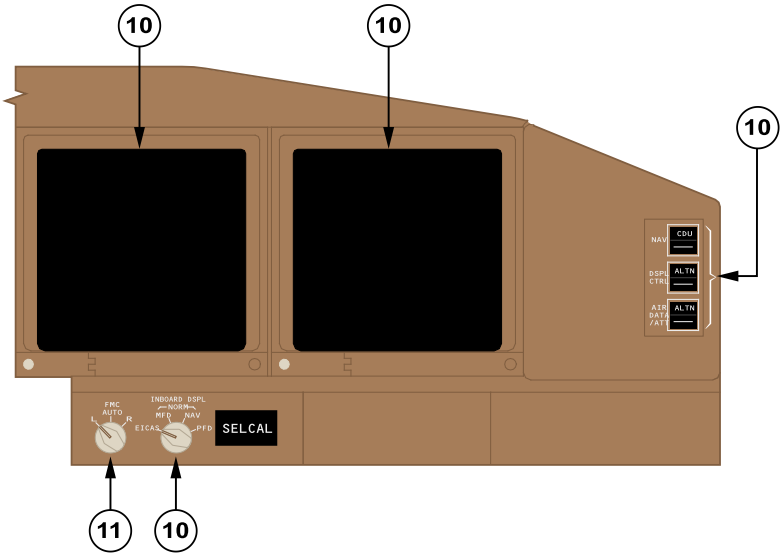
TKL to TKR, TKU to TKZ



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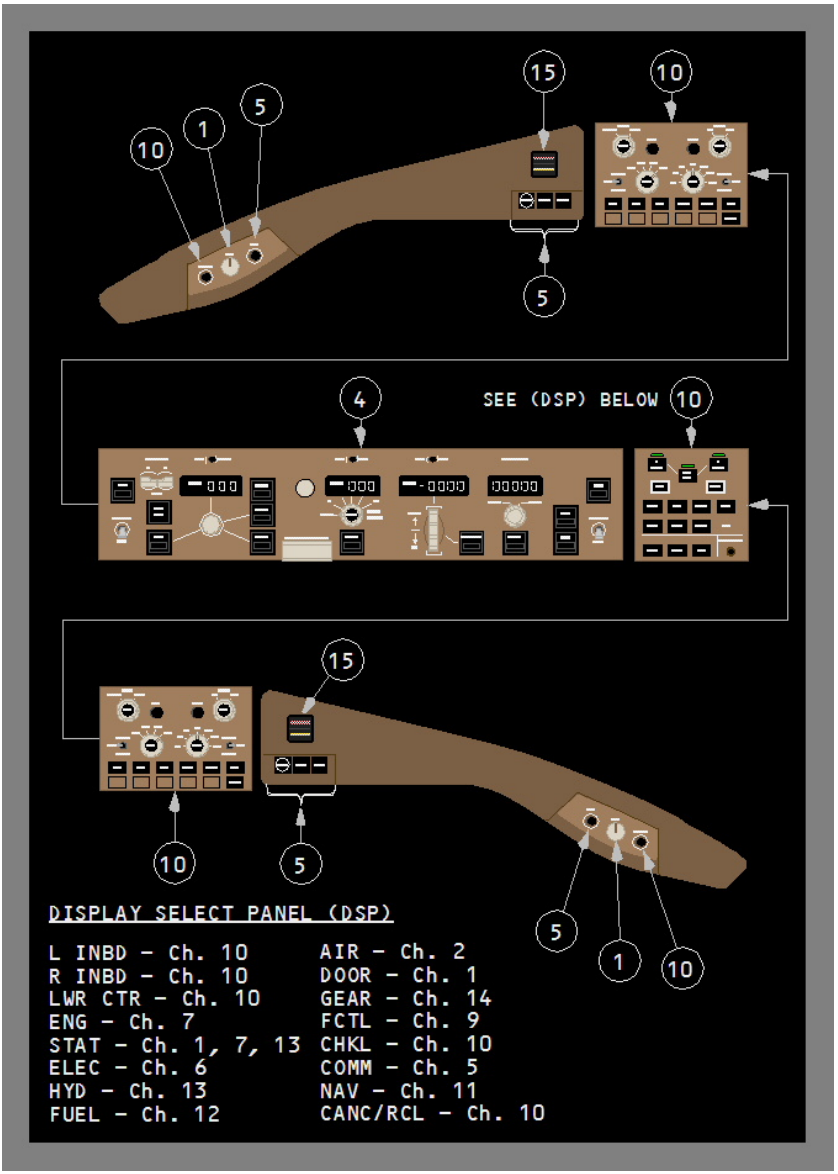
Glareshield Panel

TJA,B,C,D,G,H,TJR to TJW



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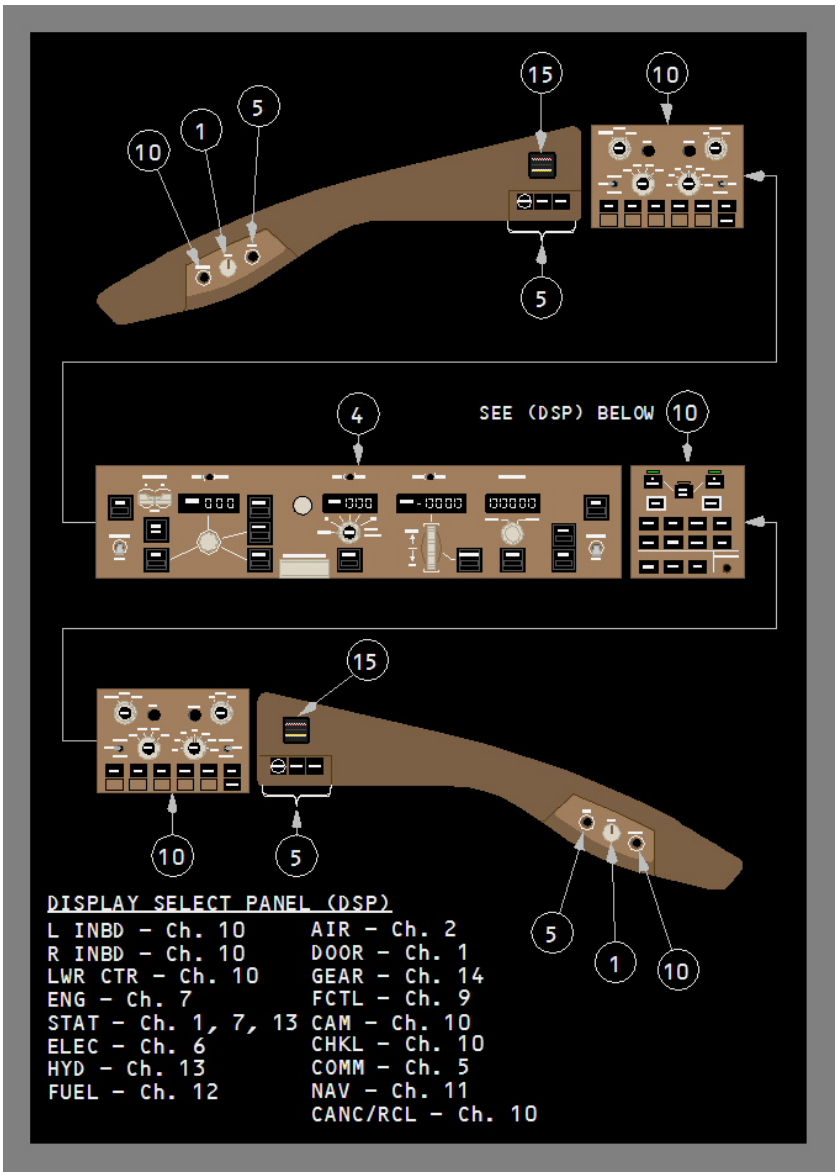
TKA to TKF, TKK to TKR, TKU to TKZ



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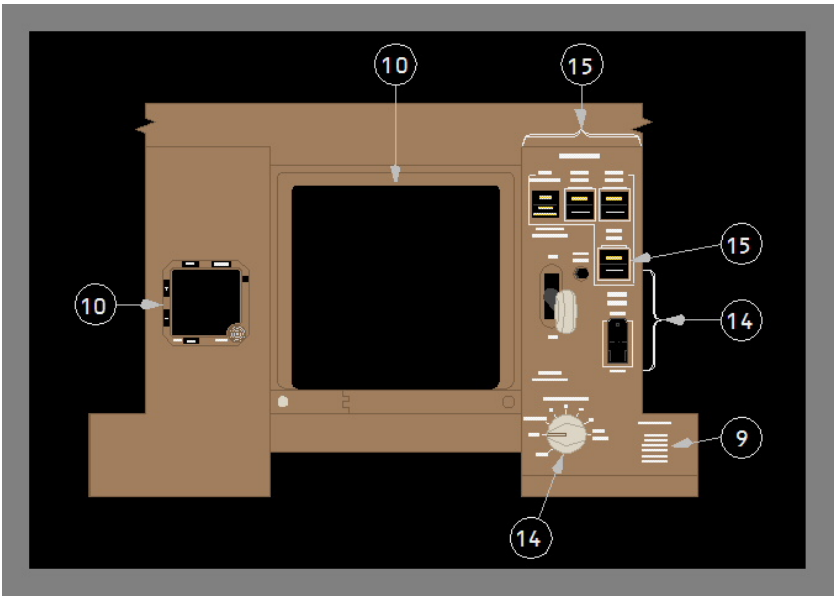
Center Forward Panel



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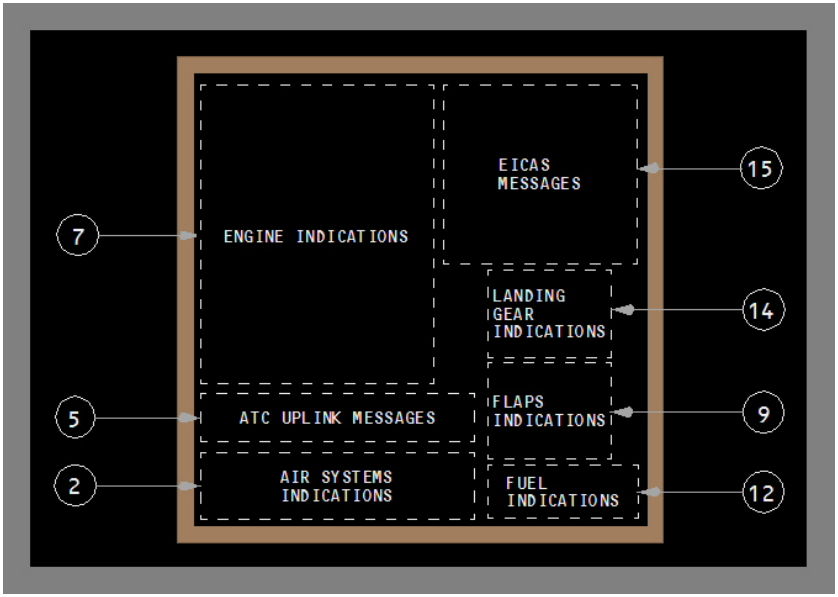
EICAS Display



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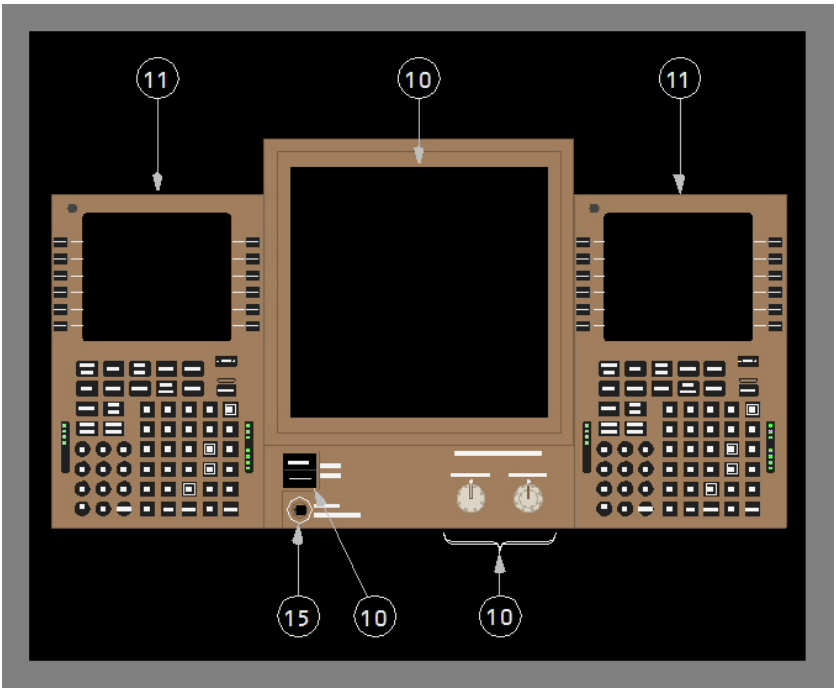
Forward Aisle Stand



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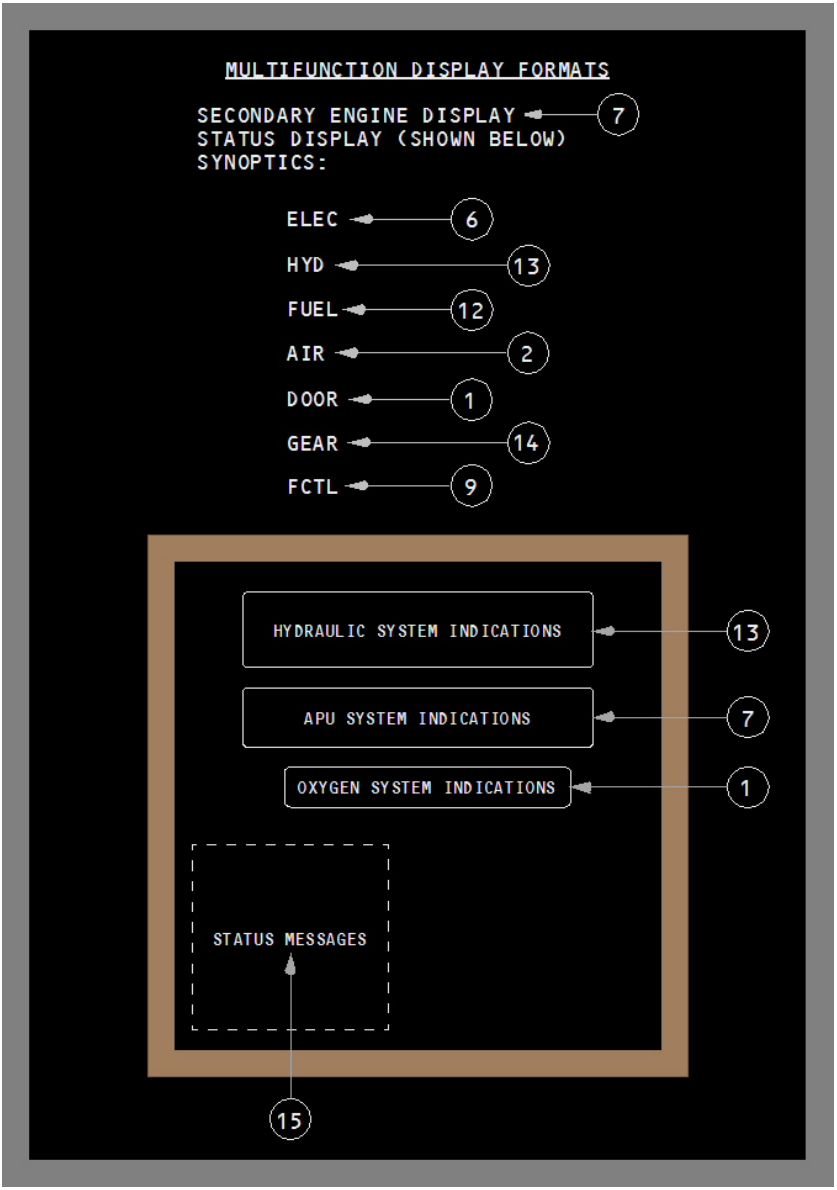
Multifunction Display

TJA,B,C,D,G,H,TJR to TJW



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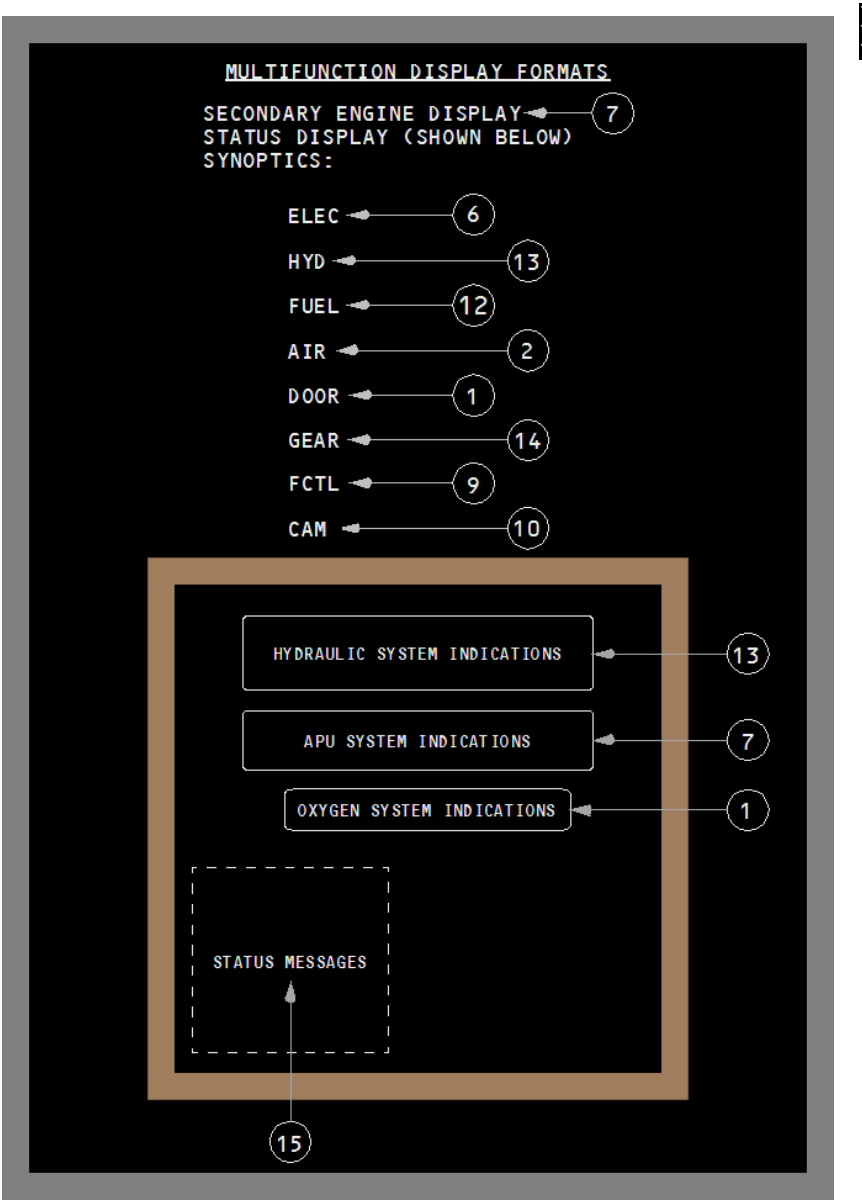
TKA to TKF, TKK to TKR, TKU to TKZ



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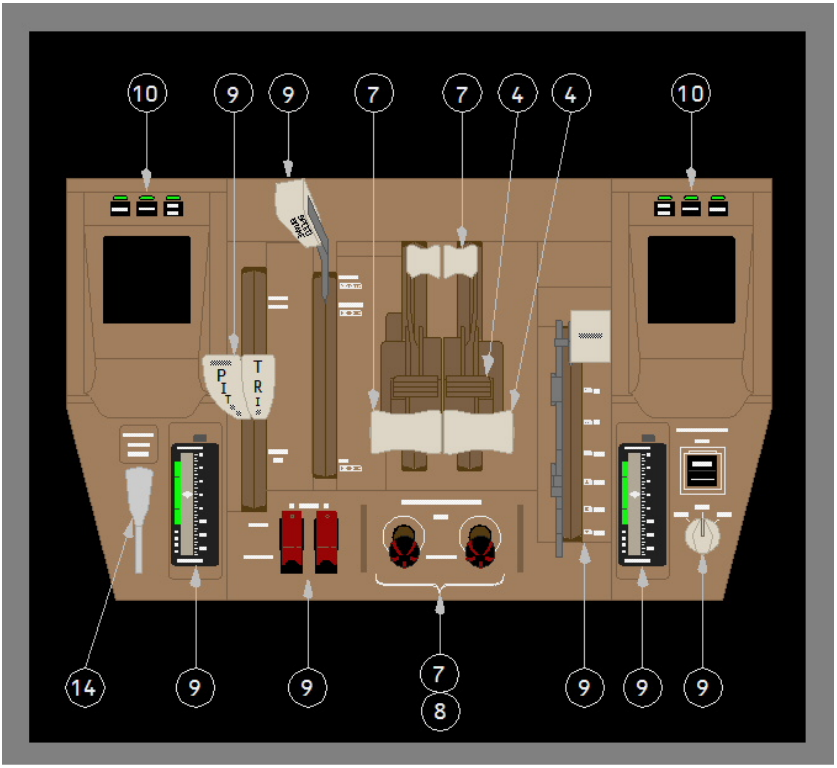
Control Stand



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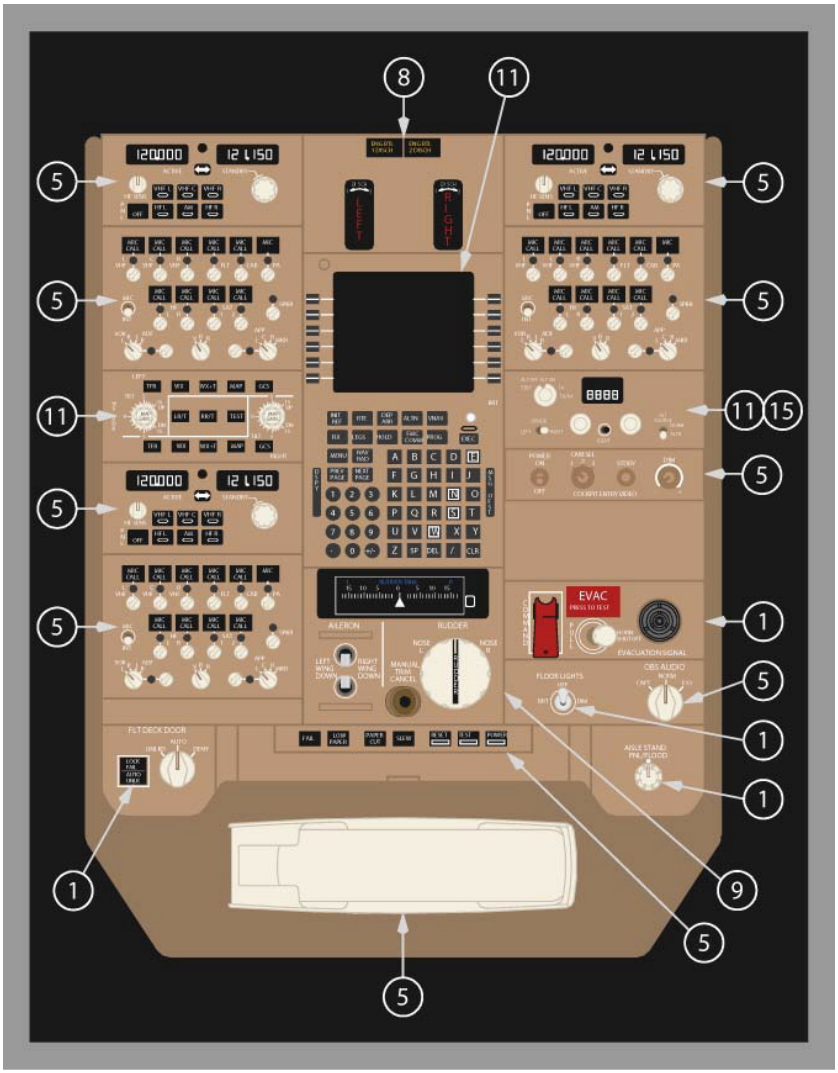
Aft Aisle Stand



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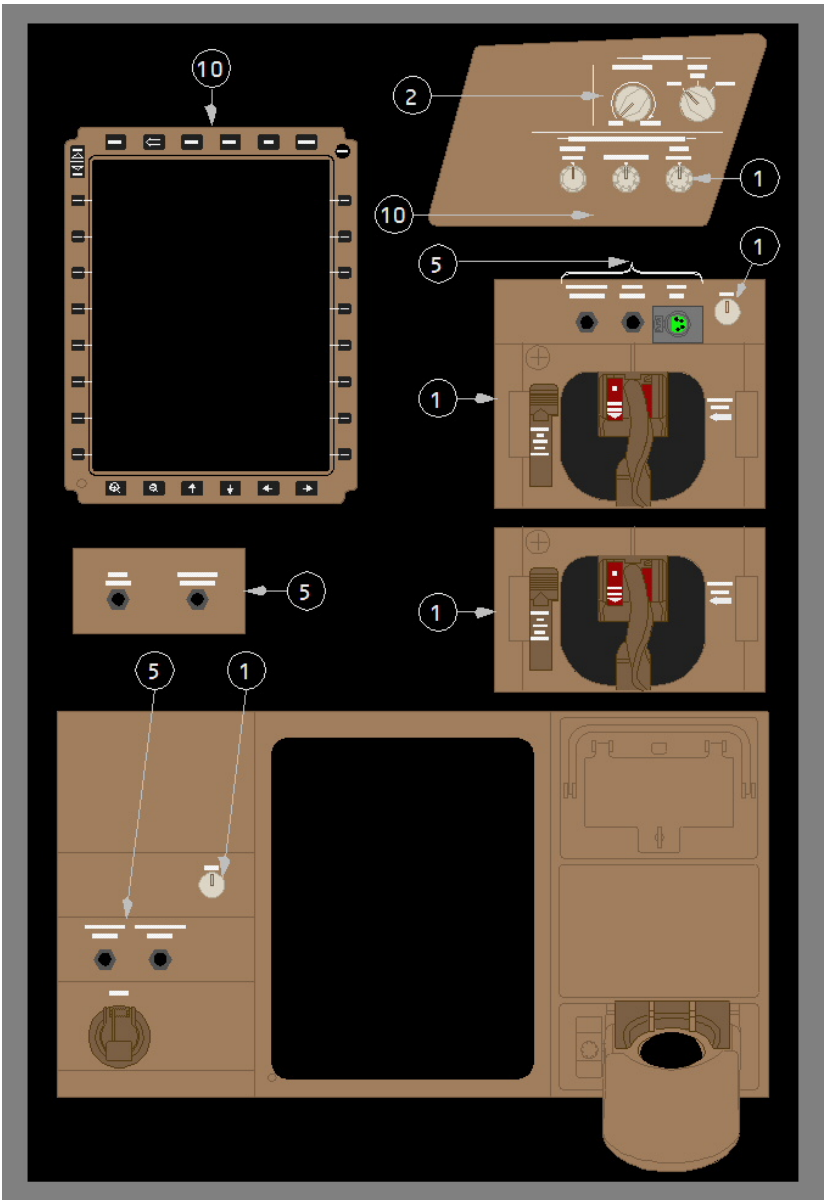
Left and Right Sidewall, First Observer, and Maintenance Access Terminal/Second Observer Panels



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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.

Note: Maintenance personnel should change switch lights. Changing the light requires changing the entire switch cap.

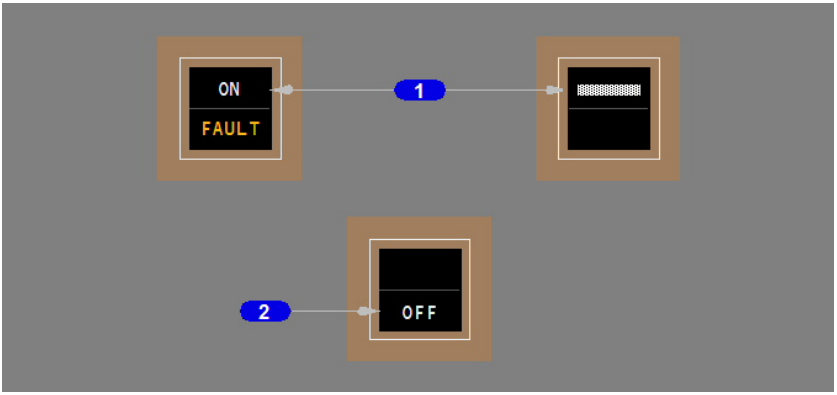
Alternate Action Switches

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 the top 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 bottom 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 (FAULT, MAN, OFF, VALVE) may be shown in the lower half of the switch.

2 Switch is OFF

OFF or a line is visible—

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- 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 are used to activate or deactivate systems or to reset system logic. The switch display indicates system status.

1 Push to Reset

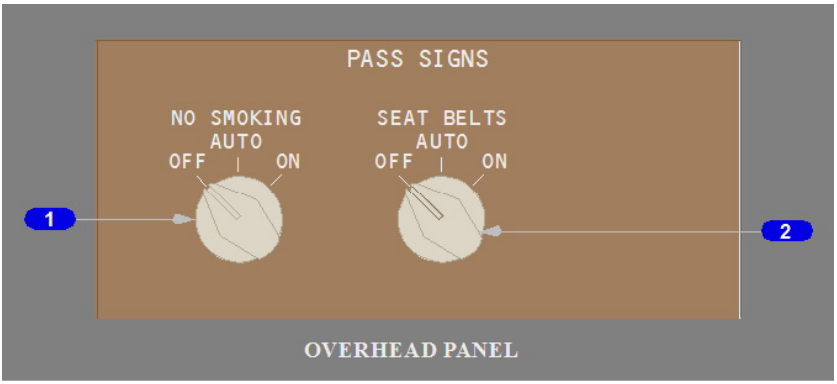
Push—the switch resets the master lights and aural alerts.

2 System Operation

Push—activates or deactivates the system.

Signs and Lighting

TJA,B,C,D,G,H,TKA to TKF



1 NO SMOKING Selector

OFF—the NO SMOKING signs are not illuminated.

AUTO—the NO SMOKING signs are illuminated or extinguished automatically with reference to airplane altitude and system configuration (see Cabin Signs on page 1.40.6 description section).

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ON—the NO SMOKING signs are illuminated.

Note: Any time passenger oxygen is deployed, the NO SMOKING and FASTEN SEAT BELTS signs illuminate automatically, regardless of the selector position.

2 SEAT BELTS Selector

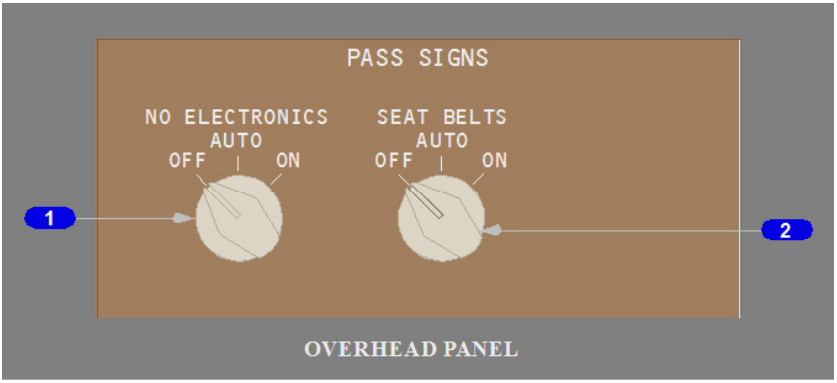
OFF—the FASTEN SEAT BELTS and RETURN TO SEAT signs are not illuminated.

AUTO—the FASTEN SEAT BELTS and RETURN TO SEAT signs are illuminated or extinguished automatically with reference to airplane altitude and system configuration (see Cabin Signs on page 1.40.6 description section).

ON—the FASTEN SEAT BELTS and RETURN TO SEAT signs are illuminated.

Note: Any time passenger oxygen is deployed, the NO SMOKING and FASTEN SEAT BELTS signs illuminate automatically, regardless of the selector position.

TJR to TJW, TKK to TKR, TKU to TKZ



1 NO ELECTRONICS Selector

OFF—the ELECTRONIC DEVICES OFF signs are not illuminated.

AUTO—the ELECTRONIC DEVICES OFF signs are illuminated or extinguished automatically with reference to airplane altitude and system configuration (see Cabin Signs on page 1.40.6 description section).

ON—the ELECTRONIC DEVICES OFF signs are illuminated.

Note: Any time passenger oxygen is deployed, the ELECTRONIC DEVICES OFF and FASTEN SEAT BELTS signs illuminate automatically, regardless of the selector position.

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2 SEAT BELTS Selector

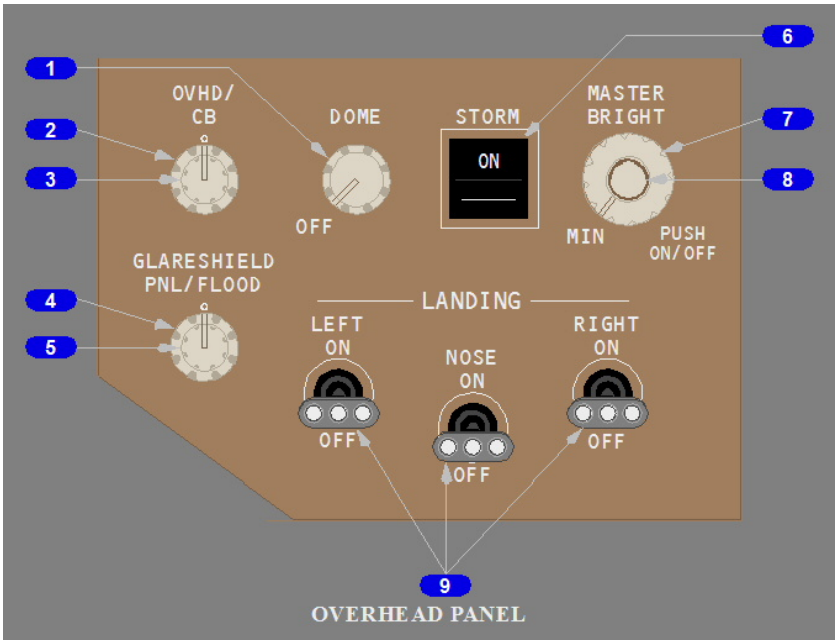
OFF—the FASTEN SEAT BELTS and RETURN TO SEAT signs are not illuminated.

AUTO—the FASTEN SEAT BELTS and RETURN TO SEAT signs are illuminated or extinguished automatically with reference to airplane altitude and system configuration (see Cabin Signs on page 1.40.6 description section).

ON—the FASTEN SEAT BELTS and RETURN TO SEAT signs are illuminated.

Note: Any time passenger oxygen is deployed, the ELECTRONIC DEVICES OFF and FASTEN SEAT BELTS signs illuminate automatically, regardless of the selector position.

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF



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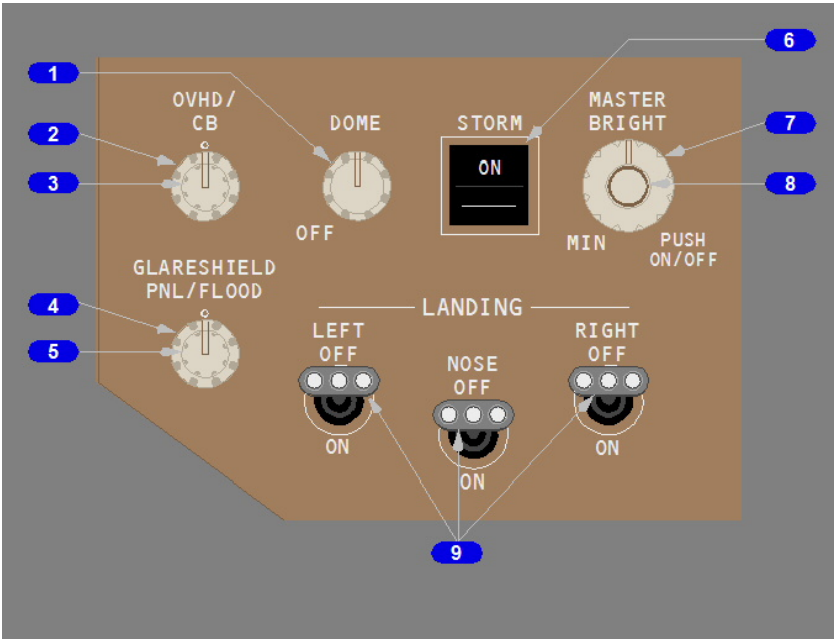
TKK to TKR, TKU to TKZ



1 DOME Light Control

Controls overhead dome light brightness.

2 Overhead (OVHD) Panel Light Control (outer)

Rotate—controls overhead panel light brightness.

3 Circuit Breaker (CB) Panel Light Control (inner)

Rotate—controls circuit breaker panel light brightness.

4 GLARESHIELD Panel (PNL) Light Control (outer)

Rotate—controls glareshield panel light and standby compass brightness.

5 GLARESHIELD FLOOD Light Control (inner)

Rotate—controls glareshield flood light brightness.

6 STORM Light Switch

ON—overrides normal controls and illuminates the following lights at maximum brightness:

- all illuminated indicator lights

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- glareshield flood lights
- instrument panel flood lights
- aisle stand flood lights
- dome lights.

7 MASTER Brightness (BRIGHT) Light Control (outer)

Rotate (when the MASTER BRIGHTNESS switch is pushed on):

- controls the brightness of all panel lights and displays (dome lights, flood lights, and circuit breaker panel lights are not controlled by this switch)
- overrides individual brightness control settings
- limits adjustment range of individual brightness controls
- has full adjustment range of all lights when all individual brightness controls are set to the center detent.

8 MASTER Brightness (BRIGHT) Light Switch (inner)

A black ring on the side of the inner switch is visible when the switch is out (OFF).

PUSH ON (in)—the MASTER BRIGHTNESS control is on.

PUSH OFF (out)—the MASTER BRIGHTNESS control is off.

Note: If display brightness cannot be set as desired when master brightness is on, pushing the MASTER BRIGHTNESS switch off may allow setting display brightness to an appropriate level using individual brightness controls.

9 LANDING Light Switches

OFF—the landing light is not illuminated.

ON—the landing light is illuminated.

Note: The nose gear landing lights cannot illuminate when the nose landing gear is not down and locked.

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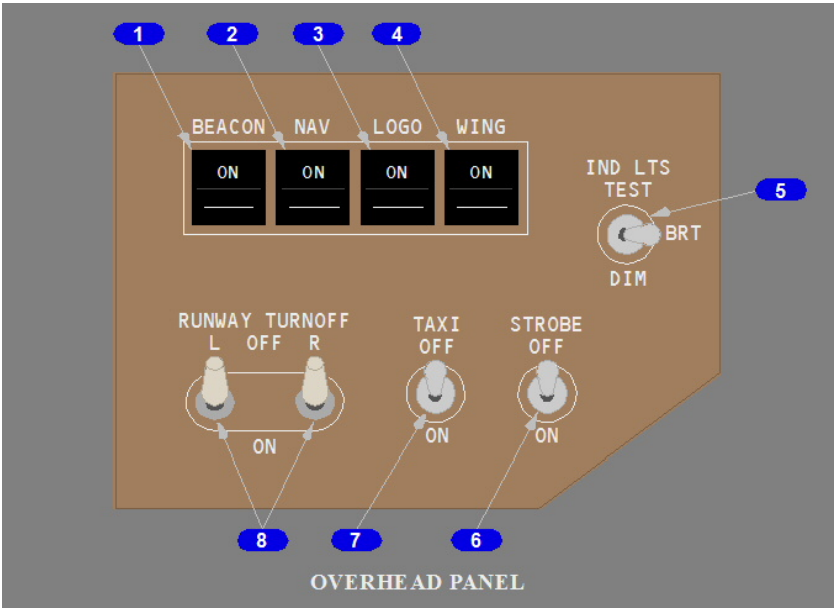
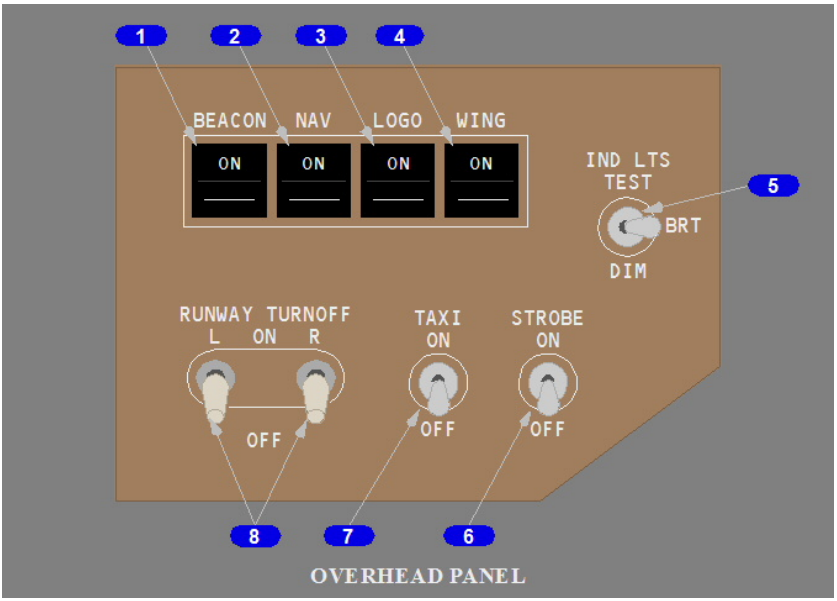
Lighting Panel

TKK to TKR, TKU to TKZ



TJA,B,C,D,G,H, TJR to TJW, TKA to TKF



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1 BEACON Light Switch

ON—the red anticollision beacon lights on the top and bottom of the fuselage operate.

2 Navigation (NAV) Position Light Switch

ON—the red, green, and white navigation position lights are illuminated.

3 LOGO Light Switch

ON—the stabilizer–mounted logo lights illuminate the airline logo on the vertical tail surface.

4 WING Light Switch

ON—the wing leading edge illumination lights are illuminated.

5 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 the switch is held
- causes test patterns to display on the stabilizer position indicators, rudder trim indicator, and radio tuning panel displays.

BRT—sets all illuminated annunciator lights to full brightness.

DIM—sets all illuminated annunciator lights to low brightness

6 STROBE Light Switch

OFF—the white anticollision strobe lights on the tips of each wing and the tailcone are off.

ON—the strobe lights operate.

7 TAXI Light Switch

OFF—the taxi lights are extinguished.

ON—the taxi lights are illuminated.

Note: The taxi lights do not illuminate when the nose landing gear is not down and locked

8 RUNWAY TURNOFF Light Switches

OFF—the runway turnoff light is extinguished.

ON—the runway turnoff light is illuminated

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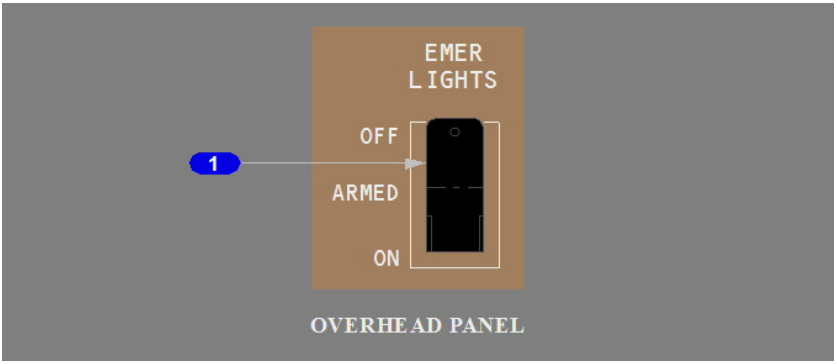
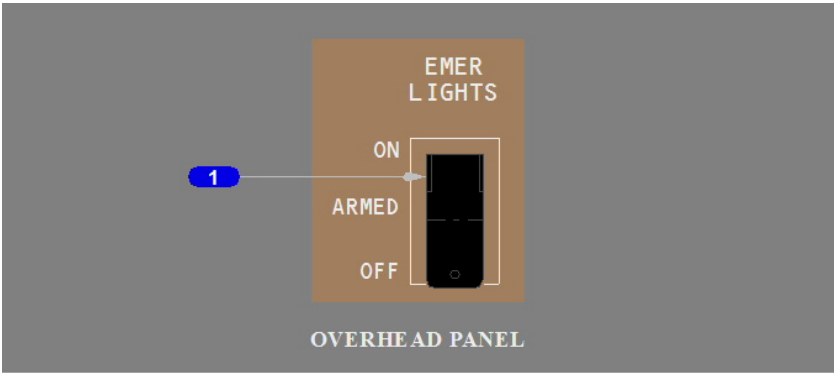
Miscellaneous Lighting Controls

Flight Deck Emergency Lights Switch

TKK to TKR, TKU to TKZ



TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



1 Emergency (EMER) LIGHTS Switch

OFF—prevents emergency lights system operation if airplane electrical power fails or is turned off.

ARMED—all emergency lights illuminate automatically if airplane electrical power fails or is turned off.

ON—all emergency lights illuminate.

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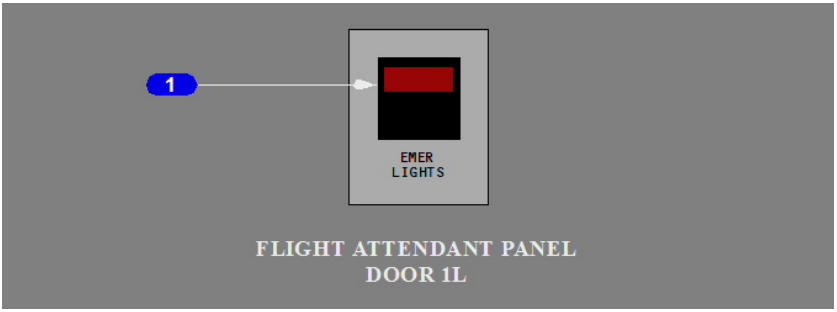
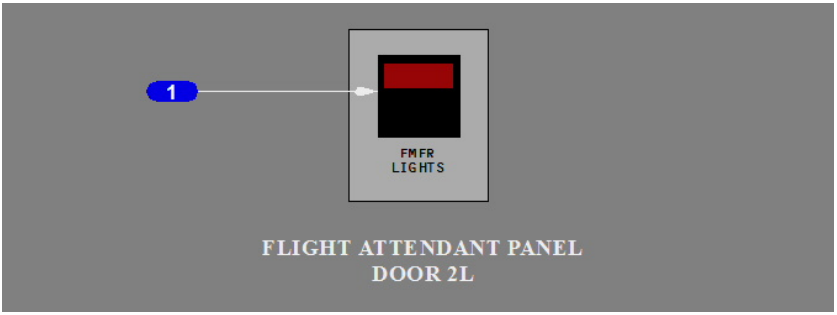
Cabin Emergency Lights Switch

TJR to TJW, TKK to TKR, TKU to TKZ



TJA,B,C,D,G, H,TKA to TKF

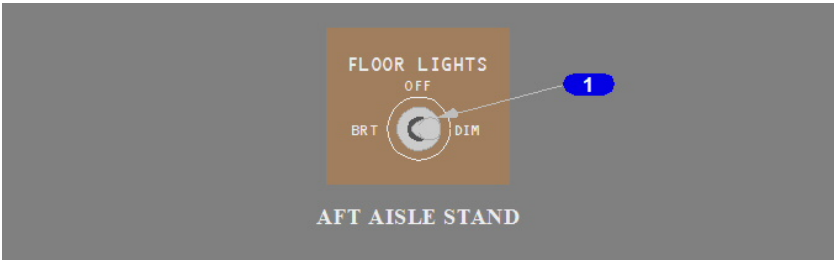


1 Cabin Emergency (EMER) LIGHTS Switch

Push—

- Illuminated (red):
  - all cabin and exterior emergency lights illuminate
  - bypasses the flight deck emergency lights switch
- Extinguished: all cabin and exterior emergency lights extinguish.

Floor Lights Switch



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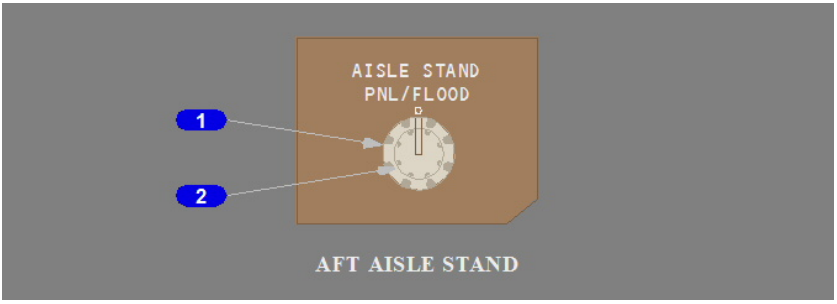
1 FLOOR LIGHTS Switch

OFF—the flight deck floor lights are not illuminated.

BRT—the floor lights are illuminated bright.

DIM—the floor lights are illuminated dim.

Aisle Stand Panel/Flood Light Control



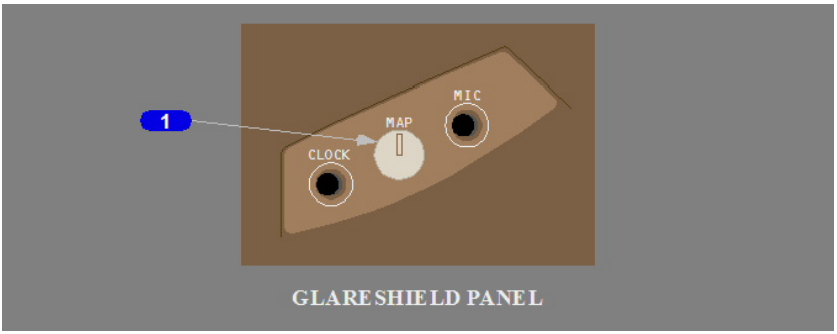
1 AISLE STAND Panel (PNL) Light Control (outer)

Rotate—controls the aisle stand instrument panel light brightness.

2 AISLE STAND FLOOD Light Control (inner)

Rotate—controls the aisle stand flood light brightness.

Map Light Control



1 MAP Light Control

Pull—on.

Push—off.

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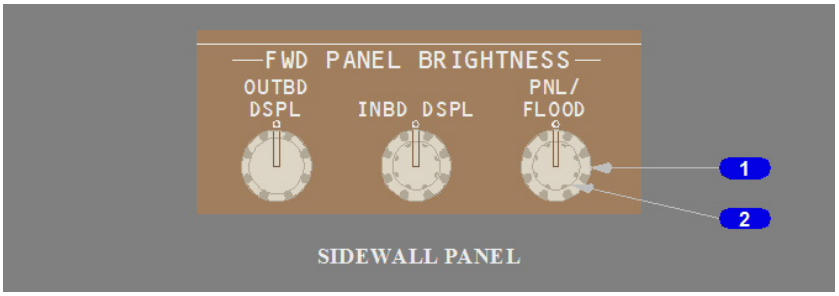
Rotate—adjusts map light brightness.

Forward Panel Brightness Controls

Note: The display and weather radar brightness controls are described in Chapter 10, Flight Instruments, Displays.



1 Forward (FWD) PANEL BRIGHTNESS Light Control (outer)

Rotate—Controls forward panel lights brightness.

2 Forward (FWD) PANEL FLOOD BRIGHTNESS Light Control (inner)

Rotate—Controls forward panel flood light brightness.

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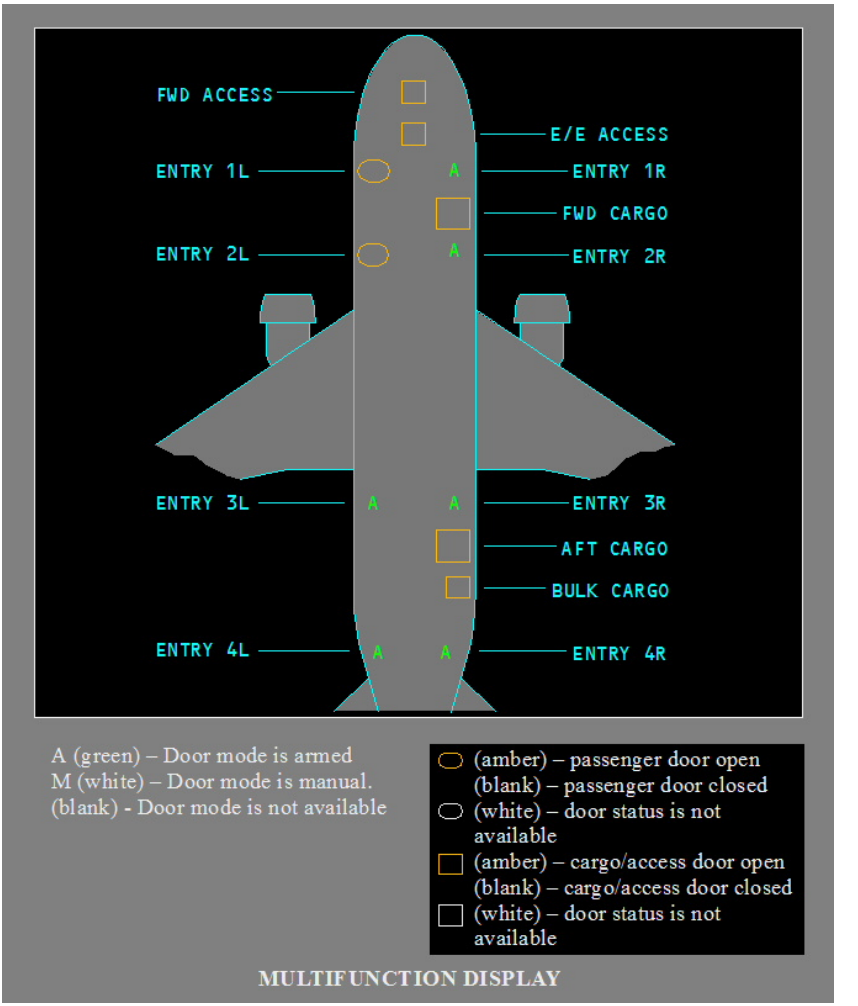
Doors and Windows

Door Synoptic Display

The doors synoptic is displayed by pushing the DOOR synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

-200,-200ER



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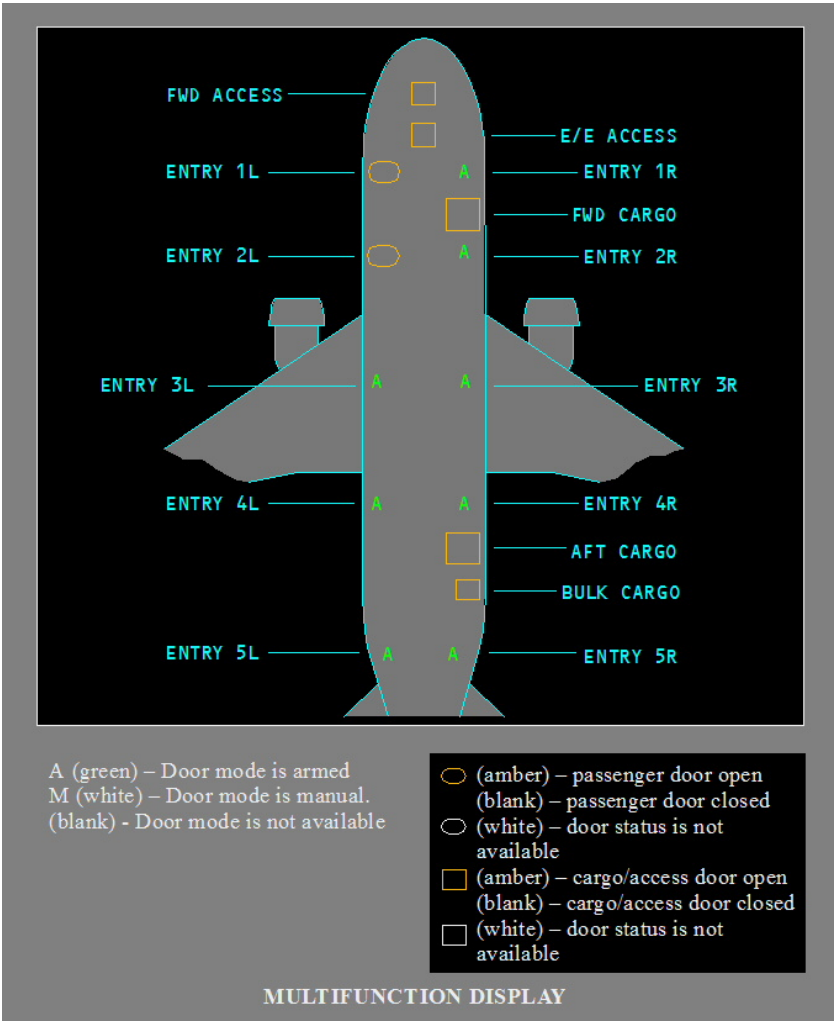
-300,-300ER



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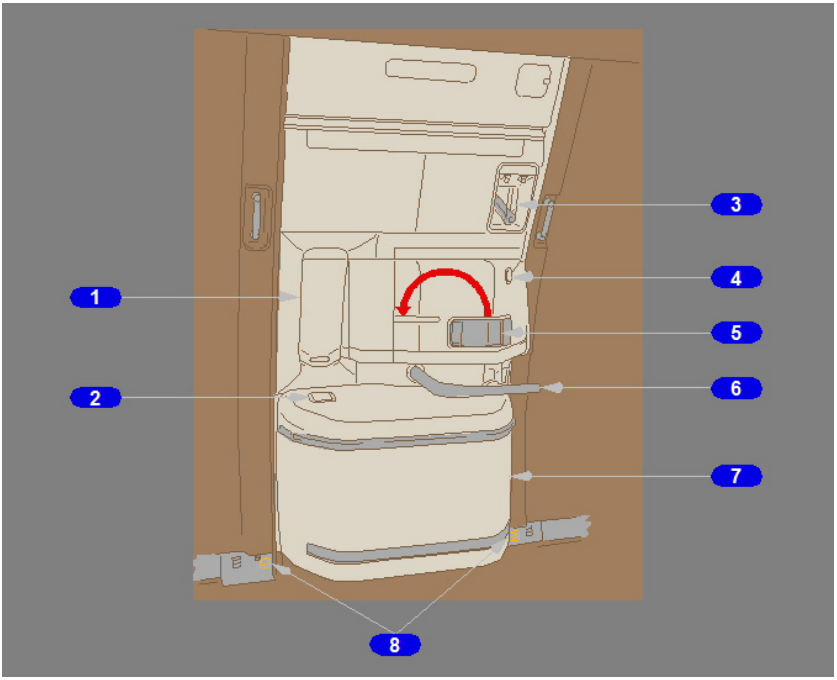
Entry Door



1 Viewing Window

Allows observation outside the airplane.

2 Slide/Raft Gas Bottle Pressure Gage

Maintenance use only.

3 Door Mode Select Panel

See Door Mode Select Panel on page 1.30.17.

4 Power Assist Reservoir Pressure Gage

If the gage needle is outside the green zone, the system is unusable.

5 Gust Lock Release Lever

Grab and pull inward to close the door.

6 Door Operating Handle

To open the door—rotate in the direction of the arrow.

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To close the door—rotate in the opposite direction of the arrow.

7 Slide/Raft

The bustle contains the slide/raft.

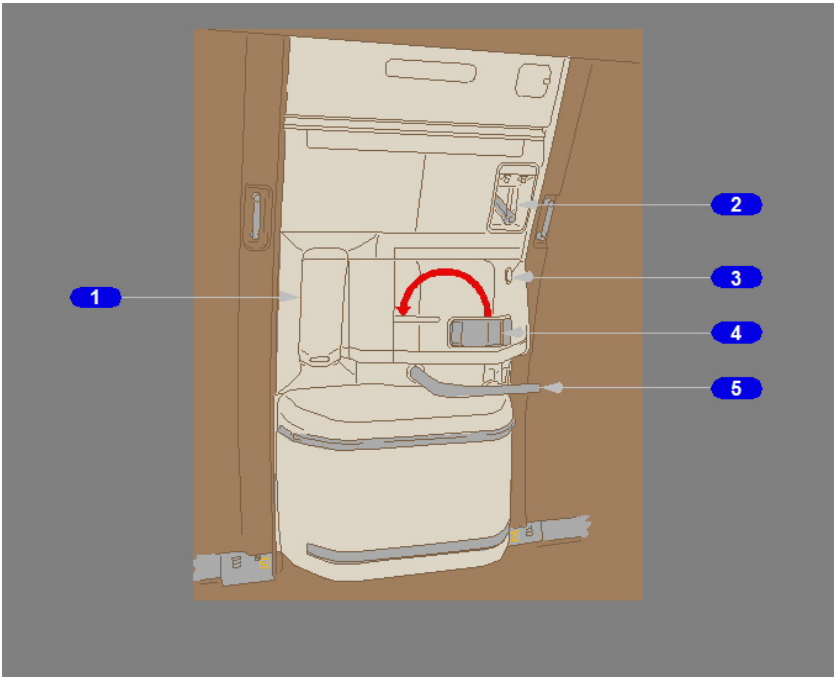
8 Girt Bar Indicator Flag Viewing Windows

Yellow in view—door and slide/raft are armed.

Black in view—door and slide/raft are not armed.

-300,-300ER

Overwing Emergency Exit Door



1 Viewing Window

Allows observation outside the airplane.

2 Door Mode Select Panel

See Door Mode Select Panel on page 1.30.17.

3 Power Assist Reservoir Pressure Gage

If the gage needle is outside the green zone, the system is unusable.

UNCONTROLLED IF DOWNLOADED OR PRINTED

4 Gust Lock Release Lever

Grab and pull inward to close the door.

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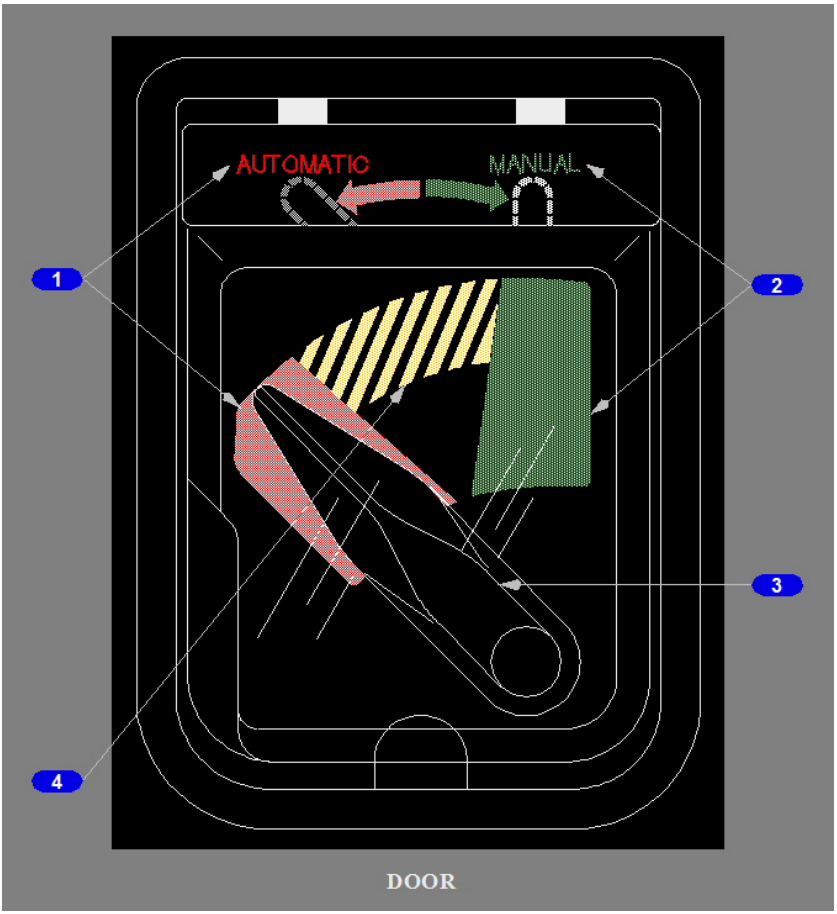
To open the door—rotate in the direction of the arrow.

To close the door—rotate in the opposite direction of the arrow.

Door Mode Select Panel



1 AUTOMATIC

Red.

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Door is armed if the mode select lever is in the middle of the red band.

When the door operating handle is moved to the OPEN position:

-300,-300ER
- the door is powered open
- overwing slide deploys, or
- the slide/raft deploys.

Note: If the door is opened from the outside, the mode select lever automatically moves to the MANUAL position.

2 MANUAL

Green.

Door is disarmed if the mode select lever is in the middle of the green band.

Moving the door operating handle to the OPEN position disables:

-300,-300ER
- power assist for door opening
- overwing slide
- automatic slide/raft deployment.

3 Door Mode Select Lever

Used to select the required mode for flight, AUTOMATIC, or arrival, MANUAL.

4 Unsafe Band

If the mode select lever is anywhere in the unsafe band, the door may be either armed or disarmed.

CAUTION: To ensure that the door is properly armed or disarmed, the door mode selector must be positioned in the middle of the red or green band.

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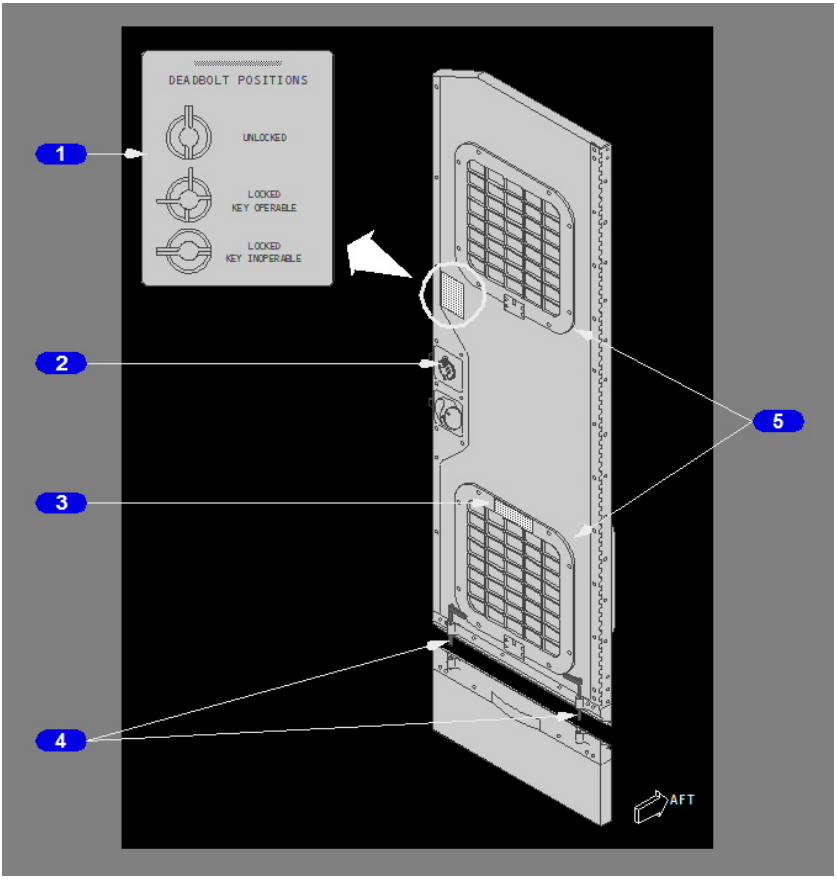
Flight Deck Door



1 DEADBOLT POSITIONS Placard

2 Deadbolt Levers

3 Emergency Egress Placard

Describes how to separate lower break-away panel from a jammed door to allow door opening and egress.

4 Shear Pins

Retract out of lower break-away panel when shear pin levers rotate down.

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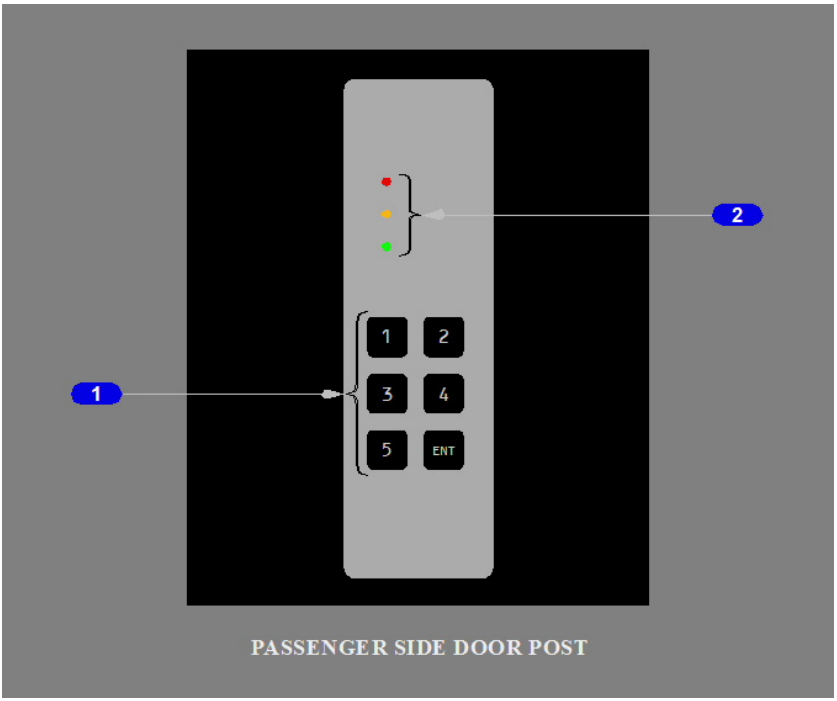
5 Security Grill

Prevents intrusion into flight deck if decompression panels open due to cabin depressurization.

Flight Deck Emergency Access Panel



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.

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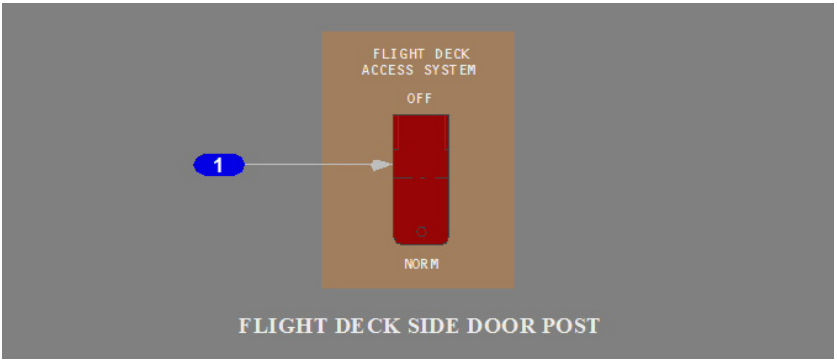
Flight Deck Access System Switch

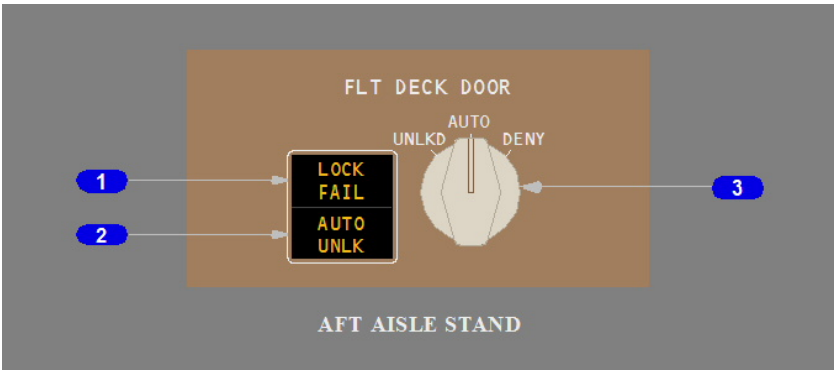


1 FLIGHT DECK ACCESS SYSTEM Switch

OFF—removes electrical power from door lock.

NORM (Normal)—flight deck access system configured for flight.

Flight Deck Door Lock Panel



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.

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3 Flight (FLT) DECK DOOR Lock Selector

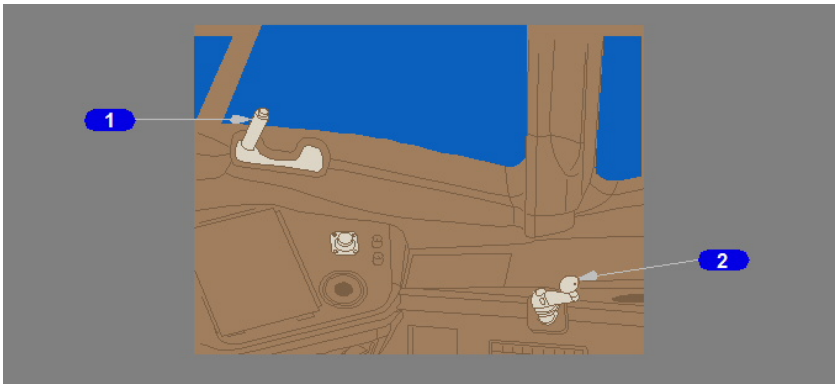
Spring loaded to AUTO. Selector must be pushed in to rotate from AUTO to UNLKD. Selector must not be pushed in to rotate from AUTO to DENY.

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 Number Two Window



1 Window Lock Lever

Forward—with the window fully closed, locks the window. If the lock lever is properly locked, the orange indicator is not visible below the release button. The EICAS message WINDOW FLT DECK L, R displays if a window is not properly latched.

Aft—unlocks the window so it can be cranked open.

2 Window Crank

Used to position the window open or closed when the window lock lever is unlocked.

To reposition the window crank without moving the window, push and hold the button in the center of the window crank.

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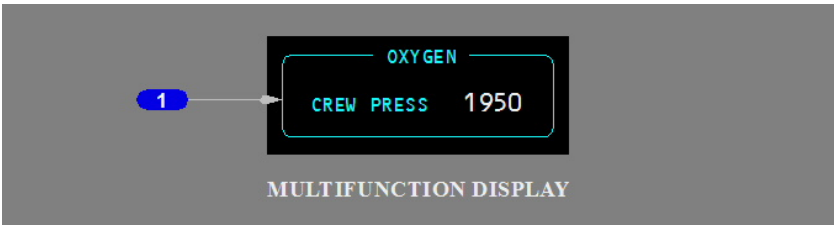
Oxygen Systems

Oxygen Indications

TJA,B,C,D,G,H,TKA to TKF

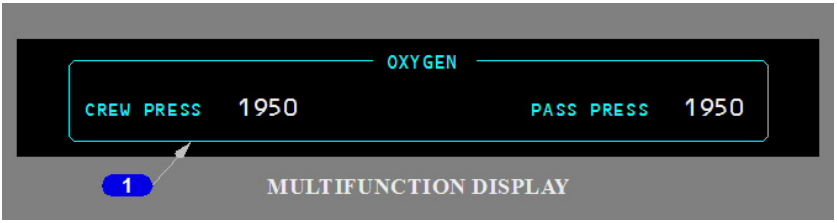


1 Oxygen Pressure Display

Displays crew oxygen cylinder pressure (PSI).

Note: Access is through the display select panel STATUS switch.

TJR to TJW,TKK to TKR,TKU to TKZ



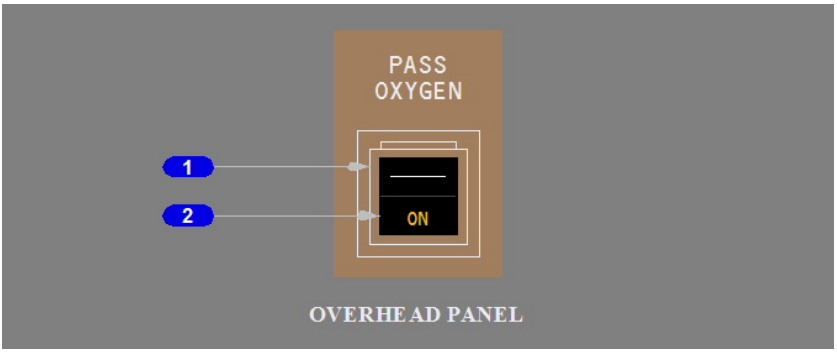
1 Oxygen Pressure Display

Displays crew and passenger oxygen cylinder pressure (PSI).

Note: Access is through the display select panel STATUS switch.

Passenger Oxygen Switch

TJA,B,C,D,G,H,TKA to TKF



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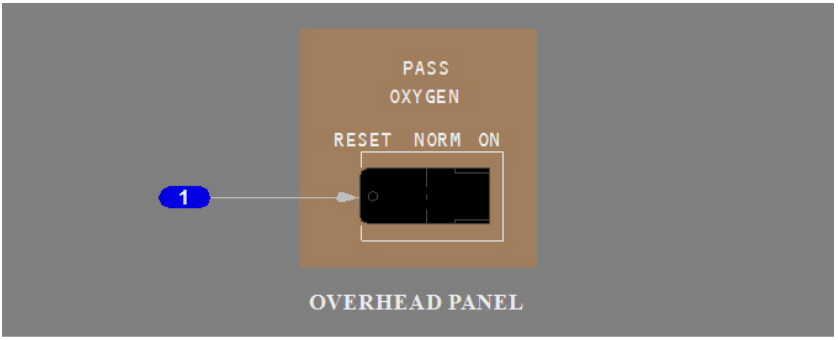
1 Passenger (PASS) OXYGEN Switch

Push—the cabin oxygen masks drop.

2 Passenger Oxygen ON Light

Illuminated (amber)—The passenger oxygen system is operating and the masks have dropped.

TJR to TJW, TKK to TKR, TKU to TKZ



1 Passenger (PASS) OXYGEN Switch

RESET (spring-loaded)—flow control units close if cabin altitude is below 13,500 feet.

NORM—system automatically activates when cabin altitude reaches approximately 13,500 feet.

ON (spring-loaded)—system activates and cabin oxygen masks drop.

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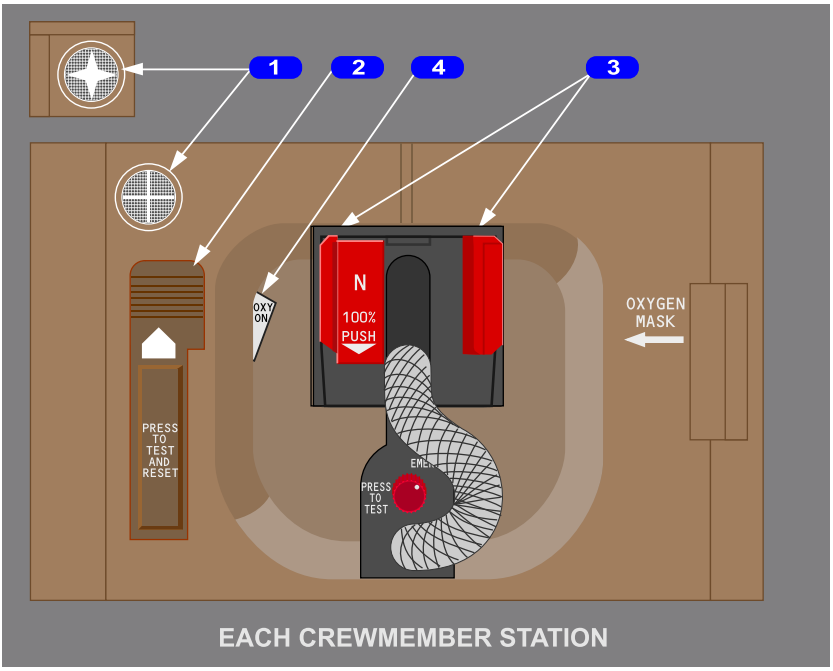
Oxygen Mask Panel



1 Oxygen Flow Indicator

Shows a yellow cross when oxygen is flowing.

2 RESET/TEST Switch

Push—

- with the left oxygen panel door closed and the OXY ON flag not displayed, turns oxygen on momentarily to test the regulator
- with the left oxygen panel door closed and the OXY ON flag displayed:
  - turns oxygen off and deactivates the mask microphone
  - reactivates the boom microphone.

3 Oxygen Mask Release Levers

Squeeze and pull—

- unlocks the oxygen panel doors
- releases the mask
- oxygen turns on when the oxygen panel doors open

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- automatically selects the mask microphone when the left oxygen panel door is opened
- disables the boom microphone.

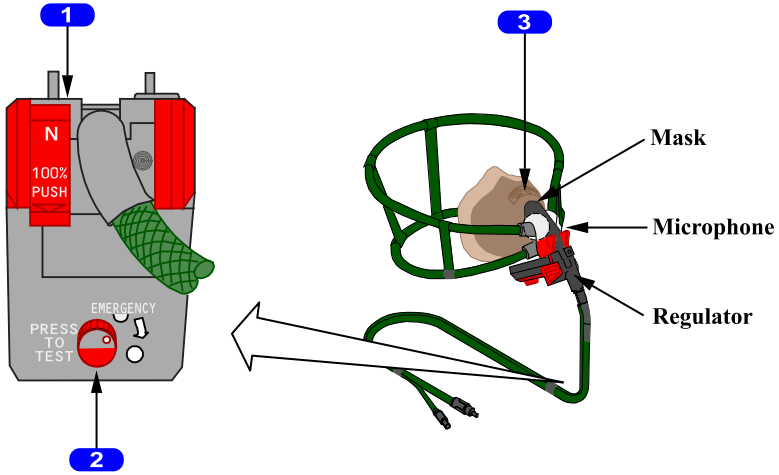
Squeeze (right lever)—inflates the mask harness.

Release—deflates the mask harness into position on the head and face.

4 Oxygen (OXY) ON Flag

In view—oxygen is on.

Oxygen Mask and Regulator



CREWMEMBER STATION
(1 EACH)

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

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF, TKK to TKR, TKU to TKZ

Normal (non-emergency) position—supplies air/oxygen mixture or 100% oxygen on demand, depending upon the position of the Normal/100% switch.

Normal (non-emergency) position—supplies air/oxygen mixture or 100% oxygen on demand, depending upon the position of the Normal/100% switch. Automatically supplies 100% oxygen under positive pressure when cabin altitude is above a preset value.

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EMERGENCY position (rotate in the direction of the arrow)—supplies 100% oxygen under positive pressure at all cabin altitudes (protects against smoke and harmful vapors). Use to purge contaminants from the mask and to remove condensation or fogging from interior of mask lens.

PRESS TO TEST—tests the positive pressure supply to the regulator.

CAUTION: **Use of EMERGENCY mode depletes oxygen supply at higher rate than 100% or N mode. Use EMERGENCY mode only as conditions require.**

Note: Communication in EMERGENCY mode may be difficult. Switch to 100% or N mode if condtions allow.

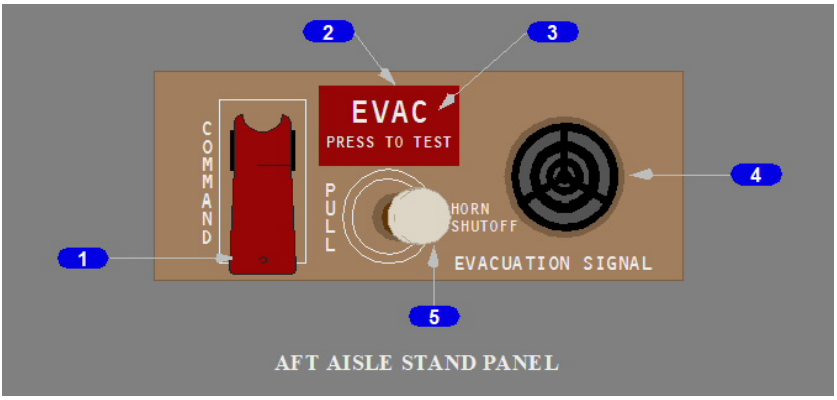
3 Smoke Vent Valve Selector

Up—vent valve closed.

Down—vent valve open, allowing oxygen flow to smoke goggles.

Emergency Evacuation Panel

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF



1 Evacuation COMMAND Switch

ON—

- the red EVAC light (flight deck) and amber EVAC lights (flight attendant panels) flash
- an audio horn sounds at each panel.

OFF (guarded position)—the evacuation signals can be activated at the flight attendant panels.

2 Evacuation (EVAC) PRESS TO TEST Switch

Push—tests the EVAC light.

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3 Evacuation (EVAC) Light

Illuminated (red)—a command switch is in the ON position.

4 EVACUATION SIGNAL Horn

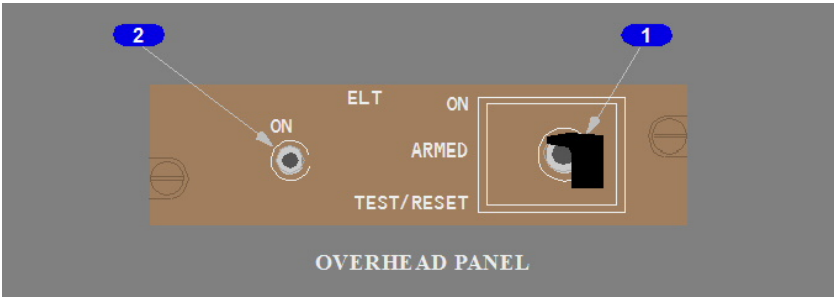
Sounds an audio signal.

5 Evacuation HORN SHUTOFF Switch

PULL—Silences the flight deck evacuation signal horn.

Fuselage Mounted Emergency Locator Transmitter

TJA,B,C,D,G, H,TKA to TKF



1 ELT Switch (guarded)

On—the ELT transmits continuously.

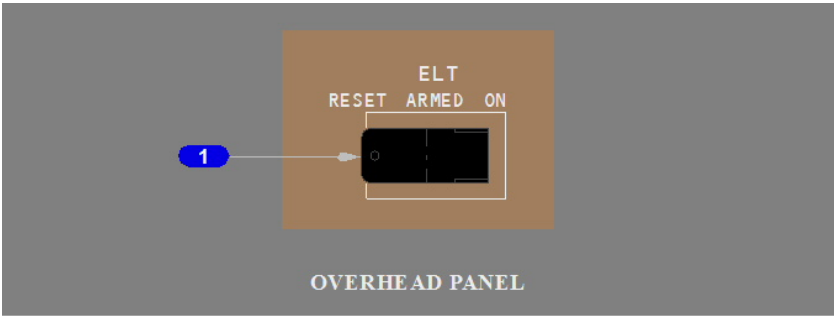
Armed—the ELT transmits when a high deceleration rate is detected.

TEST/RESET—to be determined.

2 ELT ON Light

Illuminated (TBD)—the ELT is transmitting.

TJR to TJW, TKK to TKR, TKU to TKZ



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1 Emergency Locator Transmitter (ELT) Switch

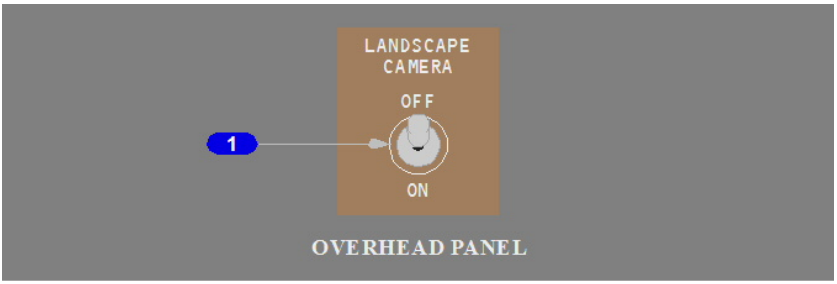
RESET (spring-loaded)—ends transmission of emergency locator signal.

ARMED (guarded position)—transmits emergency locator signal if activated by high deceleration forces.

ON—transmits emergency locator signal.

TJR to TJW

Video Landscape Camera



1 LANDSCAPE CAMERA Switch

OFF—the two video landscape cameras are unpowered.

ON—the two video landscape cameras are powered.

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Introduction

This section describes miscellaneous airplane systems, including:

- lighting systems
- oxygen systems.

Lighting Systems

Lighting systems described in this section include:

- exterior lighting
- flight deck lighting
- cabin lighting
- emergency lighting.

Exterior Lighting

Exterior lighting consists of these lights:

- landing
- runway turnoff
- taxi
- strobe
- beacon
- navigation (position)
- logo
- wing leading edge illumination
- escape slide emergency lights.

Landing Lights

The landing lights consist of the left, right, and nose gear landing lights. The left and right landing lights are located in the left and right wing root. These lights are optimized for flare and ground roll. The two nose gear–located landing lights are optimized for approach.

Runway Turnoff Lights

Runway turnoff lights are installed in the left and right wing roots. The lights illuminate the area in front of the main gear.

Taxi Lights

Taxi lights are installed on the non–steerable portion of the nose strut. They are inoperative when the nose landing gear is not down and locked.

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Strobe Lights

The strobe lights are white anticollision strobe lights located on each forward wing tip and on the tailcone.

Beacon Lights

The beacon lights are red anticollision strobe lights located on the top and bottom of the fuselage.

Navigation Position Lights

TJA,B,C,D

The navigation position lights are the standard red (left forward wingtip), green (right forward wingtip), and white (aft tip of both wings) position lights.

TJG,H, TJR to TJW, TKA to TKF, TKK to TKR, TKU to TKZ

The navigation position lights are the standard red (left forward wingtip), green (right forward wingtip), and white (aft tip of both wings and tailcone) 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 leading edge of the wing.

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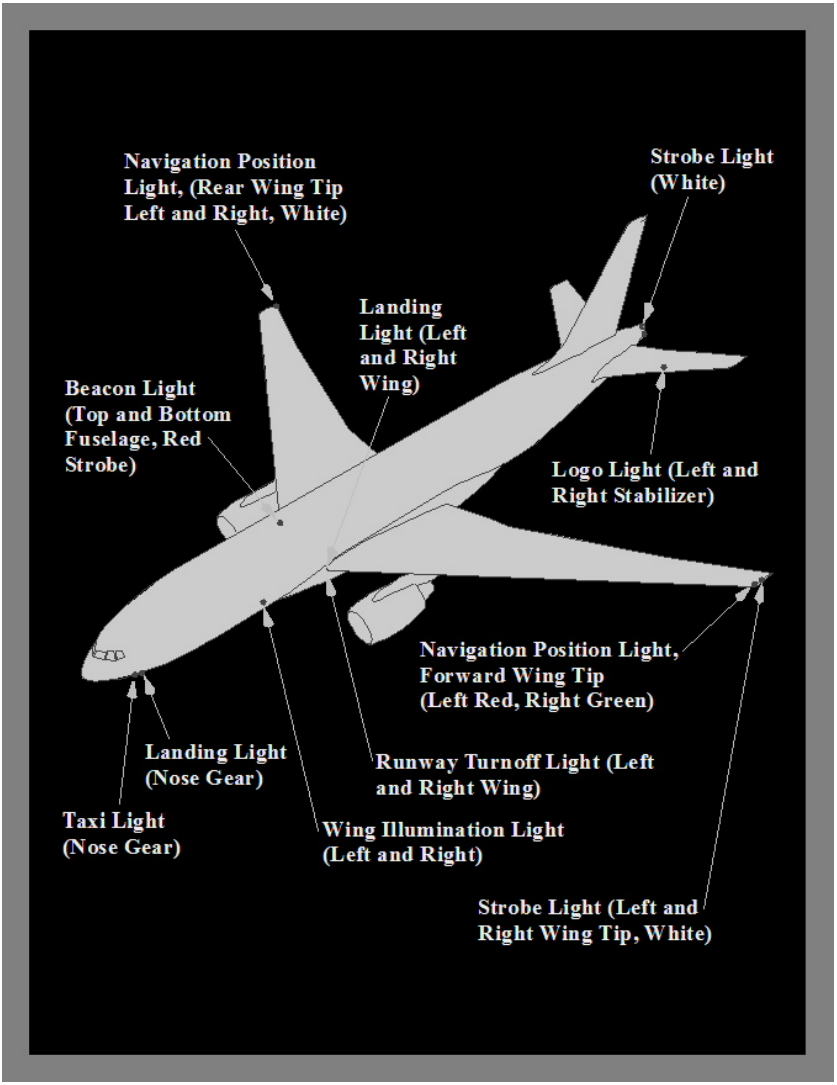
Exterior Lighting Locations

TJA,B,C,D



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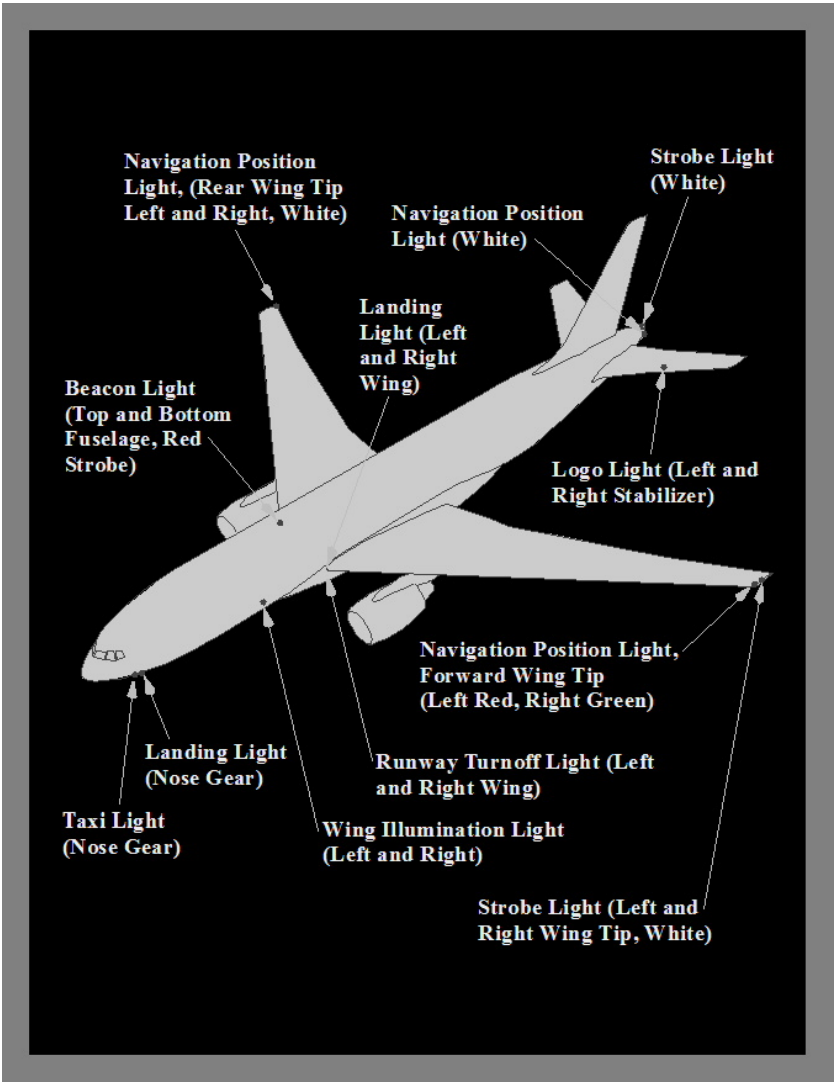
TJG,H, TJR to TJW, TKA to TKF, TKK to TKR, TKU to TKZ



Flight Deck Lighting

Flight deck lighting is provided for panel illumination, area lighting and localized illumination. Flood lights and light plates provide panel illumination. Dome lights provide flight deck area lighting. Map lights and a single utility light provide localized illumination.

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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, aisle stand flood light, and all illuminated annunciator lights illuminate at full brightness.

If normal electrical power is lost, standby electrical power is automatically provided to the primary displays. The aisle stand, left and right forward panel and glareshield flood lights, and the dome lights illuminate automatically at a fixed brightness.

Master Brightness Control System

The MASTER BRIGHTNESS control provides the means of controlling panel and display lighting brightness with the use of one control. Maximum and minimum brightness levels are adjusted as ambient lighting changes. The control is turned on when the MASTER BRIGHTNESS switch is pushed on.

Lighting controlled through the master brightness system are:

- PFDs
- MFDs
- EICAS
- CDUs
- clocks
- standby instruments
- standby compass
- digital displays
- overhead panel
- glareshield panel
- forward panels (left, center, and right)
- aisle stand panels (forward and aft).

The individual lighting controls for the above displays and panels, except the CDUs, have a center detent position identified by a white dot at the mid–range adjustment position.

Individual controls can be used for dimming individual displays and panels. The individual controls have limited adjustment capability when the MASTER BRIGHTNESS switch is on, and should be centered in the detent when first adjusting the MASTER BRIGHTNESS control. They have full range of brightness control when the MASTER BRIGHTNESS switch is off.

Display brightness is automatically adjusted based on ambient lighting when the MASTER BRIGHTNESS switch is on.

Note: If display brightness cannot be set as desired when master brightness is on, pushing the MASTER BRIGHTNESS switch off may allow setting display brightness to an appropriate level using individual brightness controls.

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Cabin Lighting

Cabin lighting near the flight deck entry door is automatically dimmed or extinguished when the flight deck door is opened while an engine is operating. This reduces the light level entering the flight deck at night.

TJA,B,C,D,G,H,TKA to TKF

Cabin Signs

The cabin signs are controlled by overhead panel selectors. The cabin signs 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 an airline defined altitude, 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 cabin signs can be controlled manually by positioning the respective switch to ON or OFF. When the SEAT BELTS and NO SMOKING selectors are in the OFF position, and oxygen is ON, the FASTEN SEAT BELTS and NO SMOKING signs illuminate.

The FASTEN SEAT BELTS and ELECTRONIC DEVICES OFF signs can be controlled manually by positioning the respective switch to ON or OFF. When the SEAT BELTS and NO ELECTRONICS selectors are in the OFF position, and oxygen is ON, the FASTEN SEAT BELTS and ELECTRONIC DEVICES OFF signs illuminate. The NO SMOKING signs are permanently illuminated.

RETURN TO SEAT signs are illuminated with the FASTEN SEAT BELTS signs, except when oxygen is deployed.

When the cabin signs illuminate or extinguish, a low tone sounds over the PA system.

TJR to TJW,TKK to TKR,TKU to TKZ

Cabin Signs

The cabin signs are controlled by overhead panel selectors. The cabin signs 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 an airline defined altitude, or
- cabin altitude above 10,000 feet, or

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- passenger oxygen on.

ELECTRONIC DEVICES OFF signs (AUTO selected):

- airplane is on the ground and the flap lever is not in the up position, or
- in flight, airplane altitude is below the value set by the configuration database, or
- cabin pressure altitude is above 10,000 feet (3,050 meters), or
- passenger oxygen is deployed.

The FASTEN SEAT BELTS and ELECTRONIC DEVICES OFF signs can be controlled manually by positioning the respective switch to ON or OFF. When the SEAT BELTS and NO ELECTRONICS selectors are in the OFF position, and oxygen is ON, the FASTEN SEAT BELTS and ELECTRONIC DEVICES OFF signs illuminate. The NO SMOKING signs are permanently illuminated.

RETURN TO SEAT signs are illuminated with the FASTEN SEAT BELTS signs, except when oxygen is deployed.

When the cabin signs illuminate or extinguish, a low tone sounds over the PA system.

Emergency Lighting

The emergency lighting system is powered by remote batteries. Battery charge is maintained by the airplane electrical system. A fully charged battery provides at least 15 minutes of operation.

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.

When the EMERGENCY LIGHTS switch in the flight deck is armed, and the door mode select lever is in the armed position, moving the door handle to the open position will cause the exterior fuselage light and the interior emergency lights at that door to illuminate.

The EICAS advisory message EMER LIGHTS is displayed if:

- the emergency lights switch is not in the ARMED position, or
- the emergency lights switch is in the ARMED position, and the emergency lights are activated by the switch at a flight attendant panel.

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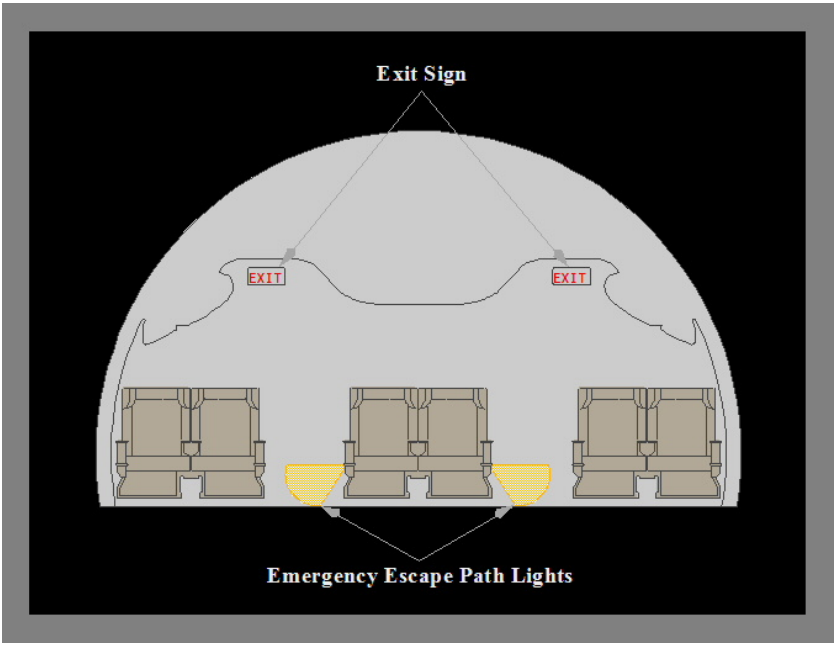
Interior Emergency Lighting



Interior emergency lighting consists of door, aisle, cross-aisle, escape path, exit lights, and luminescent exit signs.

Escape path lighting consists of lights installed in the arm rest of the center passenger seats, and on center galleys, lavatories, closets and partitions spaced at intervals in the aisles and cross-aisles. Escape path lighting illuminates emergency evacuation routes for visual guidance when all sources of lighting more than four feet above the aisle foor are obscured by smoke.

Battery powered exit lights are located at each cabin exit.

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Exterior Emergency Lighting

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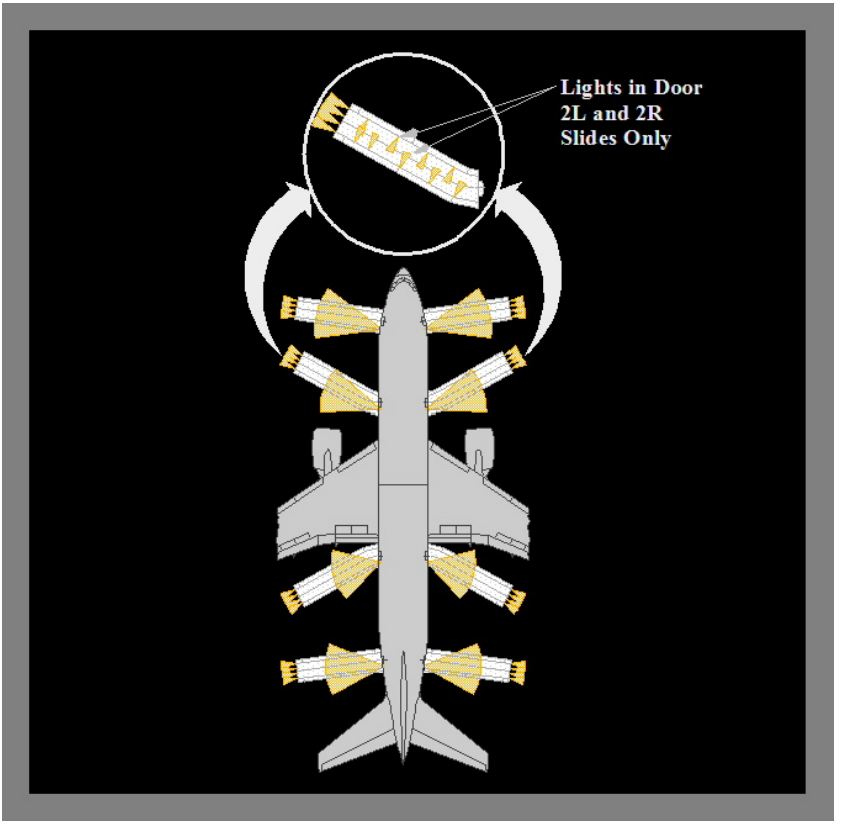

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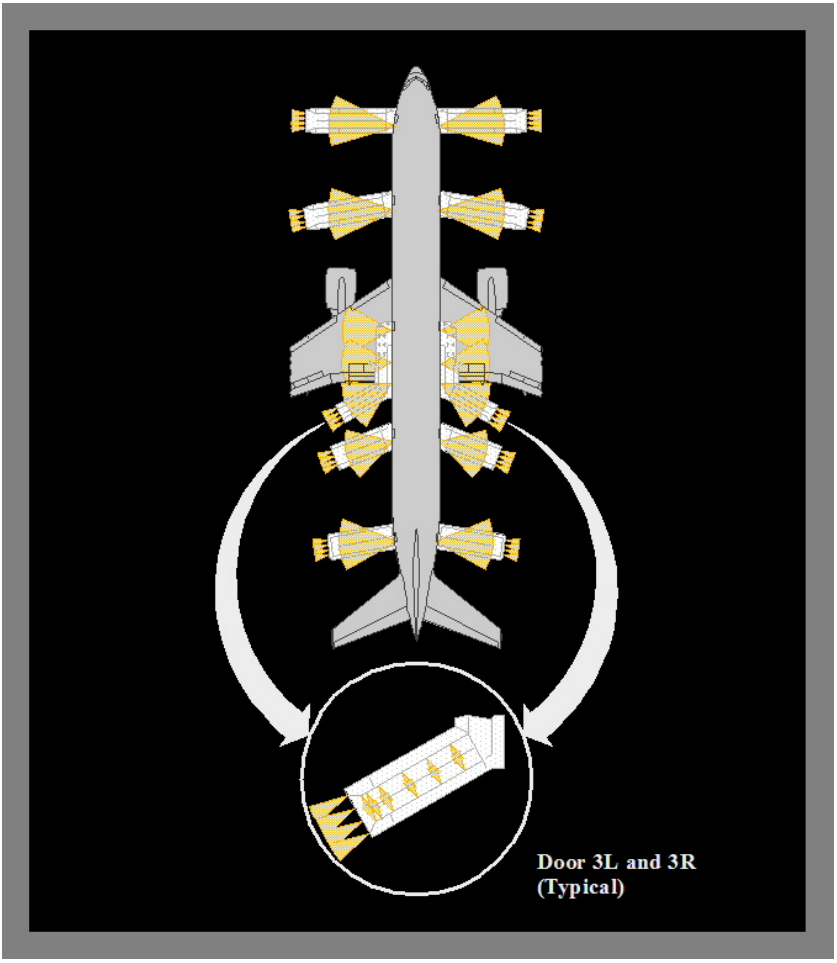
-300,-300ER



-200,-200ER Exterior emergency lighting consists of escape slide lights. The lights are located aft of each door and illuminate the areas at the base of the escape slides. The slides in doors 2L and 2R have lights built into the sliding lanes. When the slide is deployed, the lights turn on automatically to illuminate the slide lanes.

-300,-300ER Exterior emergency lighting consists of escape slide lights. The lights are located aft of each door and illuminate the areas at the base of the escape slides. The slides in doors 3L and 3R have lights built into the sliding lanes. When the slide is deployed, the lights turn on automatically to illuminate the slide lanes.

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DRAFT

-300,-300ER

The overwing exit lights are located aft of the door and illuminate the evacuation path to the escape slide. When the slide is deployed, the lights turn on automatically to illuminate the slide lanes.

Oxygen Systems

Two independent oxygen systems are provided, one for the flight crew and one for the passengers. Portable oxygen cylinders are located throughout the airplane for emergency use.

Flight Crew Oxygen System

One 115 cubic feet high-pressure oxygen cylinder supplies oxygen for the crew.

The flight crew oxygen system uses quick–donning masks and regulators located at each crew station. Oxygen pressure is displayed on the MFD STATUS display.

The EICAS advisory message CREW OXYGEN LOW alerts the flight crew of a low oxygen pressure condition.

Flight crew and observer masks and regulators are installed in oxygen mask panels near each seat. Squeezing the red oxygen mask release levers releases the mask from stowage. Removing the mask:

- inflates the mask harness
- momentarily displays the yellow oxygen flow indicator
- selects the mask microphone in the removed mask (the boom microphone is deselected).

The boom microphone can be reselected by closing the left oxygen panel door and pushing and releasing the RESET/TEST switch. This also shuts off oxygen to the mask. The oxygen flow can be restored by opening the left oxygen panel door.

Crew Oxygen Mask Microphone Test

The oxygen mask microphone can be tested without removing it from the storage box.

- Select the FLIGHT interphone transmitter and set the speaker volume as desired.
- Push and hold a MIC switch on either the audio control panel or the glare shield.
- Push both the oxygen mask RESET/TEST switch and EMERGENCY/TEST selector.

The sound of oxygen flowing is heard through the speaker, verifying microphone operation.

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Passenger Oxygen System

TJA,B,C,D,G,H,TKA to TKF

The passenger oxygen system is supplied by individual chemical oxygen generators. The oxygen system provides oxygen to:

- passenger seats
- attendant stations
- lavatory service units.

TJR to TJW,TKK to TKR,TKU to TKZ

The passenger oxygen system is supplied by a gaseous oxygen system. The oxygen system provides oxygen to:

- passenger seats
- attendant stations
- upper crew rest compartments
- lavatory service units.

TJA,B,C,D,G,H,TKA to TKF

The passenger oxygen masks and chemical oxygen generators are located in passenger service units (PSUs). Oxygen flows from a PSU generator when any mask hanging from that PSU is pulled. Oxygen is available for approximately 12 minutes. The masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet. The passenger masks can be manually deployed from the flight deck by pushing the overhead panel PASSENGER OXYGEN switch to the ON position.

TJR to TJW,TKK to TKR,TKU to TKZ

The passenger oxygen system is supplied by bottled gaseous oxygen (seven (7) 117 cubic feet oxygen bottles). The passenger oxygen masks are located in passenger service units (PSUs). The masks automatically drop from the PSUs if cabin altitude exceeds approximately 13,500 feet. The passenger masks can be manually deployed from the flight deck by pushing the overhead panel PASSENGER OXYGEN switch to the ON position. Oxygen flow can be reset by selecting the PASSENGER OXYGEN switch to the RESET position.

TJR to TJW,TKK to TKR,TKU to TKZ

Passenger oxygen pressure is displayed on the MFD STATUS display.

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Emergency Equipment Overview

This section describes the emergency equipment located throughout the airplane, including:

- emergency evacuation signal system
- emergency locator transmitters (ELTs)
- fire extinguishers
- portable flight deck emergency equipment location
- portable passenger cabin emergency equipment location.

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

Emergency Evacuation Signal System

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

The emergency evacuation signal system alerts the flight attendants to evacuate the passenger cabin.

Placing the flight deck evacuation signal COMMAND switch to ON activates the evacuation signal on the flight deck and on the flight attendant panels.

With the flight deck evacuation signal COMMAND switch in the OFF (guard down) position, pressing an EVAC COMMAND switch on a flight attendant panel will activate the evacuation signals on the flight deck and on the flight attendant panels.

Emergency Locator Transmitter (ELT)

Fuselage Mounted Emergency Locator Transmitter (ELT)

An emergency locator transmitter (ELT) is mounted to the top center of the fuselage in the passenger cabin area.

The ELT automatically transmits distress signals on 121.5 MHz, 243 MHz, and 406 MHz if a high deceleration is detected, or if the ELT switch is selected to ON.

The ELT can be deactivated by selecting the ELT switch to TEST/RESET for less than 2 seconds and back to ARMED.

TJA,B,C,D,G,H,TKA to TKF

The EICAS alert message ELT ON is displayed if the transmitter is activated. The ELT can be deactivated by placing the ELT switch to RESET momentarily, then ARMED.

TJR to TJW,
TKK to TKR,
TKU to TKZ

Passenger Cabin

TJA,B,C,D,G,H,TKA to TKF

One portable (survival) ELT, capable of transmitting distress signals on 121.5 MHz, 243 MHz, and 406 MHz, is provided in cabin area. The ELT is a compact, buoyant, automatic transmitter with a water-activated battery, a self-

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erecting antenna, a 20 m long lanyard and a special water (plastic) bag located under the lanyard for operation on ground.

Operating life	48 hours
Activation	Salt water 5 second, fresh water 5 min
Range	To an aircraft at 10,000 ft about 120 Nm

WARNING: Because of the jamming effects, the ELT must be silenced before operation of the VHF transceiver.

The operating instructions in English and French are placarded on the ELT. The following is the English version:

At sea—

- Unroll free end of cord at top of ELT.
- Tie cord securely to slide/raft.
- Place ELT in water beside slide/raft.
- ELT will operate automatically in a few seconds and will drift out to the end of 20 m cord.

On land—

- Break tape holding antenna rod and allow antenna to erect.
- Break tape holding red lanyard cord and pull clear of ELT.
- Unroll plastic bag packed under lanyard.
- Insert lower end of ELT into plastic bag and pour about 200 cc of water, tea, coffee, thin soup or urine.
- Place ELT in clear space and prop-upright, so liquid does not spill.

Switching off procedure

- Lay ELT horizontally or keep antenna under water. By laying ELT horizontally, the mercury switch will open and battery power to the transmitter is cut.

TJR to TJW, TKK to TKR, TKU to TKZ

Passenger Cabin

One portable (survival) ELT, capable of transmitting distress signals on 121.5 MHz, 243 MHz, and 406 MHz, is provided in cabin area.

Operating life	
121.5/243 MHz	60 hrs
406 MHz	24 hrs

The ELT can be operated manually.

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To activate the beacon:

- pull the switch and slide it to ON position,
- the indicator light and the oral indicator indicate beacon activation,
- the beacon begins a self test, indicator light comes on 100 sec then blinks 50 sec,
- after this the beacon enters in real distress mode,
- place beacon upright in obstacle free area. If on lake or at sea, attach the beacon the raft by means of lanyard and allow it float.

To shut down the beacon:

- in the event of false maneuver or untimely operation, carry out the shutdown of the beacon,
- the beacon is shut down by pulling TEST/OFF/ON toggle switch and slide it OFF.

CAUTION: IN THE EVENT OF UNTIMELY BEACON ACTIVATION, SHUT DOWN THE BEACON AND INFORM THE SEARCH AND RESCUE AUTHORITY IMMEDIATELY.

Miscellaneous Portable Emergency Equipment

Portable emergency equipment is stowed at strategic locations throughout the airplane. See Examples of Emergency Equipment Location on page 1.45.18

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.

Note: The directions for use of the fire extinguisher are 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.

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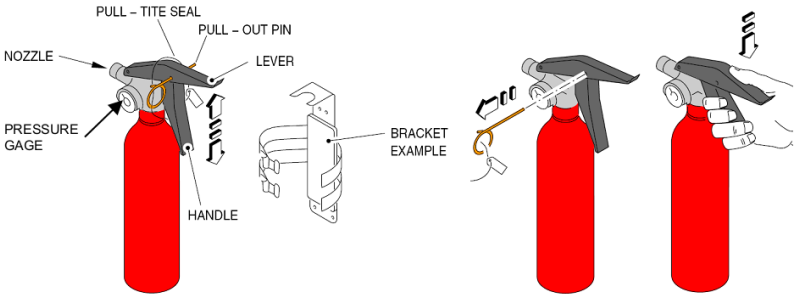
CAUTION: **For electrical fires, remove the power source as soon as possible. Avoid discharging directly on persons due to possibility of suffocating effects. Do not discharge too close to fire as the discharge stream may scatter the fire. As with any fire, keep away from the fuel source. Avoid breathing vapors, fumes and heated smoke as much as possible.**



Halon Fire Extinguisher Operation

To use the halon fire extinguisher:

- pull ring pin from lever and handle
- hold extinguisher upright with hand under handle and thumb on top of lever
- from a distance of 6 to 10 feet, direct the nozzle towards the base of the fire source

  Note: The extinguisher stream will shoot over 10 foot distance.
- squeeze the lever downward with thumb
- spray at the base of the flame in quick side-to-side-motion.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

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.

Note: The directions for use of the fire extinguisher are printed on the extinguisher.

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.**

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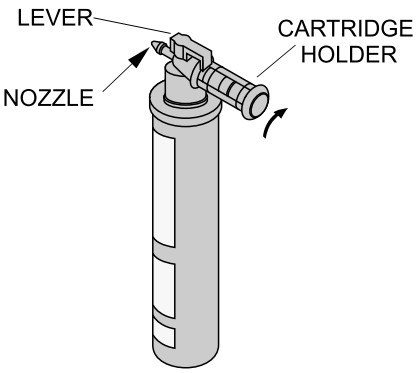

Water Fire Extinguisher Operation

To use the water fire extinguisher:

- remove it from stowage
- turn handle clockwise as far as possible (charges bottle with CO2)
- hold bottle upright
- direct nozzle at base of fire
- press trigger to discharge.

Smoke Goggles

Smoke goggles are for use in conjunction with quick donning oro-nasal masks in the flight deck, for protection against smoke and toxic vapors. They are located at each flight deck crew station.

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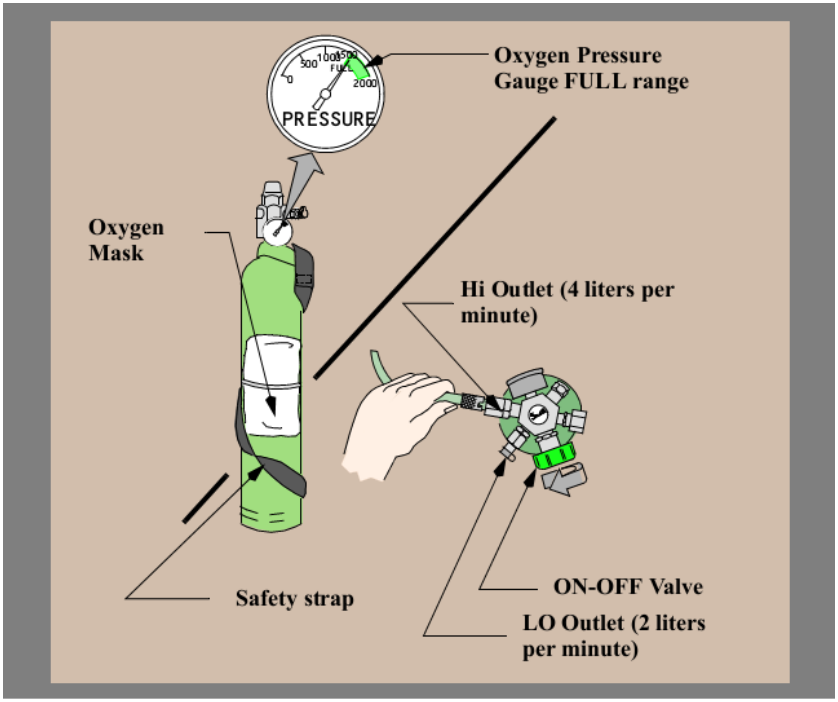
Portable Oxygen Bottles

Portable oxygen bottles are stowed in various locations in the 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.



Portable Oxygen Bottle Use

To use the portable oxygen bottle:

- use safety strap when carrying the bottle
  Note: Use extream care while transporting portable oxygen bottle.
- remove mask from its bag
- rotate the ON–OFF valve fully counter-clockwise
- place mask over nose and mouth.

Emergency Flashlights

Emergency Flashlights are designed for emergency use only.

These high intensity flashlights illuminate automatically when they are removed from the stowage brackets. The light can be extinguished only by placing the flashlight back into the stowage bracket.

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DRAFT

A tamper seal secures the flashlight to ensure it is available during an emergency. The seal becomes broken after the flashlight is removed from the bracket.

EF-1 Model

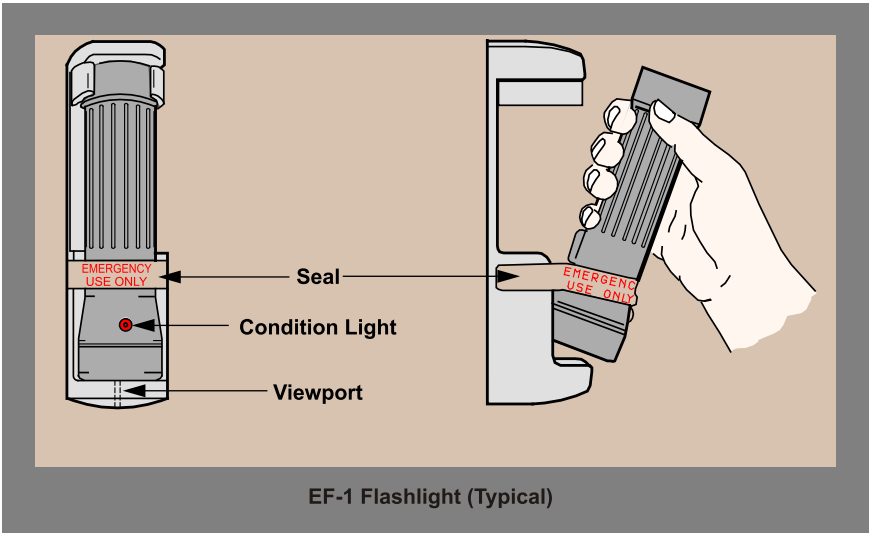
TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF
TKK to TKR,
TKU to TKZ

EF-1 flashlights are stowed on the flight deck and throughout the passenger cabin.

EF-1 flashlights are stowed throughout the passenger cabin.

The flashlight is explosion proof and powered by dry batteries. The batteries last four hours of continuous use. The batteries cannot be recharged.

An LED condition light indicates battery status. Red light blinks every three to four seconds when the battery charge is normal.



EF-1 Flashlight (Typical)

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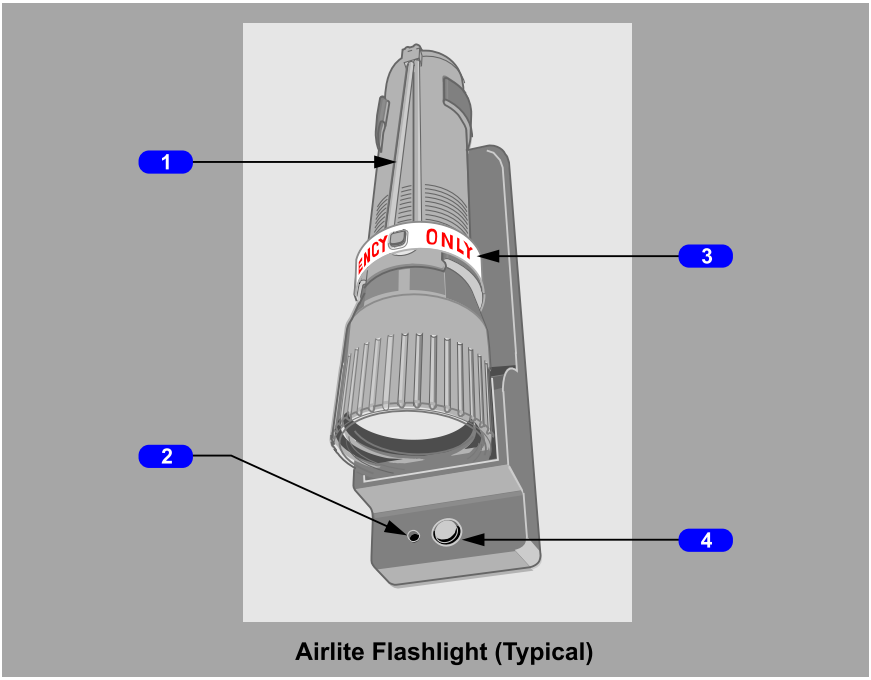
TKK to TKR, TKU to TKZ

Airlite Model

Two Airlite flashlights are stowed on the flight deck.



Airlite Flashlight (Typical)

1 Elastic Wrist Strap

2 Condition Light

Illuminated (green)—One flash during test indicates a normal battery charge.

Illuminated (red)—One flash during test indicates the battery should be replaced. Flashes every ten seconds when the battery has reached its end of life.

3 Tamper Seal

4 Push-to-Test Switch

Push—produces one green or red flash on the condition light.

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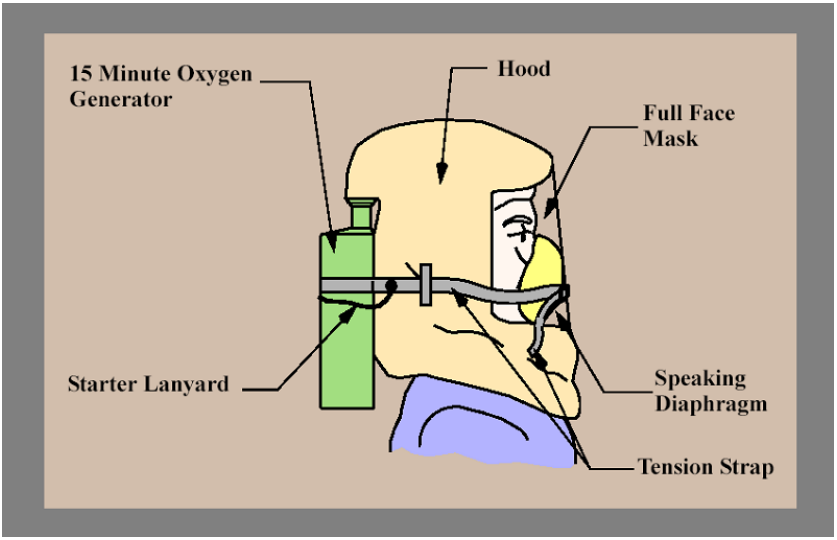
Protective Breathing Equipment (PBE/Smoke Hood)



The smoke hood is an emergency breathing device, which permits a more efficient fire fighting, e.g. in a lavatory. It must be used in the situation where breathing difficulty because of smoke and gas prevents the crew from getting near the fire.

The smoke hood has:

- an oxygen supply generator,
- a chemical scrubber, and
- a loose-fitting hood with a head harness.

When operated, the generator produces oxygen for 15 min. The oxygen supply and the breathing gas from the user is recirculated through the scrubber which removes carbon dioxide and water vapor.

PBE Operation

- Remove PBE from storage container.
- Tear off red pull strap and remove unit from plastic protective wrapper.
- Pull actuation ring in the direction indicated.
- Bend over and grasp hood opening with thumbs and pull hood overhead.
- Raise to standing position and adjust hood for most comfortable fit.
- Check neck seal for secure fit.

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Crash Axe

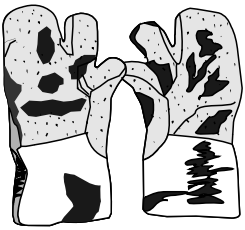
The fire axe is intended for use in emergencies, e.g. breaking and cutting inside the aircraft.

The axe handle is electrically isolated to withstand 24,000 volts.

One crash axe is located in the flight deck.

Fire Fighting Gloves

The fire fighting gloves for use by a crew member to grasp superheated metal parts or burning parts, are located in the flight deck.



Life Vests

The life vests are made from special light weight materials. The crew's life vests are red, those of the passengers' (adult/child) and infants' are yellow.

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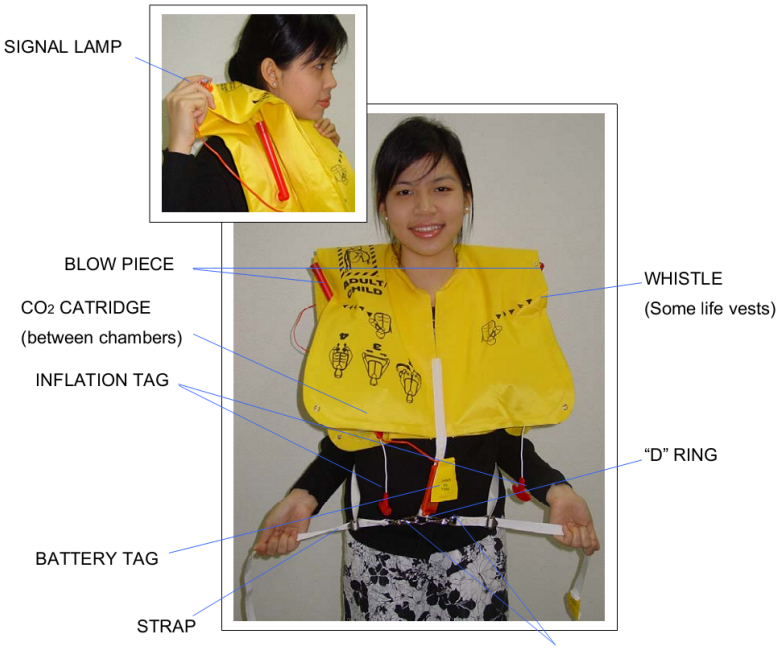
Crew/Adult Life Vests



To use life vests:

1. Put the life vest over your head and connect the snap hooks to the D ring and tighten the vest by pulling the straps.

2. When outside the aircraft, pull the inflation tags.

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3. The life vest can also be inflated manually by blowing up each of two chambers.

4. To activate the signal lamp, pull the battery tag.

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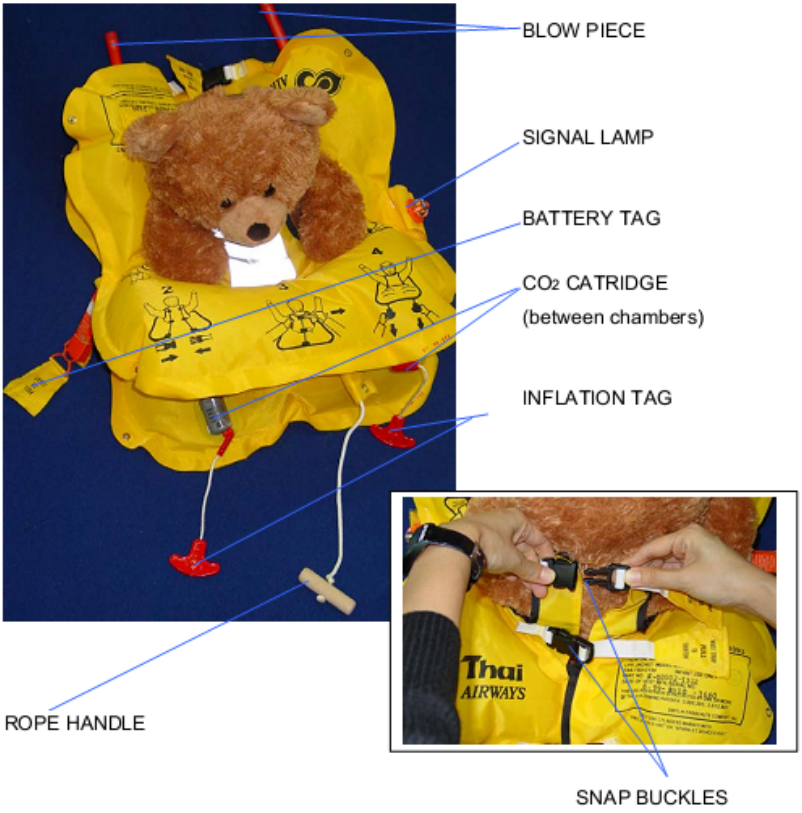
Infant Life Vest

The life vest consists of two flotation chambers, three donning buckles, an inflation system with two CO2 cartridges, manual inflation equipment, battery, signal lamp and a two meter lanyard.



Operation of Infant Life Vest

1. Fasten the three donning buckles.
2. Inflate the vest by pulling the red tab inside the aircraft, or before leaving the aircraft in an unprepared case. The life vest can also be inflated manually by blowing up each chamber.
3. To activate the lamp, pull the battery tag. The lamp will work only in water.

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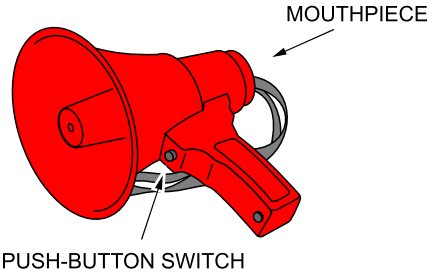
Demonstration Life Vest

The demonstration life vests, similar to the adult's but with larger opening for the head, have no CO2 cartridges. After each demonstration, the life vests must be replaced to their original storage places.

Megaphones

The megaphone is a compact battery-operated unit.

Cabin crew are responsible for using them to direct passengers as required.



Operations

1. Tear/pull off or break protective cover (if installed).
2. Hold the megaphone up, so that the microphone is touching the upper lip.
3. Squeeze the press-to-talk trigger switch to operate.
4. Point the horn towards passengers, then talk slowly in a strong COMMAND voice.
5. Regulate volume control if required.
6. Direct evacuation as situation demands.

Medical Equipment

First Aid Kit

First aid kits are stowed at different locations throughout the cabin. The number and location of first aid kits installed on board are specified in the Safety/Security Checklist. The kit provides equipment and medicines for first aid use. The contents list is attached to the case.

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Medical Kit

Medical kits are stowed in the padlocked stowage compartment. IM/Purser holds the key.

The kit may be opened after permission from the P-i-C or the IM/Purser. However, the P-i-C must always be informed.

The kit provides equipment and medicines to be used only by a medical doctor; the contents list is attached to the case.

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Automated External Defibrillator (AED)

The AED is intended to be used by trained flight attendant personnel, medical doctors and medical assistant aboard a flight to deliver electric shock to a person's heart that may be experiencing heart rhythm abnormalities (VF—Ventricular Fibrillation) and/or cardiac arrest.

The Readiness Status Indicator (top right on AED) continuously flashes (1 sec interval) to indicate the unit is operational.

AED supplementary kit comprises equipment required for sufficient use of the AED.

The Kit comprises User's manual, content list, pocket masks, disposable shavers, gauze, towels, scissors and gloves.

Universal Precaution Kit (UPK)

The purpose of the UPK is to provide the protection of cabin crew member when dealing with infectious fluid which is potentially infectious cases of suspected communicable disease such as blood, urine, vomit or faeces. The universal precaution kit contains items required below.

Content:

One UPK consists of:

- 1 × Absorbent powder
- 1 × Disinfectant cleaner
- 1 × Bonded wipe
- 1 × Disinfectant wipe
- 1 × Pair of disposable gloves
- 1 × Pair of polythene oversleeves
- 1 × Scoop/scraper
- 1 × Face/eye mask

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- 1 × Apron
- 1 × Yellow biohazard bag
- 1 × Instruction.

Examples of Emergency Equipment Location

This is an example of Emergency Equipment Location and is not kept up-to-date. The actual Emergency Equipment Location can be found in Safety/Security Checklist in flight deck, and on OH website.

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Symbol List

SYMBOL	DESIGNATION
	Oxygen mask, half-faced
	Escape rope
	AED + AED supplementary kit
In use	Medical kit (in use)
Spare	Medical kit (spare)
	O2 bottle, 310 liter, with 1 mask
	Universal Precaution Kit (UPK)
	Emergency Locator Transmitter (ELT)
	Emergency flashlight
	Life vest, red
	Megaphone

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SYMBOL	DESIGNATION
	First aid kit
	Fire extinguisher, halon
	Fire extinguisher, water
	Protective Breathing Equipment (PBE)
	Axe
	Fire gloves, pair
	Smoke goggles
	Demo kit (1 x life vest, demo + 1 x O2 mask + 1 x demo seatbelt)
	Spare kit (2 x life vest, yellow + 2 x extension belt)
	Infant life vest
	Handcuff with keys, plastic restraints and scissors

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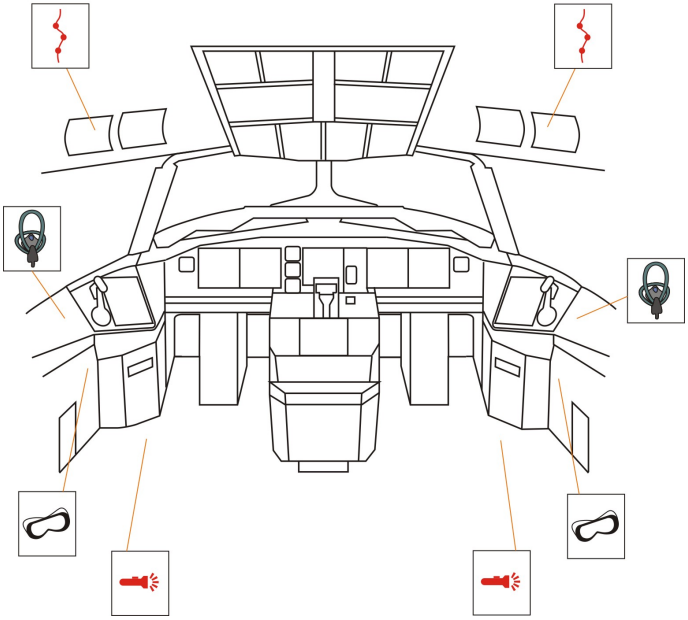
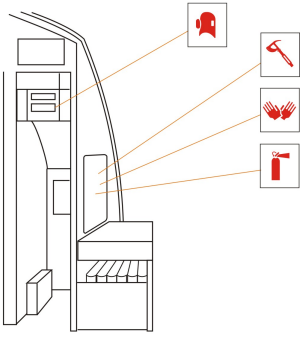
Emergency Equipment Location in the Cockpit

Cockpit-Fwd Area



Cockpit-Aft Left Area



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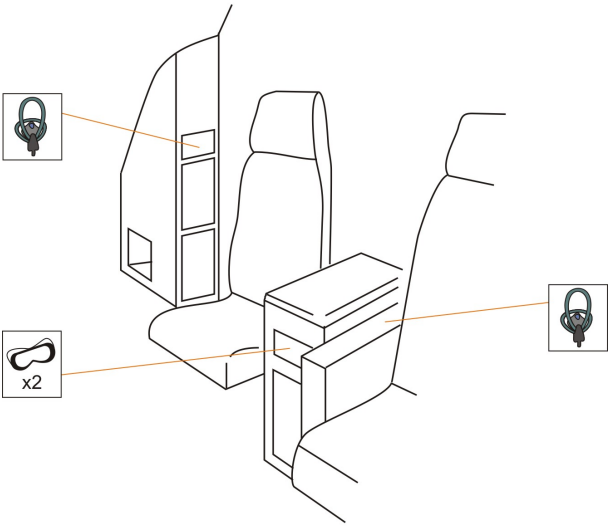
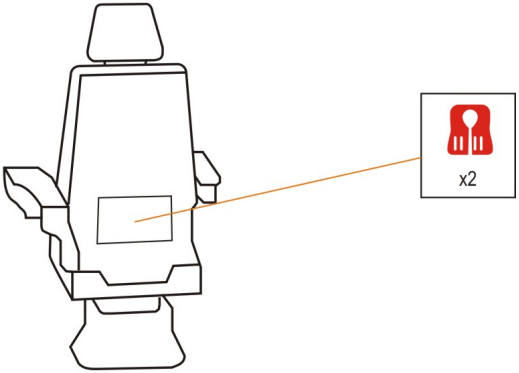
Cockpit-Aft Right Area



Captain and Co-pilot Seat



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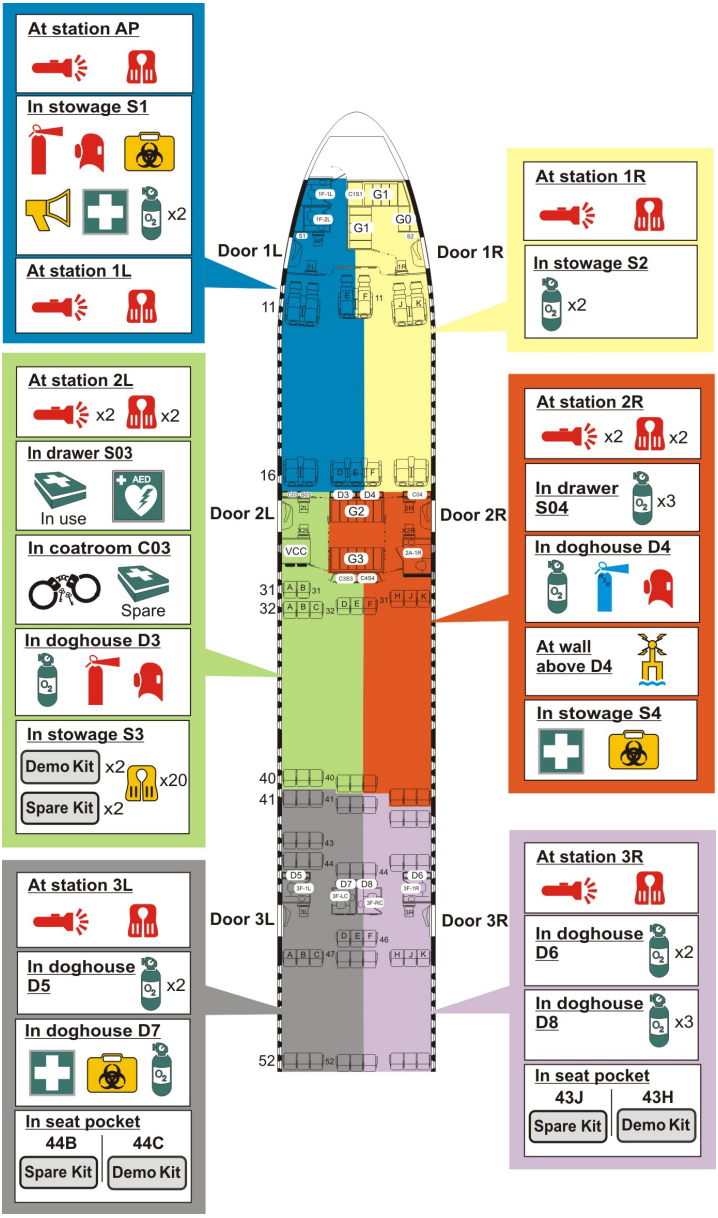
Emergency Equipment Location in the Cabin



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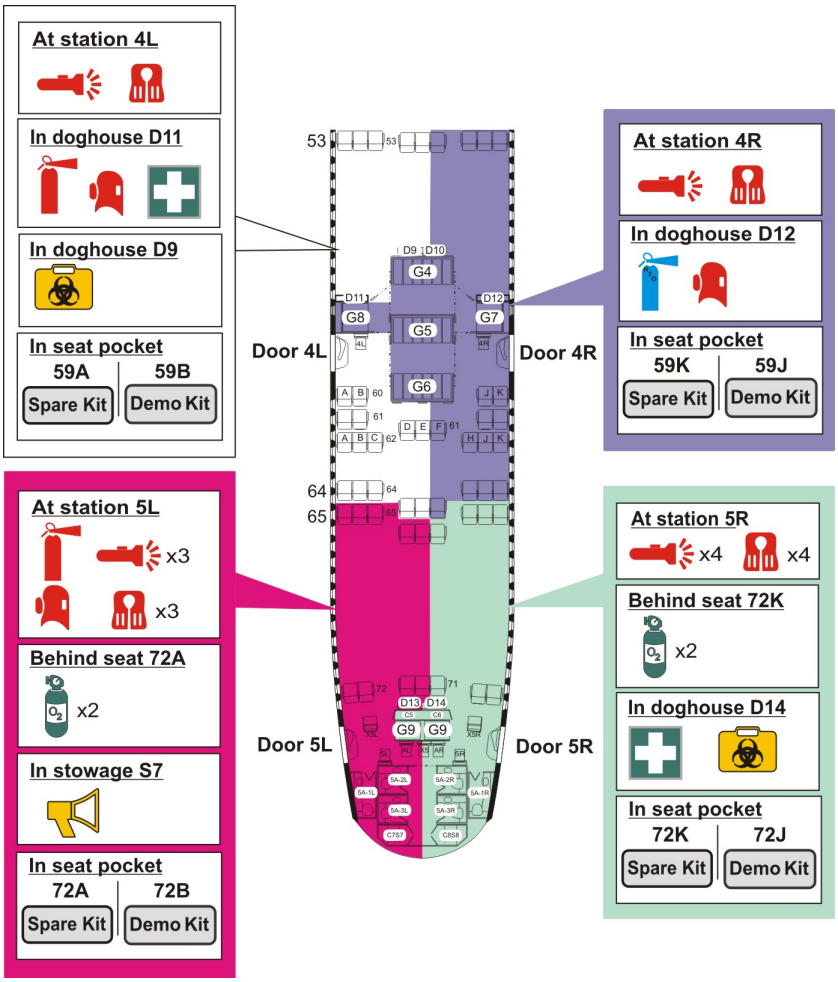

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TJR to TJW, TKK to TKR, TKU to TKZ

Introduction

This section describes the crew rest area, including:

- location and entry enclosure
- control panels
- smoke detection
- decompression
- emergency equipment and location
- evacuation.

Crew Rest

General

A door 1 overhead flight crew rest area is located in the forward part of the airplane near door 1. Access into the area is through an enclosure located in the passenger cabin near door 1L.

TJR to TJW

A door 3 overhead flight attendant rest area is located in the aft part of the airplane in the overhead above door 3. Entry into the area is through an enclosure located in the passenger cabin near door 3R.

TKK to TKR, TKU to TKZ

A door 5 overhead flight attendant rest area is located in the aft part of the airplane in the overhead between doors 4 and 5. Entry into the area is through an enclosure located in the passenger cabin across from door 5L.

WARNING: The crew rest area should not be occupied when the amber SUPPLY AIRFLOW OFF light is illuminated.

The entrance to the crew rest area has the same external appearance as a lavatory, but is placarded for crew use only.

The crew rest door should remain closed and locked at all times.

Occupancy

The crew rest may be occupied by crew members trained in the use of the crew rest evacuation routes, fire fighting procedures and depressurization procedures.

Notes: 1. A placard is installed indicating any crew rest area occupancy restrictions.

2. The crew rest area is not to be occupied during taxi, takeoff, or landing operations.

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Door 1 Overhead Crew Rest

The entrance enclosure contains an area main control panel.

An amber light is mounted on the exterior wall above the entrance door to the overhead crew rest. When smoke is detected in the area, the light flashes. The light will illuminate steady when the attendant call button on a passenger control unit inside the area has been pushed.

Notes:
1. The SUPPLY AIRFLOW OFF light will be illuminated when the airplane is below 25,000 feet.
2. If the airplane is above 25,000 feet and the SUPPLY AIRFLOW OFF light is illuminated, pushing the AIRFLOW/SMOKE RESET switch resets the conditioned air system.

TJR to TJW

Door 3 Overhead Crew Rest

Entry into the crew rest area is through an enclosure located in the passenger cabin across from door 3R. The entrance to the crew rest area is placarded for crew use only.

The entrance enclosure contains an area main control panel.

An amber call/reset light/switch is mounted on the exterior wall above the entrance door. When smoke is detected in the area, the light flashes. The light will illuminate steady when the attendant call button on a passenger control unit (PCU) inside the area has been pushed.

Conditioned air is used to provide temperature control and ventilation to the door 3 overhead crew rest area. When using the area, conditioned air flow must be available. An amber AIRFLOW OFF light on the main control panel in the entrance enclosure illuminates when conditioned air is not available.

Before entering the crew rest area, ensure that conditioned air flow is available. Verify that the AIR FLOW OFF light on the control panel in the entrance enclosure is not illuminated.

Notes:
1. The AIRFLOW OFF light will be illuminated when the airplane is below 25,000 feet.
2. If the airplane is above 25,000 feet and the AIRFLOW OFF light is illuminated, pushing the AIRFLOW/SMOKE RESET switch resets the conditioned air system.

WARNING: If the AIRFLOW OFF light remains illuminated after the AIRFLOW/SMOKE RESET switch has been pushed, the door 3 overhead crew rest area should not be occupied.

TKK to TKR, TKU to TKZ

Door 5 Overhead Crew Rest

A door 5 overhead crew rest area is located in the aft part of the airplane in the overhead between doors 4 and 5. Entry into the area is through an enclosure

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located in the passenger cabin across from door 5L. The entrance to the crew res area is placarded for crew use only.

The area has its own smoke detection system but no fire extinguishing system.

A placard is installed indicating any door 5 overhead crew rest area occupancy restrictions.

The entrance enclosure contains the main control panel.

An amber call/reset light is mounted on the exterior wall above the entrance door. When smoke is detected in the area, the light flashes. The light will illuminate steady when the attendant call button on a passenger control unit (PCU) inside the area has been pushed.

Conditioned air is used to provide temperature control and ventilation to the door 5 overhead crew rest area. When using the area, conditioned air flow must be available. An AIRFLOW OFF light on the main control panel in the entrance enclosure illuminates when conditioned air is not available.

Before entering the crew rest area, ensure that conditioned air flow is available. Verify that the AIRFLOW OFF light on the control panel in the entrance enclosure is not illuminated.

Notes: 1. The AIRFLOW OFF light will be illuminated when the airplane is below 25,000 feet.

2. If the airplane is above 25,000 feet and the AIRFLOW OFF light is illuminated, pushing the AIRFLOW/SMOKE RESET switch resets the conditioned air system.

WARNING: If the AIRFLOW OFF light remains illuminated after the AIRFLOW/SMOKE RESET switch has been pushed, the door 5 overhead crew rest area should not be occupied.

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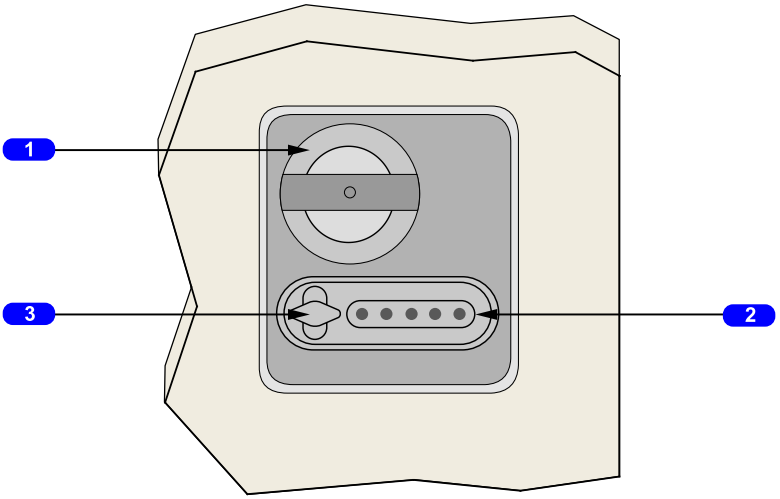
Entrance Enclosure Door Lock

A keyless door lock is installed on the entrance to the crew rest area.



OVERHEAD CREW REST
FLIGHT CREW REST

1 **Door handle**

2 **5 button keypad**

3 **Reset knob**

Door Lock Operation

To unlock the door, press the keypad buttons in the airline pre-programed code and rotate the door handle in either direction to retract the door bolt. When the door handle is released, the bolt automatically returns to the latched position allowing the door to be closed without retracting the bolt.

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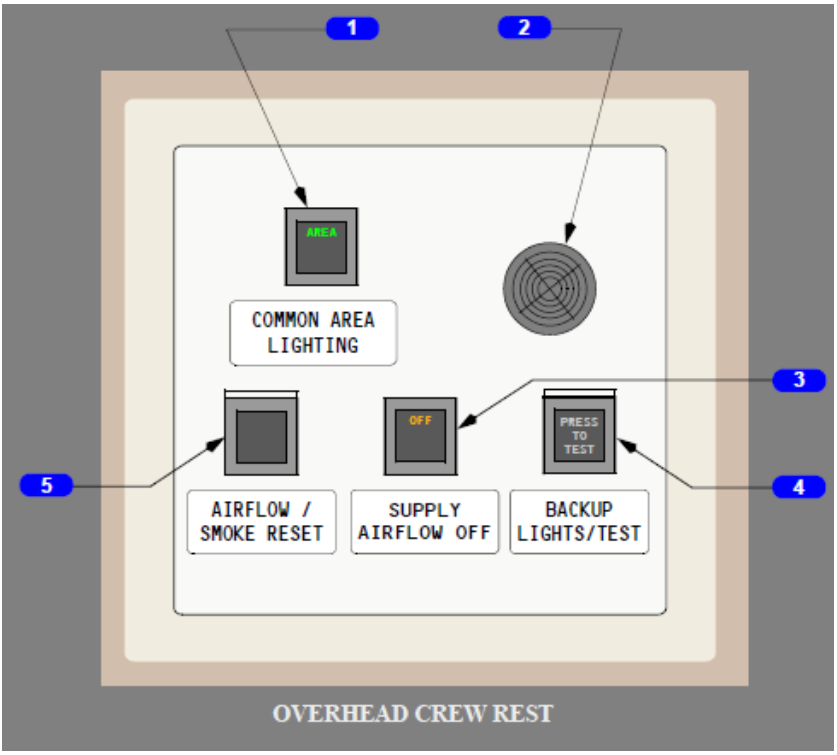
Control and Indicators

Main Control Panel



1 COMMON AREA LIGHTING Switch

Push—

- turns the common seating area lights in the area on (light illuminated)/off (light extinguished).

2 Alert horn

Horn sounds when:

- airplane decompression occurs (continuous)
- smoke is detected in the overhead crew rest area (pulsating).

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3 SUPPLY AIRFLOW OFF Light

Illuminated (amber)—

- area airflow exhaust valves are open or during smoke detection mode operations
- the area airflow is off.

Note: A HI/LO chime will sound 5 times in the area whenever the air supply shutoff valve is commanded closed.

Note: The SUPPLY AIRFLOW OFF light will be illuminated when the airplane is below 25,000 feet or in the smoke detection mode.

WARNING: The upper crew rest area should not be occupied when the amber SUPPLY AIRFLOW OFF light is illuminated.

4 BACKUP LIGHTS/TEST Switch

Guarded switch/light.

Push—illuminated (white)—

- the emergency lights in the area turn on for approximately one minute.

5 AIRFLOW/SMOKE RESET Switch

Guarded switch.

The AIRFLOW/SMOKE RESET switch is operative when:

- crew rest area smoke detectors are not in alarm
- the airplane is on the ground and the left pack is off
- the airplane is at or above 25,000 feet.

Switch operative:

Push and hold (2 seconds)—

- resets the airflow to the area
- resets aft galley electrical power.

TJR to TJW

Notes: 1. In airplanes with a door 1 upper crew rest and a door 3 upper crew rest, both AIRFLOW/SMOKE RESET switches must be pushed to ensure proper restoration of the aft galley power.

TKK to TKR, TKU to TKZ

2. In airplanes with a door 1 upper crew rest and a door 5 upper crew rest, both AIRFLOW/SMOKE RESET switch must be pushed to ensure proper restoration of the aft galley power.

Switch inoperative (crew rest area smoke detectors are in alarm):

- the crew rest area airflow remains shutdown
- exhaust ventilation air flow is provided to clear smoke from the crew rest area
- the SUPPLY AIRFLOW OFF light is illuminated
- the aft galley electrical power is shut down.

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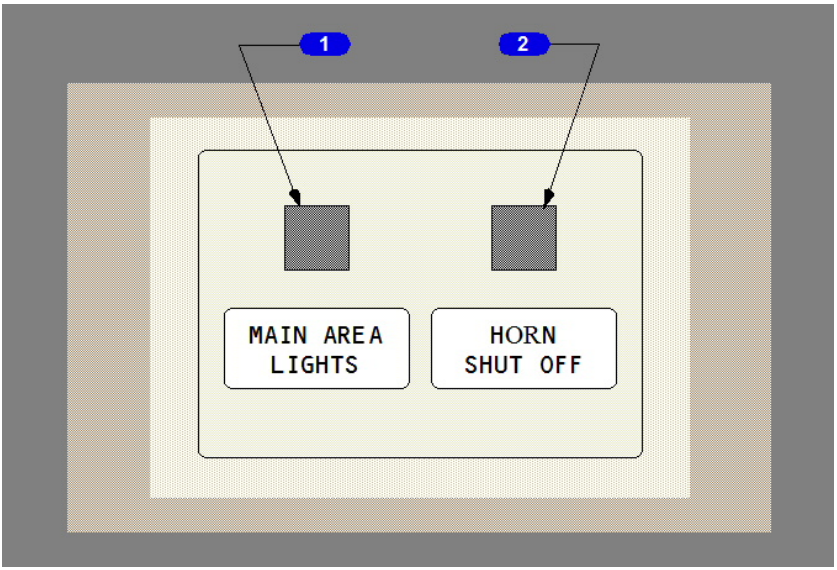
Note: The supply air system will remain inoperative and the aft galley power will remain shutdown until all smoke has been cleared from the rest area and the smoke detectors are not in alarm.

Area Lights/Decompression Reset Panel



1 MAIN AREA LIGHTS Light/Switch

Push—turns area lights on/off.

2 HORN SHUT OFF Switch

Push—

- silences the smoke detector system alarm horns
- silences the decompression alarm horns.

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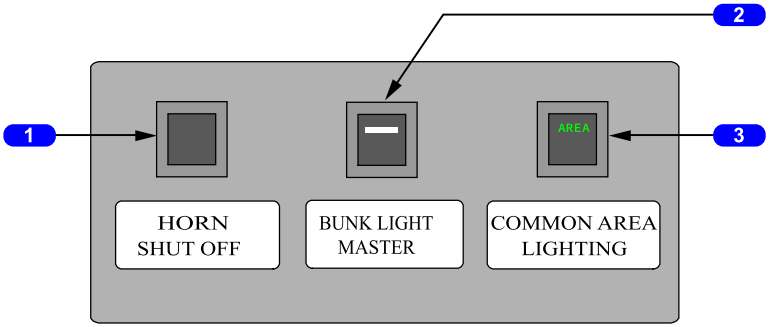
Common Area Lights/Horn Reset Panel



OVERHEAD FLIGHT ATTENDANT REST

1 HORN SHUT OFF Switch

Push—

- silences the decompression alarm horns
- silences the smoke detector system alarm horns.

2 BUNK LIGHT MASTER Switch

Push—turns all area bunk lights on/off.

3 COMMON AREA LIGHTING Switch

Push—turns common area lights on/off.

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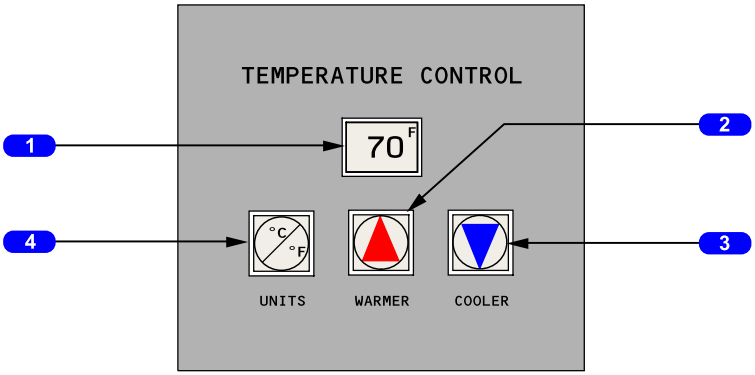
Temperature Control Panel



OVERHEAD CREW REST
FLIGHT CREW REST

1 Temperature Display

Displays—

- current ambient air temperature in degrees F or C.
- flashing, new temperature set point when warmer or cooler arrows are pushed.

2 WARMER Arrow

Push—increases temperature in crew rest area.

3 COOLER Arrow

Push—decreases temperature in crew rest area.

4 UNITS Selector

Push—toggles between degrees F and degrees C for display and temperature selection.

Oxygen System

The crew rest oxygen system is supplied by pressurized gaseous oxygen.

The oxygen masks above the bunks and seats will drop automatically in the event of a decompression.

Each mask oxygen valve is held closed by a pin inserted into the valve. Pulling on the mask withdraws the pin, causing the mask oxygen valve to open and oxygen to flow to that mask.

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The oxygen masks may be manually released by inserting a hair pin or thin rod into the hole of the oxygen compartment cover.

Note: When the oxygen masks deploy, the green oxygen indicator light in the common area illuminates.

Decompression

In the event of decompression, the oxygen mask, located in the overhead, will automatically deploy when the cabin altitude is approximately 13,500 feet. Additionally, the oxygen mask deployment horn will sound continuously and the air flow and oxygen alarm RESET light will illuminate. Oxygen flow is available when the mask is pulled.

Note: Cabin depressurization is indicated by a continuous alarm horn sounding in the crew rest area.

Crew rest occupants should immediately don the oxygen mask.

Evacuate the crew rest when directed.

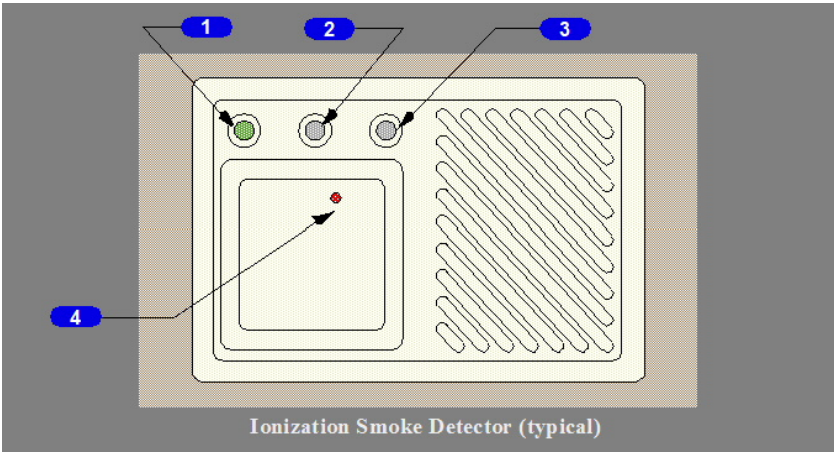
Smoke and Fire

The overhead crew rest has its own smoke detection system but no fire extinguishing system.

Crew Rest Smoke Detection

Crew Rest Smoke Detector

TJR to TJW



Ionization Smoke Detector (typical)

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1 Power Indicator Light

Illuminated (green)—

- smoke detector has power and is operating.

2 Interrupt Switch

Push—

- silences the horn and suppresses all alarm indications as long as the switch is pushed.

3 Self Test Switch

Push—

- activates the smoke detector aural and visual alarms.

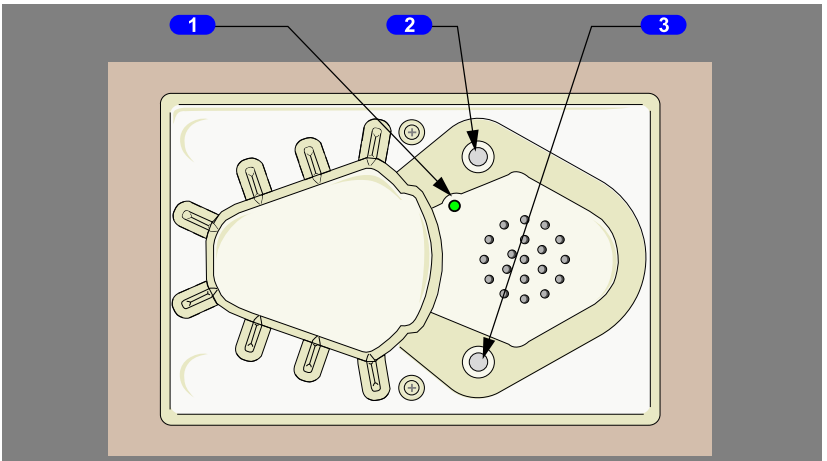
Note: The system automatically resets when the test is concluded.

4 Alarm Indicator Light

Illuminated (red)—

- presence of smoke has been detected.

TKK to TKR, TKU to TKZ



Photoelectric Smoke Detector (typical)

1 Status Indicator Light

Illuminated (green)—

- steady—smoke detector has power and is operating properly.
- blinking—maintenance is required.

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Illuminated (red)—

- steady—smoke has been detected
- blinking—detector has failed.

2 Self-Test Switch

Push—

- alarm horn sounds
- Status Indicator Light illuminates red
- external horn sounds.

3 Horn Cancel Switch

Push—

- alarm horn is silenced.

Note: When the Cancel switch is released and smoke is not sensed for 30 seconds, the smoke detector is automatically reset.

Crew Rest Smoke Detection

If smoke is detected in the Door 1 Overhead Flight Crew Rest:

- a SMOKE REST UPR DR 1 EICAS caution message is displayed
- the air supply shutoff valve is closed
- an amber light above the entrance enclosure door flashes
- a continuous chime sounds throughout the cabin
- the smoke detector integral horn sounds.

TJR to TJW

If smoke is detected in the Door 3 Overhead Flight Attendant Rest:

- a SMOKE REST UPR DR 3 EICAS caution message is displayed
- the air supply shutoff valve is closed
- an amber light above the entrance enclosure door flashes
- a continuous chime sounds throughout the cabin
- the smoke detector integral horn sounds.

TKK to TKR, TKU to TKZ

If smoke is detected in the Door 5 Overhead Flight Attendant Rest:

- a SMOKE REST UPR DR 5 EICAS caution message is displayed
- the air supply shutoff valve is closed
- an amber light above the entrance enclosure door flashes
- a continuous chime sounds throughout the cabin
- the smoke detector integral horn sounds.

Emergency Equipment

See Examples of Emergency Equipment Location on page 1.45.18.

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Evacuation from the Crew Rest Area

The overhead flight crew rest primary evacuation route is through the entrance enclosure. If the main entrance is unusable, evacuation is possible through the emergency hatch.

The overhead flight attendant rest primary evacuation route is through the entrance enclosure. If the main entrance is unusable, evacuation is possible through the emergency hatch.

WARNINGS:

1. **During exit to the main deck, stepping on the seat back may cause the seat back to fold forward. If this occurs, the crew member may lose balance and hand grip, resulting in personal injury**
2. **If the emergency hatch was used for crew evacuation, the lower hatch must be closed to help prevent the spread of smoke or fire.**

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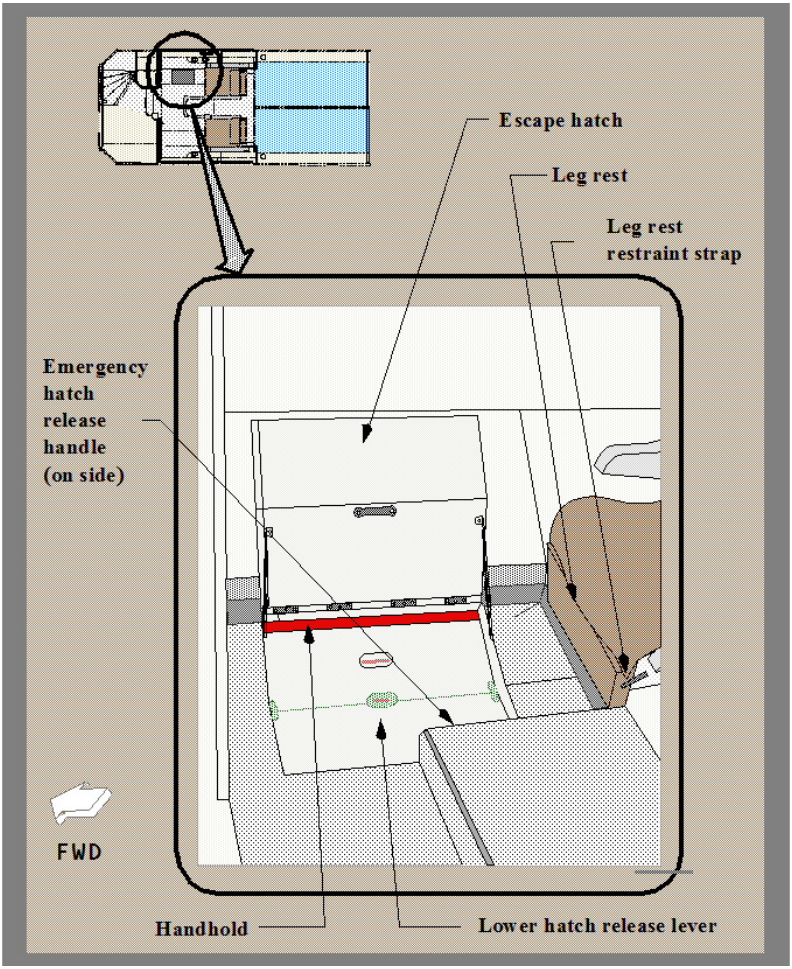
Overhead Flight Crew Rest Emergency Hatch



For egress:

- retract right seat leg rest (if required)
  Note: Secure the seat leg rest using the seat leg rest restraint straps.

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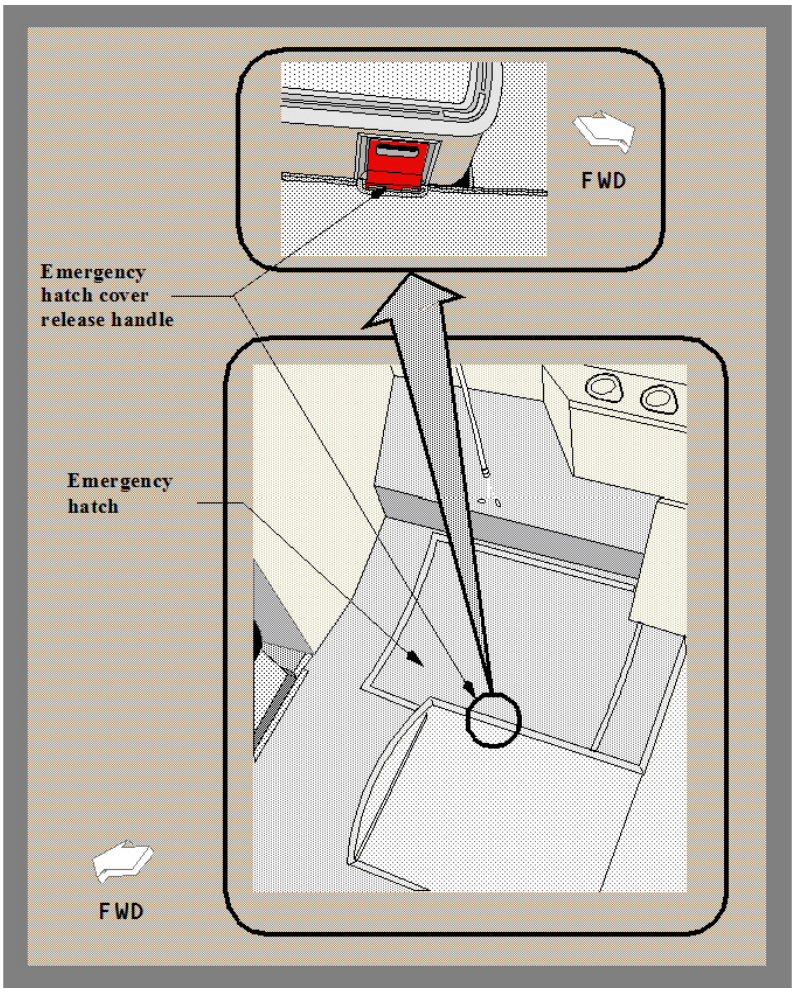

- unlatch upper hatch using the emergency hatch cover release handle

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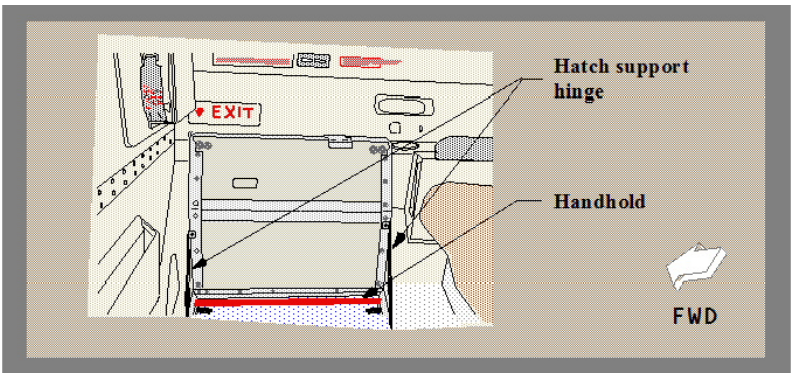
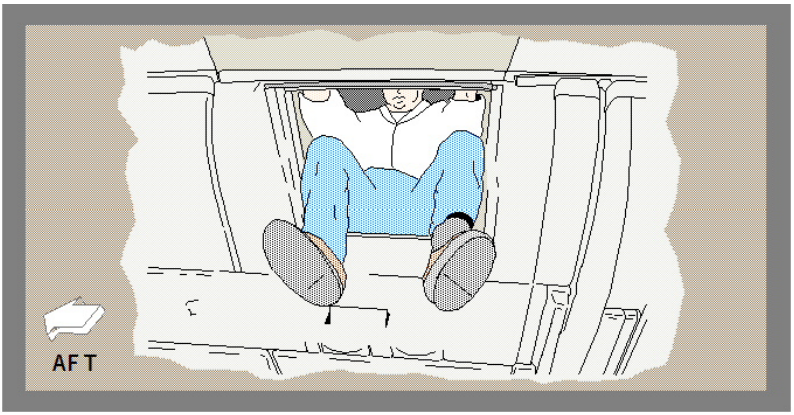


- raise upper hatch cover to fully open position to lock the hatch support hinge in place

  WARNING: Failure to ensure the hatch cover is locked in position may allow the hatch to unexpectedly close causing injury.

- unlatch lower hatch
  - push the lower hatch release lever
- command passengers in immediate area to move clear of evacuation area



- sit on floor facing outboard and lower legs into hatch opening
- reach out and grab the outboard handhold
  - keep elbows close to sides

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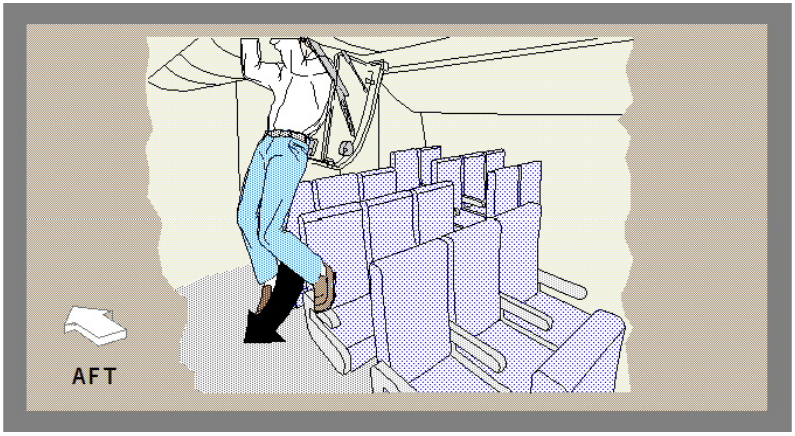

- swing down to main deck
- close the lower hatch when evacuation is complete.

Door 3 Overhead Flight Crew Rest Emergency Hatch

TJR to TJW

The primary evacuation route is through the entrance enclosure.

If the main entrance is unusable, evacuation is possible through the emergency hatch located between bunks 1 and 2.

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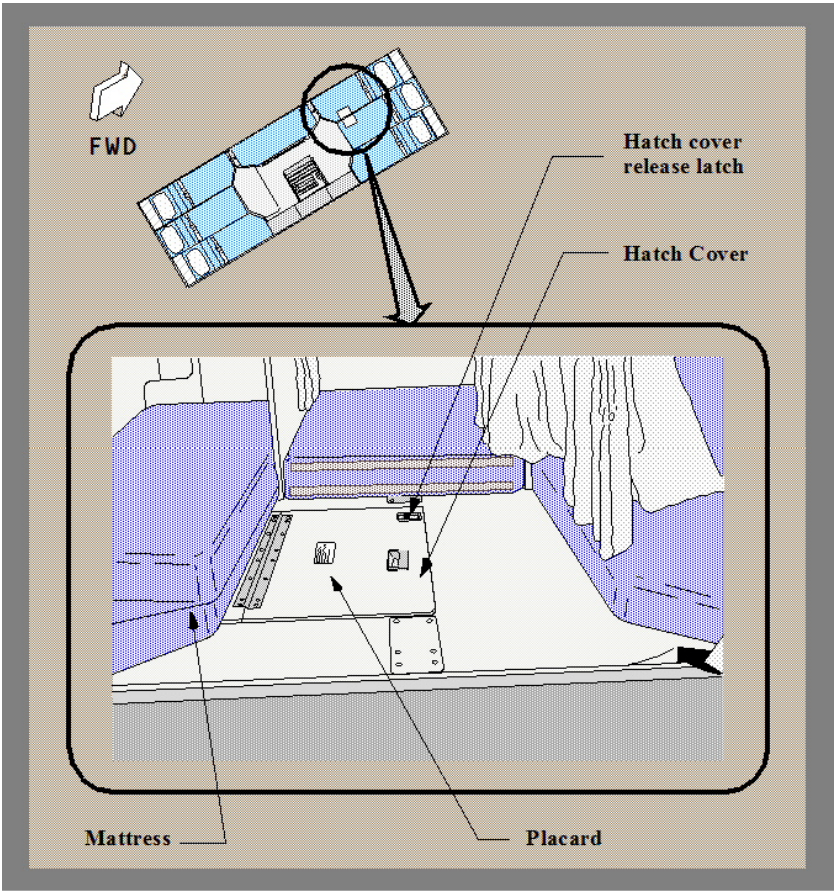

For egress:

- lift and remove the mattress pads

  Note: Stow the mattress pad where it can not obstruct emergency hatch or the aisle.
- unlatch and raise upper bunk escape hatch cover
- unlatch lower hatch
- command passengers in immediate area to move clear of evacuation area

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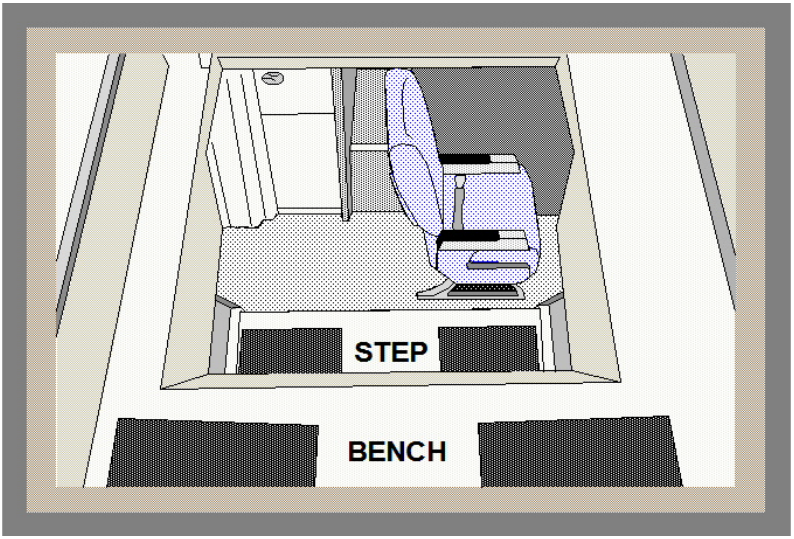
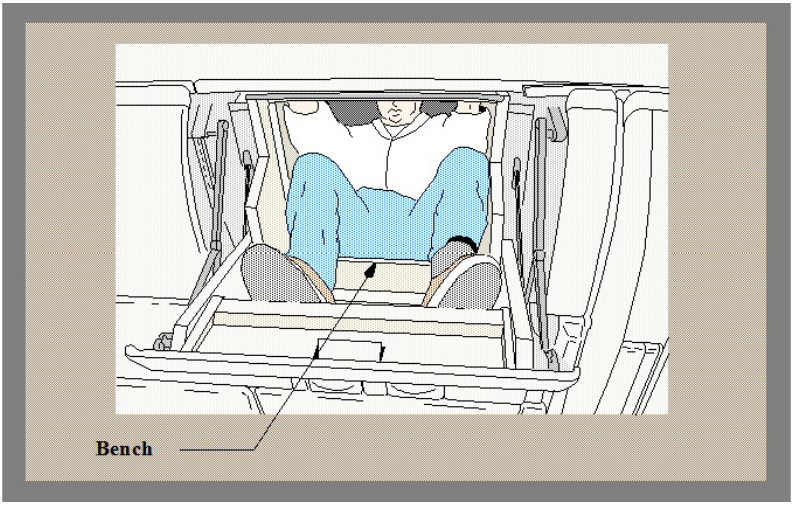


- sit on bunk facing placard
- lower legs into hatch opening



- sit on bench

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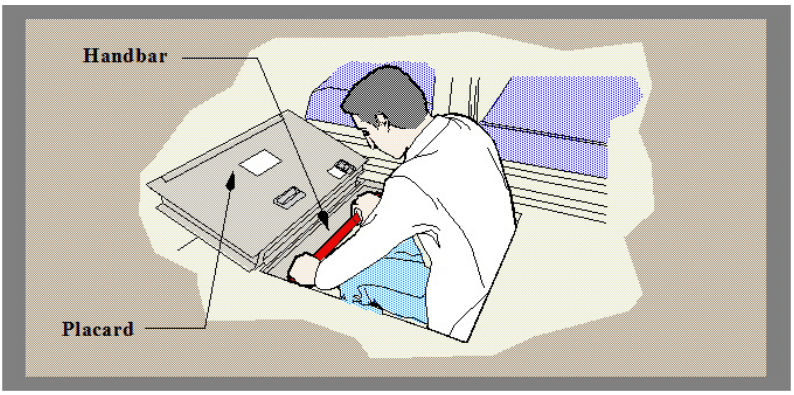
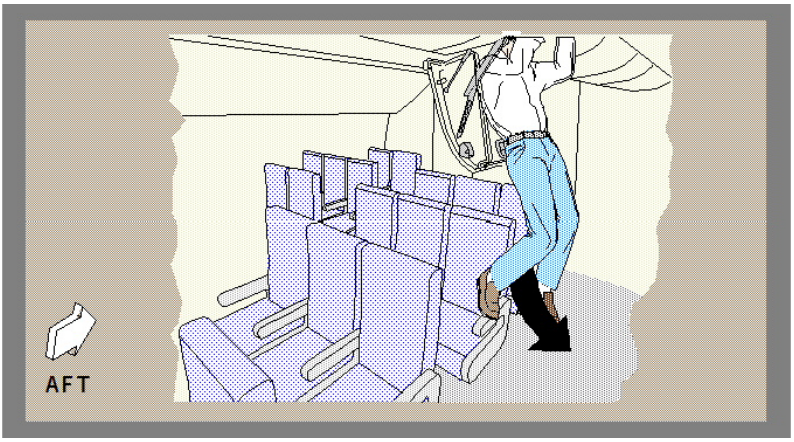


- reach out and grab the handbar
  - keep elbows close to sides



- use step on lower hatch to climb/swing down to main deck
  - use the seat armrest to assist in maintaining balance as necessary
- close the lower hatch when evacuation is complete.

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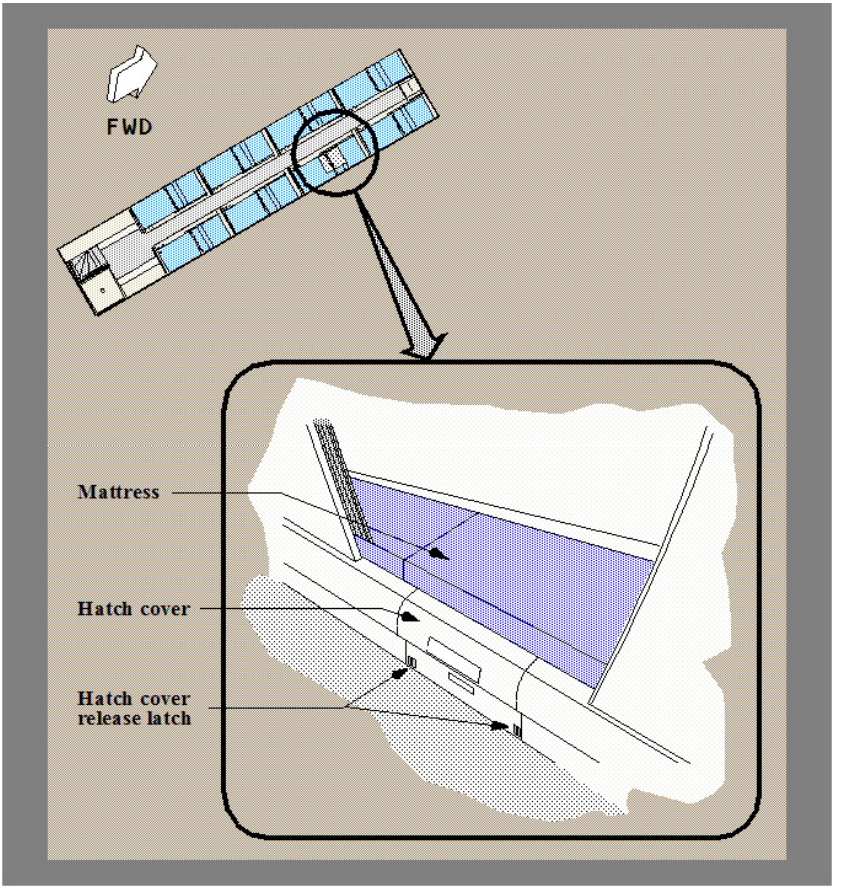
Door 5 Overhead Flight Crew Rest Emergency Hatch

TKK to TKR, TKU to TKZ



For egress:

- lift and remove the mattress pad

  Note: Stow the mattress pad where it can not obstruct emergency hatch or the aisle.
- unlatch and raise upper hatch cover

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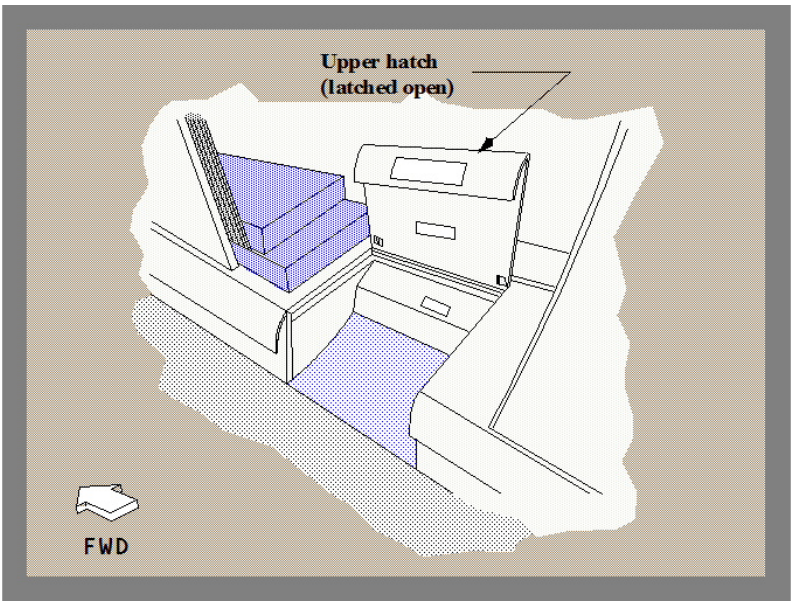
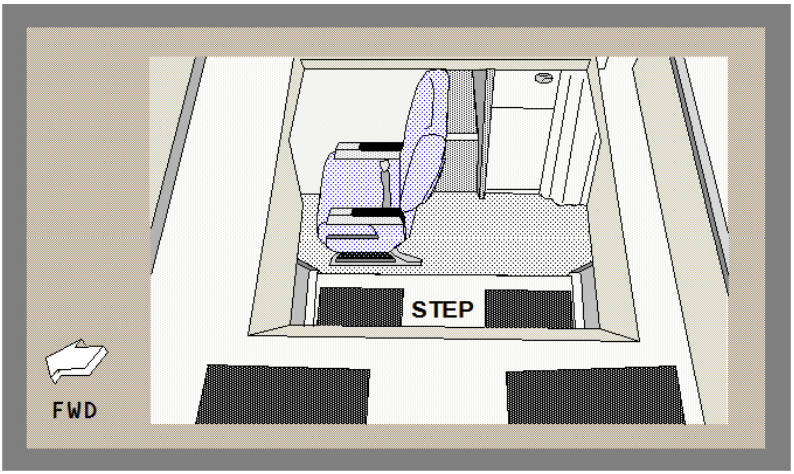


- unlatch lower hatch
- command passengers in immediate area to move clear of evacuation area



- sit on floor facing outboard and lower legs into hatch opening

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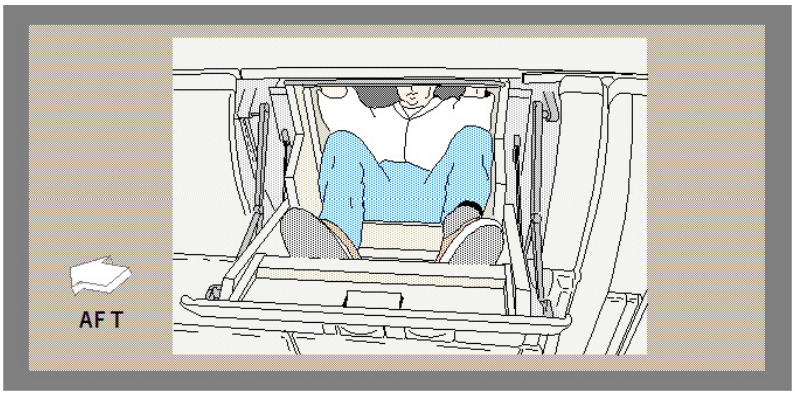
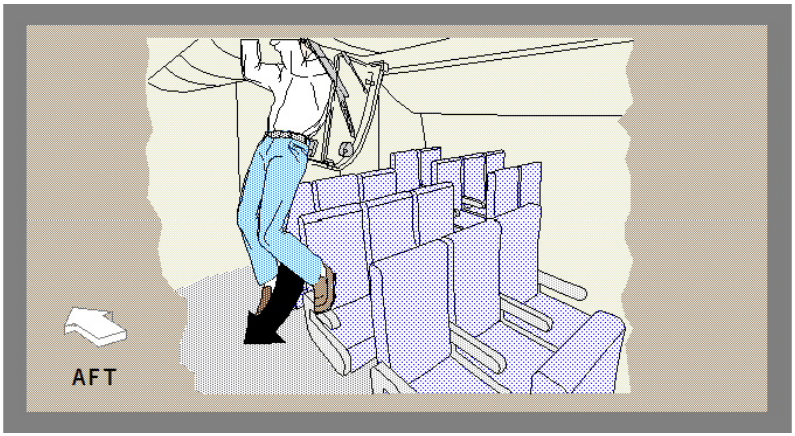


- reach out and grab the outboard handhold
  - keep elbows close to sides



- use step on lower hatch to climb/swing down to main deck
- exit to main deck
- close the lower hatch when evacuation is complete.

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Introduction

This section describes miscellaneous airplane systems, including:

- doors and windows
- flight deck seats.

Doors and Windows

The airplane has eight passenger entry doors, one flight deck door (the flight deck/cabin entry), and three cargo doors. It also has two center electrical and electronic (E/E) equipment access doors, one forward and one main. -200,-200ER

The airplane has eight passenger entry doors, two overwing exits, one flight deck door (the flight deck/cabin entry), and three cargo doors. It also has two center electrical and electronic (E/E) equipment access doors, one forward and one main. -300,-300ER

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.

The flight deck number two windows, one on the left and one on the right, can be opened by the flight crew.

An EICAS message is displayed when an entry door, cargo door, access door, or flight deck window is not closed, latched, and locked. -200,-200ER

An EICAS message is displayed when an entry door, overwing exit, cargo door, access door, or flight deck window is not closed, latched, and locked. -300,-300ER

Flight Deck Door

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 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 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

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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 30 seconds. 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. Two hinged decompression panels open to equalize pressure in the event of cabin depressurization. Each panel opening has a security grill on the flight deck side.

Features are included to prevent a jammed door due to structural deformation. A lower break-away panel is attached to the main door section by interlocking extrusions and two shear pins. If sufficient upward force occurs, the pins will shear and the break-away panel will separate from the door. If the pins fail to shear, they can be retracted manually to aid in egress. An angled door jamb aids in forcing the door open into the flight deck in case of surrounding bulkhead deformation.

Flight Deck Number Two Windows

The flight deck number two windows can be opened on the ground or in flight. The flight deck number two windows can be used for emergency evacuation. The associated window lock lever locks or unlocks the window. With the window unlocked, rotating the window crank opens the window. To open the window:

- rotate the window lock lever aft to the open position
- crank the window to the full open position (the WINDOW NOT CLOSED placard is visible).

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When closing the window, the window lock lever must be in the unlocked position. As the window approaches the full closed position, the force required on the crank increases. To close the window:

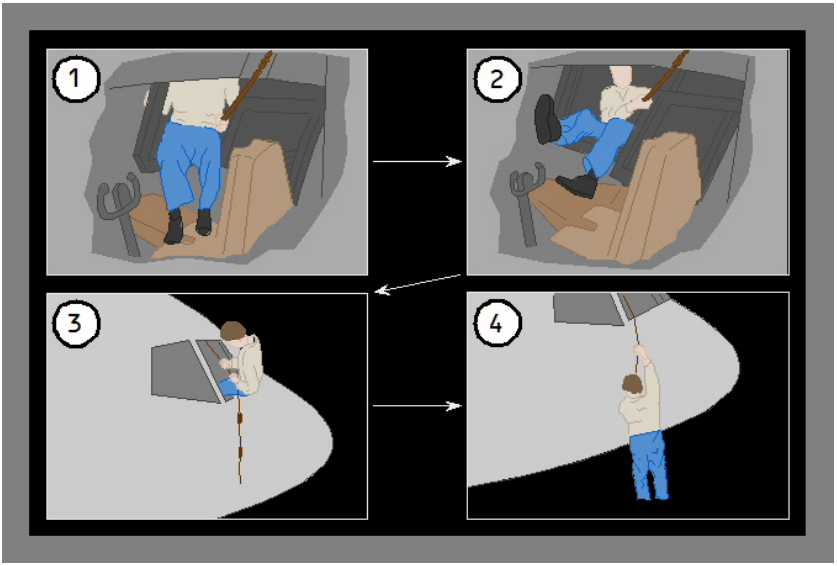
- crank the window to the full closed position (the WINDOW NOT CLOSED placard is not visible)
- rotate the window lock lever forward to the locked position.

The windows can be opened or closed in flight with minor flight deck consequences if the airplane is unpressurized. The force required to move the crank increases with airspeed. With the window open, voice, interphone, and radio audio may not be heard due to high noise levels. Prior communications arrangements with the controlling agency should be established before opening the window. The design provides an area of relatively calm air over the open window. Forward visibility can be maintained by looking out of the open window.

Escape ropes are attached to the airplane structure above both number two flight deck windows. The ropes are stowed in compartments above the pilot seats.

The EICAS advisory message WINDOW FLT DECK (L or R) or WINDOWS (both windows) is displayed if the window(s) are not closed and latched.

Flight Deck Window Emergency Egress



If the flight deck number two windows must be used for emergency egress, use the following procedure:

1. open the window
2. remove the bag containing the rope (above and aft of window)

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3. pull on rope to ensure it is securely attached
4. throw the bag out the window (bag falls off)
5. check the first rope handhold is green and is located in the window opening
6. sit on the window sill with upper body outside
7. exit in accordance with the above illustration.

CAUTION: Ensure the rope is securely fastened to the airplane.

Entry Doors

-200,-200ER The passenger entry doors are used to enter and exit the airplane, and also serve as emergency exits. There are no other cabin exits. The eight passenger entry doors are paired along the airplane fuselage. The doors are identified 1 through 4 left, and 1 through 4 right. The passenger entry doors can be opened or closed manually from inside or outside of the airplane.

-300,-300ER The passenger entry doors are used to enter and exit the airplane, and also serve as emergency exits. The two overwing exit doors are only for use as emergency exits. The eight passenger entry doors and two overwing exit doors are paired along the airplane fuselage. The doors are identified 1 through 5 left, and 1 through 5 right. The 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 of the airplane.

-300,-300ER The overwing exit doors are translating, plug-type doors. Operation is the same as the entry doors.

Each door has a vent panel connected to the door handle. The vent is designed to prevent pressurization to an unsafe level if the door is not fully closed, latched, and locked. Forward rotation of the door handle past the latched position closes the vent. Initial aft door handle rotation opens the vent to equalize cabin and ambient pressure. At low differential pressure, the door handle can be rotated to allow the door to open fully. At high differential pressure, the vent can be partially opened; however, a mechanical interlock prevents door opening until the differential pressure is reduced. At very high differential pressure, the vent cannot be opened.

Entry Door Flight Lock

Each door handle is automatically locked when airspeed is greater than 80 knots. The flight lock allows limited door handle rotation sufficient to partially open the door vent, but prevents door opening. If electrical power is removed or fails, the flight lock is spring–loaded to the unlocked position.

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Entry Door Slide/Raft

Emergency evacuation slide/raft and emergency power assist systems are contained in each entry door. Each emergency power assist system has enough power to pneumatically open the door unassisted, even if the airplane is not level because of any landing gear collapse condition. A slide/raft cover in the lower face of the door contains the slide/raft.

Overwing Escape Slide

-300,-300ER

An overwing escape slide assembly, consisting of a dual lane ramp with a dual lane slide, is contained in a exterior compartment in the wing body fairing. On activation of the overwing escape slide assembly, the inboard spoilers retract. An EICAS message is displayed if an overwing escape slide is not closed, latched, and locked.

WARNING: If door 3 is used during ditching, the door mode selector lever must be in MANUAL to allow the door to be opened without deploying the ramp/slide.

Emergency Exit Operation

Placing the mode select lever in the AUTOMATIC position:

- arms the emergency power assist system
- engages the girt bar on entry doors
- arms the escape slide/rafts
- arms the overwing escape slides. -300,-300ER

Once armed, moving the interior door handle to the open position operates the emergency power assist system actuator. The pneumatic actuator drives the door open, and the slide automatically deploys and inflates.

The emergency power assist system and the slide/raft are automatically disarmed when the door is opened from the outside. If the mode select lever is in the AUTOMATIC position and the door is opened using the exterior door handle, the mode select lever automatically moves to MANUAL and the door opens without slide/raft deployment.

The following EICAS memo messages display the overall door mode select lever positions:

- DOORS AUTO
- DOORS MANUAL
- DOORS AUTO/MANUAL.

The DOORS AUTO/MANUAL message continues to be displayed for two seconds when it is being replaced by the DOORS AUTO or DOORS MANUAL message. During this time, both the DOORS AUTO/MANUAL message and the message replacing it can be displayed.

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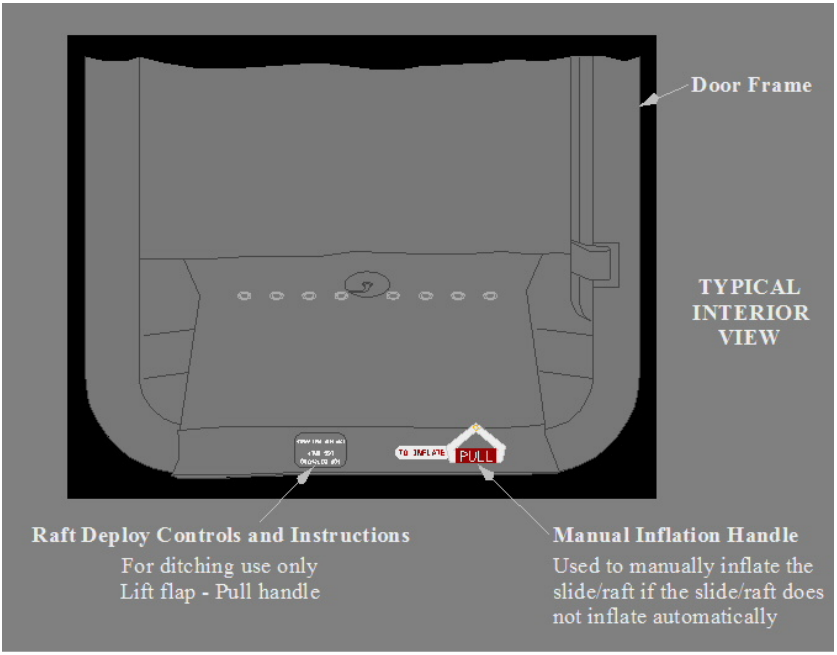
Slide/Raft Deployed



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Door 3 Slide Manual Inflation Handle

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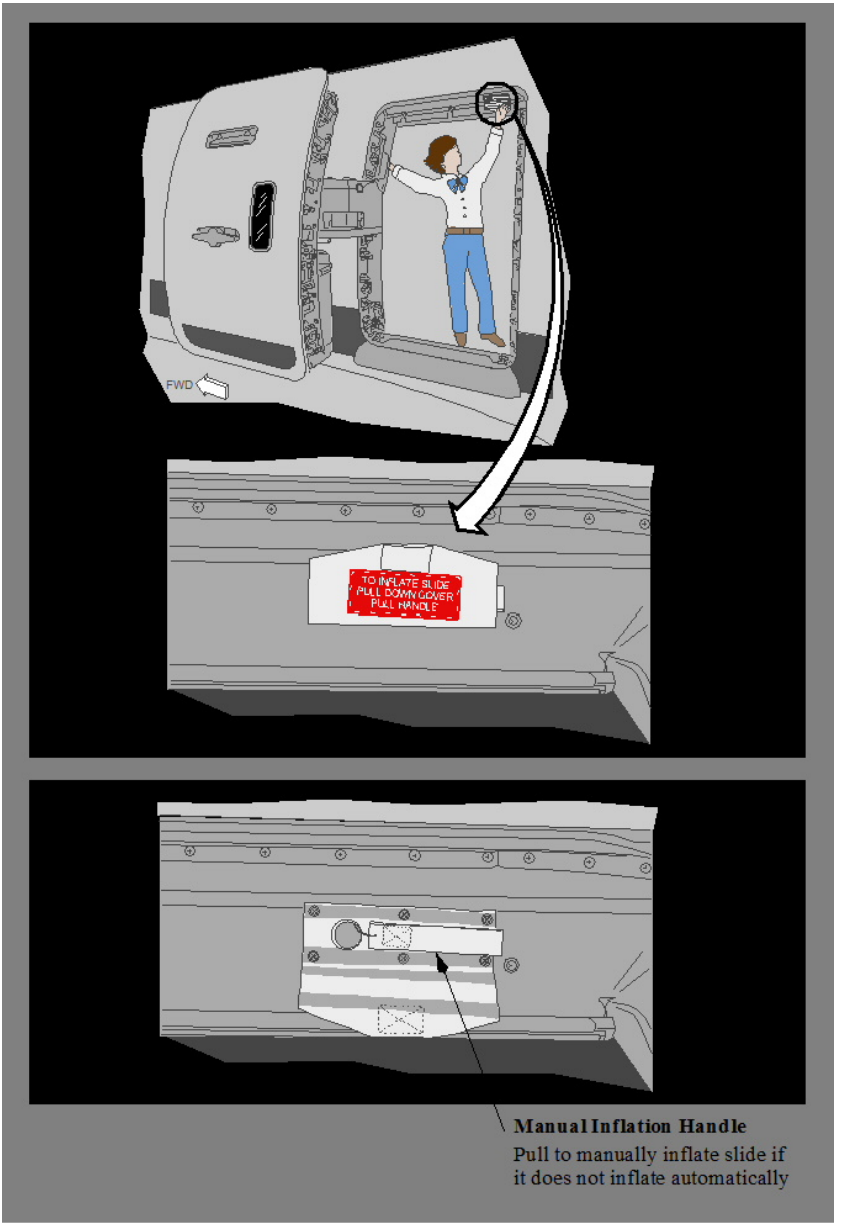

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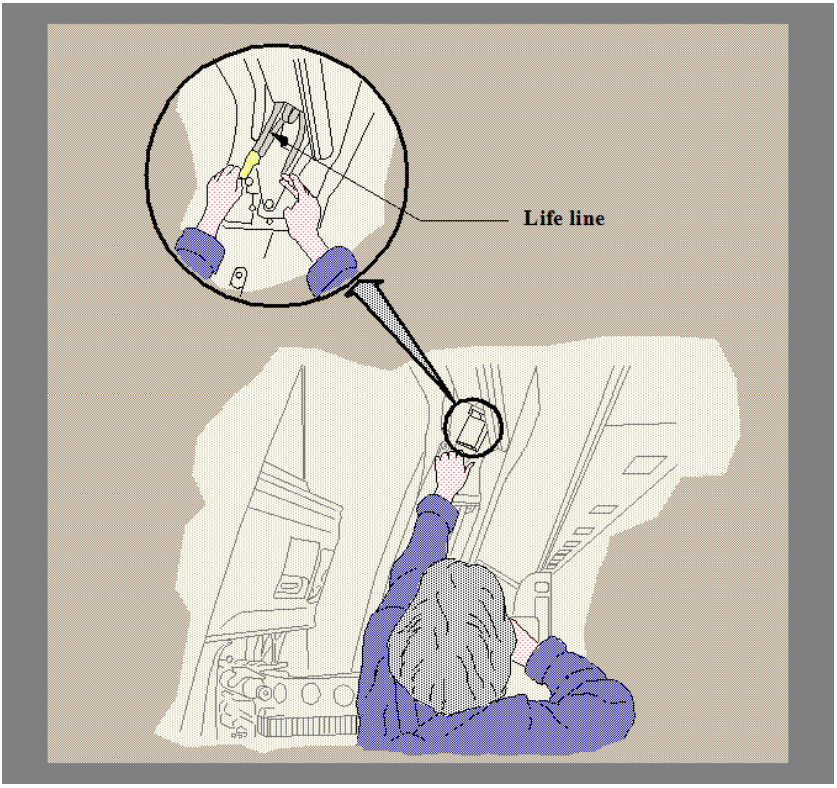
-300,-300ER

Door 3 Life Line



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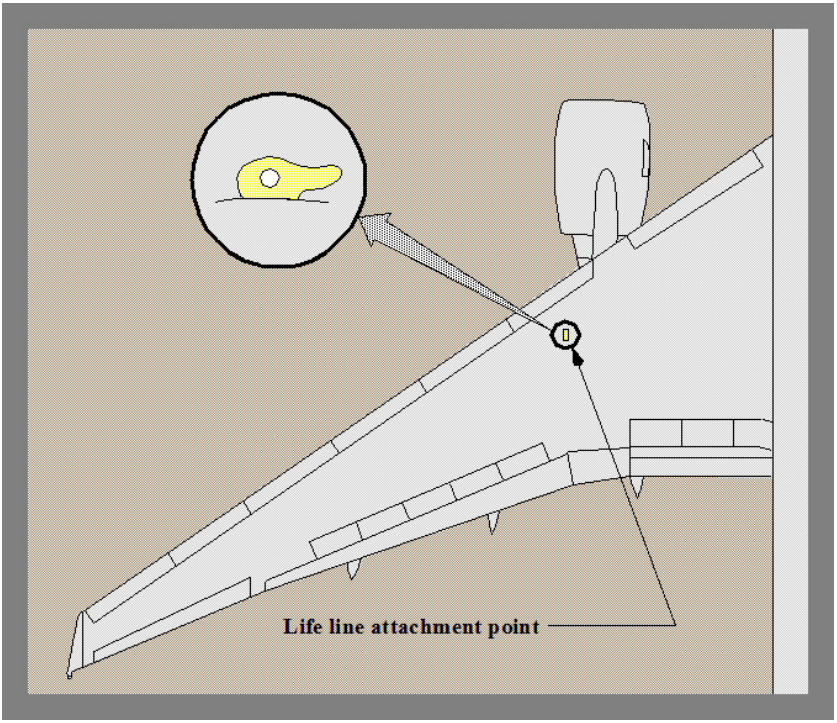

A life line is installed in the door 3 frame above each overwing exit. In a ditching emergency, the life line is attached to a hook on the wing leading edge, outboard of the engine. The life line is used as an attachment for the life raft mooring line and as a hand hold for passengers to walk out on the wing and into a life raft.

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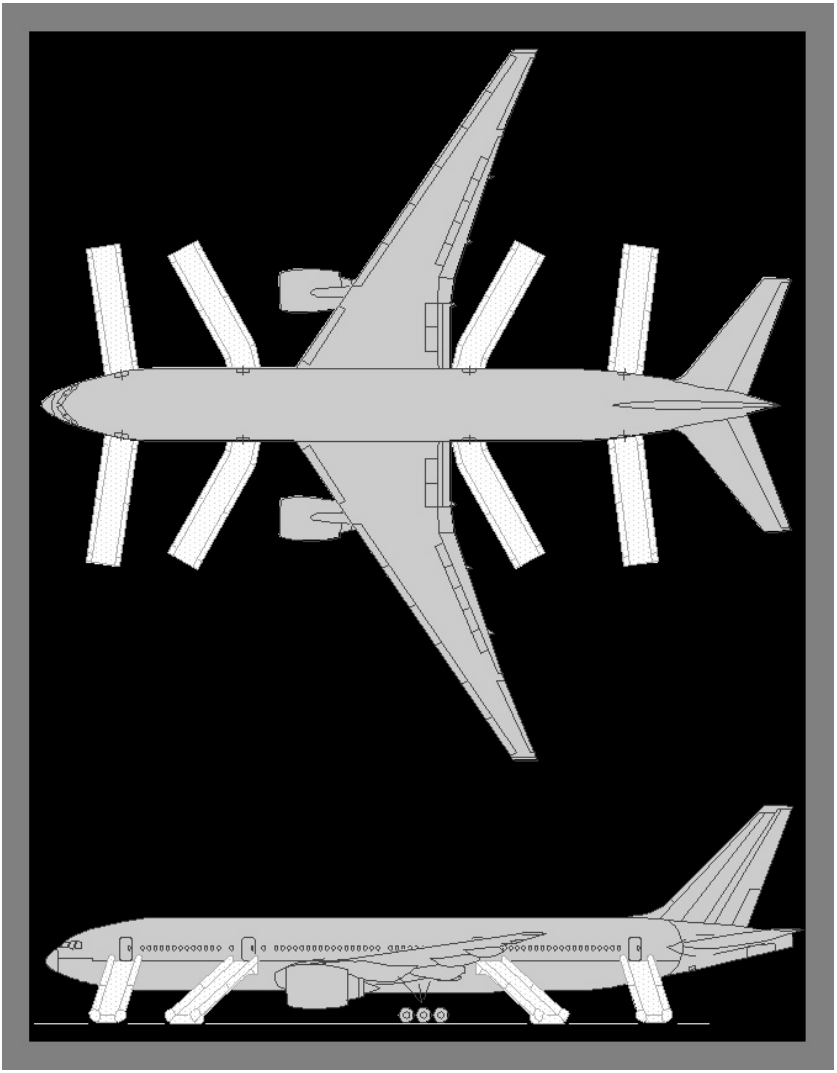
Evacuation Slide/Rafts

-200,-200ER



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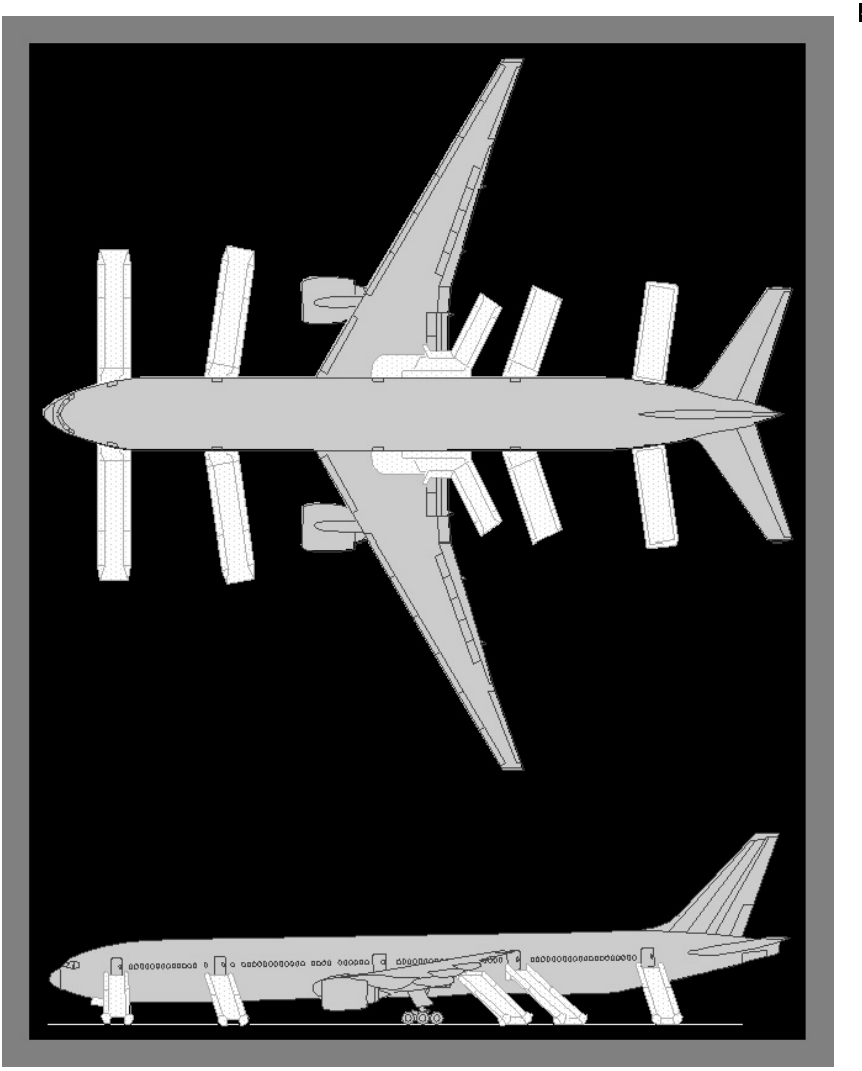
-300,-300ER



Cargo Doors

There are three lower cargo doors located on the right side of the airplane; one forward, one aft, and one bulk. 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

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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.

TJA,B,C,D,G,H,TKA to TKF,TKU to TKZ

The aft small cargo door is a plug type. To open, it first moves up out of the plug position, then it opens outward and upward.

TJR to TJW,TKK to TKR

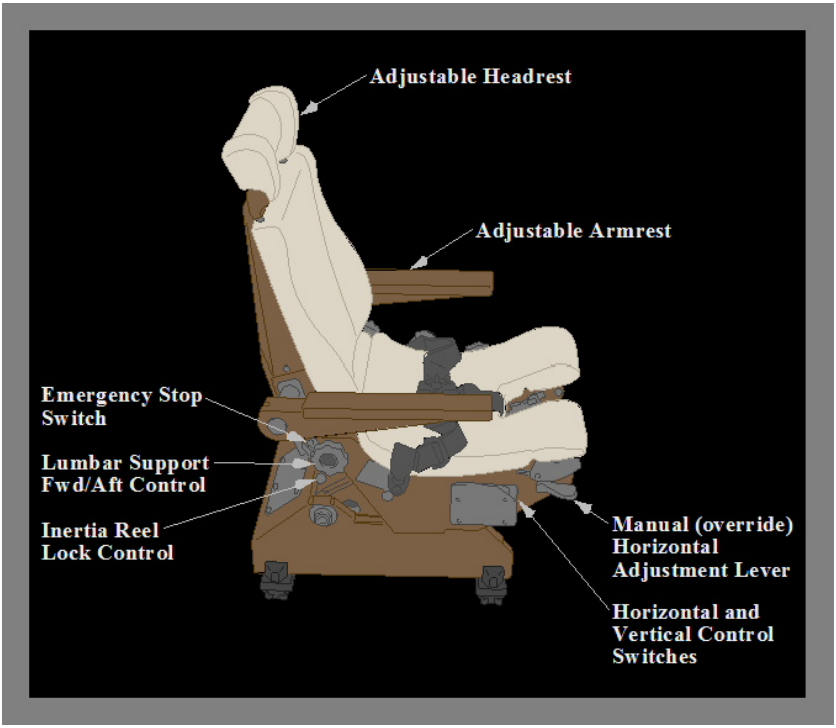
The large cargo door(s) are non-plug type of door. Door latches hold the door closed against cabin pressure loads. The door opens outward and upward.

Flight Deck Seats

The flight deck has three seat types:

- pilot seats (captain and first officer)
- first observer seat
- second observer seat.

Pilot Seats



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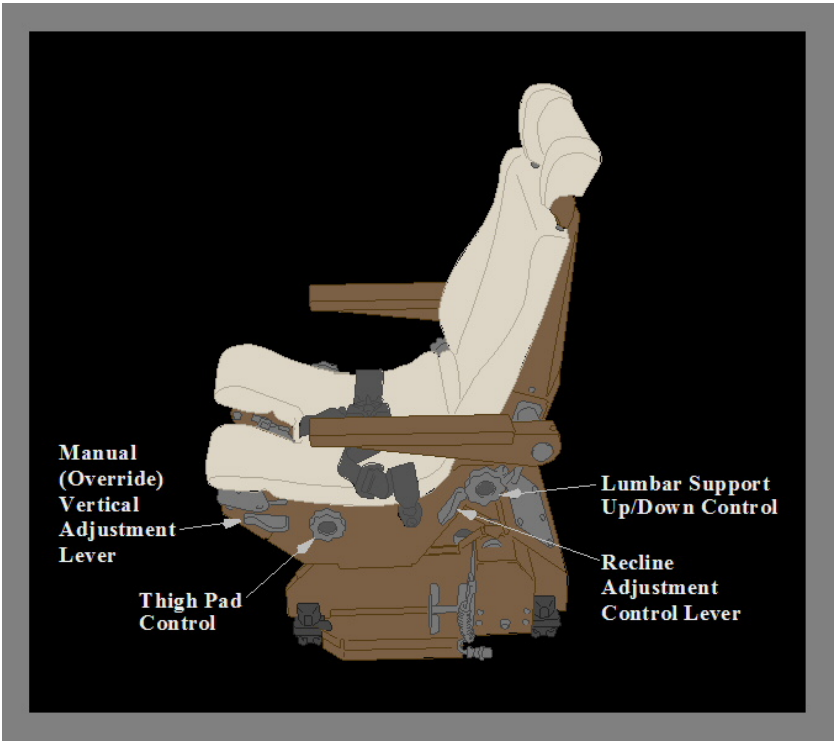

Seats:

- 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 two inches of aft travel. Electric and manual controls provide forward, aft, and vertical adjustment. Manual levers provide other adjustments.

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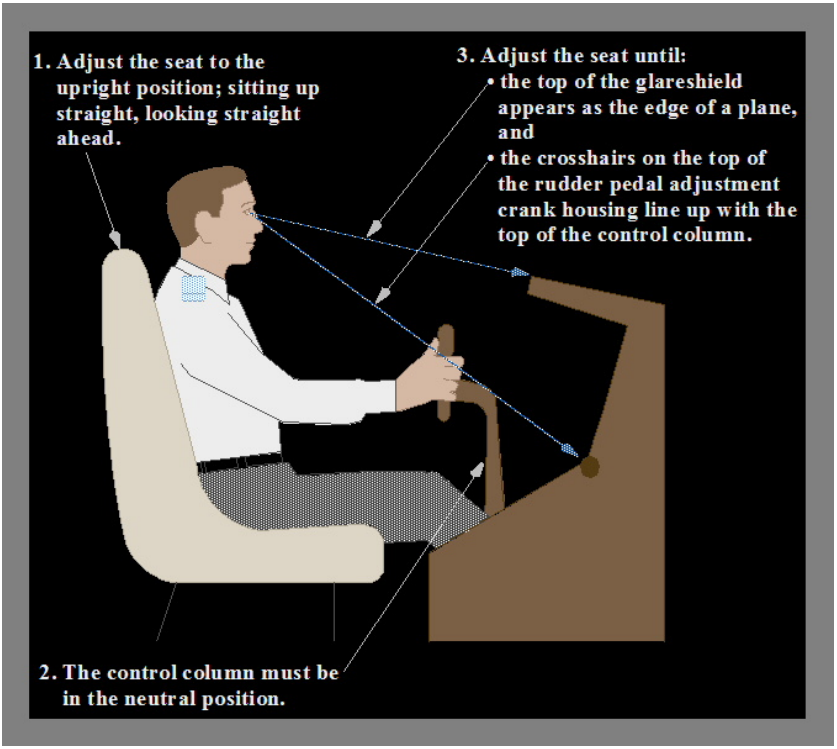
WARNING: **When using the Manual (override) Horizontal Adjustment Lever to move the seat, ensure the seat motion has stopped before releasing the lever. Releasing the Manual (override) Horizontal Adjustment Lever while the seat is still moving can damage the seat actuator. Manually moving the seat to the forward or aft stop is permissible as it does not impact the seat actuator.**

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. The headrest angle can be adjusted by moving the cushion to the right and turning it. There are eight positions.

Adjust the seat to obtain the optimum eye position as shown on the following illustration.

Pilot Seat Adjustment



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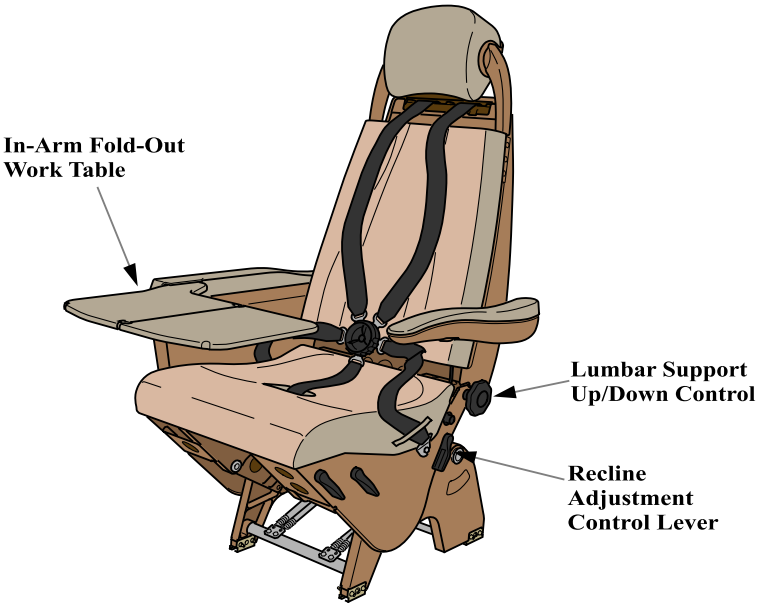
Observer Seats

TKM to TKR, TKU to TKZ



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
- lumbar support
- fold-out work table.

TKM to TKR, TKU to TKZ

TKM to TKR, TKU to TKZ

The second observer seat is not adjustable. The seat has:

- folding arm rests
- crotch strap
- shoulder harness with manual locks
- lap belt
- adjustable headrest.

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EICAS Alert Messages

Message	Level	Aural	Message Logic	
CREW OXYGEN LOW	Advisory		Crew oxygen pressure is low.	
DOOR AFT CARGO	Caution	Beeper	Cargo door is not closed and latched and locked.	TJR to TJW, TKK to TKR
DOOR AFT CARGO	Advisory		Cargo door is not closed and latched and locked.	TJA,B,C,D,G, H,TKA to TKF, TKU to TKZ
DOOR BULK CARGO	Advisory		Bulk cargo door is not closed and latched and locked.	
DOOR E/E, FWD ACCESS	Advisory		Access door is not closed and latched and locked.	
DOOR ENTRY 1–4L, R	Advisory		Entry door is not closed and latched and locked.	-200,-200ER
DOOR ENTRY 1–5L, R	Advisory		Entry door is not closed and latched and locked.	-300,-300ER
DOOR FWD CARGO	Caution	Beeper	Cargo door is not closed and latched and locked.	
DOOR WING SLIDE L, R	Advisory		The door for the unpressurized wing slide compartment is not closed and locked.	-300,-300ER
DOORS	Advisory		Two or more doors are not closed and latched and locked.	
ELT ON	Advisory		Emergency locator transmitter is on.	TJR to TJW, TKK to TKR, TKU to TKZ
EMER LIGHTS	Advisory		Emergency lighting system has been manually activated or emergency lights switch is OFF.	
PASS OXYGEN LOW	Advisory		Passenger oxygen pressure is low.	TJR to TJW, TKK to TKR, TKU to TKZ
PASS OXYGEN ON	Advisory		Passenger oxygen system is activated.	
WINDOW FLT DECK L, R	Advisory		Side window is not closed and latched.	
WINDOWS	Advisory		Left and right side windows are not closed and latched.	

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EICAS Memo Messages

Message	Level	Aural	Message Logic
DOORS AUTO	Memo		All entry doors are in the automatic mode.
DOORS AUTO/ MANUAL	Memo		Some entry doors are in the automatic mode and some are in the manual mode.
DOORS MANUAL	Memo		All entry doors are in the manual mode.

TJR to TJW, TKK to TKR, TKU to TKZ

Message	Level	Aural	Message Logic
NO ELECTRONICS ON	Memo		The NO ELECTRONICS switch is in the on position.
PASS SIGNS ON	Memo		The NO ELECTRONICS and SEAT BELTS switches are in the on position.

TJA,B,C,D,G, H,TKA to TKF

Message	Level	Aural	Message Logic
NO SMOKING ON	Memo		NO SMOKING switch is in the on position.
PASS SIGNS ON	Memo		The NO SMOKING and SEAT BELTS switches are in the on position.

Message	Level	Aural	Message Logic
SEATBELTS ON	Memo		The SEAT BELTS switch is in the on position.

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Air Systems — Chapter 2

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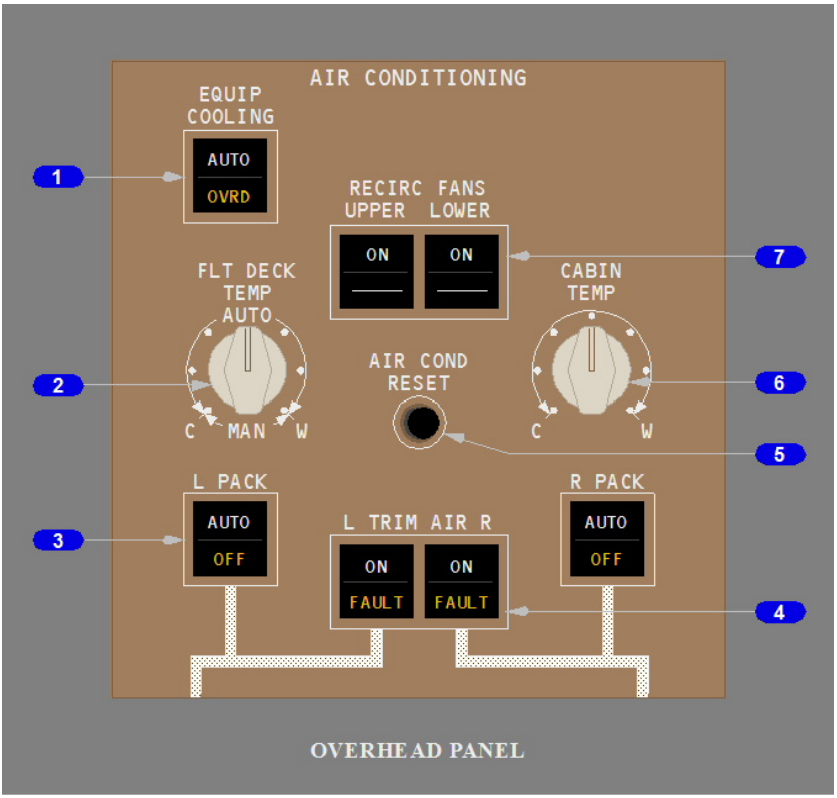
Air Conditioning System

Air Conditioning Panel



1 Equipment Cooling (EQUIP COOLING) Switch

AUTO—equipment cooling is controlled automatically.

Off (AUTO not visible)—

- both equipment cooling supply fans are not operating
- the override valve is open
- the forward cargo heat valve is closed
- the nitrogen generation system (NGS) is shut down
- OVRD is illuminated.

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OVRD (override) illuminated (amber)—the equipment cooling override valve is open. The override valve opens and the equipment cooling system configures to override mode when:

- both equipment cooling supply fans are failed, or
- smoke is detected in the equipment cooling system, or
- the EQUIP COOLING switch is off, or
- the CARGO FIRE ARM FWD switch is in ARMED.

2 Flight Deck Temperature (FLT DECK TEMP) Control

AUTO—C to W sets the temperature from 18 deg. C to 29 deg. C. Mid position (12 o'clock) sets approximately 24 deg C.

MAN (spring loaded to 6 o'clock position)—

- C (cool)—the flight deck trim air valve moves toward closed to supply cooler air
- W (warm)—the flight deck trim air valve moves toward open to supply warmer air.

3 PACK Switches

AUTO—the pack is controlled automatically.

Off (AUTO not visible)—the pack flow control valve is commanded closed.

OFF illuminated (amber)—the pack flow control valve is closed. The valve is commanded closed and the OFF light is illuminated when:

- the pack valve is failed closed, or
- a pack or compressor outlet high temperature has occurred, or
- bleed air pressure is inadequate, or
- the R PACK valve is closed during APU to Pack Takeoff procedure, or
- the PACK switch is pushed off.

4 TRIM AIR Switches

ON—the master trim air valve is commanded open and the zone trim air valves operate automatically.

Off (ON not visible)—the master trim air valve is commanded closed.

FAULT illuminated (amber)—

- the trim air valve is failed closed, or
- the trim air valve is commanded closed because a zone supply duct overheat has occurred, or
- the TRIM AIR switch is off
- if a single master trim air valve is failed closed or commanded closed, the other trim air valve continues to operate normally.

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5 Air Conditioning Reset (AIR COND RESET) Switch

Push—

- attempts to reset any closed pack flow control valve or trim air valve held closed because an overheat, control failure, or valve failure has occurred
- attempts to reset a failed recirculation fan
- resets fault protection.

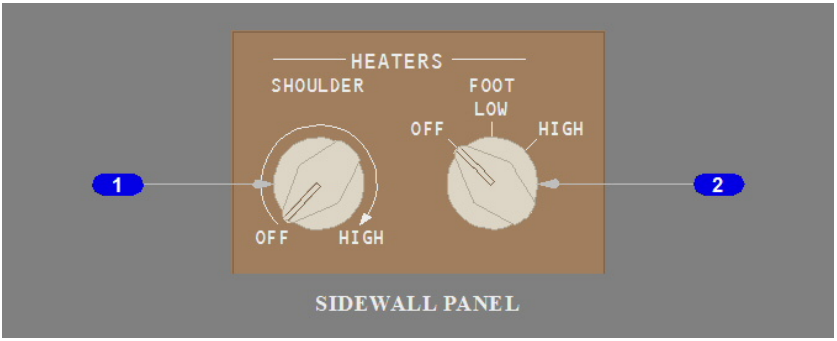
6 Cabin Temperature (CABIN TEMP) Control

C to W—sets the temperature from 18 deg. C to 29 deg. C. Mid position (12 o'clock) sets approximately 24 deg. C.

7 Recirculation Fans (RECIRC FANS) Switches

ON—the recirculation fans are controlled automatically.

Shoulder and Foot Heaters



1 SHOULDER HEATER Control

OFF to HIGH—the electric heater adds heat to the condition air supplied at shoulder level.

2 FOOT HEATER Selector

Control temperature is the same in HI and LO. Heater is inhibited when the temperature of the foot heater plate is above 18 deg. C (65 deg. F).

OFF—the under-floor electric heater is not operating.

LOW—the under-floor electric heater operates at a low heating rate.

HIGH—the under-floor electric heater operates at a high heating rate.

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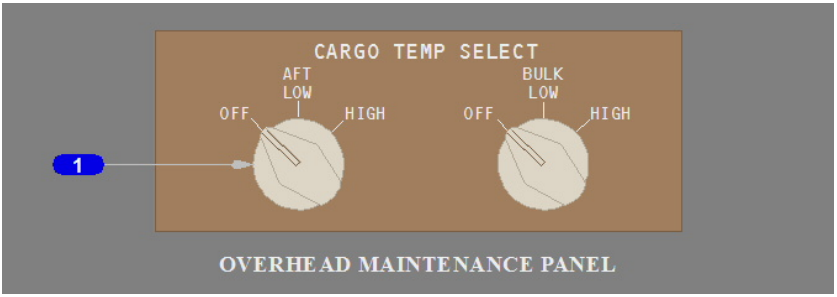
Cargo Temperature Control

Aft and Bulk Cargo Temperature Control



1 CARGO TEMPERATURE Selectors

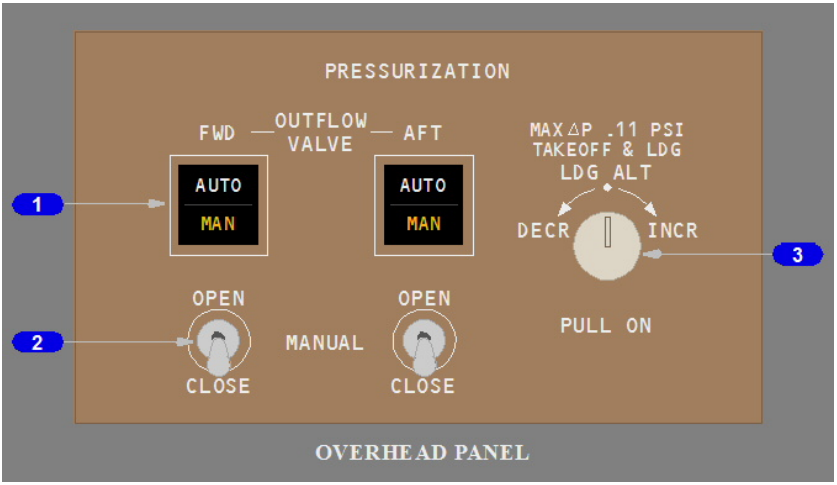
OFF—shuts off bleed air to the associated compartment.

LOW—bleed air heating system maintains the compartment temperature between 4 deg. C to 10 deg. C.

HIGH—bleed air heating system maintains the compartment temperature between 18 deg. C to 24 deg. C. For the bulk compartment only, the bulk compartment ventilation fan operates continuously.

Pressurization System

Pressurization Panel



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1 OUTFLOW VALVE Switches

AUTO—the outflow valve is controlled automatically.

MAN (manual) illuminated (amber)—

- outflow valve is controlled manually
- automatic outflow valve control and cabin altitude limiter is bypassed
- AUTO is extinguished.

2 OUTFLOW VALVE MANUAL Switches

OPEN—moves the outflow valve toward open.

CLOSE—moves the outflow valve toward closed.

3 Landing Altitude (LDG ALT) Selector

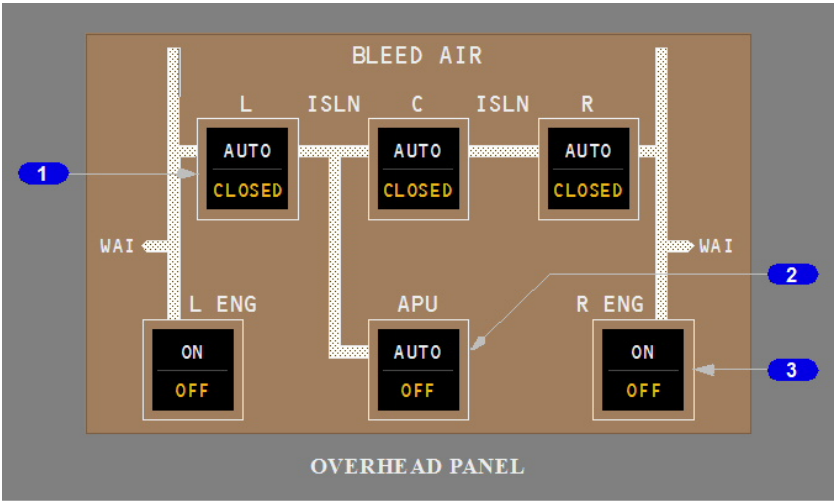
Pull ON, then rotate—

- sets landing altitude manually
- landing altitude followed by MAN is displayed on EICAS
- landing altitude changes in 100 foot increments at first detent, 500 foot increments at second detent.

Push—

- landing altitude is set automatically from FMS—see Approach on page 11.43.8
- landing altitude followed by AUTO is displayed on primary EICAS.

Bleed Air Control



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1 Bleed Isolation (ISLN) Switches

AUTO—the bleed isolation valve is controlled automatically.

Off (AUTO not visible)—the valve is commanded closed.

CLOSED illuminated (amber)—

- the valve is closed because a duct leak or bleed loss has occurred, or
- the valve is failed closed, or
- the switch is off.

2 APU Bleed Switch

AUTO—the APU bleed air valve opens by system logic when bleed air pressure is available.

OFF (AUTO not visible)—the valve is commanded closed.

OFF illuminated (amber)—

- the valve is closed because a duct leak has occurred
- the valve is failed closed, or
- the switch is off, or
- the APU fire switch is pulled out.

3 Engine (ENG) Bleed Switches

ON—the engine bleed valve opens when engine bleed air is available.

Off (ON not visible)—the valve is commanded closed.

OFF illuminated (amber)—the engine bleed valve is closed. The engine bleed valve is commanded closed and the OFF light is illuminated when:

- the engine is not running, or
- a bleed air overheat, overpressure, or bleed control system failure has occurred, or
- the valve is failed closed, or

TKK to TKR, TKU to TKZ

- the L ENG bleed valve is closed during APU to Pack Takeoff procedure, or
- the ENG fire switch is pulled out, or
- the switch is off.

Duct Pressure and Pressurization System Indications

Pressurization system indications are displayed when:

- landing altitude MAN is displayed
- either OUTFLOW VALVE switch is in MAN
- cabin altitude is in amber above normal range or in red excessive range
- cabin differential pressure is in amber above normal range or in red excessive range

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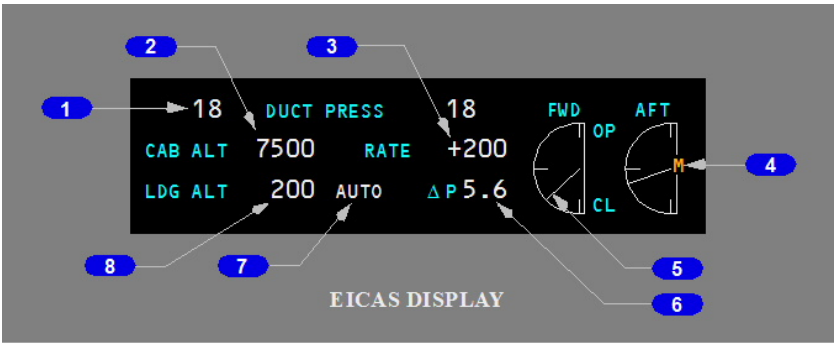
- duct pressure is in amber below normal range with the respective engine running
- the AIR synoptic switch is pushed
- any of the following EICAS messages are displayed:
  - CABIN ALTITUDE
  - CABIN ALTITUDE AUTO
  - LANDING ALTITUDE
  - OUTFLOW VALVE AFT
  - OUTFLOW VALVE FWD.



1 Duct Pressures

White—normal range.

Amber—below normal range.

2 Cabin Altitude

White—normal range.

Amber—above normal range.

Red—excessive cabin altitude.

3 Cabin Altitude Rate

+ (plus)—rate of climb.

– (minus)—rate of descent.

4 Outflow Valve Control Source

M (manual) (amber)—manual control.

Blank—automatic control.

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5 Outflow Valves Position

OP—open.

CL—closed.

6 Cabin Differential Pressure

White—normal range.

Amber—above normal range.

Red—excessive cabin differential pressure.

7 Landing Altitude Selection

AUTO (white)—altitude is set automatically from the FMC.

MAN (amber)—altitude is set by the LANDING ALTITUDE selector.

8 Landing Altitude

Landing altitude is supplied by the FMC or is manually set using the LANDING ALTITUDE selector.

Blank—display is blank without a valid FMC landing altitude or a manually set landing altitude.

Air Synoptic Display

The air systems synoptic is displayed by pushing the AIR Synoptic 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. It does not display actual air flow, therefore the display may not represent actual system operation.

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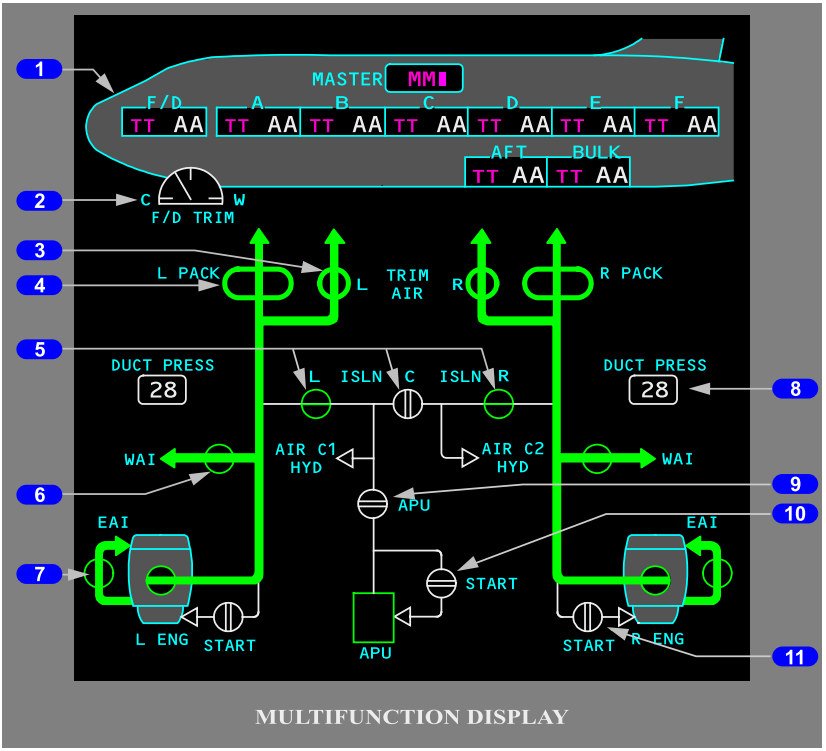

MULTIFUNCTION DISPLAY

1 Zone Temperature

MASTER—(MM) temperature setting of Passenger Temperature selector.

F/D—

- (TT) target temperature on left; displayed when:
  - at least one pack is operating, and
  - FLT DECK TEMP selector is in AUTO, and
  - temperature control is not in backup mode
- (AA) actual temperature on right.

A, B, C, D, E, and F—

- (TT) target temperature on left; displayed when:
  - at least one pack is operating, and
  - temperature control is not in backup mode
- (AA) actual temperature on right.

FWD - (AA) actual temperature

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AFT, BULK—

- (TT) target temperature on left; displayed when:
  - at least one pack is operating, and
  - FWD CARGO A/C selector is in AUTO, and
  - temperature control is not in backup mode
- (AA) actual temperature on right.

2 Flight Deck Trim Air Valve position

Position of the flight deck trim air valve.

3 Trim Air Valve

Position of the trim air valve.

4 Pack Control

Pack is operating—green oval.

Pack is not operating or pack status data is invalid—white oval.

Pack failed—amber oval with amber X.

5 Isolation Valve

Position of the isolation valve.

6 Wing Anti-Icing Valve

Position of the wing anti-icing valve.

7 Engine Anti-Icing Valve

Position of the engine anti-icing valve.

8 Bleed Air Duct Pressure

White—11 psi or greater.

Amber—less than 11 psi.

9 APU Bleed Air Valve

Position of the APU bleed air valve.

10 APU Start Valve

Position of the APU start valve.

11 Engine Start Valve

Position of the engine start valve.

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Positions of the trim air, wing anti-icing, engine anti-icing, engine start, isolation, APU bleed air, and APU start valves are displayed as:

- open—white circle with bars in-line with duct
- closed—white circle with bars across duct
- failed open—amber valve open symbol with amber X
- failed closed—amber valve closed symbol with amber X
- valve position data is not available—white circle with no bars
- for wing anti-icing valve not in commanded position—amber valve symbol with amber X
- for isolation and APU bleed air valves selected closed—amber valve closed symbol with amber X.

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Introduction

The air conditioning system supplies conditioned bleed air and recirculated cabin air at a 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
- overhead crew rest compartments.

TJR to TJW, TKK to TKR, TKU to TKZ

Pack control, zone temperature control, cabin air recirculation, fault detection, and overheat protection are all automatic. Backup system control modes operate automatically in the event of system failures.

The airplane is divided into seven temperature zones: the flight deck and six passenger cabin zones.

Air Conditioning Packs

Two 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. Each pack is controlled by two redundant channels in one of two separate controllers. If one channel fails in a controller, control of the respective pack is continued automatically by the redundant channel in that controller.

Pack Ground Operation

Both air conditioning packs are normally selected to AUTO for ground operations. Fuel consumption is about the same for single pack and two pack operation, and single pack operation causes higher flight line noise levels.

A ground source of conditioned air may be used to supply conditioned air directly to the cabin distribution system, eliminating the need for pack operation.

Pack Non-Normal Operation

Pack control, fault detection, and overheat protection are all automatic. If an overheat or other significant pack fault is detected, the pack shuts down automatically. An attempt to restore pack operation may be made by pressing the AIR COND RESET switch.

Standby Cooling Mode

For certain internal malfunctions, pack control automatically uses standby cooling mode as a backup to normal mode. In standby cooling mode, the EICAS advisory

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message PACK MODE (L, R) is displayed, and STBY COOLING is displayed in amber on the AIR synoptic.

If one pack is in standby cooling and the other pack is operating normally, the pack in standby cooling mode shuts down at lower altitudes and higher outside air temperatures when ambient conditions do not permit standby cooling. The pack restarts automatically when altitude and outside air temperatures are suitable for standby cooling.

If both packs are in standby cooling mode, or if one pack is inoperative and the other pack is in standby cooling mode, the packs or pack operates continuously to maintain cabin pressurization, regardless of altitude or outside air temperature.

In standby cooling mode, pack cooling capacity may be less than in normal mode and may result in warm flight deck or cabin temperatures at lower altitudes.

Air Distribution

The flight deck receives 100% fresh conditioned air from the left pack. The flight deck is maintained at a slightly higher pressure than the passenger cabin to prevent smoke and objectionable odors from entering the flight deck.

Recirculation fans assist the packs to maintain a constant ventilation rate through the cabin. The fans draw cabin air through filters, then reintroduce the air into the conditioned air distribution system.

Air exhausted from the passenger cabin flows into the upper recirculation system or to the lower deck, where it is either exhausted overboard through outflow valves or drawn into the lower recirculation system. Air from the recirculation fans is mixed with pack air before entering the distribution ducts.

Temperature Control

Zone temperatures are controlled by the cabin air conditioning and temperature control system (CACTCS). Hot trim air from the bleed air system is added through trim air valves in the conditioned air supply ducts. The CACTCS modulates the zone trim air valves to achieve the target temperature of the conditioned air in each zone.

Trim air from the left engine bleed is added to conditioned air ducts for the flight deck and three passenger cabin zones. Trim air from the right engine is added to the conditioned air ducts for the other three passenger cabin zones.

The CABIN TEMP selector sets a master reference temperature between 18 deg. C and 29 deg. C (65 deg. F and 85 deg. F). The master reference temperature is increased or decreased automatically or manually to set target temperatures for each temperature zone.

The target temperatures of each passenger cabin temperature zone may be modified manually plus or minus 6 deg. C (10 deg. F), within the range of

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18 deg. C and 29 deg. C (65 deg. F and 85 deg. F), using the cabin management system.

The FLT DECK TEMP selector sets the flight deck temperature to between 18 deg. C and 29 deg. C (65 deg. F and 85 deg. F). Flight deck temperature is controlled manually by setting the selector to MAN.

The temperature zone requiring the coolest temperature controls the pack outlet temperature.

If the flight deck or cabin temperature selector setting is unavailable to the pack temperature controller, the pack outlet temperature is regulated to achieve either the last temperature set or an average cabin temperature of 24 deg. C (75 deg. F).

Temperature Control With Loss of Trim Air

If the left or right trim air system is off, the CACTCS attempts to maintain all zones at the average target temperature. Flight deck temperature will be maintained between 18 deg. C and 29 deg. C (65 deg. F and 85 deg. F).

The flight deck may become uncomfortably warm or cool. Setting the CABIN TEMP selector to a cooler or warmer master temperature may achieve a cooler or warmer flight deck temperature.

Operation With Complete Loss of Zone Temperature Control

If CACTCS control of cabin temperature zones fails, or all engine and APU electrical power fails, the air supply and cabin pressurization controllers control the pack flow control valves. Pack flow rate is modulated to achieve a pack outlet temperature between 5 deg. C and 43 deg. C (40 deg. F and 110 deg. F). All flight deck ECS controls are disabled except the PACK switches.

Shoulder and Foot Heaters

Flight crew shoulder heat is provided by electric elements in the side window air diffusers. The foot heaters have electric heating elements only, with no airflow. Both are available in flight only.

Cargo Temperature Control System

Cargo Heat System

The aft and bulk cargo compartments have independent bleed air heating systems. An insulated curtain separates the two compartments.

With the CARGO TEMP selector in LOW or HIGH, the respective cargo heat shutoff valve opens and the temperature control valve opens and closes to maintain the temperature in the compartment. The lavatory/galley vent fans draw air across temperature sensors in each compartment. If both vent fans fail, cargo heat is not provided.

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With the CARGO TEMP selector in LOW and TAT less than 7 deg. C (45 deg. F), the respective temperature control valve opens. The compartment temperature is maintained between 4 deg. C and 10 deg. C (40 deg. F and 50 deg. F). With the CARGO TEMP selector in HIGH and TAT less than 21 deg. (70 deg. F), the respective temperature control valve opens. The compartment temperature is maintained between 18 deg. C and 24 deg. C (65 deg. F and 75 deg. F).

With the BULK CARGO TEMP selector in HIGH the bulk ventilation fan operates. The fan is provided for animal carriage. The system has automatic overheat protection. When an automatic overheat shutdown occurs, cargo heat to the related compartment cannot be restored in flight.

The lower forward cargo compartment is heated by warm air from the forward equipment ventilation system.

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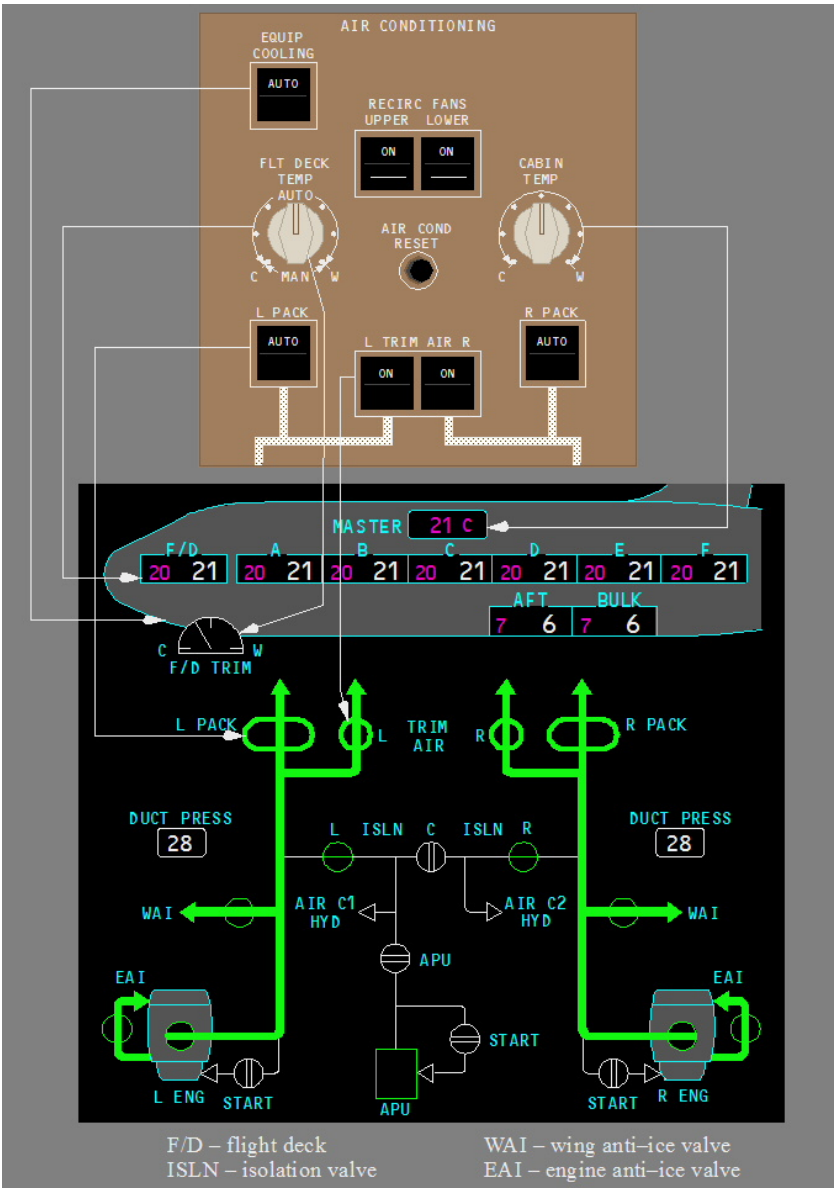
Air Conditioning System Schematic



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Equipment Cooling, Equipment Ventilation, Lavatory and Galley Ventilation

The forward equipment cooling and ventilation provides cooling and ventilation for the electrical and electronic equipment on the flight deck and in the forward electrical and electronic (E & E) compartment equipment racks.

The forward systems use internal fans and valves to direct air drawn from the cabin to the equipment and ventilates the warm exhaust air into the forward outflow valve or the forward cargo compartment, if the compartment requires additional heat. There are two cooling system supply fans, a primary and a backup. If the primary supply fan fails, the backup supply fan operates automatically.

The forward system reconfigures automatically to an override mode when:

- in flight, both supply fans fail, or
- in flight, low airflow is detected, or
- smoke is detected in the forward equipment cooling system or the forward equipment ventilation system, or
- the FWD CARGO FIRE ARM switch is ARMED, or
- the EQUIP COOLING switch is in OVRD.

In the override mode when the FWD CARGO FIRE ARM switch is not ARMED, the vent valve opens, both supply fans shut down, and the forward cargo heat valve closes. In the override mode when the FWD CARGO FIRE ARM switch is ARMED, the vent valve remains closed, both supply fans remain shut down, and the forward cargo heat valve is closed. Cabin differential pressure draws air through the flight deck panels and into the E & E equipment compartment to create a reverse flow of air across the equipment, then through the override valve to an overboard vent.

In flight, the EQUIP COOLING switch in OVRD aids smoke evacuation from the flight deck.

The override mode supplies adequate airflow for equipment cooling while the airplane is in cruise. During descent, the airflow decreases as the cabin pressure differential decreases.

On the ground, the EICAS advisory message EQUIP COOLING is displayed and the ground crew call horn in the wheel well sounds if the forward equipment cooling system is inoperative.

The aft equipment cooling and ventilating system provides cooling and ventilating air for the aft electronic equipment and ventilating air for the lavatories and galleys. Two aft ventilation fans, a primary and a backup, draw air through the aft electronic equipment and from the galleys and lavatories. The warm exhaust air is discharged through the aft outflow valve. Conditioned air is supplied to the galleys from the air distribution system.

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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: one forward and one aft. Normally, most of the outflow is through the aft outflow valve. This improves ventilation and smoke removal. Cabin altitude and full ventilation rates can be maintained by either valve.

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.

Pressurization System Automatic Operation

In flight, the cabin altitude controller operates in a climb mode, a cruise mode, or a descent mode.

The controller uses 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 supplies a small positive pressurization prior to rotation to cause a smooth cabin altitude transition to the cabin altitude climb schedule.

In cabin altitude controller climb mode, cabin altitude increases on a schedule related to the 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.

When the destination airport elevation is greater than 8,000 feet, cabin altitude controller cruise mode maintains a cabin altitude of 8,000 feet.

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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 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 ensures 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's 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 15,000 feet.

Full automatic operation of cabin altitude is possible with one outflow valve operating automatically and the other outflow valve not operating.

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 controller assumes a landing altitude of 2,000 feet.

Cabin Altitude Controller Automatic Operation With Loss of Cabin Pressurization

If a depressurization event occurs, the cabin altitude controller controls the outflow valves to preserve cabin pressure.

Pressurization System Manual Operation

If both OUTFLOW VALVE switches are in MAN, all automatic cabin altitude control functions are bypassed.

The pressurization system is in the manual mode when the OUTFLOW VALVE switches are set to MAN.

The system is manually operated by:

- setting the OUTFLOW VALVE switches to MAN
- holding the related OUTFLOW VALVE MANUAL switch to OPEN or CLOSE.

Outflow valve position is displayed on the EICAS display. If the outflow valve position is not available on EICAS, holding the respective OUTFLOW VALVE MANUAL switch in the desired position for 30 seconds will move the valve from full open or close to the selected position.

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Landing altitude (normally provided by the FMC) can be manually set using the LANDING ALTITUDE selector. Landing field selection limits are 1,000 feet below sea level to 14,000 feet above sea level. Pulling the selector out to the detent removes the FMC landing altitude and displays pressurization system indications on the EICAS display. The knob is rotated clockwise to increase or counterclockwise to decrease the landing altitude setting. Two rates of increase or decrease, low and high, are available in each direction from the spring–loaded center position.

Operation With Loss of Cabin Pressurization

With a sudden loss of cabin pressurization, the outflow valves will close immediately in an attempt to control the cabin pressure. After descent, when the airplane and cabin altitudes are approximately equal, the outflow valves open to protect the airplane against negative pressure differentials.

It is important that the flight crew not attempt to manually close the outflow valves during the descent.

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Introduction

Bleed air can be supplied by the engines, APU, or a ground air source.

Bleed air is used for:

- air conditioning
- pressurization
- wing and engine anti–icing
- APU and engine start
- aft cargo heat
- air driven hydraulic pumps
- hydraulic reservoir pressurization
- potable water tank pressurization
- TAT probe aspiration.

Engine Bleed Air Supply

Engine bleed air is supplied from either the high stage or the low stage engine sections. Low stage air is used during high power setting operations. High stage air is used during descent and other low power setting operations.

The engine bleed valves close automatically:

- during start
- for bleed source loss
- for bleed air overtemperature
- for bleed air overpressure
- for a bleed air duct leak
- when an engine fire switch is pulled
- when a ground cart is supplying air.

APU Bleed Air Supply

APU bleed air is used primarily during ground operations for pack operation and engine starting. In flight, APU bleed air is available at and below 22,000 feet.

The check valve in the APU supply line prevents reverse flow of bleed air from the duct into the APU.

APU to Pack Takeoff

TKK to TKR, TKU to TKZ

Before engine start, selecting APU from the FMC scratch pad to the SEL-APU field on the THRUST LIMIT PAGE arms the system for APU to pack takeoff. Approximately one minute after starting the second engine, the bleed air supply system configures for APU to pack takeoff.

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When APU is selected to the SEL-APU field after both engines are running but before takeoff, the bleed air supply immediately configures for APU to pack takeoff.

In APU to pack takeoff configuration:

- the left engine bleed valve is closed,
- the L ENG OFF light is illuminated and remains illuminated,
- the APU provides air to air demand pump C1 and the left pack,
- the center bleed isolation valve is closed,
- the right engine provides air to air demand pump C2,
- the right pack valve is closed, and
- the R PACK OFF light is illuminated and remains illuminated.

The system reconfigures from APU to pack takeoff to normal operation when:

- thrust is reduced to climb thrust, or
- approximately 10 minutes after takeoff, or
- the airplane is above 11,400 feet altitude, or
- APU to pack configuration cannot be continued because of failures in other systems, or
- APU to pack mode is deleted manually.

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, center, and right isolation valves separate the bleed air duct into isolated segments. The automatic system operates with the left and right isolation valves normally open. The center isolation valve is normally closed, except for engine start or single bleed source operation.

Duct Leak and Overheat Detection System

If a duct leak is detected, the system automatically isolates the leak. The EICAS caution message BLEED LEAK is displayed. The automatic isolation logic may include one, two, or three sequential steps. During isolation, the ENGINE and/or APU bleed switch OFF lights and the ISOLATION switch CLOSED lights illuminate and extinguish as the respective valves close and open.

When the temperature in the affected duct area cools, the BLEED LEAK EICAS message is no longer displayed. The valves isolating the leak remain closed and the appropriate EICAS message BLEED LOSS is displayed. The switch OFF or

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CLOSED lights are illuminated for the respective valves which remain closed to isolate the affected duct area.

CAUTION: Do not change the APU bleed, engine bleed, or bleed isolation switch positions after the system has automatically isolated the leak. Airplane damage can occur.

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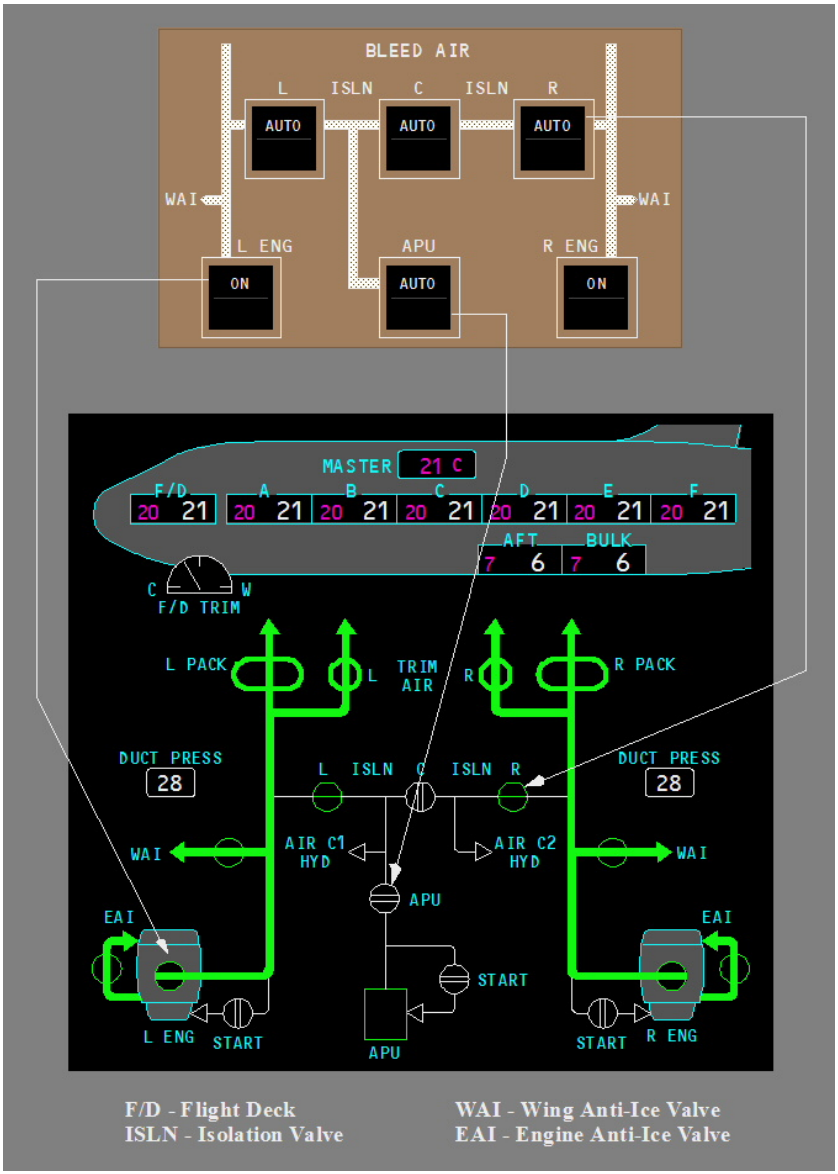
Bleed Air System Schematic



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EICAS Alert Messages

Message	Level	Aural	Message Logic
BLEED ISLN CLOSED C, L, R	Advisory		The isolation valve is failed closed when commanded open or the bleed isolation switch is OFF.
BLEED ISLN OPEN C, L, R	Advisory		The isolation valve is failed open when commanded closed.
BLEED LEAK BODY	Caution	Beeper	A bleed air leak is detected in the body area.
BLEED LEAK L, R	Caution	Beeper	A bleed air leak is detected in the wing or pack bay area.
BLEED LEAK STRUT L, R	Caution	Beeper	A bleed air leak is detected in the strut area.
BLEED LEAK STRUT L, R	Caution	Beeper	A bleed air leak or starter duct leak is detected in the strut area.
BLEED LOSS BODY	Advisory		Bleed air from the left and right body ducts is not available.
BLEED LOSS BODY L, R	Advisory		Bleed air from the body duct is not available.
BLEED LOSS WING L, R	Advisory		Bleed air from the wing duct is not available.
BLEED OFF APU	Advisory		The APU bleed valve is closed because of a system fault or the APU bleed switch is OFF.
BLEED OFF ENG L, R	Advisory		The engine bleed valve is closed because of a system fault or the engine bleed switch is OFF.
CABIN ALTITUDE	Warning	Siren	Cabin altitude is excessive.
CABIN ALTITUDE AUTO	Caution	Beeper	Automatic pressurization control is failed or both outflow valve switches are in manual.
CARGO HEAT AFT, BULK	Advisory		Cargo heat is inoperative or the cargo temperature selector is OFF.
EQUIP COOLING	Advisory		The forward equipment cooling is failed.

TJA,B,C,D,G, H,
TJR to TJW,
TKA to TKF
TKK to TKR,
TKU to TKZ

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Message	Level	Aural	Message Logic
EQUIP COOLING OVRD	Advisory		The equipment cooling system is in override mode.
LANDING ALTITUDE	Advisory		The FMC does not supply a landing altitude or the landing altitude selector is pulled.
OUTFLOW VALVE AFT, FWD	Advisory		Automatic control of the outflow valve is inoperative or the outflow valve switch is in MAN.
PACK L, R	Advisory		Pack is inoperative.
PACK L+R	Caution	Beeper	Both packs are inoperative.
PACK MODE L, R	Advisory		The pack is in the standby mode.
TRIM AIR L, R	Advisory		The trim air valve is closed.

EICAS Memo Messages

Message	Level	Aural	Message Logic
RECIRC FANS OFF	Memo		One or both recirculation fan switches are off.

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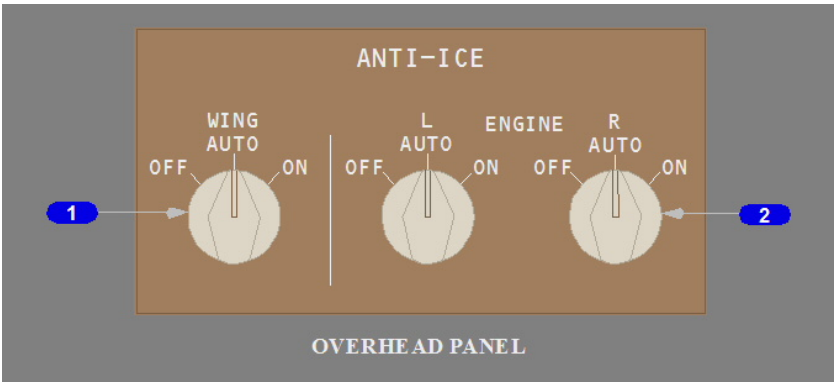
Engine and Wing Anti Icing

Anti-Ice Panel



1 WING ANTI-ICE Selector

OFF—the wing anti-icing valves are commanded closed.

AUTO—in flight, the wing anti-icing valves open when wing icing conditions exist and bleed air pressure is available.

ON—in flight, the wing anti-icing valves are commanded open.

2 ENGINE ANTI-ICE Selectors

OFF—the engine anti-icing valve is commanded closed.

AUTO—in flight, the engine anti-icing operates when engine icing conditions exist.

ON—the engine anti-icing valve is commanded open.

Note: When the ENGINE ANTI-ICE selector is in AUTO and the anti-icing valve is commanded open or when the ENGINE ANTI-ICE selector is in ON, then:

- approach idle is selected by the EEC.

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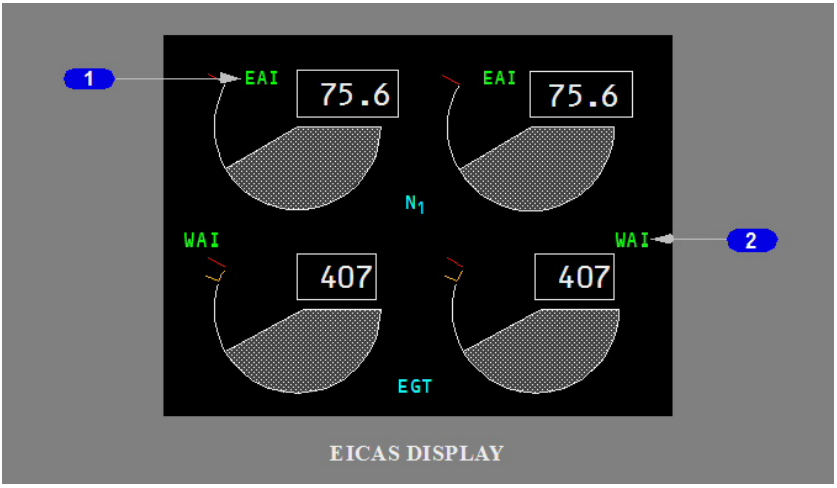
Anti-Icing Indications



1 Engine Anti-icing Indication

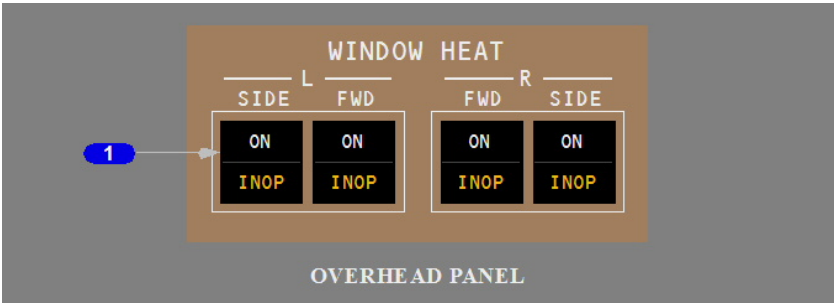
Displayed (green)—engine anti-icing valve is open.

2 Wing Anti-Icing Indication

Displayed (green)—wing anti-icing valve is open.

Window Heat and Wiper Panels

Window Heat Panel



1 WINDOW HEAT Switches

ON—controlled heat is applied to the respective windows.

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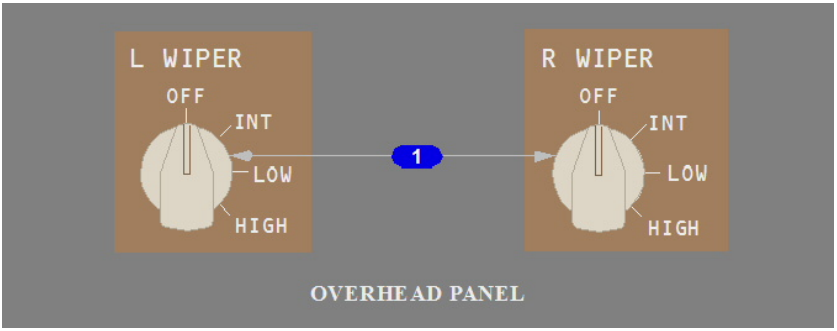
INOP (inoperative) illuminated (amber)—

- the switch is OFF, or
- an overheat has occurred, or
- a system fault has occurred.

Wiper Panels



1 WIPER Selectors

OFF—the wiper is off and is sequenced to stowed position.

INT (intermittent)—the wiper operates intermittently at low speed.

LOW—the wiper operates at low speed.

HIGH—the wiper operates at high speed.

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Introduction

The anti-icing and rain systems include:

- icing conditions detection
- engine anti-icing
- wing anti-icing
- flight deck window heat
- windshield wipers
- probe heat.

Anti-Icing Systems

Engine and wing anti-icing is provided by distributing engine bleed air to the engine inlets and to the wing leading edges.

Icing Conditions Detection

The icing conditions detection system detects engine nacelle inlet icing conditions and wing icing conditions in flight. Two probes on the forward fuselage and system logic:

- control the engine and wing anti-icing valves
- display anti-icing system operating indications on EICAS, and
- display EICAS alert messages.

Engine Anti-Icing

The engine anti-icing valves are opened by engine bleed air pressure. When an engine anti-icing valve is open, EAI is displayed on the primary EICAS display.

In flight, when an ENGINE ANTI-ICE selector is in AUTO and engine icing conditions exist, the respective engine anti-icing valve is commanded open.

When an ENGINE ANTI-ICE selector is ON, the respective engine anti-icing valve is commanded open.

Engine Anti-Icing System Leak Detection

Each engine has an anti-icing duct leak detection system. If an engine anti-icing duct leak is detected, the respective engine anti-icing valve closes.

Wing Anti-Icing

When a wing anti-icing valve is open, WAI is displayed on the primary EICAS display.

In flight, when the WING ANTI-ICE selector is in AUTO and wing icing conditions exist, the wing anti-icing valves are commanded open.

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In flight, when the WING ANTI-ICE selector is ON the wing anti-icing valves are commanded open.

When TAT is above 10 deg. C, wing anti-icing is inhibited for five minutes after liftoff.

Automatic wing anti-icing operation is inhibited when:

- TAKEOFF mode is selected, and
- less than 10 minutes has elapsed after liftoff.

If a bleed source is unavailable and bleed duct isolation has not occurred, the isolation valves open to maintain anti-icing to both wings. If one wing anti-icing valve fails closed, the wing anti-icing system closes the other valve to prevent asymmetrical wing anti-icing.

Wing Anti-Icing System Leak Detection

The bleed duct leak and overheat detection system provides wing anti-icing duct leak detection. See Duct Leak and Overheat Detection System on page 2.40.2.

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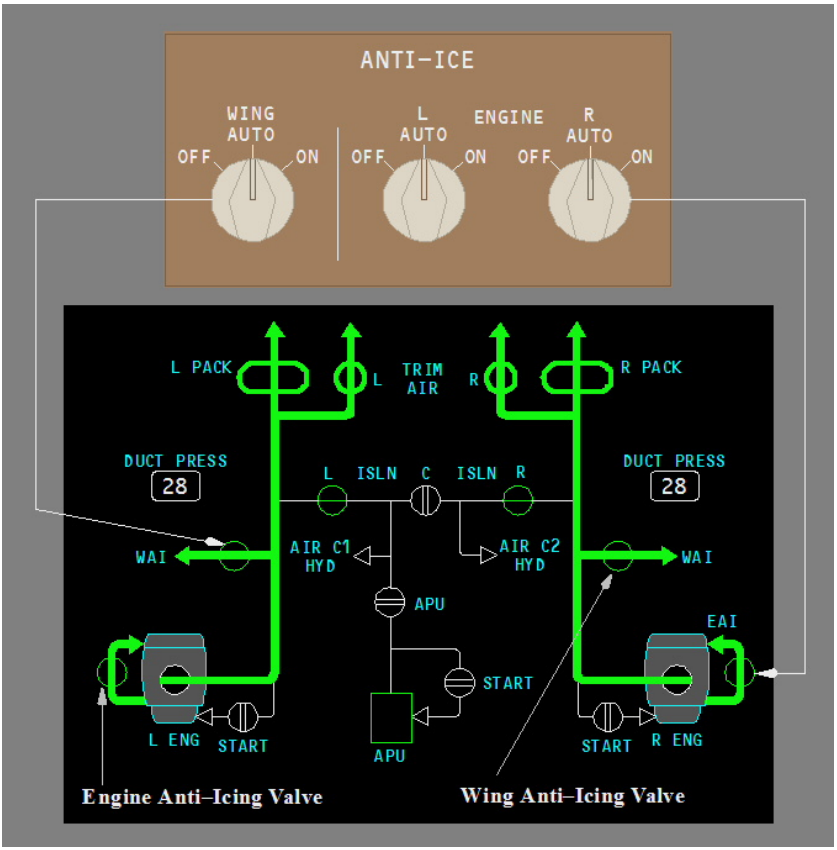
Anti-Icing System Schematic



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 all flight deck windows.

If a fault or overheat condition is sensed, power is disconnected from the respective window heat system. Pushing a WINDOW HEAT switch off for 10 seconds, then ON, resets a window heat controller fault.

A backup anti-fogging system for the forward windows operates automatically if the primary window heat system fails.

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Windshield Wipers

The three speed windshield wipers are independently controlled. When a WIPER selector is OFF, the wiper is off and stowed.

Permanent hydrophobic coating on the No. 1 windows repels the rain.

Probe Heat

Three pitot-static probes and two angle of attack probes are electrically heated for anti-icing protection when either engine is operating.

The total air temperature probe is electrically heated for anti-icing protection in flight.

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EICAS Alert Messages

Message	Level	Aural	Message Logic
ANTI-ICE ENG L, R	Advisory		The engine anti-icing valve is closed when commanded open.
ANTI-ICE LEAK ENG L, R	Caution	Beeper	A bleed air leak occurs in the engine anti-icing duct or starter duct.
ANTI-ICE LEAK ENG L, R	Caution	Beeper	A bleed air leak occurs in the engine anti-icing duct.
ANTI-ICE LOSS ENG L, R	Advisory		Anti-icing bleed air for the engine is not available.
ANTI-ICE ON	Advisory		The ANTI-ICE selector is ON, and TAT is more than 10 deg. C, and icing conditions do not exist.
ANTI-ICE WING	Advisory		One or both wing anti-icing valves are failed closed.
HEAT PITOT C	Advisory		The center pitot probe heat is failed.
HEAT PITOT L	Advisory		The left pitot probe heat is failed.
HEAT PITOT L+C+R	Advisory		The left, center, and right pitot probe heats are failed.
HEAT PITOT R	Advisory		The right pitot probe heat is failed.
ICE DETECTORS	Advisory		The icing conditions detection system has failed.
ICING ENG	Caution	Beeper	Icing conditions exist and an engine ANTI-ICE selector is OFF.
ICING WING	Advisory		Icing conditions exist and the WING ANTI-ICE selector is OFF, or icing conditions exist and wing anti-icing is inhibited during takeoff.
WINDOW HEAT	Advisory		Two or more window heats are off.
WINDOW HEAT L, R FWD	Advisory		Primary window heat for the forward window is inoperative.
WINDOW HEAT L, R SIDE	Advisory		Window heat for the side window is inoperative.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

TKK to TKR, TKU to TKZ

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Automatic Flight — Chapter 4

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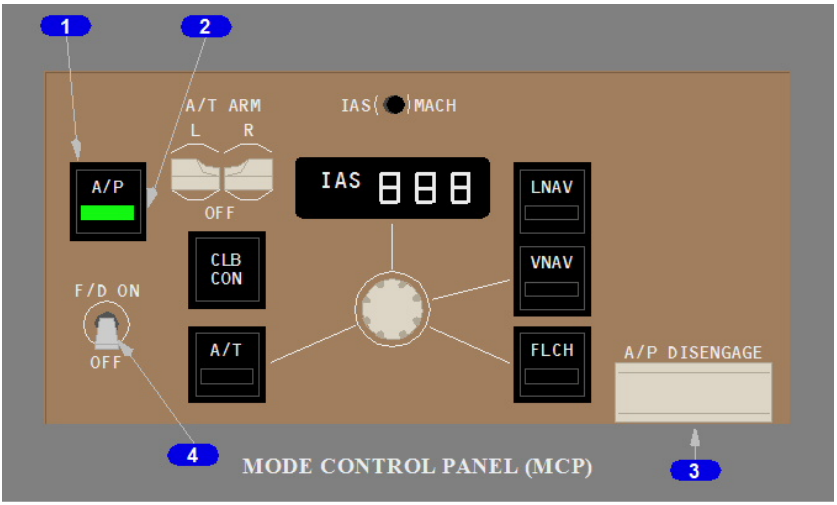
Mode Control Panel (MCP)

Autopilot Flight Director System Controls



1 Autopilot (A/P) Engage Switch

Push (either switch engages the autopilot)—

- inhibited on the ground with flaps out of UP
- when either Flight Director switch is ON, the autopilot engages in the selected flight director mode(s)
- when both Flight Director switches are OFF, the autopilot engages in:
  - heading hold (HDG HOLD) or track hold (TRK HOLD) as the roll mode; or, if bank angle is greater than five degrees, attitude hold (ATT)

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– vertical speed (V/S) or flight path angle (FPA) as the pitch mode.

2 Autopilot Engaged Light

Illuminated (green)—all operating autopilots are engaged.

3 Autopilot (A/P) DISENGAGE Bar

Push down—

- with autopilot(s) engaged:
  - disengages all autopilots
  - displays EICAS warning message AUTOPILOT DISC
  - sounds an aural warning
  - illuminates master warning lights
- prevents autopilot engagement
- displays EICAS advisory message NO AUTOLAND
- disables bank angle protection
- exposes amber and black stripes (as installed).

Lift up—

- enables autopilot engagement
- hides amber and black stripes (as installed).

4 Flight Director (F/D) Switches

The left Flight Director switch activates the flight director steering indications on the left PFD. The right Flight Director switch activates the flight director steering indications on the right PFD.

ON—

- on the ground with both Flight Director switches OFF, the first Flight Director switch positioned ON arms the flight director in takeoff go-around (TO/GA) roll mode. In addition, the first switch arms the flight director in TO/GA pitch mode when MCP selected altitude differs more than 20 feet from displayed baro altitude, or activates the flight director in altitude (ALT) pitch mode when selected altitude is within 20 feet of displayed baro altitude. If ALT mode is active, selecting an altitude more than 20 feet from displayed baro altitude and recycling the first switch arms the flight director in TO/GA roll and pitch modes. The flight mode annunciation appears on both PFDs. Positioning the second switch ON displays the flight director steering indications on the second PFD
- in flight with the autopilot disengaged and both Flight Director switches OFF, the first Flight Director switch positioned to ON activates the flight director in:
  - heading hold (HDG HOLD) or track hold (TRK HOLD) as the roll mode; or, if bank angle is greater than five degrees, attitude hold (ATT)
  - vertical speed (V/S) or flight path angle (FPA) as the pitch mode

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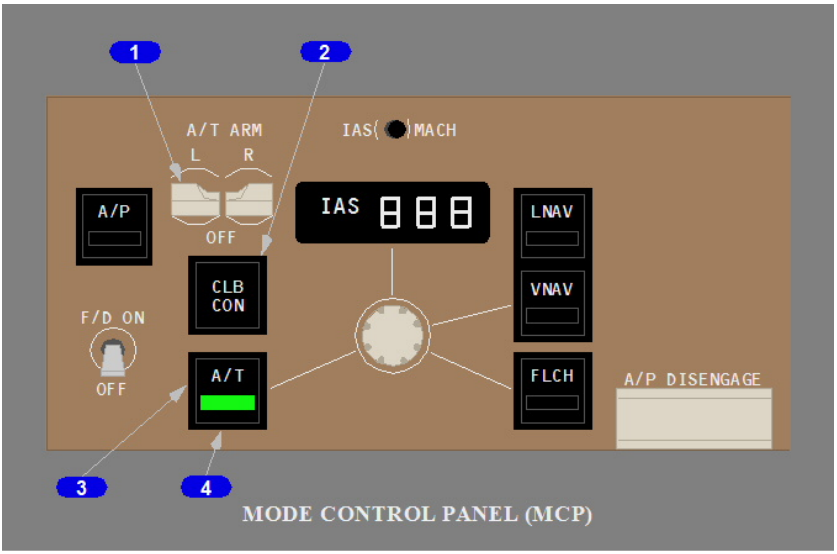
- in flight with the autopilot engaged and both Flight Director switches OFF, the first Flight Director switch positioned to ON activates the flight director in the currently selected autopilot mode(s).

OFF—

- the flight director steering indications do not display, unless
- a TO/GA switch is pushed when airspeed is greater than 80 knots and flaps are out of up.

Autothrottle System Controls



1 Autothrottle (A/T) ARM Switches

The left Autothrottle Arm switch arms or disarms the left engine autothrottle. The right Autothrottle Arm switch arms or disarms the right engine autothrottle.

ARM—

- arms selected autothrottle for mode activation
- autothrottle activates when VNAV, FLCH, or TO/GA switch pushed
- autothrottle activates when autothrottle switch pushed and pitch mode is ALT, V/S, or G/S.

OFF—

- disconnects selected autothrottle
- prevents selected autothrottle activation.

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2 Climb/Continuous (CLB/CON) Thrust Switch

On the ground and below 400 feet during takeoff, the switch is inoperative.

Push—

- with two engines operating, changes the engine thrust limit to the FMC selected climb thrust
- with only one engine operating, changes the thrust limit to maximum continuous (CON).

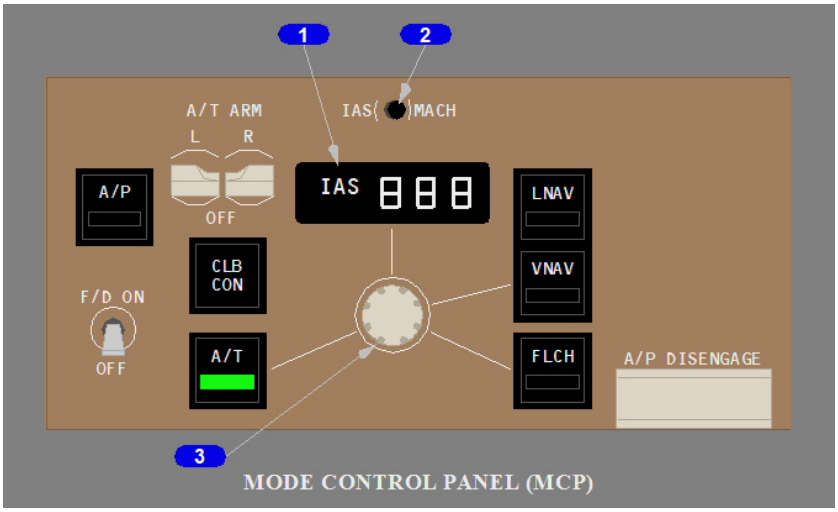
3 Autothrottle (A/T) Switch

Push—above 400 feet, with the autothrottle armed, activates the appropriate autothrottle mode for the selected AFDS pitch mode, or if no pitch mode, in speed (SPD) mode.

4 Autothrottle Light

Illuminated (green)—an autothrottle mode is activated.

Autopilot Flight Director IAS/Mach Controls



1 IAS/MACH Window

Displays 200 knots when power first applied.

Displays the speed selected by the IAS/MACH selector.

Closed when the FMC controls the speed. When changing from TO/GA to V/S, FPA, or ALT, the window displays:

- the flap placard speed minus 5 knots (flaps extended), or

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- 250 knots (flaps up), or
- a speed value entered in the IAS/MACH window after TO/GA was pushed.

Display range:

- 100–399 KIAS
- .400–.950 Mach
- .40–.95 Mach.

TKK to TKR, TKU to TKZ

The selected speed displayed as the PFD selected speed.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

In climb, automatically changes from IAS to Mach at .84 Mach.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

In climb, automatically changes from IAS to Mach at .840 Mach.

TKK to TKR, TKU to TKZ

In descent, automatically changes from Mach to IAS at 310 KIAS.

2 IAS/MACH Reference Switch

Push—

- alternately changes IAS/MACH window between IAS and Mach displays (Mach must be 0.4 or greater to switch from IAS to Mach)
- inoperative when IAS/MACH window is closed.

3 IAS/MACH Selector

Rotate—

- sets speed in IAS/MACH window and command speed on both PFDs
- inoperative when IAS/MACH window is closed.

Push—with VNAV active, alternately opens or closes the IAS/MACH window.

When the window is closed, FMC computed target speed is active and displays on PFDs.

When the window is open, FMC speed–intervention is active and IAS/MACH selector may be used to set the desired speed.

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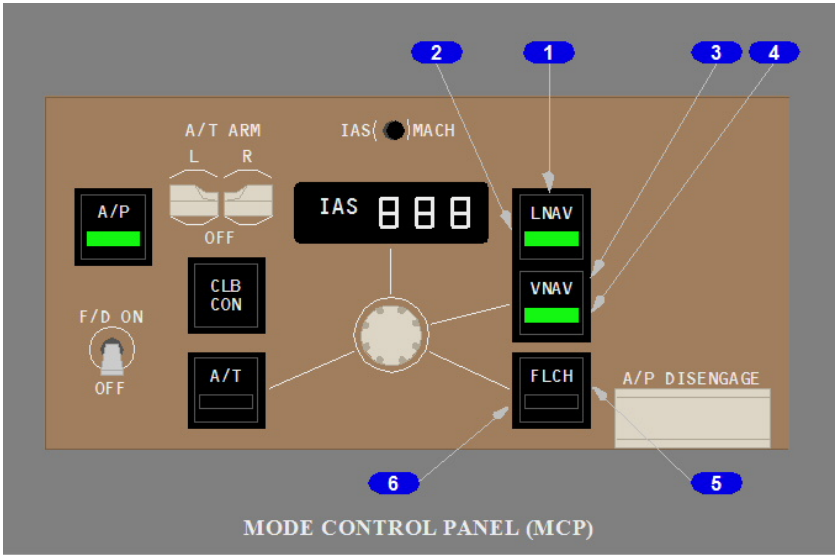
Autopilot Flight Director Roll and Pitch Controls



1 Lateral Navigation (LNAV) Switch

Push—

- arms, selects, or disarms LNAV as roll mode
- displays LNAV in white (armed) on both PFDs roll flight mode annunciations when armed. The previous roll mode remains active
- LNAV activates when the airplane is above 50 feet radio altitude and:
  - within 2.5 NM of the active leg
  - when not within 2.5 NM of the active leg and on an intercept heading to the active leg, remains armed then activates when approaching the active leg
  - when active, displays LNAV in green on the 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 scratchpad
- selection of LNAV when an active FMC route is not available displays NO ACTIVE ROUTE in the CDU scratchpad
- LNAV maintains current heading when:
  - passing last active route waypoint
  - passing last waypoint prior to a route discontinuity
  - passing last route offset waypoint

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– activating the inactive route or activating an airway intercept and not within LNAV engagement criteria.

LNAV is deactivated:

- by selecting heading hold (HDG HOLD) or track hold (TRK HOLD)
- by selecting heading select (HDG SEL) or track select (TRK SEL)
- when localizer captures
- with dual FMC failure (LNAV may be re–activated if there is an active CDU ALTN NAV route available).

LNAV is disarmed:

- by pushing the LNAV switch a second time
- by arming LOC or APP
- When the TO/GA switch is pushed with flaps not up and no instrument approach procedure loaded into the FMC
- by disengaging the autopilot and turning both flight directors off.

2 LNAV Light

Illuminated (green)—the LNAV mode is armed or active.

3 Vertical Navigation (VNAV) Switch

Push—

- arms, selects, or disarms VNAV as the 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 the FMC has insufficient data to provide VNAV guidance (such as the gross weight is invalid or there is no end-of-descent point in descent) displays PERF/VNAV UNAVAILABLE in the CDU scratchpad
- VNAV SPD, VNAV PTH, or VNAV ALT pitch mode displays in green (active) on the PFD pitch flight mode annunciation
- in VNAV SPD pitch mode, AFDS commands pitch to hold target airspeed. The autothrottle operates in the THR REF, THR, IDLE, or HOLD mode, as required by phase of flight
- in VNAV PTH pitch mode, the AFDS commands pitch to maintain FMC target altitude or VNAV path; autothrottle operates in speed (SPD) mode
- in VNAV ALT pitch mode, AFDS commands pitch to maintain MCP selected altitude; autothrottle operates in speed (SPD) mode
- when selecting VNAV and VNAV commands a descent with the MCP altitude window above the current airplane altitude, the autopilot maintains the altitude at which VNAV was selected. When on an instrument approach using VNAV, selecting the missed approach altitude does not interfere with the VNAV descent

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- when selecting VNAV and VNAV commands a climb with the MCP altitude window below the current airplane altitude, the autopilot maintains the altitude at which VNAV is selected
- With the VNAV PTH pitch mode active, the autothrottle operates in the following modes:
  - for climb or cruise—operates in the speed (SPD) mode
  - for descent—operates in the IDLE, HOLD, or speed (SPD) mode
- VNAV pitch guidance available with one engine inoperative.

VNAV is deactivated:

- by selecting TO/GA, FLCH SPD, V/S, FPA, ALT or G/S pitch mode
- if dual FMC failure occurs
- by disengaging the autopilot and turning both flight directors off.

VNAV is disarmed by:

- pushing the VNAV switch a second time, or
- arming APP.

4 VNAV Light

Illuminated (green)—the VNAV mode is 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 annunciation
- when IAS/MACH window closed, it opens to the FMC target speed, if valid. If not valid, the IAS/MACH window opens to the current speed
- when IAS/MACH window is open, it displays command speed
- when changing from TO/GA to FLCH, IAS/MACH window displays highest value of current speed or selected speed
- AFDS pitch holds selected speed. When selected altitude captured, pitch flight mode annunciation 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 provide 500 FPM vertical speed for each 1,000 feet altitude change
- AFDS attempts to reach the MCP selected altitude within two minutes if able with available thrust. Otherwise, A/T uses IDLE or CLB thrust to reach the MCP selected altitude
- with a higher altitude set in the altitude window, reference thrust limit changes to CLB when CRZ displayed or to CON with an engine inoperative.

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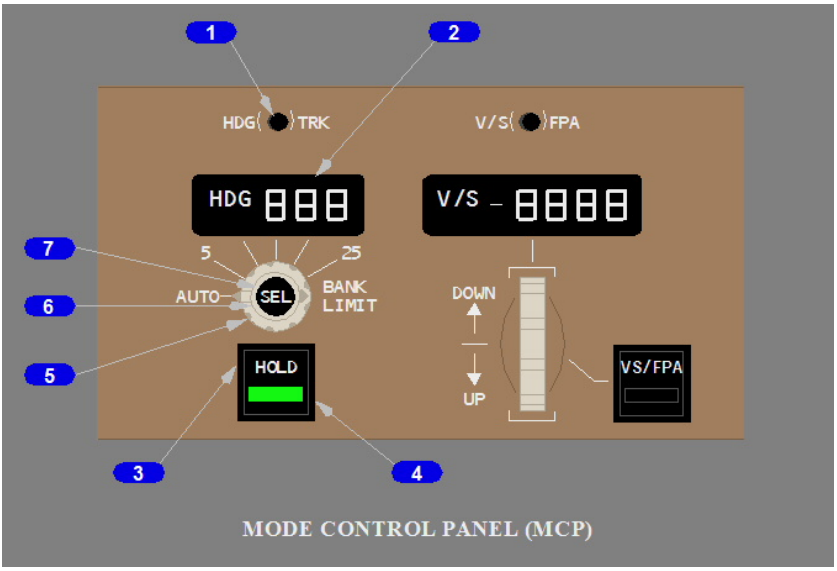
6 Flight Level Change Light

Illuminated (green)—flight level change mode is active.

Autopilot Flight Director Heading, Track, and Bank Angle Controls



1 Heading/Track (HDG/TRK) Reference Switch

Push—alternately changes the heading/track window, PFD, and ND selected heading/track references between heading and track. Also changes PFD roll flight mode annunciations, when the HDG or TRK mode is active.

2 Heading/Track Window

Displays selected heading or track; also displayed on PFDs and NDs.

When approach armed, changes to ILS front course at LOC capture.

Displays 360 when power first applied.

3 Heading/Track Hold (HOLD) Switch

Push—

- selects heading hold (HDG HOLD) or track hold (TRK HOLD) roll mode
- displays HDG HOLD or TRK HOLD on PFD roll flight mode annunciation
- AFDS commands wings level and holds heading or track when wings level.

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4 Heading/Track Hold Light

Illuminated (green)—heading/track HOLD mode is active.

5 BANK LIMIT Selector (outer)

Rotate—sets the AFDS commanded bank limit when in the heading select (HDG SEL) or track select (TRK SEL) roll mode as follows:

- AUTO—varies between 15°–25°, depending on TAS
- 5, 10, 15, 20 or 25—selected value is the maximum, regardless of airspeed.

6 Heading/Track Selector (middle)

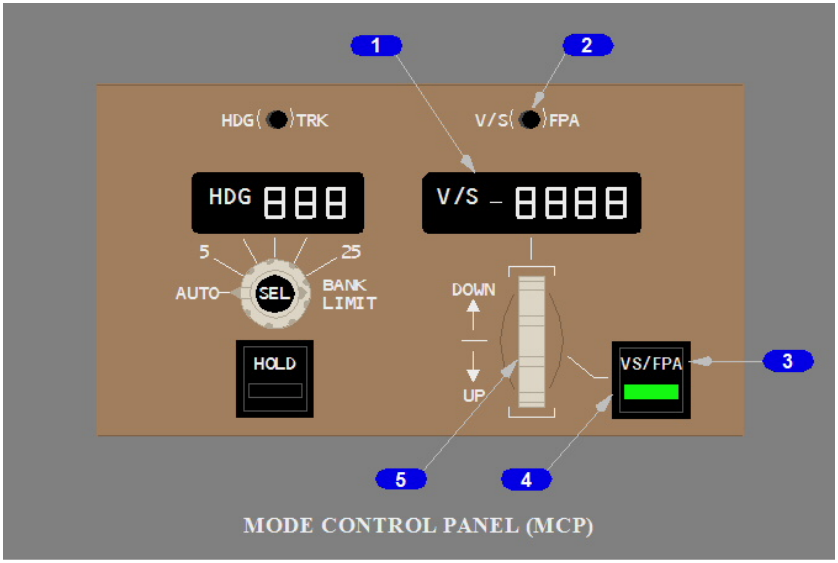
Rotate—sets heading or track in the heading/track window and on the PFDs and NDs.

7 Heading/Track Select (SEL) Switch (inner)

Push—

- selects heading select (HDG SEL) or track select (TRK SEL) as roll mode
- displays HDG SEL or TRK SEL on PFD roll flight mode annunciation
- AFDS controls roll to fly the selected heading or track
- bank is limited by bank limit selector.

Autopilot Flight Director Vertical Speed (V/S) and Flight Path Angle (FPA) Controls



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1 Vertical Speed/Flight Path Angle (V/S—FPA) Window

Displays selected vertical speed in 100 fpm increments or the selected flight path angle in 0.1° increments.

Display range:

- V/S: –8000 to +6000 fpm
- FPA: –9.9° to +9.9°.

Blank when vertical speed (V/S) or flight path angle (FPA) pitch mode is not active; display state can be pre-selected by pushing the V/S—FPA Reference Switch.

Selected vertical speed displays on the PFD vertical speed indication.

Selected flight path angle displays on the PFD attitude indicator.

2 V/S—FPA Reference Switch

Push—alternately changes vertical speed/flight path angle window and PFD references between vertical speed and flight path angle. Also changes PFD pitch flight mode annunciation, when the V/S or FPA mode is active.

3 V/S—FPA Switch

Push—

- selects V/S or FPA pitch mode
- displays V/S or FPA on the PFD pitch flight mode annunciation
- displays current vertical speed or flight path angle in the vertical speed/flight path angle window
- when selected altitude is reached, the pitch mode changes to ALT
- AFDS commands pitch to maintain the vertical speed or flight path angle displayed in the vertical speed/flight path angle window
- when V/S or FPA selected while in FLCH or VNAV, autothrottle activates in speed (SPD) mode, when armed.

4 V/S—FPA Light

Illuminated (green)—the vertical speed/flight path angle mode is active.

5 V/S—FPA Selector

UP or DOWN—sets the vertical speed or flight path angle in the vertical speed/ flight path angle window and on both PFDs.

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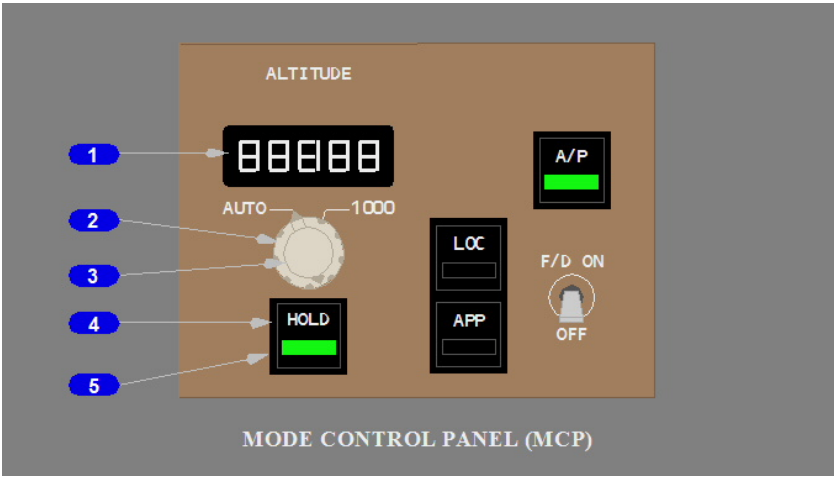
Autopilot Flight Director Altitude Controls



1 Altitude Window

Displays selected altitude.

The displayed altitude is the reference altitude for altitude alerting and level off.

The altitude range is 0 to 50,000 feet.

Displays 10,000 feet when power is first applied.

Displayed altitude transmitted to ATC.

2 Altitude Increment Selector (outer)

AUTO—

- the altitude selector changes the window display in 100 foot increments
- displays the selected BARO minimum as the altitude selector passes through that altitude. If the BARO minimum is not a 10 foot increment, displays the next highest 10 foot increment.

1000—the altitude selector changes the window display in 1,000 foot increments.

3 Altitude Selector (inner)

Rotate—sets altitude in the altitude window and on both PFDs.

Push—

- in climb or descent with altitude constraints, each push deletes the next waypoint constraint between the airplane altitude and the altitude window setting

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- in climb with no altitude constraints, and the altitude window set above the FMC cruise altitude, the cruise altitude is changed to the altitude window setting
- in 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 descend now (DES NOW) feature.

4 Altitude HOLD Switch

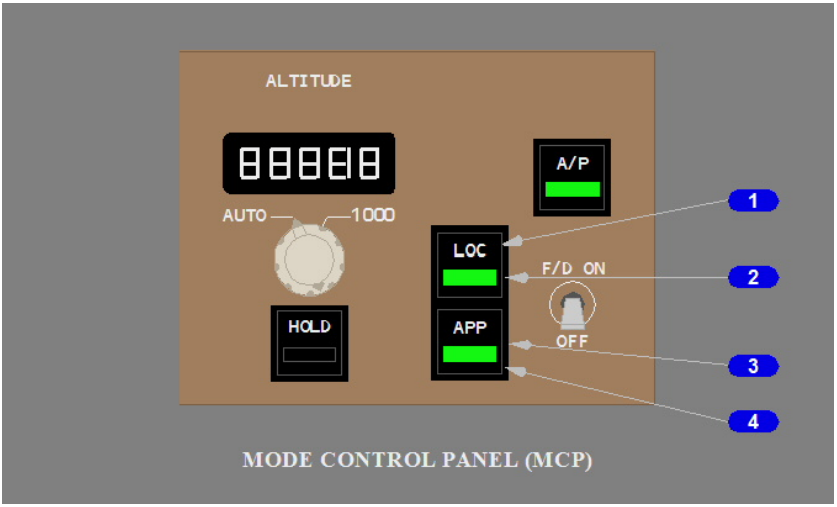
Push—

- selects altitude (ALT) pitch mode
- ALT displays on PFD pitch flight mode annunciation
- AFDS commands pitch to maintain the altitude when the switch was pushed.

5 Altitude Hold Light

Illuminated (green)—the altitude hold mode is active.

Autopilot Flight Director Approach Mode Controls



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1 Localizer (LOC) Switch

Push—

- arms, disarms, or captures localizer (LOC) as the roll mode
- displays LOC in white (armed) on the PFD roll flight mode annunciation before localizer capture; current roll mode remains active until LOC capture
- displays LOC in green (active) on the PFD roll flight mode annunciation 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° of the localizer course.

The localizer mode can be disarmed before localizer capture by:

- pushing the localizer switch a second time, or
- arming or activating LNAV.

The localizer mode can be deactivated after localizer capture by:

- selecting a roll mode other than LNAV, or
- pushing a TO/GA switch, or
- disengaging the autopilot and turning both Flight Director switches off, or
- pushing the localizer switch a second time above 1,500 feet radio altitude (reverts to the default roll mode).

2 Localizer Light

Illuminated (green)—the localizer mode is 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 prior to localizer and glideslope capture
- displays LOC and G/S in green (engaged) on PFD roll and pitch flight mode annunciations after each one is captured
- AFDS captures and tracks localizer and captures the glideslope upon interception
- localizer captures when intercept track angle is within 120° of localizer course
- glideslope captures when intercept track angle is within 80° of localizer course.

Glideslope can capture before localizer capture.

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The approach mode can be disarmed or deactivated for any status of localizer and/or glideslope by disengaging the autopilot and turning both Flight Director switches off.

When both localizer and glideslope are armed, the approach mode can be disarmed by selecting APP, LOC, LNAV, or VNAV.

The approach mode deselects:

- by pushing APP when above 1,500 feet radio altitude
- with localizer captured and glideslope armed, by selecting heading select (HDG SEL) or heading hold (HDG HOLD)
- with localizer armed and glideslope captured, by selecting any other pitch mode except VNAV
- after localizer and glideslope are captured, by selecting TO/GA mode.

4 Approach Light

Illuminated (green)—the approach modes (LOC and G/S) are armed or active.

PFD Flight Mode Annunciations (FMAs)

Notes:

1. When first activated, A/T, roll, or pitch mode changes are emphasized for 10 seconds by a green box drawn around the mode.
2. An amber horizontal line displays through the affected active pitch or roll mode when a flight mode fault is detected.
3. 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.

   NO AUTOLAND also displays on the 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.

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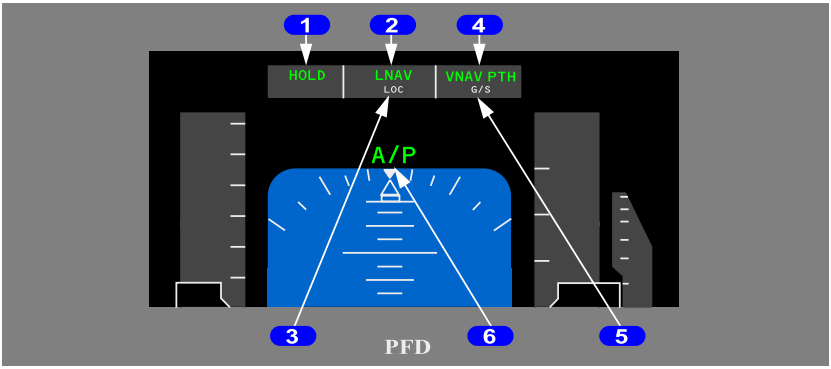

1 Autothrottle Modes (Active)

Displayed (green)—

- THR
- (L or R) THR
- THR REF
- (L or R) THR REF
- IDLE
- (L or R) IDLE
- HOLD
- (L or R) HOLD
- SPD
- (L or R) SPD.

2 AFDS Roll Modes (Active)

Displayed (green)—

- HDG HOLD
- HDG SEL
- LNAV
- LOC
- ROLLOUT
- TO/GA
- TRK SEL
- TRK HOLD
- ATT.

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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
- FPA.

5 AFDS Pitch Modes (Armed)

Displayed (white)—

- G/S
- FLARE
- VNAV.

6 AFDS (Active)

Displayed (green)—

- FLT DIR
- A/P
- LAND 3.

Displayed (green with white triangles)—▷LAND2◁

Displayed (amber)—NO AUTOLAND.

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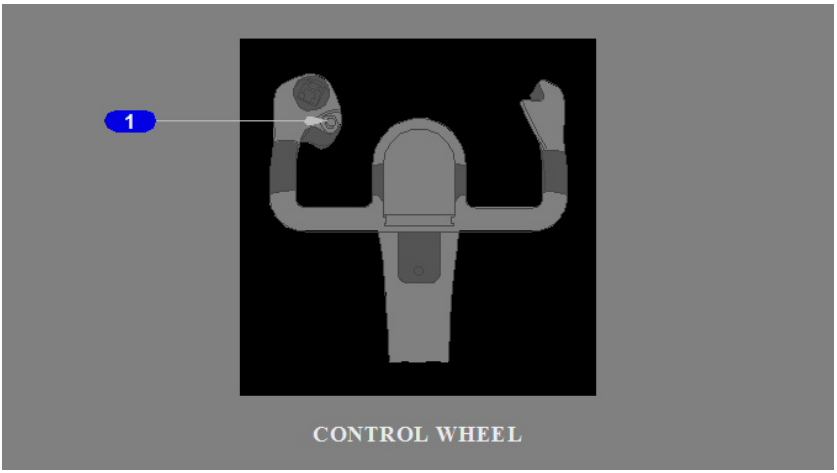
Autopilot Disengage Switch



1 Autopilot Disengage Switch

First push (either switch)—

- disengages all autopilots
- Master Warning lights illuminate
- displays the EICAS warning message AUTOPILOT DISC
- sounds an aural warning
- if the autopilot automatically disengages, first push resets the Master Warning lights, EICAS warning message, and the aural warning.

Second push—resets:

- Master Warning lights
- EICAS warning message
- aural warning.

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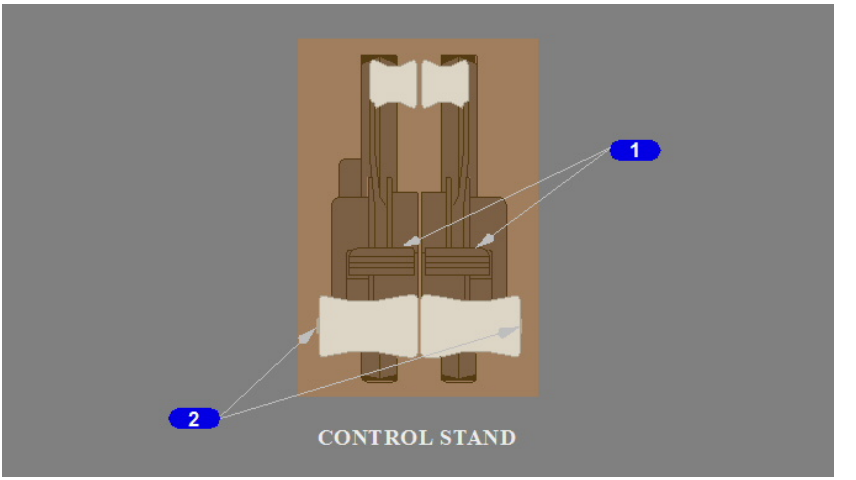
Autothrottle Disconnect and TO/GA Switches



1 Takeoff/Go-around (TO/GA) Switches

On the ground:

Push—

- below 50 knots and flaps out of up, activates autothrottle in THR REF mode at reference thrust limit selected on THRUST LIMIT page. If not pushed below 50 knots, autothrottle operation is inhibited until reaching 400 feet altitude
- pushing either switch above 80 knots disarms LNAV and VNAV, and the flight directors are displayed.

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
- disarms LNAV and VNAV, if armed
- 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 autothrottle in THR mode with GA reference thrust limit displayed. Thrust adjusts to provide 2,000 feet per minute climb
- selects TO/GA roll and pitch modes
- arms or activates LNAV if an LNAV path is available.

TKK to TKR, TKU to TKZ

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Second push (go-around active with flaps out of up, LNAV armed, TO/GA roll and pitch mode)—activates autothrottle in THR REF using GA reference thrust, or

Second push (go-around active with flaps out of up, LNAV active, TO/GA pitch mode)—activates autothrottle in THR REF using GA reference thrust, roll mode remains LNAV, or

Second push (go-around active with flaps out of up, HDG SEL or HDG HOLD active, TO/GA pitch mode)—activates autothrottle in THR REF using GA reference thrust, selects TO/GA roll and pitch modes.

2 Autothrottle Disconnect Switches

Push (either switch)—

- disconnects autothrottle (both left and right)
- illuminates Master Caution lights
- displays EICAS message AUTOTHROTTLE DISC
- if autothrottle automatically disconnects, resets Master Caution lights and EICAS message.

Second push—resets Master Caution lights and EICAS message.

Autothrottle remains armed.

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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 the 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 autopilot flight director computers (AFDCs) and the MCP.

The MCP provides control of the autopilot, flight director, altitude alert, and autothrottle systems. The MCP is used to select and activate AFDS modes, and establish altitudes, speeds, and climb/descent profiles.

The AFDCs provide control of the flight directors, and autopilot. Flight director information is displayed on the primary flight displays (PFDs). The AFDS does not have direct control of the flight control surfaces. The autopilot controls the elevators, ailerons, flaperons, and spoilers through the fly–by–wire flight control system. Autopilot rudder commands are added only during an autopilot approach and landing. The autopilot controls nose wheel steering during rollout after an automatic landing.

MCP Mode Selection

MCP switches select automatic flight control and flight director modes. A light on the switch illuminates to indicate the mode is armed or active. Mode activation is indicated by the PFD roll and pitch flight mode annunciations. Autothrottle modes are discussed later in this section.

Most modes engage with a single push. These modes include:

- flight level change (FLCH SPD)
- heading hold (HDG HOLD)
- track hold (TRK HOLD)
- heading select (HDG SEL)
- track select (TRK SEL)
- vertical speed (V/S)
- flight path angle (FPA)
- altitude hold (ALT).

Other modes arm or engage with a single push. These modes are:

- lateral navigation (LNAV)
- vertical navigation (VNAV)
- localizer (LOC)

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- approach (APP).

Desired target values can be selected on the MCP for:

- airspeed
- Mach
- heading
- track
- vertical speed
- flight path angle
- altitude.

All of these parameters except vertical speed and flight path angle can be preselected prior to autopilot and/or flight director engagement.

Autopilot Engagement

The autopilot is engaged by pushing either of the two MCP autopilot engage switches.

Autopilot Disengagement

Normal autopilot disengagement is through either control wheel autopilot disconnect switch. The autopilots can also be disengaged by:

- the MCP autopilot disengage bar, or
- overriding with the control column, control wheel, or rudder pedals (pedals will only disengage the autopilots with LAND 2 or LAND 3 annunciated).

When an override force sufficient to move the control column, control wheel, or rudder pedals (LAND 2 of LAND 3 annunciated) is applied, the fly-by-wire flight control system detects a difference between the cockpit controls and its own estimate of the expected positions and forces disengagement of the autopilot. After the autopilot is disengaged, the control system transitions the control surface commands from those of the autopilot to those of the flight crew.

An automatic autopilot disengagement occurs for some failures detected by the autopilot. The EICAS warning message AUTOPILOT DISC displays if the autopilot is manually or automatically disengaged. Depending on the system failure, it may be possible to re-engage an autopilot by pushing the autopilot engage switch.

Autopilot and Flight Director Mode Degradations

Autopilot

The autopilot system can detect the degradation of a specific autopilot mode. When an engaged mode degrades, the autopilot remains engaged in an attitude stabilizing mode based on inertial data. If the degradation persists, the condition is annunciated on the PFD by an amber line through the affected flight mode annunciation. If the degradation continues, the EICAS caution message

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AUTOPILOT displays to indicate the autopilot is operating in a degraded mode. When the degradation is no longer present, the annunciations clear, the autopilot resumes using the mode, and a green box displays around the affected flight mode annunciation on the PFD for 10 seconds.

Flight Director

When a specific flight director mode degrades, the flight director provides an attitude stabilizing command based on inertial data. If the degradation persists, the condition is annunciated by removal of the affected (pitch or roll) flight director bar. When the degradation is no longer present, the flight director commands immediately return to view.

ILS Signal Interference Monitor

The autopilot flight director system (AFDS) can detect significant ILS signal interference due to service vehicles or aircraft. If localizer or glideslope signal interference is detected, the autopilot disregards the ILS signal and remains engaged in an attitude stabilizing mode based on inertial data. Most ILS signal interferences last only a short period of time, so there is no annunciation other than erratic movement of the ILS raw data during the time the interference is present. If the condition persists, the annunciations described above for Autopilot and Flight Director Mode Degradation are provided.

Flight Director Display

The flight director steering indications are normally displayed any time the related flight director switch is ON.

The steering indications also display when the related flight director switch is OFF and a TO/GA switch is pushed, if airspeed is greater than 80 knots and the flaps are out of up. In this case, the flight director display can be removed by cycling the respective flight director switch on, then off.

A flight director mode failure, in either pitch or roll, causes the respective steering bars to disappear. The stall and overspeed protection functions also cause the pitch flight director bar to disappear.

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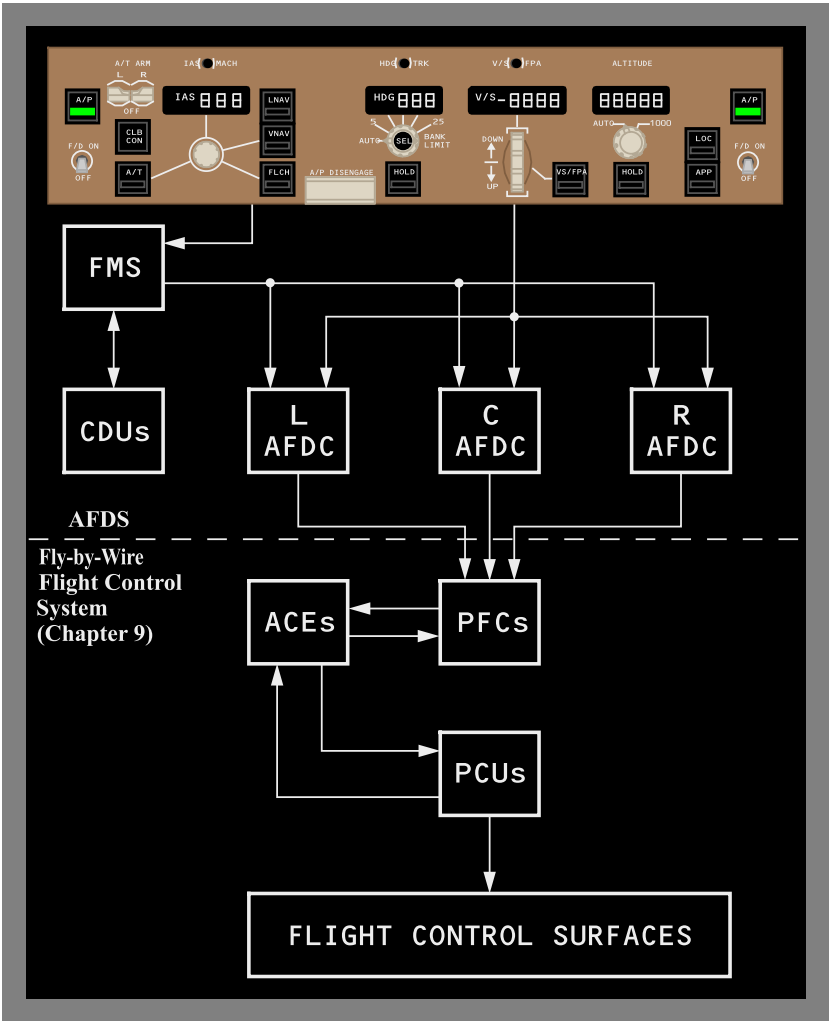
Autopilot Flight Director System Schematic



AFDS Status Annunciation

The following AFDS status annunciations display just above the PFD attitude display:

- FLT DIR (the flight director is ON and the autopilots are not engaged)
- A/P (the autopilots are engaged)

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- LAND 3 (three autopilots are engaged and operating normally for an automatic landing)
- LAND 2 (AFDS redundancy is reduced; in some cases, only two autopilots are available)
- NO AUTOLAND (the AFDS is 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 which limits the capability of the automatic landing system. Aural alerts for EICAS messages not affecting safety of flight are inhibited until after touchdown. Changes in autoland status below 200 feet, other than transition to NO AUTOLAND status, are inhibited.

AFDS Flight Mode Annunciations

The flight mode annunciations displayed just above the PFD AFDS status annunciations. The mode annunciations, from left to right, are:

- autothrottle
- roll
- pitch.

Active or captured modes display at the top of the flight mode annunciator boxes in large green letters. Armed modes (except for TO/GA in the air) display in smaller white letters at the bottom of the flight mode annunciation boxes. Degradations of a specific mode while the autopilot is engaged annunciate by an amber line through the mode annunciations. A green box displays around the mode annunciation for 10 seconds when a mode first becomes active, and when the amber line through a degraded mode is removed.

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 thrust levers manually
- SPD—autothrottle maintains command speed. Speed can be set using the MCP IAS/MACH selector or by the FMC, as displayed on the CDU CLIMB, CRUISE, or DESCENT page.

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Notes:
1. In SPD mode, the autothrottle will not exceed the operating speed limits for the airplane configuration or the referenced thrust limits displayed on the EICAS.
2. If only one thrust lever is active, "L " or "R " displays in front of SPD for the active thrust lever.

Roll Modes

Roll annunciations are:

LNAV—

- 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 ½ nm of the active leg.

HDG—

- HDG SEL (active)—airplane turns to or maintains the heading set in the MCP heading/track window
- HDG HOLD (active)—AFDS holds present heading. When turning, AFDS holds the heading reached after rolling wings level.

TRK—

- TRK SEL (active)—airplane turns to or maintains the track set in the MCP heading/track window
- TRK HOLD (active)—AFDS holds present track. When turning, AFDS holds the track reached after rolling wings level.

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° and will not roll to wings level. When the bank angle is less than 5°, AFDS rolls to wings level (HDG HOLD or TRK HOLD). When the bank angle is greater than 30°, AFDS rolls to 30° of bank.

LOC—

- LOC (armed)—AFDS captures localizer when within range and within 120° of 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; or, by pushing either TO/GA switch with airspeed greater than 80 KTS. 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.

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ROLLOUT—

- ROLLOUT (armed)—displayed below 1,500 feet radio altitude and activates below 2 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, or by pushing either TO/GA switch with airspeed greater than 80 knots. The flight director PFD pitch bar indicates an initial pitch of eight degrees up. TO/GA pitch guidance becomes active at lift-off.

After lift-off, the AFDS commands a pitch attitude to maintain:

- a target speed of V2 plus 15 knots or the airspeed at rotation (pitch attitude greater than two degrees) plus 15 knots, whichever is greater
- if current airspeed exceeds the target speed for 5 seconds, the target speed is reset to the lesser of the current airspeed or V2 plus 25 knots
- the IAS/MACH window speed if the 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, to a maximum of the IAS/MACH window speed plus 25 knots. GA displays as the thrust limit on the primary EICAS engine display.

VNAV—

VNAV is armed by pushing the VNAV switch (the light illuminates and VNAV is annunciated 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. If speed intervention is selected, the MCP IAS/MACH selector is used to manually select the speed
- VNAV PTH (active)—AFDS maintains FMC altitude or descent path with pitch commands. 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

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- VNAV ALT (active)—when 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 an early descent is desired, FLCH, V/S, or FPA may be selected to descend below the VNAV descent path. If, during the decent, VNAV is armed and the airplane descent path subsequently intercepts the VNAV descent path, VNAV activates in VNAV PTH.

V/S (active)—pushing the MCP VS/FPA switch opens the vertical speed window to display the current vertical speed. Pitch commands maintain the rate of climb or descent set in the VS/FPA window.

FPA (active)—pushing the MCP VS/FPA switch opens the flight path angle window to display the current flight path angle. Pitch commands maintain the flight path angle set in the VS/FPA window.

FLCH SPD (active)—pushing the MCP FLCH switch opens IAS/MACH window (if blanked). Pitch commands maintain IAS/MACH window airspeed or Mach.

ALT (active)—altitude hold mode is activated by:

- pushing the MCP altitude HOLD switch, or
- capturing the selected altitude from a V/S, FPA, or FLCH climb or descent.

G/S (active)—AFDS follows the ILS glideslope.

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 smoothly lowers the nosewheel to the runway.

Autothrottle System

The autothrottle system provides thrust control from takeoff through landing.

Autothrottle operation is controlled from the MCP and CDUs. The MCP provides mode and speed selection. The CDUs enable FMC reference thrust limit selection. When VNAV is active, the FMC selects autothrottle modes and target thrust values. See Flight Management, Navigation on page 11.10.1 for FMS and CDU operation.See Flight Instruments, Displays on page 10.10.1for PFD indications.

The autothrottle is either OFF, ARMED, or active. The autothrottle is off when the A/T arm switches are OFF. The autothrottle is armed when the A/T switches are ON and the autothrottle mode is blank. The autothrottle is active when the A/T arm switches are ON and there is an autothrottle mode shown. The active autothrottle modes are: IDLE, HOLD, THR, THR REF, and SPD.

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Manual Flight

The autothrottle can be operated with flight directors OFF and the autopilot not engaged. When the autopilot is not engaged, but one or both flight directors are ON and the autothrottle is active, turning off both flight directors transitions the autothrottle to SPD. The autothrottle maintains the IAS/MACH window speed.

During a manual landing, when the active autothrottle mode is SPD, or the pitch mode is VNAV with the autothrottle active, thrust reduces to IDLE at 25 feet RA and the autothrottle mode transitions to IDLE.

Automatic Activation

The autothrottle can automatically activate to provide stall protection when armed and not active (A/T mode is blank).

With the autothrottle armed and not active, the autothrottle automatically activates when the pitch mode is ALT, V/S, FPA, VNAV ALT, VNAV ALT, VNAV PTH, G/S, or there is no active pitch mode, and:

- speed is less than an FMC calculated value for one second
- thrust is below reference thrust limit
- airplane barometric altitude is 400 feet above the airport on takeoff or airplane altitude is above 100 feet RA on approach

If speed decreases to near stick shaker activation, the autothrottle automatically activates in SPD mode and advances thrust to maintain minimum maneuvering speed (approximately the top of the amber band) or the speed set in the IAS/MACH window, whichever is greater.

Notes:

1. During a climb in VNAV SPD with the autothrottle armed and not active, the autothrottle automatically activates in THR REF mode and advances thrust to the climb reference thrust limit.
2. During a descent in VNAV SPD with the autothrottle armed and not active, the autothrottle can automatically activate in HOLD mode and will not advance thrust levers to support stall protection.
3. The autothrottle will not automatically activate to support stall protection when the pitch mode is FLCH SPD or TO/GA.
4. The autothrottle will not support stall protection when the A/T mode is HOLD

The EICAS advisory message AUTOTHROTTLE L or R displays when the respective autothrottle servo fails. If the autothrottle is active and only one autothrottle is armed, the PFD autothrottle flight mode annunciation displays L or R preceding the mode. For example, L SPD indicates only the left autothrottle is active in speed mode.

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Autothrottle Thrust Lever Operation

The autothrottle system moves either or both thrust levers to provide speed or thrust control, depending on the active mode.

Thrust levers can be manually positioned without disconnecting the autothrottle. After manual positioning, the autothrottle system repositions thrust levers to comply with the active mode. The autothrottle system does not reposition thrust levers while in HOLD mode.

Note: When the pitch flight mode annunciation is FLCH SPD, the autothrottle can enter the HOLD mode. This occurs if the pilot overrides thrust levers; or, in a descent, when thrust levers retard to IDLE. When in HOLD mode, thrust lever servos are inhibited and the autothrottle does not control thrust or speed. Thrust levers can be manually advanced.

Autothrottle Disconnect

The autothrottle system can be disconnected manually by pushing either autothrottle disconnect switch, except during conditions that cause the autothrottle to automatically activate. The autothrottle can also be disconnected manually by positioning both A/T ARM switches to OFF, or individually by positioning the left or right A/T ARM switch to OFF. Positioning one or both A/T ARM switches to OFF prevents activation of all autothrottle modes for the affected autothrottle.

Autothrottle disconnect occurs automatically:

- if a fault in the active autothrottle mode is detected
- when either reverse thrust lever is raised to reverse idle
- if the thrust levers are overridden during a manual landing, after the autothrottle has begun to retard the thrust levers to idle
- when both engines are shut down.

The EICAS caution message AUTOTHROTTLE DISC displays and an aural alert sounds when the autothrottle is manually or automatically disconnected. The EICAS caution message and aural alert are inhibited if the disconnect occurs because of reverse thrust.

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, annunciation of TO/GA roll and pitch mode occurs when the first flight director switch is positioned ON

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- PFD displays FLT DIR 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 knots, 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 80 knots, autothrottle annunciation changes to HOLD
- with speed greater than 80 knots, pushing a TO/GA switch disarms LNAV and VNAV
- during takeoff, the FMC records the barometric altitude as the airplane accelerates through 100 knots. This altitude is used to activate VNAV, enable autothrottle activation (if not active), command acceleration for flap retraction, and set climb thrust if an altitude has been selected. Radio altitude is used for activation of LNAV.

At lift-off:

- pitch command target speed is V2 + 15. 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
- 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 + 15
  - V2 + 15, if airspeed is above V2 + 15
- if a TO/GA switch is pushed:
  - removes takeoff and climb derates and assumed temperature thrust reduction
  - A/T in HOLD, A/T activates in THR REF
- at 50 feet radio altitude, LNAV activates, if armed. Roll commands bank to track the active route
- at 400 feet, VNAV activates, when armed. Pitch commands the current airspeed. The 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

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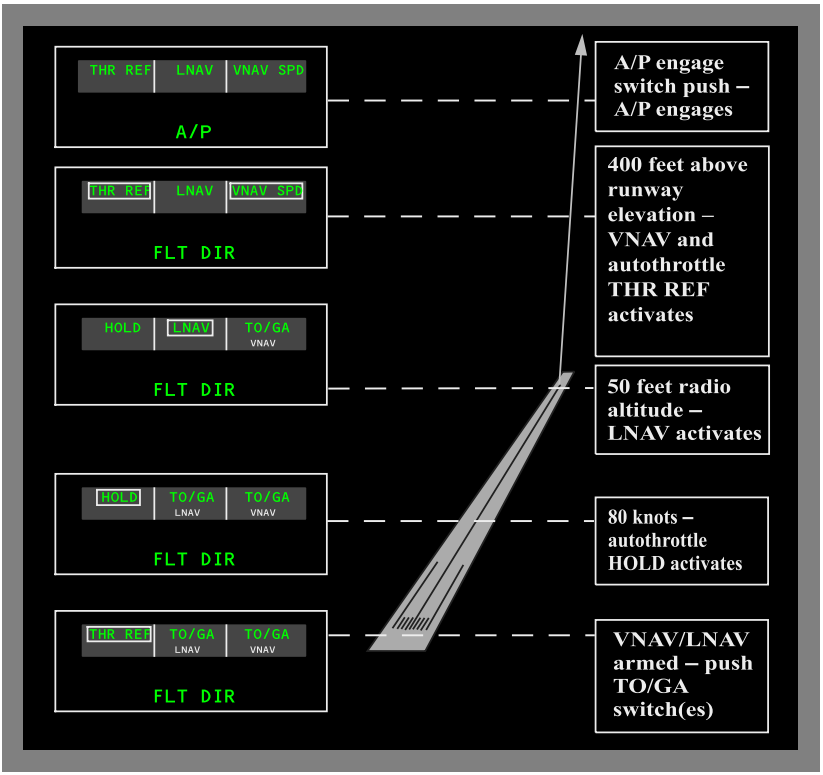
- when flaps are up, pitch commands an acceleration to VNAV climb speed. VNAV climb speed is the greater of:
  - VREF + 80 knots, or
  - speed transition associated with origin airport
- at thrust reduction point (either an altitude or a flap position), FMC changes reference thrust limit to armed climb limit (CLB, CLB 1, or CLB 2).

The TO/GA mode is terminated 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 FMS. Using LNAV and VNAV ensures the most economical operation.

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Other roll modes available are:

- heading hold (HDG HOLD)
- heading select (HDG SEL)
- track hold (TRK HOLD)
- track select (TRK SEL).

Other pitch modes available are:

- altitude hold (ALT)
- flight level change (FLCH SPD)
- vertical speed (V/S)
- flight path angle (FPA).

Profile illustrations show the use of LNAV and VNAV.

Automatic Flight—Approach and Landing

The AFDS provides autopilot guidance for ILS approaches.

Pushing the APP switch arms localizer in roll mode and glideslope in pitch mode. Either localizer or glideslope can be captured first.

Pushing the LOC switch arms the AFDS for localizer tracking. Descent on the localizer can be accomplished using VNAV, V/S, FLCH, or FPA pitch modes. The localizer mode cannot capture if the intercept angle exceeds 120°. All other non-ILS approaches can be flown using LNAV and VNAV modes, or HDG SEL, TRK SEL, V/S, or FPA modes.

With a command speed of VREF+5 knots and landing flaps, there is sufficient wind and gust protection available with the autothrottle active. The autothrottle adjusts thrust quickly when airspeed decreases below command speed. The autothrottle decreases thrust slowly when airspeed is more than command speed. In turbulence, thrust may be somewhat higher than necessary to maintain command speed. Average speed may be somewhat higher than the command speed.

Runway Alignment

Runway alignment is a submode of the approach mode. With crosswinds, the crab angle is reduced at touchdown. Runway alignment also compensates for a single engine approach.

For crosswinds requiring more than 10° of crab angle, runway alignment occurs at 500 feet AGL. A sideslip of 5° 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°, 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°. This

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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°, no runway alignment occurs until 200 feet AGL, where a sideslip is introduced to align the airplane with the runway.

If an engine fails prior to the approach, the 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.

In the event of moderate or strong crosswinds from the side opposite the failed engine, no wings level sideslip is commanded, since the airplane is already banked into the wind.

Flare

The flare mode brings the airplane to a smooth automatic landing touchdown. The flare mode is not intended for single autopilot or flight director only operation.

Flare is armed when LAND 3 or LAND 2 is annunciated on the PFDs. At approximately 50 feet radio altitude, the autopilots start the flare maneuver. FLARE replaces the G/S pitch flight mode annunciation

During flare:

- between 25 and 50 feet radio altitude, the autothrottle begins retarding thrust levers to idle
- PFD autothrottle annunciation changes from SPD to IDLE
- at touchdown, the FLARE annunciation no longer displays and the nose wheel is lowered to the runway.

Rollout

Rollout provides localizer centerline rollout guidance. Rollout arms when LAND 3 or LAND 2 annunciates.

At less than two feet radio altitude, rollout activates. ROLLOUT replaces the LOC roll 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 disengage.

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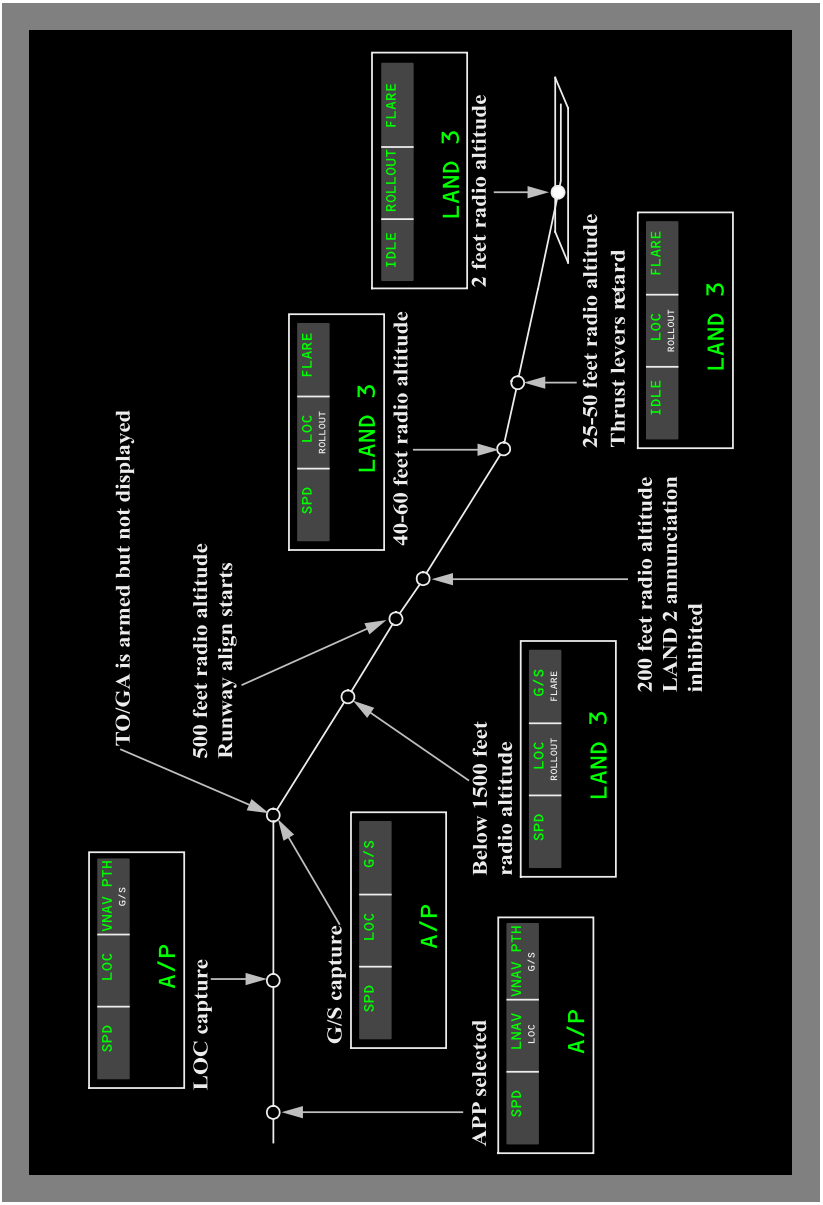
Automatic Flight Approach Profile



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Automatic Flight—Go-Around

TO/GA is armed when flaps are out of up or glideslope is captured. The 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 off, pushing either TO/GA switch displays the flight director bars.

The TO/GA switches are inhibited when on the ground and enabled again when in the air for a go-around or touch and go.

With the first push of either TO/GA switch:

- roll and pitch activate in TO/GA
- autothrottle activates in thrust (THR) to establish a minimum climb rate of 2,000 FPM
- the AFDS increases pitch to hold the selected speed as thrust increases
- 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)

TKK to TKR, TKU to TKZ

- with an LNAV path available, LNAV automatically activates:
  - above 50 feet radio altitude when autopilot is not engaged, or
  - above 200 feet radio altitude when autopilot is engaged.

TKK to TKR, TKU to TKZ

Notes:

1. With an LNAV path available, LNAV arms until above minimum engagement altitude.
2. During go-around from a LAND 2 or LAND 3 approach, automatic LNAV activation causes disengagement of autopilot rudder control. If executing an engine out missed approach with TAC inoperative, manual rudder control may be required to prevent large roll and yaw excursions.

With the second push of either TO/GA switch:

- autothrottle activates in thrust reference (THR REF) at full go–around thrust

TKK to TKR, TKU to TKZ

- LNAV remains active with an LNAV path available.

TO/GA level-off:

- at the set altitude, AFDS pitch mode changes to altitude hold (ALT)

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- if altitude is captured or if V/S or FPA is active, MCP speed is automatically set to:
  - the flap placard speed minus 5 knots
  - 250 knots if flaps are up, or
  - a speed value entered in the IAS/Mach window after TO/GA was pushed
- TO/GA remains the active roll mode until LNAV automatically engages or another roll mode is selected. TKK to TKR, TKU to TKZ
- TO/GA remains the active roll mode until another roll mode is selected. TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

TO/GA mode termination:

- below 400 feet radio altitude, disengage autopilot and turn off both flight directors, or automatic LNAV activation (after automatic LNAV activation, a different roll mode can be selected) TKK to TKR, TKU to TKZ
- below 400 feet radio altitude, disengage autopilot and turn off both flight directors TJA,B,C,D,G, H, TJR to TJW, TKA to TKF
- above 400 feet radio altitude, select a different roll or pitch mode.

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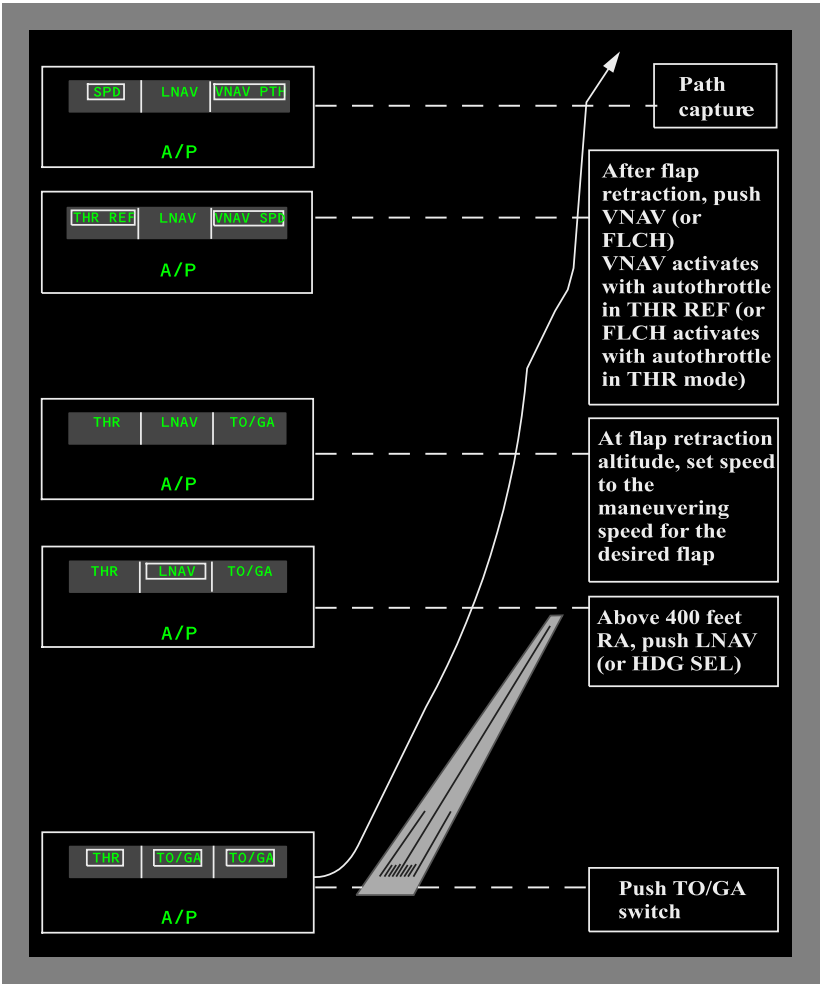
Automatic Flight Go-Around Profile

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



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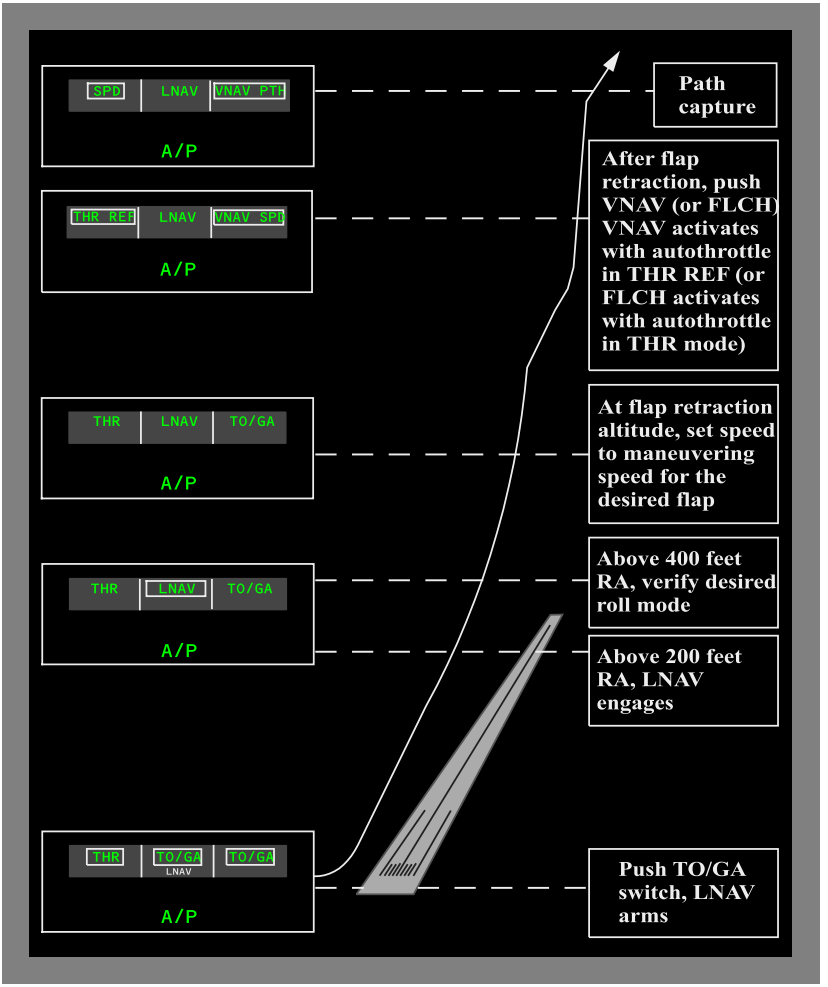
TKK to TKR,
TKU to TKZ



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° or slightly below the pitch limit, whichever is lower.

As rate of climb increases, the AFDS 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

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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).

If 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

There are three forms of flight envelope protection in the autopilot:

- stall protection
- overspeed protection
- roll envelope bank angle protection.

An AUTOPILOT caution message and roll or pitch mode failures alert the pilot if the envelope is exceeded, and the autopilot prevents further envelope violations.

See Pitch Envelope Protection on page 9.20.10 and see Bank Angle Protection on page 9.20.13 for a description of flight envelope protection.

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EICAS Alert Messages

Message	Message	Aural	Message Logic
AUTOPILOT	Caution	Beeper	Autopilot is operating in a degraded mode. Active roll and/or pitch mode may have failed, or the autopilot has entered envelope protection.
AUTOPILOT DISC	Warning	Siren	Autopilot has disconnected.
AUTOTHROTTLE DISC	Caution	Beeper	Both autothrottles have disconnected.
AUTOTHROTTLE L, R	Advisory		Affected autothrottle is OFF or has failed.
NO AUTOLAND			Autoland is not available.
	Caution	Beeper	Message is a caution if fault occurs after LAND 3 or LAND 2 is annunciated, or approach has been selected but does not engage by 600 feet AGL.
	Advisory		Message is an advisory if fault occurs before LAND 3 or LAND 2 is annunciated.
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 is annunciated.
	Advisory		Message is an advisory if fault occurs before LAND 3 is annunciated.

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Communications Chapter 5

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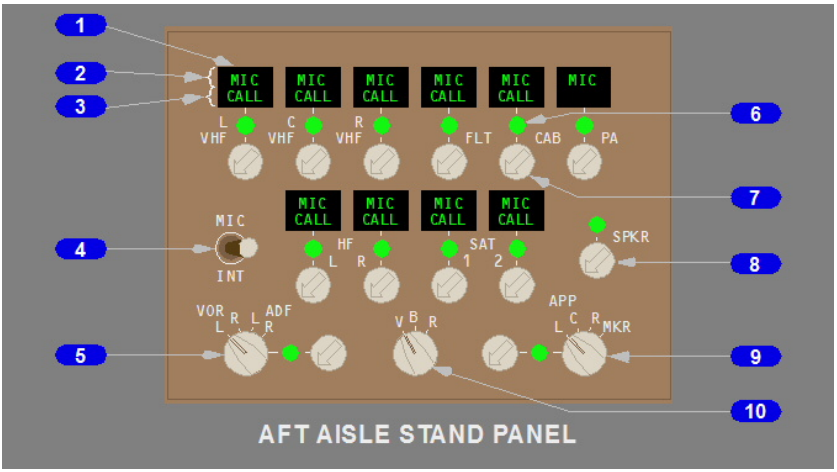
Audio Control Panel



1 Transmitter Select Switches

Push—

- the MIC light illuminates
- the MIC light for any other transmitter extinguishes
- selects the respective transmitter (radio or intercommunications) for transmission from this crew station (only one can be selected at a time for each crew station)
- selects the receiver audio on, if not already manually selected on
- pushing the CAB transmitter select switch twice within one second places a priority call to a selected cabin station.

Second push—

- deselects the transmitter
- deselects receiver audio.

Note: Second push of the CAB select switch deselects the transmitter and receiver audio only after one second has elapsed from the first push.

2 MIC Lights

Illuminated (green)—indicates the transmitter is selected.

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3 CALL Lights

Illuminated (green)—

- indicates a call on SELCAL, the flight interphone (FLT), the cabin interphone (CAB), or SATCOM (SAT)
- resets when the respective transmitter select switch is pushed or, if already pushed, by pressing a MIC/INTERPHONE switch (the SATCOM CALL light remains illuminated until the call ends)
- PA does not have a CALL light.

4 MIC/Interphone (INT) Switch

MIC—keys the boom microphone or oxygen mask on the selected radio transmitter or other system.

Center—off position (spring-loaded to center).

INT—keys the boom microphone or oxygen mask on the flight interphone.

5 VOR/ADF Receiver Selector

Selects the VOR or ADF receiver to be monitored:

- VOR L—left VOR
- VOR R—right VOR
- ADF L—left ADF
- ADF R—right ADF.

6 Receiver Lights

Illuminated (green)—indicates the respective receiver volume control is manually selected on.

7 Receiver Volume Controls

Push—turns the respective receiver audio on or off.

Rotate—controls receiver volume.

8 Speaker (SPKR) Volume Control

Push—turns the respective flight deck speaker on or off.

Rotate—controls flight deck speaker volume.

Note: Inoperative on First Observer audio control panel.

9 Approach (APP) Receiver Selector

Selects the approach receiver to be monitored:

- APP L—left ILS
- APP C—center ILS

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- APP R—right ILS
- MKR—marker beacon.

10 Navigation Filter Selector

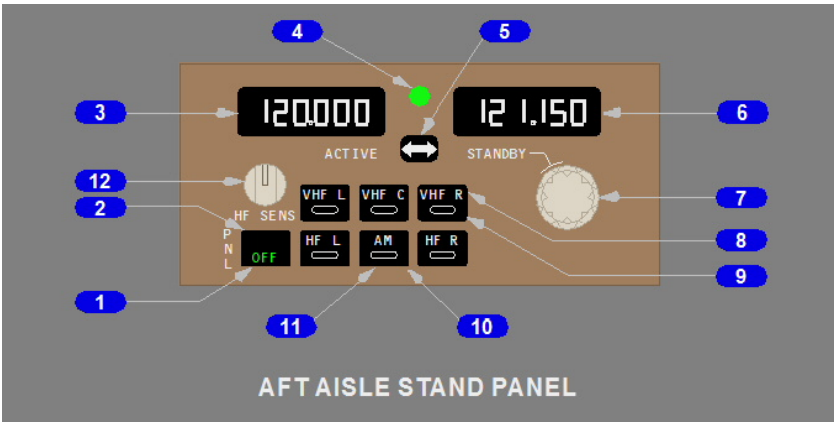
Filters VOR, ADF, ILS, or DME audio:

- V (voice)—only the voice audio is heard
- B (both)—both the voice and range audio are heard
- R (range)—range audio (navigation aid Morse code identifier) is heard.

Note: Marker beacon audio is available in all positions.

Radio System

Radio Tuning Panel



1 Radio Tuning Panel OFF Light

Illuminated (green)—the radio tuning panel is off.

2 Radio Tuning Panel OFF Switch

Push—disconnects the panel from the communication radios.

3 ACTIVE Frequency Window

Displays the tuned frequency of the selected radio.

Displays DATA if the selected radio is in the data mode (not applicable for VHF L).

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4 Offside Tuning Light

Illuminated (green)—

- the radio normally associated with this panel is being tuned by another radio tuning panel, or
- the radio tuning panel is being used to tune a radio not normally associated with this 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.

5 Frequency Transfer Switch

Push—

- transfers the STANDBY window frequency to the ACTIVE window and tunes the selected radio to the new active frequency
- transfers the ACTIVE window frequency to the STANDBY window.

6 STANDBY Frequency Window

Displays the preselected or previously tuned frequency of the selected radio.

With data link installed, displays DATA when selection of the frequency transfer switch would reconfigure the selected radio to the data mode (not applicable for VHF L).

7 Frequency Selector

Rotate—

- outer knob—selects the portion of the STANDBY frequency to the left of the decimal point
- inner knob—selects the portion of the STANDBY frequency to the right of the decimal point.

8 Radio Tuning Switches

Push—

- selects the radio to be tuned
- the tuned frequency is displayed in the ACTIVE frequency window
- the standby frequency is displayed in the STANDBY frequency window.

TJR to TJW, TKA to TKF, TKK to TKR, TKU to TKZ

Push and hold—removes automatic squelch on selected VHF radio until switch is released.

9 Radio Tuning Lights

Illuminated—indicates the selected radio.

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10 AM Switch

Push—sets the AM or USB mode for the selected HF.

11 AM Light

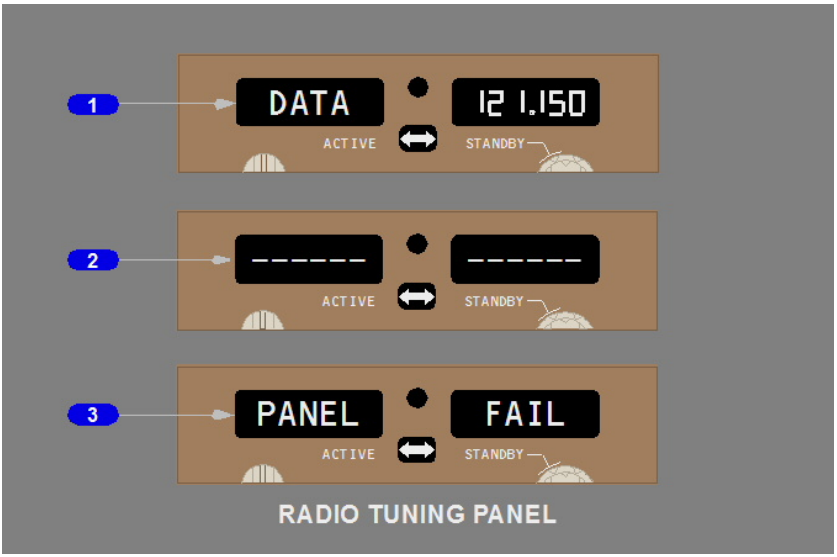
Illuminated—HF AM is selected.

Extinguished—HF USB is selected.

12 HF Sensitivity Control

Rotate—adjusts the sensitivity of the on–side HF receiver.

Radio Tuning Panel Indications



1 DATA Mode

Displays DATA in the ACTIVE frequency window when the selected radio is being used in the data mode.

2 Radio Fail

Displays dashes in both windows when the selected radio is failed or has been disconnected.

3 PANEL FAIL

The radio tuning panel is failed.

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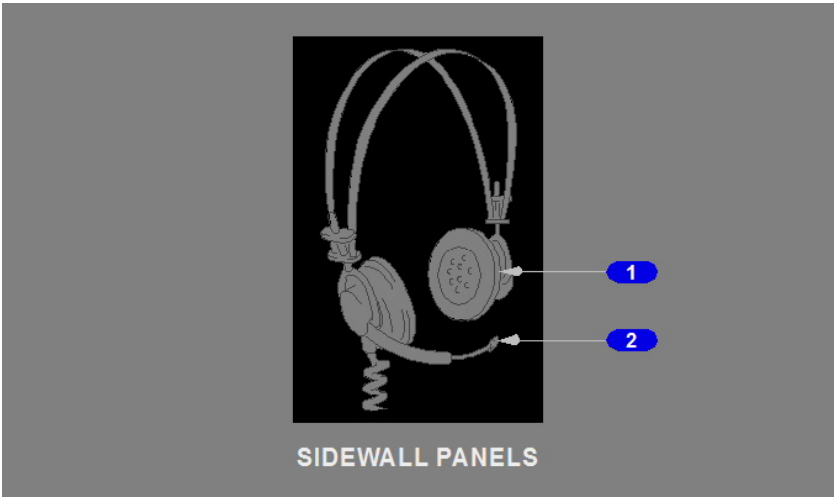
Miscellaneous Communication Controls

Headphone/Boom Microphone (Typical)



1 Headphone

Used to monitor audio from the respective audio control panel.

Audio volume is adjusted using audio control panel controls for the associated station.

Available at all flight deck stations.

2 Boom Mic

Activation of a control wheel, glareshield or audio control panel mic/interphone switch transmits on the system selected for use at that station.

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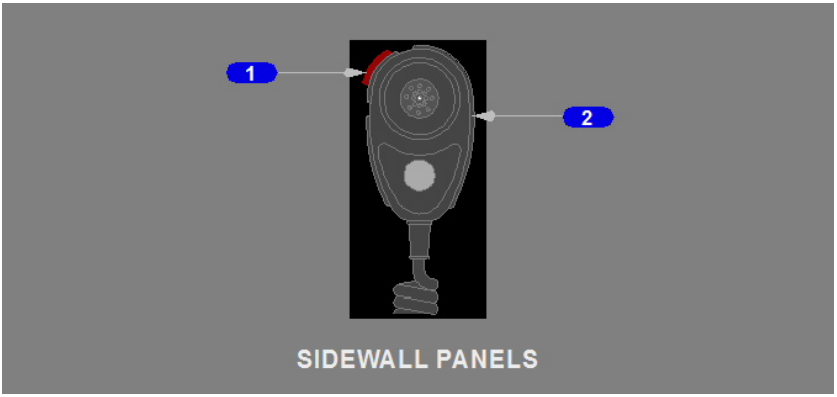
Hand Microphone (Typical)



1 Hand Microphone Push-To-Talk Switch

Push—activates the hand microphone.

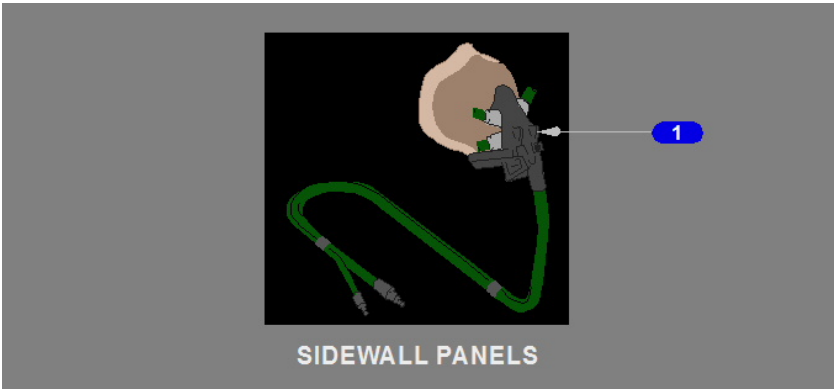
2 Hand Microphone

Transmits on the system selected by the audio control panel.

Available at the Captain and First Officer stations.

Optional for the First and Second Observer stations.

Oxygen Mask Microphone (Typical)



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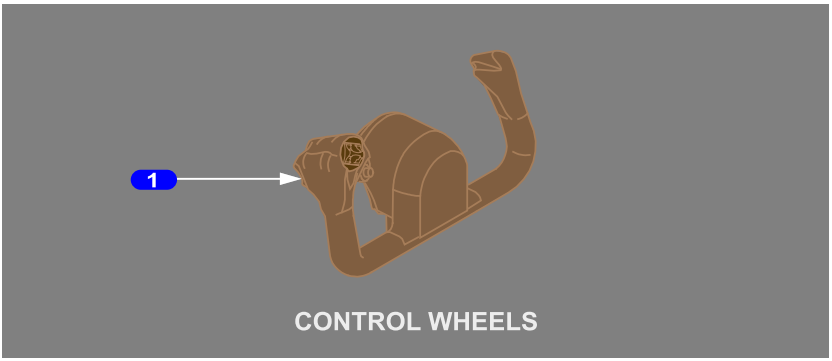
DRAFT

1 Oxygen Mask Microphone

Enabled when the oxygen mask doors are open. The boom microphone is disabled.

Activation of a control wheel, glareshield or audio control panel mic/interphone switch transmits on the system selected for use at that station.

Control Wheel Microphone/Interphone Switch



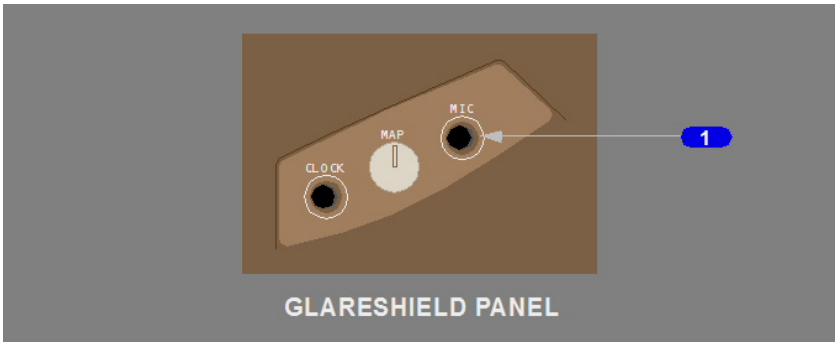
1 Control Wheel Mic/Interphone Switch

MIC—allows oxygen mask or boom microphone transmission on selected transmitter. Spring-loaded to center.

CENTER—off position.

INT—allows oxygen mask or boom microphone transmission on the flight interphone system. Spring-loaded to center.

Glareshield Microphone Switch



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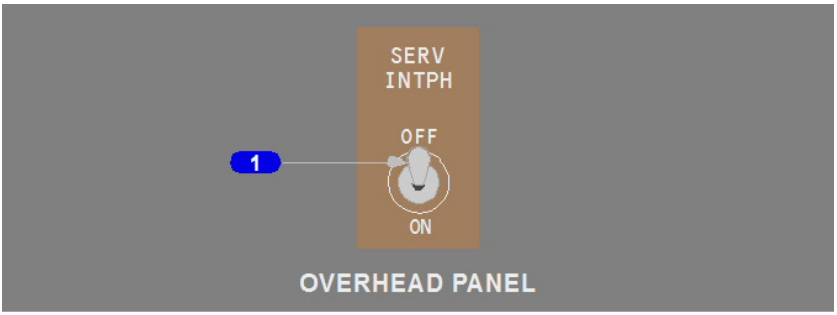
DRAFT

1 Glareshield MIC Switch

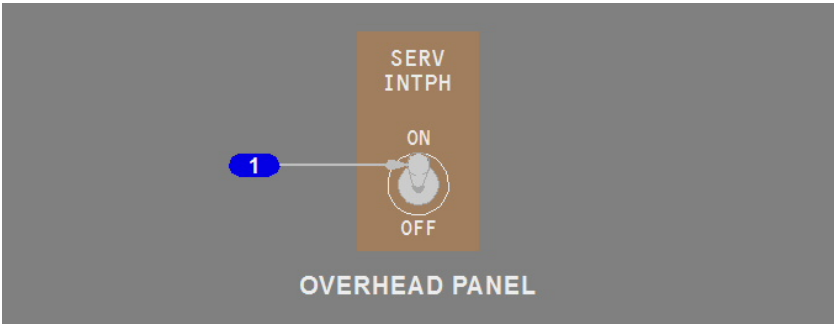
Push—allows oxygen mask or boom microphone transmission on the selected transmitter.

Service Interphone Switch

TKK to TKR, TKU to TKZ



TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



1 Service (SERV) Interphone (INTPH) Switch

OFF—allows independent operation of the service and flight interphone systems.

ON—connects the service and flight interphone systems.

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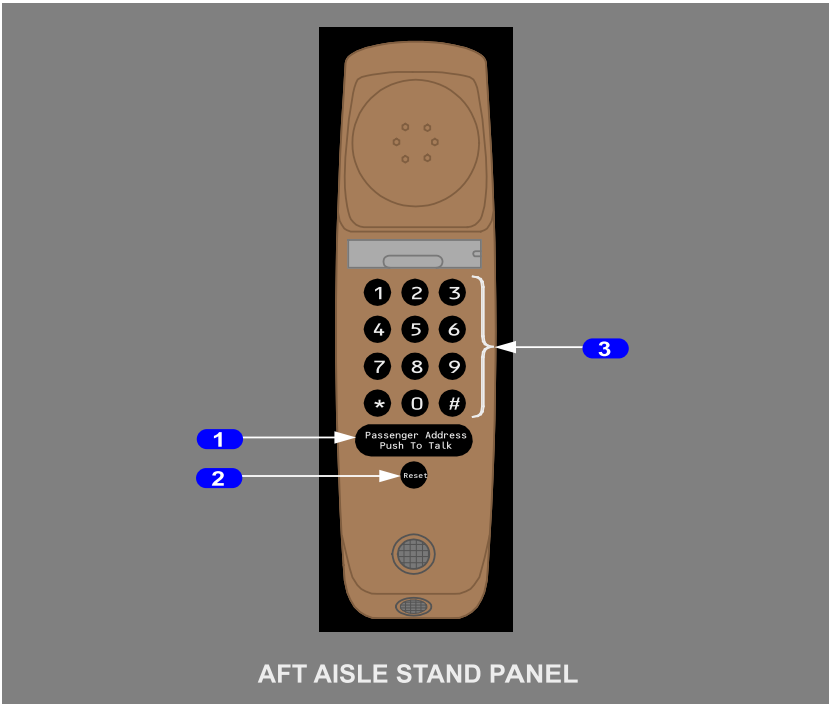
Handset



1 Passenger Address Push To Talk Switch

Push—

- connects the handset microphone to the selected PA area
- only used in the PA mode.

2 Reset Switch

Push—cancels a call or incorrectly selected code.

3 Numeric Keys

Push—selecting a code calls the respective station or PA area.

Note: Dial codes entered using the handset are not displayed on the CDU cabin interphone pages.

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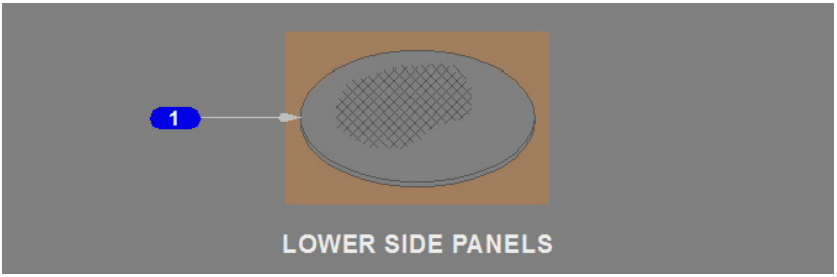
DRAFT

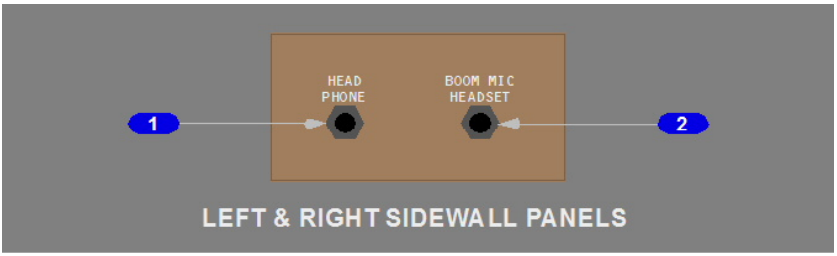
Flight Deck Speaker



1 Flight Deck Speaker

Controlled by the speaker volume control on the respective audio control panel.

Boom Microphone/Headphone Panel



1 HEAD PHONE Jack

Accepts a flight crew headphone plug.

2 BOOM MIC HEADSET Jack

Accepts a flight crew boom mic plug.

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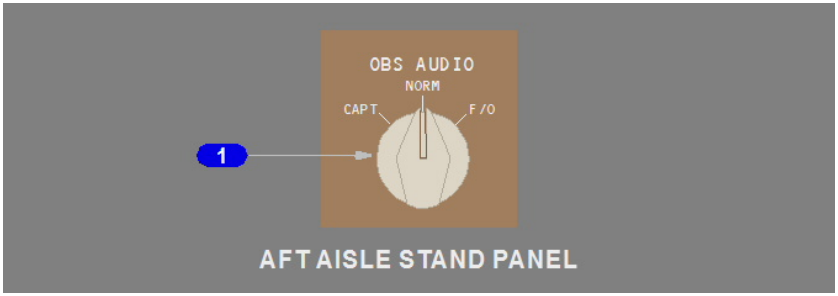
Observer Audio Selector



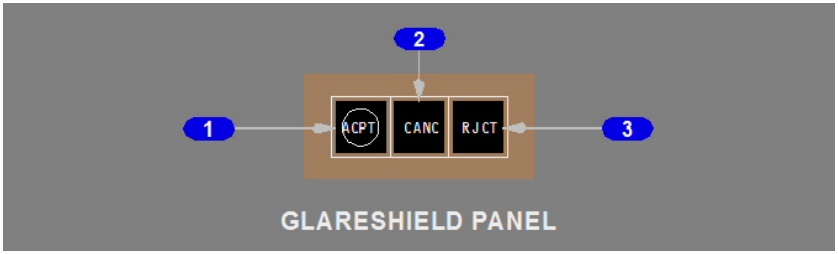
1 Observer (OBS) AUDIO Selector

CAPT—connects the Captain's hand microphone, headphone, boom microphone/headset, oxygen mask microphone, speaker, and mic/interphone switches to the First Observer audio control panel.

NORM—the First Observer audio control panel is connected to the First Observer's hand microphone, headphone, boom microphone/headset and oxygen mask microphone.

F/O—connects the First Officer's hand microphone, headphone, boom microphone/headset, oxygen mask microphone, speaker, and mic/interphone switches to the First Observer audio control panel.

Data Link Accept/Cancel/Reject Switches



1 Accept (ACPT) Switch

Push—

- a positive response to a displayed message is downlinked to the origin of the displayed message
- functions the same as selecting an MFD communications display ACCEPT command key.

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2 Cancel (CANC) Switch

Push—

- the message is removed from the display
- functions the same as selecting an MFD communications display CANCEL command key.

3 Reject (RJCT) Switch

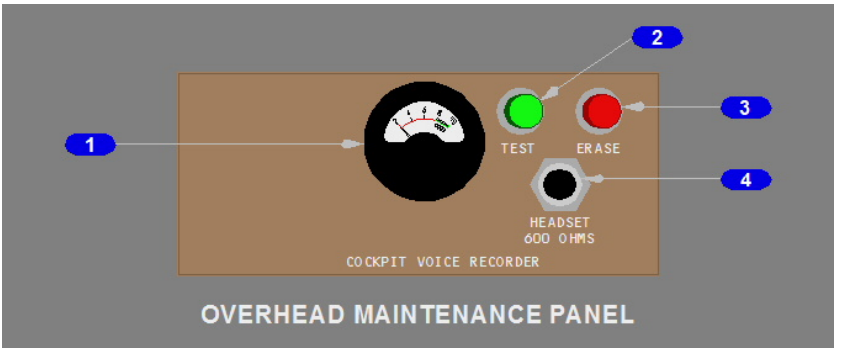
Push—

- a negative response to the displayed message is downlinked to the origin of the displayed message
- functions the same as selecting an MFD communications display REJECT command key.

Cockpit Voice Recorder System

Cockpit Voice Recorder Panel

TJA,B,C,D,G,H



1 Cockpit Voice Monitor Indicator

Pointer deflection indicates recording or erasure on all channels.

During test, the pointer rises into the green band.

2 Cockpit Voice Recorder TEST Switch

Push and hold for five seconds—tests all four cockpit voice recorder channels (1 per second).

3 Cockpit Voice Recorder ERASE Switch

Push and hold for three seconds—erases voice recorder if on the ground, AC power on, and parking brake set.

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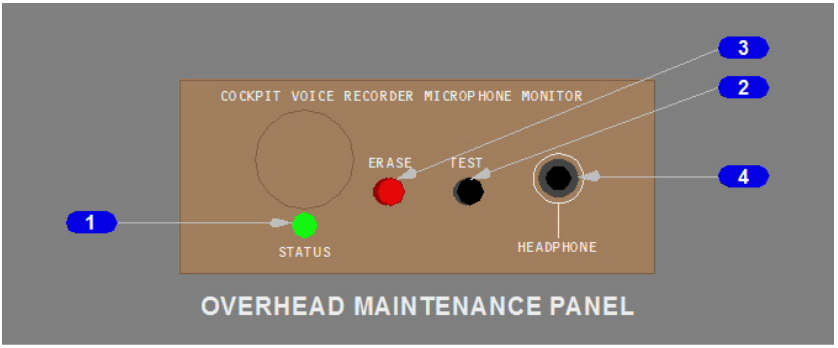
4 Cockpit Voice Recorder Headset Jack

A headset may be plugged in to monitor playback of voice audio, or to monitor tone transmission during test.

TJR to TJW



1 STATUS Indicator

Illuminated—test completed successfully. Extinguished after one second.

2 Cockpit Voice Recorder TEST Switch

Push and hold for five seconds—tests all four cockpit voice recorder channels (1 per second).

3 Cockpit Voice Recorder 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 may be plugged in to monitor playback of voice audio, or to monitor tone transmission during test.

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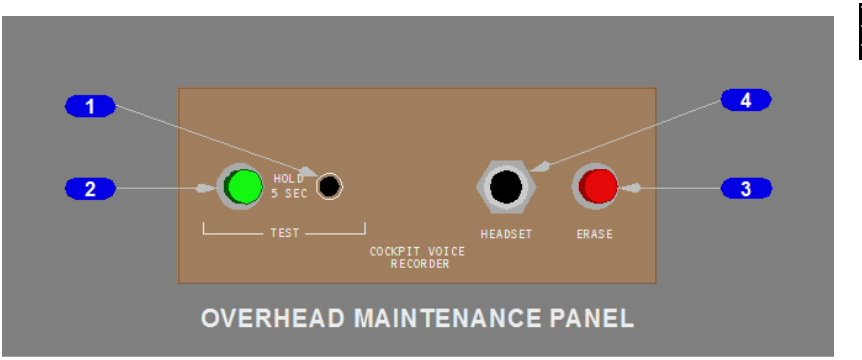
TKA to TKF,
TKK to TKR,
TKU to TKZ



1 STATUS Indicator

Illuminated—test completed successfully. Extinguished after button is released.

2 Cockpit Voice Recorder TEST Switch

Push and hold for five seconds—tests all four cockpit voice recorder channels (1 per second).

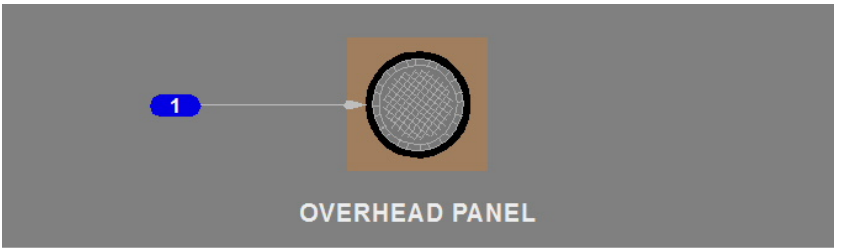
3 Cockpit Voice Recorder ERASE Switch

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 may be plugged in to monitor playback of voice audio, or to monitor tone transmission during test.

Cockpit Voice Recorder Microphone (Typical)



1 Cockpit Voice Recorder Microphone

Area microphone for the voice recorder.

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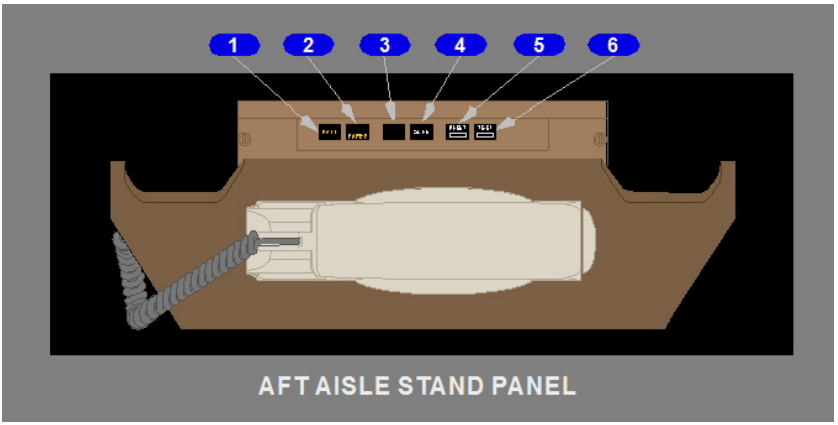
Printer Controls



1 Printer FAIL Light

Illuminated amber—

- the printer is failed.

2 Printer PAPER Light

Illuminated PAPER (amber):

- the printer is out of paper, or
- the paper is jammed.

3 Switch is not functional

4 Printer SLEW Switch

Push and hold—advances the printer paper.

5 Printer RESET Switch

Push—resets the printer if it stops operating.

6 Printer TEST Switch

Push—

- tests the printer and printer lights
- prints a test pattern.

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Introduction

The communication systems include:

- cockpit voice recorder system
- radio communication system
- SELCAL system
- SATCOM system
- communication crew alerting system
- interphone communication system (see Interphone Systems on page 5.30.1)
- data communication system (see MFD Communications Functions on page 5.40.1).

The communication systems are controlled using the:

- audio control panels
- radio tuning panels
- CDU communications pages (see Interphone Systems on page 5.30.1)
- MFD communications pages (see MFD Communications Functions on page 5.40.1)

Audio Control Panels

The audio control panels are used to manage the 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.

Microphones are keyed by pushing the desired audio control panel transmitter select switch and using the MIC position of a control wheel or audio control panel microphone/interphone switch, a glareshield MIC switch, or a hand microphone push-to-talk switch. Systems are monitored using headphones or speakers. An oxygen mask microphone is enabled and the boom microphone is disabled when the oxygen mask stowage doors are 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.

Cockpit Voice Recorder System

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

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 crewmember boom, oxygen mask, and hand microphones, independent of microphone/interphone switch positions. All inputs are recorded continuously.

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TKK to TKR, TKU to TKZ The cockpit voice recorder records any transmitted or received datalink communications and flight deck audio as selected on the audio control panels. It also records flight deck area conversations using an area microphone and crewmember boom, oxygen mask, and hand microphones, independent of microphone/interphone switch positions. All inputs are recorded continuously.

TKK to TKR, TKU to TKZ Recording continues for 10 minutes after AC electrical power is off.

Radio Tuning Panels

The radio tuning panels are used to tune the VHF and HF radios. The panels are designated left, center, and right, and are normally associated with the respective VHF and HF radios.

Radio Communication Systems

The radio communication systems consist of the VHF communication system, the HF communication system, the SATCOM system, and the SELCAL system.

VHF Communication System

Three independent VHF voice/data radios, designated VHF L, VHF C, and VHF R are installed. Any VHF radio can be controlled by any radio tuning panel. The audio control panels are used to control voice transmission and receiver monitoring.

VHF L is configured for voice communication only. VHF C and VHF R can be configured for data or voice communication. However, only one VHF radio can operate in the data mode at a time. Data communication is normally selected on VHF C.

Data Mode

The data mode can be selected and deselected on the MFD COMM display or by pushing the frequency transfer switch on the radio tuning panel. If the selected VHF radio is the default data radio (selected on the MFD COMM display), then the word DATA is displayed in the radio tuning panel active frequency window. When a standby frequency is transferred to the active window, DATA is displayed in the standby window. If a new frequency is selected in the standby window when DATA is displayed, DATA is replaced by the new frequency. Data can be returned to the standby window by selecting a frequency higher or lower than the allowable VHF frequency range.

When a VHF radio is in the data mode, it is not available for voice communications. A VHF radio can be returned to the voice communication mode by transferring a voice frequency into the ACTIVE frequency window.

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HF Communication System

There are two independent HF communication radios, designated HF L and HF R. Each HF radio can be tuned by any radio tuning panel. HF radio sensitivity can only be set on the on–side radio tuning panel.

The audio control panels are used to control voice transmission and receiver monitoring.

TJA,B,C,D,G,H

When a 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.

TJR to TJW, TKA to TKF, TKK to TKR, TKU to TKZ

When a 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.

Both HF radios use a common antenna. When either HF radio is transmitting, the antenna is disconnected from the other HF radio, and it cannot be used to transmit or receive. However, both HF radios can receive simultaneously if neither is being used for transmitting.

TJR to TJW, TKK to TKR

HF L and HF R can be configured for data or voice communication. However, only one HF radio can operate in the data mode at a time.

Data Mode

TJR to TJW, TKK to TKR

The data mode can be selected and deselected on the MFD COMM display or by pushing the frequency transfer switch on the radio tuning panel. If the selected HF radio is the default data radio (selected on the MFD COMM display), then the word DATA is displayed in the radio tuning panel active frequency window. When a standby frequency is transferred to the active window, DATA is displayed in the standby window. If a new frequency is selected in the standby window when DATA is displayed, DATA is replaced by the new frequency. Data can be returned to the standby window by selecting a frequency higher or lower than the allowable HF frequency range.

HF datalink operation is inhibited on the ground. When a HF radio is in the data mode, it is not available for voice communications. A HF radio can be returned to the voice communication mode by transferring a voice frequency into the ACTIVE frequency window.

Stuck Mic Protection

In the event a VHF or HF radio transmits for more than 30 seconds, the EICAS advisory message RADIO TRANSMIT is displayed. The message is removed when the transmission stops.

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DRAFT

TJA,B,C,D,G,H,TKA,B,C,D On the ground with both engines shut down, any VHF radio that transmits for more than 35 seconds is automatically disabled and dashes appear in the tuning panel frequency window for that radio. That radio is enabled when the microphone switch for that radio is released.

TJR to TJW, TKK to TKR, TKU to TKZ On the ground with both engines shut down, any VHF radio that transmits for more than 35 seconds is automatically disabled and an intermittent tone can be heard through the audio system for that radio. That radio is enabled when the microphone switch for that radio is released.

TKE,F On the ground with both engines shut down, any VHF radio that transmits for more than 35 seconds is automatically disabled, dashes appear in the tuning panel frequency window, and an intermittent tone can be heard through the audio system for that radio. That radio is enabled when the microphone switch for that radio is released.

SELCAL System

The SELCAL system monitors the three VHF radios and the two HF radios. When the system receives a call from a ground station, the crew is alerted through the communication crew alerting system.

SATCOM System

The SATCOM system provides both data and voice communications. The system is managed by the satellite data unit. Flight deck voice calls are controlled using the CDUs and audio control panels.

The SATCOM control pages are displayed by selecting SAT on the CDU menu page. Directories of airline-defined numbers are line-selectable or numbers may be manually entered if function is enabled by the operator.

Incoming SATCOM 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 EICAS communication message SATCOM MESSAGE displays when a SATCOM message requires flight crew attention. Servicing the message clears the EICAS message.

TJR to TJW, TKA to TKF SATCOM Main Menu Pages (Typical)

The SATCOM main menu pages allow the flight crew to initiate, answer and terminate calls, monitor call status, and access lower-level pages. Control functions are active when displayed with an asterisk.

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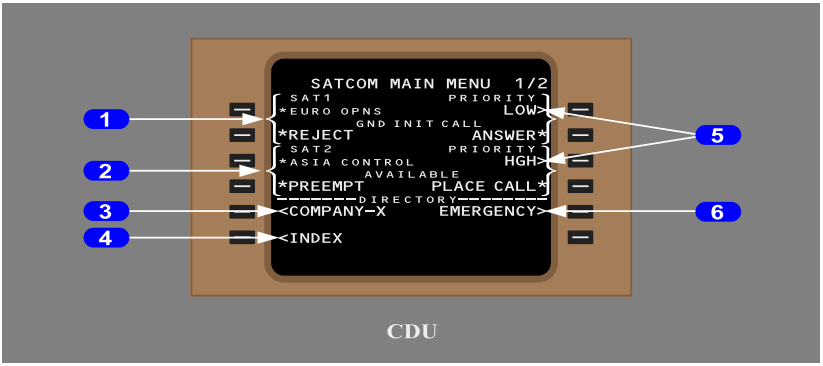
SATCOM Main Menu Page 1/2



1 Channel 1 Control Field

Push—selects active control function, SATCOM priority page, or manual phone number entry (as installed). Channel 1 status information displays in center of field.

2 Channel 2 Control Field

Push—selects active control function, SATCOM priority page, or manual phone number entry (as installed). Channel 2 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:

- EMG (Emergency)—emergency and distress calls (activates ground station alarm)
- HGH (High)—regulatory and flight safety calls
- LOW—non-safety related service calls
- PUB (Public)—passenger cabin calls

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Push (channel not in use)—displays SATCOM priority page.

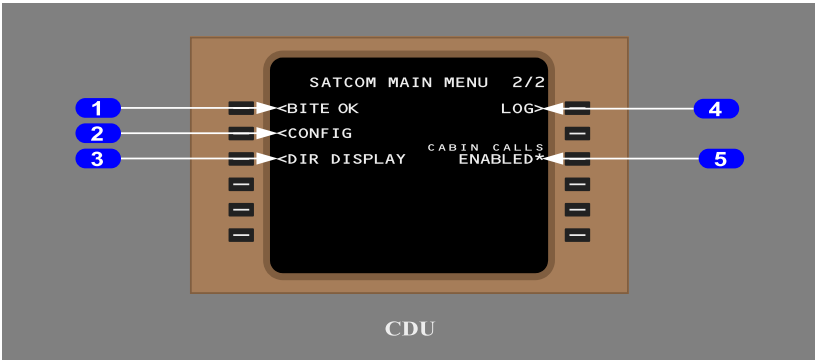
6 EMERGENCY

Displays label of first index (normally emergency).

Push—displays SATCOM directory page 1/20.

SATCOM Main Menu Page 2/2

TKA to TKF



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.

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5 CABIN CALLS

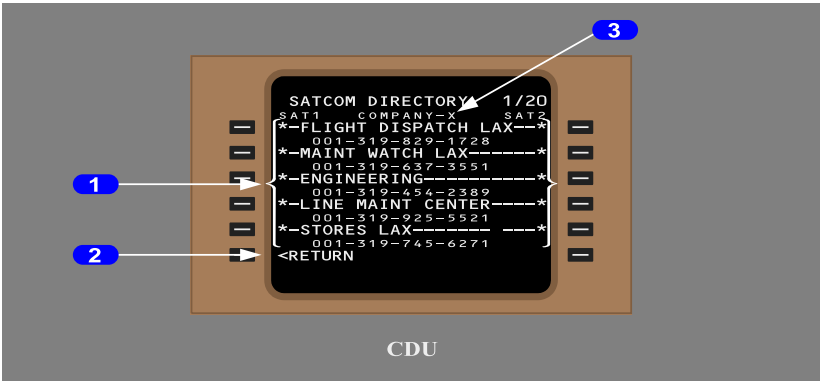
Push—selects desired cabin call status by toggling between enabled and disabled. Selecting enabled prompt displays the SATCOM cabin disable page for confirmation. If pilot confirms disabled, cabin calls in progress are terminated. TKA to TKF

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 not affected. TJR to TJW

SATCOM Directory Page (Typical)

TJR to TJW, TKA to TKF

The SATCOM directory page (XX of 20) contains a list of phone numbers used for making line-selectable calls.



1 Phone Number List

Push—preselects phone number for making call, selects voice channel via left (SAT1) or right (SAT2) 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.

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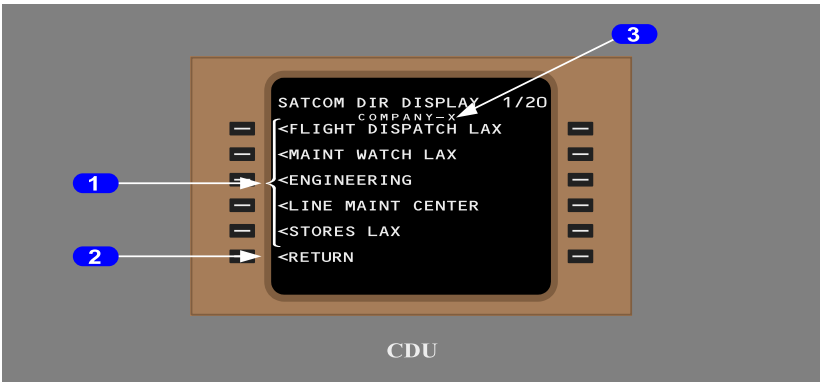
TJR to TJW, TKA to TKF

SATCOM Directory Display Page (Typical)

The SATCOM directory display page (XX of 20) contains a list of phone number labels used to revise or add directory phone numbers.



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.

TKK to TKR, TKU to TKZ

SATCOM Phone Pages (Typical)

The SATCOM phone pages allow the flight crew to initiate, answer and terminate calls, monitor call status, and access lower-level pages. Control functions are active when displayed with a caret.

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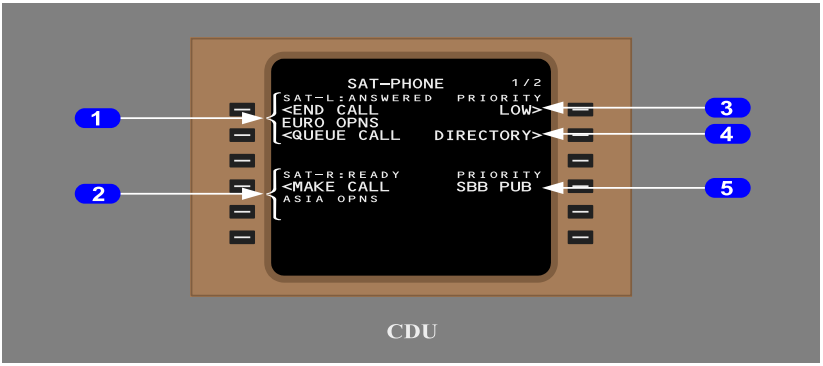
SATCOM Phone Page 1/2



1 Channel L Control Field

Push—selects active control function or manual phone number entry from scratchpad. Call status information displays in small font.

2 Channel R Control Field

Push—selects active control function or manual phone number entry from scratchpad. Call status information displays in small font.

3 Channel L PRIORITY

The following call priority levels can display:

- EMG (Emergency)—emergency and distress calls (activates ground station alarm)
- HGH (High)—regulatory and flight safety calls
- LOW—non-safety related service calls
- PUB (Public)—passenger correspondence calls

Push (channel not in use)—toggles between levels for selecting call priority.

4 DIRECTORY

Push—displays SATCOM directory index page.

5 Channel R PRIORITY

The call priority level displays SBB (SwiftBroadband) PUB when SBB voice service is available.

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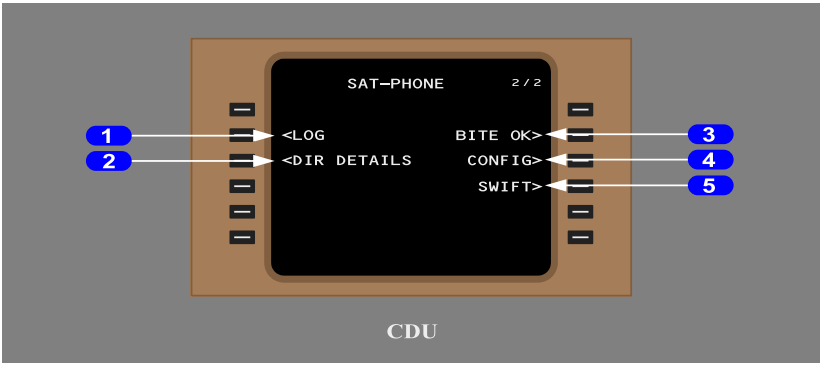
SATCOM Phone Page 2/2



1 LOG

Push—displays SATCOM log page for manual selection and control of log-on process.

2 Directory (DIR) DETAILS

Push—displays SATCOM directory details page.

3 Built-In-Test-Equipment (BITE) Status

Displays current BITE status.

Push—displays SATCOM BITE status page for access to system fault information.

4 CONFIG

Push—displays SATCOM config page for access to system configuration information.

5 SWIFT

Push—displays SBB status page for access to high speed SATCOM services information.

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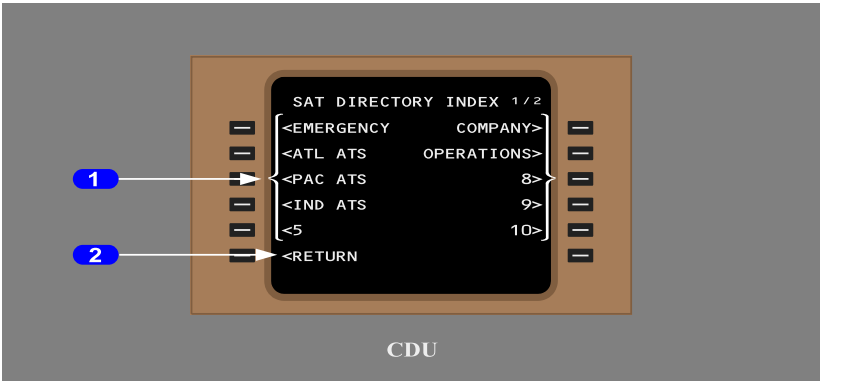
SATCOM Directory Index Page (Typical)

TKK to TKR, TKU to TKZ

The SATCOM directory index page (X/2) is used to access directory pages.



1 Index Labels

Push—displays SATCOM directory page associated with selected index label. Index labels are defined by the operator.

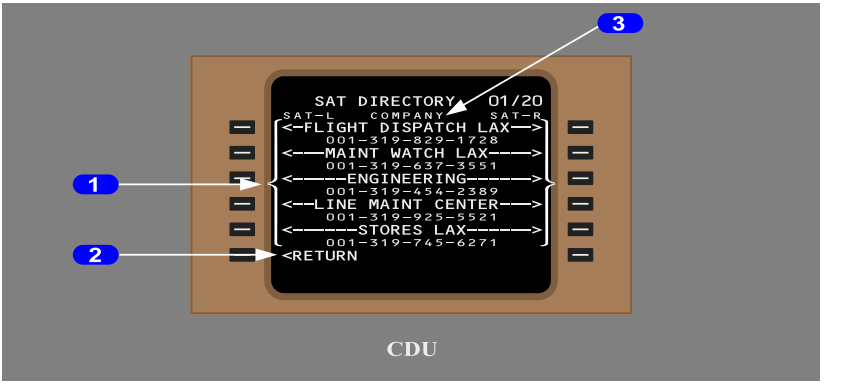
2 RETURN

Push—display returns to SATCOM phone page 1/2.

SATCOM Directory Page (Typical)

TKK to TKR, TKU to TKZ

The SATCOM directory page (XX/20) contains a list of phone numbers used for making line-selectable calls.



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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 phone page 1/2. Phone number labels and content are defined by the operator.

2 RETURN

Push—display returns to SATCOM directory index page.

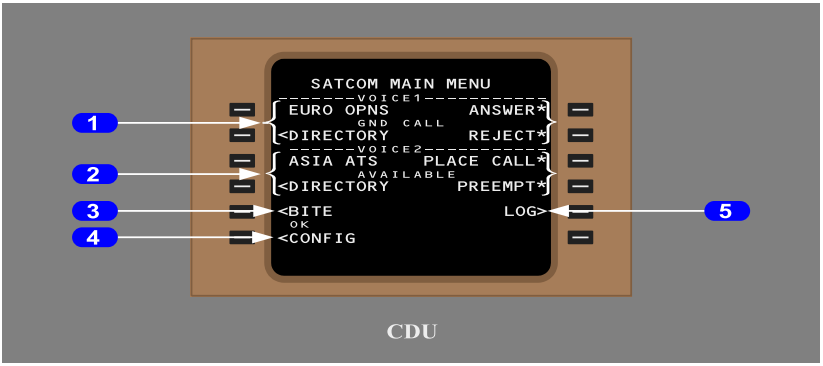
3 Index Label

Displays index label associated with selected SATCOM directory page.

TJA,B,C,D,G,H

SATCOM Main Menu Page (Typical)

The SATCOM main menu page allows the flight crew to initiate, answer and terminate calls, monitor call status, and access lower-level pages. Control functions are active when displayed with an asterisk.



1 Channel 1 Control Field

Push—selects active control function or SATCOM directory page. Channel 1 status information displays in center of field.

2 Channel 2 Control Field

Push—selects active control function or SATCOM directory page. Channel 2 status information displays in center of field.

3 Built-In-Test-Equipment (BITE)

Displays current BITE status.

Push—displays SATCOM BITE status page for access to system fault information.

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4 CONFIG

Push—displays SATCOM config page for access to system configuration information.

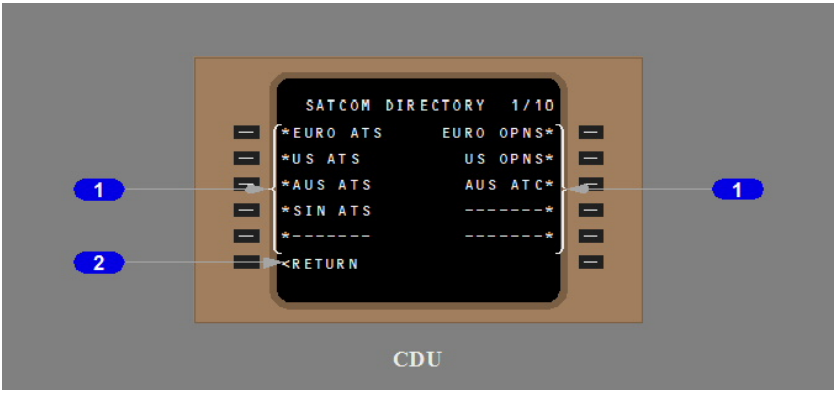
5 LOG

Push—displays SATCOM log page for manual selection and control of log-on process.

SATCOM Directory Page (Typical)

TJA,B,C,D,G,H

The SATCOM directory page (XX of 10) contains a list of phone numbers used for making line-selectable calls.



1 Phone Number List (as installed)

Push (asterisk displayed)—preselects phone number for placing call and returns display to SATCOM main menu page. Phone number labels and content are defined by the operator.

Push (caret displayed)—preselects phone number for possible call and displays SATCOM number entry page. Phone number labels and content are defined by the operator.

2 RETURN

Push—display returns to main menu page.

Communication Crew Alerting System

The communication crew alerting system provides aural and visual alerts for normal operations requiring crew awareness that may require crew action. Visual alerts are presented as EICAS messages preceded by a bullet symbol (•). The aural alert is a high–low chime. The following table shows communication crew

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alert categories and the respective aural and visual alerts for each category. See EICAS Messages on page 5.50.1 for a list of possible messages.

Crew Alert Categories

Communication Crew Alert Category	Aural Alert	Visual Alert	Comments
High	High–low chime	EICAS communication message	None currently implemented. Reserved for future use.
Medium	High–low chime	EICAS communication message	Message awareness required. Crew action may be required.
Low	None	EICAS communication message	Crew action may be required.

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Interphone Communication System

The interphone communication system includes the:

- flight interphone system
- cabin interphone system
- service interphone system
- passenger address (PA) system.

The flight interphone, service interphone, and PA systems are normally operated through the audio control panel.

The cabin interphone system is operated through the audio control panel, CDU, and 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 a flight interphone jack on the nose landing gear.

The system is used by selecting the INT (interphone) position of a control wheel or audio control panel mic/interphone switch. The interphone can also be used by selecting the FLT transmitter selector on an audio control panel and then selecting one of the following microphone switches:

- MIC position of a control wheel switch
- MIC position of an audio control panel mic/interphone switch
- a hand microphone push to talk switch
- a glareshield MIC switch.

Note: Voice level from both flight deck speakers decreases significantly when selecting the MIC/INT switch on the ACP or control wheel, the PTT switch on the hand microphone, or the MIC switch on the glareshield.

Crew alerting of a ground crew initiated call is provided by an aural alert chime, the GROUND CALL EICAS communication message, and a CALL light illuminated on the audio control panel transmitter select switch.

The ground crew is called by selecting the GND CREW dial code from the center CDU.

Service Interphone System

The service interphone system provides voice communications between ground crew stations at various locations around the airplane. The system can be

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connected to the flight interphone system through the service interphone switch on the overhead panel.

Passenger Address System

The PA system is used by the flight crew to make cabin announcements. Pushing a PA transmitter select switch on an audio control panel and activation of a microphone switch provides direct access to all PA areas.

The system is monitored by pushing the PA receiver volume control on an audio control panel. The PA system can also be selected through the cabin interphone system or the flight deck handset.

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. Boom microphones, oxygen mask microphones, and hand microphones are used by selecting the CAB transmitter select switch on an audio control panel and pushing the mic/interphone switch to the MIC position. A cabin interphone station(s) must be selected and a call initiated from the center CDU to alert the desired station to pick up the call.

EICAS communications alert messages and chimes alert the pilots to incoming cabin calls. Normal priority calls from the cabin display the CABIN CALL EICAS message. Normal priority calls made to the flight deck while another call is in progress will result in a busy signal at the handset, the calling station being displayed in the call queue, and the CABIN CALL memo message being set in EICAS. The call queue and memo messages will be cleared when communication is established between that calling station and the flight deck. Priority calls from the cabin display the CABIN ALERT EICAS message. Priority calls automatically disconnect lower priority cabin interphone calls. Priority calls placed while a priority call is in progress are automatically connected as a conference call.

The cabin interphone call queue, speed dial numbers, and directories are accessed from the center CDU cabin interphone menu.

Calls are initiated by:

- line selecting the call location on the CDU display, or
- entering the appropriate call code in the CDU scratchpad and selecting SEND.

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Pushing the audio control panel CAB transmitter select switch twice within one second places a priority call to an airline–designated call location.

A station which is in use will be disconnected from the call in progress and connected to the flight deck.

Note: Flight deck initiated calls will not interrupt a current PA announcement from the dialed station.

Calls can be answered by selecting an audio control panel CAB transmitter select switch or, if a CAB transmitter select switch is already pushed in, by pressing a mic/interphone switch to the MIC position.

Calls can be ended by selecting the CDU prompt END CALL or de-selecting the CAB transmitter selector on the audio control panel. The call also ends if the other party terminates the call.

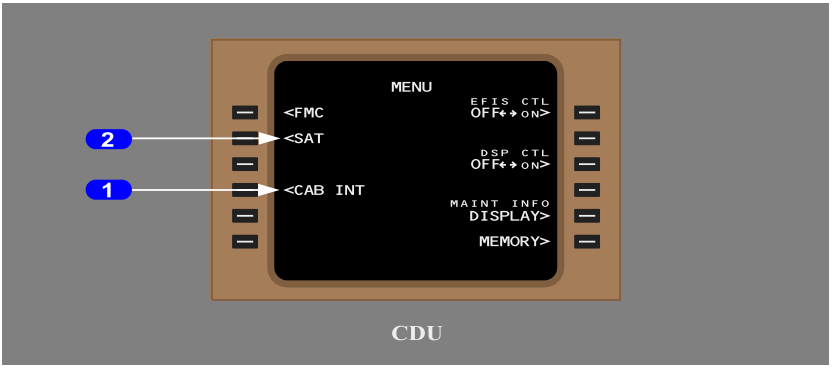
Calls can also be answered or placed using the flight deck handset. Desired call locations are entered using the numeric keys on the handset. Pressing the handset reset switch or placing the handset back on the cradle terminates the call.

Note: The handset PA push-to-talk switch is not required to operate the handset except for PA announcements.

CDU Menu Page

Pushing the CDU MENU key displays the CDU menu page.

Normally, the cabin interphone (CAB INT) and SATCOM (SAT) displays are viewed on the center CDU. The SATCOM prompt is available on all CDUs.



1 CAB INT

Push—displays the CDU cabin interphone pages.

Note: Available only on the center CDU.

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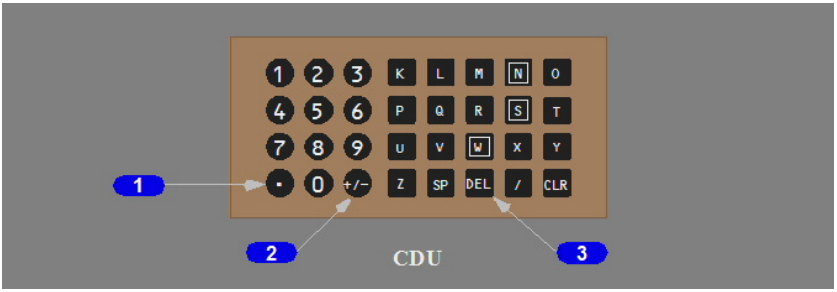
2 SAT

Push—displays the CDU SATCOM pages.

Cabin Interphone CDU Controls



1 Period (.) key

Push—displays an asterisk (*) in the scratchpad.

2 Plus/Minus (+/–) Key

Push—displays a pound sign (#) in the cabin interphone scratchpad.

3 Delete Key

Push—

- displays DELETE in the cabin interphone scratchpad
- used to delete calls from the call queue.

Cabin Interphone Main Menu

The cabin interphone menu allows the pilots to send or end calls. Calls are sent by selecting a station from the speed dial page or the directory. Two digit station codes can be manually entered into the scratchpad and the call sent using the SEND prompt. A list of the two digit station codes is located on the handset.

The directory of stations is created by the customer airline and is not shown here. The following depict typical main menu pages and selected options.

Speed Dial

The speed dial menu provides a quick means to call up to five predefined stations or groups of stations. A single push initiates the selected call.

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Call Queue

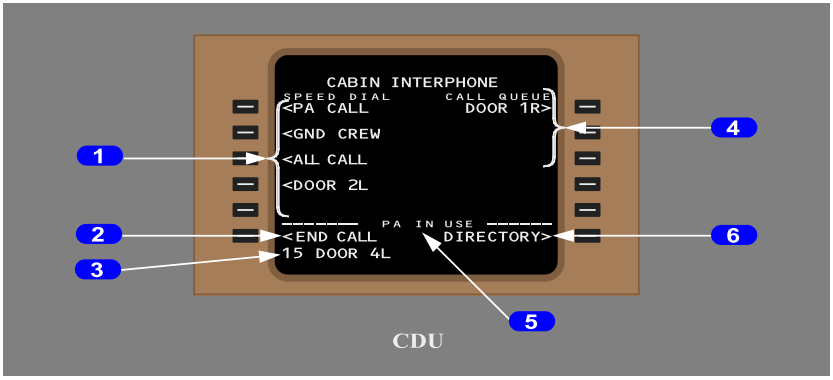
When the flight deck is involved in a call, additional incoming calls are displayed in the queue. Up to four calls can be displayed in order of the priority assigned as follows:

- PILOT ALERT
- conference calls
- cabin calls
- other calls.

The PILOT ALERT queue entry is displayed only when the flight deck is using the PA and an incoming call is received.

When there are four calls in the queue and a new, higher priority call is received, the lowest priority call is removed from the queue and the new call is displayed in the proper priority.

Cabin Interphone Main Menu Page (Typical)



1 SPEED DIAL Labels

Lists the dial code labels of predefined stations, station groups, or functions:

- PA CALL—selects the passenger address system
- ALL CALL—selects all cabin interphone stations
- GND CREW—activates an alert horn in the nose wheel well. When selected, the horn sounds briefly to alert the ground crew for communications with the flight crew.

Push—directly dials the selected station, station group or enables the selected call function.

2 SEND/END CALL

SEND

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A two–digit dial code may be manually entered with the CDU keyboard. If the dial code is valid, the dial code, dial code label, and SEND are displayed. If the dial code is invalid, INVALID CODE is displayed in the scratchpad.

Push—initiates a call to the selected station.

END CALL

Displayed during a connect call.

Push—disconnects all existing call connections.

3 CURRENT CALL

Displays the most recently selected dial code and label when a call is being connected. Dial code is removed when call is established.

Note: XX BUSY appears in the scratchpad when a cabin interphone call is attempted from the CDU to a handset that is off the hook. Line selecting <END CALL will remove the XX BUSY annunciation.

4 CALL QUEUE Labels

Lists the dial code labels of unanswered calls to the flight deck.

Push—

- initiates a call back to the displayed station(s)
- adds station(s) to the existing call (if the flight deck is currently connected in a call).

5 IN USE Status

PA IN USE—

- a portion of the airplane PA system is in use by/from the cabin crew, or
- both the PA and video entertainment systems are in use by/from the cabin crew.

VIDEO IN USE—a portion of the video entertainment system is in use.

Blank (dashes)—neither the PA nor video system is in use.

6 DIRECTORY

Push—displays the cabin interphone DIRECTORY page.

Cabin Interphone Directory Page (Typical)

The cabin interphone directory pages are used to access subdirectory pages. CDU cabin interphone directory pages and individual directory entries are predefined by the airline. Each directory label is the name of a subdirectory where the dial code labels of the individual stations or functions are listed.

Selection of the specific location(s) is accomplished on the subdirectory page.

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1 Directories

Up to 20 subdirectories can be predefined.

Push—displays the appropriate subdirectory page

2 CAB INT

Push—returns the display to the cabin interphone main menu page.

Cabin Interphone Subdirectory Page (Typical)

Selecting a dial code label on the subdirectory page initiates a call to that station or station group.

The cabin interphone subdirectory pages are used to view and select individual locations through their dial code labels.

Typical stations or station groups are:

- individual cabin station
- two or more cabin stations for conference calls
- PA call to all cabin areas
- PA call to individual cabin areas
- PA priority call to all cabin areas
- ground crew alert
- gate station (on the ground).

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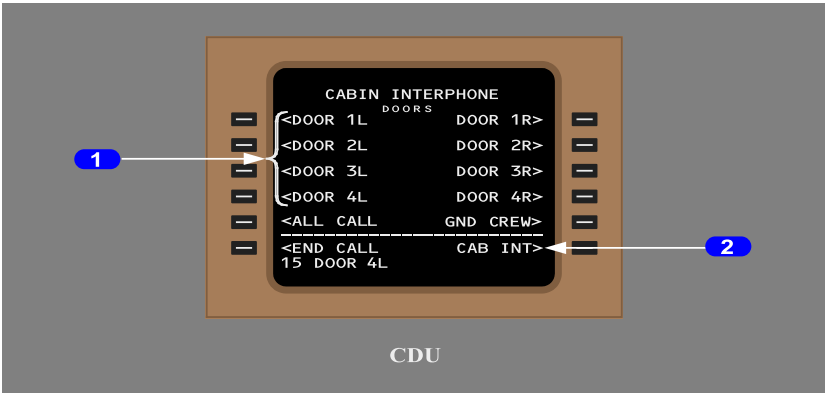

1 Dial Code Labels

Push—initiates a call to the appropriate station(s).

2 CAB INT

Push—returns the display to the cabin interphone main menu page.

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Introduction

The MFD communications functions are used to control data link features. Data link messages not processed by the FMC are received, accepted, rejected, reviewed, composed, sent, and printed using communications functions on the MFD. Data link communications can be established with participating ATC and company locations. ACARS and data link radio management functions are provided through communications management menus.

The COMM display switch, located on the display select panel, displays the communications main menu on the selected MFD. Communications functions are selected using the cursor control device. Message text entry is accomplished by entering data into the CDU scratchpad and transferring it to the appropriate area. Messages can be printed on the flight deck printer. Incoming message traffic is annunciated by EICAS communications messages.

Illustrations shown in this section depict the COMM menu with all features enabled. ATC data link requires appropriate airplane and ATC capability.

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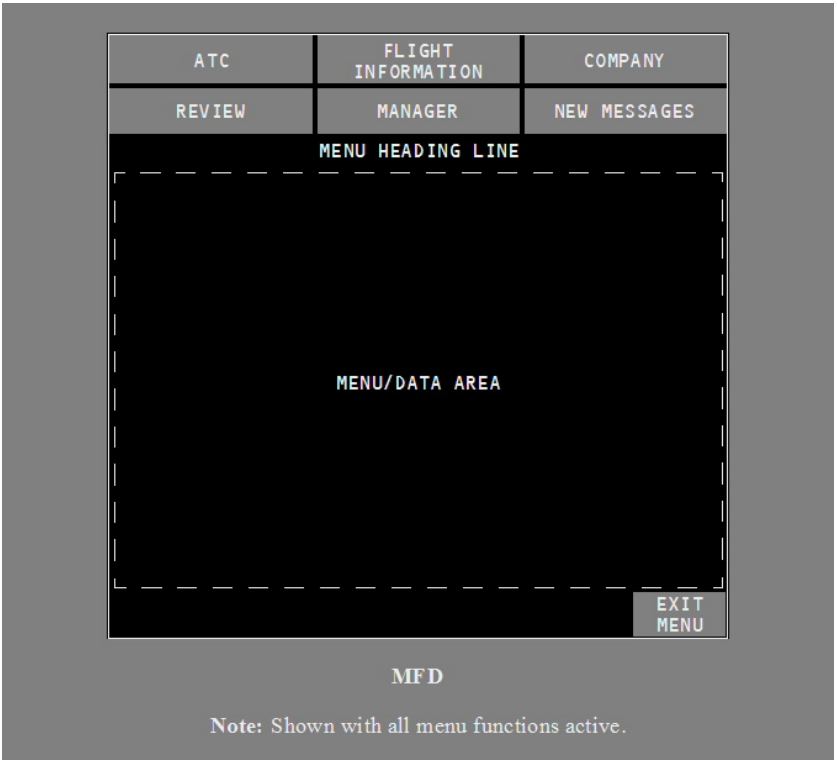
Communications Menus



MFD

Note: Shown with all menu functions active.

Company communications functions can be customized by airlines. Descriptions and illustrations provided in this section are examples of a typical installation with all communications functions active (depending on airline configuration or function availability, some functions may be inhibited).

Selectable menu items (active functions) have white text on a gray background. Inhibited items have cyan text on a black background with a cyan border. Inhibited items cannot be selected. The background color for a selected top level function is green.

Selecting ATC, FLIGHT INFORMATION, COMPANY, REVIEW, MANAGER, or NEW MESSAGES selection:

- places the appropriate title in the menu heading line
- displays the subordinate menu selections for that function in the menu/data area.

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Subordinate menu items which lead to subsequent subordinate menu(s) are followed by three dots (…). Making a selection from the subordinate menu places the title of that function in the menu heading and displays a new subordinate menu or data below. Making a selection from the subordinate menu displays the appropriate title, the menu heading, and the data below.

ATC provides downlink messages to ATC, where available.

FLIGHT INFORMATION provides for future downlink messages to the National Weather Service or a similar provider. TJA,B,C,D,G, H,TKA to TKF

FLIGHT INFORMATION provides for downlink messages that allow request of Pushback Clearance, Taxi Clearance, Departure Clearance, Oceanic Clearance, Automatic Terminal Information Service (ATIS) information, or Terminal Weather Information for Pilots (TWIP). TJR to TJW, TKK to TKR, TKU to TKZ

COMPANY provides for downlink messages to airline facilities.

REVIEW displays a list of all transmitted messages, received messages not requiring a response, or received messages with the response already sent. REVIEW is inhibited if there are no listed messages.

MANAGER provides the controls for data link and communications systems in general.

NEW MESSAGES displays a list of uplinked messages that have not been displayed or responded to. NEW MESSAGES is inhibited when there are no new messages.

Communications Control and Input Functions

Communications menus, controls, and data input methods are similar for ATC, FLIGHT INFORMATION, and COMPANY functions. Basic functions are explained here.

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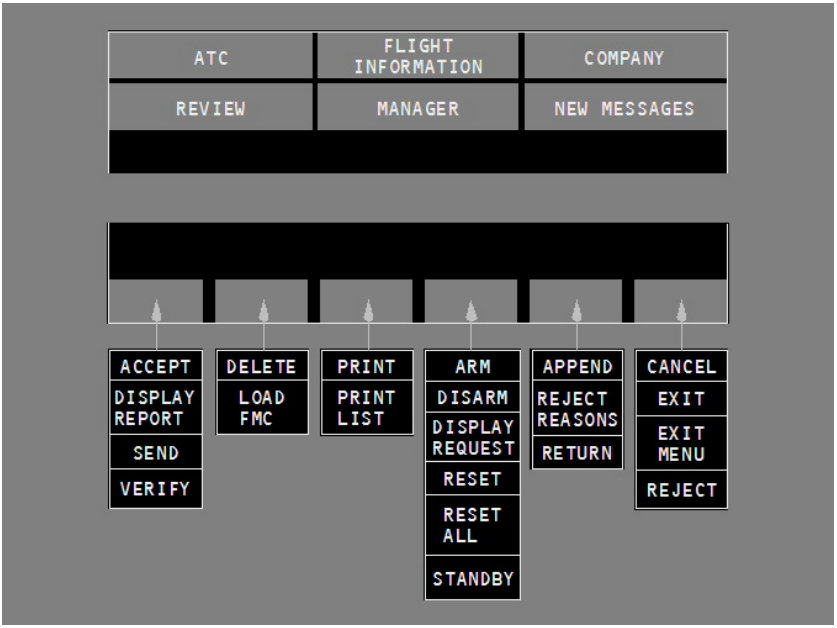
Command Key Locations



Communications command keys are displayed at the bottom of communications pages. Command keys change as appropriate for pages displayed. Each key has a label which changes based on the page displayed and the possible action. Only one label is displayed in a single location for a specific condition on the page.

Command Key Functions

The following table describes the key functions and labels for all ATC, FLIGHT INFORMATION, and COMPANY functions.

Command key label	Displayed/Inhibited	Key function
ACCEPT (uplink messages)	Displayed when: • message requires an accept/reject response, and • all message pages have been displayed. Inhibited for first 2 seconds of message display	Select: • message acceptance downlinked to message sender • ACCEPT & REJECT keys removed • message status displayed in info box

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Command key label	Displayed/Inhibited	Key function
		• CANCEL command key displayed.
APPEND (company downlink accept/reject response)	Displayed when: • all pages of the uplinked message have been displayed, and • company data link capability is operational. Inhibited when: • for first 2 seconds of uplink display, or • when company data link capability is not operational.	Select: • uplink message is removed, and • downlinked message page is displayed.
ARM (ATC downlink reports)	Displayed when an armable report is open: • REPORT LEAVING • REPORT LEVEL • REPORT PASSING • REPORT REACHING.	Select: • arms the report for automatic downlink to ATC when report conditions are met • key function changes to DISARM • report status changes from OPEN to ARMED.
CANCEL	Displayed when: • uplink message is displayed which does not require an accept or reject response, or • an uplink message is displayed which has been accepted, rejected, or • review message is displayed. Inhibited for first 2 seconds of message display.	Message is removed.
DELETE (ATC reports)	Displayed when a downlink report page is open for entry.	Select: • deletes the report without sending. • displays the COMM menu.

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Command key label	Displayed/Inhibited	Key function
DISARM (ATC reports)	Displayed when an armable report is ARMED: • REPORT LEAVING • REPORT LEVEL • REPORT PASSING • REPORT REACHING.	Select: • disarms automatic report downlink to ATC • key function changes to ARM • Report status changes from ARMED to OPEN.
DISPLAY REPORT	Displayed after accepting an uplink message which contains a report.	Displays the downlink report attached to an uplinked message.
DISPLAY REQUEST	Displayed after accepting an ATC uplink message which contains a request.	Downlink request which required an ATC response is displayed.
EXIT	Displayed when: • a downlink message is displayed, or • a manager page is displayed.	COMM main menu is displayed.
EXIT MENU	Displayed when menu is displayed.	COMM main menu is displayed.
LOAD FMC (ATC uplink)	Displayed when uplinked ATC message contains data which can be loaded into the FMC. Inhibited when active route is in a MOD condition.	Select: • FMC data is transferred into the active route, and • FMC modification is started.
PRINT	Displayed when: • displayed message can be printed, and • printer is available. Inhibited when printer is not available.	Message is sequenced for printing.
PRINT LIST	Displayed when: • new message list page is displayed, or • review list page is displayed. Inhibited when printer is not available.	All messages in the list are sequenced for printing.

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Command key label	Displayed/Inhibited	Key function
REJECT (uplink messages)	Displayed when: • message requires an accept/reject response, and • all message pages have been displayed. Inhibited for first 2 seconds of message display.	Select: • message rejection downlinked to message sender • ACCEPT and REJECT command keys removed • CANCEL command key displayed • message status displayed in info box, and • message cleared from the display 5 seconds after status changes to REJECTED.
REJECT REASONS (ATC reject downlink)	Displayed when an uplink message requires an accept or reject response.	Displays REJECT REASON page.
RESET (downlink pages)	Displayed when downlink page is displayed.	Message parameters are reset to their default values.
RESET ALL (ATC downlink pages)	Displayed when ATC VERIFY REQUEST page is displayed.	Select: • all request parameters on the VERIFY REQUEST are set to reset/default values • ATC combined request pages are reset, or • COMM main menu is displayed.
RETURN	Displayed when: • a review message is displayed, or • a downlink message is displayed, or • a VERIFY REQUEST page is displayed, or • a manager page is displayed.	Previous list page, request page, or menu is displayed.
SEND (downlink messages)	Displayed when: • required data complete, and	Select: • message transmission initiated

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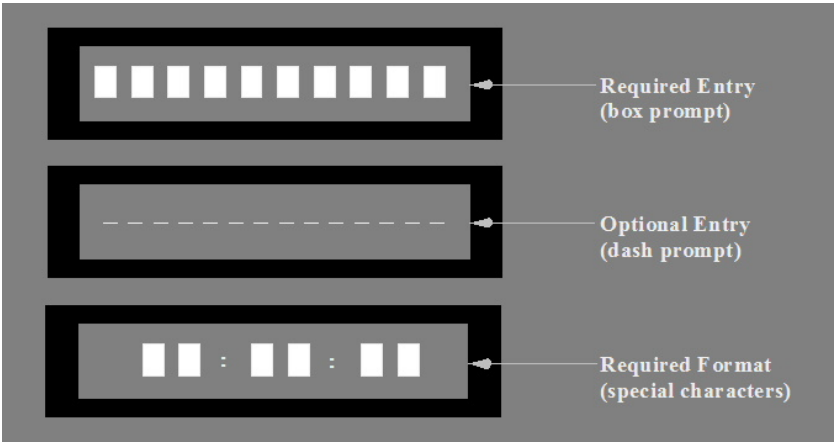
Command key label	Displayed/Inhibited	Key function
	• all company message pages have been displayed. Inhibited when transmission queue is full.	• message status displayed in info box, and • message cleared from the display 5 seconds after status changes to SENT.
STANDBY (ATC uplink messages)	Displayed when: • uplinked message is received which requires an accept/reject response, and • STANDBY has not been previously selected for this message.	Standby response is sent.
VERIFY	Displayed when data is entered on more than one of the following ATC pages: • ROUTE REQUEST • SPEED REQUEST • LEVEL REQUEST • ALTITUDE REQUEST.	Displays VERIFY REQUEST page.

TJR to TJW, TKK to TKR, TKU to TKZ TJA,B,C,D,G, H,TKA to TKF

Text Entry



Downlink message pages provide text entry fields. Scratchpad entries transfer to selected entry fields when a cursor select switch is pushed. Scratchpad entries blank when successfully transferred. Scratchpad entries remain and an INVALID ENTRY message is displayed on the MFD when the entry is not valid.

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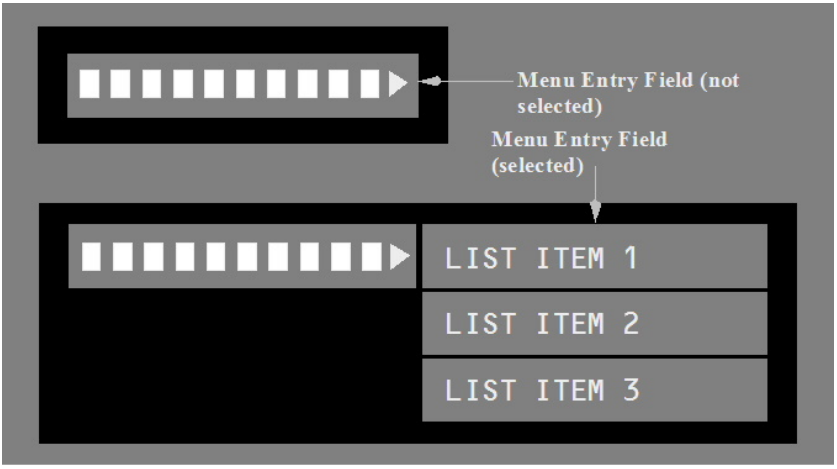
An entry field resets to a default value when a blank scratchpad is transferred. An entry field resets to the default entry prompt when DELETE is transferred.

Box and dash prompts indicate the maximum number of characters allowed.

Some entry fields have format requirements. Entry prompts display the required entry format, with special characters separating entry boxes. The required data is entered without the special characters or spaces. Scratchpad data is transferred to entry boxes after being checked for proper format. Invalid data or format prevents transfer and displays an INVALID ENTRY message.

Menu Entry Fields



Menu entry fields are used to make text entry selections from a list. Menu entry fields distinguish mandatory versus optional entry in the same manner as CDU entry field.

The menu entry field is distinguished from other entry fields by the pointer to the right of the field.

When initially selected, a list of menu items is displayed to the side of the pointer. If an item from the list is then selected using the cursor and cursor select switch, that item is transferred to the entry field. If the menu prompt is selected again and the CDU contains a valid value, that CDU value is transferred to the entry field. Actions for invalid values, an empty scratchpad, space characters, and the delete key are the same as for the CDU entry field. When the entry field is selected with text already inserted, the menu list is removed from the display.

Invalid Entries

When the scratchpad contains invalid data for the entry field, the INVALID ENTRY message is displayed in the INFO BOX. Re–entering valid data clears

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the INVALID ENTRY message on an ATC downlink page. Selecting the EXIT INFO key also clears the INVALID ENTRY message and removes the info box.

INVALID ENTRY messages on a company downlink page must be individually cleared by selecting the EXIT INFO key before valid data is re–entered into the field.

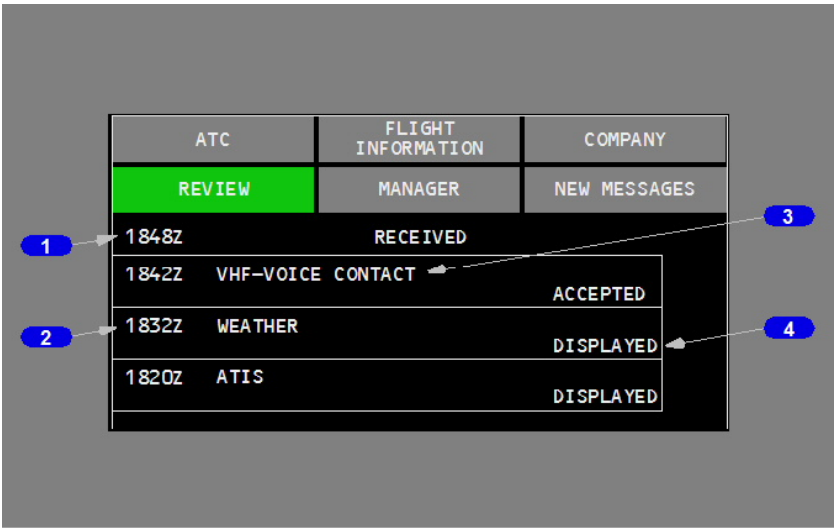
Message List

Message titles and related information can be displayed in a list. The illustration shows the REVIEW message list. A similar list is available for NEW MESSAGES.

The NEW MESSAGE list is sorted by the time of receipt, the most current message at the top. ATC uplink messages have an ATC label to the right of the message block. The message remains in the list until it is accepted, rejected, or displayed. Messages requiring an accept/reject remain in the list until the accept/reject response is accomplished.

Selecting an item from the list with the cursor and pushing the cursor select switch displays the message page. Lists are also used to view new messages.

TJA,B,C,D,G,H,TKA to TKF



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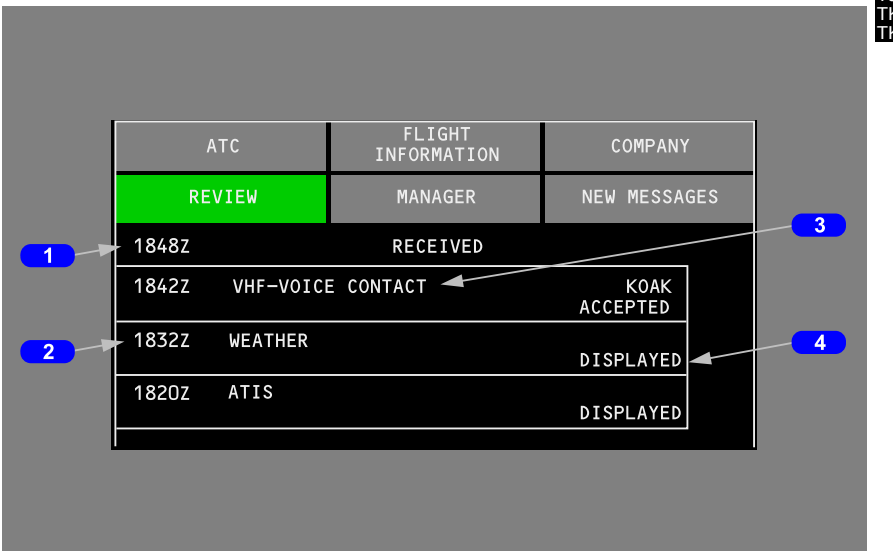
TJR to TJW, TKK to TKR, TKU to TKZ



1 Current Time

Displays current time.

2 Message Time

For new messages—time the message is received.

For review messages—time the message is received or sent.

3 Message Title

Displays message title information.

4 Message Status

Only displayed for review list boxes.

The appropriate status indicator is displayed.

Message Display Format

A typical message display format is shown. Messages selected from a list are displayed in this format.

Note: Selection of a main menu item exits the message page.

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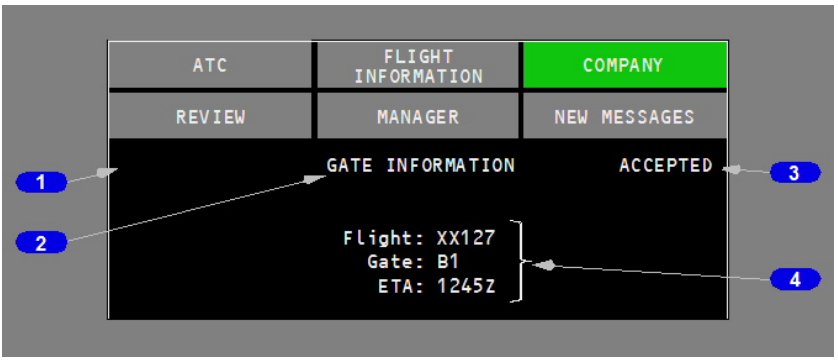
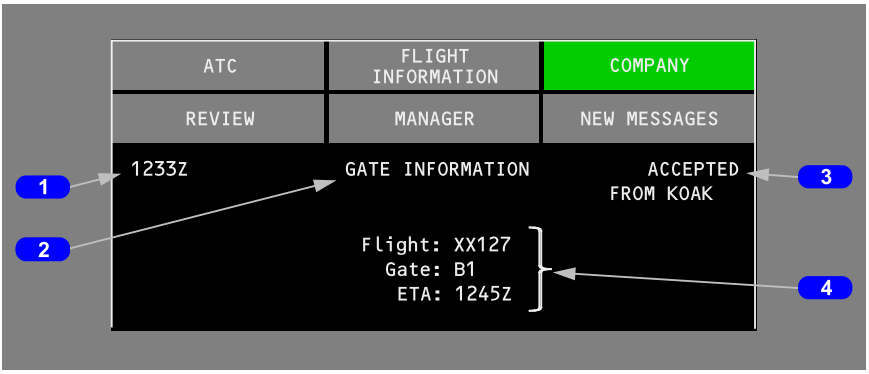
TJA,B,C,D,G, H,TKA to TKF



TJR to TJW, TKK to TKR, TKU to TKZ



1 Message Time

For downlink messages—current time.

For new messages—time the message is received.

For review messages—time the message is received or sent.

2 Message Title

Displays message title information.

3 Review State

Only displayed for review messages.

The appropriate state indicator is displayed.

4 Message Content

Located between the title and the keys.

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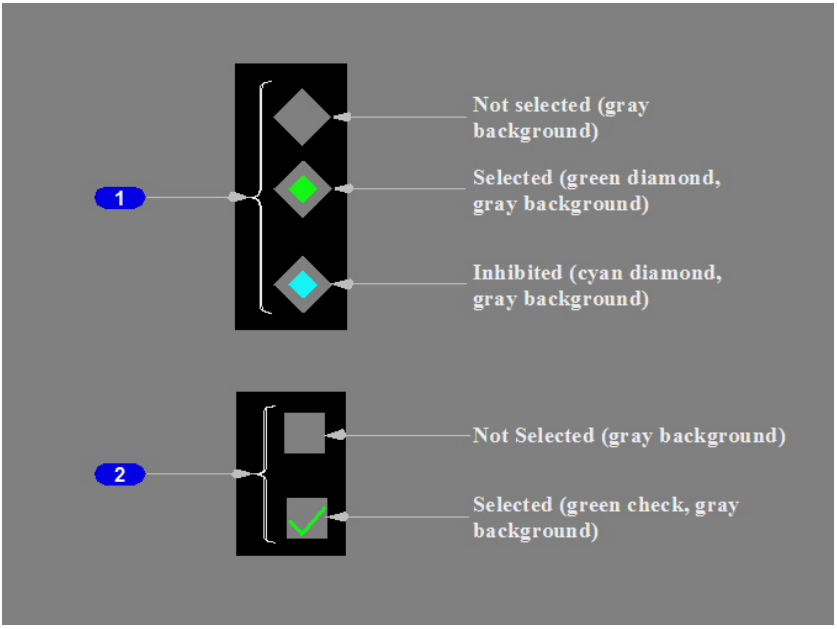
Exclusive and Non-Exclusive Select Keys

Manager and new message pages can contain select keys to activate features. Pushing the cursor select switch when the key is highlighted makes the selection. A second selection of a nonexclusive key toggles to the deselected state.



1 Exclusive Select Key

The diamond–shaped exclusive select keys are used to select a single feature from a group. Selecting a key activates the feature and all other exclusive select keys in that group are deselected. The keys are displayed in their selected or default condition. If selection is required, the SEND key is not displayed until a selection is made.

2 Non-exclusive Select Key

The square–shaped nonexclusive select keys are used to select multiple features. Selecting a key activates the feature. The keys are displayed in their previously selected or default condition. If selection is required, the SEND key is not displayed until a selection is made.

Information Messages

Messages are displayed in an information box at the bottom of the MFD. The information box covers command keys. Information messages, such as INVALID

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ENTRY, are cleared by selecting EXIT INFO. Some information messages automatically disappear.

1 Information Message Text

The text starts at the left of the box.

2 EXIT INFO Key

Select—removes the information box for the displayed message from the display.

Communications Information Messages

Communications information messages are described in the following table.

Information Message	Condition
ABORTED	ATC connection not established, lost, or loss of handoff to a new active center, while a message is transmitting, or before acceptance.
ACCEPTED	ACCEPT response received.
ACCEPTING	ACCEPT response sent.
DISPLAYED	All pages of a message not requiring an ACCEPT or REJECT response have been displayed.
COMM CONTROL TRANSITION-COMPANY MESSAGES LOST	Airplane data link system switched to a new AIMS master. Company datalink information may be lost. Incomplete company downlink messages are lost and must be created/transmitted again. If previously received Company messages are required, they must be requested again. ATC connections, data, and messages are not affected.
CONNECTING	Logon request sent, network acknowledgment received, and connect or start request not received.
INCOMPLETE MESSAGE	Only part of the displayed message is received.
INVALID ENTRY	An entry box is selected and the CDU scratchpad value is not valid.

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Information Message	Condition
LOADED	ATC uplink route modification is successfully loaded into the FMC.
LOAD ABORTED	Loading of ATC uplink route modification into the FMC is aborted.
LOADING	ATC uplink route modification is loading into the FMC.
MESSAGE TO PRINTER	Selected message(s) sent to printer.
MESSAGE LIMIT EXCEEDED	Maximum number of characters that can be transmitted in ATC downlink message is exceeded.
NO ACCEPT (company)	ACCEPT response is not successfully transmitted or an ACCEPT response is not required.
NO PRINT	An attempt to send a message(s) to the printer is unsuccessful.
NO REJECT (company)	REJECT response is not successfully transmitted or a REJECT response is not required by the message.
NO SEND	An attempt to send a downlink message is unsuccessful.
PRINTING	ATC message is printing.
REJECTED	REJECT response received.
REJECTING	REJECT response transmitting.
SENDING	The downlink message is sent.
SENT	The downlink message is received.
UNABLE TO LOAD	ATC uplink route modification can not be loaded into the FMC.

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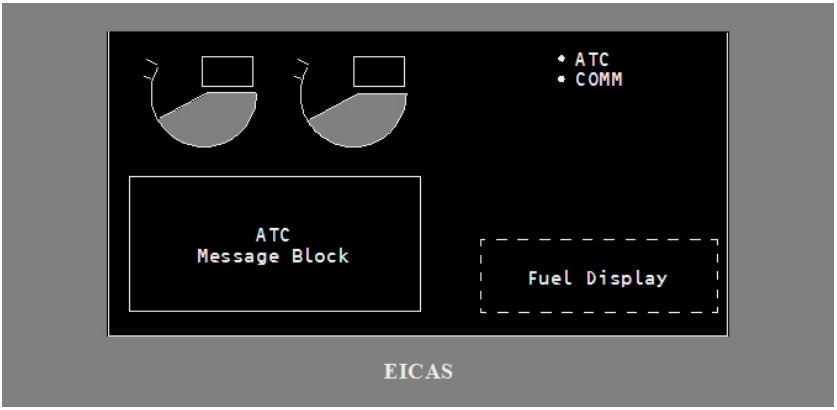
Uplink Message



ATC Uplinks

Arriving ATC uplink messages are annunciated by an •ATC communications message, an aural chime, and the display of the EICAS ATC message block. The message text is displayed below the normal EICAS engine display. Uplink messages too large to fit in the message area display the message LARGE ATC MESSAGE. The message text is displayed using the NEW MESSAGE menu selection.

TJR to TJW, TKK to TKR, TKU to TKZ

Flight Information Uplinks

Arriving flight information uplink messages are annunciated by a •COMM communications message and an aural chime. The message text is displayed using the NEW MESSAGE menu selection.

Company Uplinks

Arriving company uplink messages are annunciated by a •COMM communications message and an optional aural chime.

Accept/Reject Uplinks

ATC messages requiring an accept or reject response display those options on the EICAS display. The MFD message page displays ACCEPT, STANDBY, REJECT REASONS, and REJECT keys at the bottom. Select ACCEPT or REJECT to respond to the uplink message. The REJECT REASONS key can be selected to inform ATC why the message is being rejected.

Company messages can also be accepted or rejected on the message page.

After making a selection, the status changes to ACCEPTING/REJECTING while the response is transmitting. When the communications network sends a response indicating that the message was received, the message status changes

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to ACCEPTED/REJECTED. After a message has been accepted or rejected, a CANCEL key is displayed at the bottom of the page. Selecting CANCEL will clear the message from the display. Rejected messages are automatically removed 5 seconds after the message status changes to REJECTED.

The ACCEPT, CANCEL, and REJECT buttons on the glareshield perform the same function as the same keys on the MFD.

Reject Reasons Page

If the response to an ATC uplink message is to reject the message, the REJECT REASONS key can be selected to inform ATC why the clearance message is being rejected. Up to three lines of text can be included. Select REJECT to send the reject message with the applicable reasons.

Standby Response

When more time is required to respond to an ATC uplink, use the STANDBY key to send a delay notification.

ATC Sidelinks

ATC sidelinks are system generated ATC communication messages. They are annunciated by an •ATC communications message, aural chime, and display

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of the EICAS ATC message block. The message text is displayed below the normal EICAS engine display. Selecting CANCEL with the cursor control device or glareshield button will clear the message from the display.

ATC Data Link

ATC data link communicates with participating air traffic control centers, reducing the need for VHF voice communications. Airplane situation reports, route changes, speed and vertical clearances, and voice contact requests can be sent or received as appropriate. The COMM display ATC menu selection allows display of downlink message pages.

Uplink and downlink messages are stored. All messages are assigned the time of receipt/transmission and are printable.

ATC data link requires manual logon to a participating ATC facility. Once logged on, transfer to adjacent ATC facilities is normally automatic.

Crew Feedback

ATC uplinks containing clearance data that the crew can set on the MCP or EFIS control panel have a crew feedback display function. When the message is displayed on EICAS or the message page, the data values change from white to green when properly set by the crew. Data which provides feedback is:

- MCP speed
- MCP heading
- MCP altitude
- barometer setting
- transponder code
- VHF frequency
- HF frequency.

FMC Data Loading

Some ATC uplinks contain data for loading into the FMC. Display of the LOAD FMC command key indicates that FMC data is available for loading. Selecting LOAD FMC transfers data to the FMC and creates an FMC modification.

Both MFD information messages and FMC scratchpad messages provide indications of loading progress.

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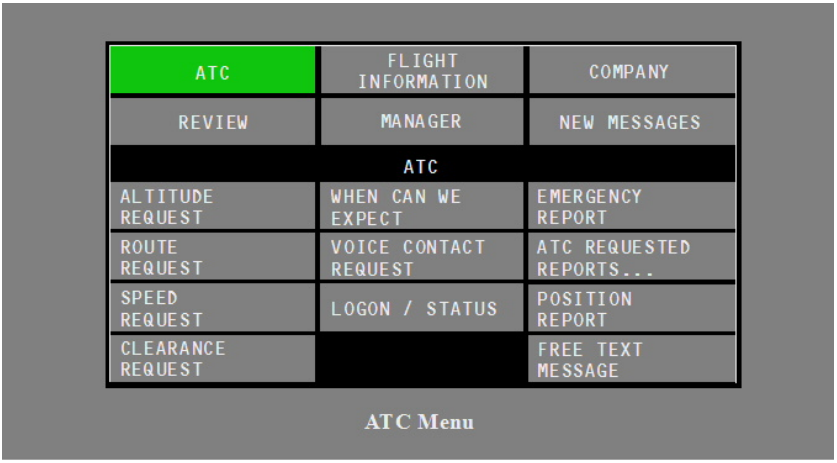
Downlink Pages

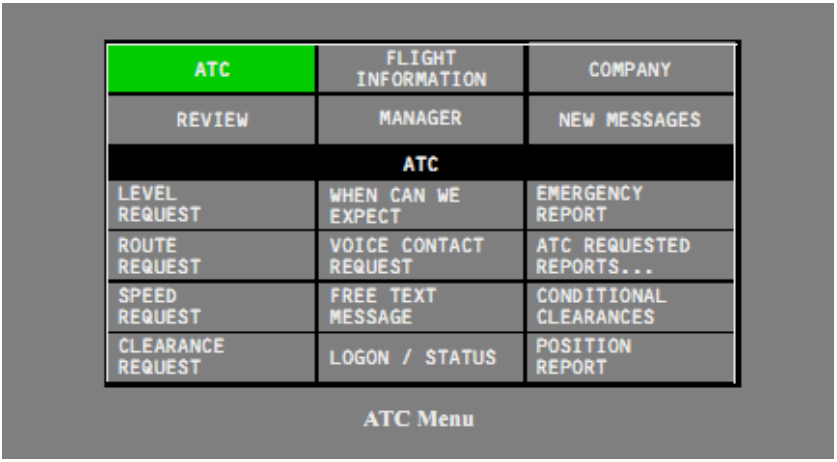
ATC Menu

TJA,B,C,D,G, H,TKA to TKF



ATC Menu

TJR to TJW, TKK to TKR, TKU to TKZ



ATC Menu

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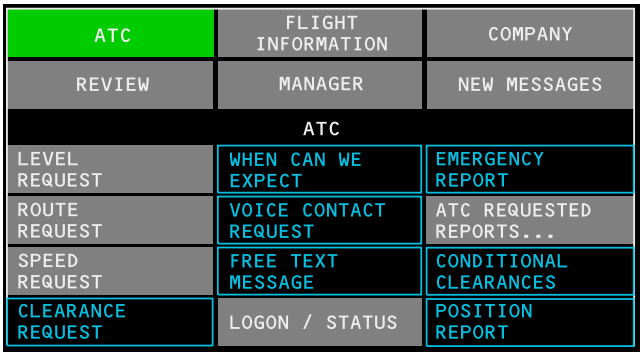
TKU to TKZ



ATC Menu - ATN Connection Established

The ATC menu provides access to ATC downlink pages.

The ATC REQUESTED REPORTS menu selection is inhibited (cyan) when no reports are requested by ATC.

TJR to TJW, TKK to TKR, TKU to TKZ

The CONDITIONAL CLEARANCES menu selection is inhibited (cyan) unless a conditional clearance is accepted by the flight crew.

TKU to TKZ

Some ATC menu selections and request messages are inhibited (cyan) when an ATN (Aeronautical Telecommunication Network) data link connection is established.

Note: This menu is not repeated when describing individual pages.

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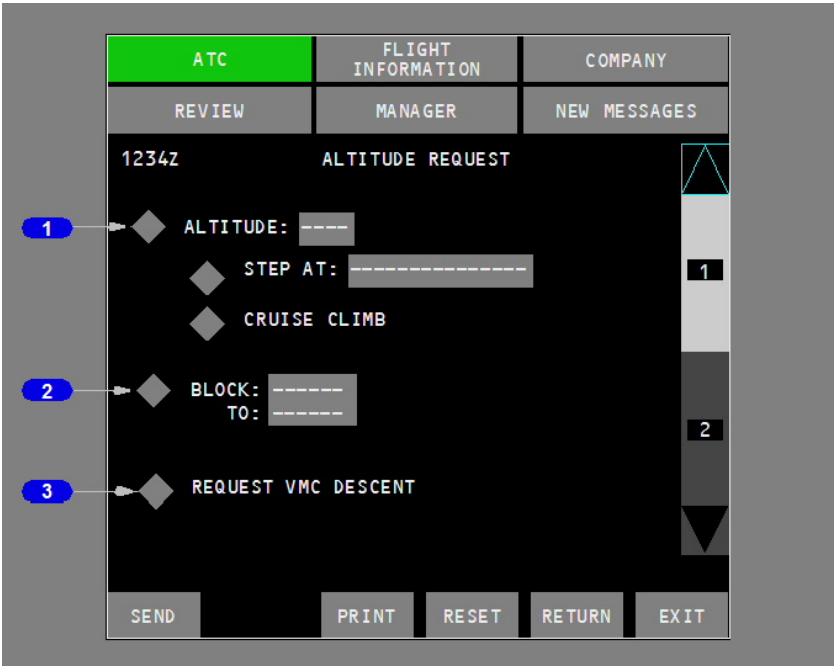
Altitude Request

TJA,B,C,D,G, H,TKA to TKF

The ALTITUDE REQUEST page allows selection of an altitude, an altitude block, or a VMC descent. A second request page allows selection of a reason for the request.



1 ALTITUDE

The requested altitude is entered into the dash prompt and the SEND key becomes active.

Pushing the SEND key requests a normal climb at climb power unless otherwise requested, or a normal descent.

Additional climb or descent options are:

- STEP AT—allows entering a time or position for the start of the climb or descent
- CRUISE CLIMB—begin a cruise climb from present position.

STEP AT is inhibited when the ALTITUDE value is less than 150 feet from current airplane altitude. Altitude entries are any valid FMC altitude. Time entries are in four digit, hours and minutes, optionally followed by a Z. Position entries are any valid FMC position.

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2 BLOCK

BLOCK is the beginning of a block altitude. TO is the end of the altitude block. Altitude entries are any valid FMC altitude.

The SEND key becomes active with an entry.

3 REQUEST VMC DESCENT

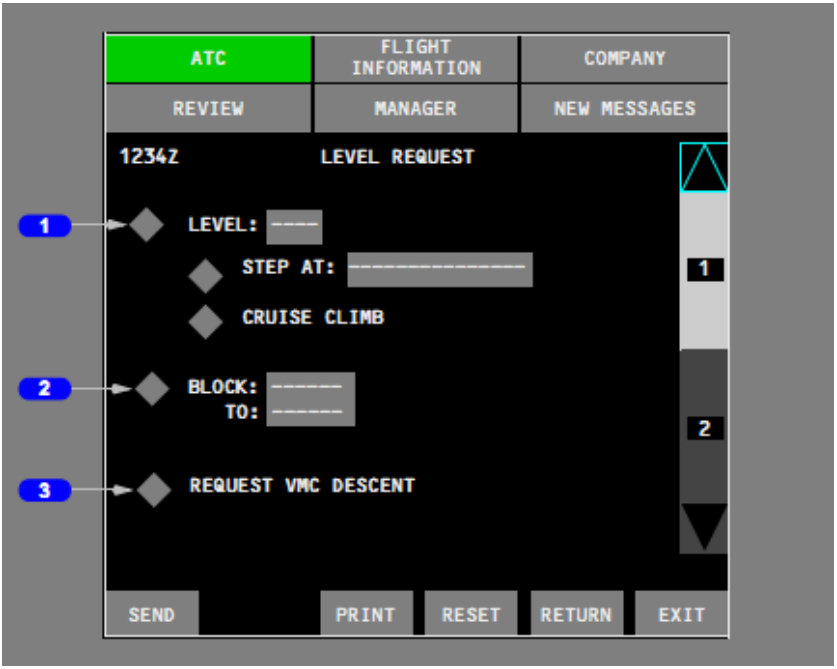
A VMC descent is begun from present position.

The SEND key becomes active with this selection.

TJR to TJW, TKK to TKR, TKU to TKZ

Level Request

The LEVEL REQUEST page allows selection of an altitude, an altitude block, or a VMC descent. A second request page allows selection of a reason for the request.



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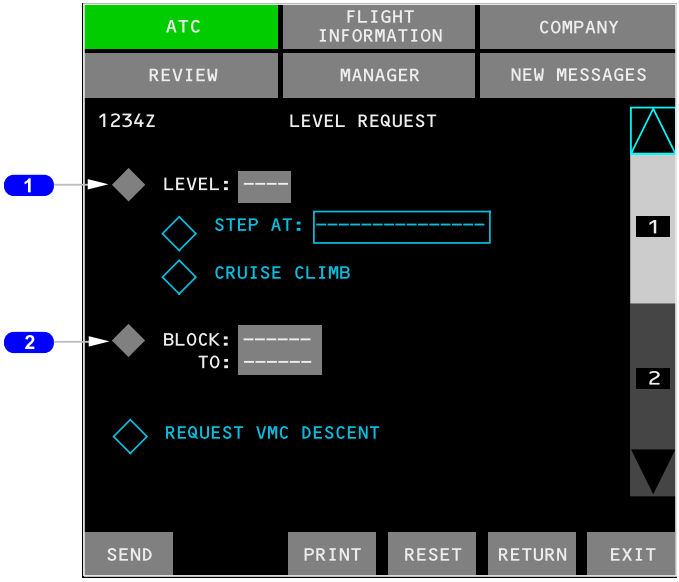

ATN Connection Established

1 LEVEL

The requested flight level is entered into the dash prompt and the SEND key becomes active.

Pushing the SEND key requests a normal climb at climb power unless otherwise requested, or a normal descent.

Additional climb or descent options are:

- STEP AT—allows entering a time or position for the start of the climb or descent
- CRUISE CLIMB—begin a cruise climb from present position.

STEP AT is inhibited when the LEVEL value is less than 150 feet from current airplane altitude. Flight level entries are any valid FMC altitude. Time entries are in four digit, hours and minutes, optionally followed by a Z. Position entries are any valid FMC position.

2 BLOCK

BLOCK is the beginning of a block altitude. TO is the end of the altitude block. Altitude entries are any valid FMC altitude.

The SEND key becomes active with an entry.

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3 REQUEST VMC DESCENT

A VMC descent is begun from present position.

The SEND key becomes active with this selection.

TJA,B,C,D,G,H,TKA to TKF

Altitude Request Reason Page

The page scroll bar selects a second ALTITUDE REQUEST page. Reasons for a request are optionally entered on this page. Up to three lines of free text can be included.

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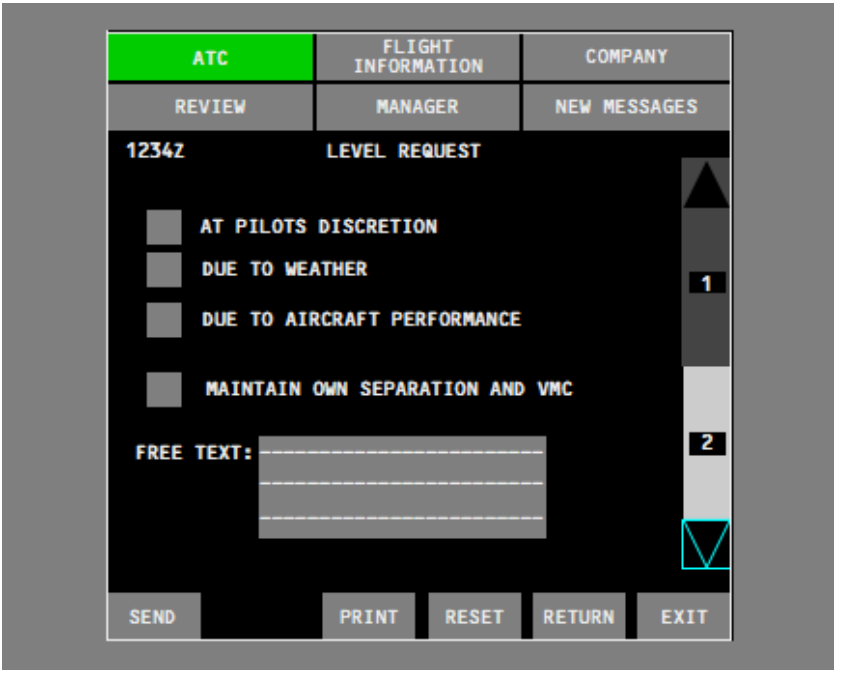
Level Request Reason Page

TJR to TJW, TKK to TKR, TKU to TKZ



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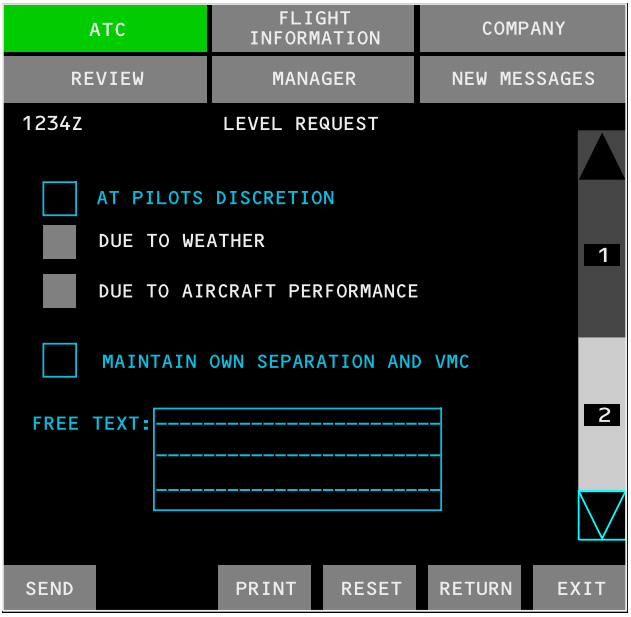

ATN Connection Established

The page scroll bar selects a second LEVEL REQUEST page. Reasons for a request are optionally entered on this page. Up to three lines of free text can be included.

Route Request

The ROUTE REQUEST page allows selection of a direct to waypoint, new route, heading or track, departure and transition, arrival and transition, weather

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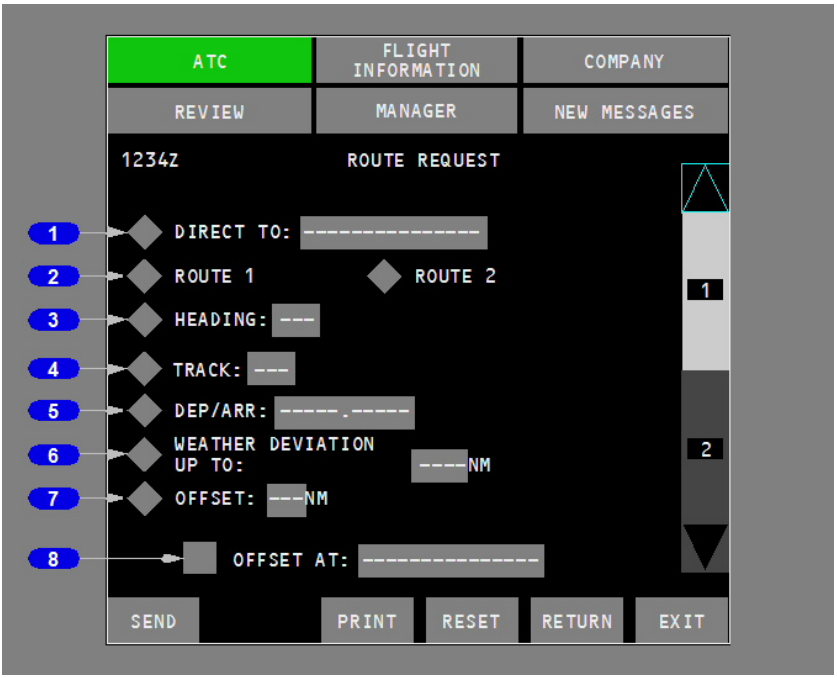
deviation, or a route offset. A second request page allows selection of a reason for the request.



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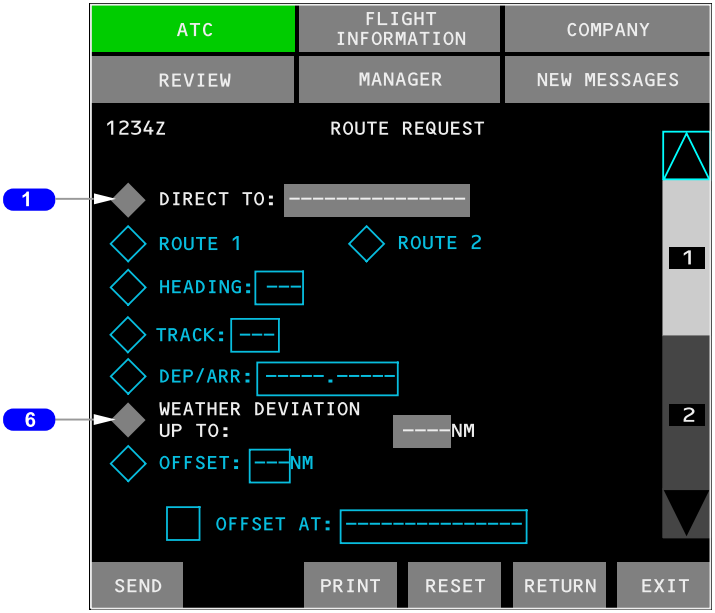
TKU to TKZ



ATN Connection Established

1 DIRECT TO

Enter any valid FMC waypoint. The SEND key becomes active with this selection.

2 ROUTE

Selects FMC route 1 or 2. Sends the selected route, including any modifications. The SEND key becomes active with this selection.

3 HEADING

Enter desired heading. When displays are referenced to true north, a TRU label is displayed right of the heading. The SEND key becomes active with this selection.

4 TRACK

Enter desired ground track. When displays are referenced to true north, a TRU label is displayed right of the ground track. The SEND key becomes active with this selection.

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5 Departure (DEP)/Arrival (ARR)

Enter one of the following:

- departure
- arrival
- departure and transition
- arrival and transition.

Default entries are:

- departure procedure/transition selected for the selected route
- the approach procedure/transition selected for the active route when the airplane is in the air and an arrival procedure/transition is not selected.

The SEND key becomes active when one of the check boxes is selected.

6 WEATHER DEVIATION UP TO

Enter desired offset in nautical miles. Valid entries are L (left) or R (right) NNN (NNN is any number from 1 to 128). Entries can be made without L or R to allow for offsets to either side of the route. The SEND key becomes active with this selection.

7 OFFSET

Enter desired FMC route offset in nautical miles. Valid entries are L or R XX (XX is any number from 1 to 99). The SEND key becomes active with this selection.

8 OFFSET AT

Enter a time or position to begin the offset. Time entries are in four digit, hours and minutes, optionally followed by a Z. Position entries are any valid FMC position.

Route Request Reason Page

TJA,B,C,D,G,H,TKA to TKF

The page scroll bar selects a second ROUTE REQUEST page similar to the ALTITUDE REQUEST page previously described. The reasons for a request are optionally entered on this page. Up to three lines of free text can be included.

TJR to TJW, TKK to TKR, TKU to TKZ

The page scroll bar selects a second ROUTE REQUEST page similar to the LEVEL REQUEST page previously described. The reasons for a request are optionally entered on this page. Up to three lines of free text can be included.

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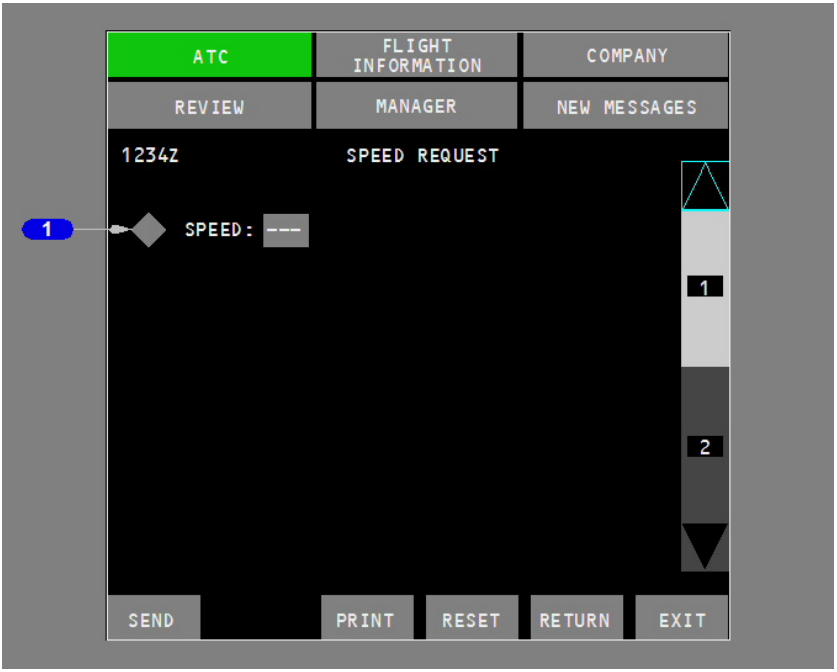
Speed Request

The SPEED REQUEST page allows selection of speed. A second request page allows selection of a reason for the request.



1 SPEED

Enter any valid FMC speed or mach number. IAS entries are rounded to the nearest 10 knots. The SEND key becomes active with this entry.

The SEND key becomes active with this entry.

Speed Request Reason Page

TJA,B,C,D,G, H,TKA to TKF

The page scroll bar selects a second SPEED REQUEST page similar to the ALTITUDE REQUEST page previously described. The reasons for a request are optionally entered on this page. Up to three lines of free text can be included.

TJR to TJW, TKK to TKR, TKU to TKZ

The page scroll bar selects a second SPEED REQUEST page similar to the LEVEL REQUEST page previously described. The reasons for a request are optionally entered on this page. Up to three lines of free text can be included.

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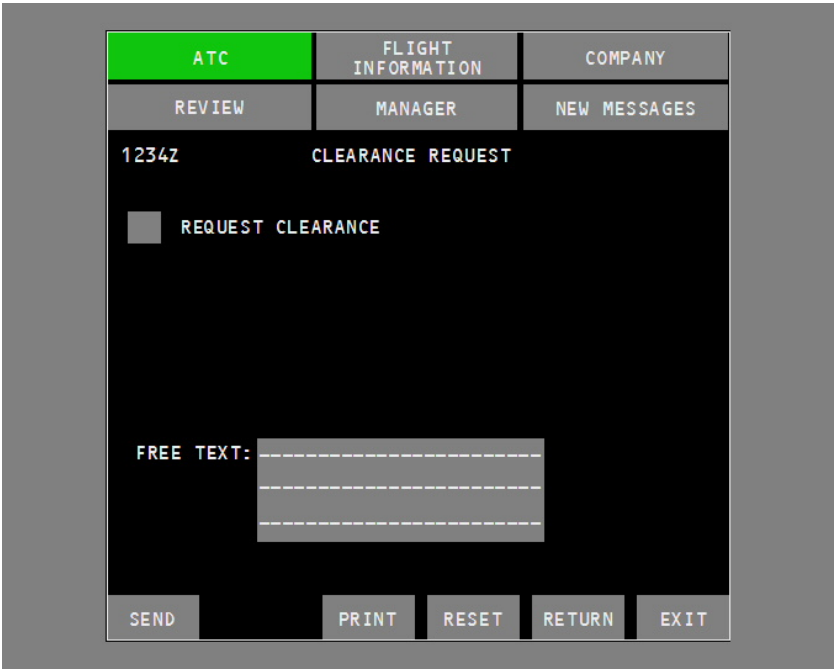
Cleareance Request



Selecting REQUEST CLEARANCE informs ATC that the crew is ready for a clearance, such as predeparture or pushback. Up to three lines of free text can be included. The SEND key becomes active with this selection.

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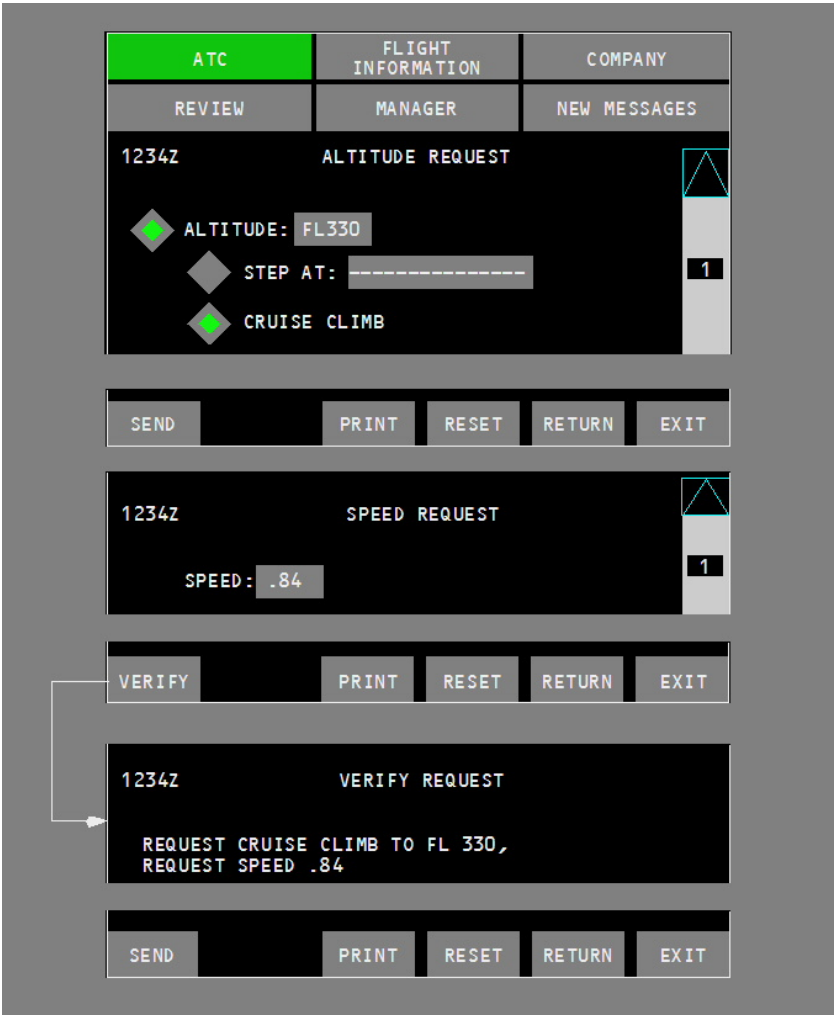
Combination Downlink Request

TJA,B,C,D,G,H,TKA to TKF



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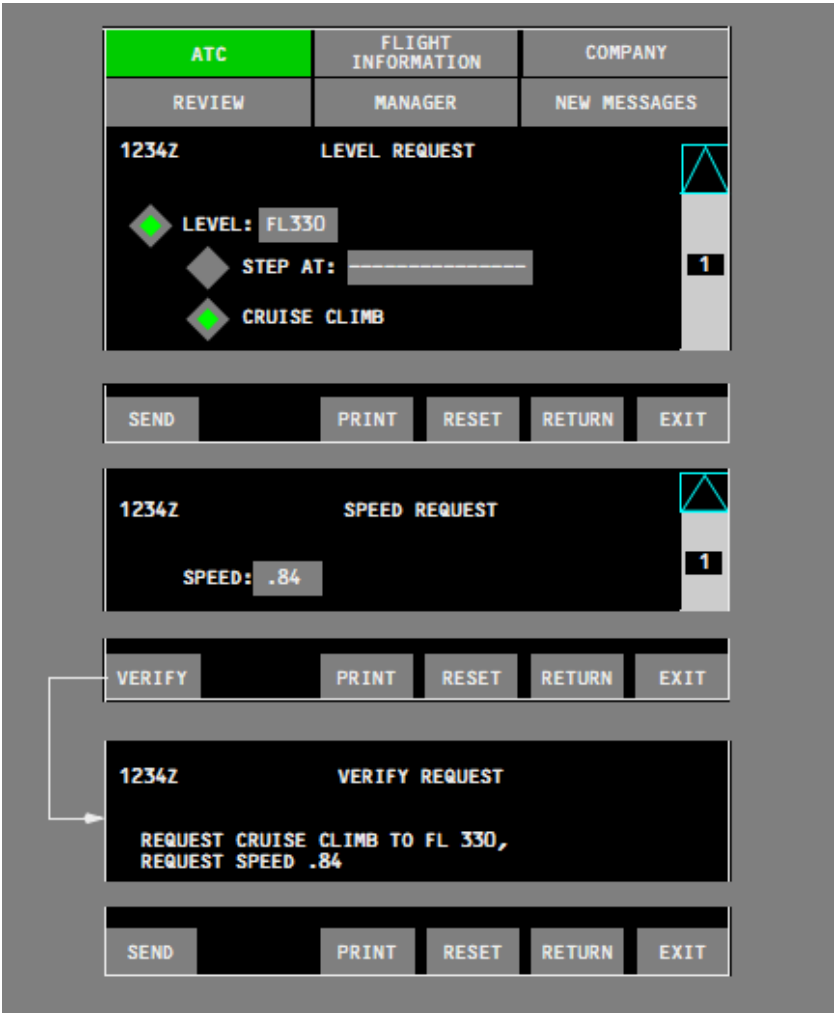
TJR to TJW, TKK to TKR, TKU to TKZ



TJA,B,C,D,G, H,TKA to TKF

Requests from the altitude, speed, and route pages can be combined into one downlink request. Each request is individually selected and filled out. Select subsequent request pages by selecting RETURN, and selecting additional downlink pages from the ATC main menu. When data is entered into the second request page, the SEND key changes to VERIFY.

TJR to TJW, TKK to TKR, TKU to TKZ

Requests from the level, speed, and route pages can be combined into one downlink request. Each request is individually selected and filled out. Select subsequent request pages by selecting RETURN, and selecting additional

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downlink pages from the ATC main menu. When data is entered into the second request page, the SEND key changes to VERIFY.

The SEND key is active on the VERIFY REQUEST page. A combined request is limited to five elements. Selecting a sixth request element displays the MESSAGE LIMIT EXCEEDED information message.

The verify page provides a display of the combined request elements. Each element is displayed on separate lines. Elements requiring revision before sending are revised on their respective request page. Selecting SEND transmits the combined downlink message to ATC.

TJA,B,C,D,G, H,TKA to TKF

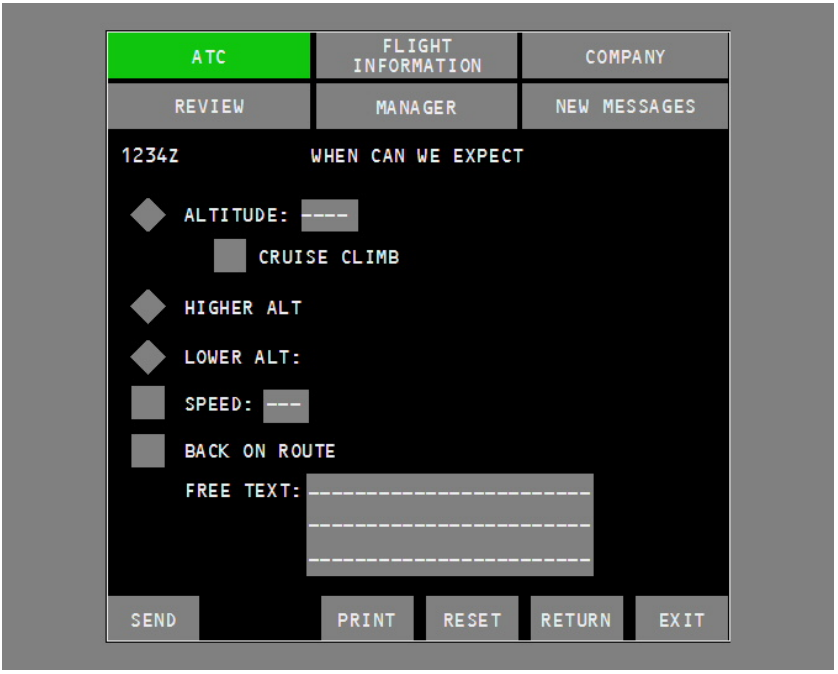
The example shows a combined altitude and speed request. The altitude request is created first.

TJR to TJW, TKK to TKR, TKU to TKZ

The example shows a combined level and speed request. The level request is created first.

When Can We Expect

TJA,B,C,D,G, H,TKA to TKF



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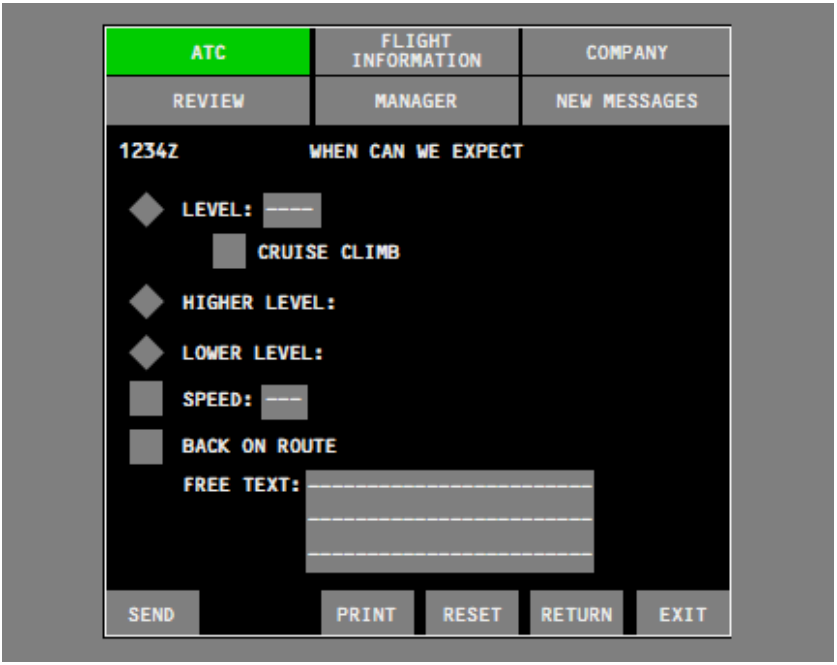
TJR to TJW, TKK to TKR, TKU to TKZ



TJA,B,C,D,G, H,TKA to TKF

Making selections asks ATC the time or location the crew can expect clearance for the requested items. Altitude, speed, and cruise climb entry rules are the same as on the ALTITUDE REQUEST and SPEED REQUEST pages. Up to three lines of free text can be included. The SEND key becomes active when a check box is selected.

TJR to TJW, TKK to TKR, TKU to TKZ

Making selections asks ATC the time or location the crew can expect clearance for the requested items. Altitude, speed, and cruise climb entry rules are the same as on the LEVEL REQUEST and SPEED REQUEST pages. Up to three lines of free text can be included. The SEND key becomes active when a check box is selected.

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Voice Contact Request

Making selection asks ATC for a voice contact. Up to three lines of free text can be included. The SEND key becomes active when the request for voice contact box is selected.

ATC Logon/Status

The ATC LOGON/STATUS page allows entry of the desired ATC facility for establishment of a data link connection.

The SEND key is displayed after all logon entries are completed. Selecting the SEND key displays SENDING status during logon transmission. Five seconds after the logon status changes to SENT, the page is exited.

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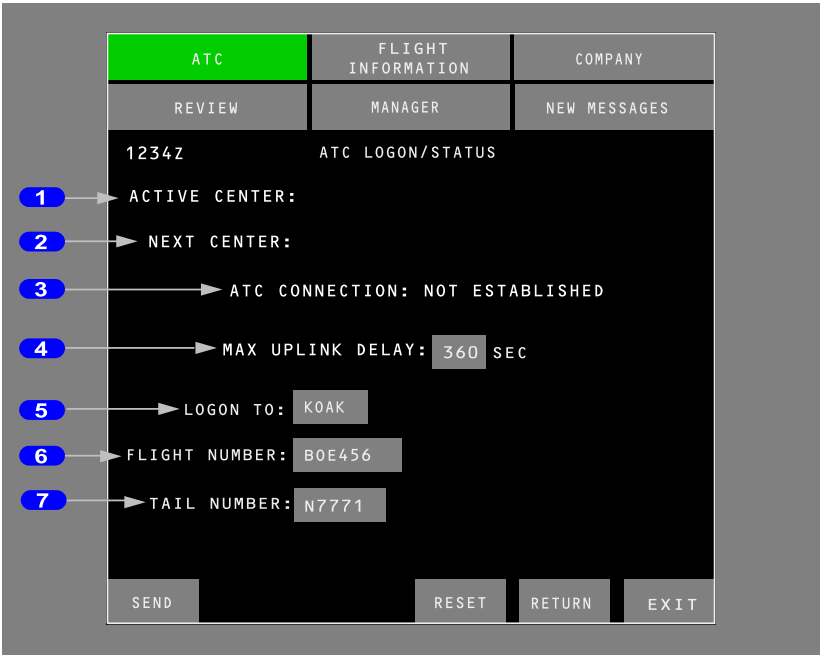
DELETION

TJA,B,C,D,G,H,TKA to TKF



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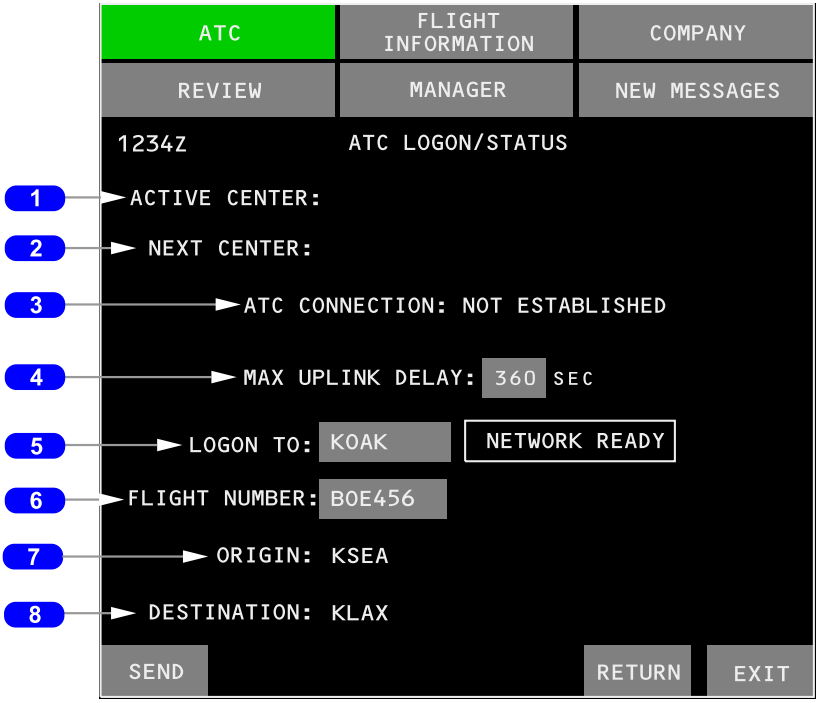
TJR to TJW,
TKK to TKR



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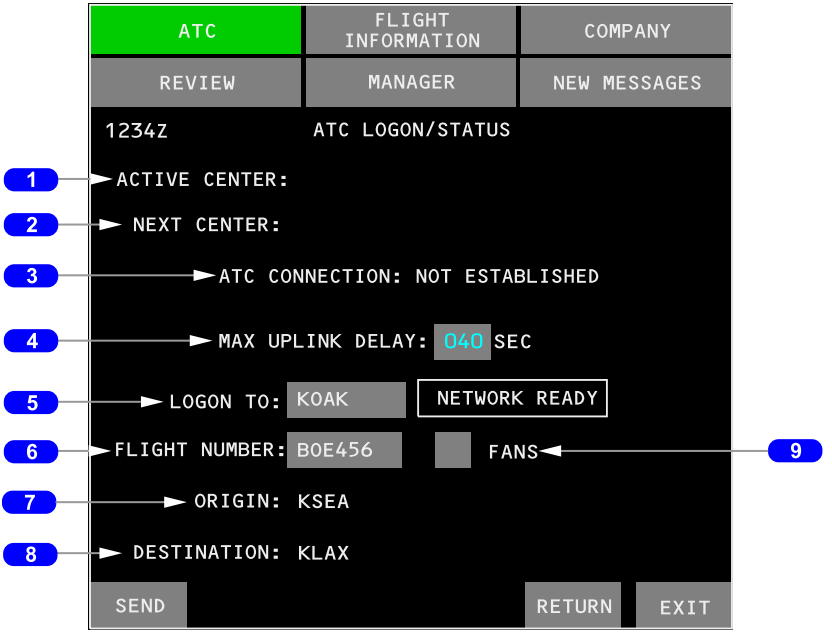
DELETION

TKU to TKZ



1 ACTIVE CENTER

Displays the ATC facility identifier where a connection is established.

2 NEXT CENTER

Displays the ATC facility identifier to which an automatic handoff transfers the connection.

3 ATC CONNECTION

Displays the status of the ATC connection, ESTABLISHED or NOT ESTABLISHED.

4 MAX UPLINK DELAY

Elapsed time from transmission to receipt of an ATC uplink message that triggers a late annunciation. The words “UPLINK DELAY EXCEEDED” precede any late ATC uplink message. Valid entries are from 1 to 999. Resets to off and displays dashes at:

- power-up

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- datalink system reset
- ATC connection terminated
- “DELETE” entry

TKU to TKZ
- non-ATN identifier entry into the LOGON TO field.

TKU to TKZ When an ATN data link connection is established, displays 040 in cyan and manual entry is inhibited. Uplink messages having an elapsed transmission time of 40 seconds or more do not display to the flight crew and an error message is sent to ATC.

5 LOGON TO

Box prompts are initially displayed. Enter the ICAO four letter identifier for the desired ATC center. The display changes to dashed prompts after establishing an ATC connection.

TJR to TJW, TKK to TKR When an ICAO identifier is entered, network status displays as:

- NETWORK READY—data communication radio available
- NETWORK NOT READY—data communication radio not available.

TKU to TKZ When an ATN identifier is entered, network status displays as:

- NETWORK READY
  - VHF data link mode 2 available, or
  - FANS select key selected and data communication radio available.
- NETWORK NOT READY:
  - VHF data link mode 2 not available, or
  - FANS select key selected and datacommunication radio not available.

TKU to TKZ When a non-ATN identifier is entered, network status displays as:

- NETWORK READY—data communication radio available
- NETWORK NOT READY—data communication radio not available.

6 FLIGHT NUMBER

Normally displays the flight number entered on the FMC route page. When the flight number is not available, box prompts are displayed. Flight number entry on this page is copied to the FMC route page. Changing this entry after establishing an ATC connection cancels the ATC connection.

7 TAIL NUMBER/ORIGIN

TJA,B,C,D,G, H,TKA to TKF TAIL NUMBER:

- Normally supplied by the airplane system. When the airplane tail number (registry number) is not available from the system, box prompts are displayed and a value can be entered. A manual entry will remain until power to AIMS is interrupted. Changing this entry after establishing an ATC connection cancels the ATC connection. Tail number is provided on the SELCAL placard.

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ORIGIN:

- Displays flight number airport of origin.

TJR to TJW, TKK to TKR, TKU to TKZ

DELETION

8 DESTINATION

TJR to TJW, TKK to TKR, TKU to TKZ

Displays destination airport.

9 FANS Select Key

TKU to TKZ

Displays when a four character ATN identifier is entered into the LOGON TO field. Selection allows the flight crew to send a FANS logon request.

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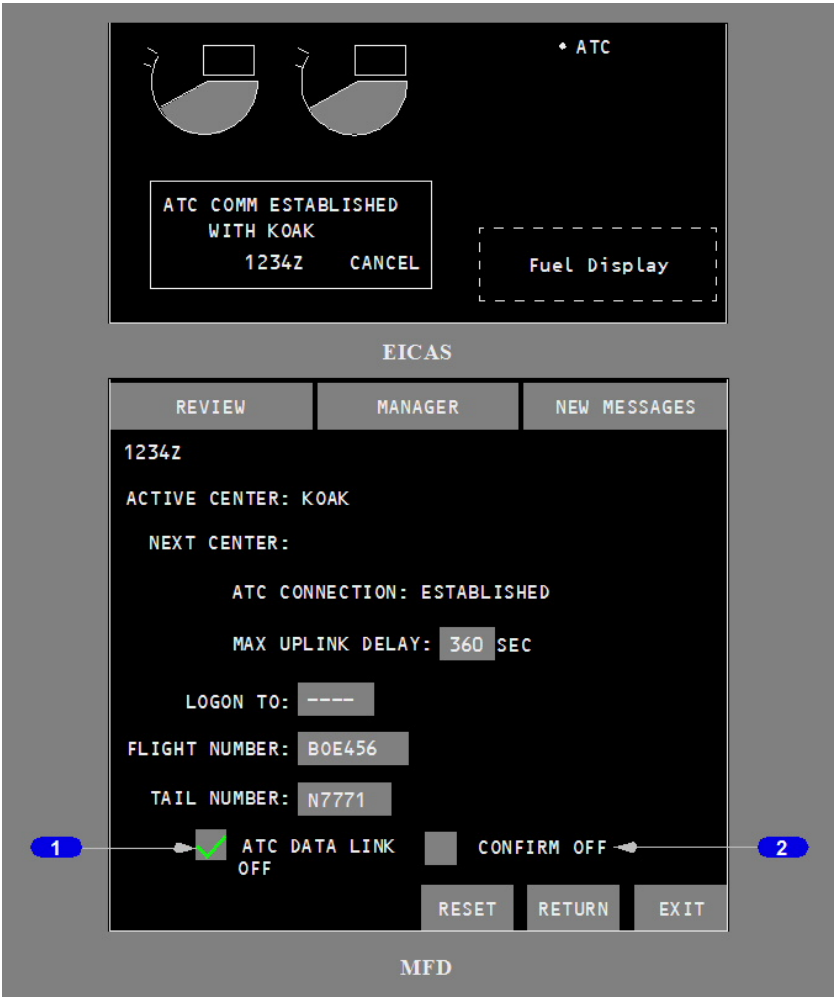
ATC Connection Displays

TJA,B,C,D,G,H,TKA to TKF



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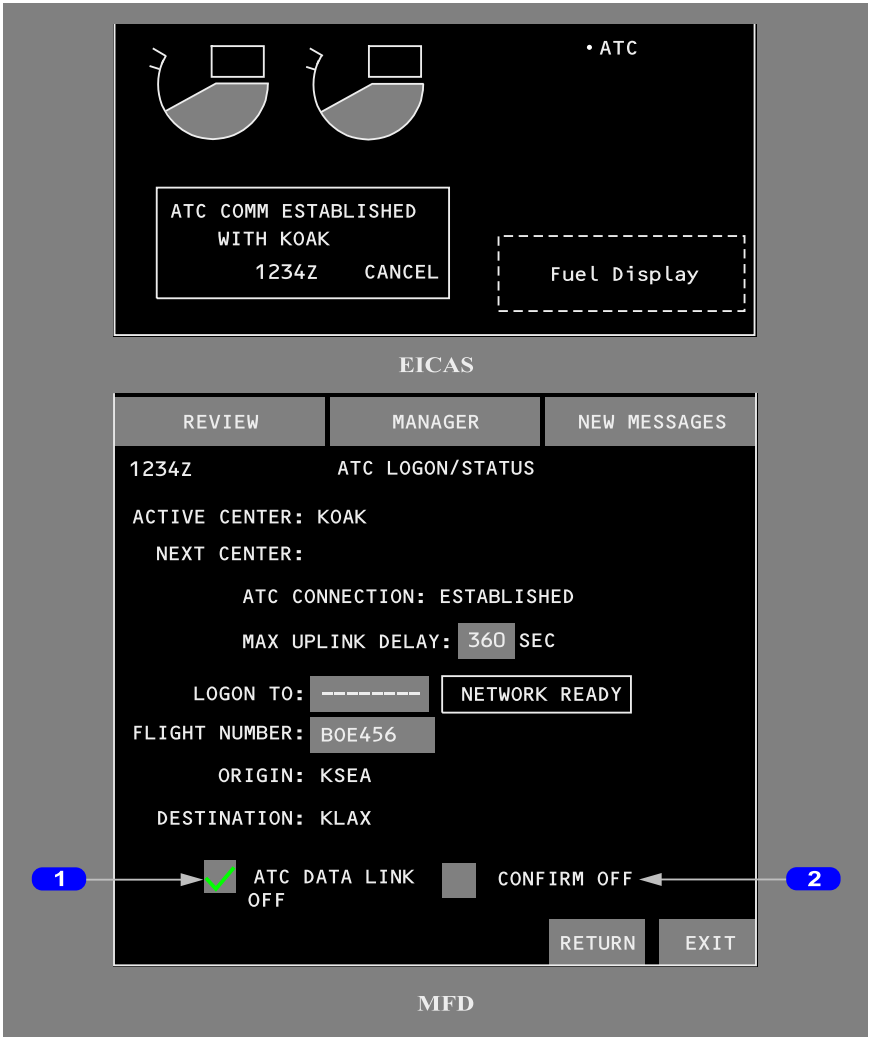
TJR to TJW,
TKK to TKR



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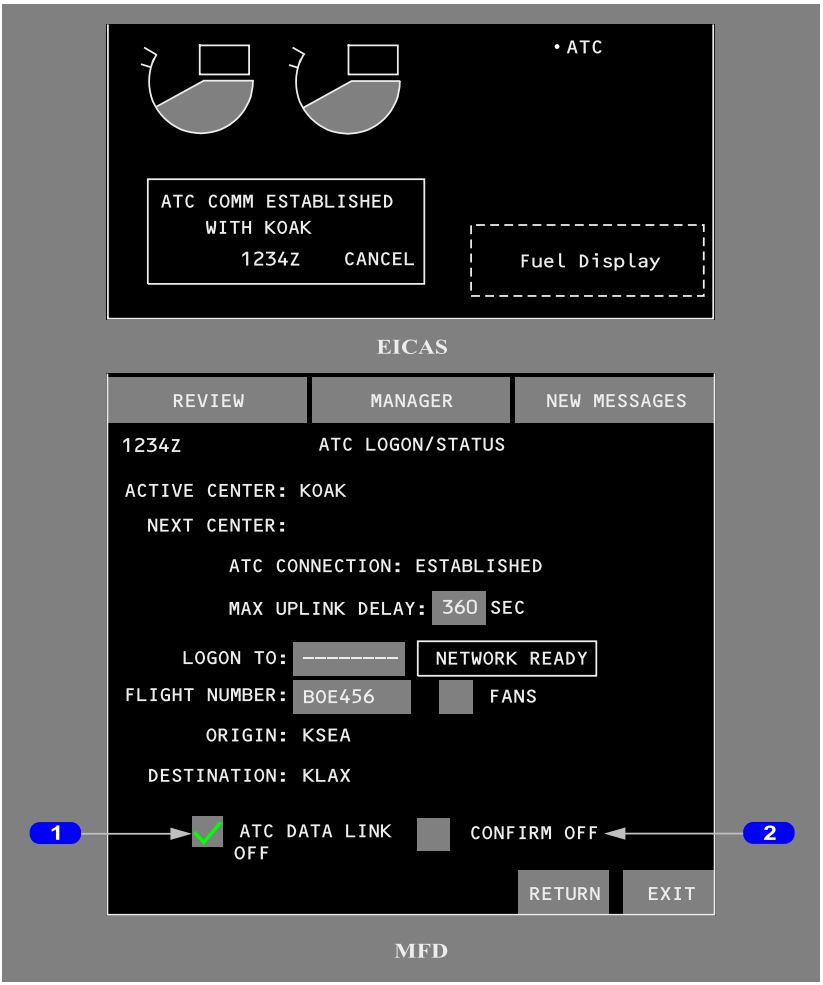
TKU to TKZ



1 ATC DATA LINK OFF

Displayed when an ATC connection is established.

Selecting ATC DATA LINK OFF displays the CONFIRM OFF selection.

2 CONFIRM OFF

Selecting CONFIRM OFF sends the termination request.

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The EICAS communication message •ATC is displayed when the connection is terminated.

Loss of ATC Connection

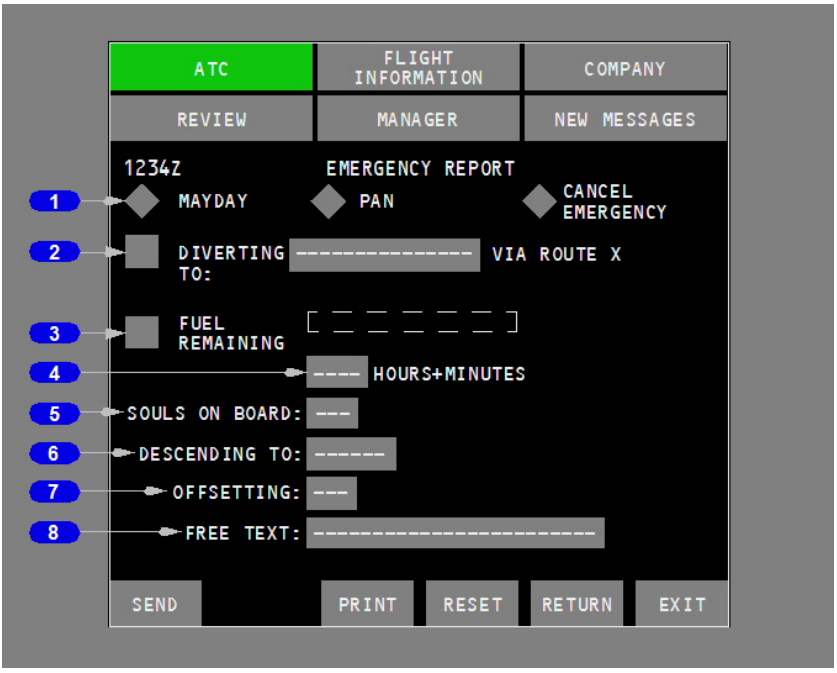
If the EICAS alert message DATALINK LOST is displayed for 16 minutes, the ATC connection is automatically lost and the EICAS communication message •ATC is displayed.

Once an ATC connection is terminated or lost, the logon entries revert to the default values.

Emergency Report

This page informs ATC of an emergency. Sending this report with MAYDAY selected places automatic dependent surveillance (ADS) into the emergency mode.

TJA,B,C,D,G,H,TKA to TKF



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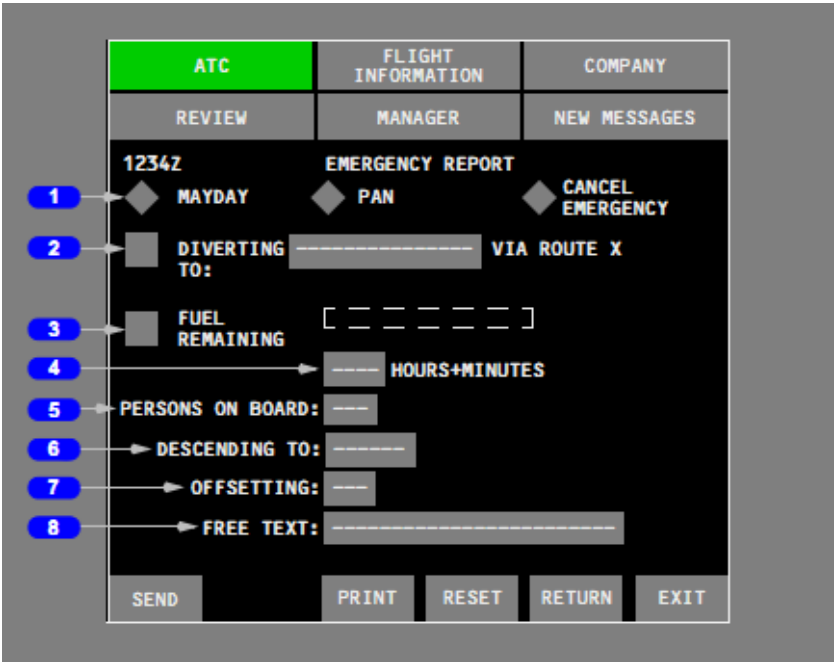
TJR to TJW,
TKK to TKR,
TKU to TKZ



1 MAYDAY, PAN, CANCEL EMERGENCY

Select MAYDAY or PAN emergency. The SEND key becomes active. CANCEL EMERGENCY informs ATC that a previous emergency is now canceled and returns ADS to the normal mode. CANCEL EMERGENCY is inhibited until MAYDAY or PAN downlink is sent.

2 DIVERTING TO

Defaults to the destination airport from the active route. The default route number is displayed. Enter any valid FMC position.

3 FUEL REMAINING

Displays the FMC fuel remaining from the PROGRESS page.

4 FUEL REMAINING—HOURS+MINUTES

Defaults to time provided from the FMC. Manually enter fuel remaining in hours and minutes. Use two numeric characters for hours followed by two numeric characters for minutes.

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5 SOULS ON BOARD/ PERSONS ON BOARD

TJA,B,C,D,G,H,TKA to TKF

SOULS ON BOARD:

- Manual entry of number of souls on board is required. Enter up to three numeric characters.

TJR to TJW, TKK to TKR, TKU to TKZ

PERSONS ON BOARD:

- Manual entry of number of persons on board is required. Enter up to three numeric characters.

6 DESCENDING TO

Enter the altitude for an immediate descent. The default value is the MCP altitude when it is more than 150 feet below current altitude.

7 OFFSETTING

Enter any valid FMC route offset value.

8 FREE TEXT

24 characters of free text can be included.

Note: When data is entered in all fields above OFFSETTING, the system will not accept data entry for the OFFSETTING and FREE TEXT fields. Entering data in one of these two fields displays the MESSAGE LIMIT EXCEEDED information message.

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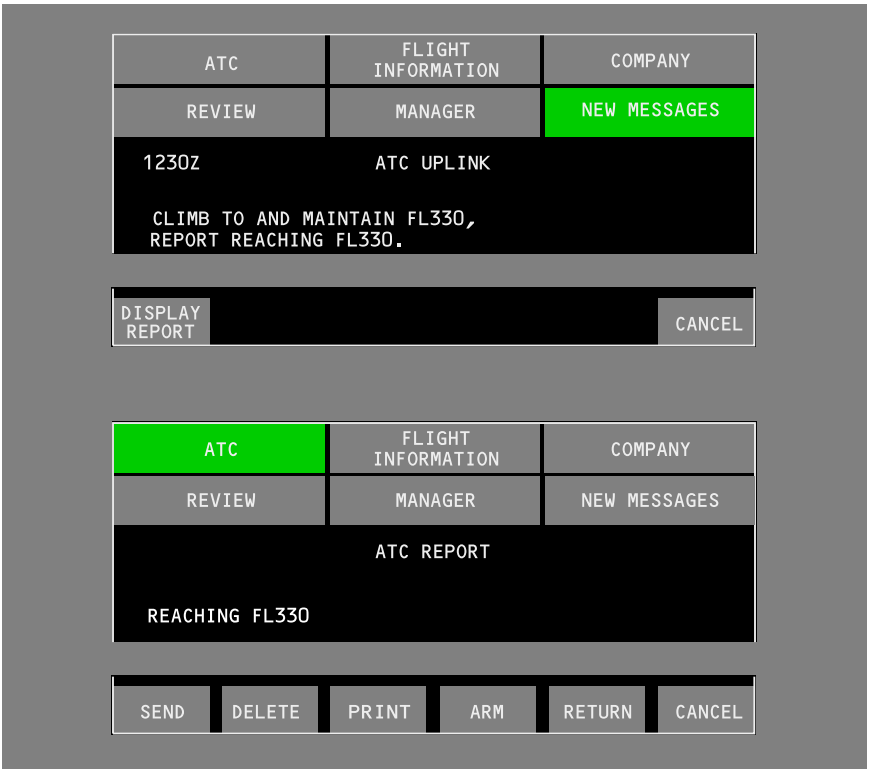
ATC Reports

ATC Requested Report

TJA,B,C,D,G,H,TKA to TKF



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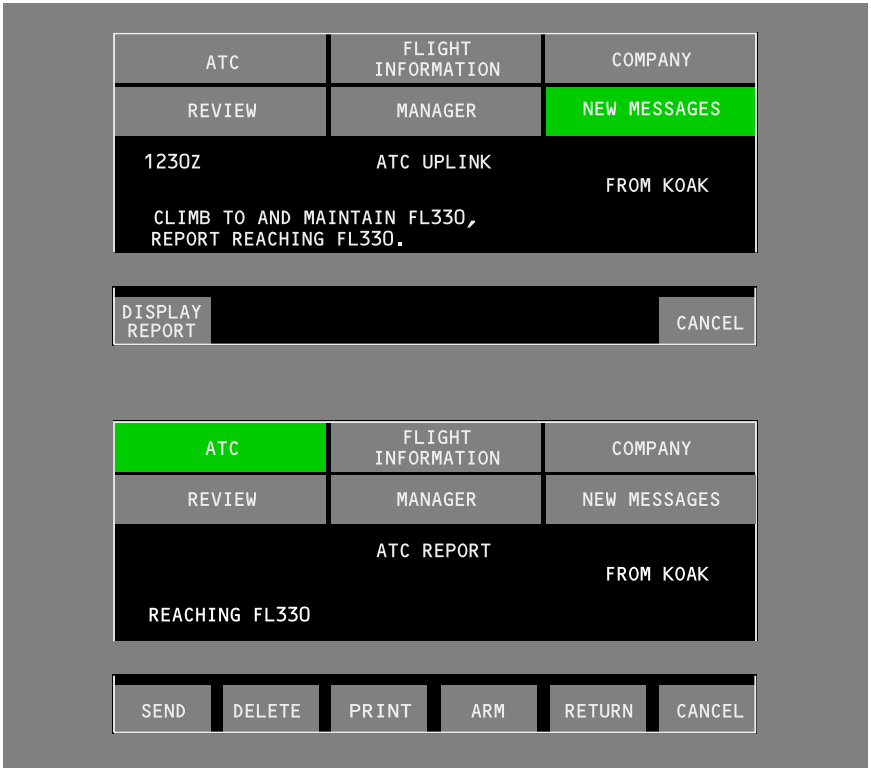
TJR to TJW,
TKK to TKR,
TKU to TKZ



ATC uplink messages can contain a request for a report. When the uplink is accepted, the DISPLAY REPORT key is displayed. Selecting DISPLAY REPORT displays the ATC requested report. A displayed report can be sent. Some reports can be armed for automatic transmission when conditions are met.

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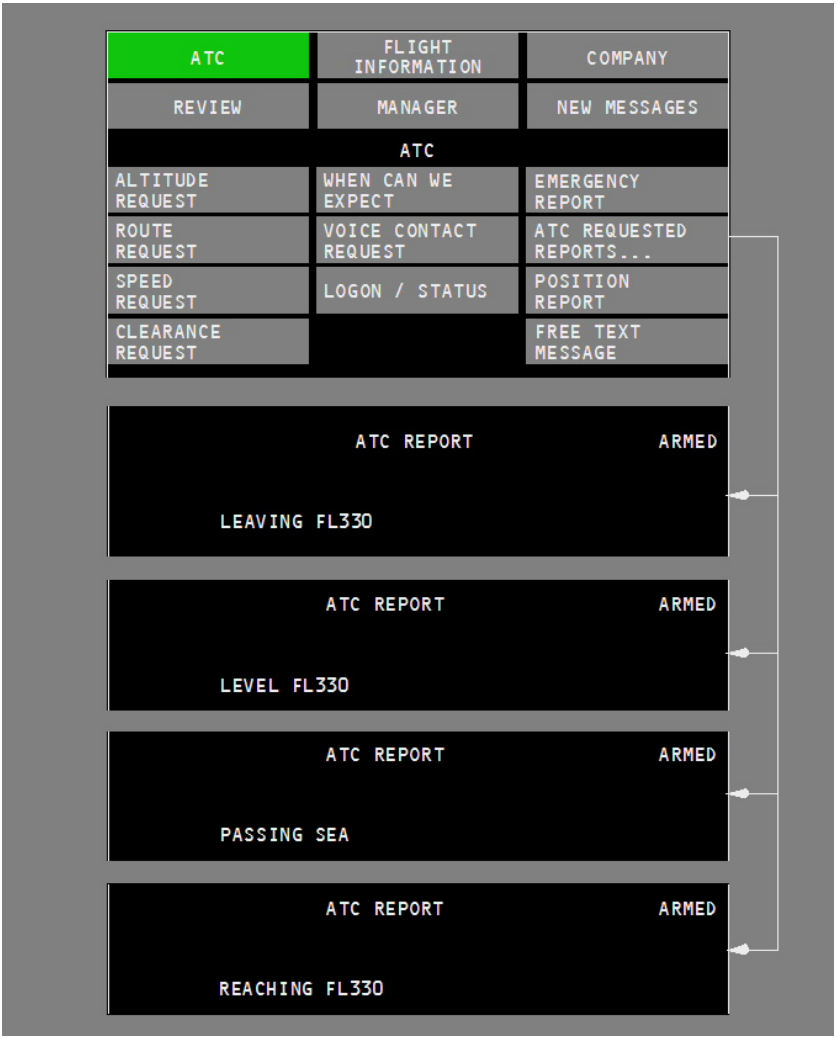
Armable Report

TJA,B,C,D,G,H,TKA to TKF



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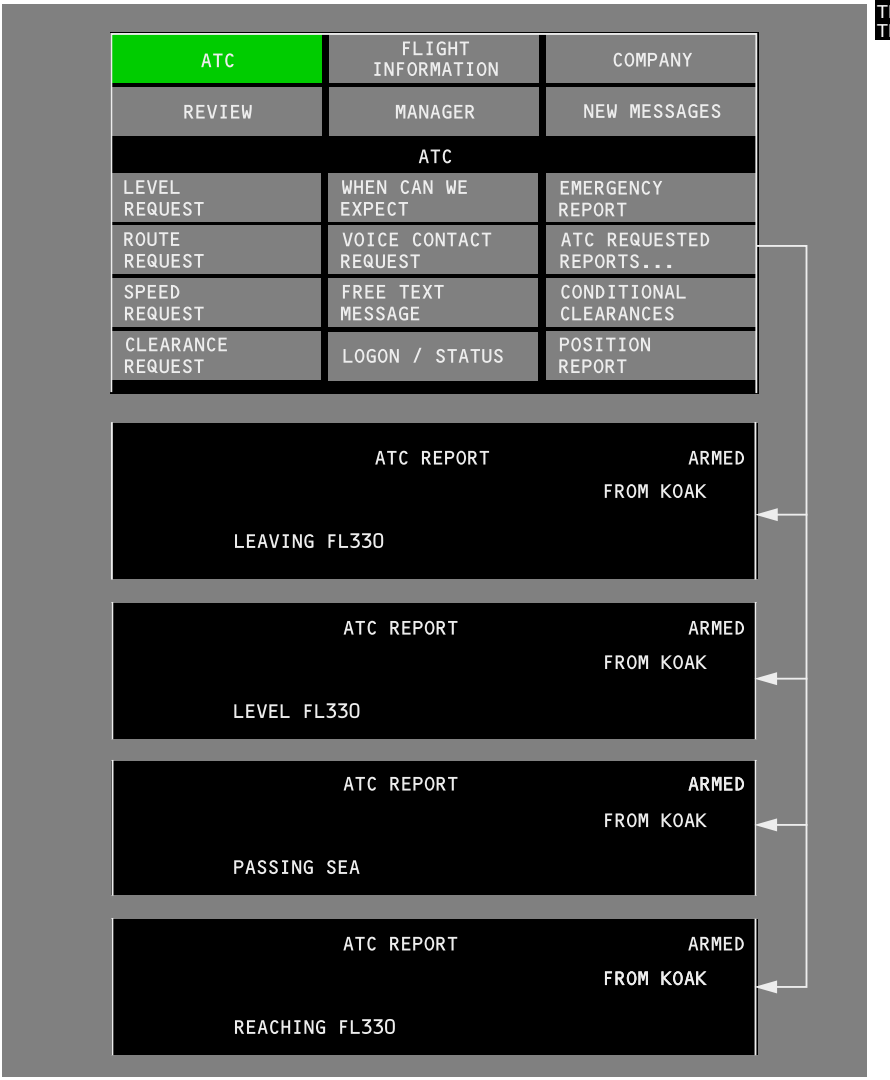
TJR to TJW, TKK to TKR, TKU to TKZ



All reports requested by ATC can be displayed using the ATC REQUESTED REPORT menu selection. The LEAVING, LEVEL, PASSING, and REACHING reports can be armed for automatic transmission. Selecting the ARM key for a report displays ARMED for the report status. When a report is armed, the ARM key changes to DISARM. When a report is automatically transmitted, an ATC uplink message confirms the report was sent.

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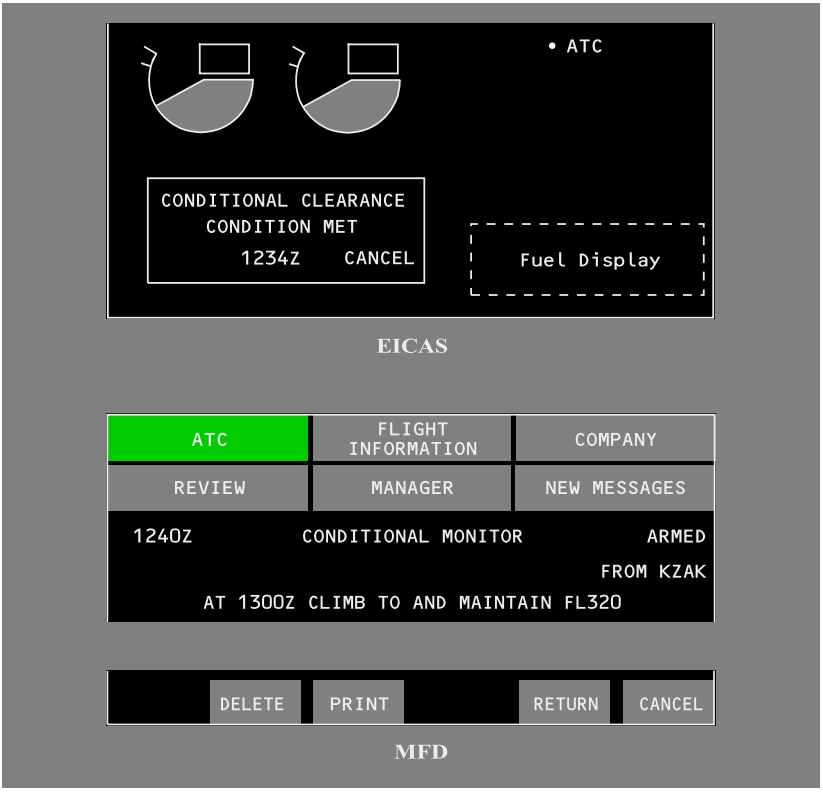
TJR to TJW, TKK to TKR, TKU to TKZ

Conditional Clearances

Conditional clearances are ATC directions for route modification at some future location, time or altitude. The CONDITIONAL CLEARANCES item on the ATC menu is normally non-selectable. It becomes selectable when a conditional clearance is accepted by the flight crew. The communications management system then monitors the clearance parameters and notifies the flight crew with an ATC uplink when each condition is either met or not met.



When a conditional clearance must be canceled (e.g. a new clearance is received by voice that supersedes the conditional clearance) the crew can select CONDITIONAL CLEARANCES from the ATC menu and then choose DELETE on the CONDITIONAL MONITOR page.

Note: Deleting a conditional clearance does not disarm or delete any other ATC requested reports contained in the clearance. Each individual ATC report must be disarmed or deleted manually.

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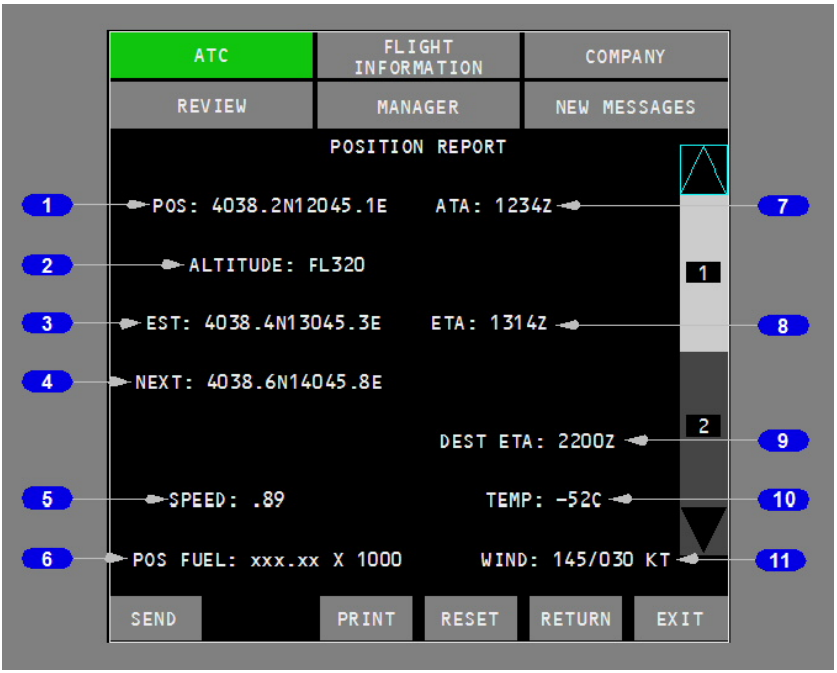
Position Report

Use the POSITION REPORT page to manually send a position report.

Note: Current position is also reported to ATC when sending the POSITION REPORT, but is not displayed.

TJA,B,C,D,G,H,TKA to TKF



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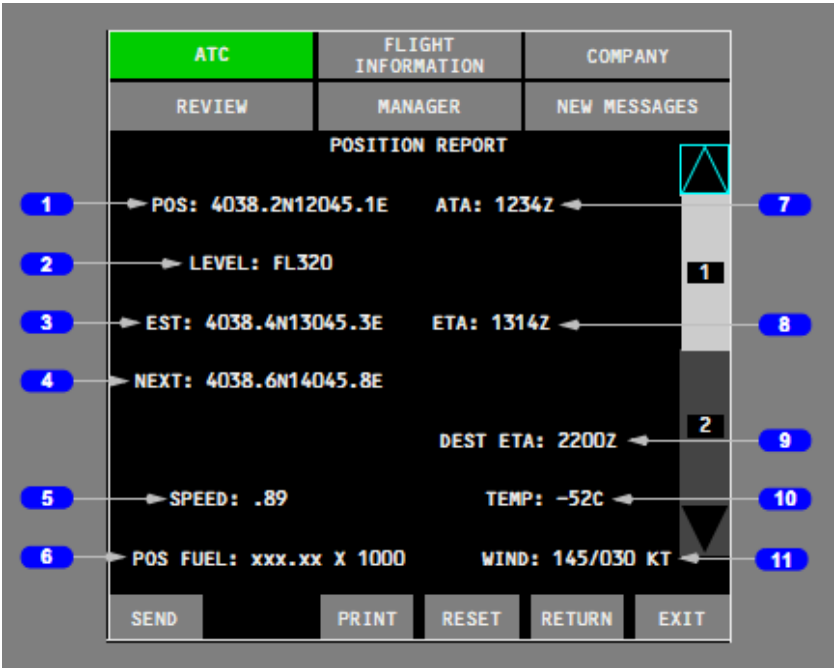
TJR to TJW, TKK to TKR, TKU to TKZ



1 Position (POS)

Displays the last sequenced waypoint. Displays all asterisks (*) when no FMC data is available.

Latitude and longitude are displayed in the same order as the FMC position report page. Degree and minute values precede the compass letter, just as the crew uses in a voice report.

2 ALTITUDE/LEVEL

TJA,B,C,D,G, H,TKA to TKF

ALTITUDE:

- Displays current altitude. Displays all asterisks (*) when no FMC data is available.

TJR to TJW, TKK to TKR, TKU to TKZ

LEVEL:

- Displays current flight level. Displays all asterisks (*) when no FMC data is available.

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3 EST

Displays the active waypoint. Accepts any valid FMC active route waypoint entry. Entry of a waypoint not in the active route results in the INVALID ENTRY message.

4 NEXT

Displays the next waypoint following the EST waypoint. Accepts any valid FMC active route waypoint entry. Entry of a waypoint not in the active route results in the INVALID ENTRY message.

5 SPEED

Displays FMC speed. Accepts valid speed entry.

6 Position (POS) FUEL

Displays FMC calculated fuel remaining at the POS waypoint. Displays all asterisks (*) when no FMC data is available.

7 ATA

Displays actual time of arrival at the last sequenced waypoint. Displays all asterisks (*) when no FMC data is available.

8 ETA

Displays estimated time of arrival for the EST waypoint. Accepts valid time entry.

9 Destination (DEST) ETA

Displays estimated time of arrival for the destination airport. Accepts a valid time entry. Displays all asterisks (*) when no FMC data is available.

10 Temperature (TEMP)

Displays air temperature. Displays all asterisks (*) when no FMC data is available.

11 WIND

Displays wind bearing and speed. Displays all asterisks (*) when no FMC data is available.

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Optional Position Report Items

A report of current turbulence and icing conditions can be included with the position report.

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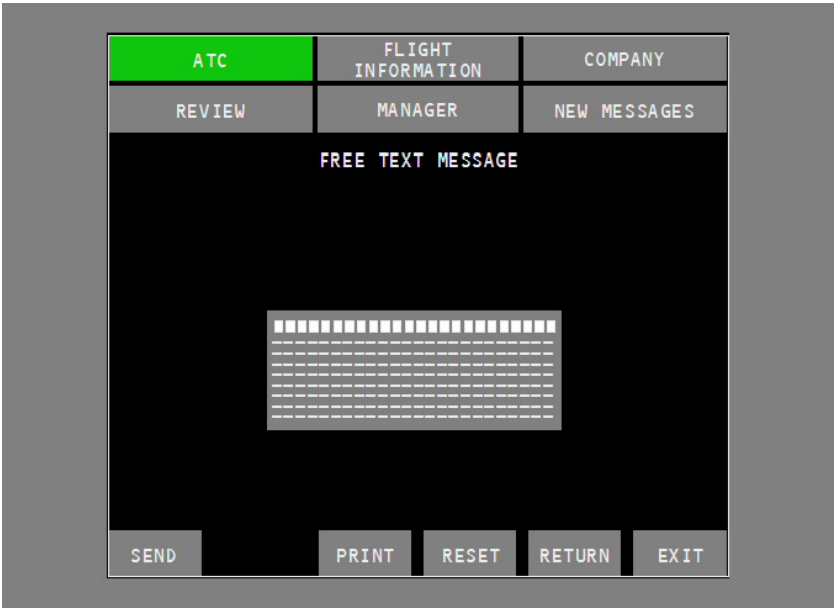
Free Text Message



Nine lines of text can be transmitted.

Flight Information

The flight information function is reserved for future use. The communications main menu FLIGHT INFORMATION selection is inhibited.

TJA,B,C,D,G, H,TKA to TKF

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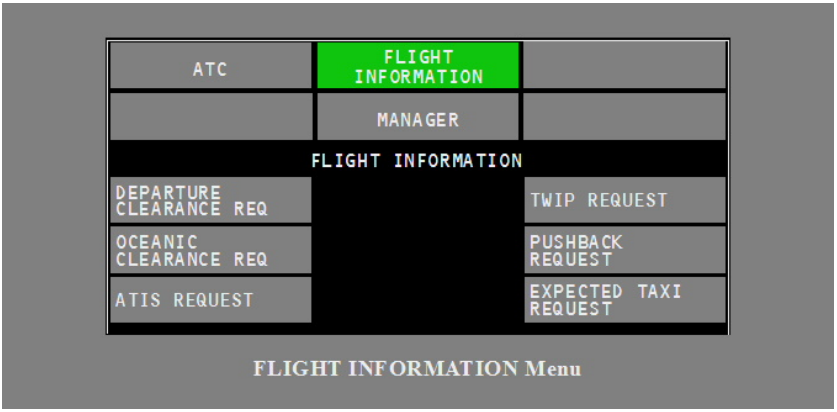
TJR to TJW, TKK to TKR, TKU to TKZ

Flight Information Menu



FLIGHT INFORMATION Menu

The Flight Information menu provides access to FLIGHT INFORMATION downlink pages.

TJR to TJW, TKK to TKR, TKU to TKZ

Departure Clearance Request

The DEPARTURE CLEARANCE REQUEST page allows request downlinks to obtain clearance via datalink in a more timely manner with reduced risk of

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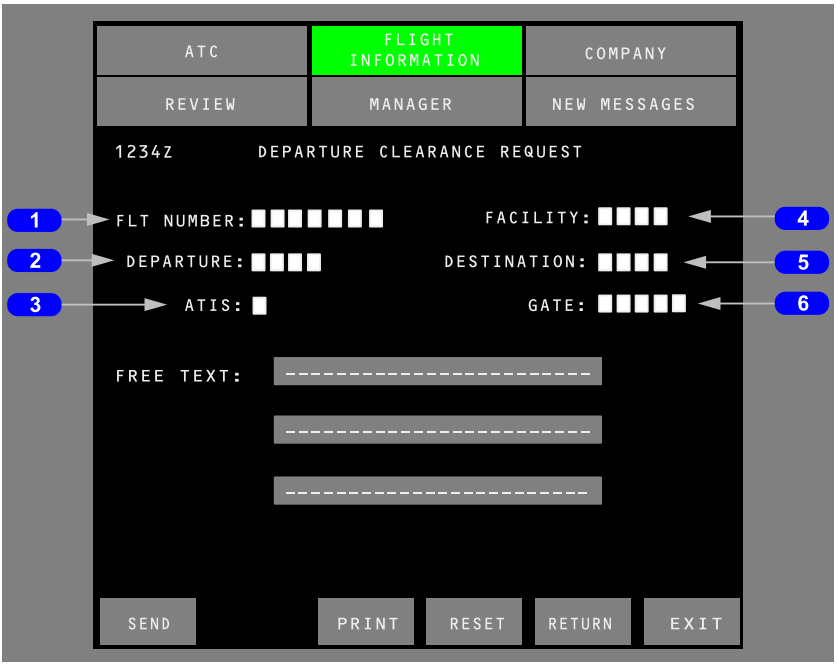
incorrect voice transmission. The clearance may be viewed on the MFD or printed.



1 FLIGHT NUMBER

Flight number defaults to FMC flight number, if entered. If previously entered and flight number is more than 7 characters, only the first 7 characters display.

When boxes display, valid entry is flight number up to 7 characters.

2 DEPARTURE

Departure airport defaults to FMC origin.

Valid entry is a valid ICAO identifier.

3 ATIS

Valid entry is any character A through Z.

4 FACILITY

Valid entry is a 4 character ATC facility identifier.

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5 DESTINATION

Destination airport defaults to FMC destination.

Valid entry is a valid ICAO identifier.

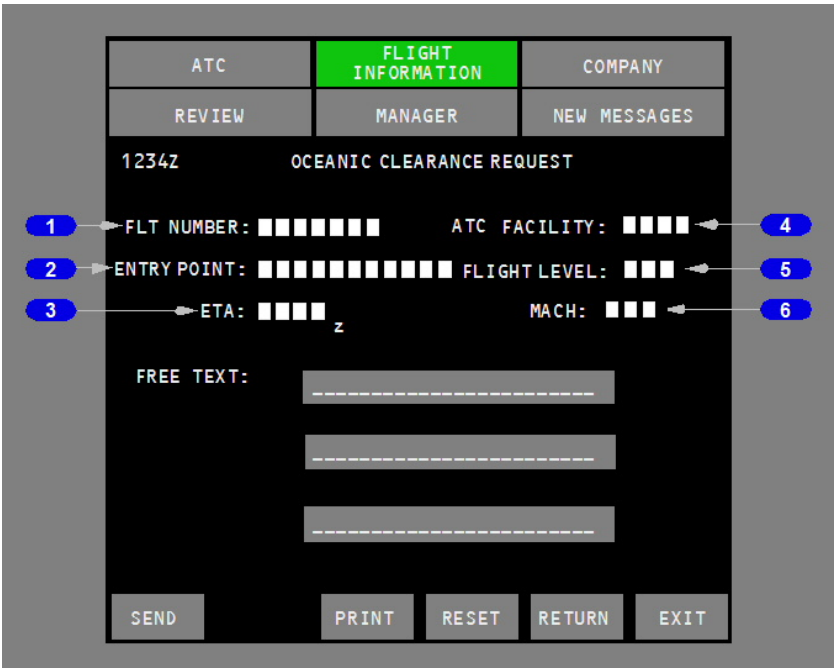
6 GATE

Valid entry is a gate number at the reference airport, POS INIT page.

TJR to TJW, TKK to TKR, TKU to TKZ

Oceanic Clearance Request

The OCEANIC CLEARANCE REQUEST page allows request downlinks to obtain clearance via datalink in a more timely manner with reduced risk of incorrect voice transmission. The clearance may be viewed on the MFD or printed.



1 FLIGHT NUMBER

Flight number defaults to FMC flight number, if entered. If previously entered and flight number is more than 7 characters, only the first 7 characters display.

When boxes display, valid entry is flight number up to 7 characters.

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2 ENTRY POINT

Valid entry is up to 15 characters; tenths of a minute of latitude or longitude may not display. A valid entry must be at least 3 characters. Entries of 7 or more characters are decoded as a latitude/longitude.

3 ETA

If an ENTRY POINT has been entered, it is a waypoint in the active route, and an ETA has not been entered; the ETA box defaults to the predicted ETA at the waypoint.

Valid entry is any time in the range 0000 to 2359.

4 ATC FACILITY

Valid entry is a 4 character ATC facility identifier.

5 FLIGHT LEVEL

Valid entry is a 3 character flight level; for example, 350.

6 MACH

Valid entry is any Mach number between 0.4 and 0.92. Entry of leading zero and decimal point is not required.

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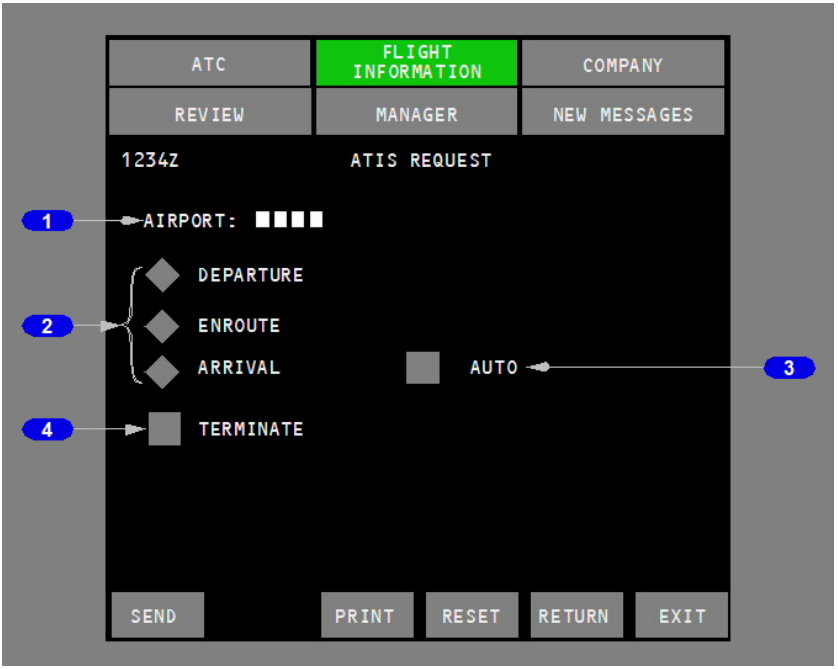
TJR to TJW, TKK to TKR, TKU to TKZ

ATIS Request

The ATIS REQUEST page allows request downlinks for digital ATIS information without using voice radio. ATIS information may be viewed on the MFD or printed.



1 AIRPORT

If a departure airport exists in the active route and the airplane is on the ground, the default entry is the departure airport. If the destination airport exists in the active route and the airplane is in flight, the default entry is the destination airport.

Valid entry is a four character ICAO identifier.

2 ATIS SELECTOR GROUP

The default is none selected. Only one selection can be made at a time. The SEND key becomes active with selection. Pushing the SEND key requests the selected information.

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3 AUTOMATIC UPDATE

If ARRIVAL selected, the AUTO update selection box displays. Selection provides automatic updating. If ENROUTE selected, updating is automatic; AUTO does not display.

4 TERMINATE

Displays when an ENROUTE or ARRIVAL AUTO update has been selected. Selection cancels automatic updating and sets ATIS SELECTOR to none selected.

The SEND key becomes active with this selection.

TWIP Request

TJR to TJW, TKK to TKR, TKU to TKZ

The Terminal Weather Information for Pilots (TWIP) REQUEST page allows request downlinks for digital TWIP information without using voice radio. TWIP information may be viewed on the MFD or printed.

1 AIRPORT

Valid entry is a four character ICAO identifier.

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2 TWIP SELECTOR

The default is none selected. Only one selection can be made at a time. The SEND key becomes active with selection. Pushing the SEND key requests the selected information.

3 TERMINATE AUTOMATIC UPDATE

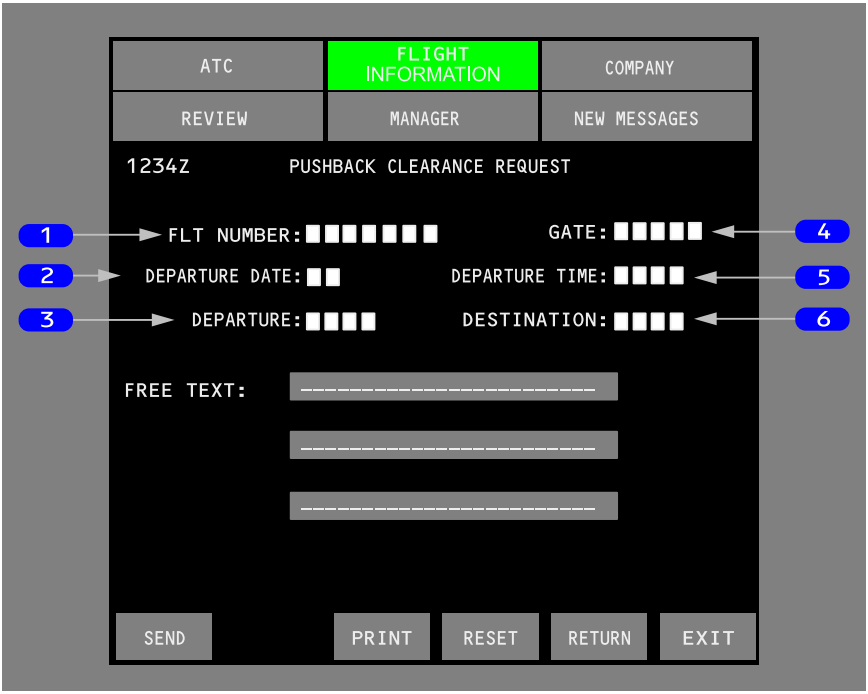
Displays when AUTOMATIC UPDATE has been selected. Selection cancels automatic updating and sets TWIP SELECTOR to none selected.

The SEND key becomes active with this selection.

TJR to TJW, TKK to TKR, TKU to TKZ

Pushback Clearance Request

The PUSHBACK CLEARANCE REQUEST page allows request downlinks to obtain clearance via datalink in a more timely manner with reduced risk of incorrect voice transmission. The clearance may be viewed on the MFD or printed.



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1 FLIGHT NUMBER

Flight number defaults to FMC flight number, if entered. If previously entered and flight number is more than 7 characters, only the first 7 characters display.

When boxes display, valid entry is flight number up to 7 characters.

2 DEPARTURE DATE

Valid entry is scheduled departure date.

3 DEPARTURE

Departure airport defaults to FMC origin.

Valid entry is a valid ICAO identifier.

4 GATE

Valid entry is a gate number at the reference airport, POS INIT page.

5 DEPARTURE TIME

Valid entry is scheduled departure time.

6 DESTINATION

Destination airport defaults to FMC destination.

Valid entry is a valid ICAO identifier.

Expected Taxi Clearance Request

TJR to TJW, TKK to TKR, TKU to TKZ

The EXPECTED TAXI CLEARANCE REQUEST page allows request downlinks to obtain clearance via datalink in a more timely manner with reduced risk of

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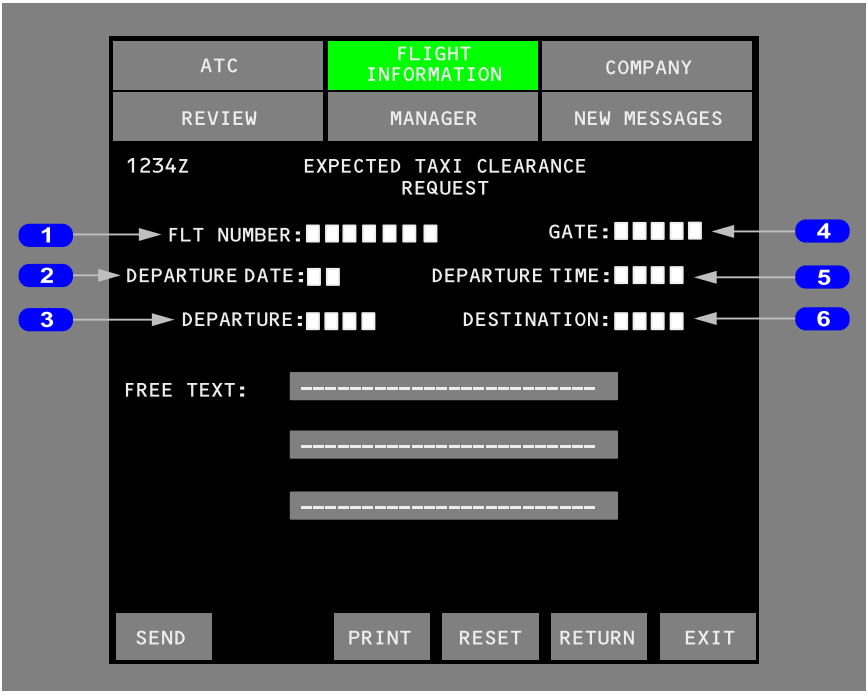
incorrect voice transmission. The clearance may be viewed on the MFD or printed.



1 FLIGHT NUMBER

Flight number defaults to FMC flight number, if entered. If previously entered and flight number is more than 7 characters, only the first 7 characters display.

When boxes display, valid entry is flight number up to 7 characters.

2 DEPARTURE DATE

Valid entry is scheduled departure date.

3 DEPARTURE

Departure airport defaults to FMC origin.

Valid entry is a valid ICAO identifier.

4 GATE

Valid entry is a gate number at the reference airport, POS INIT page.

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5 DEPARTURE TIME

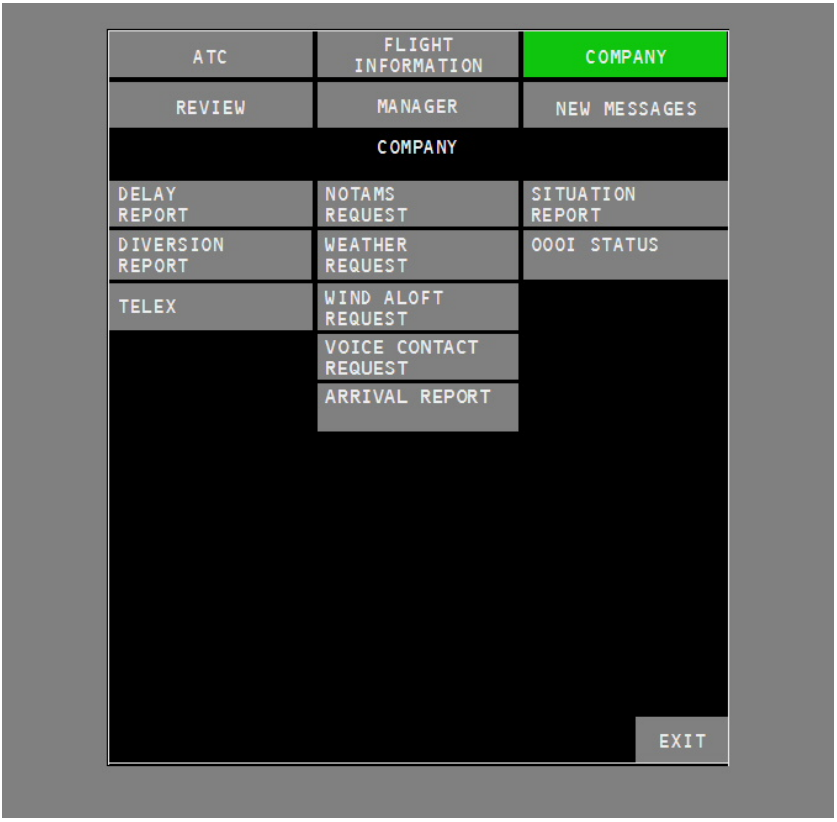
Valid entry is scheduled departure time.

6 DESTINATION

Destination airport defaults to FMC destination.

Valid entry is a valid ICAO identifier.

Company Menu



Company downlink menus are accessed by selecting the COMPANY function.

Note: Situation report is HIJACK REPORT. Sending this report alerts the ATC, and organization concerned.

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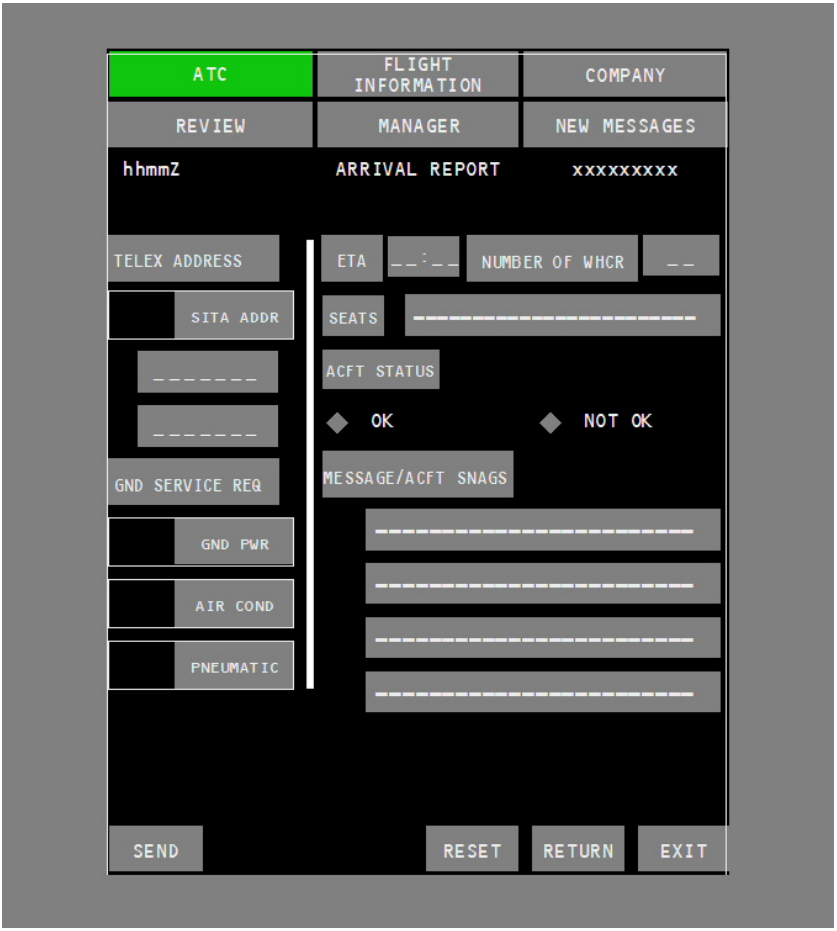
Arrival Report



The arrival report page combines ETA report, gate assignment request, and ground service request into a single downlink message. In addition, telex and important airplane SNAG message can be inserted for operating and maintenance actions.

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Company Downlink Message Page

This COMPANY report page shows both exclusive and nonexclusive selections, a required entry, and optional menu selections.

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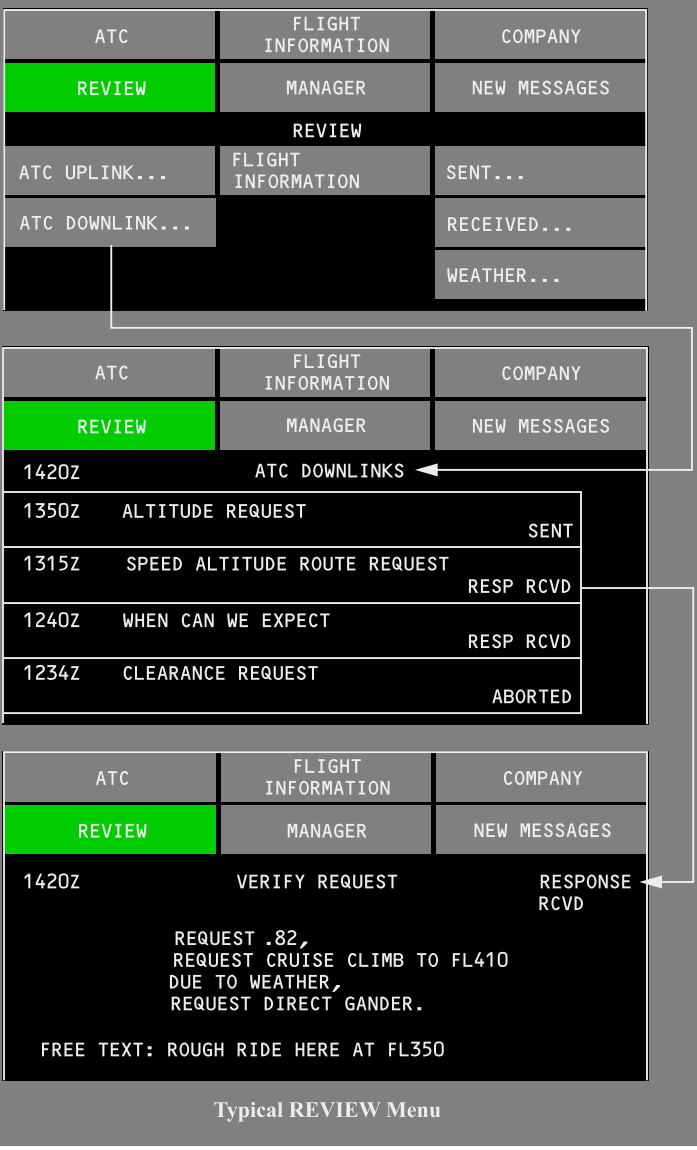
Review Menu



Typical REVIEW Menu

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Review messages are accessed by selecting the REVIEW menu. Both uplink and downlink messages are displayed in review lists. The review menu is inhibited (cyan) if there are no review messages in that category.

Review State Indicators

Each review message list field and each review message displays the last state of the referenced message. Only one state can apply to a message at a time.

State Indicator	Condition
ABORTED	ATC data link connection lost before sending response to uplink message or completing a downlink message.
ACCEPTING	The received message was displayed and an ACCEPT response was initiated.
ACCEPTED	The received message was displayed, an ACCEPT response was initiated, and the service provider has acknowledged receipt of the response.
DISPLAYED	The received message was displayed (no accept/reject response was required).
NO ACCEPT	The received message was displayed, an ACCEPT response was initiated, but the service provider did not acknowledge receipt of the response.
NO REJECT	The received message was displayed, a REJECT response was initiated, but the message destination did not acknowledge receipt of the response.
NO SEND	The downlink message was initiated to be sent and the service provider did not acknowledge receipt of the message.
REJECTING	The received message was displayed and a REJECT response was initiated.
REJECTED	The received message was displayed, a REJECT response was initiated, and the message destination has acknowledged receipt of the response.
RESPONSE RCVD	ATC uplink message received in response to a downlink request.
SENDING	The downlink message was initiated to be sent.
SENT	The downlink message was initiated to be sent and the service provider has acknowledged receipt of the message.

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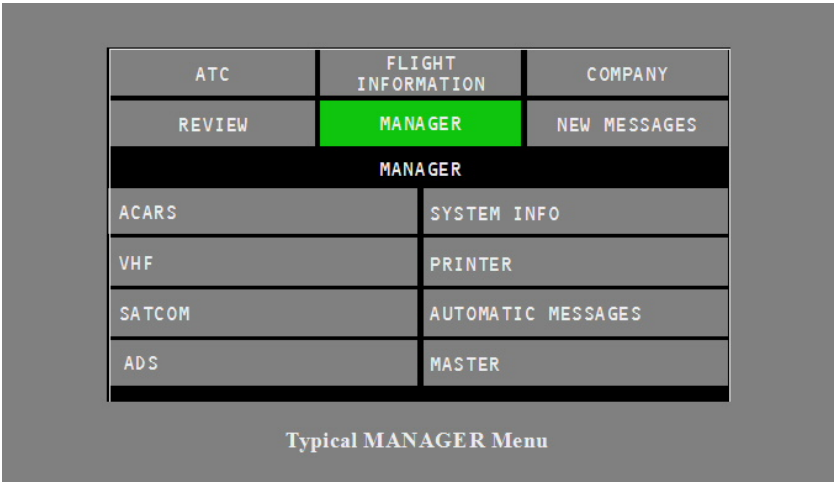
Manager Functions

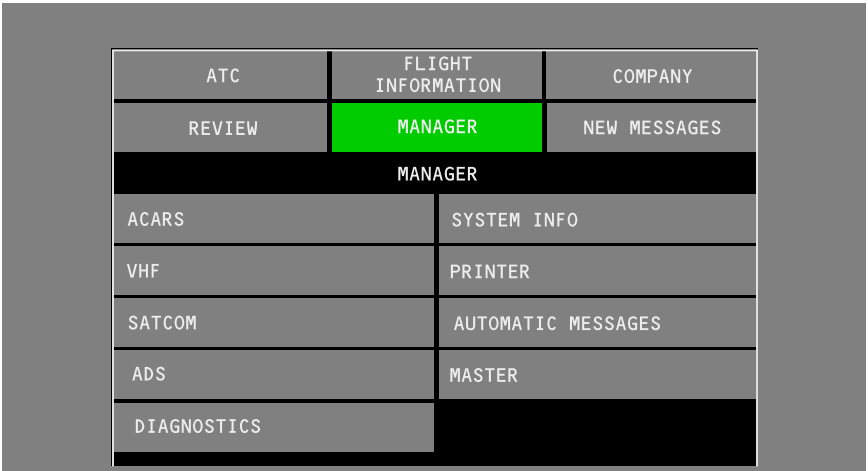
Manager Menu

TJA,B,C,D,G,H,TKA to TKF



Typical MANAGER Menu

TKU to TKZ*



Typical MANAGER Menu

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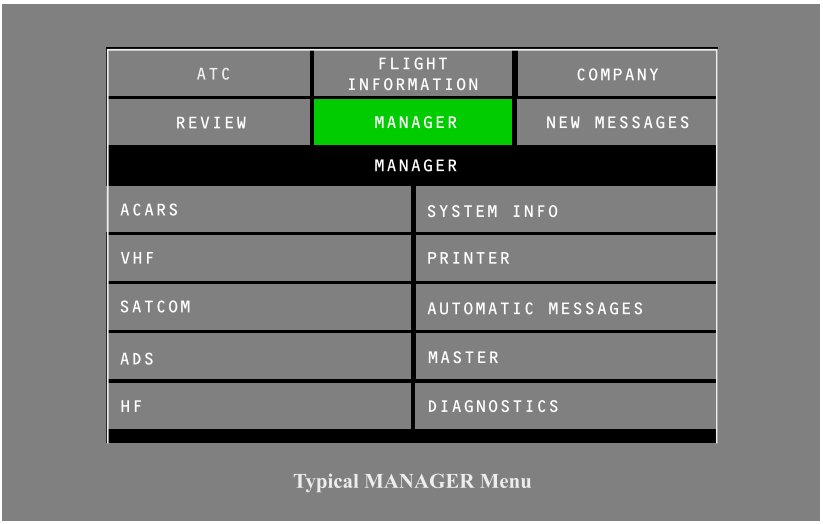
DELETION

TJR to TJW, TKK to TKR



Typical MANAGER Menu

The MANAGER menu page provides access to the manager functions.

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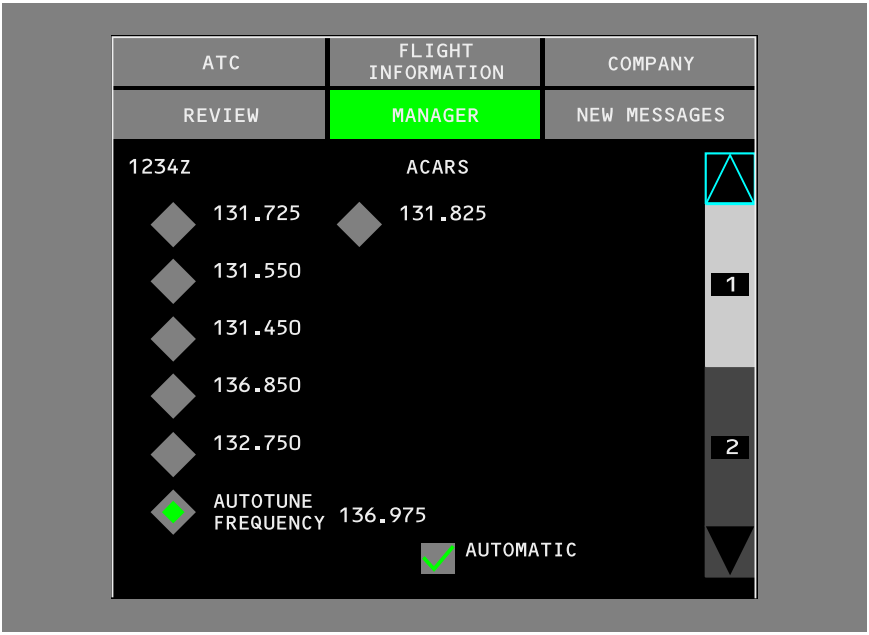
ACARS Manager



The ACARS manager page provides selection of ACARS frequencies. Manager messages related to ACARS are on ACARS page two.

The AUTOMATIC key is selected by default and frequency selection is controlled by ACARS. Manually selecting a frequency or deselecting the AUTOMATIC key places ACARS in manual mode and disables automatic frequency scanning. If the AUTOMATIC key is subsequently selected, the system returns to automatic mode and frequency selection is controlled by ACARS. If the service provider uplinks a request to change frequency, the AUTOTUNE FREQUENCY key displays and ACARS tunes to the requested frequency.

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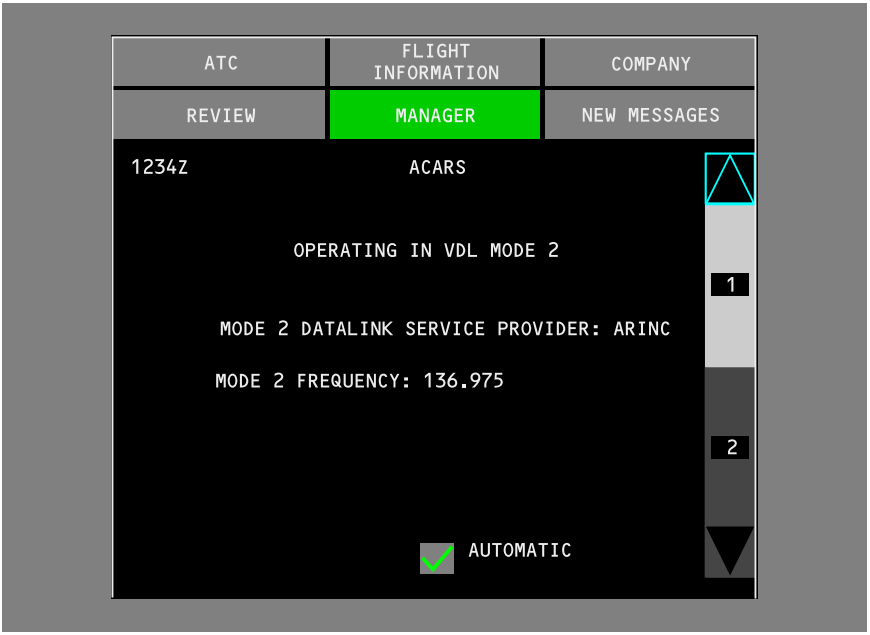
DELETION

TKK to TKR, TKU to TKZ*



DELETION

When operating in VHF datalink (VDL) mode 2, only the service provider, active frequency, and AUTOMATIC key are displayed. Deselecting the AUTOMATIC key places ACARS in manual mode and returns to the previous page format with highest priority frequency for current position selected.

TKK to TKR, TKU to TKZ*

ACARS Manager Page 2/2

This page allows the operator to select/deselect VHF or SATCOM transmission of data. ACARS is set to auto mode (both boxes selected) at power-up or during a manual data communication system reset. Normally, this permits ACARS to automatically use VHF or SATCOM (if VHF is unavailable). If both boxes are deselected, ACARS loses the capability to send downlink messages, but can receive and display uplink messages.

TJA,B,C,D,G, H,TKA to TKE, TKU to TKZ

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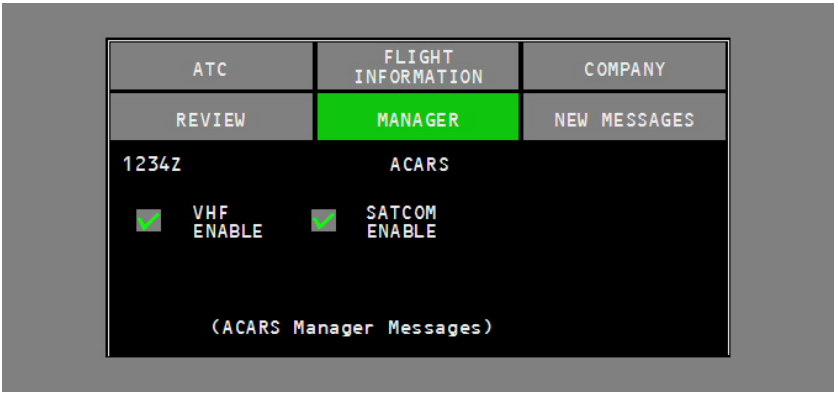
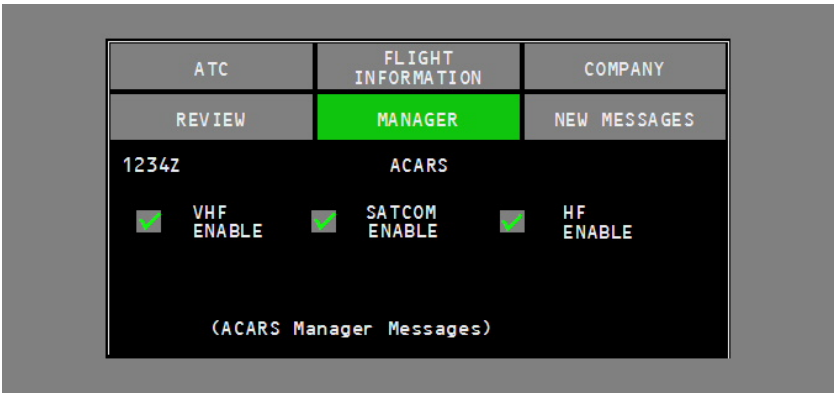
TJA,B,C,D,G, H,TKA to TKF, TKU to TKZ



TJR to TJW, TKK to TKR

This page allows the operator to select/deselect VHF, SATCOM, or HF transmission of data. ACARS is set to automode (all boxes selected) at power-up or during a manual data communication system reset. Normally, this permits ACARS to automatically use VHF, SATCOM (if VHF is unavailable), or HF (if VHF and SATCOM are unavailable). If all boxes are deselected, ACARS loses the capability to send downlink messages, but can receive and display uplink messages.

TJR to TJW, TKK to TKR



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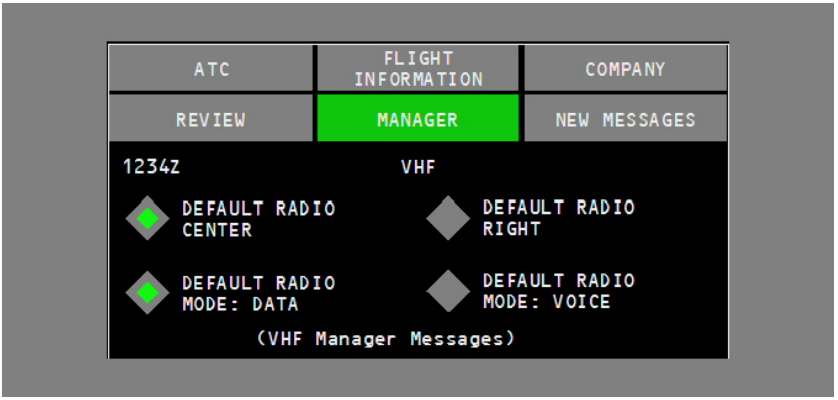
VHF Manager



The VHF manager page provides the capability to select the default radio and to configure the default radio to the voice or data mode. Manager messages related to the VHF system are also presented on this page.

If the DEFAULT RADIO CENTER key is selected, the center VHF radio becomes the default radio. If the DEFAULT RADIO RIGHT key is selected, the right VHF radio becomes the default radio.

If the DEFAULT RADIO MODE DATA key is selected, the default radio is set to the data mode. If the DEFAULT RADIO MODE VOICE key is selected, the default radio is set to the voice mode.

Notes: 1. To select another VHF default radio, the SATCOM ENABLE key must be deselected on ACARS manager page 2. TJA,B,C,D,G, H,TKA to TKF, TKU to TKZ

2. To select another VHF default radio, the SATCOM ENABLE and HF ENABLE key must be deselected on ACARS manager page 2. TJR to TJW, TKK to TKR

If the DEFAULT RADIO MODE DATA key is selected, the default radio is set to data mode. If the DEFAULT RADIO MODE VOICE key is selected, the default radio is set to voice mode.

Note: The default radio can also be set to data or voice mode using the Radio Turning Panel.

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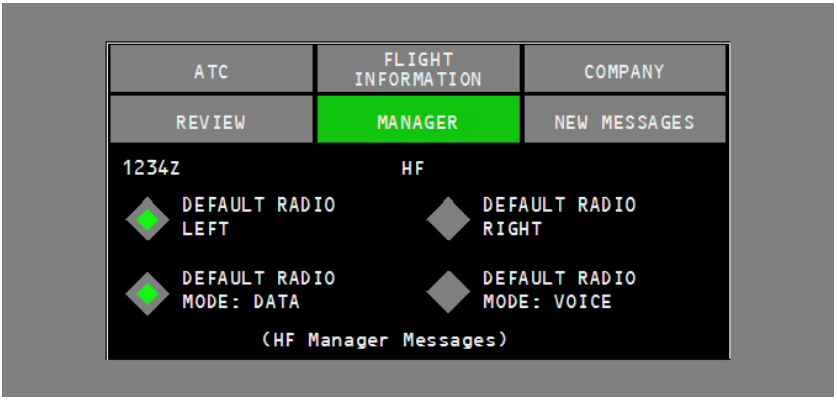
TJR to TJW, TKK to TKR

HF Manager

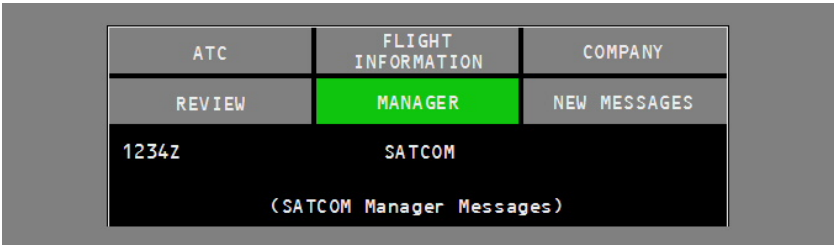


If the DEFAULT RADIO LEFT is selected, the left HF radio becomes the default radio. If the DEFAULT RADIO RIGHT is selected, the right HF radio becomes the default radio.

If the DEFAULT RADIO MODE: DATA is selected, the default HF radio is set to data mode. If the DEFAULT RADIO MODE: VOICE is selected, the default HF radio is set to voice mode.

Note: The default HF radio can also be set to the data or voice mode via the Radio Tuning Panel.

SATCOM Manager



The SATCOM manager page displays manager messages related to the SATCOM system.

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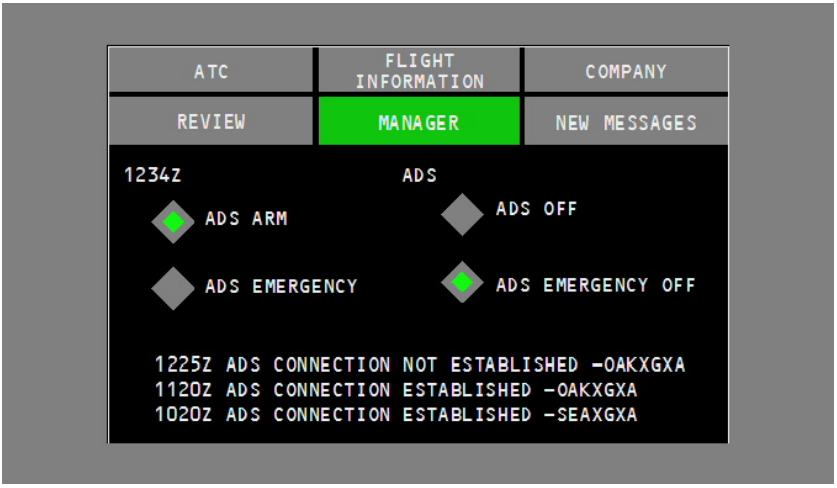
Automatic Dependent Surveillance Manager



When ADS is armed, AUTOMATIC position report messages are sent to ATC and COMPANY.

The ADS page controls the following airplane ADS functions:

- ADS ARM—allows airplane ADS functions
- ADS OFF—inhibits airplane ADS functions
- ADS EMERGENCY—sends an alert to ATC indicating an emergency situation (resets to ADS EMERGENCY OFF at power-up)
- ADS EMERGENCY OFF—cancels emergency indication to ATC.

A list of ADS connection status is displayed on the ADS page.

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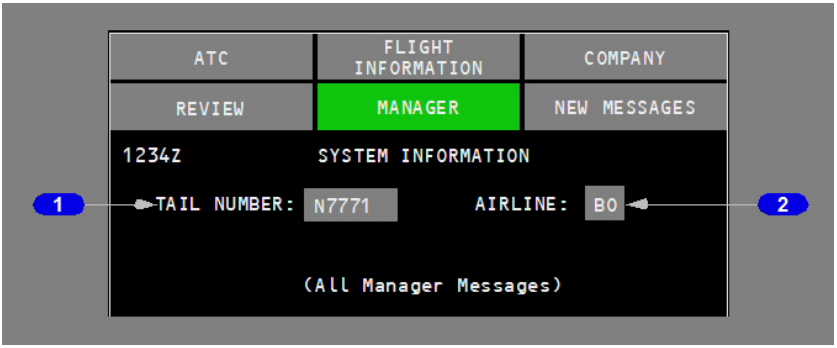
System Information Manager

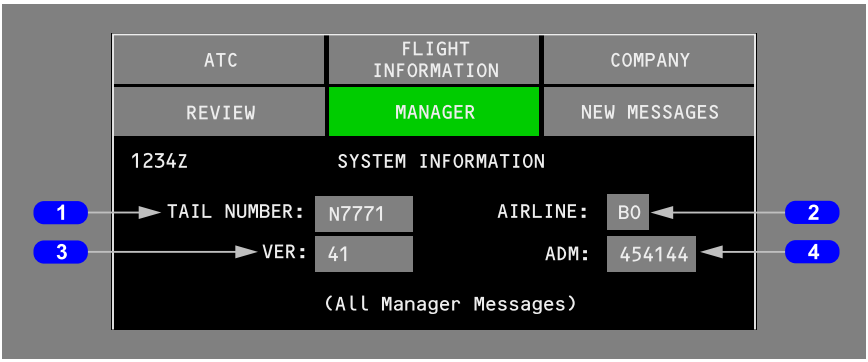
The system information manager page displays manager messages for all applicable systems.

TJA,B,C,D,G,H, TKA to TKF*



TJR to TJW, TKK to TKR

TKU to TKZ



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1 TAIL NUMBER

Normally supplied by the airplane system. When the airplane tail number (registry number) is not available from the system, box prompts are displayed and a value can be entered. A manual entry will remain until power to AIMS is interrupted. Changing this entry after establishing an ATC connection cancels the ATC connection. Tail number is provided on the SELCAL placard. TJA,B,C,D,G, H, TKA to TKF*

Normally supplied by the airplane system. When the airplane tail number (registry number) is not available from the system or a hot battery power cycle has occurred, box prompts are displayed and a value can be entered. If a hot battery power cycle has occurred, manually entering the tail number will validate the tail number provided by the system. The tail number then becomes a non-modifiable field. If the tail number was not available from the system, a manual entry will remain until power to AIMS is interrupted. Changing this entry after establishing an ATC connection cancels the ATC connection. Tail number is provided on the SELCAL placard. Manual entry is inhibited after engine start. TJR to TJW, TKK to TKR, TKU to TKZ*

2 AIRLINE

Normally supplied by the airplane system, but can be manually entered or overwritten. When the airline identifier is not available from the system, box prompts are displayed. A valid entry is two alphanumeric characters and will remain until power to AIMS is interrupted. Changing this entry after establishing an ATC connection cancels the ATC connection.

3 VER

TKU to TKZ

The VER field is used in ATN CPDLC addressing. Normally supplied by the airplane system, but can be manually entered or overwritten. When the VER field is not available from the system, box prompts are displayed. A valid entry is two hexadecimal characters and will remain until power to AIMS is interrupted. The only valid entry is 41. Other than an entry made when box prompts are displayed, changing the value causes ACARS to reset to voice mode.

4 ADM

TKU to TKZ

The ADM field is used in ATN CPDLC addressing. Normally supplied by the airplane system, but can be manually entered or overwritten. When the ADM field is not available from the system, box prompts are displayed. A valid entry is six hexadecimal characters and will remain until power to AIMS is interrupted. The value of this field is the airline ICAO three character identifier in hexadecimal. Other than an entry made when box prompts are displayed, changing the value causes ACARS to reset to voice mode.

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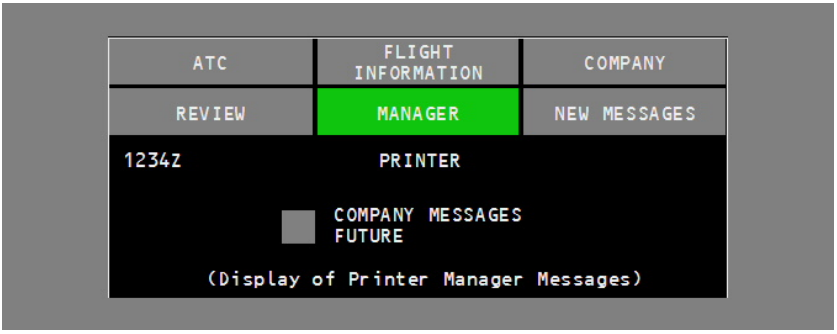
Printer Manager



The printer manager page can be set to send messages directly to the printer. Manager messages related to the printer system are also presented on this page.

If the COMPANY MESSAGES FUTURE key is selected, company messages that normally display on the MFD are sent directly to the printer and the •PRINTER EICAS message is displayed. Future messages are not included in the new messages or review categories.

Automatic Messages Manager

The AUTO MESSAGES OFF selection inhibits automatic sending, display, or printing of company messages. Manager messages related to the automatic messages capability are also presented on this page.

When the AUTOMATIC MESSAGES OFF key is selected, the CONFIRM OFF key is displayed. Selecting the CONFIRM OFF key turns off the capability to automatically send, display, or print company messages.

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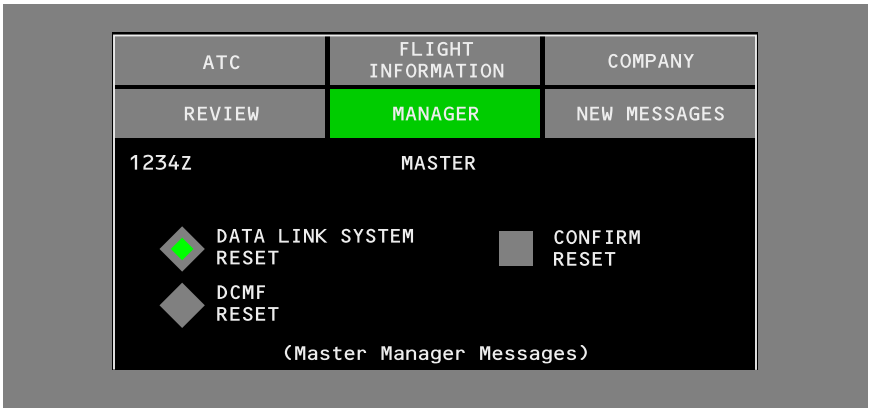
Master Manager

TJA,B,C,D,G, H,TKA to TKF

TJR to TJW, TKK to TKR, TKU to TKZ



The master manager page provides the capability to reset the data communication system. Manager messages related to the master features are also presented on this page.

Data Link System Reset

If the DATA LINK SYSTEM RESET key is selected, the CONFIRM RESET key is displayed. If the CONFIRM RESET key is selected, the following occurs.

On the ground:

- all new messages are deleted
- all messages queued for downlink are deleted
- all review messages are deleted
- ATC reports are deleted.

In flight:

- flight information and company new messages are deleted

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- flight information and company messages queued for downlink are deleted
- light information and company review messages are deleted
- ATC displays reset to default values.

On the ground or in flight:

- flight information and company displays reset to default values
- center VHF radio is selected as the default and set to data mode on the ground or voice mode in flight

TJR to TJW, TKK to TKR

- right HF radio is selected as the default and set to voice mode
- AUTO MESSAGES OFF is deselected
- COMPANY MESSAGES FUTURE is deselected
- ADS OFF is selected
- ADS EMERGENCY OFF is selected
- all manager status messages are deleted
- two seconds after selection, the CONFIRM RESET key is removed from the display and the DATA LINK SYSTEM RESET key is displayed as not selected.

This reset does not occur at power-up.

TJR to TJW, TKK to TKR, TKU to TKZ

Except for configuration of ACARS data radios, the data link system is automatically reset after each flight. Reset occurs approximately 10 minutes after the last engine is shut down, and with any entry door open.

Data link capability for the flight management system, OMS, and EICAS related maintenance functions, and cabin functions are not reset with this feature.

TJR to TJW, TKK to TKR, TKU to TKZ

Data Communication Management Function (DCMF) Reset

If the DCMF RESET key is selected, the CONFIRM RESET key is displayed. If the CONFIRM RESET key is selected, the following occurs:

- ACARS data communication management function is reset
- center VHF radio is selected as the default and set to data mode.

TJR to TJW, TKK to TKR, TKU to TKZ

Diagnostics Manager

The diagnostics manager page is for maintenance use only.

Manager Messages

Manager messages are displayed in reverse chronological order (the newest message is nearest the top of the display). The time of occurrence is displayed with each message. The manager messages are listed in the following table.

TJA,B,C,D,G, H,TKA to TKF

Function	Manager Message
ACARS	ACARS CONNECTION ESTABLISHED
	NO ACARS CONNECTION

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Function	Manager Message	
	ACARS MODE VHF—ENABLE	
	ACARS MODE VHF—NOT ENABLE	
	ACARS MODE SATCOM—ENABLE	
	ACARS MODE SATCOM—NOT ENABLE	
ACARS	ACARS CONNECTION ESTABLISHED	TKU to TKZ
	NO ACARS CONNECTION	
	VHF—ENABLE	
	VHF—NOT ENABLE	
	SATCOM—ENABLE	
	SATCOM—NOT ENABLE	
	VDLM2 CAPABLE	
	VDLM2 NOT CAPABLE	
	ATN CAPABLE	
	ATN NOT CAPABLE	
ACARS	ACARS CONNECTION ESTABLISHED	TJR to TJW, TKK to TKR
	NO ACARS CONNECTION	
	VHF—ENABLE	
	VHF—NOT ENABLE	
	SATCOM—ENABLE	
	SATCOM—NOT ENABLE	
	HF—ENABLE	
	HF—NOT ENABLE	
	VDLM2 CAPABLE	
	VDLM2 NOT CAPABLE	
ADS	ADS CONNECTION ESTABLISHED—ATC facility	
	ADS CONNECTION LOST—ATC facility	
	ALL ADS CONNECTIONS LOST	
VHF	VHF LINK ESTABLISHED	TJA,B,C,D,G, H, TJR to TJW, TKA to TKF, TKK to TKR
	NO VHF LINK	
	VHF DATA MODE RADIO FAILURE	
	VHF DATA MODE RADIO NORMAL	
VHF	VHF LINK ESTABLISHED	TKU to TKZ

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Function	Manager Message
	NO VHF LINK
	VHF DATA MODE RADIO FAILURE
	VHF DATA MODE RADIO NORMAL
	VDLM2 ESTABLISHED
	NO VDLM2 LINK
	ATN ESTABLISHED
	NO ATN LINK
SATCOM	SATCOM LINK ESTABLISHED
	NO SATCOM LINK
	SATCOM DATA MODE FAILED
	SATCOM DATA MODE NORMAL
PRINTER	PRINTER OPERABLE
	PRINTER NOT OPERABLE
	COMPANY FUTURE MESSAGES TO PRINTER—ON
	COMPANY FUTURE MESSAGES TO PRINTER—OFF
AUTOMATIC MESSAGES	AUTOMATIC MESSAGES—ON
	AUTOMATIC MESSAGES—OFF
MASTER	DATA LINK SYSTEM—RESET
MASTER	DATA LINK SYSTEM—RESET
	DCMF—RESET
	DCMF—RESET FAILED
HF	HF LINK ESTABLISHED
	NO HF LINK
	HF DATA MODE RADIO FAILURE
	HF DATA MODE RADIO NORMAL

TJA,B,C,D,G, H,TKA to TKF

TJR to TJW, TKK to TKR, TKU to TKZ

TJR to TJW, TKK to TKR

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New Messages

New Messages Menu

TJA,B,C,D,G,H,TKA to TKF

Typical NEW MESSAGE List

TJR to TJW,TKK to TKR,TKU to TKZ

Typical NEW MESSAGE List

New uplink messages are displayed with ATC messages displayed above flight information messages which are displayed above company messages. Within ATC, flight information and company, messages are listed by the time they are received. The newest message is at the top of the group. Messages are removed from the list when displayed or an accept/reject response is sent.

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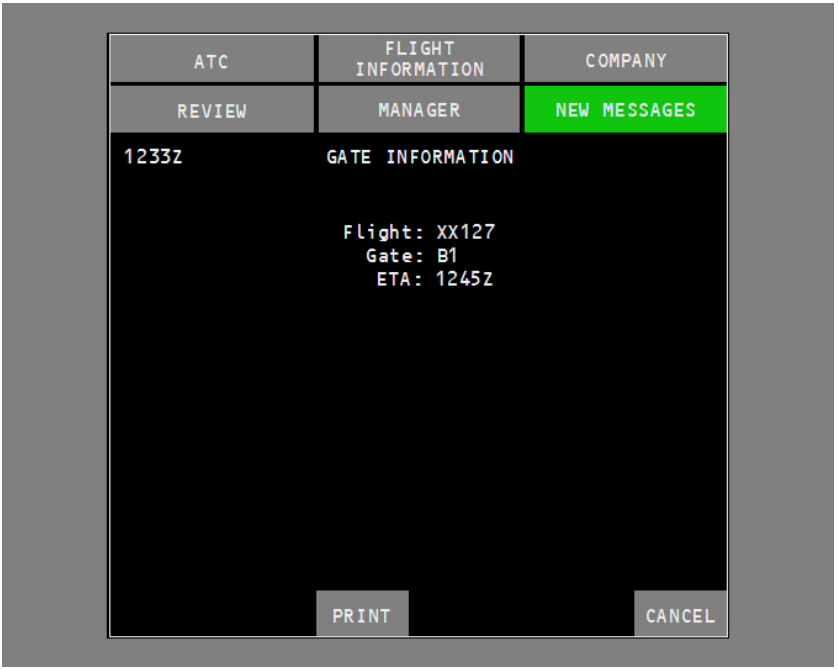
New messages can also be accessed by selecting the NEW MESSAGES menu, which displays list boxes for all pending messages. A message is displayed by selecting the appropriate message line.

New ATC uplinks which respond to downlink requests display a key which displays the original downlink request.

New Message—No Response Required



Received messages remain in the new messages list until after they are displayed. If an ACCEPT or REJECT response is required, the message remains in the list until accepted or rejected.

The display above shows a received message that does not require a response. The ACCEPT and REJECT keys are not displayed for this message. The message can be cleared by selecting the CANCEL key on the MFD or pushing the CANCEL switch on the glareshield.

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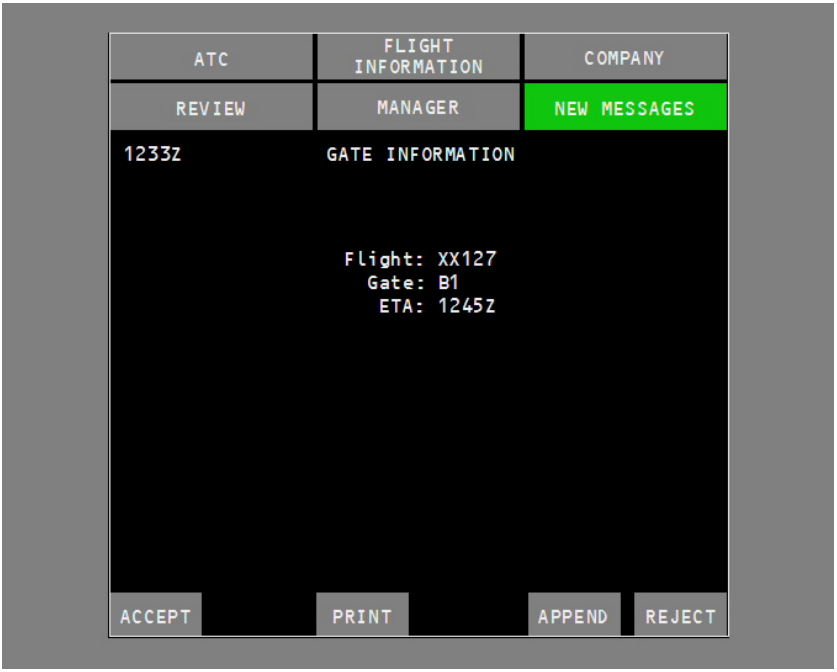
New Message—Response Required



The display above shows a message that requires an ACCEPT or REJECT response. The ACCEPT and REJECT keys are displayed.

An APPEND capability is provided for certain received messages which require an accept or reject response. In this case, the APPEND key is displayed.

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EICAS Alert Messages

Message	Level	Aural	Message Logic	
DATALINK LOST	Advisory		Datalink is temporarily lost.	
DATALINK SYS	Advisory		Datalink system has failed.	
HF DATALINK	Advisory		HF datalink has failed.	TJR to TJW, TKK to TKR
RADIO TRANSMIT	Advisory		A VHF or HF radio is keyed for 30 seconds or more.	
SATCOM	Advisory		SATCOM system has failed.	
SATCOM DATALINK	Advisory		SATCOM datalink has failed.	
SATCOM VOICE	Advisory		SATCOM voice communication has failed.	
SATVOICE LOST	Advisory		SATCOM voice communication is temporarily lost.	TJR to TJW, TKK to TKR, TKU to TKZ
VHF DATALINK	Advisory		VHF datalink has failed.	

EICAS Communication Messages

Message	Level	Message Logic	Crew Action
•ATC	Medium	An ATC data link message has been received or an armed report has been sent.	Respond to message displayed on EICAS or select the MFD communications display.
•CABIN ALERT	Medium	Pilot alert received over cabin interphone.	Respond to the alert.
•CABIN CALL	Medium	Pilot call received over cabin interphone.	Respond to the call.
•CABIN READY	Medium	CABIN READY received over cabin interphone.	Crew awareness. Automatically removed after one minute.
•COMM	Medium/ low	A data link message has been received.	Select COMM display on the MFD.
•COMM BUSY	Medium	Communications system pending data link message queue is full.	Respond to current pending data link messages.

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Message	Level	Message Logic	Crew Action
TJR to TJW, TKK to TKR, TKU to TKZ •DATALINK AVAIL	Low	A lost data link connection has been re-established.	Resume use of data link communication.
•FMC	Medium	An FMC related data link message has been received.	Select FMC from the CDU MENU page if not already in the FMC mode. View the message title in the CDU scratchpad. View the message on the appropriate CDU page.
•GROUND CALL	Medium	Pilot call received over flight interphone from nose wheel well.	Respond to the call.
•PRINTER (with data link installed)	Medium/ low	A data link message has been received and sent to the printer.	Review the printed message.
•SATCOM MESSAGE	Medium/ low	SATCOM voice system information available if SATCOM system is selected on a CDU.	View the SATCOM CDU message.
TJR to TJW, TKK to TKR, TKU to TKZ •SATVOICE AVAIL	Low	SATCOM voice capability re-established after a temporary loss.	Resume use of SATCOM voice.
•SELCAL	Medium	SELCAL received or any SATCOM voice call received.	Respond to the call.

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Electrical — Chapter 6

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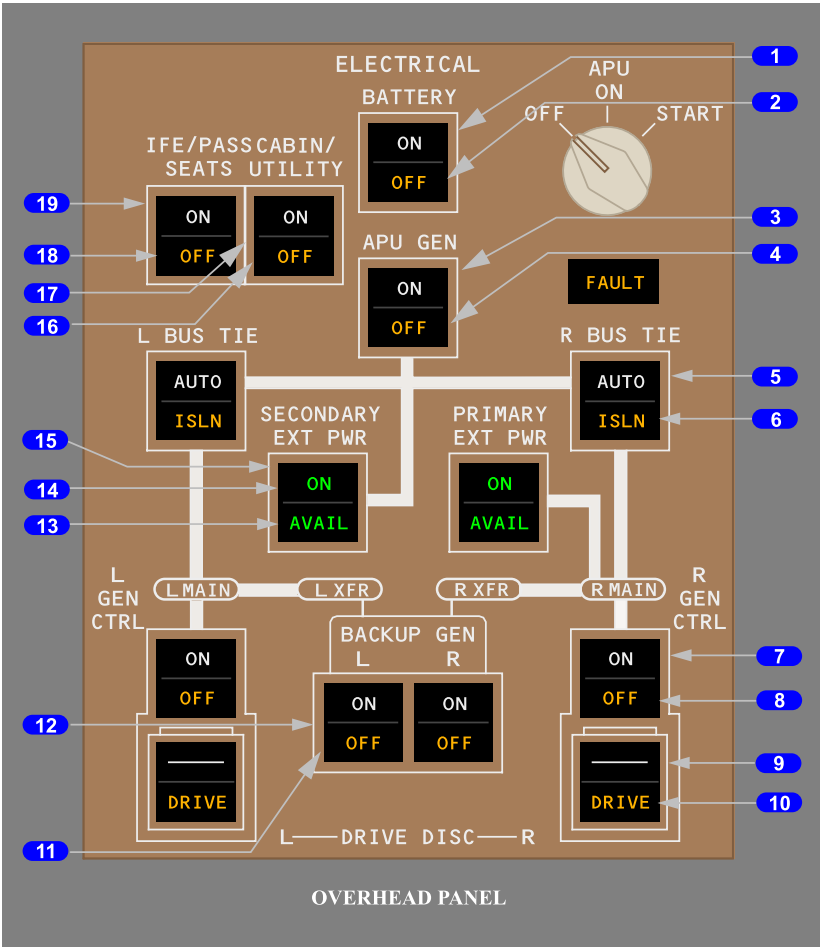
Electrical Panel



OVERHEAD PANEL

1 BATTERY Switch

ON—

- on the ground and the airplane does not have AC power:
  - some switch annunciator lights are illuminated
  - allows the APU to be started

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- on the ground after AC power is disconnected or lost:
  - standby busses and emergency lighting are powered
  - the left inboard, outboard, and upper center displays, and the left CDU are powered.

OFF—on the ground, battery bus is not powered.

2 Battery OFF Light

Illuminated (amber)—the battery switch off and the airplane has AC power.

3 APU Generator (APU GEN) Switch

ON—APU generator breaker is armed.

OFF—APU generator breaker open .

4 APU Generator OFF Light

Illuminated (amber)—

- the APU GEN switch is off, or
- with the APU running, secondary external power not connected, and the auxiliary power breaker open.

5 BUS TIE Switches

AUTO—bus tie breaker is armed.

OFF—bus tie open.

6 Bus Isolation (ISLN) Lights

Illuminated (amber)—bus tie breaker is open because:

- BUS TIE switch is off, or
- BUS TIE switch is in AUTO and a fault has occurred.

7 Generator Control (GEN CTRL) Switches

ON—generator breaker is armed.

OFF—

- generator breaker open
- resets fault trip circuitry.

8 Generator OFF Lights

Illuminated (amber)—generator breaker open.

9 Drive Disconnect Switches

Push—

- disconnects the integrated drive generator (IDG) from the engine

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- requires maintenance action on the ground to reconnect the IDG.

10 Generator DRIVE Lights

Illuminated (amber)—IDG oil pressure is low.

11 Backup Generator OFF Lights

Illuminated (amber)—
- backup generator switch is off, or
- a fault occurred, or
- engine is shutdown, or
- engine fire switch is out.

12 Backup Generator (BACKUP GEN) Switches

ON—backup generator converter armed.

OFF—
- backup generator control relay open
- resets the fault circuitry.

13 External Power AVAIL Lights

Illuminated (green)—external power is plugged in and power quality is acceptable.

14 External Power ON Lights

Illuminated (green)—external power is connected to the bus.

15 External Power (EXT PWR) Switches

Push—
- when AVAIL light is illuminated, connects external AC power
- when ON light is illuminated, disconnects external AC power.

16 CABIN/UTILITY Power OFF Light

Illuminated (amber)—CABIN/UTILITY power switch is off and the airplane has AC power.

17 Cabin/Utility (CABIN/UTILITY) Power Switch

ON—powers cabin and utility systems.

OFF—
- disconnects power from cabin and utility systems
- powers some cabin lighting.

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18 IFE/PASS SEATS OFF Light

Illuminated (amber)—IFE/PASS SEATS power switch is off and the airplane has AC power.

19 In-Flight Entertainment System/Passenger Seats (IFE/PASS SEATS) Power Switch

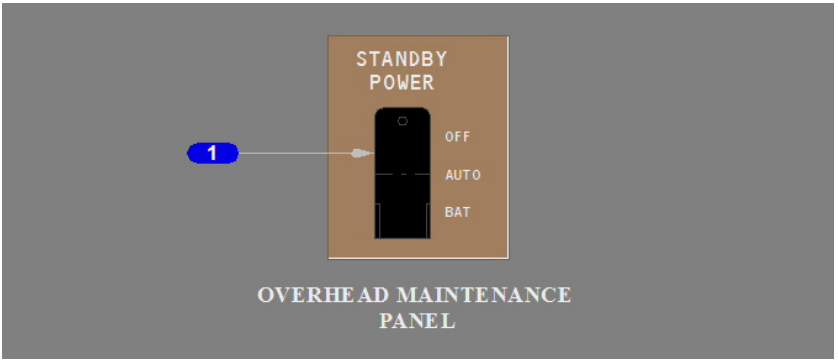
ON/OFF—powers/disconnects power from:

- IFE and passenger seat systems
- ground maneuvering camera system.

TKA to TKF, TKK to TKR, TKU to TKZ

Overhead Maintenance Panel

Standby Power Switch



1 STANDBY POWER Switch

Note: Ground operation only.

OFF—the AC standby bus is not powered.

AUTO (guarded)—the standby busses transfer to battery power if normal AC power is lost.

BAT (momentary)—

- with AC power not available and Battery switch ON, powers the standby AC bus from the battery through the standby static inverter
- initiates a DC/standby self-test in the inverter when AC power is available.

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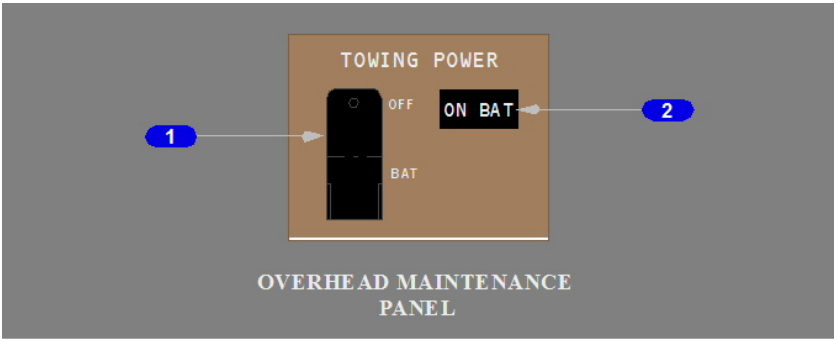
Towing Power Switch

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



1 TOWING POWER Switch (Ground Operation Only)

OFF—main battery disconnected from towing bus.

BAT—with BAT switch in OFF and ground handling bus not powered, main battery powers:

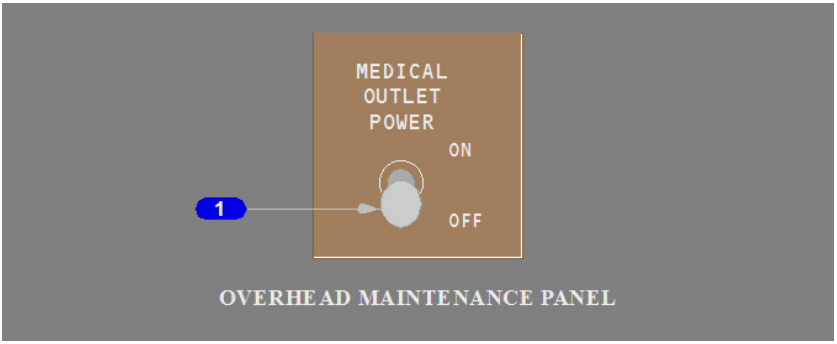
- position lights
- flight interphone
- Captain's instrument panel flood lights
- brake accumulator pressure indicator
- brake source light.

2 Towing Power ON BAT Light

Illuminated (white)—towing bus powered by main battery.

Medical Outlet Power Control

TJR to TJW, TKK to TKR, TKU to TKZ



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1 **MEDICAL OUTLET POWER Switch**

ON—power medical outlet.

Electrical Synoptic Display

The electrical synoptic is displayed by pushing the ELEC synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

The electrical power flow display is created from the displayed switch and contactor positions and by the displayed status of electrical equipment. Actual electrical flow is not displayed, therefore the electrical flow bars do not represent actual system operation.

The electrical synoptic display of switch, contactor, and flow bar position and status are not included in the MEL. The electrical synoptic display of switch, contactor, and flow bar position and status is not required for flight crew to accomplish any normal or non-normal procedure.

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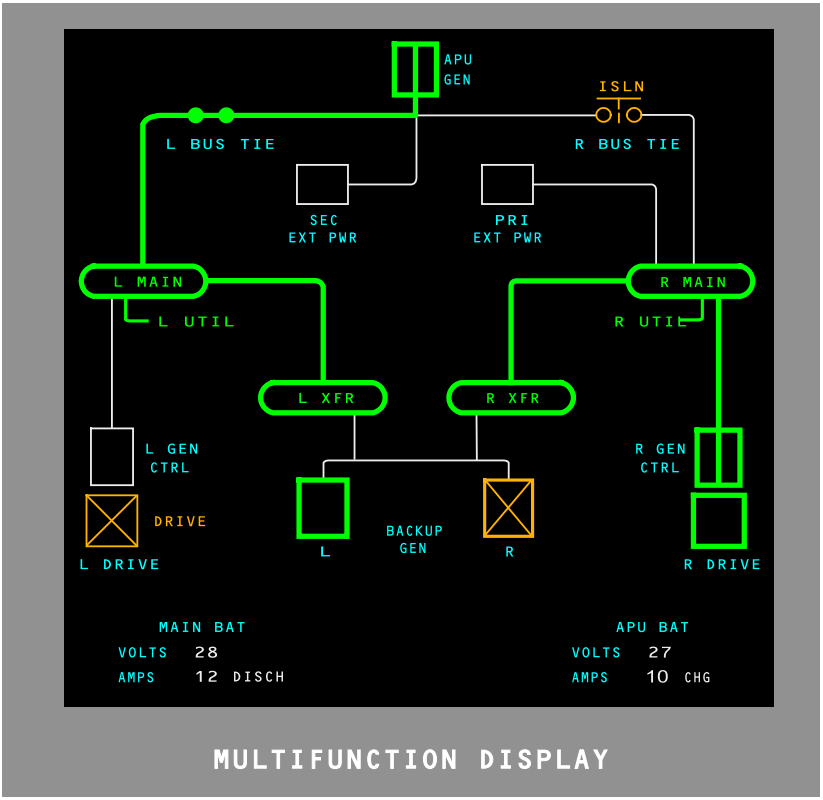

MULTIFUNCTION DISPLAY

Status of the electrical generators, drives, breakers, and power flow are displayed as:

- power flowing—wide green line
- power not flowing—thin white line
- generator on or available—green
- generator off—white
- generator not supplying electrical power or failed—amber X in amber box
- drive oil pressure low—amber DRIVE
- drive disconnected with engine runnung—amber X in amber box
- bus tie open due to electrical fault or BUS TIE switch Off—amber ISLN.

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Introduction

The electrical system generates and distributes AC and DC power to other airplane systems, and is comprised of: main AC power, backup power, DC power, standby power, and flight controls power. System operation is automatic. Electrical faults are automatically detected and isolated.

AC Electrical System

The AC electrical system is the main source for airplane electrical power.

Electrical Load Management System (ELMS)

The ELMS provides load management and protection to ensure power is available to critical and essential equipment.

If the electrical loads exceed the power available (airplane or external), ELMS automatically sheds AC loads by priority until the loads are within the capacity of the airplane or ground power generators. The load shedding is galleys first, then utility busses. Utility busses are followed by individual equipment items powered by the main AC busses. When an additional power source becomes available or the loads decrease, ELMS restores power to shed systems (in the reverse order). The message LOAD SHED displays on the electrical synoptic when load shed conditions exist.

The ELMS also provides inputs for display of EICAS messages for manual center tank fuel pump shut off during climb/cruise, and automatic shut off to prevent unintentional dry fuel pump operation when the center fuel tank is empty.

AC Electrical System Power Sources

The entire airplane AC electrical load can be supplied by any two main AC power sources.

The main AC electrical power sources are:

- left and right engine integrated drive generators (IDGs)
- APU generator
- primary and secondary external power.

The power sources normally operate isolated from one another. During power source transfers on the ground (such as switching from the APU generator to an engine generator) operating sources are momentarily paralleled to prevent power interruption.

Integrated Drive Generators (IDGs)

Each engine has an IDG. Each IDG has automatic control and system protection functions.

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When an engine starts, with the GENERATOR CONTROL switch selected ON, the IDG automatically powers the respective main bus. The previous power source is disconnected from that bus.

The IDG can be electrically disconnected from the busses by pushing the GENERATOR CONTROL switch to OFF. The IDG can also be electrically disconnected from its respective bus by selecting an available external power source prior to engine shutdown. (See Primary External Power on page 6.20.2 and see Secondary External Power on page 6.20.3 in this section.)

The DRIVE light illuminates and the EICAS message ELEC GEN DRIVE L or R displays when low oil pressure is detected in an IDG. The IDG drive can be disconnected from the engine by pushing the respective DRIVE DISCONNECT switch. The IDG cannot be reconnected by the flight crew.

High drive oil temperature causes the IDG to disconnect automatically.

APU Generator

The APU generator is electrically identical to the IDG generators. The APU generator can power either or both main busses, and may be used in flight as a replacement to an IDG source.

If no other power source is available when the APU generator becomes available, the APU generator automatically connects to both main AC busses. If the primary external source is powering both main busses, the APU powers the left main bus, and the primary external source continues to power the right main bus. If the primary external source is powering the right main bus, and the secondary external source is powering the left main bus, the APU then powers the left main bus and the primary external source continues to power the right main bus. If the secondary external source is powering both main busses, the APU then powers both main busses.

The APU generator OFF light illuminates when the APU is operating and the APU generator breaker is open because of a fault or the APU GENERATOR switch is selected OFF. When the APU GENERATOR switch is ON and a fault is detected, the APU generator cannot connect to the busses.

In flight, when both transfer busses are unpowered, the APU starts automatically, regardless of APU selector position. See APU Operation on page 7.30.1 for APU starter operation.

Primary External Power

Primary external power can power the left and right main busses. When the primary power source voltage and frequency are within limits, the primary external power AVAIL (available) light illuminates. If no AC power is applied, either external power source will power the airplane if the BATTERY switch is ON.

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If no other source is powering the main busses, with the BATTERY switch ON, pushing the PRIMARY EXTERNAL POWER switch ON connects primary external power to both main busses. When primary external power is connected to a main bus, the PRIMARY EXTERNAL POWER ON light illuminates and the AVAIL light extinguishes.

If a single IDG powers both busses, pushing the PRIMARY EXTERNAL POWER switch ON connects primary external power to both busses and removes the IDG source.

If both IDGs are powering their respective busses, the APU generator is NOT running and secondary external power is NOT available, pushing the PRIMARY EXTERNAL POWER switch ON connects primary external power to both busses and removes the IDG sources.

If both IDGs are powering their respective busses, and secondary external power is available, pushing the PRIMARY EXTERNAL POWER switch to ON connects primary external power to the right main bus, leaving the left main bus powered from the left IDG.

If the APU generator is running, pushing the PRIMARY EXTERNAL POWER switch ON connects primary external power to the right main bus, leaving the previous source connected to the left main bus.

If both busses are powered from secondary external power, pushing the PRIMARY EXTERNAL POWER switch ON connects primary external power to the right main bus, leaving secondary external power connected to the left main bus.

Pushing the PRIMARY EXTERNAL POWER switch while primary external power is ON, disconnects primary external power. The previously connected power source is reconnected, if available.

Secondary External Power

Secondary external power can power the left and right main busses. When the secondary external power source voltage and frequency are within limits, the secondary external power AVAIL (available) light illuminates.

If no AC power is applied, the BATTERY switch must be ON or primary external power must be available for secondary external power to power the airplane. If the BATTERY switch is ON and no other source is powering the main busses, pushing the SECONDARY EXTERNAL POWER switch ON connects secondary external power to both main busses. When secondary external power is connected to a main bus, the SECONDARY EXTERNAL POWER ON light illuminates and the AVAIL light extinguishes.

If a single IDG powers both main busses, pushing the SECONDARY EXTERNAL POWER switch ON connects secondary external power to both busses and removes the IDG source. Similarly, if only secondary external power is available

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and both IDGs are powering their respective busses, pushing the SECONDARY EXTERNAL switch ON connects secondary external power to the left main bus. When the right engine is shut down, there is a no–break transfer of power of secondary external power to the right main bus.

If both IDGs are powering their respective busses, and both secondary and primary external power are available, pushing the SECONDARY EXTERNAL POWER switch ON connects secondary external power to the left main bus, leaving the right main bus powered from the right IDG.

If the APU generator is running, pushing the SECONDARY EXTERNAL POWER switch ON connects secondary external power to the left main bus, leaving the right IDG or primary external power connected to the right main bus.

If both busses are powered from primary external power, pushing the SECONDARY EXTERNAL POWER switch ON connects secondary external power to the left main bus, leaving primary external power connected to the right main bus. If no other source is available, secondary external power is connected to both main busses.

Pushing the SECONDARY EXTERNAL POWER switch while secondary external power is ON disconnects secondary external power. The previously connected power source is reconnected, if available.

AC Electrical Power Distribution

AC power is distributed through the left and right main busses and the ground service bus.

AC Main Busses

The right IDG normally powers the right main bus and the left IDG normally powers the left main bus. The APU normally powers both main busses when they are not powered by any other source.

When external power is connected:

- primary external power normally powers the right main bus
- secondary external power normally powers the left main bus.

Bus tie relays, controlled by BUS TIE switches, isolate or parallel the right and left main busses. When both BUS TIE switches are set to AUTO, the bus tie system operates automatically to maintain power to both main busses.

Power transfers are made without interruption when the airplane is on the ground, except when switching between primary and secondary external power sources.

The source order for powering left and right main busses in flight is the:

- respective IDG
- APU generator
- opposite IDG.

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The main busses power individual equipment items such as:

- cooling vent fan
- recirculation fans
- lavatory/galley fans
- electric hydraulic pumps
- IFE.

Each main bus also powers its associated busses (typical loads are shown in parentheses):

- transfer bus (DC system transformer–rectifiers, AC standby bus)
- utility bus (forward galley heater, chiller boost fan, gasper fan, captain's and first officer's foot and shoulder heaters, door area heaters, lavatory water heaters and shavers)
- galley busses.

Ground Service Bus

The ground service bus is normally powered by the right main bus. Alternate sources of power for the ground service bus are:

- the APU generator
- primary external power.

The ground service bus powers:

- the main battery charger
- the APU battery charger
- miscellaneous cabin and system loads.

Ground Handling Bus

The ground handling bus can be powered on the ground only from the APU generator or from the primary external power source. It is provided for loads such as cargo handling, fueling/defueling operations, and other equipment energized only during ground operations.

Autoland

During autoland, the busses isolate to allow three independent sources to power the three autopilots:

- the left IDG powers the left AC transfer bus, the left main DC bus, and the captain's flight instrument bus
- the right IDG powers the battery bus and AC standby bus through the main battery charger
- the backup system powers the right AC transfer bus, the right DC bus, and the first officer's flight instrument bus.

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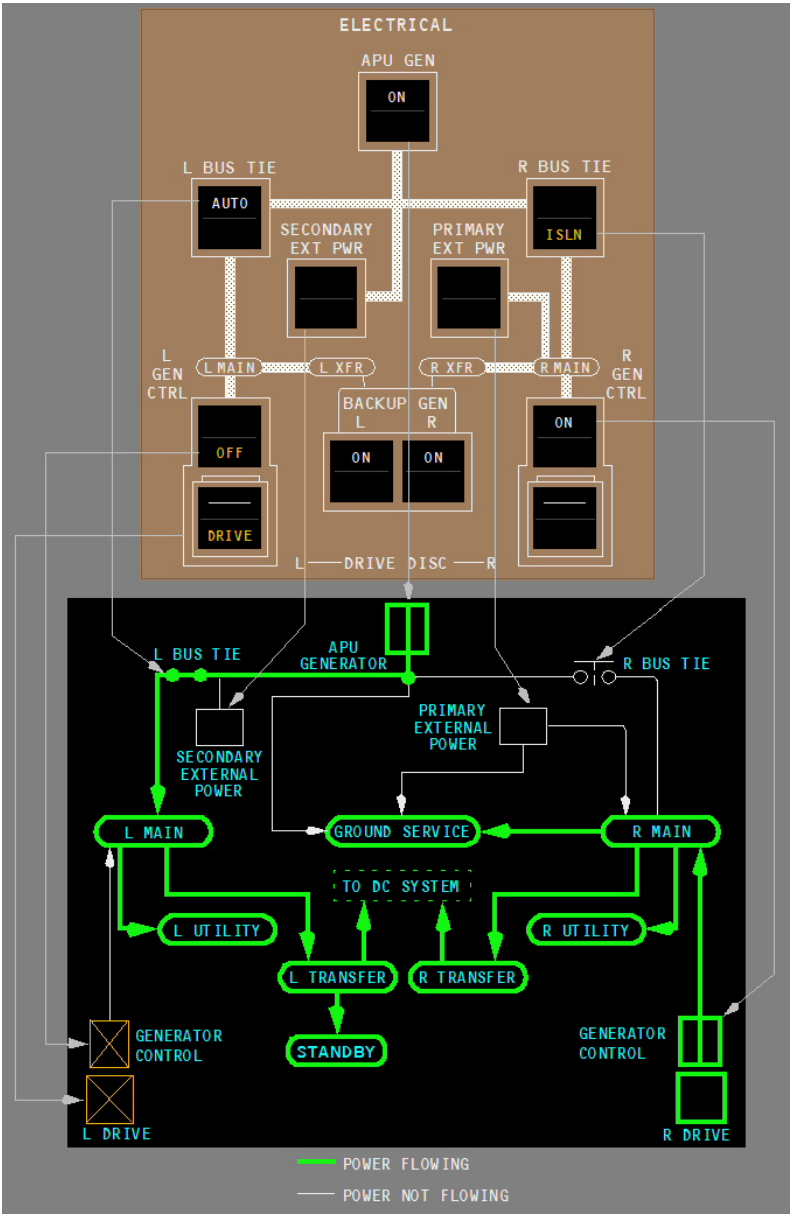
AC Electrical System Schematic



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Backup AC Electrical System

The backup electrical system is designed to automatically provide power to selected airplane systems. The backup electrical system automatically powers one or both transfer busses when:

- only one main AC generator (includes APU) is available
- power to one or both of the main AC busses is lost
- approach (APP) mode is selected for autoland
- the system is automatically tested after engine starts.

The system transfers power without interruption.

Backup Generators

Backup power is provided by one variable speed, variable frequency generator mounted on each engine. A frequency converter converts the generator frequency to a constant 400 Hz. Only one backup generator can power the converter at a time.

Each backup generator contains two permanent magnet generators (PMGs) that supply power to the flight control DC electrical system (see DC Electrical System on page 6.20.9).

If both IDGs and the APU generator are inoperative, a backup generator powers essential airplane equipment. To reduce electrical loading on the backup generator, the following systems are inoperative:

- TCAS
- SATCOM
- center tank override/jettison pumps (center tank fuel is unusable and cannot be jettisoned)
- position and other exterior lights (except nose gear landing lights)
- all non-essential cabin equipment (galleys, entertainment systems, etc.)
- passenger cabin lighting (except night, galley and cross-aisle lights)
- cabin temperature control (remains operative, but in degraded mode)
- right HF radio
- right HF radio and associated datalink.

TJA,B,C,D,G,H,TKA to TKF,TKU to TKZ
TJR to TJW,TKK to TKR

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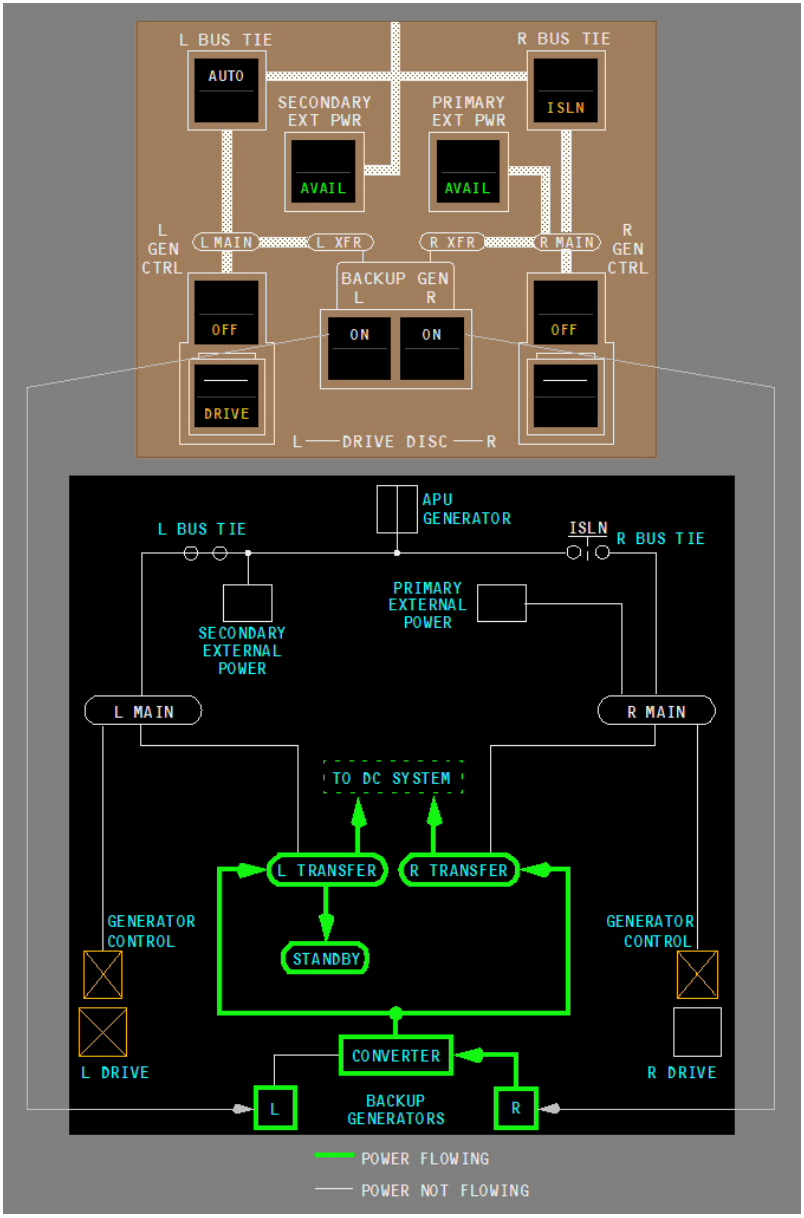
Backup AC Electrical System Schematic



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DC Electrical System

The DC electrical system includes:

- main DC electrical system
- batteries.
- towing power
- flight control DC electrical system.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Main DC Electrical System

The main DC electrical system uses four transformer–rectifier units (TRUs) to produce DC power. The TRUs are powered by the AC transfer busses.

Main DC Power Distribution

TRU DC electrical power is distributed to various DC busses as follows:

The left TRU powers the left main DC bus, which provides a second DC power source for:

- left flight control power supply assembly (PSA)
- right main DC bus.

The right TRU powers the right main DC bus, which provides a second DC power source for:

- right flight control PSA
- left main DC bus.

The C1 TRU powers the captain's flight instrument bus and the battery bus. The captain's flight instrument bus provides a second DC power source for:

- center flight control PSA
- first officer's flight instrument bus.

The C2 TRU powers the first officer's flight instrument bus, which provides a second DC power source for the captain's instrument bus.

Batteries

The main battery is connected directly to the hot battery bus and provides standby power to other busses (see Standby Electrical System on page 6.20.12). The main battery charger normally powers the hot battery bus and maintains the main battery fully charged.

The APU battery is connected directly to the APU battery bus and provides dedicated power to the APU electric starter, which is used when sufficient bleed air duct pressure is unavailable for the APU air turbine starter. The APU battery charger normally powers the APU battery bus and maintains the APU battery fully charged.

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TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

Towing Power

Permits towing operations without AC power. With the TOWING POWER switch selected to BAT position, main battery power is provided through the hot battery bus to systems required for towing. When AC power is applied to the airplane and the TOWING POWER switch is in BAT, the main battery provides back-up if AC power is lost during towing.

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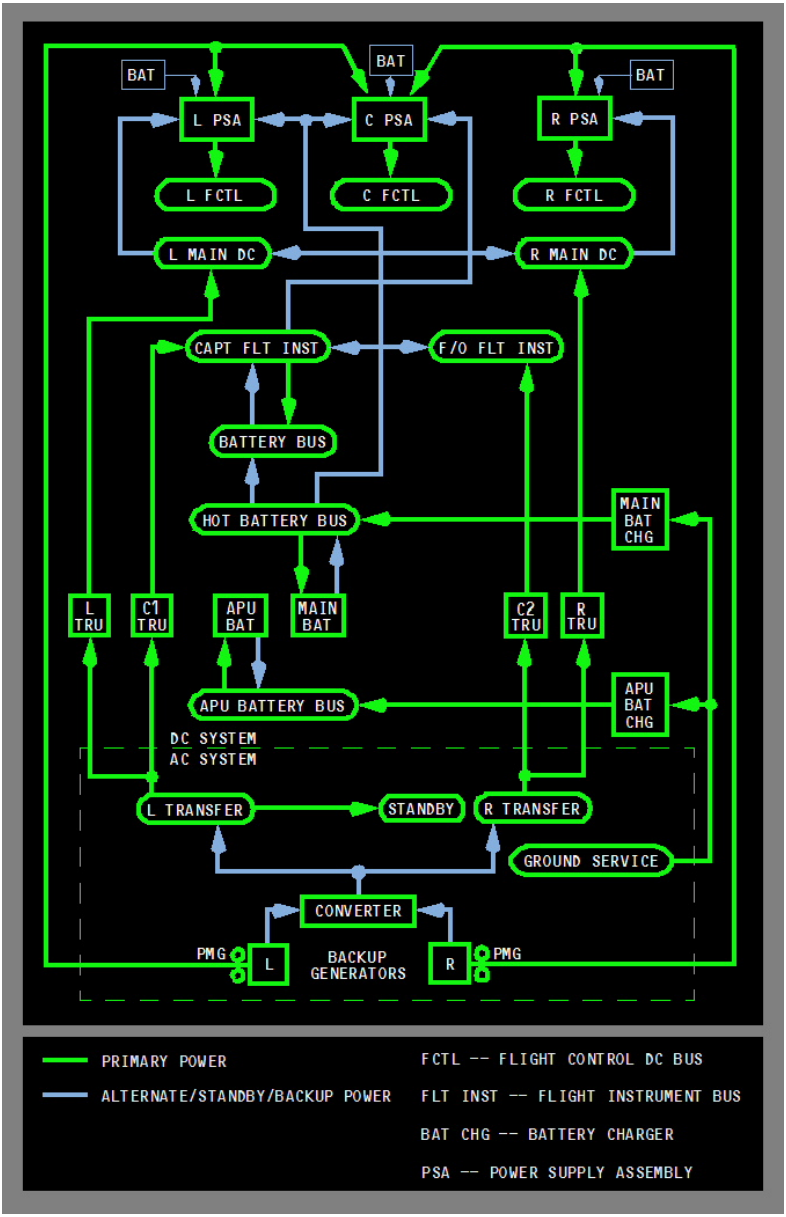
DC and Flight Control Electrical Systems Schematic



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Flight Control DC Electrical System

The flight control DC electrical system is a dedicated power source for the primary flight control system.

Primary power for the flight control DC electrical system comes from permanent magnet generators (PMGs) housed within each backup generator. Variable frequency PMG AC power is used by individual power supply assemblies (PSAs) to provide DC power to the three flight control DC busses.

To ensure a high level of system reliability, each PSA also has multiple DC power sources. If primary PMG AC power is not available, secondary power for the left and right PSAs is provided by the related main DC bus. Secondary power for the center PSA is provided by the captain's flight instrument bus. The hot battery bus provides additional backup power for the left and center PSAs only.

Each PSA also uses a dedicated battery to prevent power interruptions to the related flight control DC bus. The batteries have limited capacity and are incorporated to supply power for brief periods during PSA power source transfers.

Standby Electrical System

The standby electrical system can supply AC and DC power to selected flight instruments, communications and navigation systems, and the flight control system, if there are primary electrical power system failures.

The standby electrical system consists of:

- the main battery
- the standby inverter
- the RAT generator and its associated generator control unit
- the C1 and C2 TRUs.

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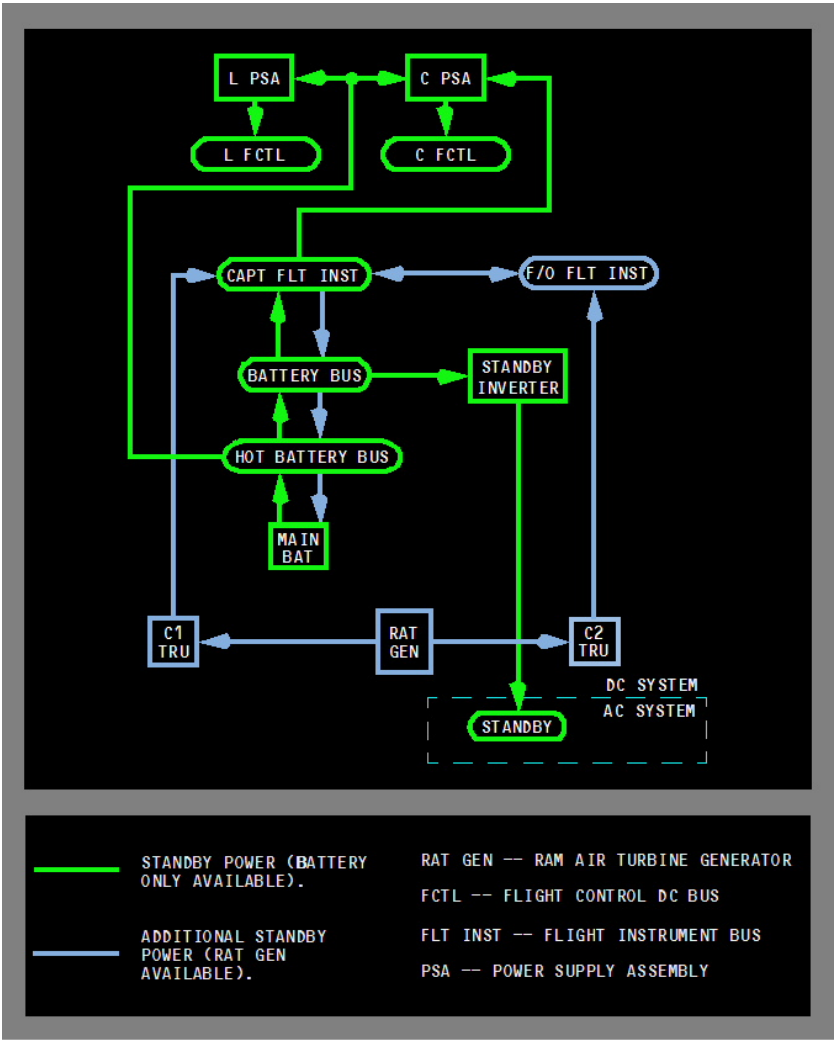
Standby Electrical System Schematic



Main Battery

The main battery provides standby power to the:

- hot battery bus
- battery bus
- captain's flight instrument bus

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DRAFT

- left and center flight control PSAs
- standby inverter.

Note: The main battery can power the standby system for a minimum of 10 minutes.

Standby Inverter

The standby inverter converts DC power to AC power. The inverter powers the AC standby bus if the left transfer bus is not powered.

Ram Air Turbine (RAT) Generator

The RAT generator provides standby power to the C1 and C2 TRUs. The RAT generator has no operating time limits, and operates at all airspeeds and altitudes.

The RAT can supply electrical and hydraulic power simultaneously. If the RAT is unable to maintain RPM, the RAT generator electrical load is shed until RPM is satisfactory. Power for standby electrical loads is provided by the main battery during deployment of the RAT and when RAT generator loads are shed.

The RAT is deployed automatically if both AC transfer busses lose power in flight. The RAT can be manually deployed by pushing the RAM AIR TURBINE switch on the overhead panel.

RAT deployment and operation are described in Chapter 13, Hydraulics.

Cabin Systems and Utility Power

Electrical power to some cabin and utility systems are controlled from the flight deck.

IFE and Passenger Seats

The IFE/PASS SEATS Power switch on the ELECTRICAL panel controls power to the IFE and passenger seats. Pushing the switch OFF removes power from:

- all IFE components
- passenger seats, including:
  - seat motor power
  - personal computer power outlets, and
  - telephones.

Cabin and Utility Systems

The CABIN/UTILITY Power switch controls power to cabin and utility systems. When the switch is OFF power is removed from:

- ground service bus, except:
  - main and APU battery chargers
  - left forward fuel pump

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- utility busses
- galleys
- fluorescent cabin lighting
- beacon, logo, and wing lights.

Additionally, when the CABIN/UTILITY Power switch is OFF, power is provided to:

- night lights
- reading lights
- attendant work lights
- some galley and crew rest lights.

Medical Power Outlet

TJR to TJW, TKK to TKR, TKU to TKZ

A medical outlet to supply 115-volt/60 hertz power and 28-volt DC power is installed. The outlet is located in the passenger cabin on the sidewall forward of door 4L. The outlet is covered with a plug similar to the plugs in the existing cabin service outlets. Power to the outlet is controlled by a switches on the flight deck. The outlet provides power airborne and on the ground.

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EICAS Alert Messages

Message	Level	Aural	Message Logic
ELEC AC BUS L, R	Caution	Beeper	AC bus is unpowered.
ELEC BACKUP GEN L, R	Advisory		Backup generator has failed.
ELEC BACKUP SYS	Advisory		Backup power system has failed.
ELEC BATTERY OFF	Advisory		Battery switch is OFF.
ELEC BUS ISLN L, R	Advisory		Bus tie breaker is open due to an AC electrical system fault or Bus Tie switch is OFF.
ELEC CABIN/UTIL OFF	Advisory		Cabin/utility power switch is OFF.
ELEC GEN DRIVE L, R	Advisory		Generator drive oil pressure is low.
ELEC GEN OFF APU	Advisory		APU generator control breaker is open.
ELEC GEN OFF L, R	Advisory		Generator control breaker is open.
ELEC GND HDLG BUS	Advisory		Ground handling bus relay has failed.
ELEC IFE/SEATS OFF	Advisory		In-Flight Entertainment System/ Passenger Seats Power switch is OFF.
ELEC STANDBY SYS	Advisory		A fault is detected in the standby power system.
DELETION MAIN BATTERY DISCH	Advisory		Main battery is discharging or hot battery bus is unpowered.

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APU System Description 7.30

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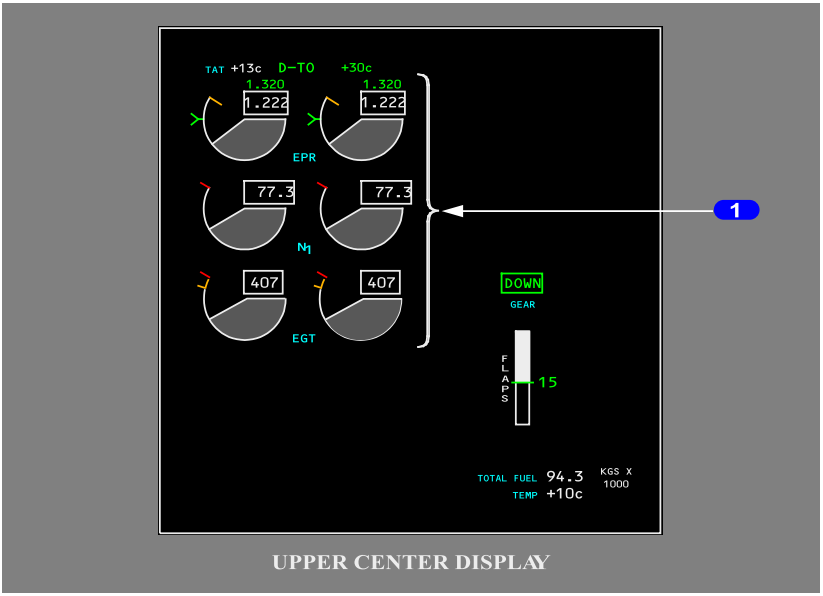
EICAS Display

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF



1 Primary Engine Indications

Displayed full time on the EICAS display:

- EPR
- N1
- EGT.

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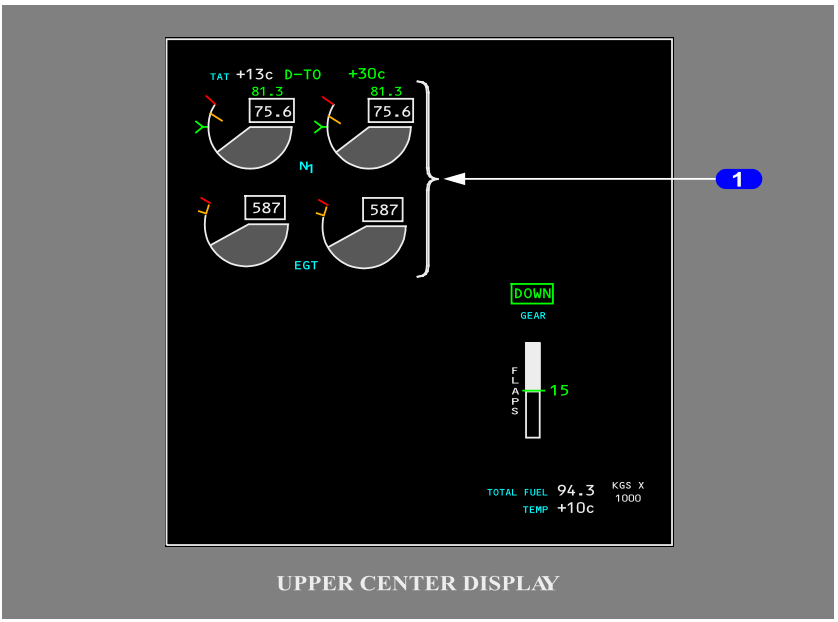
TKK to TKR,
TKU to TKZ



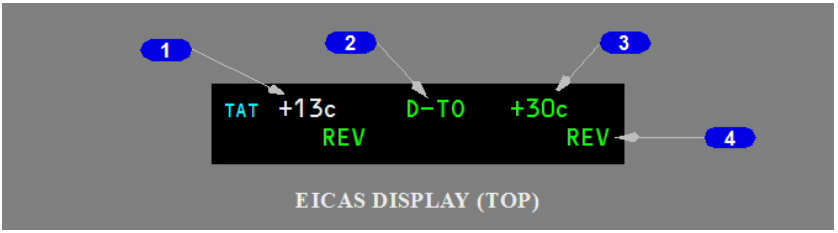
UPPER CENTER DISPLAY

1 Primary Engine Indications

Displayed full time on the EICAS display:

- N1
- EGT.

Mode Indications



EICAS DISPLAY (TOP)

1 Total Air Temperature (TAT)

Displayed (white)—TAT (degrees C).

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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
- G/A—maximum go-around thrust
- A–TO, A–TO 1, A–TO 2—APU-to-Pack or APU-to-Pack derated takeoff thrust.

TKK to TKR, TKU to TKZ

3 Assumed Temperature

Displayed (green)—selected assumed temperature (degrees C) for reduced thrust takeoff.

4 Thrust Reverser Indication

Displayed REV (amber)—reverser in transit.

Displayed REV (green)—reverser fully deployed.

EPR Indications

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Notes: 1. During tailwind conditions, slight EPR fluctuations may occur prior to 5 knots forward airspeed.

2. When reverse thrust is activated, the following indications are not displayed:
   - maximum EPR line
   - commanded EPR
   - reference/target EPR indication
   - reference EPR.

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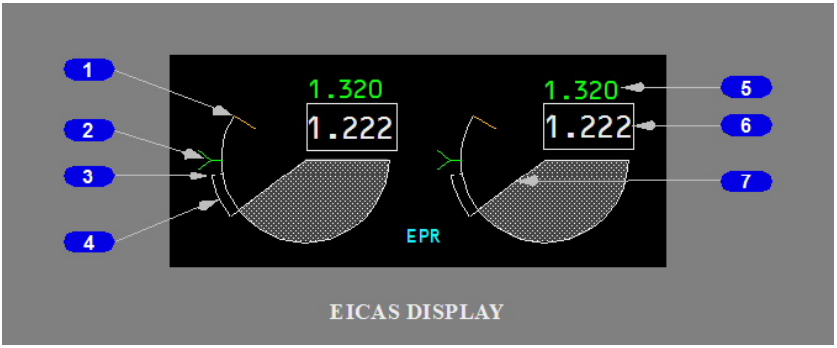

1 Maximum EPR Line

Displayed (amber).

2 Reference/Target EPR Indication

Displayed (green)—reference EPR limit.

Displayed magenta—target FMC commanded EPR when VNAV is engaged and:

- the autothrottle is engaged in THR or THR REF mode, or
- the autothrottle is not engaged.

3 Commanded EPR

Displayed (white).

4 Commanded EPR Sector

Displays momentary difference between engine EPR and EPR commanded by thrust lever position.

5 Reference EPR

Displayed (green).

6 Actual EPR

Displayed (white).

7 Actual EPR Indication

Displayed (white).

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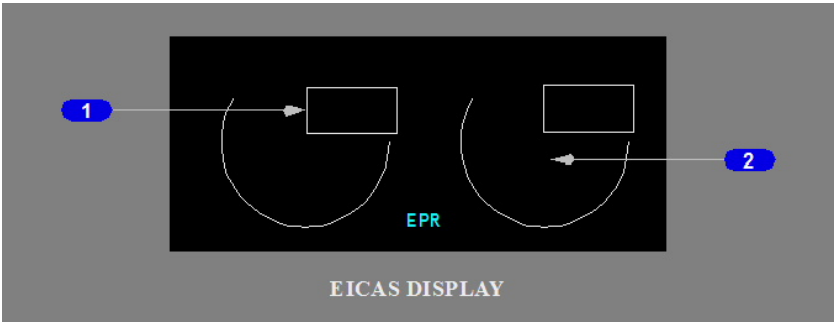
EPR Indications (Alternate Mode)

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF



1 Actual EPR

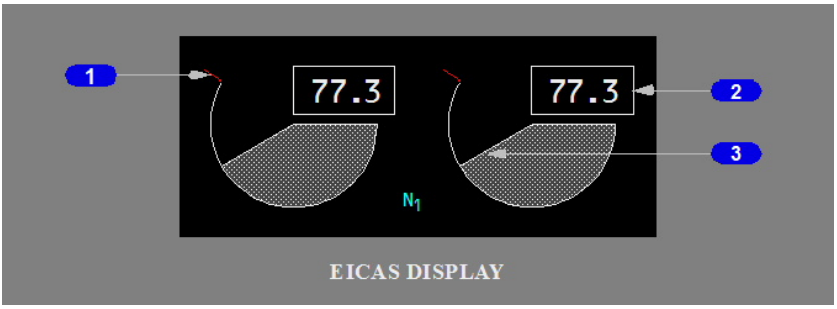
Displayed (blank).

2 Actual EPR Indication

Displayed (blank).

N1 Indications

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF



1 N1 Red Line

Displayed (red)—N1 RPM operating limit.

2 N1

Digital N1 RPM (%), displayed:

- (white)—normal operating range
- displayed (red)—operating limit reached.

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3 N1 Indication

N1 RPM, displayed:

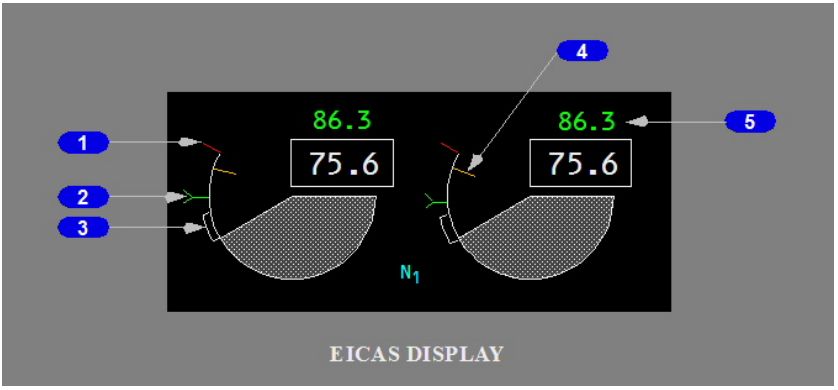
- (white)—normal operating range
- displayed (red)—operating limit reached.

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

N1 Indications (Hard Alternate Mode)

Note: When reverse thrust is activated, the following indications are not displayed:

- maximum N1 line
- commanded N1
- reference/target N1 indication
- reference N1.



1 N1 Red Line

Displayed (red).

2 Reference/Target N1 Indication

Displayed (green)—reference N1 limit.

Displayed (magenta)—target FMC commanded N1 when VNAV is engaged and:

- the autothrottle is engaged in THR or THR REF mode, or
- the autothrottle is not engaged.

3 Commanded N1 Sector

Displays momentary difference between engine N1 and N1 commanded by thrust lever position.

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4 Maximum N1 Line

Displayed (amber).

5 Reference N1

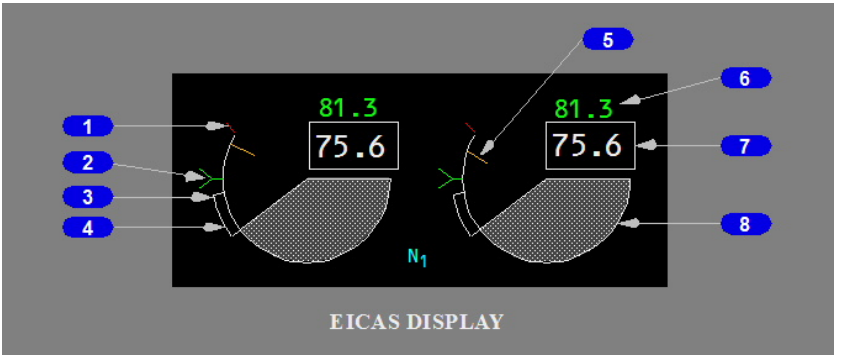
Displayed (green)—thrust reference calibrated for N1.

N1 Indications (All Modes)

TKK to TKR, TKU to TKZ

Note: When reverse thrust is activated, the following indications are not displayed:

- maximum N1 line
- commanded N1
- reference/target N1 indication
- reference N1.



1 N1 Red Line

Displayed (red)—N1 RPM operating limit.

2 Reference/Target N1

Displayed (green)—reference N1 limit.

Displayed (magenta)—target FMC commanded N1 when VNAV is engaged and:

- the autothrottle is engaged in THR or THR REF mode, or
- the autothrottle is not engaged.

3 Commanded N1

Displayed (white).

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4 Commanded N1 Sector

Displays momentary difference between engine N1 and N1 commanded by thrust lever position.

5 Maximum N1 Line

Displayed (amber).

6 Reference N1

Displayed (digital, green).

7 N1

Digital N1% RPM, displayed:

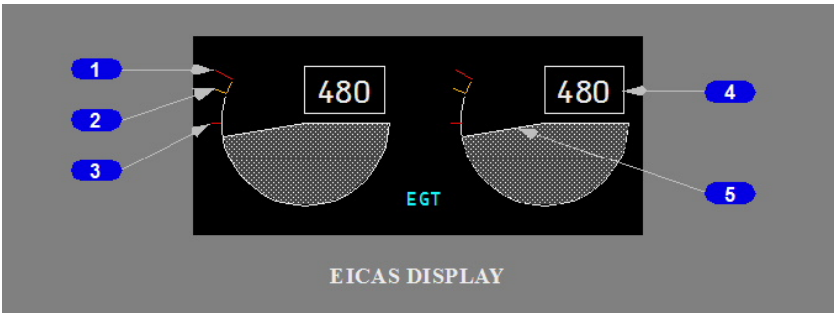
- (white)—normal operating range
- displayed (red)—operating limit reached.

8 N1 Indication

N1 RPM, displayed:

- (white)—normal operating range
- displayed (red)—operating limit reached.

EGT Indications



1 EGT Red Line

Displayed (red)—maximum takeoff EGT limit.

2 EGT Amber Band

Displayed (amber)—maximum continuous EGT limit.

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3 EGT Start Limit Line

Displayed (red):

- with the FUEL CONTROL switch in CUTOFF, or
- with the N2 RPM below idle
- with the N3 RPM below idle.

TKK to TKR, TKU to TKZ

4 EGT

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

EGT (degrees C), displayed:

- (white)—normal operating range
- (amber)—maximum continuous limit reached
- (red)—maximum start or takeoff limit reached.

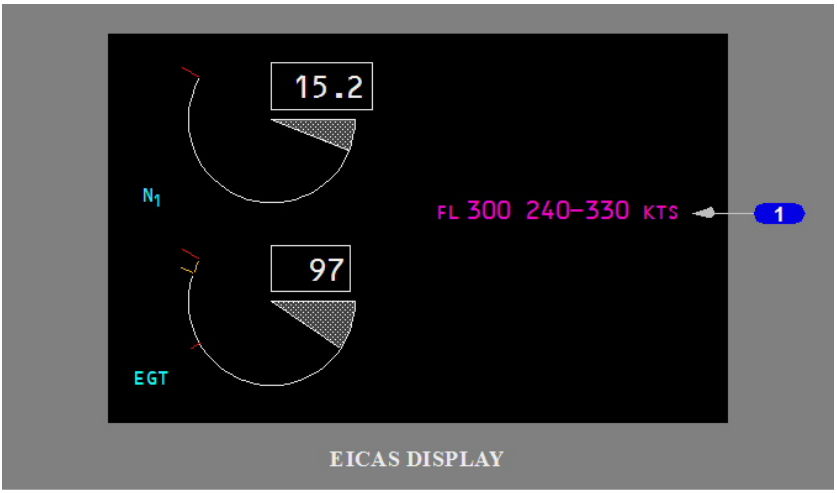
5 EGT Indication

Displayed:

- (white)—normal operating range
- (amber)—maximum continuous limit reached
- (red)—maximum start or takeoff limit reached.

In-Flight Start Envelope

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



EICAS DISPLAY

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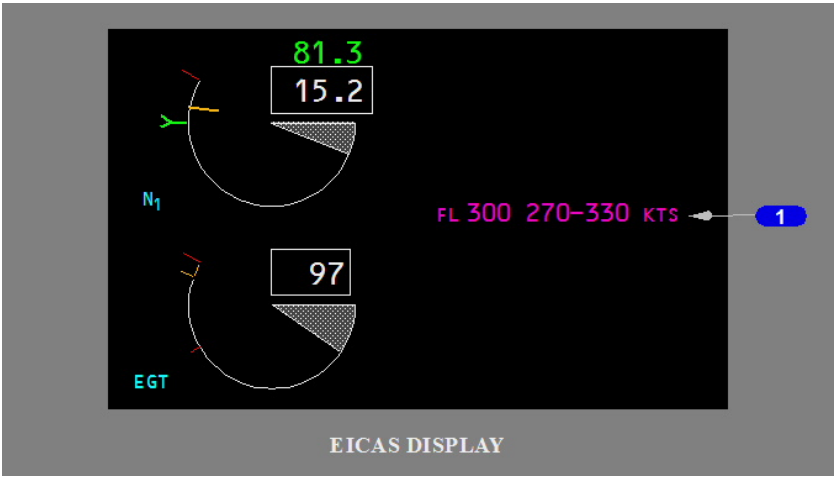
TKK to TKR, TKU to TKZ



EICAS DISPLAY

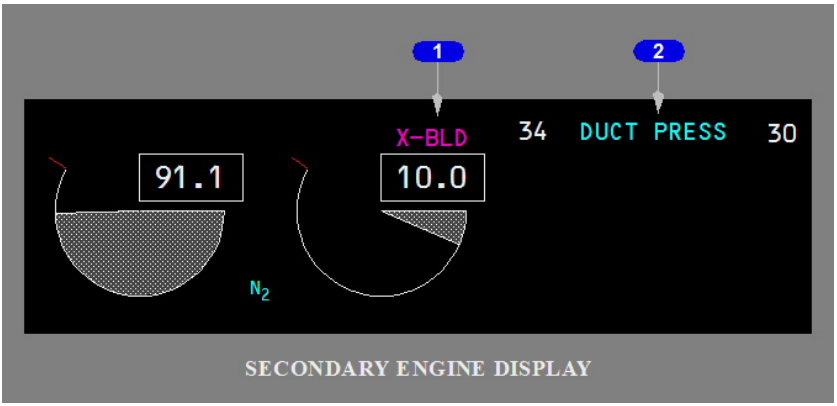
1 In-Flight Start Envelope

Displayed (magenta)—airspeed range for an in-flight start at the current flight level or maximum flight level (whichever is less) when the respective engine fire switch is in and:

- a FUEL CONTROL switch is in CUTOFF, or
- engine N2 RPM is below idle
- engine N3 RPM is below idle.

TKK to TKR, TKU to TKZ TJA,B,C,D,G, H, TJR to TJW, TKA to TKF TKK to TKR, TKU to TKZ

Crossbleed Start Indications



SECONDARY ENGINE DISPLAY

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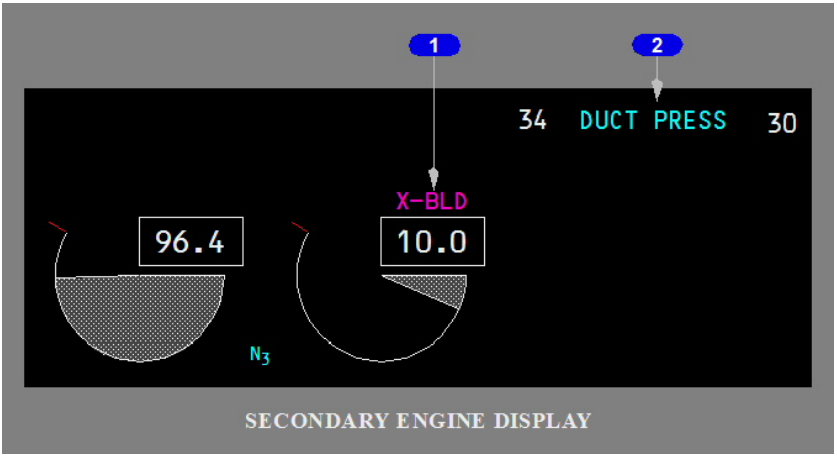
TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



1 Crossbleed (X-BLD) Start Indication

Indicates crossbleed air is recommended for an in-flight start.

Displayed (magenta):

- the in-flight start envelope is displayed
- the respective engine fire switch is in
- airspeed is lower than that for a windmilling start.

2 DUCT Pressure (PRESS)

Displayed (white numbers)—pressure in the left and right bleed air ducts in psi when the respective engine fire switch is in and:

- a FUEL CONTROL switch is in CUTOFF
- engine N2 RPM is below idle
- engine N3 RPM is below idle.

TKK to TKR, TKU to TKZ

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Secondary Engine Indications

See Display Select Panel (DSP) on page 10.10.43 for display selection of Secondary Engine indications.

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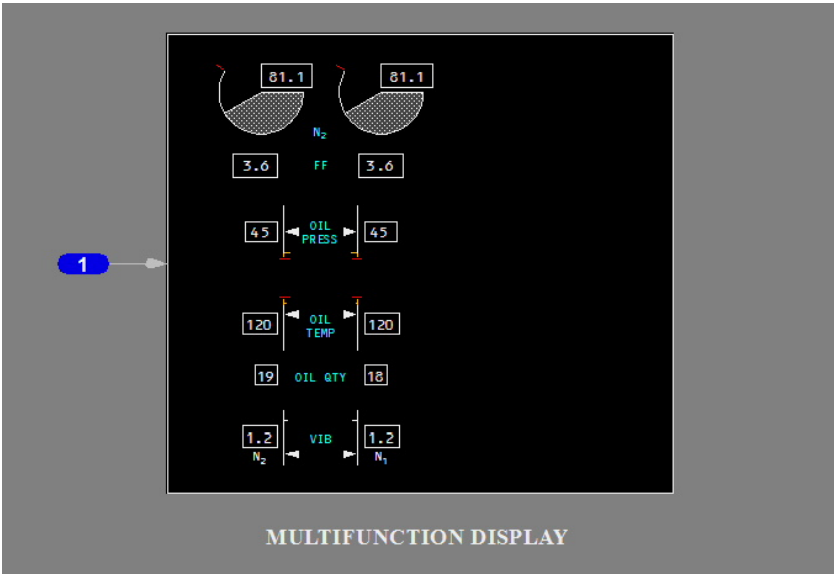
Secondary Engine Display

TKK to TKR, TKU to TKZ



1 Secondary Engine Display

Displays:

- N2 RPM
- fuel flow (FF)
- oil pressure
- oil temperature
- oil quantity
- vibration.

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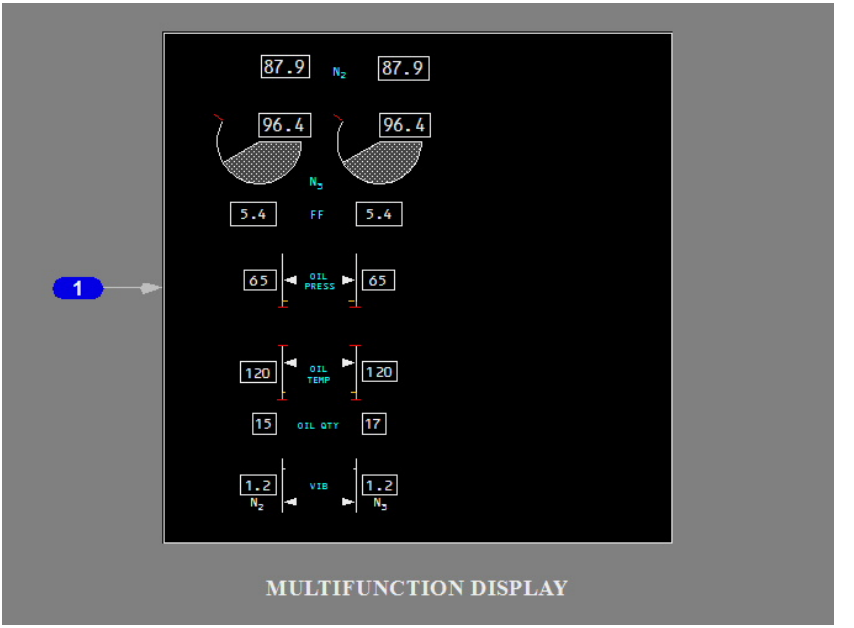
TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF



1 Secondary Engine Display

Displays:

- N2 RPM
- N3 RPM
- fuel flow (FF)
- oil pressure
- oil temperature
- oil quantity
- vibration.

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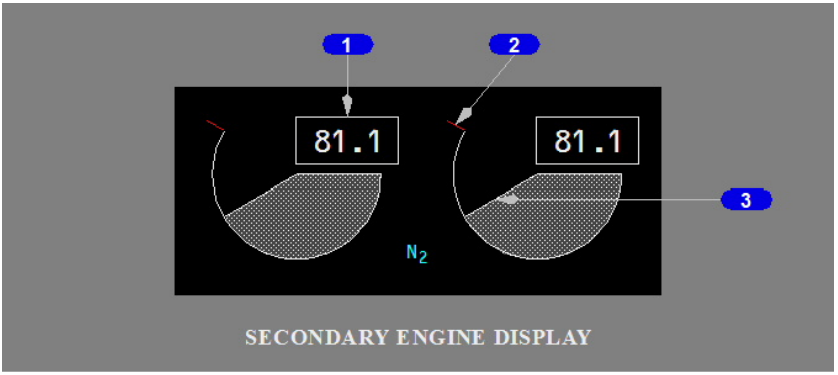
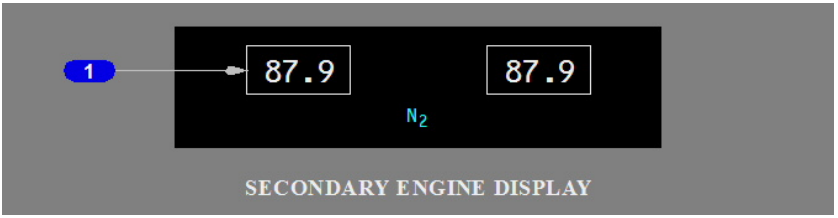
N2 Indications

TKK to TKR, TKU to TKZ



TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



1 N2

N2 RPM (%), displayed:

- (white)—normal operating range
- (red)—operating limit reached.

TKK to TKR, TKU to TKZ

2 N2 Red Line

N2 RPM operating limit, displayed (red).

TKK to TKR, TKU to TKZ

3 N2 Indication

N2 RPM, displayed:

- (white)—normal operating range
- (red)—operating limit reached.

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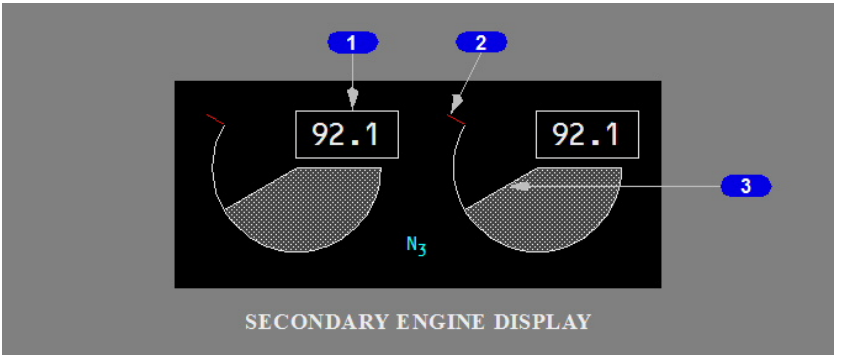
N3 Indications

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



1 N3

N3 RPM (%), displayed:

- (white)—normal operating range
- (red)—operating limit reached.

2 N3 Red Line

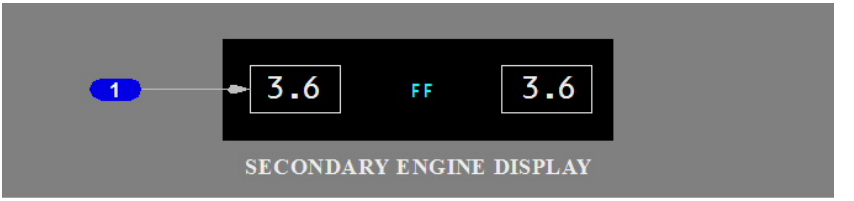
N3 RPM operating limit, displayed (red).

3 N3 Indication

N3 RPM, displayed:

- (white)—normal operating range
- (red)—operating limit reached.

Fuel Flow Indications



1 Fuel Flow

Displayed (white)—fuel flow to the engine (kilograms per hour × 1000).

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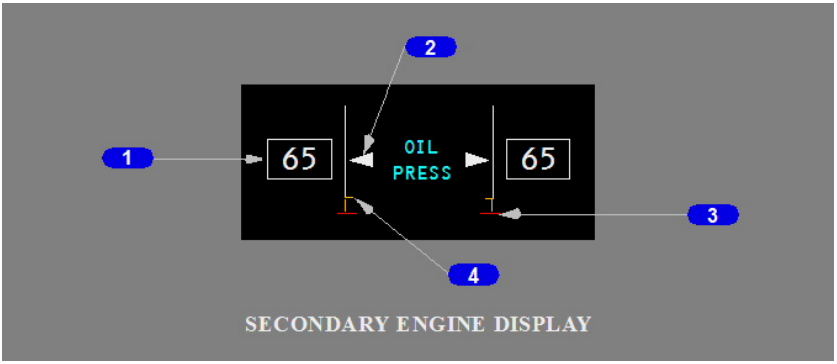
Oil Pressure Indications



1 Oil Pressure

Engine oil pressure (psi), displayed:

- (white)—normal operating range
- (amber)—caution range reached
- (red)—operating limit reached.

2 Oil Pressure Pointer

Engine oil pressure, displayed:

- (white)—normal operating range
- (amber)—caution range reached
- (red)—operating limit reached.

3 Oil Pressure Red Line

Displayed (red)—oil pressure operating limit.

Vertical position of oil pressure red line will vary with N2 RPM.

4 Oil Pressure Amber Band

Displayed (amber)—oil pressure caution range.

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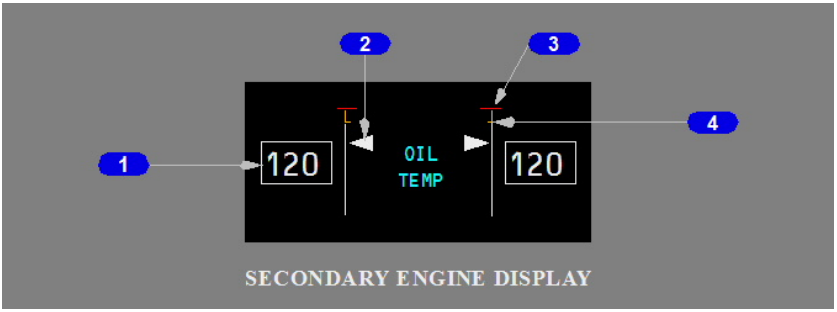
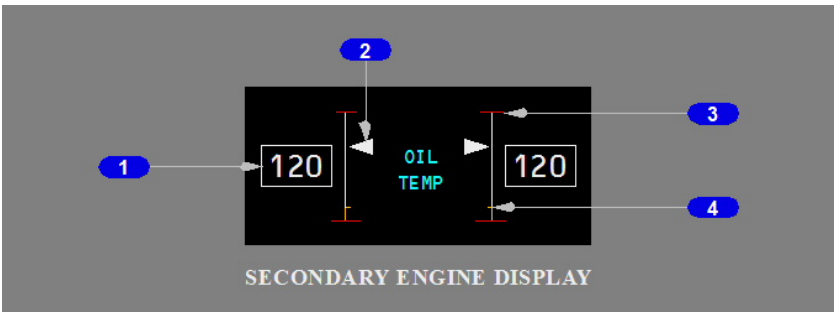
Oil Temperature Indications

TKK to TKR, TKU to TKZ



TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



1 Oil Temperature

Engine oil temperature (degrees C), displayed:

- (white)—normal operating range
- (amber)—caution range reached
- (red)—operating limit reached.

2 Oil Temperature Pointer

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.

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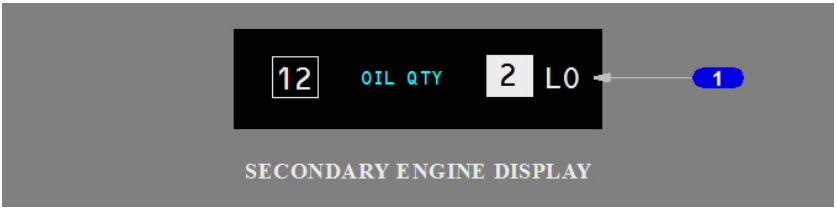
Oil Quantity Indications



1 Oil Quantity

Usable oil quantity.

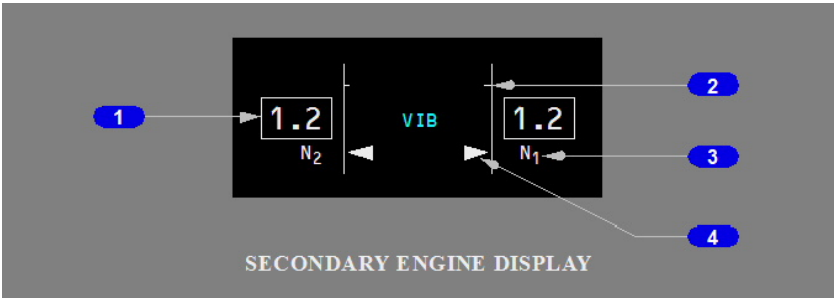
Displayed:

TKK to TKR, TKU to TKZ TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

- in metric unit (liters)
- in imperial unit (quarts)
- (white)—normal quantity
- (reverses the display to show black numbers on white background)—low quantity.

Note: LO—displayed (white) when quantity is low.

Engine Vibration Indications



1 Engine Vibration

Engine vibration, displayed:

- (white)—normal operating range
- (black numbers, white background)—high vibration.

2 Engine Vibration High Band

Displayed (white)—vibration level at which automatic display of secondary engine indications occurs.

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3 Vibration Source

Identifies the vibration source being displayed.

Displayed (white)—vibration source with the highest vibration:

- N1 rotor vibration
- N2 rotor vibration
- N3 rotor vibration.

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

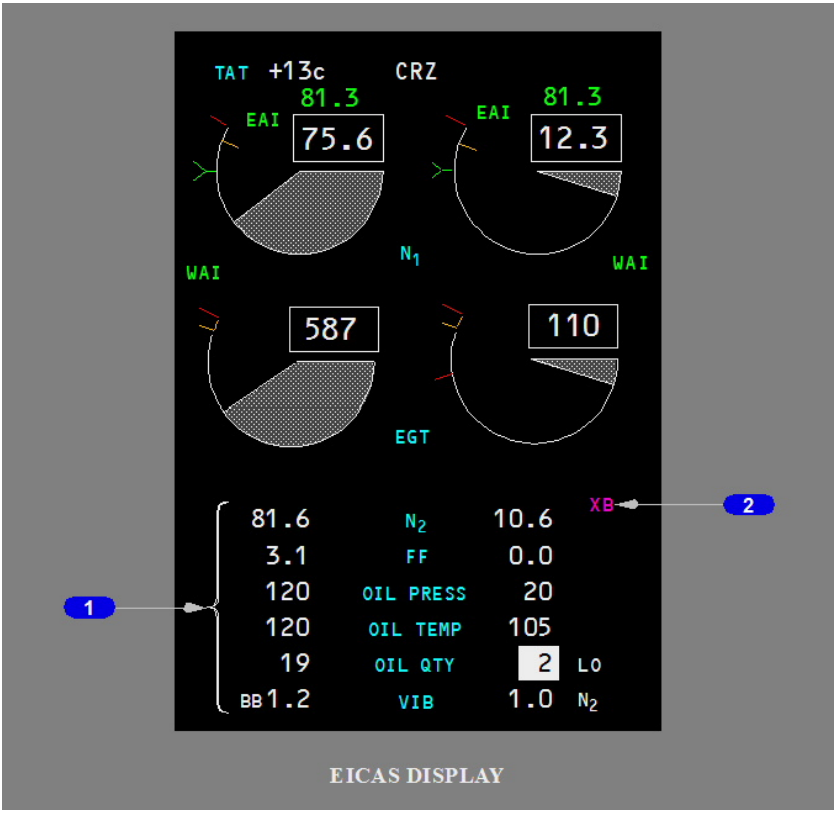
If the vibration source BB (broad band vibration) is displayed, the source is unknown and average vibration is displayed.

4 Engine Vibration Pointer

Displayed (white)—engine vibration.

Compact Engine Indications

TKK to TKR,
TKU to TKZ



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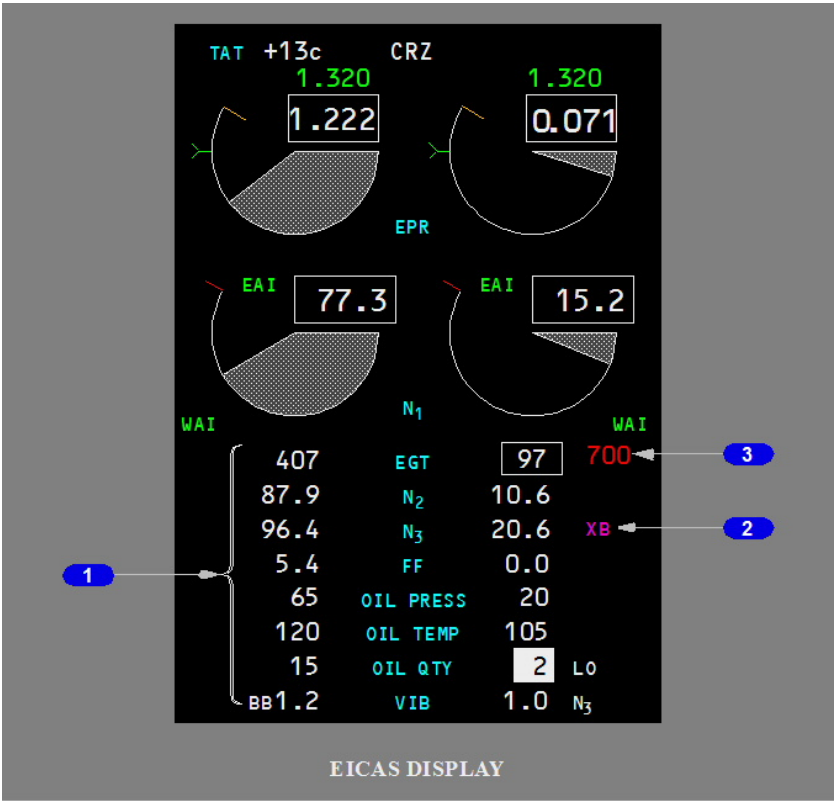
TJA,B,C,D,G,H, TJR to TJW, TKA to TKF



1 Compact Engine Indications

The following changes to EICAS and the normal secondary engine display occur:

- FF, OIL PRESS, OIL TEMP are displayed as digital readouts only. The digital displays turn amber or red if limits are exceeded.
- OIL QTY and VIB are displayed as digital readouts only. Low oil quantity and high vibrations are displayed the same as in the normal format.

TKK to TKR, TKU to TKZ

- N2 changes from round dial displays to a digital display. The digital display is framed by an amber or red box if limits are exceeded.

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

- EGT and N3 change from round dial displays to digital displays. The digital displays are framed by an amber or red box if limits are exceeded.

2 Crossbleed (XB) Start Indication

Displayed (magenta).

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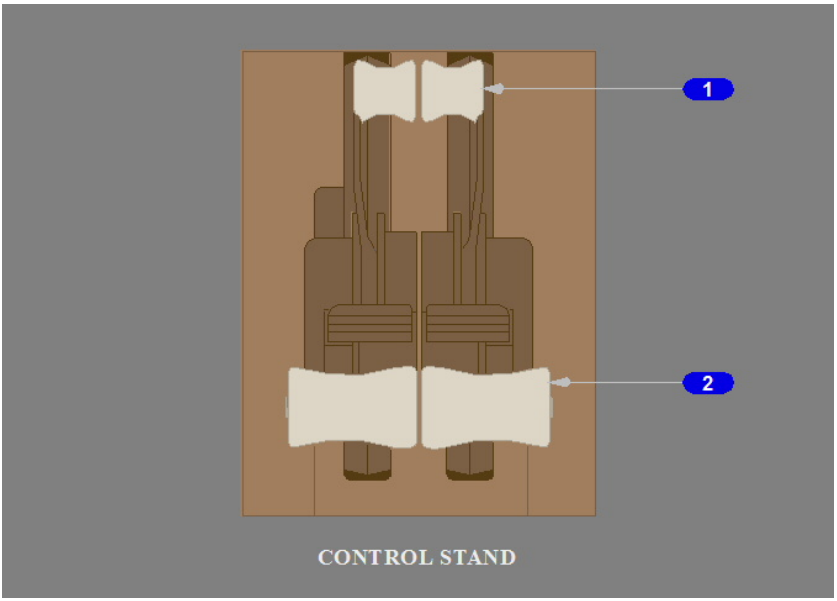
TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

3 EGT start limit

Displayed (red).

Engine Controls

Thrust Levers



1 Reverse Thrust Levers

Control engine reverse thrust.

Reverse thrust can only be selected when the forward thrust levers are closed.

Actuates automatic speedbrakes (see Spoiler Speedbrake Operation on page 9.20.16).

2 Forward Thrust Levers

Controls engine forward thrust.

The thrust levers can only be advanced if the reverse thrust levers are down.

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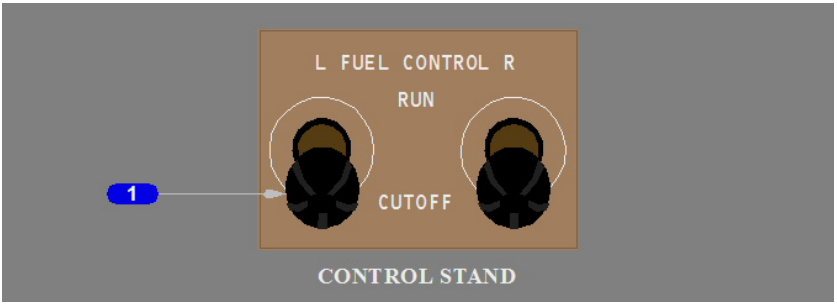
Fuel Control Switches



1 FUEL CONTROL Switch

RUN (AUTOSTART ON)—

- Opens the spar fuel valve
- arms the engine fuel valve (the EEC opens the valve when required)
- arms the selected ignitors (the EEC turns the ignitors on when required).

RUN (AUTOSTART OFF)—

- opens the spar fuel valve
- opens the engine fuel valve
- turns ignitors on.

CUTOFF—

- closes the fuel valves
- removes ignitor power
- unlocks the engine fire switch.

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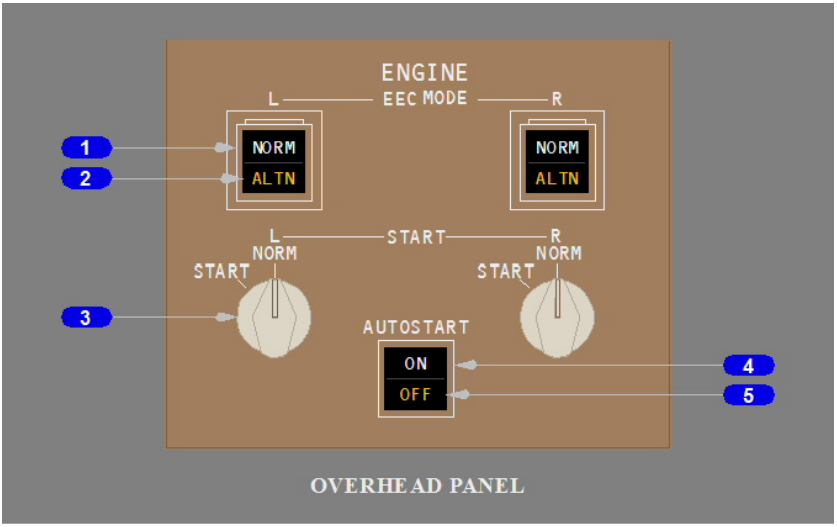
Engine Control Panel



1 Electronic Engine Control (EEC) Mode Switch

NORM—

- selects the normal engine control mode for engine control
- the EEC sets thrust using N1 RPM as the controlling parameter
- the EEC sets thrust using EPR as the controlling parameter.

TKK to TKR, TKU to TKZ, TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Off (ALTN visible)—

- selects the alternate engine control mode for engine control
- thrust is set using N1 RPM as the controlling parameter.

2 Electronic Engine Control (EEC) Alternate (ALTN) Light

Illuminated (amber)—the alternate engine control mode is either automatically or manually selected.

3 START Selector

START—

- initiates engine start by opening the start valve
- releases to NORM at start valve cutout.

NORM—

- the start valve closes
- ignition is automatically provided during engine start-up or if engine flameout occurs (if the FUEL CONTROL switch is in RUN).

TKK to TKR, TKU to TKZ

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4 AUTOSTART Switch

ON—arms the autostart system.

OFF—

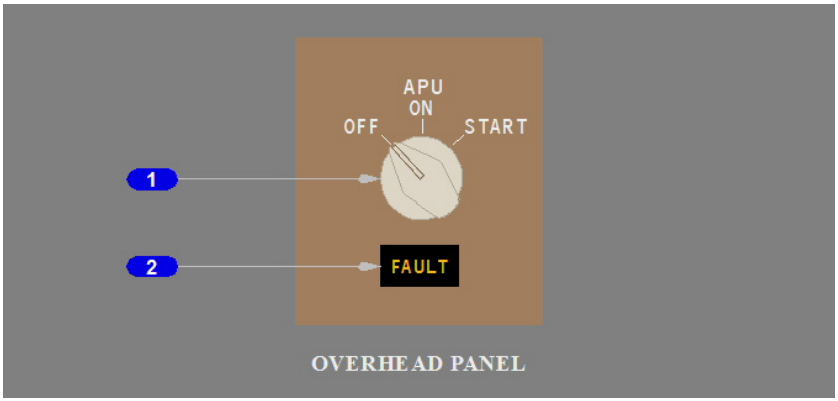
- the autostart system is disabled
- the start is manually controlled.

5 AUTOSTART OFF Light

Illuminated (amber)—the AUTOSTART switch is OFF.

Auxiliary Power Unit (APU)

APU Controls



1 APU Selector

OFF—

- closes the APU bleed air isolation valve
- initiates normal shutdown
- resets auto shutdown fault logic.

ON (APU operating position)—

- opens the APU fuel valve and inlet door
- activates AC or DC fuel pump
- powers the APU controller.

START (momentary position, spring-loaded to ON)—initiates automatic start sequence.

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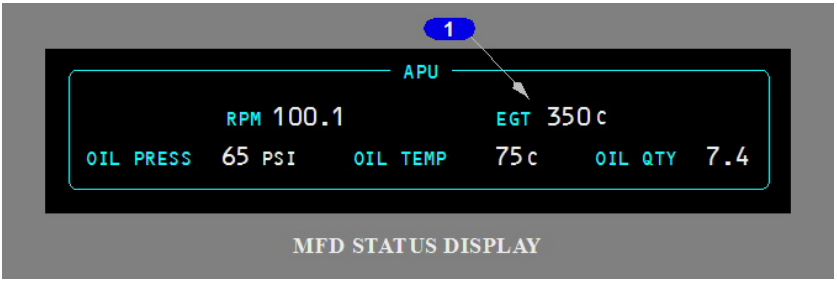
2 APU FAULT Light

Illuminated (amber):

- APU fault and/or fire is detected
- APU shutdown due to fault and/or fire
- momentarily during APU controller self-test.

APU Indications



1 APU Status Display

RPM—APU rotation speed in percent RPM.

EGT—APU exhaust gas temperature.

OIL PRESS—APU oil pressure in PSI.

OIL TEMP—APU oil temperature.

OIL QTY—APU oil quantity (liters).

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Introduction

The airplane is powered by two General Electric Model GE90–115BL engines. The engines are rated at 115,540 pounds of takeoff thrust each. TKK to TKR, TKU to TKZ

The airplane is powered by two Rolls Royce Trent 875 engines. The engines are rated at 76,580 pounds of takeoff thrust each. TJA,B,C,D,G, H

The airplane is powered by two Rolls Royce Trent 892 engines. The engines are rated at 91,450 pounds of takeoff thrust each. TJR to TJW, TKA to TKF

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 on a common shaft. The N2 rotor consists of a high pressure compressor section and a high pressure turbine section on a common shaft. The N1 and N2 rotors are mechanically independent. The N2 rotor drives the engine accessory gearbox. TKK to TKR, TKU to TKZ

The engines are three–rotor axial flow turbofans of high compression and bypass ratio. The N1 rotor consists of the fan and a low pressure turbine section on a common shaft. The N2 rotor consists of an intermediate pressure compressor section and an intermediate pressure turbine section on a common shaft. The N3 rotor consists of a high pressure compressor section and a high pressure turbine section on common shaft. The N1, N2, and N3 rotors are mechanically independent. The N3 rotor drives the engine accessory gearbox. TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Each engine is controlled by an EEC. The EECs monitor autothrottle and flight crew inputs through the thrust levers to automatically control the engines.

Each engine has individual flight deck controls. Thrust is set by positioning the thrust levers. The thrust levers are positioned automatically by the autothrottle system or manually by the flight crew. See Flight Management Computer on page 11.32.1 for a description of FMC thrust management functions.

Engine indications are displayed on the EICAS display.

Engine Intermix

TKK to TKR, TKU to TKZ

Both engines are set to operate at the same thrust rating. Replacement engine thrust rating is increased or decreased to match the thrust rating of the installed engine configuration. An EGT amber band (maximum continuous limit) difference between engines may be indicated, but these indications are normal.

Engine Indications

Primary and secondary engine indications are provided. Engine indications are displayed on the EICAS display and any selected MFD.

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Primary Engine Indications

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

EPR, N1, and EGT are the primary engine indications. The primary engine indications are always displayed on the EICAS display. Normally the EICAS is on the upper center display unit. If that unit fails the EICAS display automatically moves to the lower center display unit.

TKK to TKR, TKU to TKZ

N1 and EGT are the primary engine indications. The primary engine indications are always displayed on the EICAS display. Normally the EICAS is on the upper center display unit. If that unit fails, the EICAS display automatically moves to the lower center display unit.

Secondary Engine Indications

TKK to TKR, TKU to TKZ

N2, fuel flow, oil pressure, oil temperature, oil quantity, and engine vibration are secondary engine indications. Secondary engine indications are displayed on the selected MFD to provide timely indication of a change to engine parameters. The secondary engine indications can be displayed by pushing the secondary engine display switch (the ENG switch on the display select panel). The secondary engine indications are automatically displayed when the display initially receives electrical power, or:

- a FUEL CONTROL switch is moved to CUTOFF in flight
- an engine fire switch is pulled in flight
- the FUEL FLOW ENG L, R alert message is displayed
- a secondary engine parameter is exceeded, or
- engine N2 RPM is below idle in flight.

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

N2, N3, fuel flow, oil pressure, oil temperature, oil quantity, and engine vibration are secondary engine indications. Secondary engine indications are displayed on the selected MFDto provide timely indication of a change to engine parameters. The secondary engine indications can be displayed by pushing the secondary engine display switch (the ENG switch on the display select panel). The secondary engine indications are automatically displayed when the display initially receives electrical power, or:

- a FUEL CONTROL switch is moved to CUTOFF in flight
- an engine fire switch is pulled in flight

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF*

- the FUEL FLOW ENG L, R alert message is displayed
- a secondary engine parameter is exceeded, or
- engine N3 RPM is below idle in flight.

The secondary engine display:

- shows on the lower MFD, if available
- Shows and latches any time the secondary engine indications are automatically displayed
- shows again, if latched, after any other display page is selected then blanked

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- can be cleared by pushing the secondary engine display switch, if the display is not latched.

Automatic display of secondary engine indications is for crew awareness and does not require pilot action.

Only parameters with published operating limits generate EICAS messages. In general, procedures are written so that flight crews are not required to analyze or troubleshoot engine indications to diagnose problems or initiate procedures. EICAS monitors designated engine parameters and displays an EICAS alert message to notify the crew to take an action when published limits are exceeded. Flight crew procedures are accomplished in response to these alerts.

Normal Display Format

TKK to TKR, TKU to TKZ

Primary engine indications and the N2 indications are both digital readouts and round dial/moving pointer indications. The digital readouts display numerical values while the moving pointers indicate relative value.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Primary engine indications and the N3 indication are digital readouts and round dial/moving pointer indications. The digital readouts display numerical values while the moving pointers indicate relative value.

TKK to TKR, TKU to TKZ

Oil pressure, oil temperature, and vibration indications are both digital readouts and vertical indication/moving pointers. Fuel flow and oil quantity are digital readouts only. All digital readouts are enclosed by boxes. The dial and vertical indications display the normal operating range, caution range, and operating limits (as applicable).

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Oil pressure, oil temperature, and vibration indications are both digital readouts and vertical indication/moving pointers. Fuel flow, N2, and oil quantity are digital readouts only. All digital readouts are enclosed by boxes. The dial and vertical indications display the normal operating range, caution range, and operating limits (as applicable).

Normal operating range is displayed on a dial or vertical indication in white.

The oil temperature and oil pressure vertical indication has caution ranges displayed by amber bands. If oil temperature or oil pressure reaches the caution range, the digital readout, digital readout box, and pointer all change color to amber.

TKK to TKR, TKU to TKZ

N1, N2, EGT, oil pressure, and oil temperature indications have operating limits indicated by red lines. If one of these indications reaches the red line, the digital readout, box, and pointer change color to red for that indication.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

N1, EGT, N3, oil pressure, and oil temperature indications have operating limits indicated by red lines. If one of these indications reaches the red line, the digital readout, box, and pointer change color to red for that indication.

The EGT indication has a maximum continuous limit represented by an amber band. The maximum continuous limit does not apply during takeoff or go-around.

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If EGT reaches the maximum continuous limit, the digital indication, box, pointer, and dial all change color to amber. EGT indications are inhibited from changing to amber during takeoff or go-around for five minutes. The EGT indication is often in the amber band during takeoff; this is acceptable. The EGT indication has a maximum takeoff limit displayed by a red line. If EGT reaches the maximum takeoff limit, the digital indication, box, pointer and dial, all change color to red.

TKK to TKR, TKU to TKZ

If an N1, N2, or EGT red line is exceeded, the box enclosing the digital readout remains red after the exceeded limit returns to the normal range. The red box color can be canceled to white or recalled to red by pushing the cancel/recall switch on the display select panel. An indication changes color back to white when it returns to the normal operating range.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

If an N1, N3, or EGT red line is exceeded, the box enclosing the digital readout remains red after the exceeded limit returns to the normal range. The red box color can be canceled to white or recalled to red by pushing the cancel/recall switch on the display select panel. An indication changes color back to white when it returns to the normal operating range.

For low oil quantity, the oil quantity digital readout changes to black text on a white background. The white text LO is displayed adjacent to the readout.

For high engine vibration, the vibration digital readout changes to black text on a white background.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

The maximum EPR limit is indicated by an amber line at the top of the EPR dial. The EPR indication does not change color when maximum EPR is reached. The reference/target EPR indication displays the FMS reference or target EPR. The commanded EPR indication displays the EEC calculated EPR commanded by thrust lever position.

Compact Display Format

TKK to TKR, TKU to TKZ

In compact format, primary and secondary engine indications are combined on the same display. The N1 and EGT indications are displayed as they are normally (moving pointer/round dial and digital indications). All other indications change to digital readouts only, with the exception that the N2 digital readout is boxed if a parameter is exceeded. If an amber or red line parameter for a digital indication is exceeded, the digital indication changes color to amber or red (as does the box that appears around the N2 indication for a red line exceedance). If the N2 red line is exceeded, the red color of the box around the digital indication can be returned to white (if the exceeded parameter has returned to normal) by pushing the display select panel CANCEL/RECALL switch.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

In compact format, primary and secondary engine indications are combined on the same display. The EPR and N1 displays are the same as the normal displays. All other indications change to digital readouts only. If an amber or red line parameter for a digital indication is exceeded, the digital indication changes color to amber or red (as does the box that appears around an EGT, N2, or

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N3 indication). If the N1, N2, N3, or EGT red line is exceeded, the red color of the box around the digital indication can be returned to white (if the exceeded parameter has returned to normal) by pushing the display select panel CANCEL/RECALL switch.

Primary and secondary engine indications are displayed on EICAS in compact format whenever:

- secondary engine display is automatically selected, and the lower multifunction display is failed, unpowered, or is occupied, or
- secondary engine display is manually selected to the lower center MFD and the lower MFD is failed, unpowered, or occupied with EICAS.

Electronic Engine Control (EEC)

Each EEC has full authority over engine operation. The EEC uses thrust lever inputs to automatically control forward thrust and reverse thrust. The EEC has two control modes: normal and alternate. In the normal mode, the EEC uses EPR as the parameter for setting thrust. In the alternate mode, the EEC uses N1 RPM as the controlling parameter. TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

Each EEC has full authority over engine operation. The EEC uses thrust lever inputs to automatically control forward thrust 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 parameter for setting thrust. TKK to TKR, TKU to TKZ

EEC Normal Mode

In the normal mode, the EEC sets thrust by controlling EPR based on thrust lever position. EPR is commanded by positioning the thrust levers either automatically with the autothrottles, or manually by the flight crew. TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

In the normal mode, the EEC sets thrust by controlling N1 based on thrust lever position. N1 is commanded by positioning the thrust levers either automatically with the autothrottles, or manually by the flight crew. TKK to TKR, TKU to TKZ

Maximum EPR represents the maximum rated thrust available from the engine. The EEC continuously computes maximum EPR. TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

Maximum N1 represents the maximum rated thrust available from the engine. The EEC continuously computes maximum N1. TKK to TKR, TKU to TKZ

Maximum rated thrust is available in any phase of flight by moving the thrust levers to the full forward positions.

EEC Alternate Mode

If the required signals are not available to operate in the normal mode, the EEC automatically uses the alternate mode. In the alternate mode, the EEC schedules

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N1 as a function of thrust lever position. The alternate mode provides soft and hard levels of control:

- Soft—When the EEC automatically switches an engine to the alternate mode and the EEC mode switch remains in NORM, the EEC is in the soft alternate mode (the switch position is NORM, the EEC mode is alternate). At a fixed thrust lever position, thrust does not change.
- Hard—When ALTN is manually selected on an EEC mode switch, that engine is switched to the hard alternate mode (the switch position is ALTN, the EEC mode is alternate). Reference and target N1, and maximum and commanded N1 values are displayed on the N1 indication during the hard alternate mode. Thrust may change to set the commanded N1 when ALTN is manually selected.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

For the normal, soft alternate, and hard alternate modes, the following EPR and N1 information is displayed:

EEC mode switch—NORM EEC mode—Normal	EEC mode switch—NORM EEC mode—Soft Alternate	EEC mode switch—ALTN EEC mode—Hard Alternate
• EPR: actual, command, reference/target, maximum • N1: actual, red line.	• EPR: blank • N1: actual, red line.	• EPR: blank • N1: actual, command, reference/target, maximum, red line.

TKK to TKR, TKU to TKZ

For the normal, soft alternate, and hard alternate modes, actual, command, reference/target, maximum, and red line N1 information is displayed.

Automatic reversion or manual selection to the alternate mode is indicated by the EICAS advisory message ENG EEC MODE (L, R) and illumination of the EEC ALTN light on the associated EEC mode switch. Selecting the alternate mode on both engines eliminates thrust lever stagger at equal thrust settings, or asymmetric thrust when the thrust levers are operated together.

The autothrottles remain engaged whenever the EEC automatically switches to the alternate mode. The alternate mode N1 reference/target values are computed by the FMC.

Note: The autothrottles remains connected whenever the EEC is in the alternate mode.

The alternate mode schedule (N1 schedule) provides equal or greater thrust than the normal mode for the same thrust lever position.

Thrust protection is not provided in the alternate mode 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. The EICAS caution message ENG LIMIT PROT (L, R) is displayed if the thrust lever position

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commands an N1 greater than the maximum rated thrust (maximum N1). N1 and N2 red line protection is still available in the alternate control mode.

N1 and N2 red line protection is provided in the alternate control mode. TKK to TKR, TKU to TKZ

N1, N2, and N3 red line protection is provided in the alternate control mode. TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Overspeed Protection

The EEC also provides N1 and N2 red line overspeed protection. If N1 or N2 approaches overspeed, the EEC commands reduced fuel flow. The EICAS advisory message ENG RPM LIMITED (L or R) is provided when overspeed protection is provided. TKK to TKR, TKU to TKZ

The EEC also provides N1, N2, and N3 red line overspeed protection. If N1, N2, or N3 approaches overspeed, the EEC commands reduced fuel flow. The EICAS advisory message ENG RPM LIMITED (L or R) is provided when overspeed protection is provided. TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

If the EECs are in alternate mode, advancing the thrust levers full forward provides some overboost and should be considered only during emergency situations when all other available actions have been taken and terrain contact is imminent.

Engine Idle

The EEC selects minimum idle or approach idle. Minimum idle is a lower thrust than approach idle. TKK to TKR, TKU to TKZ

The EEC selects minimum idle, intermediate idle, or approach idle. Minimum idle is a lower thrust than approach idle or intermediate idle. Intermediate idle is selected when the Landing Gear lever DN. TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Approach idle is selected in flight when:

- engine anti-ice is operating
- the flaps are commanded to 25 or greater
- one hydraulic system air–driven demand pump is inoperative, and the flaps are out of the UP position
- the opposite engine bleed air valve is closed.

Approach idle decreases acceleration time for go-around. Approach idle is maintained until after touchdown, when minimum idle is selected.

Thrust Control Malfunction Protection

TKK to TKR, TKU to TKZ

The EEC provides protection against an uncontrolled high thrust malfunction during ground operation. The EEC shuts down the affected engine when:

- airplane is on ground,
- thrust lever is at idle, and
- engine is above idle speed and not decelerating normally.

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The EICAS caution message ENG FAIL (L or R) is displayed when the engine falls below idle speed.

Engine Start and Ignition System

The engines can be started using the autostart system or manually. Autostart is the normal starting mode. Selecting OFF on the AUTOSTART switch disables autostart and allows manual, pilot–monitored, starting.

TKK to TKR, TKU to TKZ

Bleed air 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.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Bleed air 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.

The START selectors control the starter air valves. Ignition and fuel flow are controlled through the FUEL CONTROL switches.

TKK to TKR, TKU to TKZ

At approximately idle N2 RPM, the EEC commands starter cutout, and the START selector releases to the NORM position.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

The EEC monitors the start and commands starter cutout at 50 percent N3 RPM. The START selector releases to the NORM position.

TKK to TKR, TKU to TKZ

A maximum start limit line (red) is displayed on the EGT indication when the FUEL CONTROL switch is moved to CUTOFF or engine N2 RPM is below idle. It remains displayed after the FUEL CONTROL switch is moved to RUN until the engine is stabilized at idle. The EGT indication changes color to red if the EGT start limit is reached during starting.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

A maximum start limit line (red) is displayed on the EGT indication when the FUEL CONTROL switch is moved to CUTOFF or engine N3 RPM is below idle. It remains displayed after the FUEL CONTROL switch is moved to RUN until the engine is stabilized at idle. The EGT indication changes color to red if the EGT start limit is reached during starting.

Autostart

TKK to TKR, TKU to TKZ

Autostart allows the EEC to control fuel and ignition. With the AUTOSTART switch ON, the autostart sequence is initiated by rotating the START selector to START and moving the FUEL CONTROL switch to RUN. For in-flight windmill starts the autostart sequence is initiated by moving the FUEL CONTROL switch to RUN.

The START selector opens the starter air valve to begin dry motoring the engine. Moving the FUEL CONTROL switch to RUN opens the spar fuel valve, but not the engine fuel valve. The proper sequencing of fuel and ignition is controlled by the autostart system. With the FUEL CONTROL switch positioned to RUN, the

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EEC opens engine fuel valve and energizes the ignitor(s) at the appropriate N2 RPM.

During autostart, the EEC monitors EGT, N2 RPM, and other engine parameters until the engine reaches idle. During ground start, the autostart system monitors engine parameters and will abort the start for any of the following:

- hot start
- hung start
- no EGT rise
- compressor stall
- starter shaft failure
- no N1 rotation
- insufficient air pressure for starter operation
- start time exceeds the starter duty cycle timer.

Note: The autostart system does not monitor oil pressure and temperature.

If a hot start, hung start, no EGT rise, or compressor stall is detected, and N2 RPM is less than starter cutout speed, the EEC turns off fuel and ignition and motors the engine for 4 seconds before making a second or third attempt. The second attempt uses both ignitors. If the second attempt fails, a third attempt is made by adjusting the starting fuel flow. If N2 RPM is greater than starter cutout speed, the EEC turns off fuel and ignition, closes the starter air valve and allows the engine to spool down below 30 percent N2 RPM. It then reopens the starter air valve and motors the engine before re-introducing fuel and ignition for subsequent attempt(s).

On the ground, if all attempts fail, the EEC aborts the start. Fuel and ignition are shut off and the engine is motored for 30 seconds to clear residual fuel. The starter air valve then closes and the START selector releases to the NORM position. The EICAS caution message ENG AUTOSTART (L or R) is displayed.

On the ground, autostart does not attempt a second or third start if there is no N1 rotation, insufficient air pressure, the starter shaft fails, the EGT exceeds the start limit line, or the start time exceeds the starter duty cycle. The EICAS caution message ENG AUTOSTART (L or R) is displayed.

Note: For in-flight starts, the autostart system temporarily discontinues the start if a preset EGT between the start and takeoff EGT red line limits is reached, or a hung start is detected. Autostart takes corrective action if some start problems are detected, but does not abort the start.

Whenever the AUTOSTART switch is selected OFF, the EICAS advisory message ENG AUTOSTART OFF is displayed and the AUTOSTART switch OFF light illuminates.

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TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Autostart

Autostart allows the EEC to control fuel and ignition. With the AUTOSTART switch ON, the autostart sequence is initiated by rotating the START selector to START and moving the FUEL CONTROL switch to RUN. For in-flight windmill starts the autostart sequence is initiated by moving the FUEL CONTROL switch to RUN.

The START selector opens the starter air valve to begin dry motoring the engine. Moving the FUEL CONTROL switch to RUN opens the spar fuel valve, but not the engine fuel valve. The proper sequencing of fuel and ignition is controlled by the autostart system. With the FUEL CONTROL switch positioned to RUN, the EEC opens engine fuel valve and energizes the ignitor(s) above the appropriate N2 and N3 RPM.

During autostart, the EEC monitors EGT, N3 RPM, and other engine parameters until idle N3 RPM is achieved. During ground start, the autostart system monitors engine parameters and will abort the start for any of the following:

- hot start
- hung start
- no EGT rise
- compressor stall
- starter shaft failure
- no N1 rotation
- insufficient air pressure for starter operation
- start time exceeds the starter duty cycle timer.

Note: The autostart system does not monitor oil pressure and temperature.

If a hot start, hung start, no EGT rise, or compressor stall is detected and N3 RPM is less than starter cutout speed, the EEC turns off fuel and ignition and motors the engine for 20 to 30 seconds (depending on the detected condition). Following motoring and after EGT falls below 100 deg. C, the EEC re-introduces fuel and ignition using both ignitors. If the second attempt fails and N3 RPM is less than starter cutout speed, the EEC turns off fuel and ignition and motors the engine for 30 seconds and until the EGT is below 100 deg. C. The starter air valve then closes and the START selector releases to the NORM position. The EICAS caution message ENG AUTOSTART (L or R) is displayed.

On the ground, if no N1 rotation, low starter air pressure, starter shaft failed condition is detected, if the starter duty cycle timer expires, or the start is aborted above starter cutout speed, the EEC aborts the autostart sequence without motoring and will not make a second attempt. The starter air valve then closes and the START selector releases to the NORM position. The EICAS caution message ENG AUTOSTART (L or R) is displayed.

Note: For in-flight starts, the autostart system temporarily discontinues the start if the takeoff EGT red line limit is reached, or if a no light-off or a

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hung start is detected. If one of these conditions is detected, autostart will windmill the engine for 30 seconds before making another attempt. For starter assisted in-flight starts, autostart does not motor the engine with the starter between attempts. Instead, windmill motoring is used and the starter is re-engaged on the following start attempt. Autostart takes corrective action if some start problems are detected, but does not abort the start. During the second or subsequent start attempts autostart re-introduces fuel and ignition when the EGT falls below 200 deg. C.

Whenever the AUTOSTART switch is selected OFF, the EICAS advisory message ENG AUTOSTART OFF is displayed and the AUTOSTART switch OFF light illuminates.

Manual Start

The AUTOSTART switch must be OFF to accomplish a manual start. The start is accomplished in accordance with the Manual Engine Start procedure (see Manual Engine Start on page SP.7.2). Ignition and fuel are provided as soon as the FUEL CONTROL switch is positioned to RUN. The start must be monitored until the engine stabilizes at idle.

For ground starts, the FUEL CONTROL switch should not be moved to RUN until EGT is below 100 deg. C.

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF,
TKK to TKR,
TKU to TKZ

In-Flight Start

In-flight start envelope information is displayed on the EICAS display when an engine is not running in flight (N2 RPM below idle RPM) or when an engine is shut down in flight and the respective engine fire switch is not pulled. The in-flight start envelope indicates the airspeed range necessary to ensure an in-flight start at the current flight level. If the current flight level is above the maximum start altitude, the maximum start altitude and respective airspeed range are displayed.

Secondary engine indications are displayed automatically when a FUEL CONTROL switch is moved to CUTOFF in flight or if N2 RPM goes below idle RPM while in flight. A crossbleed start indication is displayed next to the N2 indication if airspeed is below that recommended for a windmilling start, the in-flight start envelope is displayed, and the respective engine fire switch is in.

Refer to Engine In-Flight Start, Chapter NNC.7 for the in-flight start procedure.

For in-flight starts, autostart makes continuous start attempts until the engine either starts or the pilot aborts the start attempt by positioning the FUEL CONTROL switch to CUTOFF (and positioning the start switch to NORM if it was a starter assisted attempt).

In-Flight Start

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

In-flight start envelope information is displayed on the EICAS display when an engine is not running in flight (N3 RPM below idle RPM) or when an engine is shut down in flight and the respective engine fire switch is not pulled. The in-flight

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start envelope indicates the airspeed range necessary to ensure an in-flight start at the current flight level. If the current flight level is above the maximum start altitude, the maximum start altitude and respective airspeed range are displayed.

Secondary engine indications are displayed automatically when a FUEL CONTROL switch is moved to CUTOFF in flight or if N3 RPM goes below idle RPM while in flight. A crossbleed start indication is displayed next to the N3 indication if airspeed is below that recommended for a windmilling start.

Refer to Engine In–Flight Start, Chapter NNC.7 for the in-flight start procedure.

For in-flight starts, autostart makes continuous start attempts until the engine either starts or the pilot aborts the start attempt by positioning the FUEL CONTROL switch to CUTOFF (and positioning the START switch to NORM if it was a starter assisted attempt).

During a windmilling in-flight start, the EEC monitors engine parameters to provide the best fuel schedule to ensure the shortest possible start time.

Engine Ignition

Each engine has two ignitors. The EEC automatically selects the appropriate ignitor(s). The EEC alternates ignitors for successive engine ground starts. Dual ignitors are always used for in–flight starts.

Main AC power is the normal power source for ignition. Standby AC power provides a backup source.

TKK to TKR, TKU to TKZ

When the START selector is in the NORM position and a flameout is detected, continuous ignition is automatically provided until three seconds after the flameout condition is cleared whenever:

- the flap lever is out of the UP position, or
- engine anti-ice is on.

TKK to TKR, TKU to TKZ

On the ground, continuous ignition is inhibited when N1 is below approximately 55%.

Auto-Relight

TKK to TKR, TKU to TKZ

An auto-relight capability is provided for flameout protection and sub-idle stall recovery. If the EEC detects an engine flameout, both ignitors activate. A flameout is detected when a rapid decrease in N2 occurs, or N2 is less than idle RPM. If a sub-idle stall is detected, fuel is shut off for one second in an attempt to clear the stall.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

There is no manual continuous ignition selection or automatic continuous ignition function. Engine flameout protection is provided for an auto-relight and rain/ hail ingestion. The auto-relight function is activated whenever an engine is at or below idle with the FUEL CONTROL switch in RUN. When the EEC detects an engine flameout, the respective engine ignitors are activated. If the engine does

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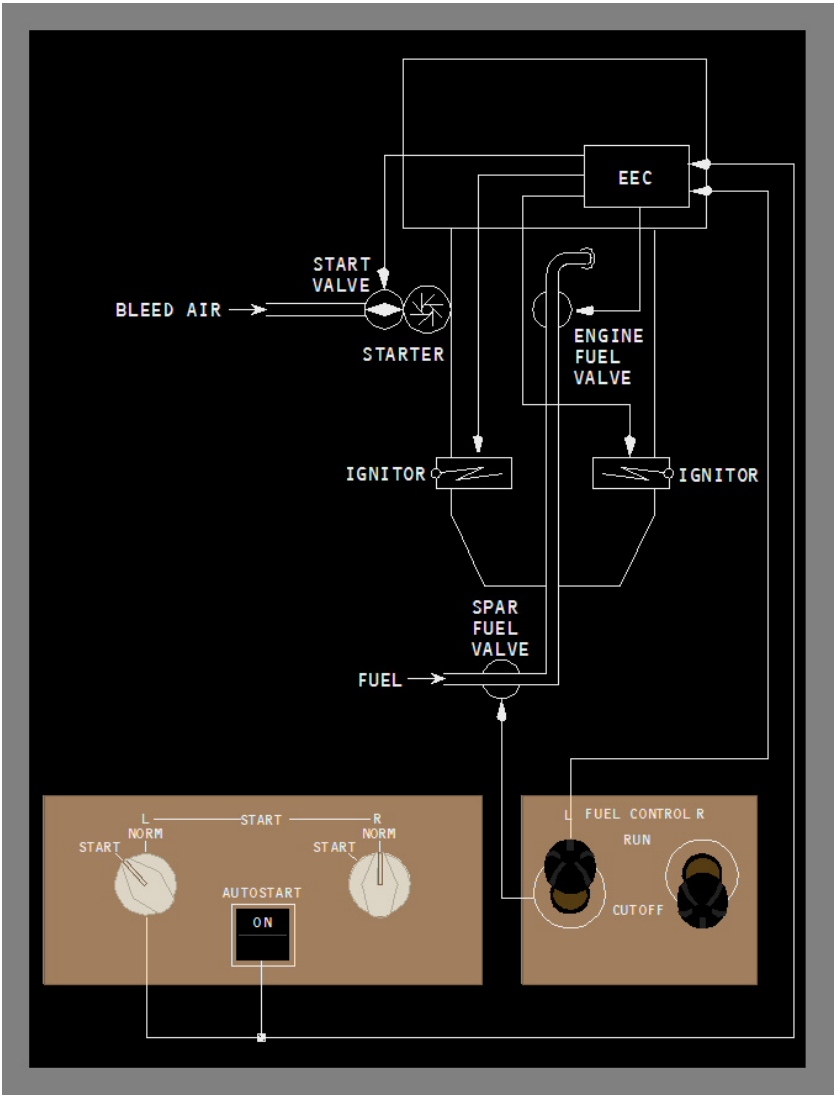
not recover and continues to run down below 35% N3, the EEC shuts off fuel and ignition and disables the auto-relight function.

The EEC also provides protection against flameout during periods of excessive rain/hail ingestion. When a flameout is detected, the EEC energizes both ignitors.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Engine Start and Ignition System Schematic



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Engine Fuel System

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

Fuel is supplied by fuel pumps located in the fuel tanks. The fuel flows through a spar fuel valve located in the main tank. It then passes through the first stage engine fuel pump where additional pressure is added. It flows through a fuel/oil heat exchanger where it is preheated. A fuel filter removes contaminants. The second stage of the engine fuel pump adds more pressure before the fuel reaches the fuel metering unit. The fuel metering unit adjusts fuel flow to meet thrust requirements. The fuel then flows through the engine fuel valve into the engine.

TKK to TKR, TKU to TKZ

Fuel is supplied by fuel pumps located in the fuel tanks. The fuel flows through a spar fuel valve located in the main tank. It then passes through the first stage engine fuel pump where additional pressure is added. The second stage of the engine fuel pump adds more pressure. It flows through a fuel/oil heat exchanger where it is preheated. A fuel filter removes contaminants. The fuel then reaches the fuel metering unit. The fuel metering unit adjusts fuel flow to meet thrust requirements. The fuel then flows through the engine fuel valve into the engine.

The spar and engine fuel valves allow fuel flow to the engine when both valves are open. The valves open when the engine fire switch is IN and the FUEL CONTROL switch is in RUN. Both valves close when either the FUEL CONTROL switch is in CUTOFF or the engine fire switch is OUT.

Fuel flow is measured after passing through the engine fuel valve. Fuel flow is displayed on the secondary engine display. Fuel flow information is also provided to the FMS.

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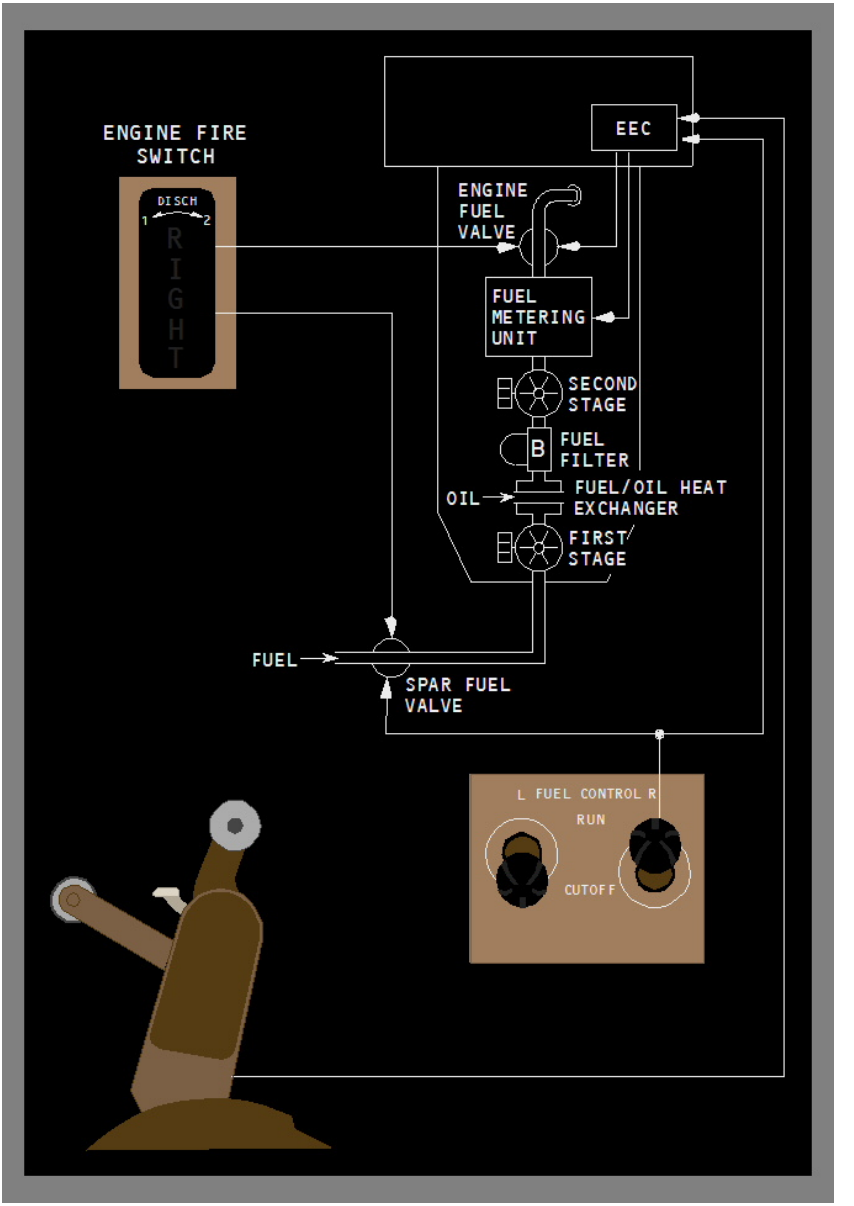
Engine Fuel System Schematic

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF



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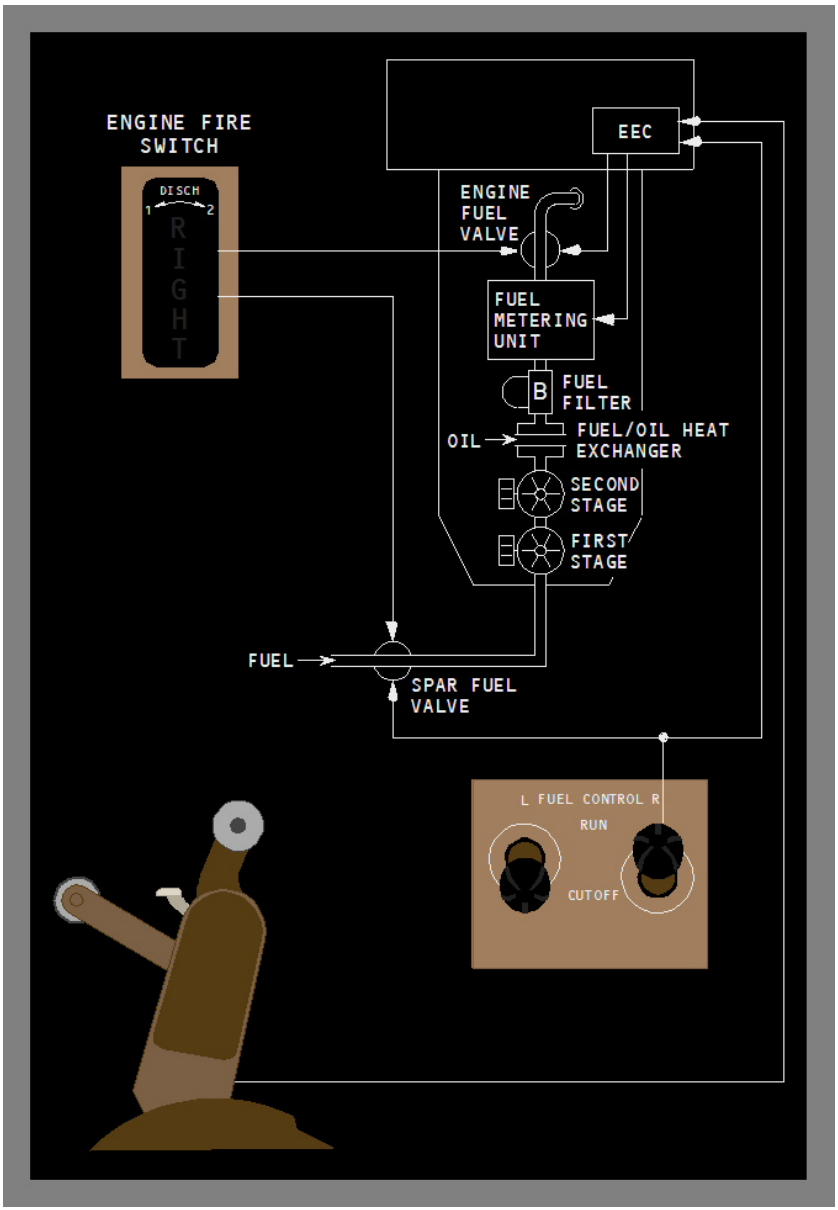
TKK to TKR,
TKU to TKZ



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Engine Oil System

The oil system provides pressurized oil to lubricate and cool the engine main bearings, gears and accessory drives. The oil system also provides automatic fuel heating for fuel system icing protection.

TKK to TKR, TKU to TKZ

Oil is pressurized by an engine-driven oil pump. From the pump, the oil flows through the oil filter. If the oil filter becomes clogged, then oil bypasses the oil filter and the EICAS advisory message ENG OIL FILTER (L, R) is displayed. The oil flows through the fuel/oil heat exchangers and then through the backup generator oil/oil heat exchanger, and is then delivered to the engine main bearings, gears, and accessory drives. A scavenge pump returns the oil to the reservoir.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Oil is pressurized by an engine-driven oil pump. From the pump, the oil flows through the high pressure oil filter. The oil flows through the air/oil heat exchanger, and fuel/oil heat exchangers and is then delivered to the engine main bearings, gears, and accessory drives. A scavenge pump returns the oil to the reservoir. Prior to the reservoir, the oil flows through a scavenge oil filter. If the scavenge oil filter becomes clogged, then oil bypasses the filter.

TKK to TKR, TKU to TKZ

Oil pressure, temperature, and quantity are displayed on the secondary engine display. Oil pressure and oil temperature are measured prior to entering the engine.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

Oil pressure, temperature, and quantity are displayed on the secondary engine display. Oil pressure is measured prior to entering the engine. Oil temperature is measured after leaving the engine, prior to entering the reservoir.

There is no minimum oil quantity limit (no amber or start limit line); however, a low oil quantity causes automatic display of the secondary engine display and reverses the display indication to show black numbers on a white background. There are no operating limitations for the engine oil quantity; therefore, there are no flight crew procedures based solely on a response to low oil quantity.

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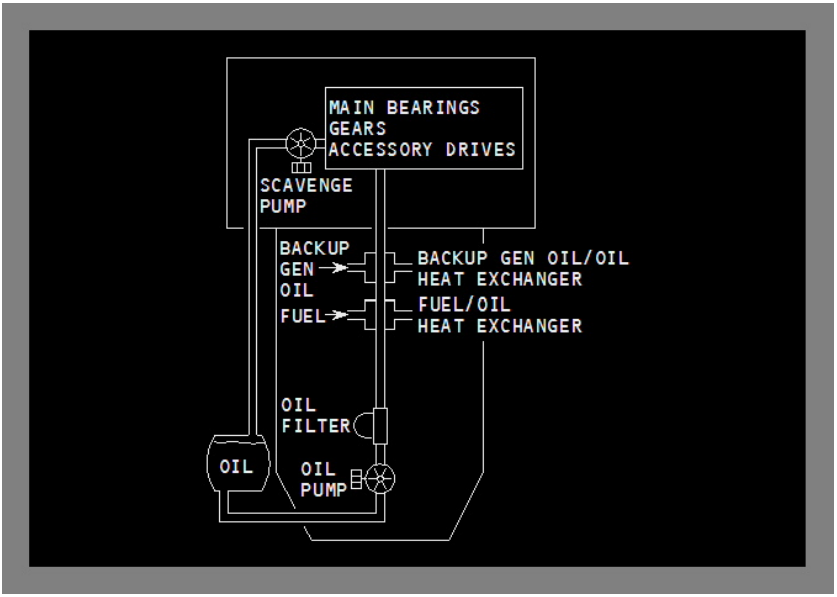
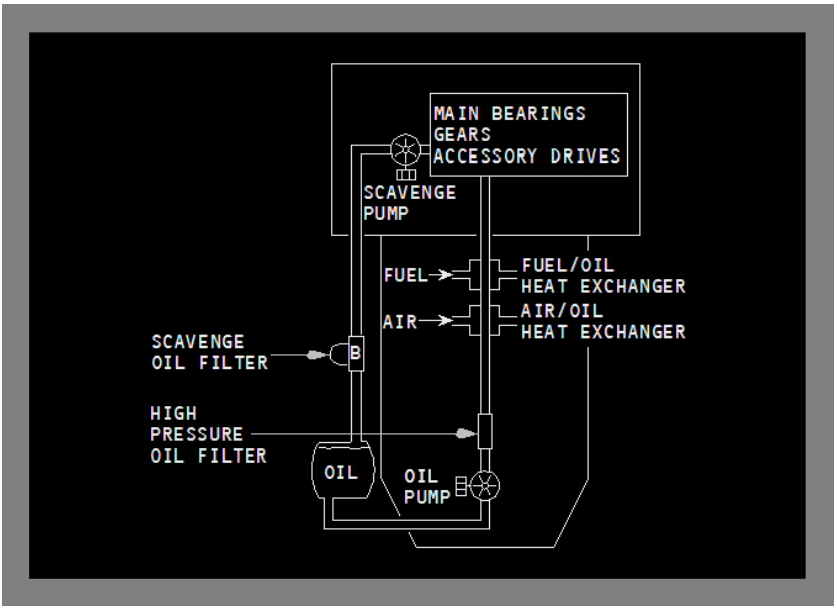
Engine Oil System Schematic

TKK to TKR, TKU to TKZ



TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



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Thrust Reverser System

Each engine has a hydraulically actuated fan air thrust reverser. Reverse thrust is available only on the ground.

The reverse thrust levers can be raised only when the forward thrust levers are in the idle position. When the reverse thrust levers are raised, the EEC opens the reverser isolation valve. The EEC inhibits reverser isolation valve actuation and reverser deployment unless the airplane is on the ground with the engine running. The EECs also control thrust limits during reverser operation. This requirement supports asymmetric thrust airplane controllability when a thrust reverser fails to deploy.

When the reverse thrust levers are pulled aft to the interlock position:

- the autothrottle disengages
- the auto speedbrakes deploy.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

When the reverser system is activated:

- the reverser translating sleeves hydraulically move aft
- the fan flow blocker doors rotate into place to direct fan air through stationary cascade guide vanes
- the reverser indication (REV) is displayed above each digital EPR indication (REV is displayed in amber when the reverser is in transit).

TKK to TKR, TKU to TKZ

When the reverser system is activated:

- the reverser translating sleeves hydraulically move aft
- the fan flow blocker doors rotate into place to direct fan air through stationary cascade guide vanes
- the reverser indication (REV) is displayed above each digital N1 indication (REV is displayed in amber when the reverser is in transit).

When the interlock releases:

- the reverse thrust levers can be raised to the maximum reverse thrust position
- the REV indication changes to green when the reverser is fully deployed.

Pushing the reverse thrust levers to the full down position retracts the reversers to the stowed and locked position. The thrust levers cannot be moved forward until the reverse thrust levers are fully down.

The EICAS advisory message ENG REV LIMITED (L or R) is displayed if the reverser cannot deploy when commanded, or can deploy only with reverse thrust limited to idle. Not all conditions limiting or preventing reverse thrust can be detected before reverse thrust selection. For these conditions, the reverse thrust levers cannot be moved beyond the interlock position.

The EICAS advisory message ENG REVERSER (L or R) is displayed on the ground to indicate a reverser system fault.

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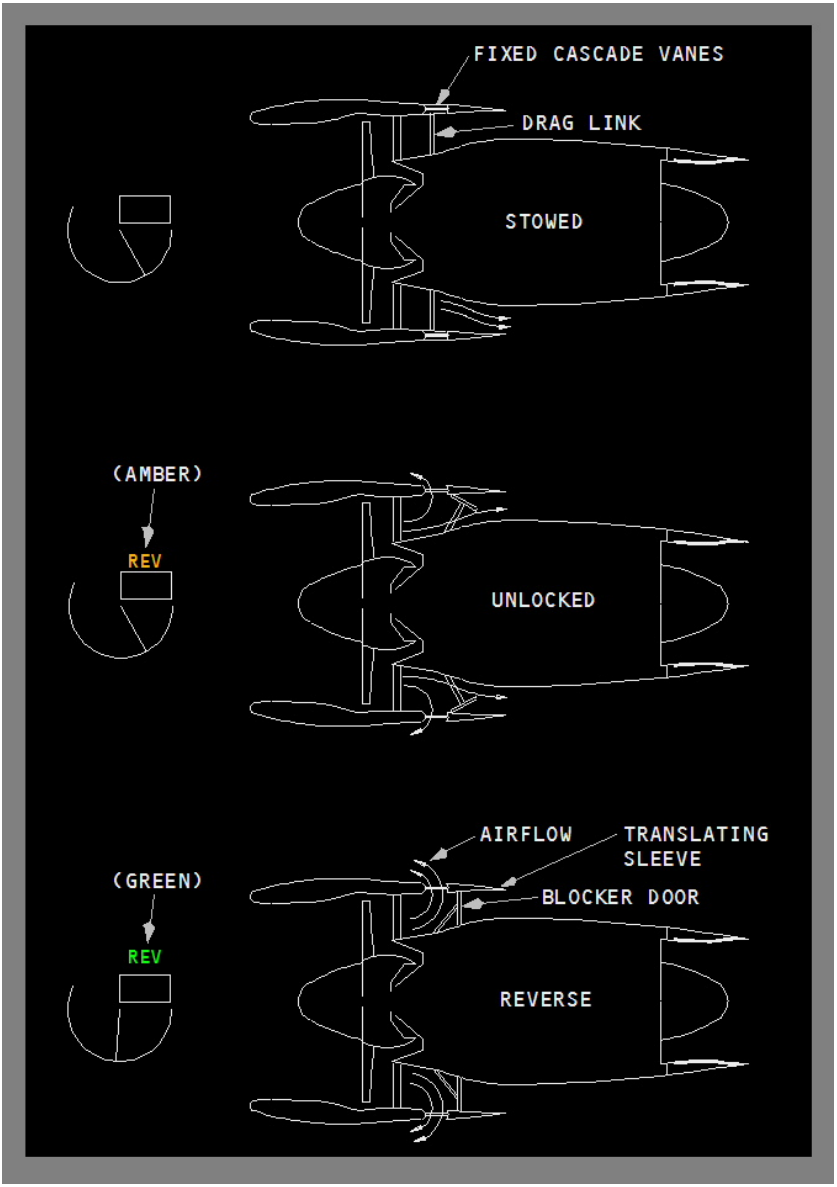
Thrust Reverser Schematic



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Airborne Vibration Monitoring System

TKK to TKR, TKU to TKZ

The airborne vibration monitoring system monitors engine vibration levels. The vibration indications are displayed on the secondary engine display. The vibration source indication is also displayed. If the vibration monitoring system cannot determine the source (N1 or N2), broadband (BB) is displayed for the affected engine. Broadband vibration is the average vibration detected.

TKK to TKR, TKU to TKZ

The airborne vibration monitoring system is primarily intended for engine condition monitoring, but it is also a useful tool for isolating and determining corrective action for engine anomalies. There is no certified vibration limit, but when a high vibration level is reached, the secondary engine parameters are automatically displayed. Since there are no operating limitations for the airborne vibration monitoring system, there are no specific flight crew actions (or procedures) based solely on vibration indication. High N1 vibration indication would most likely be accompanied by tactile vibration. This is not the case with high N2 vibration indication. Both N1 and N2 high vibrations may be accompanied by anomalies in other engine parameters and will usually respond to thrust lever adjustment.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

The airborne vibration monitoring system monitors engine vibration levels. The vibration indications are displayed on the secondary engine display. The vibration source indication is also displayed. If the vibration monitoring system cannot determine the source (N1, N2 or N3), broadband (BB) is displayed for the affected engine. Broadband vibration is the average vibration detected.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

The airborne vibration monitoring system is primarily intended for engine condition monitoring, but it is also a useful tool for isolating and determining corrective action for engine anomalies. There is no certified vibration limit, but when a high vibration level is reached, the secondary engine parameters are automatically displayed. High N1 vibration indication would most likely be accompanied by tactile vibration. This is not the case with high N2 or N3 vibration indication. N1, N2, and N3 high vibrations may be accompanied by anomalies in other engine parameters and will usually respond to thrust lever adjustment.

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.

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Engine Failure Alert System

The engine failure alert system provides alerts when actual engine performance is less than commanded engine performance during a part of the takeoff and for other phases of flight.

A red ENG FAIL is displayed on the PFD if actual thrust is less than commanded thrust during takeoff with airspeed between 65 knots and 6 knots prior to V1. The PFD display is accompanied by the voice annunciation ENGINE FAIL and the Master WARNING lights illuminating.

The EICAS caution message ENG FAIL (L or R) is displayed if an engine unexpectedly decelerates to less than idle speed. The message remains displayed until the engine recovers or the fuel control switch is moved to CUTOFF.

The EICAS caution message ENG THRUST (L or R) is displayed if:

- actual thrust is significantly less than commanded thrust, or
- actual thrust is not increasing to commanded thrust, and
- airspeed is V1 –6 knots or greater.

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Introduction

The auxiliary power unit (APU) is a self–contained gas turbine engine located in the airplane tail cone.

The APU can be started and operated to the airplane maximum certified altitude.

The APU supplies bleed air and electrical power. Electrical power has priority over bleed air. Electrical power is available throughout the airplane operating envelope. Bleed air is available at or below 22,000 feet.

Additional information is available as following:

- See APU Bleed Air Supply on page 2.40.1 for a description of APU bleed air operation
- See APU Generator on page 6.20.2 for a description of APU electrical operation
- See APU Fire Protection on page 8.20.3 for a description of the APU fire protection system
- See APU Fuel Feed on page 12.20.7 for a description of the APU fuel system.

APU Operation

APU Start

The APU is started either by an electric start motor or an air turbine starter.

The electric starter is powered by the APU battery. The main airplane battery powers the inlet door, fuel valve, and fire detection system.

The air turbine starter uses engine bleed air or ground cart air to start the APU.

Starter selection is automatic. The air turbine starter has priority over the electric start motor when there is sufficient bleed air duct pressure.

Rotating the APU selector to START begins the automatic start sequence.

APU fuel is supplied from the left fuel manifold by any operating AC fuel pump or the DC fuel pump. With AC power available and the APU selector in the ON position, the left forward fuel pump operates automatically.

If AC power is not available or no AC pump pressurizes the left fuel manifold, the DC pump in the left main tank provides APU fuel. On the ground, the APU can be started with no pumps operating.

When the APU air inlet door reaches the full open position the starter engages. After the APU reaches the proper speed, ignition and fuel are provided. When the APU reaches approximately 50 percent, the starter disengages and ignition is turned off.

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If the start fails, the APU shuts down automatically. The EICAS message APU SHUTDOWN is displayed.

APU Automatic Start

In flight, if both AC transfer busses lose power, the APU automatically starts, regardless of APU selector position. The APU can be shut down by positioning the selector to ON, then OFF.

APU Run

The EICAS memo message APU RUNNING is displayed when the APU is operating normally.

APU Shutdown

Rotating the APU selector to OFF begins the shutdown cycle by closing the APU bleed air valve. The APU continues running for a cooldown period. The EICAS memo message APU COOLDOWN is displayed during the cooldown period. When the cooldown period finishes, the APU shuts down.

APU Operating Modes

The APU has attended and unattended operating modes. The attended mode operates when either engine is running or starting, or when the airplane is in flight. The unattended mode operates at all other times on the ground.

APU Attended Mode

In the attended mode, any of the following faults cause the APU to shut down immediately:

- APU fire/inlet over temperature
- overspeed/loss of overspeed protection
- APU controller failure
- speed droop.

There is no cool down period. The EICAS advisory message, APU SHUTDOWN, displays.

For the following faults, the APU continues to operate and the EICAS message APU LIMIT displays:

- high EGT
- high oil temperature
- low oil pressure.

There is no cooldown period when the APU is shut down after the APU LIMIT message is displayed.

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APU Unattended Mode

In the unattended mode, any of the following faults cause the APU to shut down immediately:

- APU fire/inlet overtemperature
- overspeed/loss of overspeed protection
- high EGT
- low oil pressure
- high oil temperature
- generator oil filter approaching bypass
- intake door failure
- APU controller failure
- speed droop
- no combustion on start
- no acceleration on start.

There is no cooldown period.

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EICAS Alert Messages

Message	Level	Aural	Message Logic
APU LIMIT	Caution	Beeper	APU operation has exceeded a limit.
APU SHUTDOWN	Advisory		APU has shut down.
ENG AUTOSTART L, R	Caution	Beeper	On the ground during a start: • autostart did not start the engine, or • the AUTOSTART switch is off, the FUEL CONTROL switch is in RUN, and the engine RPM is low.
ENG AUTOSTART OFF	Advisory		The AUTOSTART switch is off.
ENG CONTROL L, R	Advisory		Fault has occurred in the EEC system.
ENG EEC MODE L, R	Advisory		The EEC is operating in the alternate mode.
ENG FAIL L, R	Caution	Beeper	Engine speed is below idle.
ENG FUEL FILTER L, R	Advisory		An impending fuel filter bypass condition exists.
ENG FUEL VALVE L, R	Advisory		Engine fuel or fuel spar valve position is not in the commanded position.
ENG IDLE DISAGREE	Advisory		One engine is at approach idle and the other engine is at minimum idle.
ENG LIMIT PROT L, R	Caution	Beeper	The engine control is operating in the alternate mode and commanded N1 exceeds maximum N1.
ENG OIL FILTER L, R	Advisory		Engine oil filter contamination has caused oil to bypass the oil filter.
ENG OIL PRESS L, R	Caution	Beeper	The engine oil pressure is low.
ENG OIL TEMP L, R	Advisory		The engine oil temperature is high.
ENG REV LIMITED L, R	Advisory		The engine thrust reverser will not deploy or reverse thrust will be limited to idle on landing.

TKK to TKR, TKU to TKZ

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Message	Level	Aural	Message Logic
ENG REVERSER L, R	Advisory		A fault is detected in the engine reverser system.
TKK to TKR, TKU to TKZ ENG RPM LIMITED L, R	Advisory		The EEC is limiting engine thrust to prevent N1 or N2 from exceeding the RPM operating limit.
TJA,B,C,D,G, H, TJR to TJW, TKA to TKF ENG RPM LIMITED L, R	Advisory		The EEC is limiting engine thrust to prevent N1, N2, or N3 from exceeding the RPM operating limit.
ENG SHUTDOWN	Caution		Both engines were shut down by the fuel control switches or the engine fire switches.
ENG SHUTDOWN L, R	Caution		The engine is shutdown by the FUEL CONTROL switch or the Engine Fire switch.
ENG START VALVE L, R	Advisory		The engine start valve is not in commanded position.
ENG STARTER CUTOUT L, R	Caution	Beeper	The engine start valve is open when commanded to close, or the START selector remains in START.
ENG THRUST L, R	Caution	Beeper	The engine thrust is less than the thrust commanded.

EICAS Memo Messages

Message	Level	Aural	Message Logic
APU COOLDOWN	Memo		APU is in cool down mode.
APU RUNNING	Memo		The APU is running, and is not in the cool down mode.

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Fire Protection — Chapter 8

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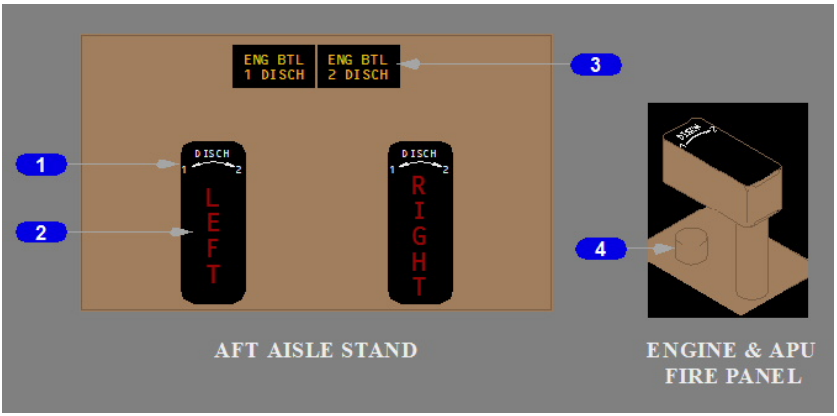
Engine Fire Protection

Engine Fire Panel



1 Engine Fire Switches

In (normal position, mechanically locked)—unlocks automatically for a fire warning, or when the FUEL CONTROL switch is in CUTOFF.

Out—

- arms both engine fire extinguishers
- closes the associated engine and spar fuel valves
- closes the associated engine bleed air valves
- trips the associated engine generators off
- shuts off hydraulic fluid to the associated engine-driven hydraulic pump
- depressurizes the associated engine-driven hydraulic pump
- removes power to the thrust reverser isolation valve.

Rotate to position 1 or 2—discharges the selected fire extinguisher into the engine.

2 Engine Fire Warning Lights

Illuminated (red)—

- an engine fire is detected, or
- the FIRE/OVERHEAT TEST switch is pushed.

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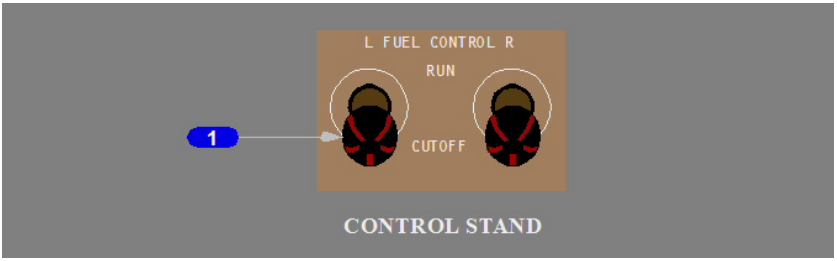
3 Engine Bottle Discharged (ENG BTL DISCH) Lights

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)—

- an associated engine fire is detected, or
- the FIRE/OVERHEAT TEST switch is pushed.

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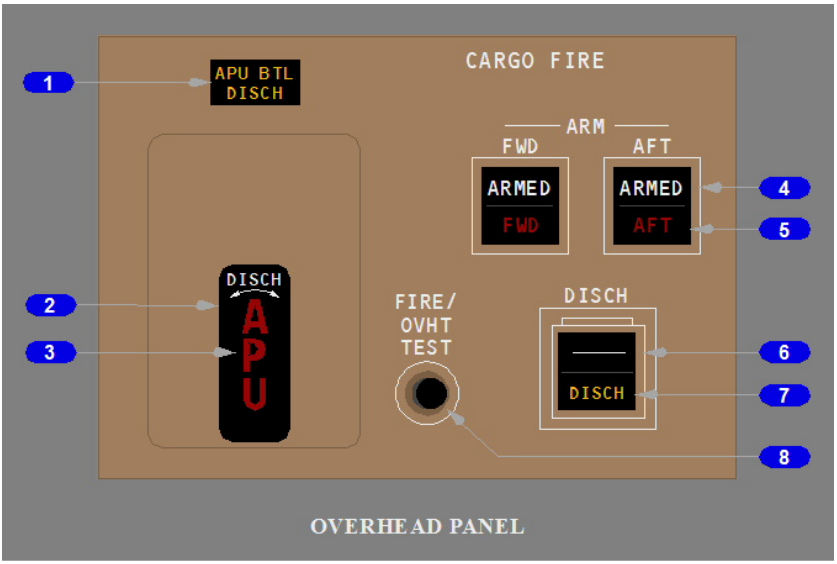
APU and Cargo Fire Panel



1 APU Bottle Discharge (APU BTL DISCH) Light

Illuminated (amber)—the extinguisher bottle is discharged or has low pressure.

2 APU Fire Switch

In—normal position, mechanically locked; unlocks automatically for a fire warning.

Out—

- arms the APU fire extinguisher bottle
- closes the APU fuel valve
- closes the APU bleed air valves
- closes the APU air inlet door
- trips the APU generator field and generator breaker
- shuts down the APU (if automatic shutdown does not occur).

Rotate—either direction discharges the APU fire extinguisher into the APU compartment.

3 APU Fire Warning Light

Illuminated (red)—

- an APU fire is detected, or

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- the FIRE/OVERHEAT TEST switch is pushed.

The APU automatically shuts down for a detected fire.

4 CARGO FIRE ARM Switches

ARMED—

- arms all cargo fire extinguisher bottles
- arms the selected compartment extinguisher valve
- turns off both lower recirculation fans
- shuts down cargo heat
- shuts down In-Flight Entertainment (IFE) System
- commands the packs to provide the minimum air flow required to provide pressurization
- shuts down the bulk cargo compartment ventilation system operation (aft cargo fire only)
- shuts down the lavatory/galley vent fan(s)
- puts the equipment cooling system into the override mode (forward cargo fire only)

TKK to TKR, TKU to TKZ

- shuts down Nitrogen Generation System.

Off (blank)—normal position.

5 CARGO FIRE Warning Lights

Illuminated (red)—the FIRE/OVERHEAT TEST switch is pushed, or associated cargo compartment smoke is detected and aircraft systems are commanded to shut down—

- AFT or FWD illuminated—
  - both lower recirculation fans
  - lavatory/galley vent fans
  - cargo heat in respective compartment
- FWD illuminated—
  - equipment cooling system in the override mode.

6 CARGO FIRE Discharge (DISCH) Switch

Push—discharges the fire extinguisher bottles into the ARMED cargo compartment.

Note: The bulk cargo compartment is included in the AFT cargo fire extinguishing system.

7 CARGO FIRE Discharge (DISCH) Light

Illuminated (amber)—the fire extinguishers have discharged.

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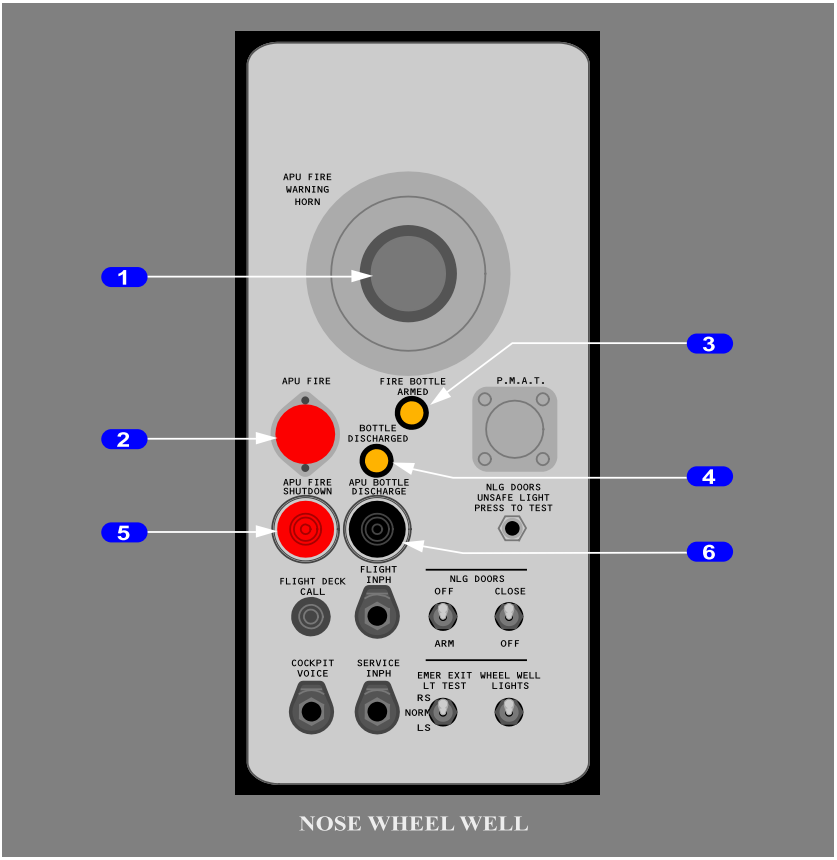
8 FIRE/OVERHEAT TEST Switch

Push and hold—

- sends fire/overheat test signals to the engine, APU, wheel well, and cargo compartment fire detector systems
- tests flight deck fire and overheat indications (see Fire and Overheat Detection System Fault Test on page 8.20.6).

APU Ground Control Fire Protection Panel



1 APU FIRE WARNING HORN

Sounds intermittently during ground operation for an APU fire or fire test.

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2 APU FIRE Light

Illuminated (red)—

- an APU fire is detected, or
- a fire/overheat test is in progress.

The APU automatically shuts down for a detected fire.

3 APU FIRE BOTTLE ARMED Light

Illuminated (amber)—the APU fire extinguisher is armed.

4 APU BOTTLE DISCHARGED Light

Illuminated (amber)—the extinguisher bottle pressure is low.

5 APU FIRE SHUTDOWN Switch

Push (red)—

- shuts down the APU
- arms the APU fire extinguisher.

6 APU BOTTLE DISCHARGE Switch

Push—discharges the APU fire extinguisher into the APU compartment.

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Introduction

There are fire detection and extinguishing systems for the:

- APU
- cargo compartments
- engines
- lavatories.

The door 1 upper crew rest compartment has a fire detection system, but no fire extinguishing system. TJR to TJW, TKK to TKR, TKU to TKZ

The door 3 upper crew rest compartment has a fire detection system, but no fire extinguishing system. TJR to TJW

The door 5 upper crew rest compartment has a fire detection system, but no fire extinguishing system. TKK to TKR, TKU to TKZ

The engines also have overheat detection systems.

The main gear wheel wells have a fire detection system, but no fire extinguishing system.

Additional information is available as following:

- See Air Systems on page 2.10.1 for descriptions of equipment smoke evacuation, and bleed duct leak and overheat detection
- See Anti-ice, Rain on page 3.10.1 for a description of engine anti–ice system leak protection.

Engine Fire Protection

Engine fire protection consists of these systems:

- engine fire and overheat detection
- engine fire extinguishing.

Engine Fire and Overheat Detection

There are two detector loops in each engine nacelle. Each detector loop provides both fire and overheat detection. Normally, both loops must detect a fire or overheat condition to cause an engine fire warning or overheat caution.

If a fault is detected in one loop, the system automatically switches to single loop operation. If the operating loop senses a fire or overheat, the system provides the appropriate fire warning or overheat caution.

If there are faults in both detector loops in an engine nacelle, no fire or overheat detection is provided. The EICAS advisory message DET FIRE ENG (L or R) is displayed if the engine fire detection system fails.

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Engine Fire Warning

The indications of an engine fire are:

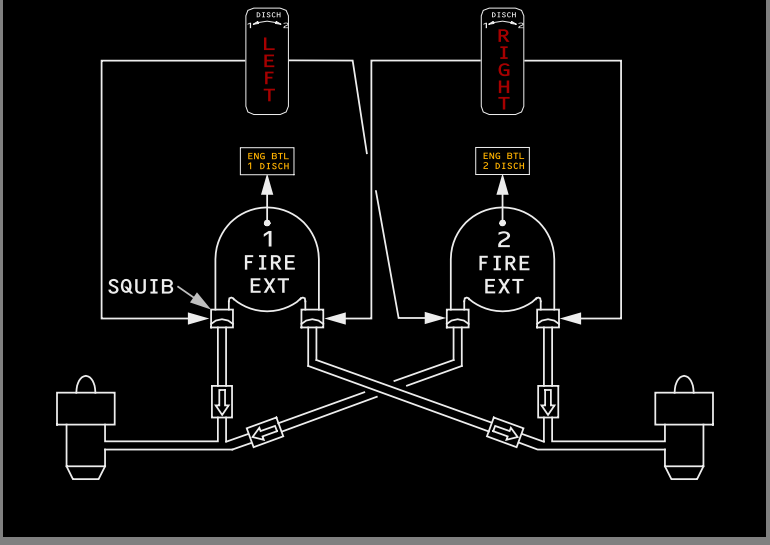
- the fire bell sounds
- the master WARNING lights illuminate
- the EICAS warning message FIRE ENG (L or R) is displayed
- the engine fire switch LEFT or RIGHT fire warning light illuminates
- the engine fire switch unlocks
- the engine FUEL CONTROL (L or R) switch fire warning light illuminates.

Engine Overheat Caution

The indications of an engine overheat are:

- the caution beeper sounds
- the master CAUTION lights illuminate
- the EICAS caution message OVERHEAT ENG (L or R) is displayed.

Engine Fire Extinguishing



ENGINE FIRE EXTINGUISHING DIAGRAM

There are two engine fire extinguisher bottles. Either or both bottles can be discharged into either engine.

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When the engine fire switch is pulled out, rotating the fire switch in either direction discharges a single extinguisher bottle into the associated engine. Rotating the engine fire switch in the other direction discharges the remaining extinguisher bottle into the same engine.

If an extinguisher bottle is discharged or has low pressure:

- the ENG BTL (1 or 2) DISCH light illuminates
- the EICAS advisory message BOTTLE (1 or 2) DISCH ENG is displayed.

APU Fire Protection

APU fire protection consists of these systems:

- APU fire detection
- APU fire extinguishing.

APU Fire Detection

The APU compartment has dual fire detector loops. There is no APU overheat detection.

Normally, both loops must detect a fire to produce a fire warning. An APU fire warning automatically shuts down the APU.

If a fault is detected in one loop, the system automatically switches to single loop operation. If the operating loop detects a fire, an APU fire warning occurs and the APU shuts down.

The EICAS advisory message DET FIRE APU is displayed if the APU fire detection system fails.

APU Fire Warning

The indications of an APU fire warning are:

- the fire bell sounds
- the master WARNING lights illuminate
- the EICAS warning message FIRE APU is displayed
- the APU fire switch fire warning light illuminates
- the APU fire switch unlocks.

APU Fire Extinguishing

There is one APU fire extinguisher bottle. When the APU fire switch is pulled out, rotating the switch in either direction discharges the extinguisher bottle into the APU compartment. If the bottle is discharged or has low pressure:

- the APU BTL DISCH light illuminates
- the EICAS advisory message BOTTLE DISCH APU is displayed.

On the ground with both engines off an APU fire signal from either APU fire detector loop causes APU shutdown and extinguisher bottle discharge.

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Main Wheel Well Fire Protection

The main wheel well has fire detection only. There is no fire extinguishing system. The nose wheel well does not have a fire detection system.

Main Wheel Well Fire Detection

The main wheel well fire detection system consists of dual fire detector loops.

Main Wheel Well Fire Warning

The indications for a main wheel well fire are:

- the fire bell sounds
- the EICAS warning message FIRE WHEEL WELL is displayed
- the master WARNING lights illuminate.

Cargo Compartment Fire Protection

Cargo compartment fire protection consists of these systems:

- cargo compartment smoke detection
- cargo compartment fire extinguishing.

Note: The bulk cargo compartment is included in the aft cargo fire detection and extinguishing systems.

Cargo Compartment Smoke Detection

-200,-200ER The forward and aft cargo compartments each have smoke detectors. Each compartment is divided into three detection zones. If smoke is detected in any zone, a fire warning occurs.

-300,-300ER The forward and aft cargo compartments each have smoke detectors. Each compartment is divided into four detection zones. If smoke is detected in any zone, a fire warning occurs.

Whenever cargo compartment smoke detection is inoperative, the EICAS advisory message DET FIRE CARGO (FWD or AFT) is displayed.

Cargo Compartment Fire Warning

The indications of a cargo compartment fire are:

- the fire bell sounds
- the master WARNING lights illuminate
- the EICAS warning message FIRE CARGO (FWD or AFT) is displayed
- the CARGO FIRE (FWD or AFT) fire warning light illuminates.

Cargo Compartment Fire Extinguishing

Five fire extinguisher bottles are installed for cargo compartment fire extinguishing. Pushing the FWD or AFT CARGO FIRE ARM switch (ARMED visible) arms the extinguishers.

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In flight, pushing the CARGO FIRE DISCHARGE switch causes the immediate total discharge of two extinguisher bottles into the selected compartment. After a time delay, the remaining three extinguisher bottles discharge at a reduced flow rate into the selected compartment. If the airplane lands before all of the bottles discharge, one of the remaining bottles discharges at the reduced rate on touchdown.

On the ground, if a CARGO FIRE DISCHARGE switch is pushed, two extinguisher bottles discharge into the selected compartment, but only one of the remaining extinguisher bottles discharges after the time delay.

When cargo fire extinguisher bottle discharge is initiated:

- The CARGO FIRE DISCHARGE switch light illuminates when the first two extinguisher bottles begin to discharge.
- The EICAS advisory message BOTTLE DISCH CARGO is displayed when the first two extinguisher bottles have completely discharged.

Crew Rest Compartment Fire Protection

TJR to TJW, TKK to TKR, TKU to TKZ

Door 1 Upper Crew Rest Compartment Smoke Detection

TJR to TJW, TKK to TKR, TKU to TKZ

Smoke detectors are installed in the door 1 upper crew rest compartment. If smoke is detected, an aural alert sounds in the door 1 crew rest compartment. The EICAS caution message SMOKE REST UPR DR 1 indicates smoke in the compartment.

Door 3 Upper Crew Rest Compartment Smoke Detection

TJR to TJW

Smoke detectors are installed in the door 3 upper crew rest compartment. If smoke is detected, an aural alert sounds in the door 3 upper crew rest compartment. The EICAS caution message SMOKE REST UPR DR 3 indicates smoke in the compartment.

Door 5 Upper Crew Rest Compartment Smoke Detection

TKK to TKR, TKU to TKZ

Smoke detectors are installed in the door 5 upper crew rest compartment. If smoke is detected, an aural alert sounds in the door 5 crew rest compartment. The EICAS caution message SMOKE REST UPR DR 5 indicates smoke in the compartment.

Lavatory Fire Protection

Lavatory fire protection consists of these systems:

- lavatory fire detection
- lavatory waste container fire extinguishing.

Lavatory Fire Detection

Each lavatory has a single smoke detector. If smoke is detected, an aural alert sounds in the lavatory and in the cabin. In addition, the lavatory call light flashes

TJR to TJW, TKK to TKR, TKU to TKZ

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and the master call light at the associated attendant station flashes. The EICAS advisory message SMOKE LAVATORY is displayed.

TJA,B,C,D,G,H,TKA to TKF

Each lavatory has a single smoke detector. If smoke is detected, an aural alert sounds in the lavatory and in the cabin. In addition, the lavatory call light flashes and the master call light at the associated attendant station flashes. The EICAS advisory message SMOKE LAV/COMPT is displayed.

Lavatory Fire Extinguishing

Each lavatory has a fire extinguisher located in the waste container cabinet. Fire extinguisher operation is automatic. There is no flight deck indication.

Fire and Overheat Detection System Fault Test

The fire and overheat detection system has automatic and manual fault testing.

Fire and Overheat Detection System Automatic Fault Test

Fire and overheat detection system testing is automatic. The engine and APU systems continuously monitor the fire/overheat detector loops for faults. The cargo and wheel well systems continuously monitor for any system faults.

If a fault is detected, the system automatically reconfigures for single loop operation. Complete system failures are indicated by an EICAS advisory message for the failed system:

- DET FIRE ENG (L or R)
- DET FIRE APU
- DET FIRE CARGO (FWD or AFT).

Fire and Overheat Detection System Manual Fault Test

The fire and overheat detection systems can be tested manually by pushing and holding the FIRE/OVERHEAT TEST switch.

The indications for a manual fire and overheat detection system test are:

- the fire bell sounds
- the nose wheel well APU fire warning horn sounds (on the ground)
- the EICAS warning message FIRE TEST IN PROG is displayed
- these lights illuminate:
  - the master WARNING lights
  - the LEFT and RIGHT engine fire warning lights
  - the APU fire warning light
  - the nose wheel well APU fire warning light
  - the LEFT and RIGHT FUEL CONTROL switch fire warning lights
  - 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 FIRE TEST IN PROG message; the switch can be

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released. The appropriate system EICAS messages are displayed with the FIRE TEST FAIL message:

- DET FIRE APU
- DET FIRE CARGO (FWD or AFT)
- DET FIRE ENG (L or R)
- DET FIRE WHEEL WELL
- DET OVERHEAT ENG (L or R).

All test messages clear when the test switch is released. If the switch is released with the FIRE TEST IN PROG message displayed, the test ends without completing.

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EICAS Alert Messages

Airplane System EICAS Messages

Message	Level	Aural	Message Logic
BOTTLE 1, 2 DISCH ENG	Advisory		Engine fire extinguisher bottle 1 or bottle 2 pressure is low.
BOTTLE DISCH APU	Advisory		APU fire extinguisher bottle pressure is low.
BOTTLE DISCH CARGO	Advisory		Both rapid discharge cargo fire extinguisher bottle pressures are low.
DET FIRE APU	Advisory		APU fire detection is inoperative.
DET FIRE CARGO AFT, FWD	Advisory		Affected cargo compartment smoke detection is inoperative.
DET FIRE ENG L, R	Advisory		Affected engine fire detection and overheat are inoperative.
FIRE APU	Warning	Fire Bell	Fire is detected in the APU.
FIRE CARGO AFT, FWD	Warning	Fire Bell	Smoke is detected in the affected cargo compartment.
FIRE ENG L, R	Warning	Fire Bell	Fire is detected in the engine.
FIRE WHEEL WELL	Warning	Fire Bell	Fire is detected in a main wheel well.
OVERHEAT ENG L, R	Caution	Beeper	Engine overheat detected.

Cabin System EICAS Messages

Cabin Area

Message	Level	Aural	Message Logic	
SMOKE LAVATORY	Advisory		Smoke is detected in one or more lavatories.	TJR to TJW, TKK to TKR, TKU to TKZ
SMOKE LAV/COMPT	Advisory		Smoke is detected in one or more lavatories, or other enclosed compartment.	TJA,B,C,D,G, H,TKA to TKF

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Crew Rest Area

Message	Level	Aural	Message Logic
SMOKE REST UPR DR 1	Caution	Beeper	Smoke is detected in door 1 upper crew rest compartment.
SMOKE REST UPR DR 3	Caution	Beeper	Smoke is detected in door 3 upper crew rest compartment.
SMOKE REST UPR DR 5	Caution	Beeper	Smoke is detected in door 5 upper crew rest compartment.

TJR to TJW, TKK to TKR, TKU to TKZ

TJR to TJW

TKK to TKR, TKU to TKZ

System Test Messages

The following messages are associated only with the manually-initiated fire test.

Message	Level	Aural	Message Logic
DET FIRE WHEEL WELL	Advisory		Wheel well fire detection system is failed.
DET OVERHEAT ENG L, R	Advisory		Affected engine overheat detection system is failed.
FIRE TEST FAIL	Warning		One or more fire/overheat detection systems have failed to successfully complete the manually initiated fire/overheat test.
FIRE TEST IN PROG	Warning		A manually initiated fire/overheat detection system test is in progress.
FIRE TEST PASS	Warning		A manually initiated test of the fire/overheat detection system has been completed.

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Flight Controls — Chapter 9

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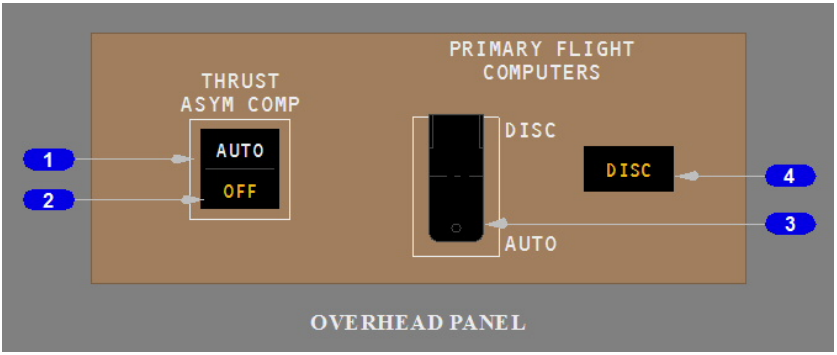
Thrust Asymmetry Compensation and Primary Flight Computers Controls



1 Thrust Asymmetry Compensation (THRUST ASYM COMP) Switch

AUTO—the thrust asymmetry compensation system operates automatically if a thrust asymmetry condition is detected.

OFF—disconnects the thrust asymmetry compensation system from the flight control system.

2 Thrust Asymmetry Compensation OFF Light

Illuminated (amber)—the thrust asymmetry compensation system has been automatically or manually disconnected.

3 PRIMARY FLIGHT COMPUTERS Disconnect Switch

DISC—

- disconnects the primary flight computers (PFCs) from the flight control system
- puts the flight control system in the direct mode
- AUTO can be reselected to attempt restoration of secondary or normal mode operation.

AUTO—

- the flight control system operates in the normal mode
- system faults automatically cause the system to switch to the secondary or direct modes.

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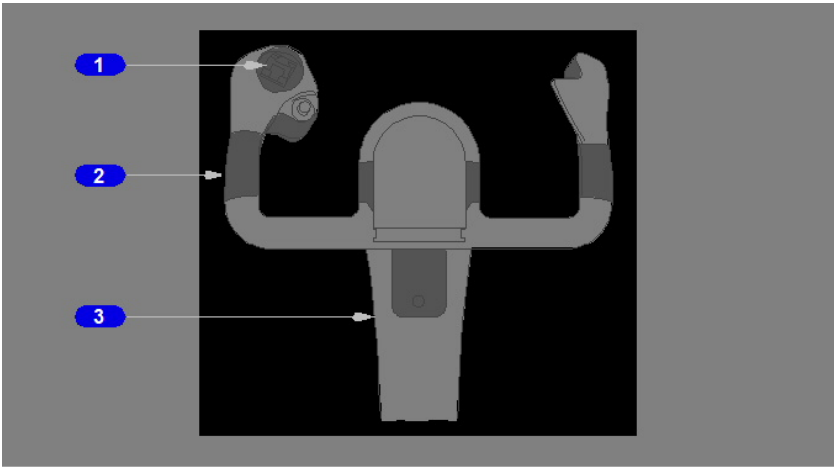
4 PRIMARY FLIGHT COMPUTERS Disconnect (DISC) Light

Illuminated (amber)—the primary flight computers are disconnected automatically or manually and the system is in the direct mode.

Pitch and Stabilizer Trim Systems

Control Wheel and Column



1 Pitch Trim Switches

Spring—loaded to neutral.

Push (both switches)—

- in the normal mode in flight, changes the trim reference airspeed
- in the normal mode on the ground, moves the stabilizer
- in the secondary and direct modes, moves the stabilizer.

2 Control Wheel

Rotate—deflects the ailerons, flaperons, and spoilers in the desired direction.

Moves and remains displaced with aileron trim.

3 Control Column

Push/pull—commands the airplane to pitch in the desired direction:

- in the normal mode, deflects the elevator and horizontal stabilizer
- in the secondary and direct modes, deflects the elevator.

Does not move with pitch trim operation.

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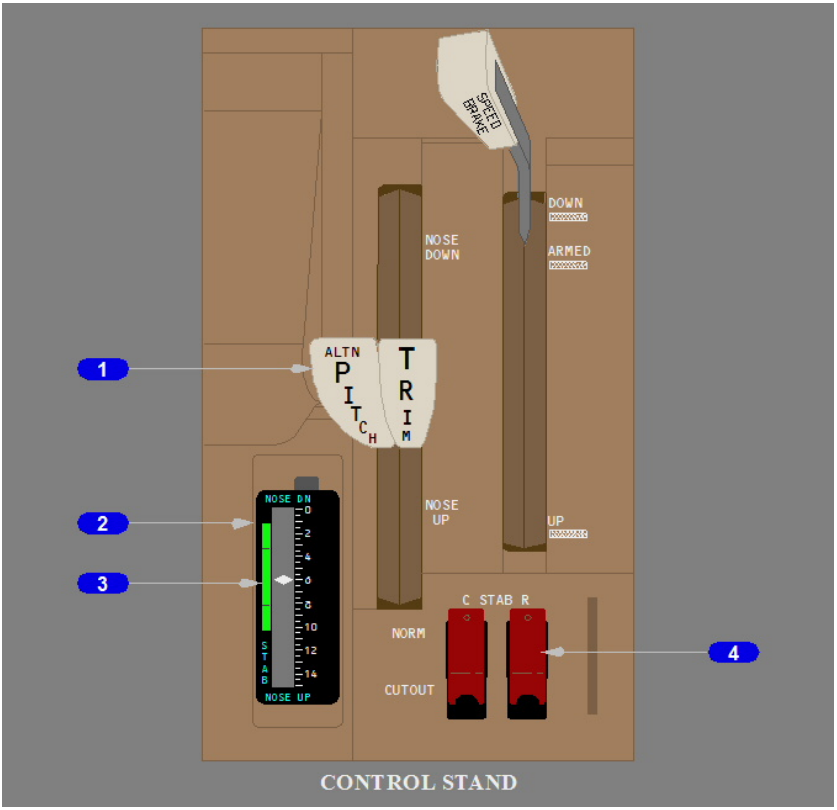
Stabilizer Trim System



1 Alternate (ALTN) PITCH TRIM Levers

Spring—loaded to neutral.

Push/pull (both levers)—

- in the normal mode, changes trim reference airspeed and moves the stabilizer directly
- in the secondary and direct modes, moves the stabilizer directly.

2 Stabilizer (STAB) Position Indicator

Indicates stabilizer position in units of trim.

3 Takeoff Trim Green Band

The green band indicates the allowable takeoff trim range, based on gross weight, takeoff thrust, and CG information from the FMC. When no information

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is available, or V1 speed is not selected or entered, the green band defaults to midrange.

If the stabilizer signal is not present or is invalid, the green band and the pointer are not displayed.

4 Stabilizer (STAB) Cutout Switches

NORM—

- hydraulic power is supplied to the related stabilizer trim control module
- if unscheduled stabilizer motion is detected, center and/or right system hydraulic power to the related stabilizer trim control module is automatically shut off.

CUTOUT—shuts off the respective center or right hydraulic system power to the related stabilizer trim control module.

Aileron and Rudder Trim Controls

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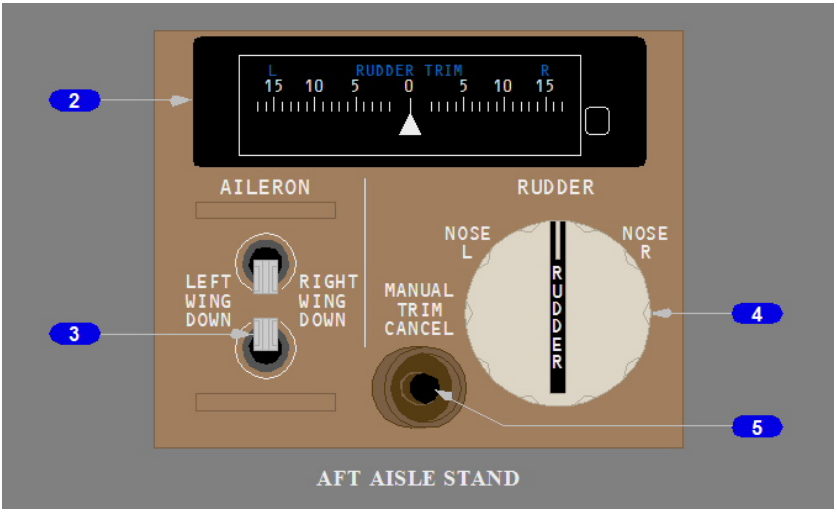

1 AILERON TRIM Indicator

Indicates units of aileron trim.

2 RUDDER TRIM Indicator

Indicates units of rudder trim.

3 AILERON Trim Switches

Push (both switches)—moves the control wheel, ailerons, flaperons, and spoilers in the desired direction (spring—loaded to neutral).

4 RUDDER Trim Selector

Spring—loaded to neutral.

Rotate—

- trims the rudder in the desired direction
- the trim runs at high speed with the knob rotated past the first left or right detent
- the rudder pedals move with rudder trim operation.

5 MANUAL TRIM CANCEL Switch

Push—cancels manual rudder trim in the normal and secondary flight control system modes.

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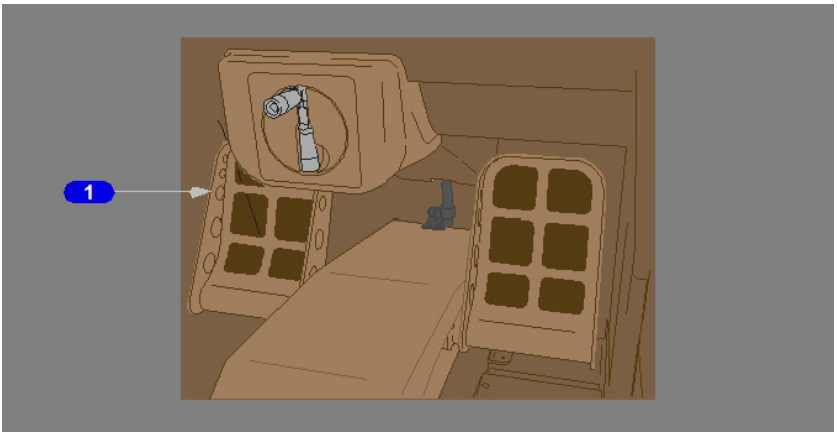
Rudder/Brake Pedals



1 Rudder Pedals

Push—deflects the rudder in the desired direction.

See Brake System on page 14.20.3 for brakes and see Nose Wheel and Main Gear Aft Axle Steering on page 14.20.3 for nosewheel steering description.

Speedbrake Lever

On the ground:

- the speedbrake lever moves to DOWN and all spoiler panels retract if either thrust lever is advanced to the takeoff thrust position
- the speedbrake lever moves to UP and all spoiler panels extend if either reverse thrust lever is raised to the reverse idle detent.

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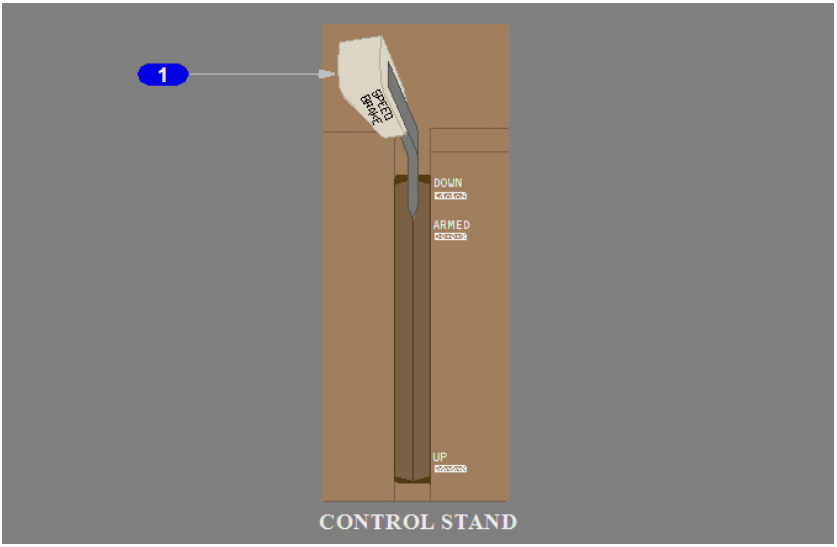

1 Speedbrake Lever

DOWN (detent)—all spoiler panels are retracted.

ARMED—

- the auto speedbrake system is armed
- after landing, the speedbrake lever automatically moves to UP and the spoiler panels extend.

UP—the required spoiler panels extend to their maximum in-flight or on-ground position (intermediate positions can be selected).

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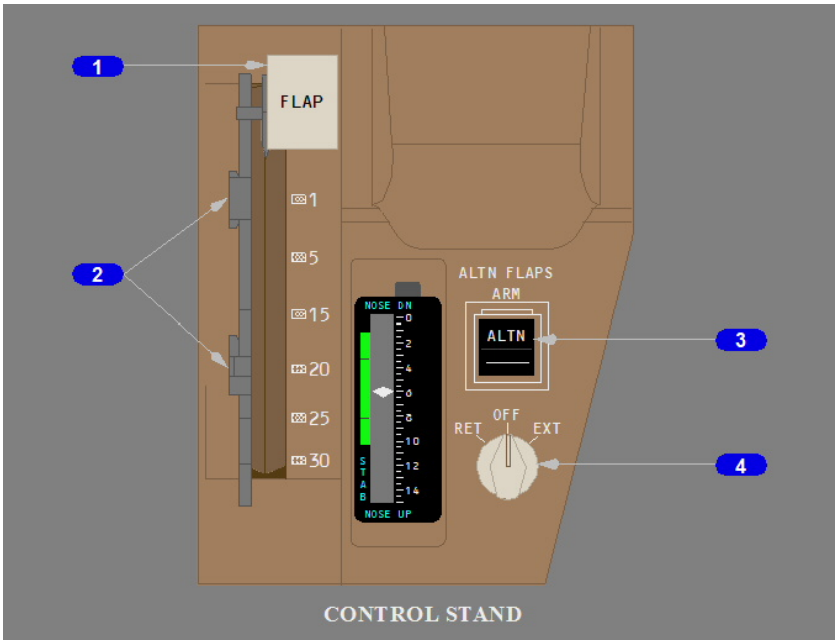
Flap System

Flap Controls



1 Flap Lever

Primary mode—positions the slats and flaps hydraulically.

Secondary mode—positions the slats and/or flaps electrically if hydraulic operation fails.

2 Flap Gates

1—prevents inadvertent retraction of the slats.

20—prevents inadvertent retraction of the flaps past the go-around position.

3 Alternate Flaps Arm (ALTN FLAPS ARM) Switch

Push (ALTN displayed)—

- arms the alternate flap control mode
- arms the alternate flaps selector
- disables primary and secondary flap/slat mode operation
- asymmetry/skew and uncommanded motion protection, autoslat, and flap/slat load relief are not available

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- the flap lever is inoperative.

4 Alternate Flaps Selector

RET—the slats and flaps are electrically retracted.

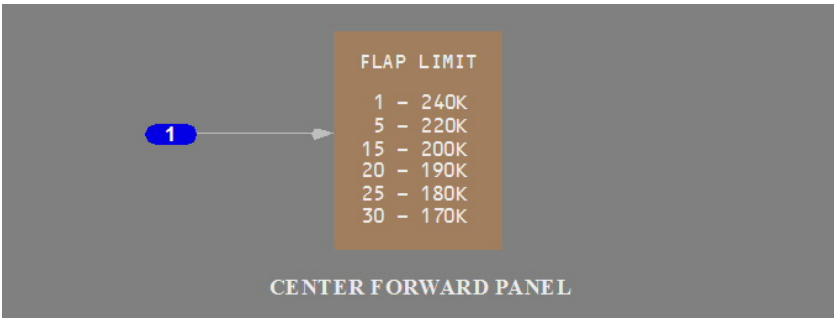
OFF—alternate flaps are deactivated.

EXT—

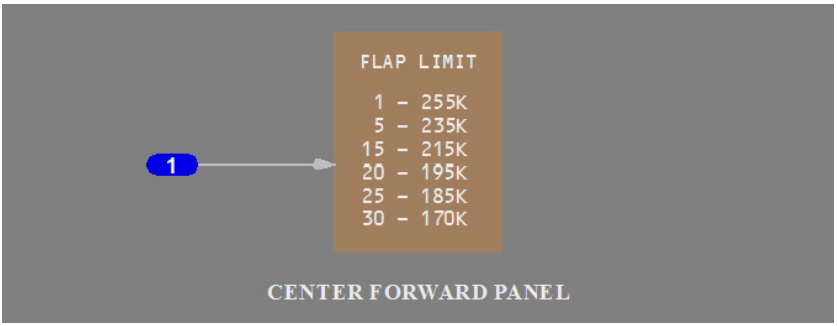
- the slats and flaps are electrically extended
- maximum extension is flaps 20, with the slats at the midrange position.

Flap Limit Placard

-200



-200ER



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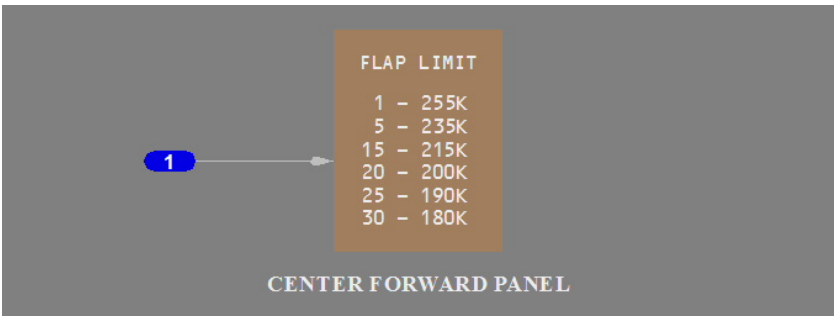
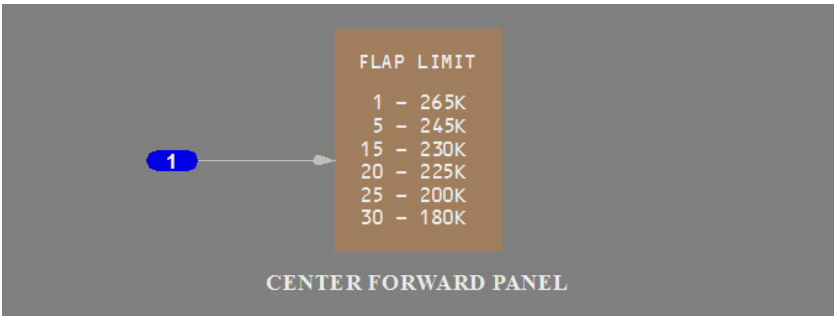
-300



-300ER



1 Flap Limit Placard

Flaps extended speed limits.

Normal Flap Position Indication

Displays combined flap and slat positions when all surfaces are operating normally and control is in the primary (hydraulic) mode. The indicator shows continuous motion.

The indication is no longer displayed 10 seconds after slat retraction.

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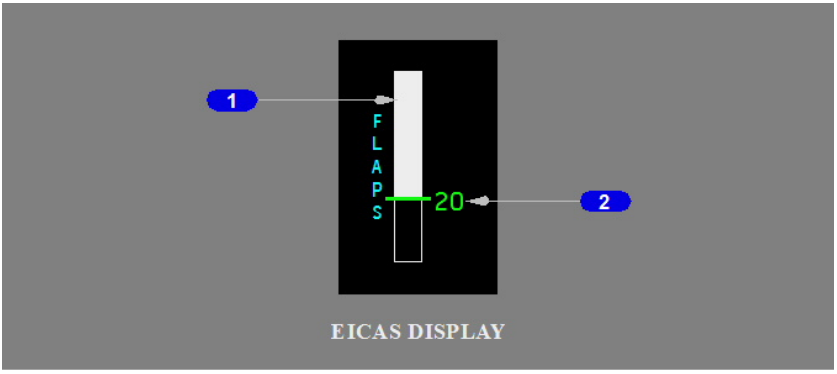

1 Flap Position (white)

UP—the slats and flaps are retracted.

1—the slats extend to the midrange position.

5, 15, and 20—

- the slats remain in the midrange position
- the flaps extend to the commanded position.

25—the slats extend to the fully extended position. The flaps extend to 25.

30—the flaps extend to 30.

Loss of position information is displayed as a white outline with no tape fill and no flap lever position indications.

2 Flap Lever Position (line and number)

Magenta—the slats or flaps are in transit to the commanded position.

Green—the slats and flaps are in the commanded position.

The line and number change color.

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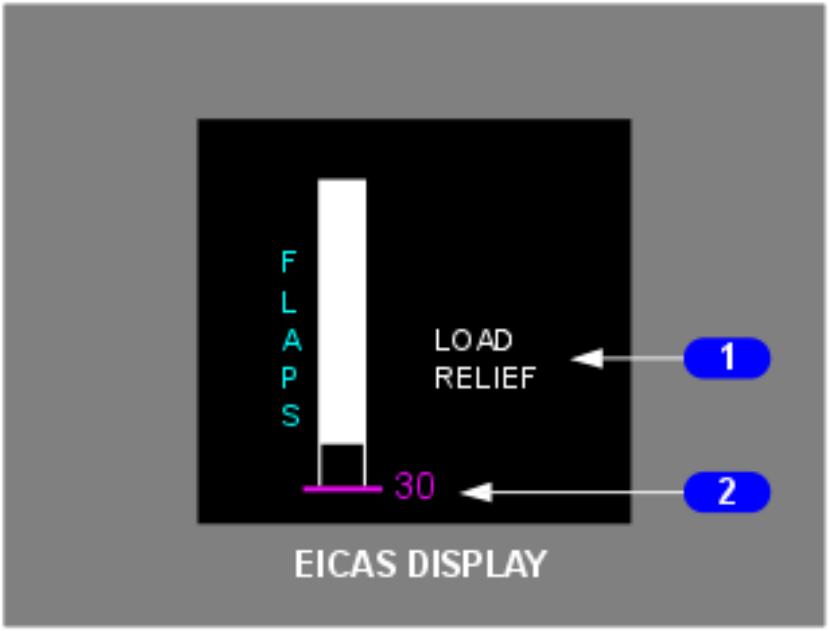
Flap Load Relief Indication



1 Flap LOAD RELIEF Indication

Displayed (white)—

- flap load relief is retracting the flaps, or inhibiting extension, as required to prevent air load damage due to excessive airspeed
- extension from UP is being inhibited due to either excessive airspeed or altitude.

2 Flap Lever Position

Magenta—the slats or flaps are in transit to the commanded position.

Non-Normal Flap and Slat Position Indication

If any flap/slat is non-normal or if control is in the secondary mode, slat and flap positions are shown independently. Each wing is also shown separately.

Indicator motion is continuous between flap detents.

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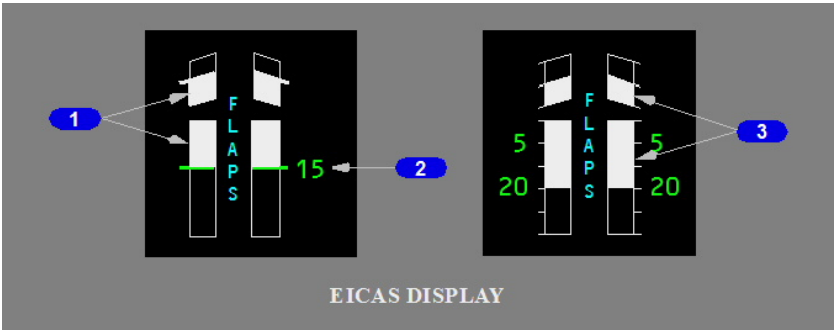

1 Expanded Flap and Slat Position Indications

The slat indication fills up (forward) for extension.

The flap indication fills down (aft) for extension.

Indication colors of outline and fill are:

- white when operating in secondary mode
- amber when the respective FLAPS DRIVE or SLATS DRIVE EICAS message is displayed.

Loss of position information is displayed as a white outline with no tape fill and no flap lever position indications.

2 Flap Lever Position (line and number)

Magenta—the slats or flaps are in transit to the commanded position.

Green—the slats or flaps are in the commanded position.

The numbers are shown next to the flap position indicator only.

3 Alternate Flap and Slat Position Indications (white)

Slat and flap extension is limited to slats midrange and flaps 20.

Displayed automatically when the alternate control mode is armed.

Slats—displays the position of the slats.

Flaps—displays the position of the flaps.

Flap position index marks—reference flaps 5 and 20.

Loss of position information is displayed as a white outline with no tape fill and no position index marks or numbers.

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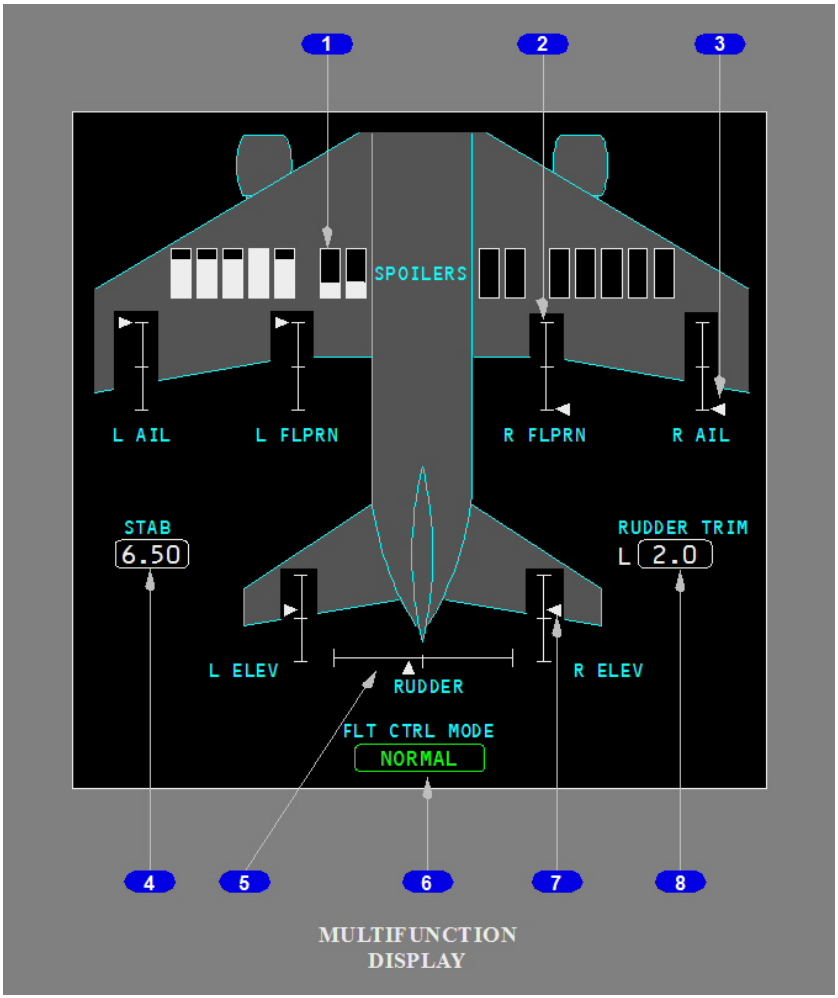
Flight Control Synoptic Displays

The flight control synoptic is displayed by pushing the FCTL synoptic display switch on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

Normal Flight Control Synoptic



1 **Spoiler Position**

2 **Flaperon Position**

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3 **Aileron Position**

4 **Stabilizer Position**

5 **Rudder Position**

6 **Primary Flight Control System Mode**

7 **Elevator Position**

8 **Rudder Trim Position and Direction**

L—Left

R—Right

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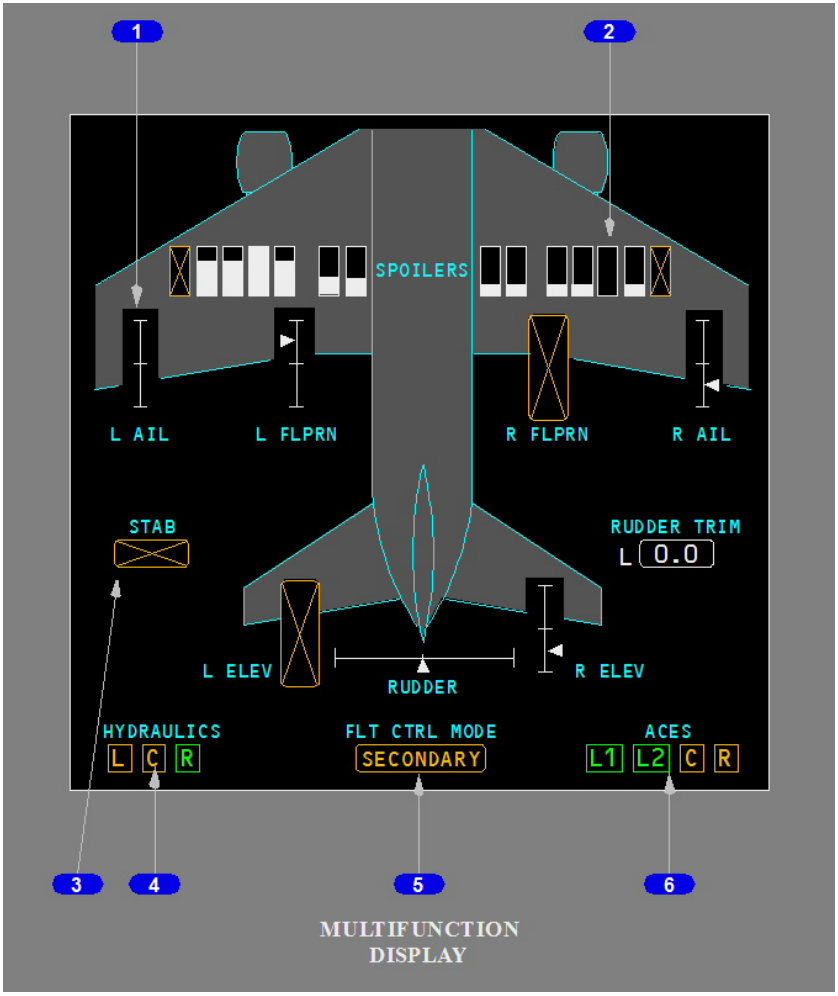
Non–Normal Flight Control Synoptic



1 **Unknown Aileron Position**

2 **Unknown Spoiler Condition**

3 **Failed Control Surface or Trim Function (amber)**

4 **Hydraulic System Failure Indications**

Green—the hydraulic system is functioning normally.

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Amber—the failed hydraulic system.

5 **Flight Control Mode SECONDARY or DIRECT Indication (amber)**

6 **Actuator Control Electronic Failure Indications**

Green—the ACE is functioning normally.

Amber—the failed ACE.

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Introduction

The primary flight control system uses conventional control wheel, column, and pedal inputs from the pilot to electronically command the flight control surfaces. The system provides conventional control feel and pitch responses to speed and trim changes. The system electronic components provide enhanced handling qualities and reduce pilot workload.

The primary flight control system is highly redundant, with three operating modes: normal mode, secondary mode, and direct mode. The primary flight controls are powered by redundant hydraulic sources. The secondary flight controls, high lift devices consisting of flaps and slats, are hydraulically powered with an electrically powered backup system.

Pilot Controls

The pilot controls consist of:

- two control columns
- two control wheels
- two pairs of rudder pedals
- control wheel pitch trim switches
- alternate pitch trim levers
- the speedbrake lever
- the flap lever
- aileron trim switches
- rudder trim selector
- manual rudder trim cancel switch.

The columns and wheels are connected through jam override mechanisms. If a jam occurs in a column or wheel, the pilots can maintain control by applying force to the other column or wheel to overcome the jam.

The rudder pedals are rigidly connected between the two sides.

The speedbrake lever allows manual or automatic symmetric actuation of the spoilers.

The pilot controls command these system electronic components:

- four actuator control electronics (ACEs)
- three primary flight computers (PFCs).

The ACEs receive input signals from all pilot controls. The ACEs send control signals to the primary flight control surfaces. Each ACE is assigned to different actuators on the control surfaces. No single ACE controls more than one actuator on a control surface. Some ACEs are not assigned to all control surfaces.

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The EICAS caution message FLIGHT CONTROLS is displayed if:

- multiple ACE and/or hydraulic system failures cause the loss of a significant number of control surfaces, or
- other flight control system faults are detected.

The ACEs can transmit pilot control inputs directly to the control surfaces, or they can send the pilot inputs to the PFCs. When the ACEs are sending pilot inputs to the PFCs, the ACEs receive control commands back from the PFCs and use the commands to position the flight control surfaces.

The PFCs use information from other airplane systems (such as air data, inertial data, flap and slat position, engine thrust, and radio altitude) to compute control surface commands for enhanced handling qualities. See Primary Flight Control System Modes on page 9.20.5 for a description of these handling quality enhancements.

The autopilot also sends commands to the PFCs, which then produce control surface commands. See Autopilot Flight Director System on page 4.20.1.

Flight Control Surfaces

Pitch control is provided by:

- two elevators
- a movable horizontal stabilizer.

Roll control is provided by:

- two flaperons
- two ailerons
- fourteen spoilers.

Yaw control is provided by:

- single rudder
- partial span tab.

The two elevators and horizontal stabilizer work together to provide pitch control. A detailed description of pitch control is given in a separate section later in this chapter.

The flaperons and ailerons provide roll control, assisted by asymmetric spoilers.

The flaperons are located between the inboard and outboard flaps on both wings. In the normal mode, they are used for roll control with the flaps either retracted or extended. For increased lift, the flaperons move down and aft in proportion to trailing edge flap extension.

The ailerons are located outboard of the outboard flaps on each wing. For increased lift, the ailerons move down for flaps 5, 15, and 20, to improve takeoff performance.

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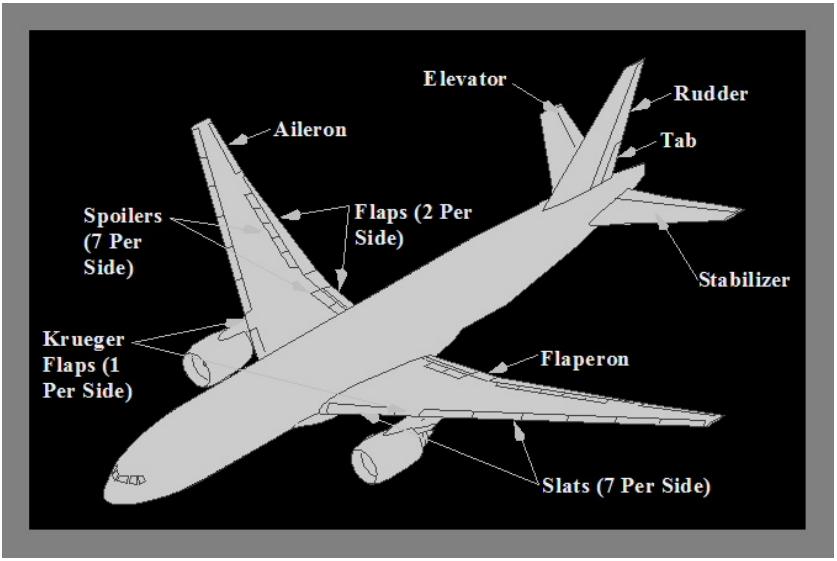
In the normal mode, the ailerons and spoilers 5 and 10 are locked out during high–speed flight; the flaperons and remaining spoilers provide sufficient roll control. During low speed flight, these panels augment roll control.

Yaw control is provided by a single rudder, which is almost the same height as the vertical tail. The lower portion of the rudder has a hinged section (tab) that deflects twice as far as the main rudder surface to provide additional yaw control authority. During takeoff, the rudder becomes aerodynamically effective at approximately 60 knots.

Flaps and slats provide high lift for takeoff, approach, and landing.

Symmetric spoilers are used as speedbrakes.

Flight Control Surface Locations



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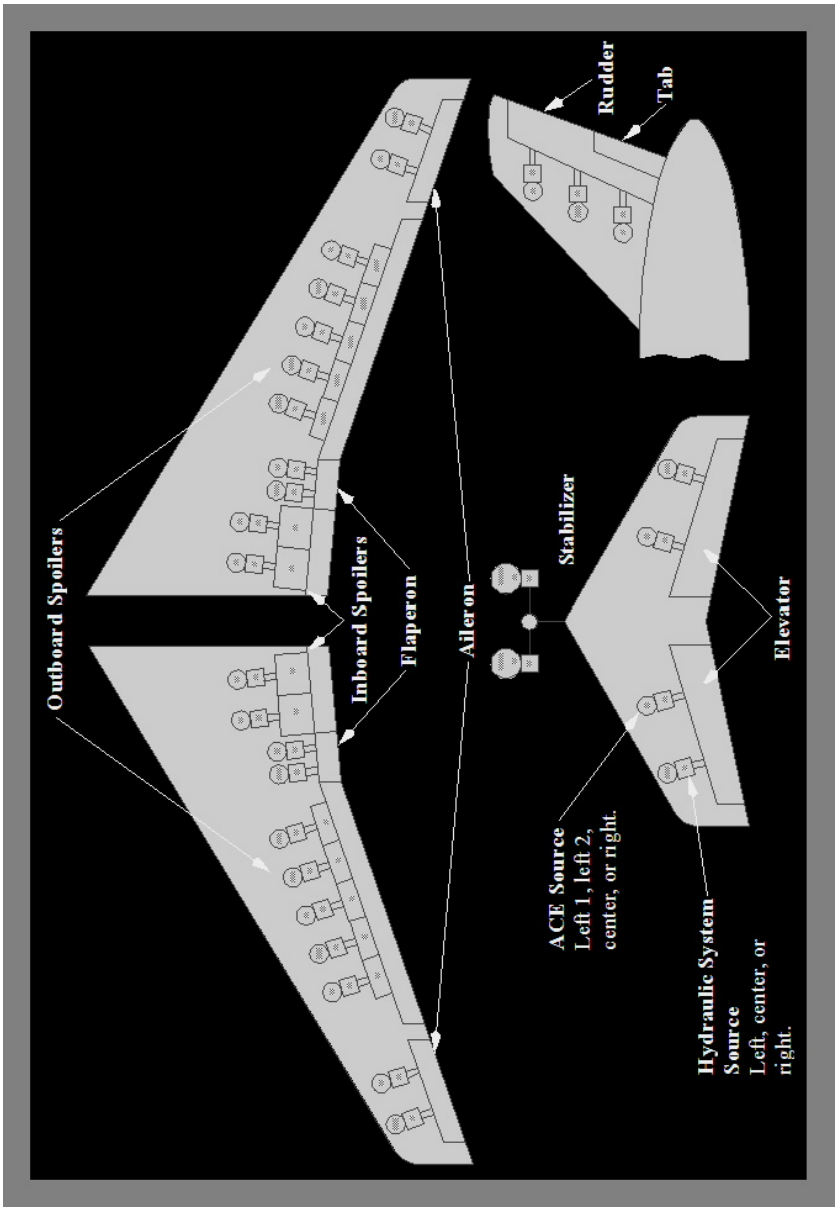
Actuator Control Electronics/Hydraulic Power Distribution



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Primary Flight Control System Modes

There are three primary flight control system modes (flap and slat system modes are described later in this section):

- normal
- secondary
- direct.

All the modes use the same pilot controls and flight control surfaces.

Flight Control System Normal Mode

In normal mode during manual flight, four ACEs receive pilot control inputs and send these signals to the three PFCs. The PFCs verify these signals and information from other airplane systems in order to compute control surface commands. These commands are then sent back to the ACEs. The ACEs send enhanced signals to the flight control surface actuators.

When the autopilot is engaged, the autopilot system sends commands to the PFCs. The PFCs generate control surface commands, which are then sent to the ACEs in the same manner as pilot control inputs. The autopilot commands move the pilot controls to provide indications of what the autopilot is doing. If the pilot overrides the autopilot with control inputs, the PFCs disconnect the autopilot and use the pilot control inputs. The autopilot is only available during normal mode operation. See Automatic Flight Operations on page 4.20.10 for autopilot operation.

After the hydraulic systems are shut down, the PFCs self–test. During the test, various EICAS alert and status messages display, trim indicator information blinks, and various failure indications display on the flight controls synoptic. When the self test is complete, the EICAS messages disappear, and the trim indicator and synoptic display return to normal. This happens about two minutes after the EICAS caution message HYD PRESS SYS L+C+R is displayed.

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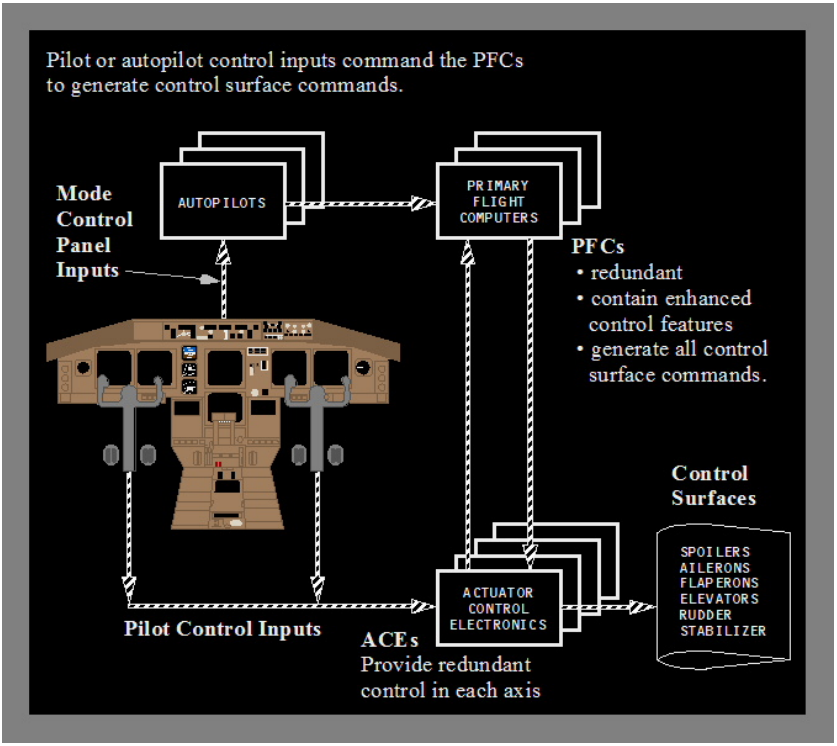
Normal Mode



Flight Envelope Protection

The primary flight control system provides flight envelope protection when operating in normal mode. Flight envelope protection reduces the possibility of inadvertently exceeding the flight envelope by providing crew awareness of envelope margins through tactile, aural, and visual cues. Envelope protection does not reduce pilot control authority.

The envelope protection functions are described later in this section and include:

- stall protection
- overspeed protection
- bank angle protection.

See Automatic Flight on page 4.10.1 for a description of PFD flight mode annunciations, mode control panel operation, autothrottle operation, and flight envelope protection.

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See Flight Instruments, Displays on page 10.10.1 for a description of PFD indications.

See Warning Systems on page 15.10.1 for a description of aural and visual cues.

Flight Control System Secondary Mode

When the PFCs can no longer support the normal mode due to internal faults or lack of required information from other airplane systems, they automatically revert to the secondary mode. The ACEs continue to receive pilot control inputs and send these signals to the three PFCs. However, the PFCs use simplified computations to generate flight control surfaces commands. These simplified commands are sent back to the ACEs, where they are sent to the control surface actuators the same way as in the normal mode.

The simplified PFC control laws used in the secondary mode affect airplane handling qualities. All flight control surfaces remain operable. The elevator and rudder are more sensitive at some airspeeds.

The following functions are not available in the secondary mode:

- autopilot
- auto speedbrakes
- envelope protection
- gust suppression
- tail strike protection
- thrust asymmetry compensation
- yaw damping (may be degraded or inoperative).

TJR to TJW, TKK to TKR, TKU to TKZ

The EICAS caution message FLIGHT CONTROL MODE is displayed when the primary flight control system is in the secondary mode. The secondary mode cannot be manually selected.

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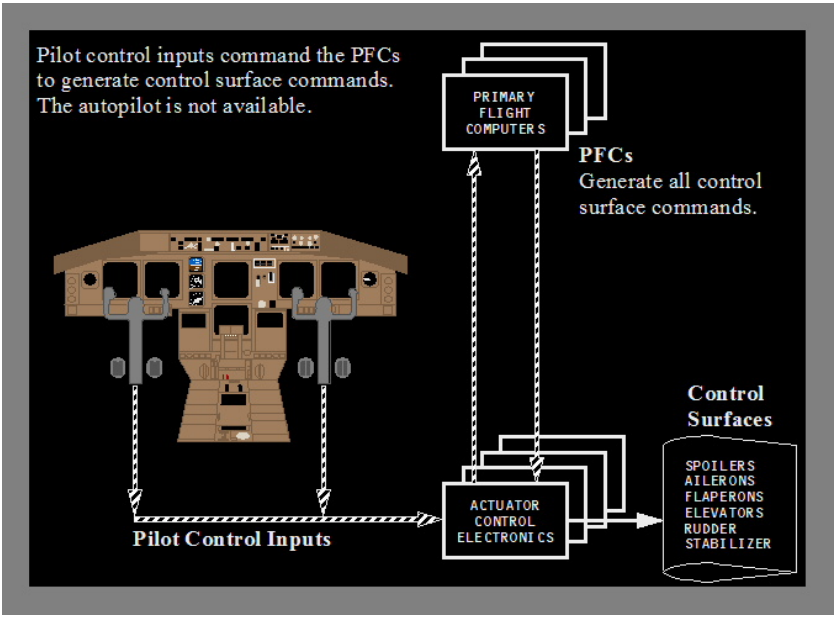
Secondary Mode



Flight Control System Direct Mode

The ACEs automatically transition to the direct mode when they detect the failure of all three PFCs or lose communication with the PFCs. The direct mode can also be manually selected by moving the PRIMARY FLIGHT COMPUTERS DISCONNECT switch to DISC.

In the direct mode, the PFCs no longer generate control surface commands. Pilot inputs received by the ACEs are sent directly to the control surface actuators.

The direct mode provides full airplane control for continued safe flight and landing. Airplane handling qualities are approximately the same as in the secondary mode. The EICAS caution message PRI FLIGHT COMPUTERS is displayed when the system is in the direct mode.

In the direct mode, the following functions are not available:

- autopilot
- auto speedbrakes
- envelope protection
- gust suppression

TJR to TJW, TKK to TKR, TKU to TKZ

- tail strike protection
- manual rudder trim cancel switch

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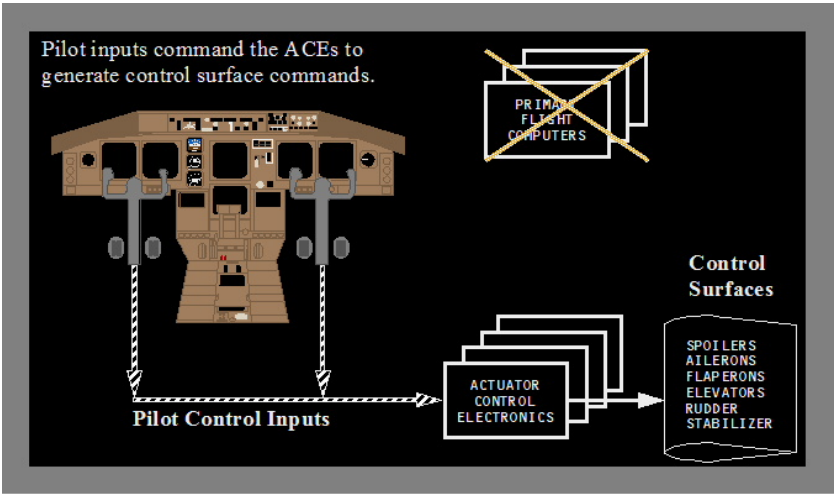
- thrust asymmetry compensation
- yaw damping.

Direct Mode



Mechanical Backup

In the unlikely event of a complete electrical system shut-down, cables from the flight deck to the stabilizer and selected spoilers allow the pilot to fly straight and level until the electrical system is restarted.

Normal Mode Pitch Control

In the normal mode, airplane pitch control characteristics are like conventional airplanes, with improved handling qualities. Unlike conventional airplanes, the control column does not directly position the elevator in flight. The control column commands the PFCs to generate a pitch maneuver. The PFCs automatically position the elevator and the stabilizer to generate the commanded maneuver. The PFCs constantly monitor airplane response to pilot commands and reposition the elevator and stabilizer to carry out these commands. Airplane pitch responses to thrust changes, gear configuration changes, and turbulence are automatically minimized by PFC control surface commands.

The PFCs also provide compensation for flap and speedbrake configuration changes, and turns up to 30° of bank. The PFCs automatically control pitch to maintain a relatively constant flight path. This eliminates the need for the pilot to make control column inputs to compensate for these factors. For turns up to 30° of bank, the pilot does not need to add additional column back pressure to

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maintain altitude. For turns of more than 30° of bank, the pilot does need to add column back pressure.

As airspeed changes, the PFCs provide conventional pitch control characteristics by requiring the pilot to make control column inputs or trim changes to maintain a constant flight path.

Primary Pitch Trim Control

Primary pitch trim is controlled by the dual pitch trim switches on each control wheel. Both switches must be moved to command trim changes. The primary pitch trim switches are inhibited when the autopilot is engaged. Pitch trim does not move the control column.

In the normal mode, primary pitch trim operates differently on the ground than it does in flight. On the ground, the stabilizer is directly positioned when the pilot uses the pitch trim switches. In flight, the pitch trim switches do not position the stabilizer directly, but make inputs to the PFCs to change the trim reference speed. The trim reference speed is the speed at which the airplane would eventually stabilize if there were no control column inputs. Once the control column forces are trimmed to zero, the airplane maintains a constant speed with no column inputs. Thrust changes result in a relatively constant indicated airspeed climb or descent, with no trim inputs needed unless airspeed changes.

When pilot trim inputs are made, the PFCs automatically move the elevators to achieve the trim change, then move the stabilizer to streamline the elevator. Stabilizer motion may also automatically occur to streamline the stabilizer and elevator for thrust and configuration changes.

Alternate Pitch Trim

Alternate pitch trim is controlled by the dual alternate pitch trim levers on the control stand. Both levers must be moved to command trim changes. These levers move the trim reference airspeed (normal mode) and also move the stabilizer (all modes). The alternate pitch trim levers are linked to the stabilizer trim control modules (STCM) via control cables, and then mechanically to the stabilizer. Alternate pitch trim commands have priority over wheel pitch trim commands in all flight control modes.

Moving the alternate pitch trim levers with the autopilot engaged does not disconnect the autopilot, but does move the stabilizer. Moving the alternate pitch trim levers during stall or overspeed protection does move the stabilizer, but does not remove column forces.

Note: The alternate pitch trim levers should not be used with the autopilot engaged, or during stall or overspeed protection.

Pitch Envelope Protection

The pitch envelope protection functions include:

- stall protection

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- overspeed protection.

Stall Protection

Stall protection reduces the likelihood of inadvertently exceeding the stall angle of attack by providing enhanced crew awareness of the approach to a stall or to a stalled condition.

Stall protection limits the speed to which the airplane can be trimmed. The trim reference speed is limited by inhibiting trim in the nose up direction when the airplane slows to a speed where maneuver margin is limited. This trim inhibit speed is approximately the minimum maneuvering speed (top of the amber band) at lower altitudes, and can be 10 to 20 knots lower than the top of the amber band at higher altitudes. The pilot must apply continuous aft column pressure, at higher than normal force, to maintain airspeed below trim inhibit speed.

Overspeed Protection

Overspeed protection limits the speed to which the airplane can be trimmed. At VMO/MMO, overspeed protection limits the trim reference speed so that trim is inhibited in the nose down direction. The pilot must apply continuous forward column force to maintain airspeed above VMO/MMO. Use of the alternate pitch trim levers does not reduce column forces.

Elevator Variable Feel

The PFCs calculate feel commands based on airspeed. In general, control column forces increase:

- as airspeed increases for a given column displacement, or
- as column displacement increases.

Tail Strike Protection

TJR to TJW, TKK to TKR, TKU to TKZ

During takeoff or landing, the PFCs calculate if a tail strike is imminent and decrease elevator deflection, if required, to reduce the potential for tail strike. Activation of tail strike protection does not provide feedback to the control column.

Secondary and Direct Mode Pitch Control

Airplane pitch control is different in the secondary and direct flight control modes. The control columns now command a proportional elevator deflection instead of a maneuver command. Secondary and direct modes do not provide automatic pitch compensation for:

- thrust changes
- gear configuration changes
- turbulence
- flap and speedbrake configuration changes
- turns to 30° bank angle.

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In secondary and direct modes, the elevator variable feel system provides two feel force levels instead of a continuous variation with airspeed. The force levels change with flap position. With the flaps up, the feel forces provide maneuver force levels that discourage overcontrol in the pitch axis at high speeds. With flaps out of up, the feel forces decrease to provide force levels appropriate for approach and landing.

In the secondary and direct modes, both the primary pitch trim switches and the alternate pitch trim levers move the stabilizer directly. There is no trim reference speed.

Stabilizer Hydraulic Power and Non-Normal Operation

The stabilizer is powered by the center and right hydraulic systems. Stabilizer position commands from the PFCs and alternate pitch trim levers are sent to the stabilizer trim control modules, which control hydraulic power to the stabilizer. There are two modules, one for each stabilizer hydraulic source.

Stabilizer Shutdown

If uncommanded stabilizer motion is sensed, hydraulic power to the stabilizer trim control module that caused the motion is automatically shut off. If a module is inoperative due to an automatic shutdown or another failure, the EICAS advisory message STABILIZER C or STABILIZER R is displayed. The stabilizer remains operative through the remaining stabilizer trim control module.

If both stabilizer trim control modules automatically shut down or fail, the EICAS warning message STABILIZER is displayed. The STABILIZER warning is also displayed if automatic shutdown fails to stop uncommanded motion.

The center and right stabilizer cutout switches, located on the aisle stand, control hydraulic power to the respective stabilizer trim control module. Placing both switches in the CUTOUT position removes all hydraulic power from the stabilizer. The EICAS advisory message STABILIZER CUTOUT is displayed when both stabilizer cutout switches are in the CUTOUT position. The STABILIZER warning message is no longer displayed.

In the normal flight control mode, when the stabilizer is manually shut down or failed, pitch trim is still available. Pilot pitch trim inputs change the PFC trim reference speed. The PFCs then reposition the elevators to trim the airplane.

The control column can be used to interrupt pitch trim commands from the wheel pitch trim switches. This feature allows the pilot to quickly stop uncommanded trim changes due to stuck pitch trim switches. The pitch trim commands are interrupted if the control column is displaced in the opposing direction.

Stabilizer Position Indication and Green Band

Stabilizer position is displayed on two stabilizer position indicators located on the aisle stand. Stabilizer position is also displayed on the flight controls synoptic.

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The stabilizer position indicators also display the takeoff green band indication. The green band automatically displays the acceptable range for takeoff stabilizer positions. There are three green band segments that can be illuminated for takeoff:

- the mid-band
- the nose down band (which includes the mid-band)
- the nose up band (which includes the mid-band).

The green band is calculated using the FMC inputs of CG, gross weight, takeoff thrust and V1.

A nose gear oil pressure switch provides an automatic cross–check of the CG to ensure that the correct green band has been selected. When either the nose up or nose down band is selected, the pressure switch position is compared to the computed green band. The EICAS advisory message STAB GREENBAND is displayed if the pressure switch and the green band disagree. If the stabilizer signal is not present or is invalid, the green band and the pointer are not displayed.

Normal Mode Roll Control

Roll control is similar to conventional airplanes. Aileron and flaperon surface deflections are proportional to control wheel displacement. Spoilers begin to extend to augment roll control after several degrees of control wheel rotation. Control wheel forces increase as control displacement increases. Control wheel forces do not change with airspeed changes. The ailerons are locked out at high speeds.

Spoilers 4 and 11 are mechanically controlled through a cable from the control wheel. These spoilers are available for roll control until the speedbrake lever is moved to near the UP position, when they function as speedbrakes only. Spoilers 5 and 10 are locked out at high speed.

Aileron Trim

Dual aileron trim switches located on the aisle stand must be pushed simultaneously to command trim changes. Use of aileron trim causes control wheel rotation.

The amount of aileron trim is indicated on a scale on the top of each control column.

Aileron trim is inhibited when the autopilot is engaged.

Bank Angle Protection

Bank angle protection reduces the likelihood of exceeding the bank angle boundary due to external disturbances, system failures, or inappropriate pilot action.

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Bank angle protection provides roll control wheel inputs when airplane bank angle exceeds the bank angle protection boundary of approximately 35°. If the boundary is exceeded, the control wheel force rolls the airplane back within 30° of bank. This roll command can be overridden by the pilot. Maximum control wheel deflection always commands maximum control surface deflection. The autopilot disengage bar disables bank angle protection.

Excessive bank angles are indicated on the PFD bank indicator. The indicator changes color to amber at bank angles exceeding 35°.

Secondary and Direct Mode Roll Control

Roll control in the secondary and direct modes is very similar to roll control in the normal mode. Bank angle protection is not available in either the secondary or direct mode. Spoilers 5 and 10 are always locked out.

Normal Mode Yaw Control

Yaw control operation is similar to a conventional airplane. Rudder surface deflections are proportional to rudder pedal movements.

Pedal forces increase as pedal displacement increases. Pedal forces do not change with airspeed changes.

The rudder ratio changer automatically reduces rudder deflection (for a given pedal input) as airspeed increases. This protects the vertical tail structure from stresses resulting from large rudder surface deflections at high airspeeds. Sufficient rudder authority is provided at all airspeeds to maintain airplane control in engine–out conditions, as well as during takeoffs and landings in crosswinds.

Thrust Asymmetry Compensation

The thrust asymmetry compensation (TAC) system significantly reduces uncommanded flight path changes associated with an engine failure. TAC continually monitors engine data to determine the thrust level from each engine. If the thrust level on one engine differs by 10 percent or more from the other engine, TAC automatically adds rudder to minimize yaw.

Before liftoff, TAC does not fully compensate for the failed engine so the pilot can recognize engine failure through roll/yaw cues. These roll/yaw cues are greatly reduced when compared to an airplane operating without TAC. After liftoff, TAC attempts to fully compensate for the failed engine.

The amount of rudder used is proportional to the engine thrust difference. Rudder movement is back-driven through the rudder pedals and displayed on the rudder trim indicator. Following engine failure, the pilot can trim the airplane using additional rudder trim, control wheel input, aileron trim, or autopilot engagement.

TAC is available except:

- when airspeed is below 70 knots on the ground, or

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- when reverse thrust is applied, or
- when automatically disengaged due to system malfunction or loss of engine thrust data.

TAC automatically disengages if engine thrust data is lost. TAC may also disengage following severe engine damage or surge if it is unable to determine an accurate thrust level. TAC may still cause some rudder deflection in the appropriate direction just before automatically disengaging.

TAC can be manually overridden by making manual rudder pedal inputs. TAC is only available in the normal flight control mode. To manually disarm TAC, push the THRUST ASYM COMP switch on the overhead panel. If TAC is automatically or manually disconnected, the EICAS advisory message THRUST ASYM COMP displays.

Wheel to Rudder Cross–Tie

A wheel to rudder cross–tie function provides the capability of being able to control the initial effects of an engine failure using control wheel inputs only. Control wheel inputs can deflect the rudder up to 8°.

Wheel to rudder cross-tie is operative in flight below 210 knots in the normal mode.

Yaw Damping

In the normal mode, the yaw damping function provides turn coordination and Dutch roll damping.

Gust Suppression

A gust suppression function reduces the effects of lateral gusts and improves lateral ride quality through a combination of yaw and roll commands. Operation does not result in either rudder pedal or control wheel movement.

Rudder Trim

The rudder trim control can be used to command manual rudder trim in all three flight control modes. Two rudder trim speeds are available. Low rate rudder trim is commanded by rotating the control to the detent. High rate rudder trim is commanded by rotating the control past the detent. Manual Trim Cancel switch actuation causes manually set rudder trim to move to the zero units position at the high speed trim rate. The zero position achieved by actuating the switch is not as accurate as manually trimming to zero units. The switch has no effect on rudder trim inputs from TAC.

Secondary and Direct Mode Yaw Control

Secondary and direct mode yaw control is similar to normal mode yaw control. Pedal feel forces are unchanged from normal mode; however, rudder response is slightly different.

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In secondary and direct modes, the rudder ratio changer is degraded to two fixed ratios determined by flap position. With flaps up, the rudder response to pedal inputs is less than with the flaps down.

In the secondary mode:

- gust suppression is inoperative
- yaw damping is degraded (for some failures, it may be inoperative)
- thrust asymmetry compensation is inoperative.

In the direct mode the following are inoperative:

- gust suppression
- yaw damping
- the manual rudder trim cancel switch
- thrust asymmetry compensation.

Spoilers

There are 7 sets of spoilers, 5 outboard and 2 inboard of the flaperons, on the upper surface of each wing. The spoilers are numbered from left to right, 1 through 14. Spoilers on opposing wings are symmetrically paired.

Spoiler panels are used as speedbrakes to increase drag and reduce lift, both in flight and on the ground. The spoilers also supplement roll control in response to control wheel commands. Spoiler panels 5 and 10 are locked out during cruise, depending on altitude and airspeed.

All three hydraulic systems supply the spoilers. Each hydraulic system is dedicated to a different set of spoiler pairs to provide isolation and maintain symmetric operation in the event of hydraulic system failure. If a single spoiler fails, the corresponding spoiler on the other wing retracts. Failure of a single or multiple spoiler pairs causes the EICAS advisory message SPOILERS to display.

Spoiler Speedbrake Operation

The 14 spoiler panels are used as speedbrakes. In the normal mode, when used as speedbrakes, spoilers 5 and 10 are available as ground speedbrakes only. In the secondary and direct modes, spoilers 4, 5, 10, and 11 are locked out.

The speedbrake spoilers are controlled by the speedbrake lever located on the control stand. The speedbrake lever has three marked positions:

- DOWN
- ARMED
- UP.

The speedbrake lever can be placed in intermediate positions between ARMED and UP.

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In the ARMED position, the speedbrake lever is driven aft to the UP position when the landing gear is fully on the ground (not tilted) and the thrust levers are at idle.

On the ground when either reverse thrust lever is moved to the reverse idle detent, the speedbrakes automatically extend. The speedbrake lever does not need to be in the ARMED position. A mechanical link between the speedbrake lever and the reverse thrust levers raises the speedbrake lever out of the DOWN detent. The speedbrake lever is then driven aft and the speedbrakes extend. If either thrust lever is advanced to a takeoff position, the speedbrake lever is driven to the down position.

Automatic speedbrakes are not available in the secondary and direct modes.

There is no limitation for extension of speedbrakes in a landing configuration.

Flaps and Slats

The flaps and slats are high lift devices that increase wing lift and decrease stall speed during takeoff, approach, and landing.

The airplane has an inboard and an outboard flap on the trailing edge of each wing, and one inboard and six outboard slats on the leading edge. A two-position Krueger flap provides a seal between the inboard slat and engine nacelle on each wing.

In the flaps 1 position, only the slats move. Flaps 5, 15, and 20 are takeoff flap positions. Flaps 25 and 30 are landing flaps positions. Flaps 20 is used for some non–normal landing conditions.

-200

To protect against inadvertent deployment during cruise, flap and slat extension from the UP position is inhibited when speed is more than 250 knots or altitude is above approximately 20,000 feet.

-200ER,-300

To protect against inadvertent deployment during cruise, flap and slat extension from the UP position is inhibited when speed is more than 265 knots or altitude is above approximately 20,000 feet.

-300ER

To protect against inadvertent deployment during cruise, flap and slat extension from the UP position is inhibited when speed is more than 275 knots or altitude is above approximately 20,000 feet.

If the flap handle is moved out of UP while the flaps are inhibited, LOAD RELIEF displays.

Flap and Slat Sequencing

When the flap lever is in the UP detent, all flaps and slats are commanded retracted. Moving the flap lever aft allows selection of flap detent positions 1, 5, 15, 20, 25 and 30. The flaps and slats sequence so that the slats extend first and retract last.

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Starting from flaps UP, selection of flaps 1 commands the slats to move to the midrange position. The flaps remain retracted.

Selection of the flaps 5, 15, and 20 positions commands the flaps to move to the position selected. The slats remain in the midrange position.

Selection of flaps 25 commands both the flaps and slats to move to landing positions. First the slats extend to the fully extended position, then the flaps extend to the landing flaps 25 position.

Selection of flaps 30 commands the flaps to extend to the primary landing position.

During retraction, flap and slat sequencing is reversed.

The mechanical gate at the flaps 20 detent prevents inadvertent retraction of the flaps past the go-around flap setting. The mechanical gate at flaps 1 prevents inadvertent retraction of the slats past the midrange position.

Flap and Slat Modes

Three modes of flap and slat operation are possible:

- primary (hydraulic)
- secondary (electric)
- alternate (electric).

The flaps and slats can operate independently in either the primary or secondary mode. However, independent flap and slat operation in the alternate mode is not possible.

Primary mode hydraulic power is supplied by the center hydraulic system. Secondary and alternate mode electrical power is supplied by the left and right AC busses.

The secondary mode is automatically engaged whenever the primary mode fails to move the flaps or slats to the selected position. Once engaged, the secondary mode remains engaged until the affected system surfaces are fully retracted or center hydraulic system pressure is restored.

-200 In the secondary mode, the flaps and slats are positioned by electric motors. Because autoslats are unavailable, the slats are fully extended at all flap positions (if airspeed is less than 215 knots) to improve stall handling characteristics. If airspeed exceeds 215 knots, the slats retract to the midrange position (the midrange index on the slat position indicator), or will not extend beyond the midrange position.

-200ER In the secondary mode, the flaps and slats are positioned by electric motors. Because autoslats are unavailable, the slats are fully extended at all flap positions (if airspeed is less than 239 knots) to improve stall handling characteristics. If airspeed exceeds 239 knots, the slats retract to the midrange

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position (the midrange index on the slat position indicator), or will not extend beyond the midrange position.

-300

In the secondary mode, the flaps and slats are positioned by electric motors. Because autoslats are unavailable, the slats are fully extended at all flap positions (if airspeed is less than 246 knots) to improve stall handling characteristics. If airspeed exceeds 246 knots, the slats retract to the midrange position (the midrange index on the slat position indicator), or will not extend beyond the midrange position.

-300ER

In the secondary mode, the flaps and slats are positioned by electric motors. Because autoslats are unavailable, the slats are fully extended at all flap positions (if airspeed is less than 256 knots) to improve stall handling characteristics. If airspeed exceeds 256 knots, the slats retract to the midrange position (the midrange index on the slat position indicator), or will not extend beyond the midrange position.

If the slats are in the midrange position (flaps 1 through 20) when the secondary mode is engaged, they remain in that position until the flaps are retracted to UP, or extended beyond 20.

TKK to TKR, TKU to TKZ

On the ground, secondary electric mode extension or retraction is inhibited when groundspeed is less than 40 knots, center hydraulic system pressure is low, and two of the following three items are true:

- left engine N2 is less than 50 percent,
- right engine N2 is less than 50 percent,
- primary external power is available.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

On the ground, secondary electric mode extension or retraction is inhibited when groundspeed is less than 40 knots, center hydraulic system pressure is low, and two of the following three items are true:

- left engine N3 is less than 50 percent,
- right engine N3 is less than 50 percent,
- primary external power is available.

The alternate mode allows direct manual operation of the flaps and slats through the secondary drive electric motors. The alternate flaps ARM switch:

- disables normal control
- arms the alternate mode
- engages the electric motors
- the flap lever no longer controls flaps/slats.

The three-position alternate flaps selector extends and retracts the flaps and slats. The flaps and slats extend simultaneously, but slat retraction is inhibited until the flaps are up. Alternate mode flap and slat extension is limited to slats midrange and flaps 20. Asymmetry protection, uncommanded motion protection, autoslats, and flap/slat load relief are not available in the alternate mode.

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The alternate mode must be manually selected. Slat and flap operation time in the secondary and alternate modes is greatly increased.

Flap/Slat Load Relief

In the primary mode, the flap load relief system protects the flaps from excessive air loads. If flap airspeed placard limits are exceeded with the flaps in the 15 through 30 position, LOAD RELIEF is displayed and the flaps automatically retract to a position appropriate to the airspeed. Flaps start to retract when airspeed is 1 knot higher than the flap placard airspeed. Load relief retraction is limited to flaps 5.

When airspeed is 5 knots below the flap placard airspeed for the commanded flap position, the flaps automatically re-extend. Re–extension is limited to the commanded flap position.

If a flap overspeed exists, load relief prevents flap extension beyond the 5, 15, 20, or 25 positions until airspeed is sufficiently reduced. Flap load relief is available only in the primary mode. The EICAS flap display indicates an in-transit flap condition and shows actual flap position. The flap lever does not move during flap load relief operation. Load relief for slats is not required in the primary or alternate modes.

-200 Slat load relief is available in the secondary mode. If airspeed exceeds 215 knots with the slats fully extended, they retract to midrange and LOAD RELIEF is displayed.

-200ER Slat load relief is available in the secondary mode. If airspeed exceeds 239 knots with the slats fully extended, they retract to midrange and LOAD RELIEF is displayed.

-300 Slat load relief is available in the secondary mode. If airspeed exceeds 246 knots with the slats fully extended, they retract to midrange and LOAD RELIEF is displayed.

-300ER Slat load relief is available in the secondary mode. If airspeed exceeds 256 knots with the slats fully extended, they retract to midrange and LOAD RELIEF is displayed.

Autoslats

The autoslat system enhances airplane stall characteristics. Upon receiving a signal from the stall warning system, the slats automatically extend from the midrange position to the fully extended landing position. The slats retract a few seconds after the signal is removed. Slats are fully extended to improve stall handling characteristics.

Autoslat operation is armed at flaps 1, 5, 15 and 20 and is available only in the primary slat mode.

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Flap and Slat Asymmetry Detection

A detection system detects asymmetrical extension or retraction of an individual flap. After detection, the flap drive shuts down and the EICAS message FLAPS DRIVE is displayed.

A detection system detects slat asymmetry. Loss of all but the most outboard slats on each wing is also detected. When slat loss or asymmetry occurs, the system shuts down the slat drive and displays the SLATS DRIVE EICAS message.

Uncommanded Flap or Slat Motion

Uncommanded motion is detected when the slats or flaps:

- move away from the commanded position
- continue to move after reaching a commanded position
- or move in a direction opposite to that commanded.

If the flap or slat is operating in the primary mode, uncommanded motion first causes an automatic transfer to the secondary mode. The EICAS message FLAPS PRIMARY FAIL or SLATS PRIMARY FAIL is displayed. If motion continues, the system shuts down. The EICAS message FLAPS DRIVE or SLATS DRIVE is displayed.

Flap Indications

Flap position indications are displayed on the primary EICAS display. A single vertical indicator displays combined flap and slat position. The position commanded by the flap lever is also displayed. Ten seconds after all flaps and slats are up, the entire indication is no longer displayed.

If flap/slat control is in the secondary or alternate mode, or if any non–normal condition is detected, an expanded flap indication is displayed automatically. The position of the left and right flaps and slats are separately indicated. In the alternate mode, the position commanded by the flap lever is replaced by flap position index marks at all flap and slat positions, and numbers at flaps 5 and flaps 20. The index marks are used as a guide to position the flaps to the desired setting.

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EICAS Alert Messages

Note: Configuration (CONFIG) warning messages are described in Chapter 15, Warning Systems.

Message	Level	Aural	Message Logic
AUTO SPEEDBRAKE	Advisory		A fault is detected in the automatic speedbrake system.
FLAPS DRIVE	Caution	Beeper	Flap drive mechanism has failed.
FLAPS PRIMARY FAIL	Caution	Beeper	Flaps are operating in the secondary mode.
FLAP/SLAT CONTROL	Caution	Beeper	Flap/slat electronics units are inoperative.
FLIGHT CONTROL MODE	Caution	Beeper	Flight control system is operating in the secondary mode.
FLIGHT CONTROLS	Caution	Beeper	Multiple flight control surfaces are inoperative or other flight control system faults are detected.
FLT CONTROL VALVE	Advisory		One or more flight control valves are failed closed or one or more flight control shutoff switches are in SHUTOFF.
PITCH DOWN AUTHORITY	Caution	Beeper	Pitch down authority is limited.
PITCH UP AUTHORITY	Caution	Beeper	Pitch up and flare authority is limited.
PRI FLIGHT COMPUTERS	Caution	Beeper	Flight control system is operating in the direct mode.
SLATS DRIVE	Caution	Beeper	Slat drive mechanism has failed.
SLATS PRIMARY FAIL	Caution	Beeper	Slats are operating in the secondary mode.
SPEEDBRAKE ARMED	Memo		Speedbrakes are armed.
SPEEDBRAKE EXTENDED	Caution	Beeper	Speedbrake is extended when radio altitude is between 15 and 800 feet, or when the flap lever is in a landing position, or when either thrust lever is not closed.

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Message	Level	Aural	Message Logic
SPOILERS	Advisory		One or more spoiler pairs are inoperative.
STAB GREENBAND	Advisory		Nose gear pressure switch disagrees with computed stabilizer greenband.
STABILIZER	Warning	Siren	Uncommanded stabilizer motion is detected or stabilizer is inoperative.
STABILIZER C	Advisory		Center stabilizer control path is inoperative.
STABILIZER CUTOUT	Advisory		Both stabilizer cutout switches are in CUTOUT.
STABILIZER R	Advisory		Right stabilizer control path is inoperative.
THRUST ASYM COMP	Advisory		Thrust asymmetry compensation is inoperative.

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Flight Instruments, Displays — Chapter 10

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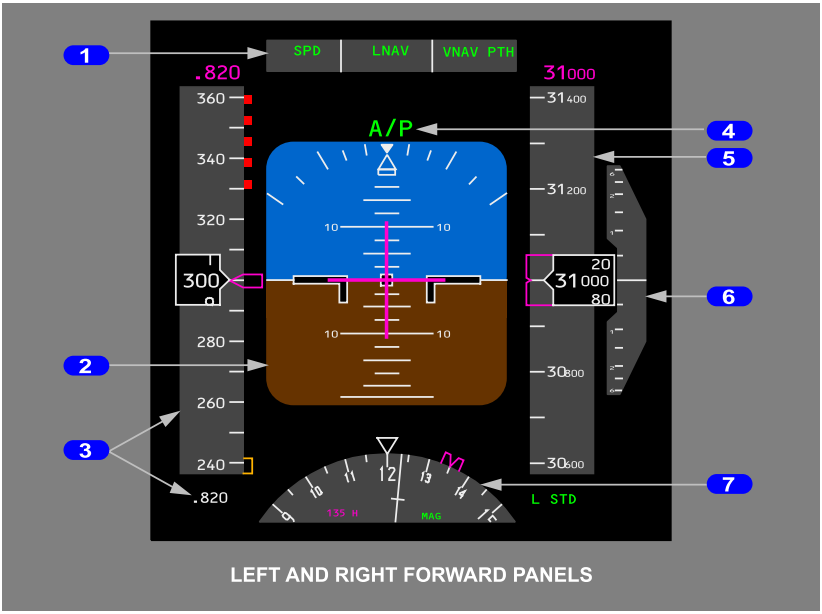
Primary Flight Display (PFD)

PFD Indications



LEFT AND RIGHT FORWARD PANELS

1 Flight Mode Annunciations

See PFD Flight Mode Annunciations (FMAs) on page 4.10.15.

2 Attitude, Steering, and Miscellaneous Indications

Displays Air Data Inertial Reference System (ADIRS) attitude information.

3 Airspeed/Mach Indications

Displays ADIRS airspeed information and other airspeed related information.

4 Autopilot, Flight Director System Status

See PFD Flight Mode Annunciations (FMAs) on page 4.10.15.

5 Altitude Indications

Displays ADIRS altitude and other altitude-related information.

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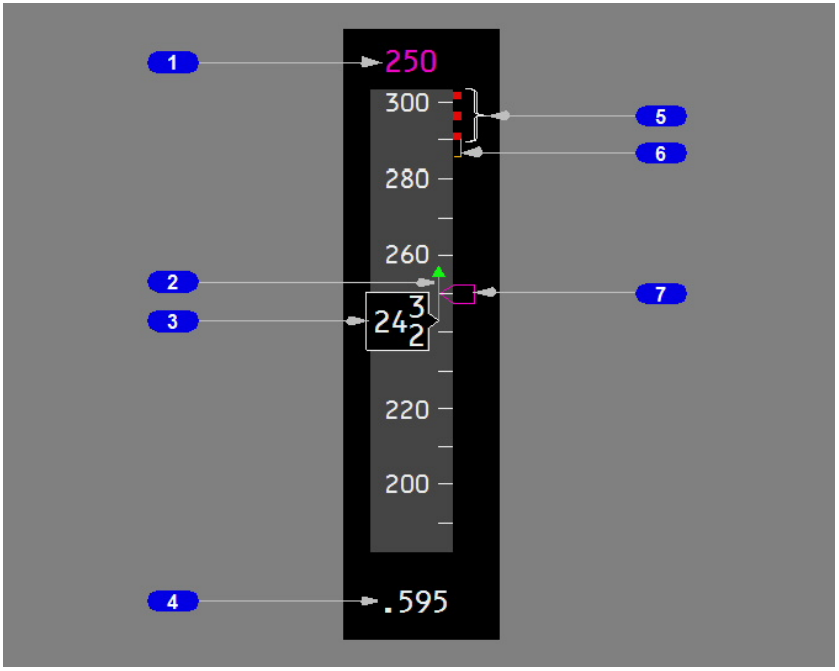
6 Vertical Speed Indication

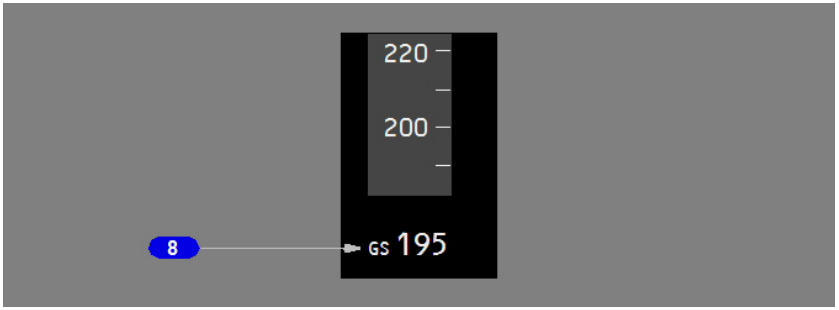
Displays ADIRS vertical speed and other vertical speed information.

7 Heading and Track Indications

Displays current ADIRS heading, track and other heading information.

PFD Airspeed Indications





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1 Selected Speed

Displays the airspeed/Mach selected in the mode control panel MCP IAS/MACH window (see Autopilot Flight Director IAS/Mach Controls on page 4.10.4).

Displays the FMC—computed airspeed/Mach when the MCP IAS/MACH window is blank.

2 Speed Trend Vector

Indicates predicted airspeed in ten seconds based on current acceleration or deceleration.

3 Current Airspeed

Indicates current ADIRS airspeed.

The box around the current airspeed indication turns amber when airspeed is below minimum maneuvering speed.

4 Current Mach

Displays current ADIRS Mach at or above 0.40.

5 Maximum Speed

Indicates maximum permissible airspeed as limited by the lowest of the following:

- Vmo/Mmo
- landing gear placard speed, or
- flap placard speed.

6 Maximum Maneuvering Speed

When displayed, indicates maneuver margin to high speed buffet. Bottom of the bar is the airspeed that provides 1.3 g maneuver capability (or an alternative approved maneuver capability as preset by maintenance). Bar may be displayed when operating at high altitude at relatively high gross weights.

Note: 1.3 g maneuver capability occurs at 40° of bank in level flight.

7 Speed Bug

Points to the airspeed/Mach selected in the MCP IAS/MACH window.

Points to FMC—computed airspeed when the MCP IAS/MACH window is blank.

The bug is five knots in height.

When the selected speed is off scale, the bug is parked at the top or bottom of the tape, with only one half the bug visible.

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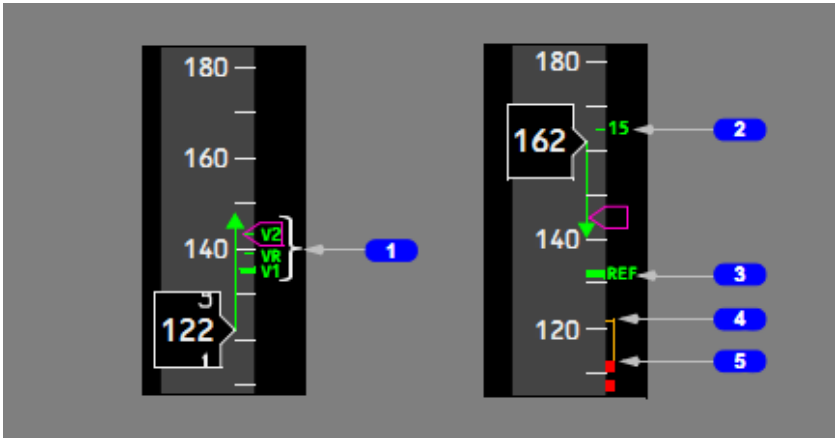
8 Current Ground Speed

Displays ground speed when Mach number is less than 0.40.

When a transition occurs between the display of ground speed and Mach number, the new display is highlighted with a white box for 10 seconds.

PFD Reference Speeds



1 Takeoff Reference Speeds

Displays the takeoff reference speeds V1, VR (displays R if VR is within 4 knots of V1 or V2), and V2, selected on the CDU (see Takeoff Reference Page on page 11.40.41):

- displayed for takeoff
- NO V SPD is displayed if V speeds are not selected on the CDU
- V1 is displayed 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, or
  - after 10 minutes have passed without flap lever movement, or
  - after VREF has been selected (for a turn-back).

2 Flap Maneuvering Speeds

Indicates flap maneuvering speed for flap retraction or extension.

Not displayed above approximately 20,000 feet altitude.

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3 Landing Reference Speed

Displays the VREF speed as selected on the CDU (see Approach Reference Page on page 11.43.19).

VREF speed is displayed at the bottom of the airspeed indication when the value is off the scale.

4 Minimum Maneuvering Speed

Indicates maneuver speed margin to stick shaker or low speed buffet. Top of the bar is the airspeed that provides:

- 1.3 g maneuver capability to stick shaker with flaps down.
- 1.3 g maneuver capability to stick shaker or VREF + 80, whichever is less, with flaps up at or below 20,200 FT.
- 1.3 g maneuver capability to low speed buffet (or an alternative approved maneuver capability as preset by maintenance), with flaps up above 20,200 FT.

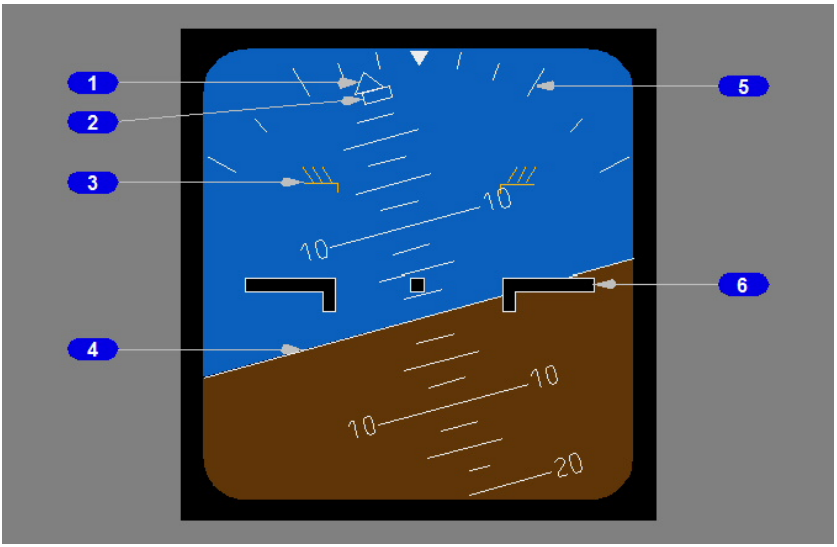
Displayed with first flap retraction after takeoff.

Note: 1.3 g maneuver capability occurs at 40° of bank in level flight.

5 Minimum Speed

Indicates the airspeed where stick shaker activates.

PFD Attitude Indications



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1 Bank Pointer

Indicates:

- ADIRS bank in reference to the bank scale.
- direction towards wings level.

Fills and turns amber if bank angle is 35° or more.

2 Slip/Skid Indication

Displaces beneath the bank pointer to indicate slip or skid.

Fills white at full scale deflection.

Turns amber if bank angle is 35° or more; fills amber if the slip/skid indication is also at full deflection.

3 Pitch Limit Indication

Indicates pitch limit (stick shaker activation point for existing flight conditions). Limited to a maximum of +30°.

Displayed when the flaps are not retracted, or at slow speeds with the flaps retracted.

4 Horizon Line and Pitch Scale

Indicates the ADIRS horizon relative to the airplane symbol.

Pitch scale is in 2.5° increments.

5 Bank Scale

Fixed reference for the bank pointer.

Scale marks are at 0°, 10°, 20°, 30°, 45°, and 60°.

6 Airplane Symbol

Indicates airplane attitude with reference to the ADIRS horizon.

PFD Steering Indications

Note: See TCAS PFD Vertical Guidance on page 15.10.10 for TCAS Steering Indications and Time Critical Warnings.

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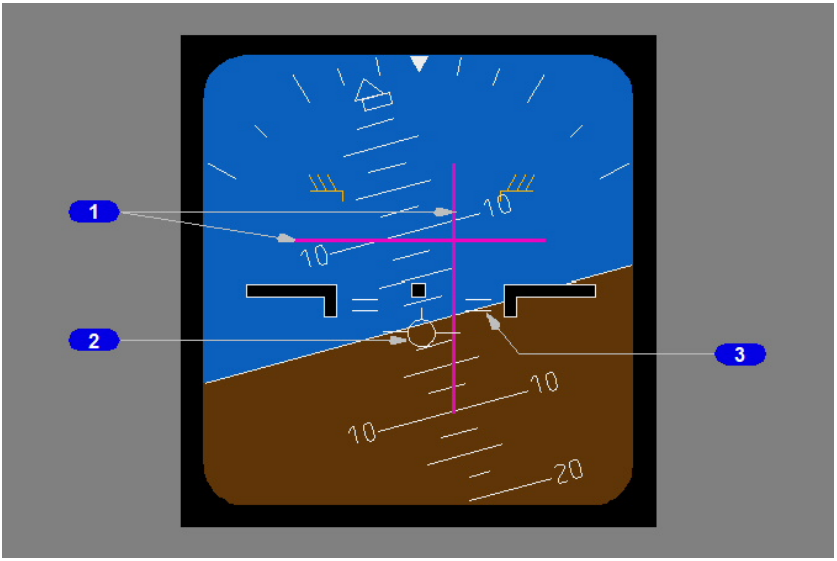

1 Flight Director Pitch and Roll Bars

Indicates flight director pitch and roll steering commands.

See Flight Director Display on page 4.20.3.

2 Flight Path Vector (FPV)

Displays flight path angle and drift angle if:

- FPV is selected on the EFIS control panel, or
- FPA (flight path angle) is selected on the MCP.

Flight path angle is displayed relative to the horizon line.

Drift angle is represented by the perpendicular distance from the centerline of the pitch scale to the FPV symbol.

3 Selected Flight Path Angle (FPA)

Indicates the selected flight path angle when FPA is selected on the MCP.

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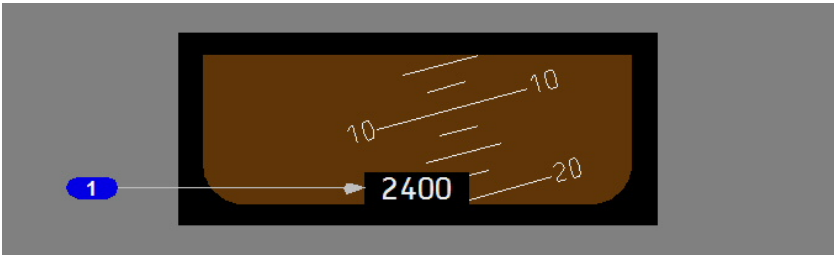
PFD Radio Altitude Indications



1 Radio Altitude

Displays radio altitude below 2,500 feet AGL.

The display box is highlighted in white for 10 seconds when passing below 2,500 feet.

Turns amber when below radio altitude minimums.

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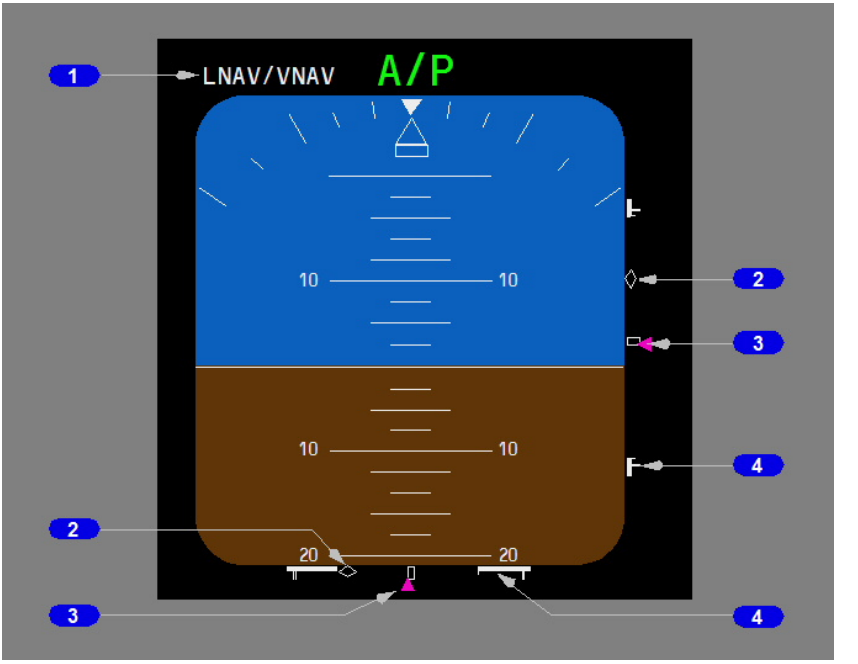
PFD Navigation Performance Indications

TKK to TKR,
TKU to TKZ

Navigation Performance Scales display when LNAV, VNAV, or TO/GA are active modes or when LNAV is armed. Vertical scales do not display during cruise with VNAV PTH active.



1 Navigation Source Reference

Displays the source of navigation performance for the navigation scales.

The lateral scale source is shown first, followed by the vertical scale source. Possible combinations are:

- ILS
- LOC/VNAV—Localizer with VNAV deviation
- LNAV/ G/S—LNAV deviation with glideslope
- LNAV/VNAV—LNAV and VNAV deviation.

2 Anticipation Cue

Represents the relative position of the path for the selected and activated approach.

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3 Deviation Pointer

Indicates the position of the FMC course relative to the airplane.

Pointer:

- unfilled magenta symbol when parked at deflection limit
- filled magenta when not parked at deflection limit
- indicates relative position from the annunciated navigation source
- flashes for ten seconds if pointer migrates into bar area for more than five seconds.

4 Deviation Scale

Indicates RNP for the active phase of flight.

Deviation:

- bars represent Actual Navigation Performance (ANP)
- area between bars indicates margin available to remain within Required Navigation Performance (RNP) criteria
- ANP bars and scale turn amber if pointer migrates into bar area for more than five seconds.
- ANP bars and scale turn amber when LNAV is in the armed mode and the NAV UNABLE RNP message is displayed.

If ANP equals RNP the:

- bars meet in the middle
- bars turn amber
- UNABLE RNP EICAS message displays.

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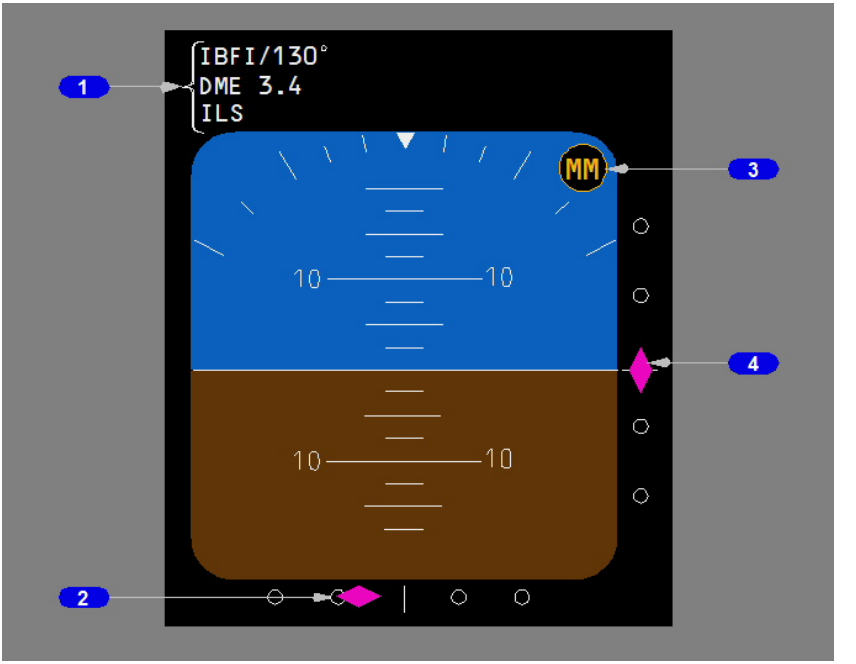
PFD Instrument Landing System Indications

TKK to TKR,
TKU to TKZ



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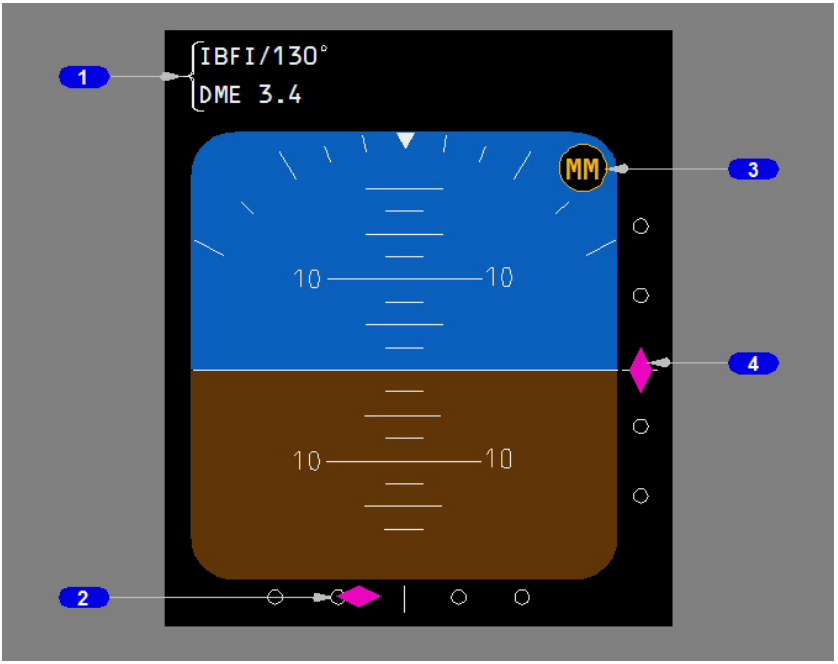
TJA,B,C,D,G,H, TJR to TJW, TKA to TKF



1 Approach Re ference

TKK to TKR, TKU to TKZ

Displays the selected ILS identifier or frequency, approach front course, ILS DME distance, and source annunciation.

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

Displays the selected ILS identifier or frequency, approach front course, and ILS DME distance.

If the tuned ILS frequencies disagree, the frequency turns amber with an amber horizontal line through it.

If the approach courses in the ILS receivers disagree, the course turns amber with an amber horizontal line through it.

2 Localizer Pointer and Scale

The localizer pointer:

- indicates localizer position relative to the airplane
- is in view when the localizer signal is received
- fills in solid when within 2 ½ dots from the center.

The scale is in view after the frequency is tuned.

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At low radio altitudes, with the autopilot or flight director engaged, the scale turns amber and the pointer flashes to indicate excessive localizer deviation.

At low altitudes, with LNAV engaged and LOC armed, the localizer scale turns amber and the pointer flashes if the localizer is not captured.

3 Marker Beacon Indication

The marker beacon indication appears flashing when over one of the marker beacon transmitters:

- IM—an airway or inner marker beacon
- MM—a middle marker beacon
- OM—an outer marker beacon.

The indication flashes in cadence with the beacon identifier.

4 Glideslope Pointer and Scale

The glideslope pointer:

- indicates glideslope position relative to the airplane, and:
  - is in view when the glideslope signal is received
  - fills in solid when within 2 ½ dots from the scale center.

The scale is in view after the frequency is tuned.

At low radio altitudes, with the autopilot or flight director engaged, the scale turns amber and the pointer flashes to indicate excessive glideslope deviation.

PFD Expanded Localizer Indications

1 Expanded Localizer Scale

Displays when the autopilot is in LOC mode and the airplane is close to the runway center line. Provides a more sensitive display.

A rectangle equals ½ dot deviation.

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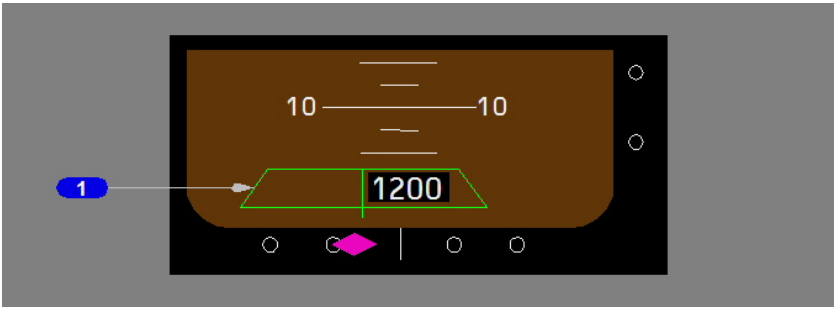
TJR to TJW, TKK to TKR, TKU to TKZ

PFD Rising Runway Indications



1 Rising Runway

Displayed below 2,500 feet radio altitude when the localizer pointer is in view for both front and back courses.

Moves toward the airplane symbol below 200 feet radio altitude.

The stem of the rising runway symbol flashes when localizer deviations cause the diamond to flash.

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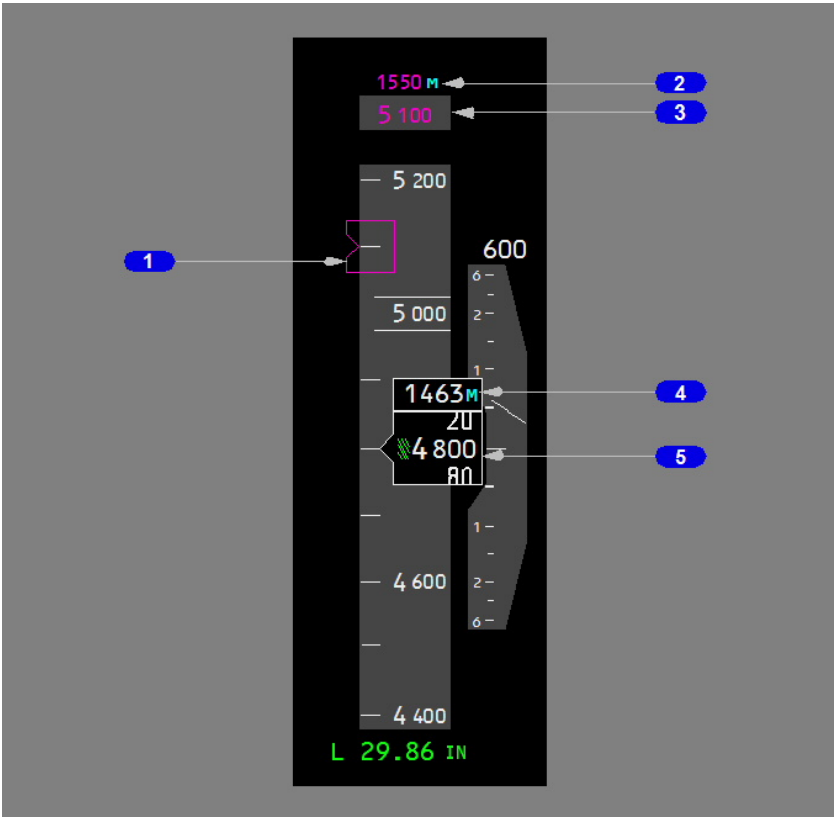
PFD Altitude Indications



1 Selected Altitude Bug

Indicates the altitude set in the MCP altitude window.

When the selected altitude is off scale, the bug is parked at the top or bottom of the tape, with only one half the bug visible.

2 Selected Altitude—Meters

Displayed when MTRS is selected on the EFIS control panel MTRS switch.

Indicates selected altitude in meters (selected in feet in the MCP altitude window).

Displays in 10 meter increments.

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3 Selected Altitude

Displays the altitude set in the MCP altitude window.

The selected altitude box is highlighted in white between 900 feet and 200 feet prior to reaching the selected altitude.

4 Current Altitude—Meters

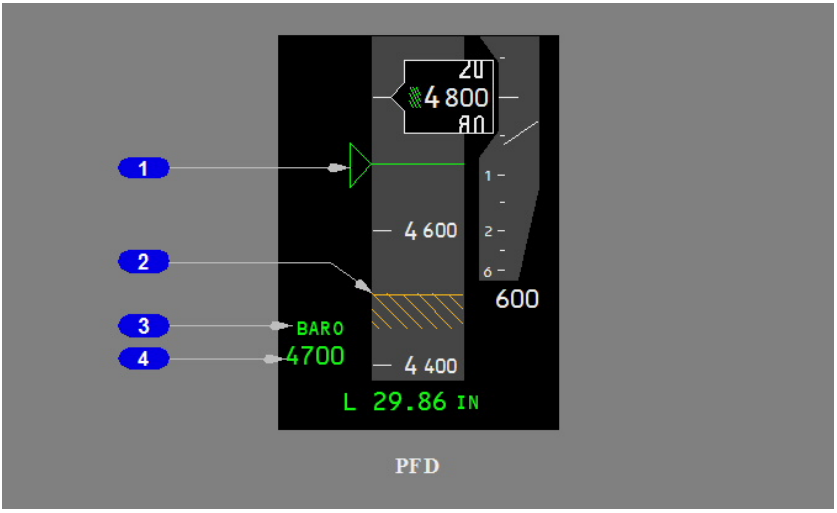
Displayed when MTRS is selected on the EFIS control panel MTRS switch.

Displays altitude in meters.

5 Current Altitude

Indicates current ADIRS altitude.

PFD Landing Altitude/Minimums Indications



1 BARO Minimums Pointer

When BARO minimums are displayed, the number is also represented as a pointer and line on the altitude scale.

Turns steady amber when the airplane descends below baro minimums.

2 Landing Altitude Indication

The crosshatched area indicates the FMC landing altitude for the destination runway or airport.

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Indicates the landing altitude for the departure runway or airport until 400 NM or one-half the distance to the destination, whichever occurs first.

3 Minimums Reference

Displays BARO when the EFIS control panel MINS reference selector is set to BARO.

Displays RADIO when the EFIS control panel MINS reference selector is set to RADIO (no corresponding pointer or line on the altitude scale).

Turns amber and flashes for 3 seconds when the airplane descends below selected minimum altitude.

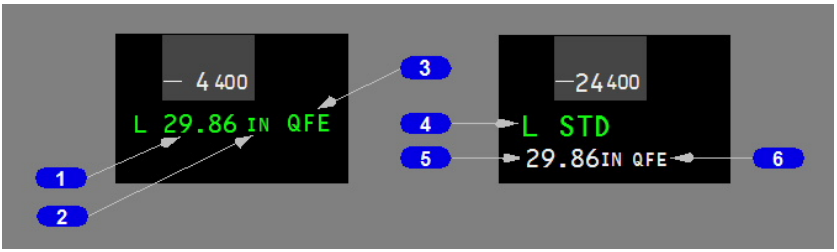
4 Minimums

Displays the approach minimums altitude set using the EFIS control panel MINS selector:

- BARO minimums are feet MSL
- RADIO minimums are radio altitude feet AGL.

Turns amber and flashes for 3 seconds when the airplane descends below selected minimum altitude.

PFD Barometric Indications



1 Barometric Setting

Indicates the barometric setting selected on the EFIS control panel barometric selector.

STD is displayed when STD is selected on the EFIS control panel barometric STD switch.

Display is boxed and changes to amber if a barometric setting is selected, MCP altitude is above transition altitude, and airplane climbs more than 300 feet above transition altitude; or if STD is selected, MCP altitude is below transition flight level, and airplane descends more than 300 feet below transition flight level.

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2 Barometric Reference

Indicates the barometric setting units selected on the EFIS control panel barometric reference selector:

- IN is inches of mercury
- HPA is Hectopascals.

3 QFE Altitude Reference

Indicates QFE altitude reference selected on the CDU APPROACH REF page.

When selected, QFE is boxed for 10 seconds.

The altitude tape is shaded green during QFE operation.

When QNH is selected, the green shading is removed; QNH is displayed for 10 seconds, then blanks.

4 Autopilot/Flight Director Barometric Source

L or R indicates that the left or right EFIS control panel is the barometric setting reference for the autopilot or flight director (the same indication is displayed on both PFDs).

Displayed when a flight director switch is ON or the autopilot is engaged.

- F/D—one turned on and one not on determines L or R
- F/D—both on—L is displayed
- A/P—first one pushed on determines L or R.

5 Preselected Barometric Setting

A barometric setting can be preselected when STD is displayed.

The preset barometric setting is selected on the EFIS control panel barometric selector and is displayed below STD.

6 QFE

When STD is selected, a small QFE appears when QFE is selected.

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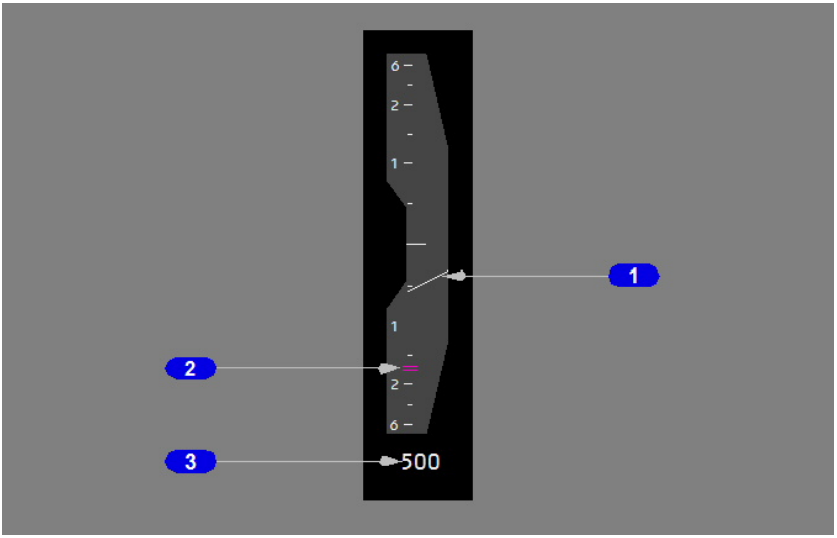
PFD Vertical Speed Indications



1 Vertical Speed Pointer

Indicates current vertical speed.

2 Selected Vertical Speed Bug

Indicates the speed selected in the MCP vertical speed window with the V/S pitch mode engaged.

3 Vertical Speed

Displays vertical speed when greater than 400 feet per minute.

The display is located above the vertical speed indication when climbing and below when descending.

PFD Heading/Track Indications

Note: The selected track bug and selected heading bug are not displayed at the same time.

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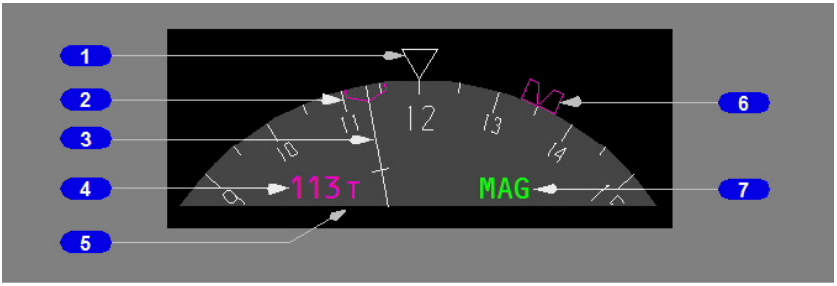

1 Current Heading Pointer

Indicates current heading.

2 Selected Track Bug (MCP Selection)

The selected track bug is displayed on the inside of the compass rose.

If selected track exceeds display range, the bug parks on the side of the compass rose in the direction of the shorter turn to the track.

3 Track Line

Indicates the current track.

4 Selected Heading/Track (MCP Selection)

Digital display of the selected heading or track bug.

5 Selected Heading/Track Reference (MCP Selection)

When HDG (heading) is selected, an H is displayed.

When TRK (track) is selected, a T is displayed.

6 Selected Heading Bug (MCP Selection)

The selected heading bug is displayed on the outside of the compass rose.

If selected heading exceeds display range, the bug parks on the side of the compass rose in the direction of the shorter turn to the heading.

7 Heading/Track Reference

Displays the automatic or manually selected heading/track reference:

- MAG (magnetic north)
- TRU (true north).

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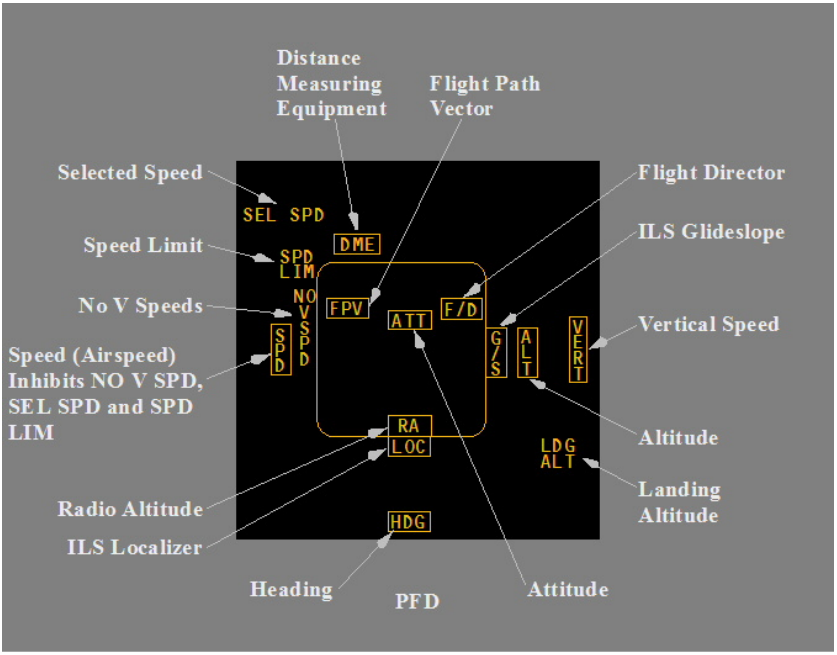
PFD Failure Flags

Note: PFD failure flags replace the appropriate display to indicate source system failure, or lack of computed information.



Navigation Display (ND)

Note: See ND Symbology on page 10.40.11 for a detailed explanation of the ND symbology shown on the following pages.

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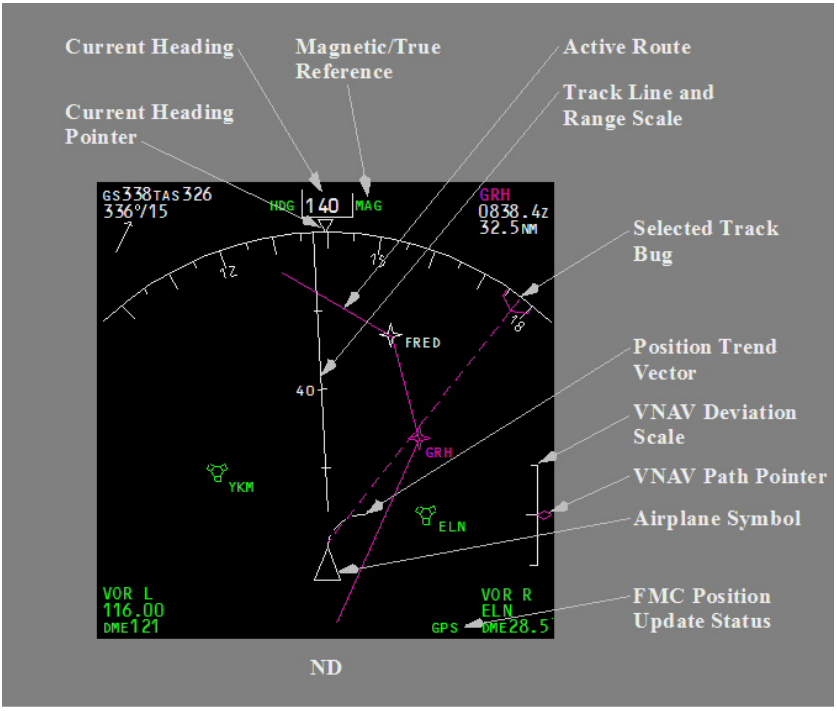
ND Map Mode

Expanded Map Mode

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF



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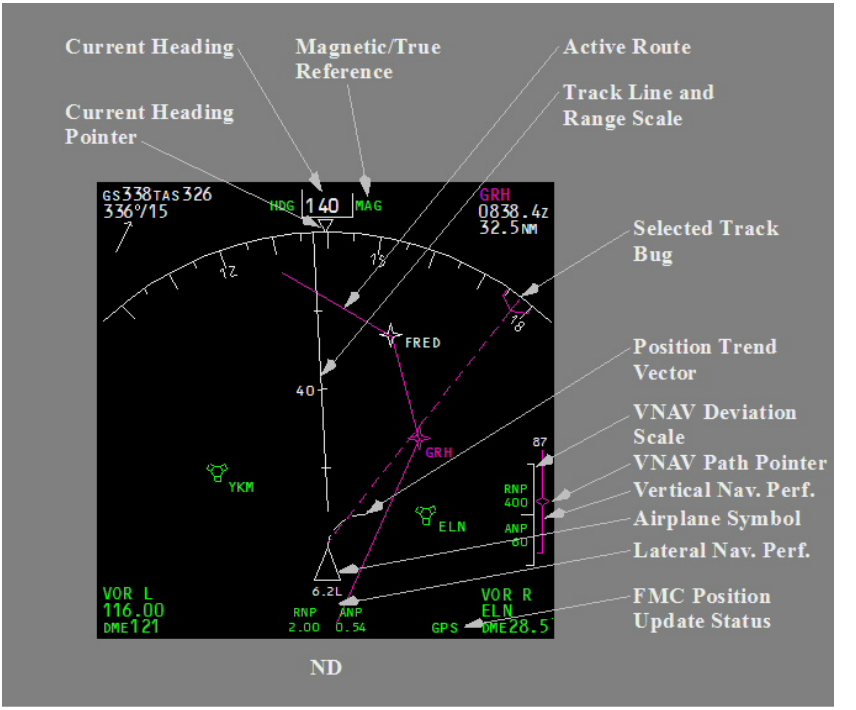
TKK to TKR,
TKU to TKZ



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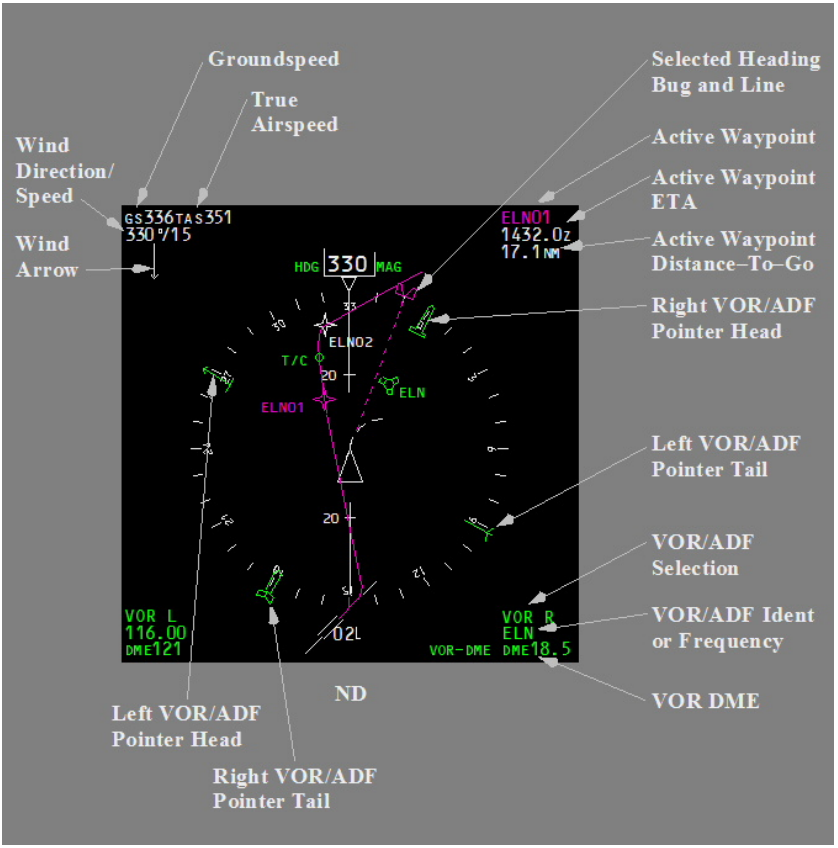
Centered Map Mode

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF



ND

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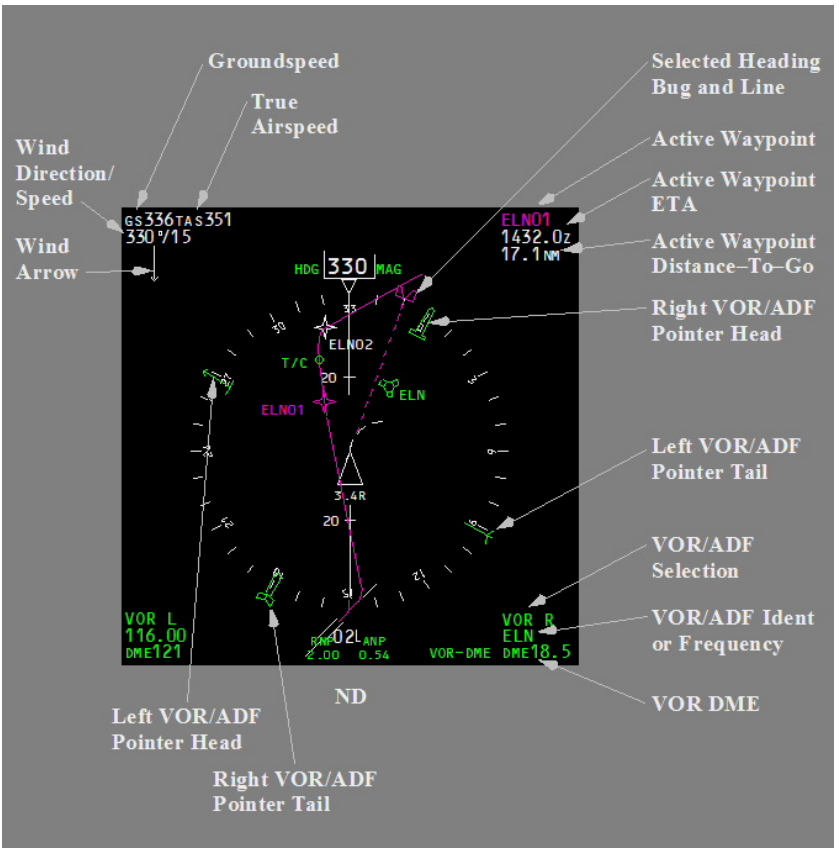
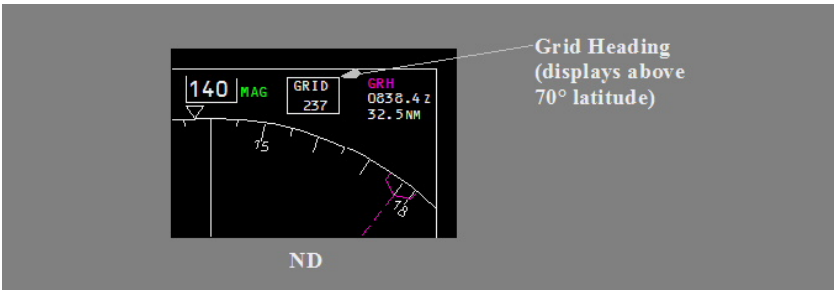
TKK to TKR,
TKU to TKZ



ND Grid Heading Display

TJR to TJW,
TKK to TKR,
TKU to TKZ



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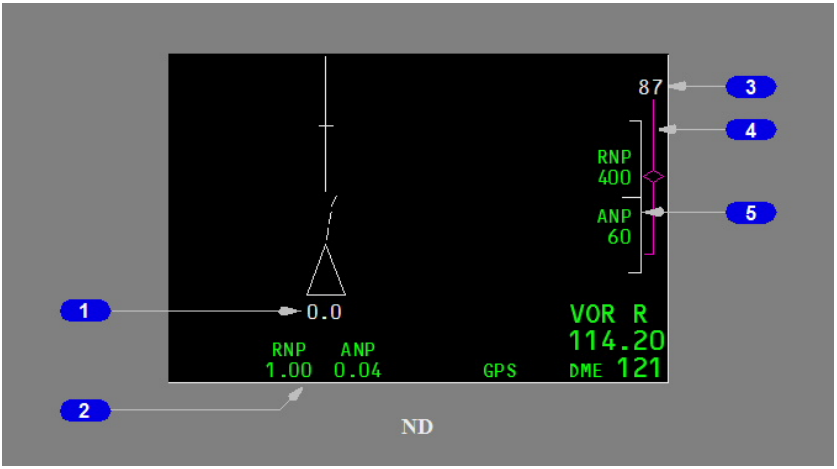
TKK to TKR,
TKU to TKZ

ND Navigation Performance Indications



1 Lateral Path Deviation

A digital value is displayed below the airplane symbol to show the lateral deviation (in NM) when an active path is defined. The numeric value is followed by an R or L to indicate the airplane position relative to the path.

If map range is greater than 10 NM or deviation is 10 NM or greater, the lateral deviation is rounded to the nearest 0.1 NM.

If map range is 10 NM and deviation is less than 10 NM, the lateral deviation is rounded to the nearest 0.01 NM.

2 Lateral RNP/ANP

Digital display (in NM) of the RNP and ANP. The RNP can be changed on the CDU RNP PROGRESS page 4.

Normally green, changes to amber when ANP exceeds RNP.

3 Vertical Path Deviation

Digital vertical path deviation (in feet) displays when value exceeds 20 feet.

4 Vertical Path Deviation Band

Band is centered on VNAV path pointer and represents current vertical RNP.

5 Vertical RNP/ANP

Digital vertical deviation values (in feet). RNP can be changed on the CDU RNP PROGRESS page 4.

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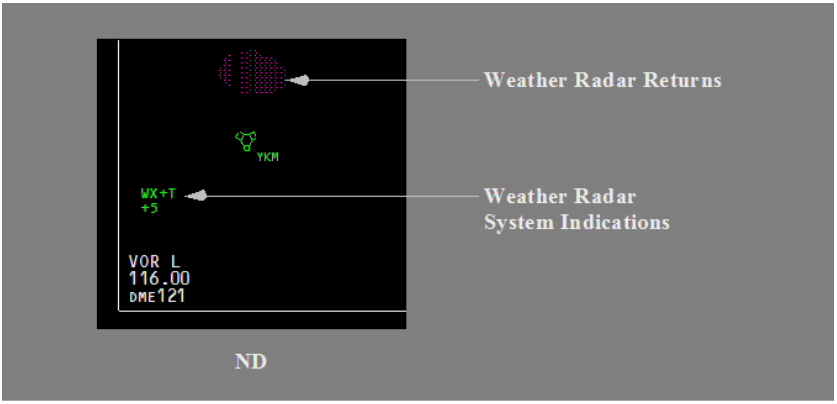
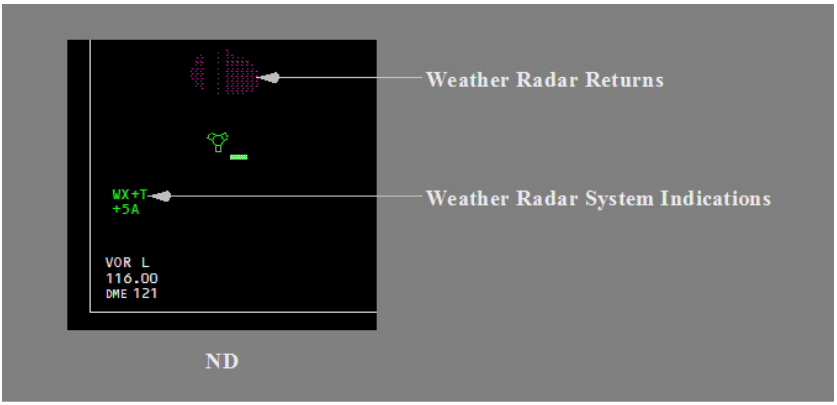
ND Weather Radar System Display Indications

TJA,B,C,D,G,H,TKA to TKF



TJR to TJW,TKK to TKR,TKU to TKZ



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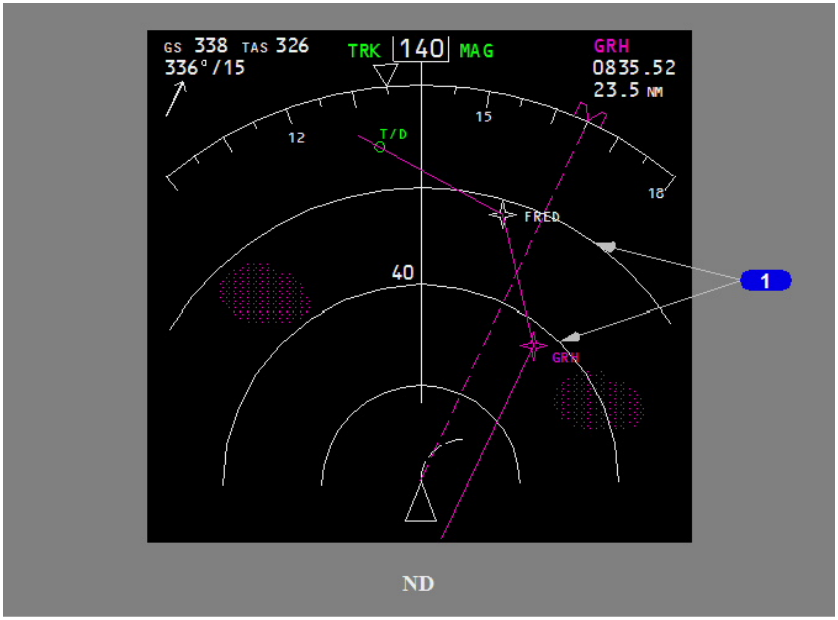

1 TCAS/Weather Radar Range Arcs

Three range arcs in place of the range scale tics on map when TCAS, weather radar, or terrain is selected.

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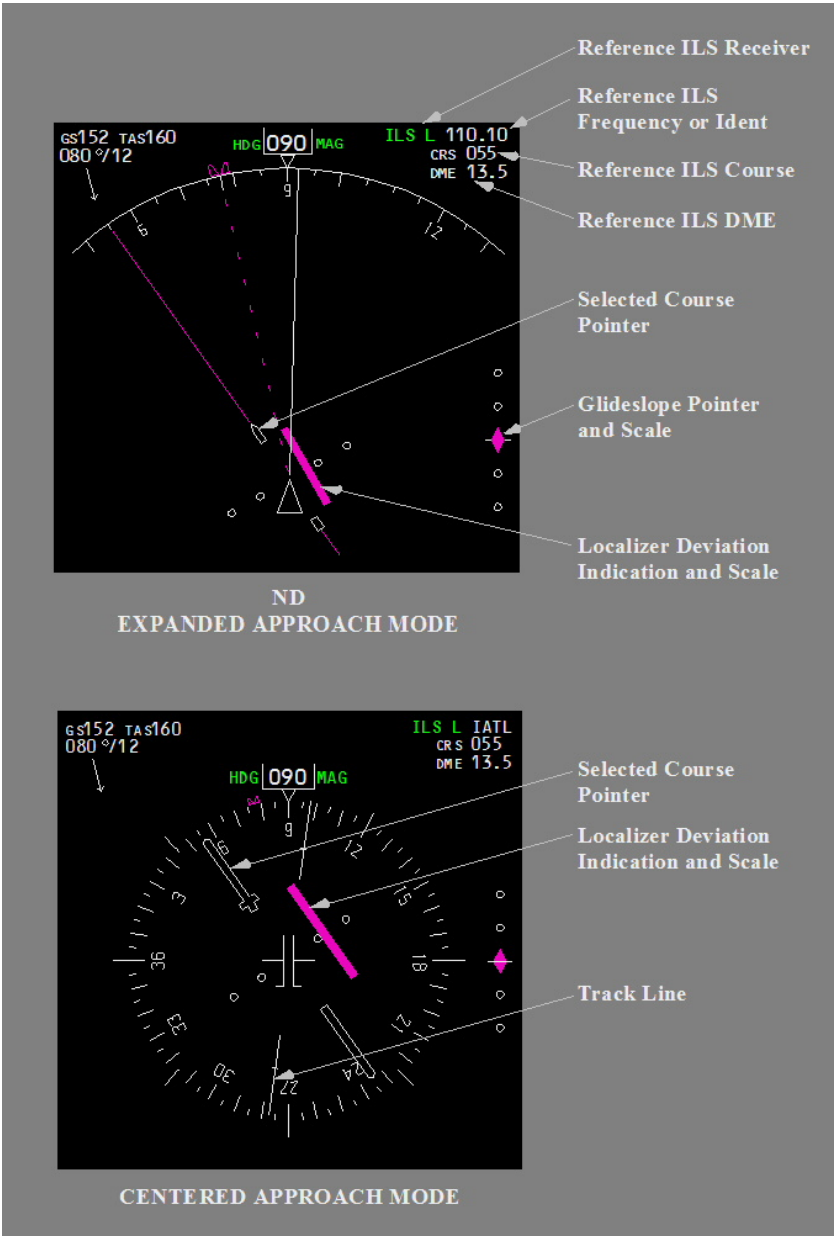
ND Approach Mode



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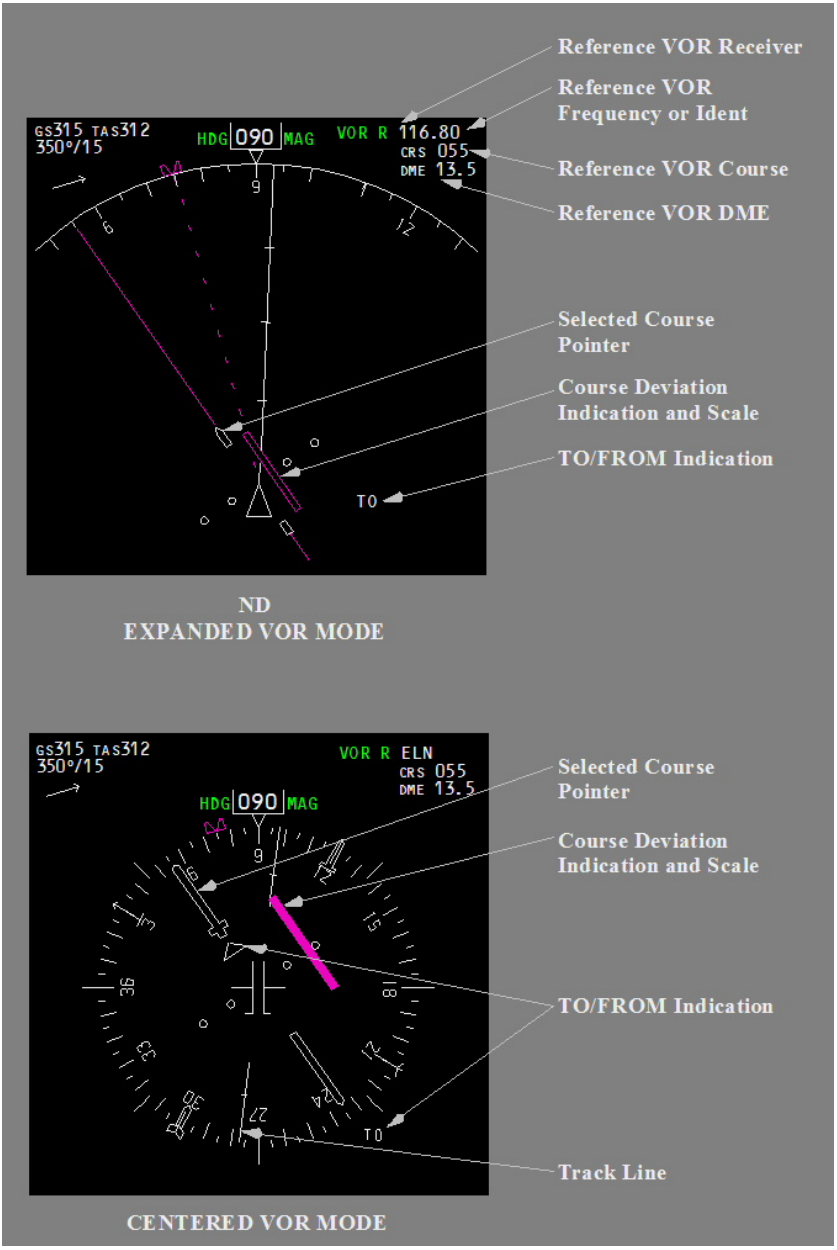
ND VOR Mode



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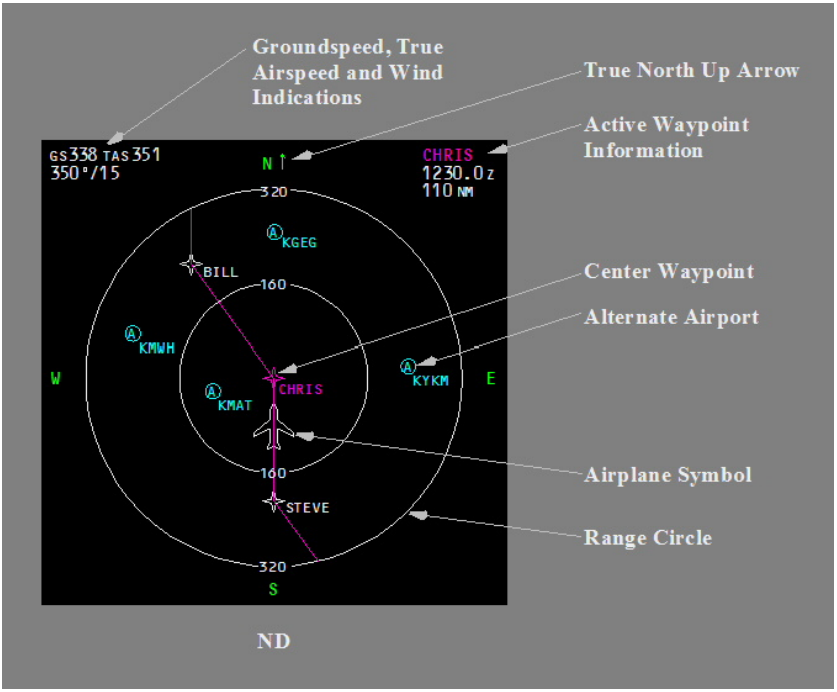
ND Plan Mode



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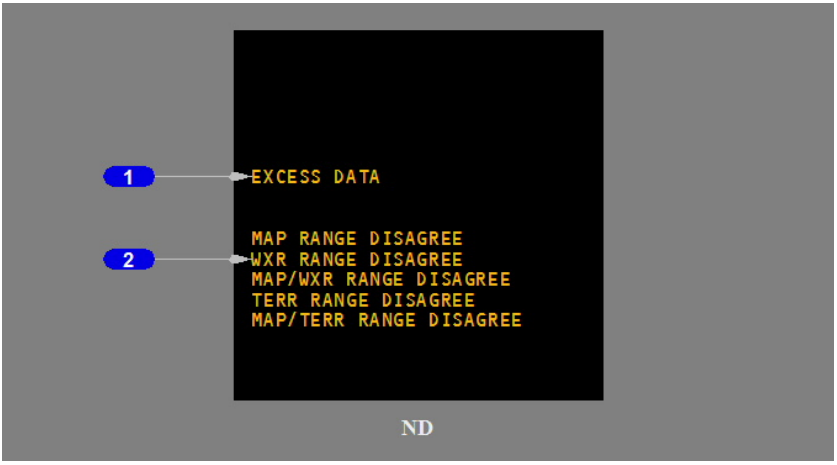
ND Failure Indications and Flags

ND Failure Messages



1 Excess Data

The amount of map information sent to the primary display system is too great to display.

2 MAP/WXR Range Disagree

The selected range and range of display information disagree.

Map information is removed.

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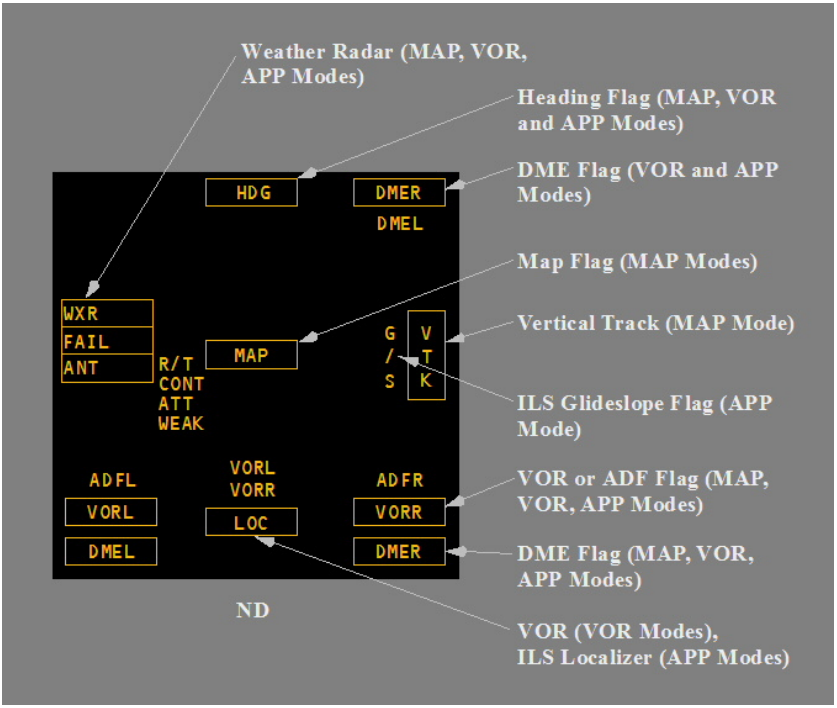
ND Failure Flags

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 the ND mode selected.



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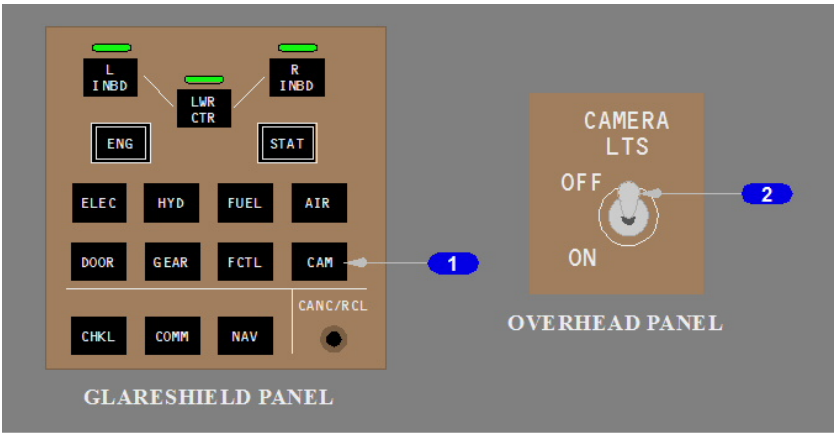
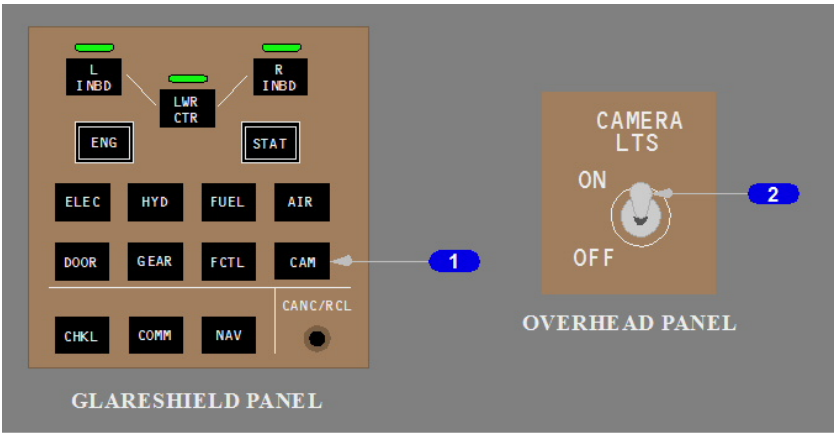
TKA to TKF, TKK to TKR, TKU to TKZ
TKK to TKR, TKU to TKZ

Ground Maneuver Camera System



TKA to TKF



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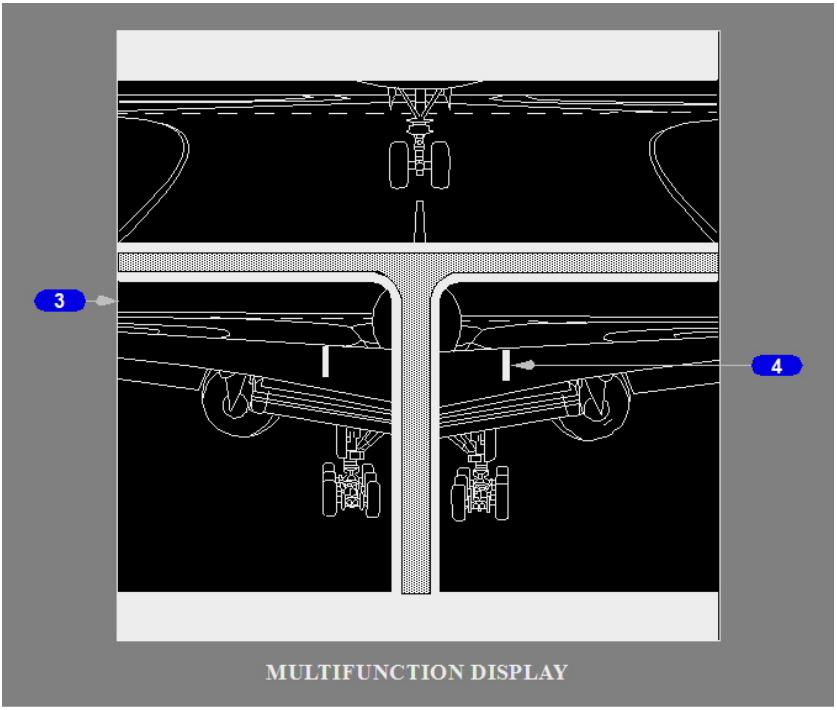

1 Camera (CAM) Display Switch

Push—displays the main and nose landing gear on the selected MFD.

2 CAMERA LTS Switch

ON—turns on lights to illuminate the main and nose landing gear. The nose gear must be down and locked, and the BEACON light switch must be ON for the camera lights to operate.

3 Ground Maneuver Camera System Display

The main and nose landing gear are displayed on the selected MFD when the CAM display switch is pushed.

4 Main Landing Gear Location Stripes

The main landing gear location stripes, located on the tops of the wings, are directly above the outside of the main gear wheels. The stripes assist the pilot in locating the main gear wheels in adverse lighting conditions.

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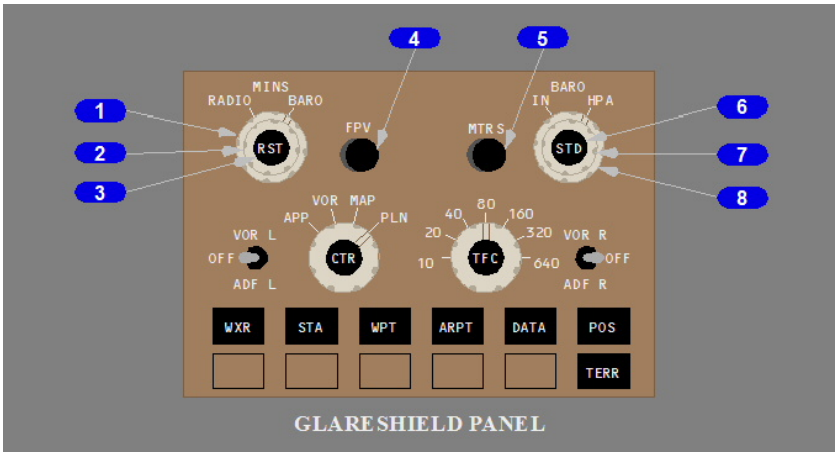
EFIS Control Panels

The left EFIS control panel controls the left PFD and ND. The right EFIS control panel controls the right PFD and ND.

EFIS Control Panel PFD Controls



1 Minimums (MINS) Reference Selector (outer)

RADIO—selects radio altitude as the PFD minimums reference.

BARO—selects barometric altitude as the PFD minimums reference.

2 Minimums (MINS) Selector (middle)

Rotate (slew)—adjusts the PFD radio or baro minimums altitude.

3 Minimums Reset (MINS RST) Switch (inner)

Push—

- resets the PFD minimums alert display
- blanks the minimums display when green.

4 Flight Path Vector (FPV) Switch

Push—displays the PFD flight path vector.

5 Meters (MTRS) Switch

Push—displays PFD altitude meters indications.

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6 Barometric Standard (BARO STD) Switch (inner)

Push—

- selects the standard barometric setting (29.92 inches Hg/1013 HPA) for the PFD barometric reference
- if STD is displayed, selects the preselected barometric setting
- if no preselected barometric setting is displayed, displays the last value before STD was selected.

7 Barometric (BARO) Selector (middle)

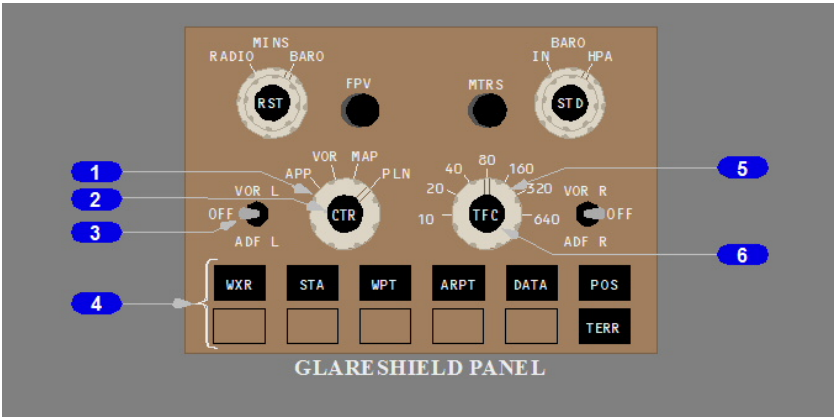
Rotate (slew)—adjusts the PFD barometric reference.

8 Barometric (BARO) Reference Selector (outer)

IN—selects inches of mercury as the PFD barometric reference.

HPA—selects Hectopascals as the PFD barometric reference.

EFIS Control Panel ND Controls



1 ND Mode Selector (outer)

Selects the desired ND map 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 CTR APP mode.

VOR—

- displays VOR navigation information in heading-up format

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- displays reference VOR receiver, VOR frequency or identification, course, DME, and TO/FROM indication
- weather radar and TCAS are not displayed in CTR VOR mode.

MAP—
- displays FMC—generated route and map information, airplane position, heading, and track
- displays waypoints, including the active waypoint, within the selected range
- displays VNAV path deviation.

PLN—
- displays a non-moving, true north-up, route depiction
- the airplane symbol represents actual airplane position
- allows route step-through using the CDU legs page
- weather radar and TCAS are not displayed in PLN mode.

2 ND Center (CTR) Switch (inner)

Push—
- displays the full compass rose (centered) for APP, VOR, and MAP modes
- subsequent pushes alternate between expanded and centered displays.

3 VOR/ADF Switches

Displays VOR or ADF information on the respective ND.

VOR—displays the VOR pointer, VOR frequency or identification and associated DME information in all modes except PLAN.

OFF—removes VOR and ADF displays.

ADF—displays the ADF pointer and ADF frequency or identification in all modes except PLAN.

4 Map Switches

The map switches:
- displays selected detailed ND data
- displays can be selected simultaneously
- second push removes the data.

WXR (weather radar)—turns the weather radar on and off, and displays weather radar information (see Weather Radar on page 11.20.11). Also displays range information when in the expanded APP or VOR modes.

STA (station)—
- displays high and low altitude navigation aids, if the ND range selector is in the 10, 20 or 40 NM range

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- displays high altitude navigation aids, if the ND range selector is in the 80, 160, 320, or 640 NM range.

WPT (waypoint)—displays waypoints, if the ND range selector is in the 10, 20 or 40 NM range.

ARPT (airport)—displays airports on all ranges.

DATA—displays the FMC estimated time of arrival, altitude at each waypoint, and altitude constraints at each waypoint.

POS (Position)—

- displays ADIRU and GPS positions
- displays VOR raw data radials extended from the nose of the airplane to the stations displayed on the CDU NAV RAD page.

TERR (terrain)—displays terrain data. (See Terrain Display on page 15.10.13.)

5 ND Range Selector (outer)

Selects the desired ND nautical mile range scale.

6 ND Traffic (TFC) Switch (inner)

Push—displays TCAS ND information. (See TCAS Traffic and TCAS Alert Message TRAFFIC Display on page 15.10.7.) Also displays range information when in the expanded APP or VOR modes.

Instrument Source Select Panels

The instrument source switches are provided for use if a display-related failure is not detected by automatic system monitors. Normally, the display system

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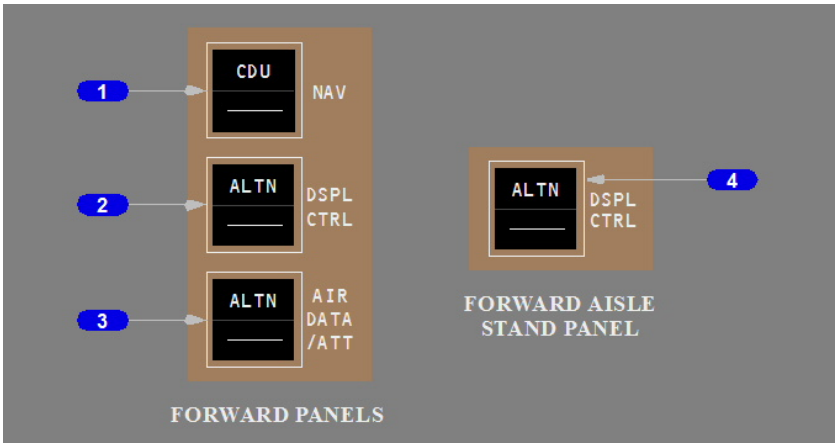
automatically reconfigures for failures without the pilot having to use these switches.



1 Navigation (NAV) Source Switch

Off—normal position (CDU not visible, switch out):

- with the FMC selector in AUTO, the active FMC provides the information to generate the ND map
- if both FMCs fail, the CDU provides navigation data.

CDU—non-normal position (CDU visible, switch in). The selected CDU generates the ND map. Normally, the sources are:

- left ND map—left CDU
- right ND map—right CDU.

2 Display Control (DSPL CTRL) Source Switch

Off—normal position (ALTN not visible, switch out):

- automatically selects display processing channels for the left outboard and inboard, or right outboard and inboard display pairs
- reconfigures display processing channels as required for display unit or processing channel failures.

ALTN—non-normal position (ALTN visible, switch in). An alternate display processing channel is selected to replace the current display processing channel.

3 Air Data/Attitude (AIR DATA/ATT) Source Switch

Off—normal position (ALTN not visible, switch out):

- the ADIRU provides air data and attitude information to the PFD and ND

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- Alternate sources or the SAARU are automatically selected to replace ADIRU air data or attitude, as required.

ALTN—non-normal position (ALTN visible, switch in). The PFD and ND alternate air data/attitude source is selected as follows:

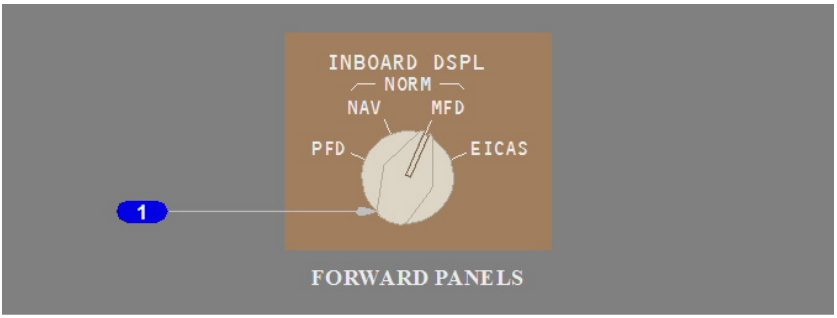
- air data (captain): SAARU single channel
- air data (first officer): ADIRU single channel
- attitude (captain and first officer): SAARU.

4 Center Display Control (DSPL CTRL) Source Switch

Same as the display control source switches for the left and right inboard and outboard display units, except this switch controls the upper center and lower center display units.

Heading Reference and Inboard Displays

Inboard Display Controls



1 INBOARD Display (DSPL) Selector

Selects what is displayed on each inboard display unit.

PFD—displays the PFD, blanks the PFD on the outboard display unit, and inhibits selections made from the display select panel.

NAV—displays the ND and inhibits selections made from the display select panel.

MFD—displays the selection made on the display select panel.

EICAS—

- displays EICAS
- inhibits most selections made from the display select panel (limited ENG, FUEL, and AIR displays can be selected)
- blanks the upper center display unit.

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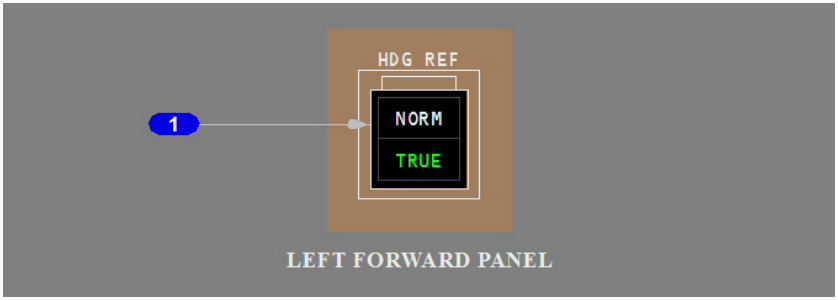
Note: The PFD automatically appears on an inboard display unit if the adjacent outboard display unit fails, regardless of switch position.

Heading Reference Controls



1 Heading Reference (HDG REF) Switch

Pushing alternately selects the heading reference for the PFDs, NDs, AFDS, and FMCs.

NORM—

- normally references magnetic north
- automatically references true north when north of 82°N latitude (or north of 73°N between 80°W and 170°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 AFDS roll modes other than LNAV when north of 82°N latitude (or north of 73°N between 80°W and 170°W) or south of 82°S latitude (or south of 60°S between 120°E and 160°E).

TRUE—references true north regardless of latitude.

When the AFDS roll mode is HDG SEL, switching the heading reference switch from NORM to TRUE or TRUE to NORM engages the HDG HOLD mode.

When the AFDS roll mode is TRK SEL, switching the heading reference switch from NORM to TRUE or TRUE to NORM engages the TRK HOLD mode.

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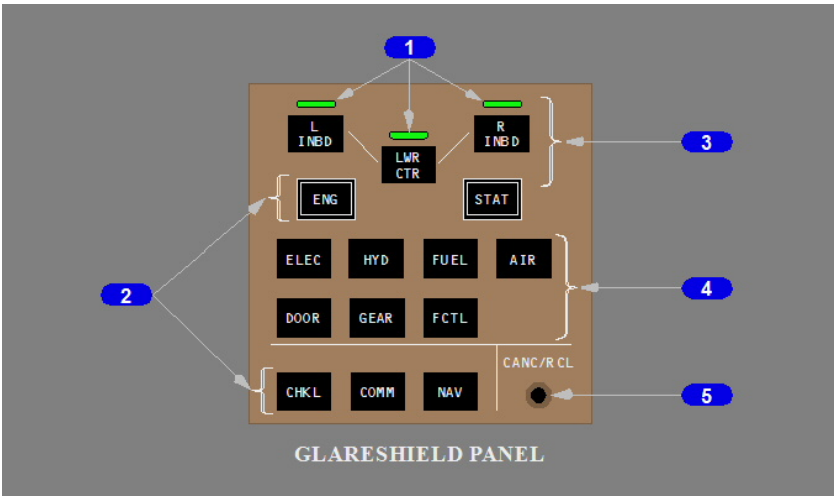
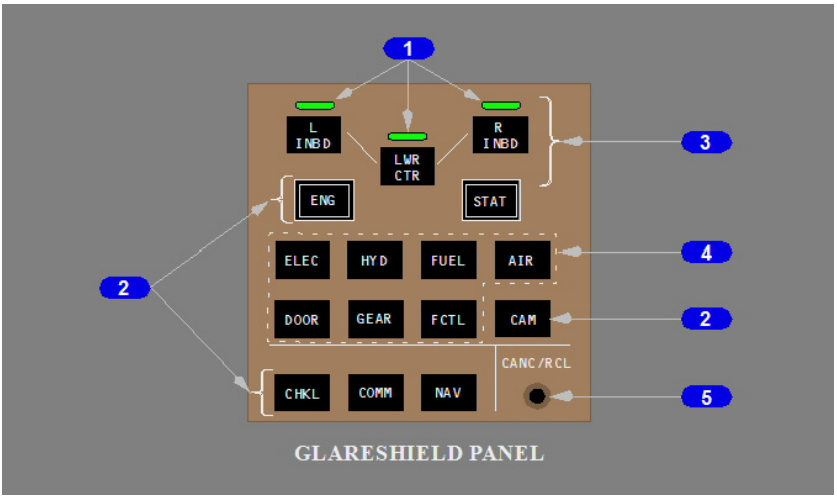
Display Select Panel (DSP)

TJA,B,C,D,G, H,TJR to TJW



TKA to TKF, TKK to TKR, TKU to TKZ



1 Display Lights

Illuminates to show the display unit the display select panel controls.

2 Display Switches

Pushing the switch displays the associated display. Pushing the same switch a second time blanks the display or (left and right inboard display units) redisplays

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the ND if there is only one page of messages. If there are more than one page of messages, pushing STAT pages through the messages.

ENG—secondary engine EICAS (Ch. 7).

STAT—status page:

- hydraulic system indications (Ch. 13)
- APU indications (Ch. 7)
- oxygen system indications (Ch. 1)
- status messages for dispatch determination (Ch. 15).

CHKL—checklist (this chapter).

COMM—communications (Ch. 5).

NAV—navigation display (this chapter).

TKA to TKF, TKK to TKR, TKU to TKZ

CAM—ground maneuver camera system (this chapter).

3 Multifunction Display (MFD) Switches

Selects the active MFD (left inboard, lower center, or right inboard display unit) for display selection.

The appropriate left or right INBOARD DISPLAY selector must be in the MFD or EICAS position. The other display select panel switches determine what is displayed on the selected MFD.

4 Synoptic Switches

Pushing the switch displays the associated synoptic. Synoptics present a simplified view of system status as an aid for crew situational awareness. Pushing the same switch a second time blanks the display or (left and right inboard display units) redisplays the ND.

ELEC—electrical system (Ch. 6).

HYD—hydraulic system (Ch. 13).

FUEL—fuel system (Ch. 12).

AIR—air systems (Ch. 2).

DOOR—doors (Ch. 1).

GEAR—landing gear and brake systems (Ch. 14).

FCTL—flight control system (Ch. 9).

5 Cancel/Recall (CANC/RCL) Switch

See Display Select Panel on page 15.10.3.

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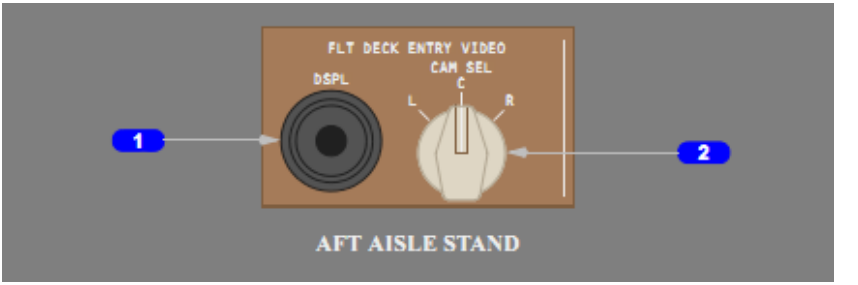
Flight Deck Entry Video Surveillance System (FDEVSS)

Flight Deck Entry Video Panel—Display on MFD

TKK to TKR,
TKU to TKZ



1 Display (DSPL) Switch

Push—displays surveillance video on active MFD.

If using an INBD display unit, the appropriate left or right INBOARD DSPL selector must be in the MFD position.

Second push—cancels display of surveillance video on active MFD.

2 Camera (CAM) Selector (SEL)

Selects camera location for display on selected MFD.

L—displays view of door 1L and flight deck door area.

C—displays view from flight deck door looking aft.

R—displays view from door 1R looking toward cross-aisle.

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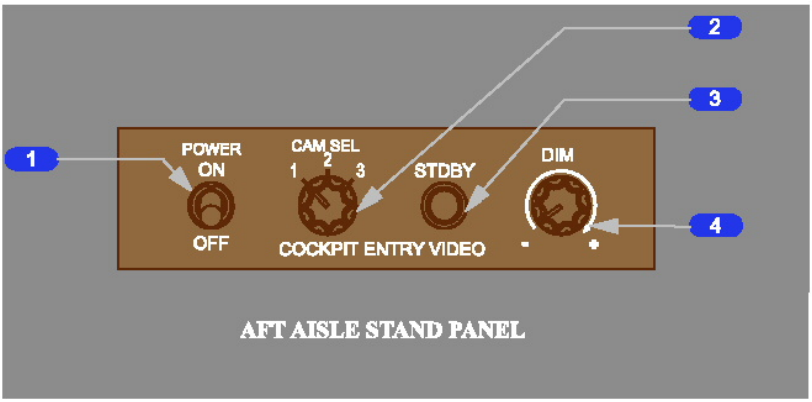
TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

Flight Deck Entry Video Panel & Display—Display on Overhead Panel



1 POWER Switch

ON—cockpit entry video system is ON

OFF—cockpit entry video system is OFF.

2 Camera (CAM) Selector (SEL)

Selects camera location for display on the overhead panel.

1—Camera 1 selected for viewing

2—Camera 2 selected for viewing

3—Camera 3 selected for viewing.

3 Standby (STDBY) Switch

Momentarily push to put the cockpit entry video system into or out of standby mode.

4 Dim (DIM) Control

Rotate to control the display brightness of the cockpit entry video system.

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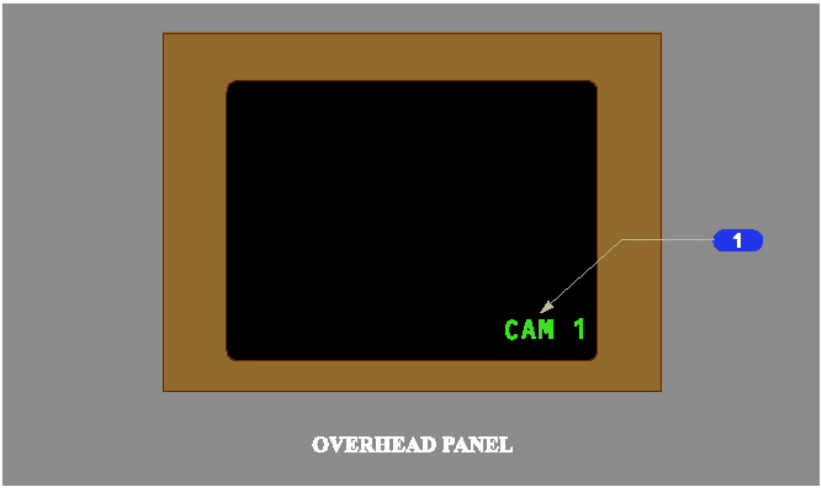

1 Selected Camera Annunciation

Displays the Selected Camera as follows:

- CAM 1—displays view of flight deck door area.
- CAM 2—displays view of door 1L area.
- CAM 3—displays view of door 1R area.

Cursor Control Device (CCD)

The left CCD controls the left inboard and lower center display unit cursor position and operation.

The right CCD controls the right inboard and lower center display unit cursor position and operation.

The left CCD is shown; the right CCD is similar, except the cursor select switch and the LWR CTR switches are located on the opposite side of the CCD.

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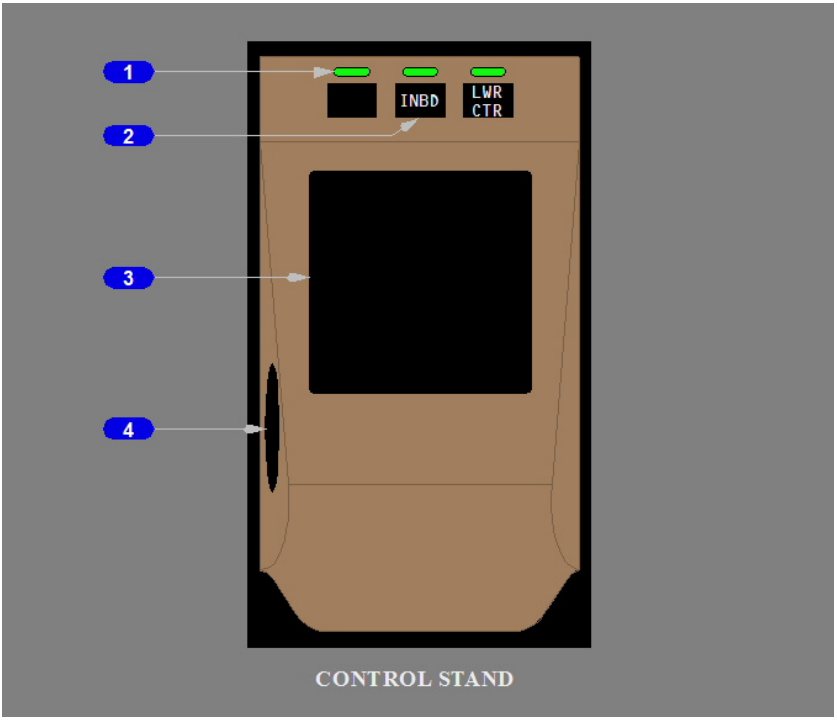

1 Cursor Location Lights

The associated annunciator light illuminates to indicate which display unit is selected.

2 Cursor Location Switches

Selects the display unit where the cursor appears (inboard or lower center display) and automatically deselects the previous display unit.

3 Touch Pad

Finger movement on the touch pad moves the cursor on the selected display. Lifting the finger off the pad and putting it back down in a different location (except the corner areas) does not move the cursor. The cursor only moves when the finger is moved on the touch pad surface.

Corner areas—placing a finger in one of the four corners puts the cursor in that respective corner of the screen. Moving the cursor into a corner region without lifting the finger from the pad does not have this effect.

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4 Cursor Select Switch

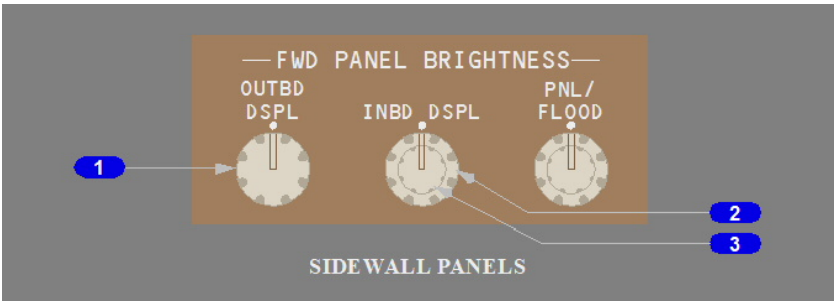
Push—activates the area of the screen that the cursor is currently in, such as a menu item or command button. The area is highlighted by a white border to indicate it can be selected.

The switch is used to select menus, checklists, checklist steps, and other functions.

Display Brightness Controls

Forward Panel Brightness Controls

The left panel is shown.



1 Outboard Display (OUTBD DSPL) Brightness Control

Rotate—adjusts the brightness of the outboard display unit.

2 Inboard Display (INBD DSPL) Brightness Control (outer)

Rotate—adjusts the brightness of the inboard display unit.

3 Inboard Display (INBD DSPL) Brightness Control (inner)

TJA,B,C,D,G, H,TJR to TJW

Without GMCS:

- Rotate—adjusts weather radar or terrain display brightness on the inboard display unit.
- Weather radar and terrain data cannot be displayed at the same time.

TKA to TKF, TKK to TKR, TKU to TKZ

With GMCS:

- Rotate—adjusts weather radar, terrain display, or ground maneuver camera display brightness on the inboard display unit.
- Only one function can be displayed at a time.

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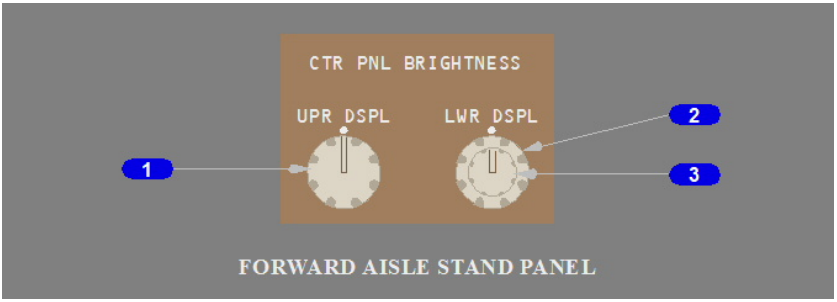
Center Panel Brightness Controls



1 Upper Display (UPR DSPL) Brightness Control

Rotate—adjusts the brightness of the upper center display unit.

2 Lower Display (LWR DSPL) Brightness Control (outer)

Rotate—adjusts the brightness of the lower center display unit.

3 Lower Display (LWR DSPL) Brightness Control (inner)

TJA,B,C,D,G, H,TJR to TJW

Without GMCS:

- Rotate—adjusts weather radar or terrain display brightness on the inboard display unit.
- Weather radar and terrain data cannot be displayed at the same time.

TKA to TKF, TKK to TKR, TKU to TKZ

With GMCS:

- Rotate—adjusts weather radar, terrain display, or ground maneuver camera display brightness on the inboard display unit.
- Only one function can be displayed at a time.

Standby Flight Instruments

The standby flight instruments include the:

- integrated standby flight display
- standby magnetic compass.

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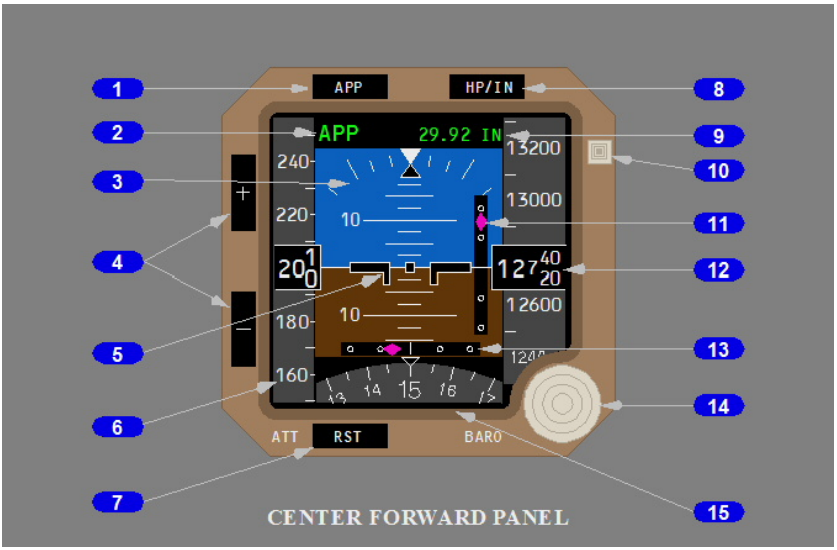
Integrated Standby Flight Display (ISFD)

Provides an independent source of attitude, airspeed, and altitude information.



1 Approach (APP) Switch

Push—

- when blank, selects APP
- when APP displayed, selects BCRS
- when BCRS displayed, blanks.

2 Approach Mode Annunciation

Indicates approach mode selected.

Blank—no approach deviation data displayed.

APP—ILS localizer and glideslope deviation data displayed.

BCRS (back course)—reverses sensing for localizer pointer during back course approaches.

3 Attitude Display

Displays airplane attitude.

Indicates bank in reference to the bank scale.

Indicates the horizon relative to the airplane symbol.

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Beyond 30° pitch, large red arrowheads (V-shaped) indicate the attitude has become excessive and the direction to the horizon line.

4 Display Brightness Switches

Push—

- + increases display brightness
- – decreases display brightness.

5 Airplane Symbol

Indicates airplane position with reference to the horizon.

6 Airspeed Indications

Indicates airspeed when above 30 knots.

7 Attitude Reset (ATT RST) Switch

Push and hold at least two seconds—

- aligns horizon with the airplane symbol
- reset takes approximately ten seconds
- starts new initialization sequence if previous attempt failed (ground only).

8 Hectopascal/Inch (HP/IN) Switch

Push—changes units of barometric reference.

9 Barometric Setting

Indicates the barometric setting selected with the barometric selector.

STD is displayed when selected with the barometric selector.

10 Ambient Light Sensor

Automatically adjusts display intensity for ambient lighting condition.

11 Glideslope Pointer and Scale

The glideslope pointer indicates glideslope position relative to the airplane—

- the pointer is in view when the glideslope signal is received
- the scale is in view when the APP mode is selected
- the pointer and scale are removed when the BCRS mode is selected.

12 Current Altitude

13 Localizer Pointer and Deviation Scale

The localizer pointer indicates localizer position relative to the airplane—

- the pointer is in view when the localizer signal is received

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- the scale is in view when either the APP or BCRS mode is selected.

14 Barometric Selector (BARO)

Rotate—changes barometric setting.

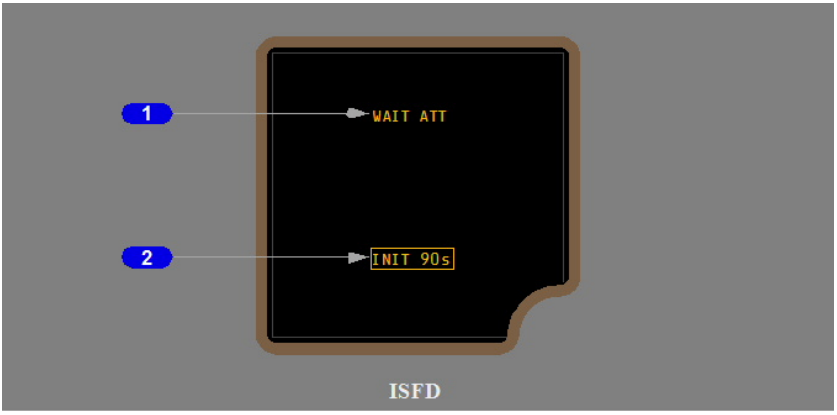
Push—

- selects standard barometric setting (29.92 inches Hg/1013 HPA)
- if STD displayed, selects the preselected barometric setting.

15 Heading Indication

Displays airplane heading.

ISFD Messages



1 Attitude Messages

Indicates attitude display status.

ATT:RST (amber)—attitude must be reset using the attitude reset switch.

ATT 10s (amber)—10 second attitude realignment in progress.

WAIT ATT (amber)—indicates temporary self-correcting loss of attitude.

2 Initialization message

INIT 90s (amber)—countdown of 90 second initialization—

- countdown stops if excessive motion is detected
- countdown resumes when motion stops
- ATT:RST displays if initialization is not complete within six minutes.

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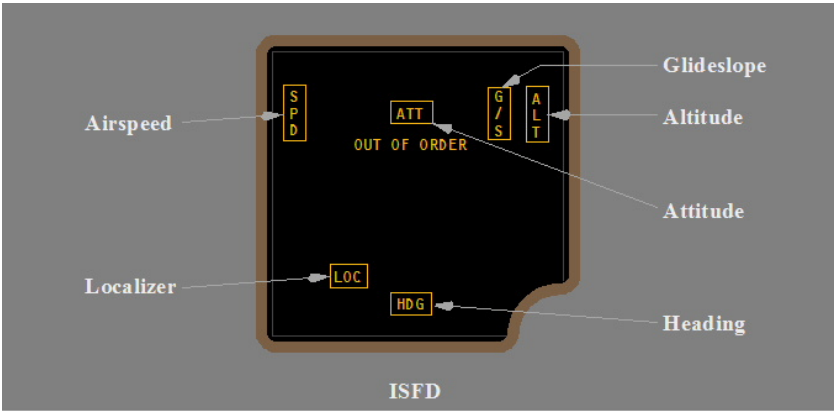
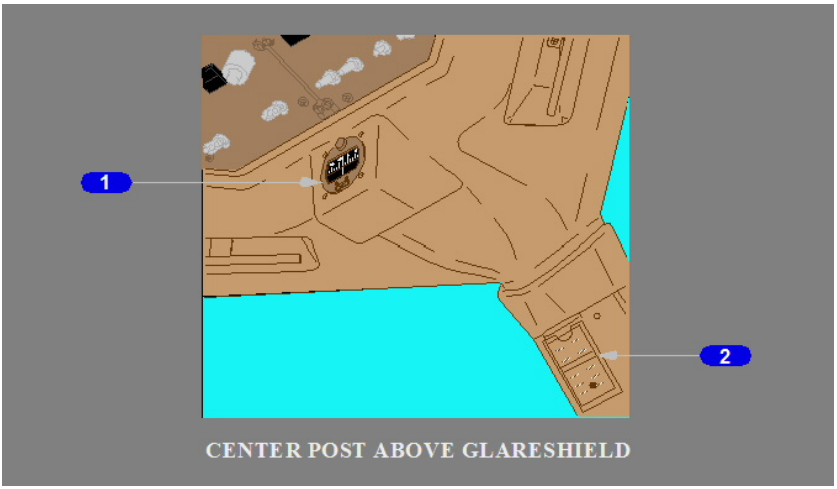
ISFD Failure Flags

Failure flag replaces appropriate display.

OUT OF ORDER indicates instrument system failure.



Standby Magnetic Compass



1 Standby Magnetic Compass

Displays magnetic heading.

2 Standby Magnetic Compass Correction Card

Provides appropriate heading corrections.

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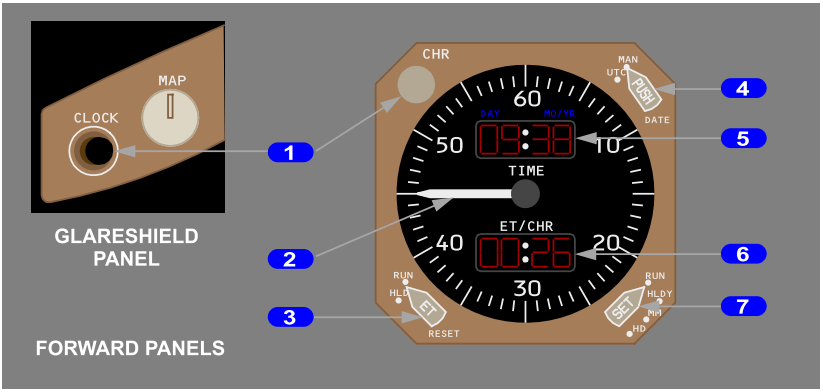
Clock

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF,K



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 the elapsed time function.

RESET—returns ET display to zero (spring loaded to HLD).

HLD (hold)—stops the elapsed time display.

RUN—starts the elapsed time display.

4 Time/Date Selector

MAN (Manual)—the clock is manually set to a time and date.

UTC—the clock is automatically set to the UTC date and time.

Push—

- alternately displays the day-month, then year in the time/date window
- subsequent selection displays only the time in the time/date window.

5 Time/Date Window

Displays time (hours, minutes) when time is selected on the time/date selector.

Alternately displays day-month and year when date is selected on the time/date selector.

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6 Elapsed Time (ET)/Chronograph (CHR) Window

Displays elapsed time (hours, minutes) or chronograph minutes.

The chronograph display replaces the elapsed time display.

Elapsed time continues to run in the background and will be displayed after the chronograph is reset.

7 Clock Set Selector

Sets the time and date when the time/date selector is set to manual.

HD (hours, day)—

- advances hours when time is selected on the time/date selector
- advances days when date is selected on the time/date selector.

MM (minutes, month)—

- advances minutes when time is selected on the time/date selector
- advances months when date is selected on the time/date selector.

HLDY (hold, year)—

- stops the time indicator and sets the seconds to zero when time is selected on the time/date selector
- advances years when date is selected on the time/date selector.

RUN—starts the time indicator.

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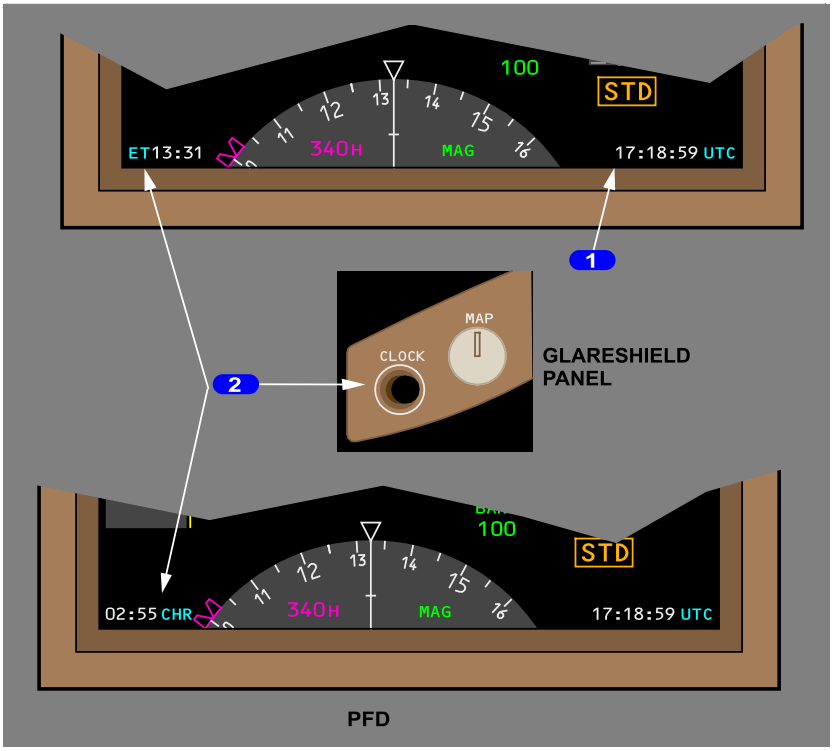
TKL to TKR,
TKU to TKZ



1 CLOCK

Coordinated Universal Time (UTC):

- displays in hours, minutes and seconds
- displays dashes if no information available
- UTC sources are GPS or AIMS (if GPS is unavailable).

2 CLOCK SWITCH

Push—alternately selects chronograph (CHR) reset/start/stop and return to elapsed time (ET).

Chronograph:

- displays in minutes and seconds
- available if GPS is unavailable
- not available in PLAN mode.

Elapsed Time:

- displays in hours and minutes

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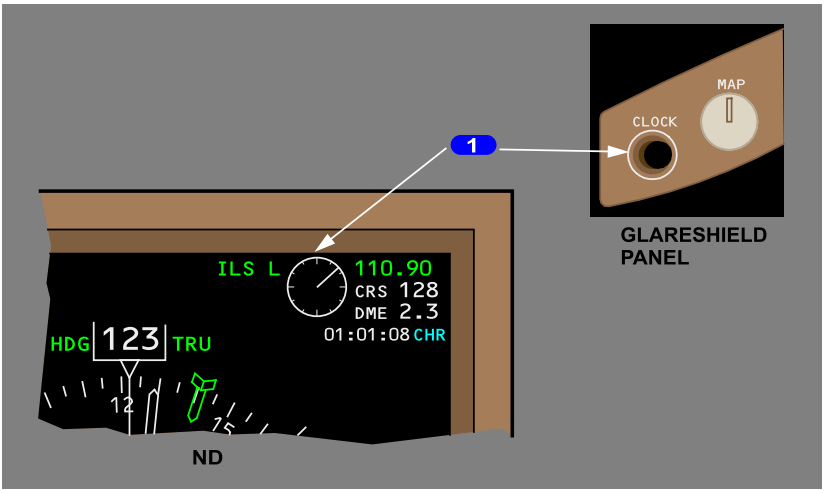
- begins advancing at lift-off
- stops advancing at touchdown
- resets to zero:
  - at initial power-up, or
  - when both Fuel Control switches moved to Run, or
  - at lift-off.

TKL to TKR, TKU to TKZ

Chronograph



1 CLOCK Switch

Push—alternately selects chronograph (CHR) reset/start/stop and deselects display.

- displays in hours, minutes and seconds
- analog dial and sweep second hand
- displays dashes if no information available
- chronograph available if GPS is unavailable
- chronograph not available in PLAN mode.

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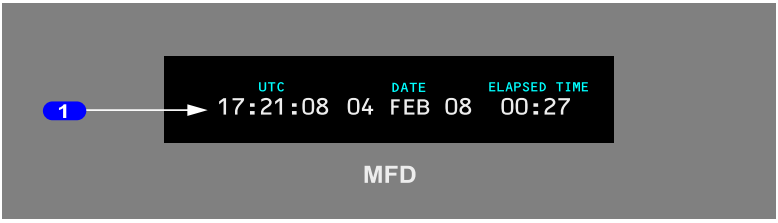
Time/Date/Elapsed Time Display

TKL to TKR, TKU to TKZ

Located on lower right corner of the status (STAT) display.



1 Status Page Indications

Dashed lines are displayed if information is not available.

Elapsed time:

- displays in hours and minutes
- begins advancing at lift-off
- stops advancing at touchdown
- resets to zero:
  - at initial power-up, or
  - when both Fuel Control switches moved to Run, or
  - at lift-off.

EFIS Control Panels and Display Select Panel (DSP)—CDU Alternate Control

The CDU provides an alternate way to control the functions of the EFIS control panel and/or the display select panel.

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 related control panels.

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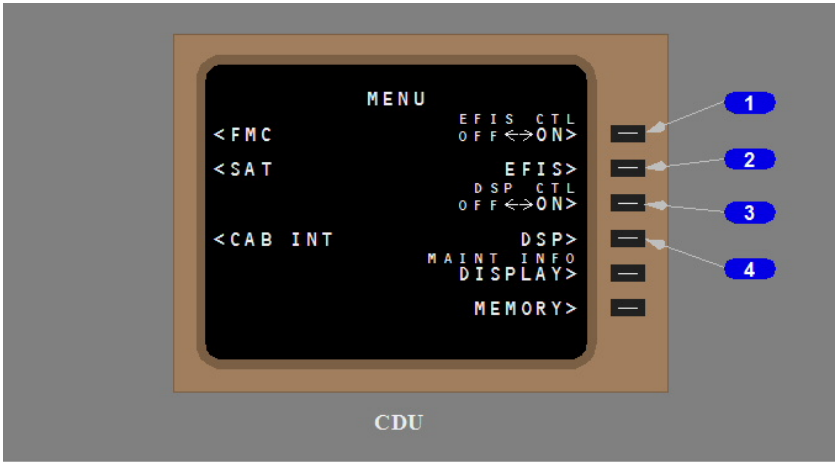
CDU EFIS/DSP Control Selection



1 EFIS Control (CTL) Select Key

Transfers control of the EFIS from the EFIS control panel to the CDU (left EFIS control panel transfers to the left CDU, right EFIS control panel transfers to the right CDU).

2 EFIS Page Select Key

Selects the EFIS CONTROL page when EFIS control is on.

3 Display Select Panel Control (DSP CTL) Select Key

Transfers control of the display select panel control from the display select panel to the CDU.

4 Display Select Panel (DSP) Page Select Key

Selects the DISPLAY SELECT PANEL CONTROL page when the DSP control is on.

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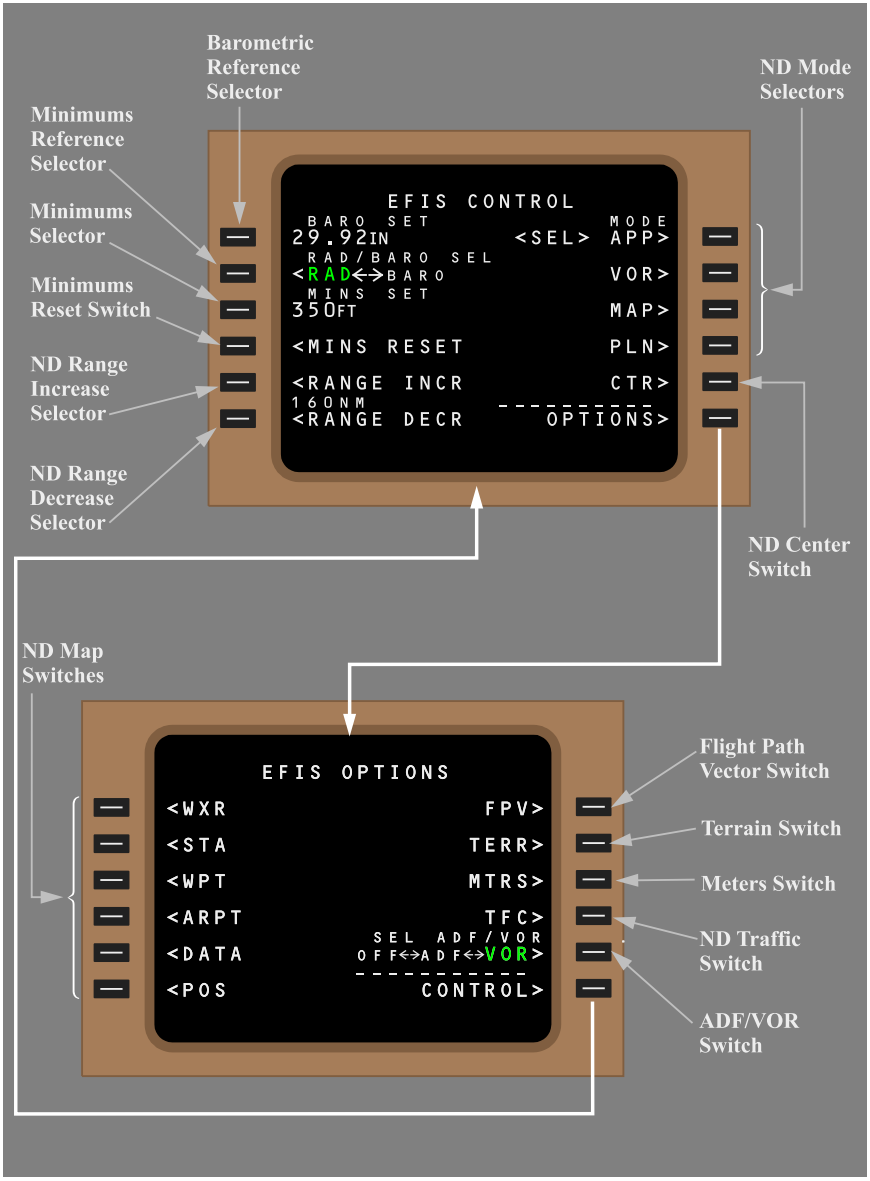
EFIS Control CDU Pages



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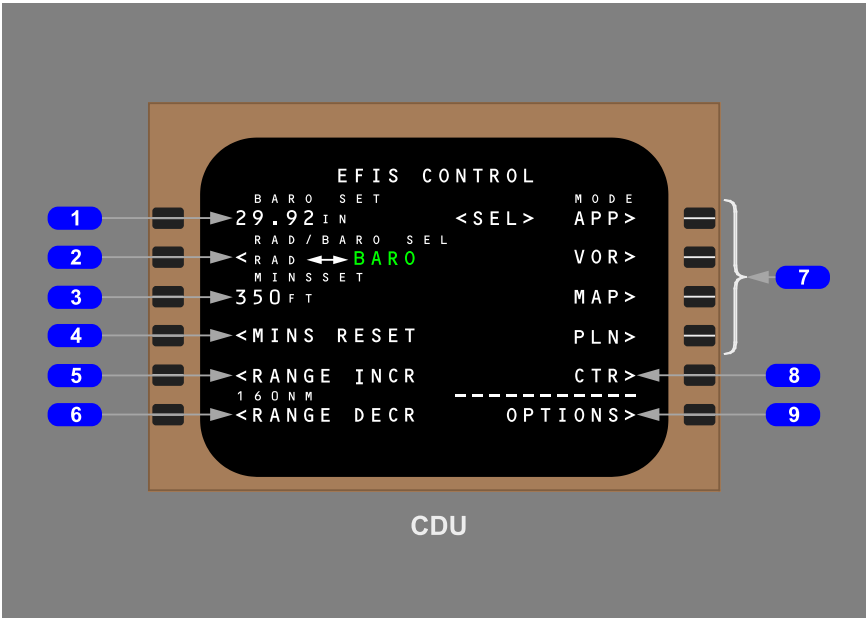
EFIS Control Page



1 Barometric (BARO) SET

Valid entry is reference barometric setting.

- entries of 22.00 to 32.00 or 2200 to 3200 display as IN (inches of mercury)
- entries of 745 to 1084 display as HPA (hectopascals)
- entry of "I" to change the displayed value to IN
- 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.

2 Radio (RAD) or Barometric (BARO) Select (SEL)

- Push—alternately selects RAD (radio altimeter) or BARO (barometric altimeter) as the minimums reference on the PFD. Selected mode displays in large green font.

3 Minimums (MINS) SET

- Entered minimums display on respective PFD.
- BARO selected in 2L, valid entries are –101 to 15,000 feet.

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- 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.

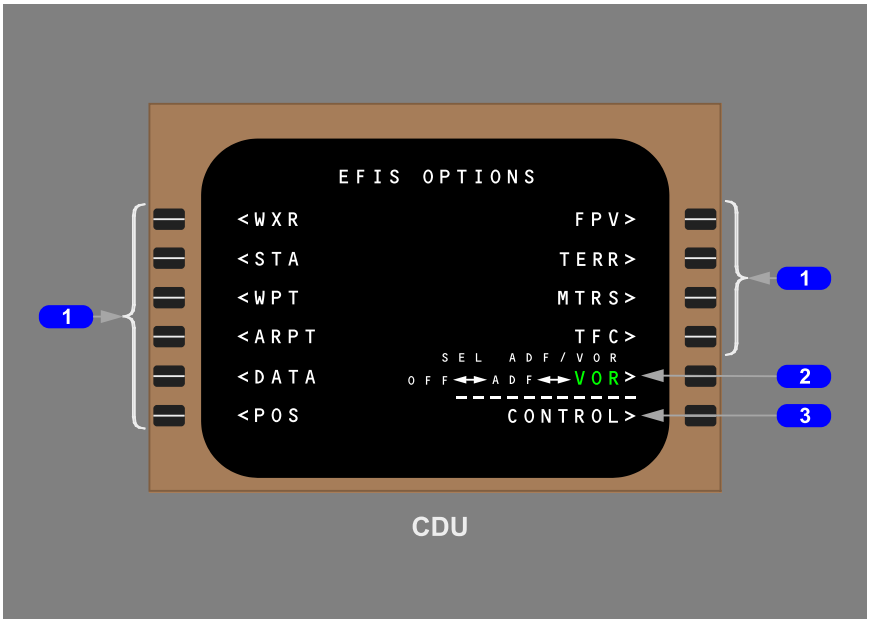
8 Center (CTR)

Push—alternately displays centered and expanded APP, VOR, and MAP modes.

9 OPTIONS

Push—displays EFIS OPTIONS page.

EFIS Options Page



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1 WXR, POS, MTRS, FPV, TFC, TERR, WPT, STA, ARPT, DATA

Push—selects respective PFD/ND options.

2 ADF/VOR

Push—sequentially selects ADF, VOR, or OFF for the pointer display on the ND. Selected mode displays in large green font.

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.

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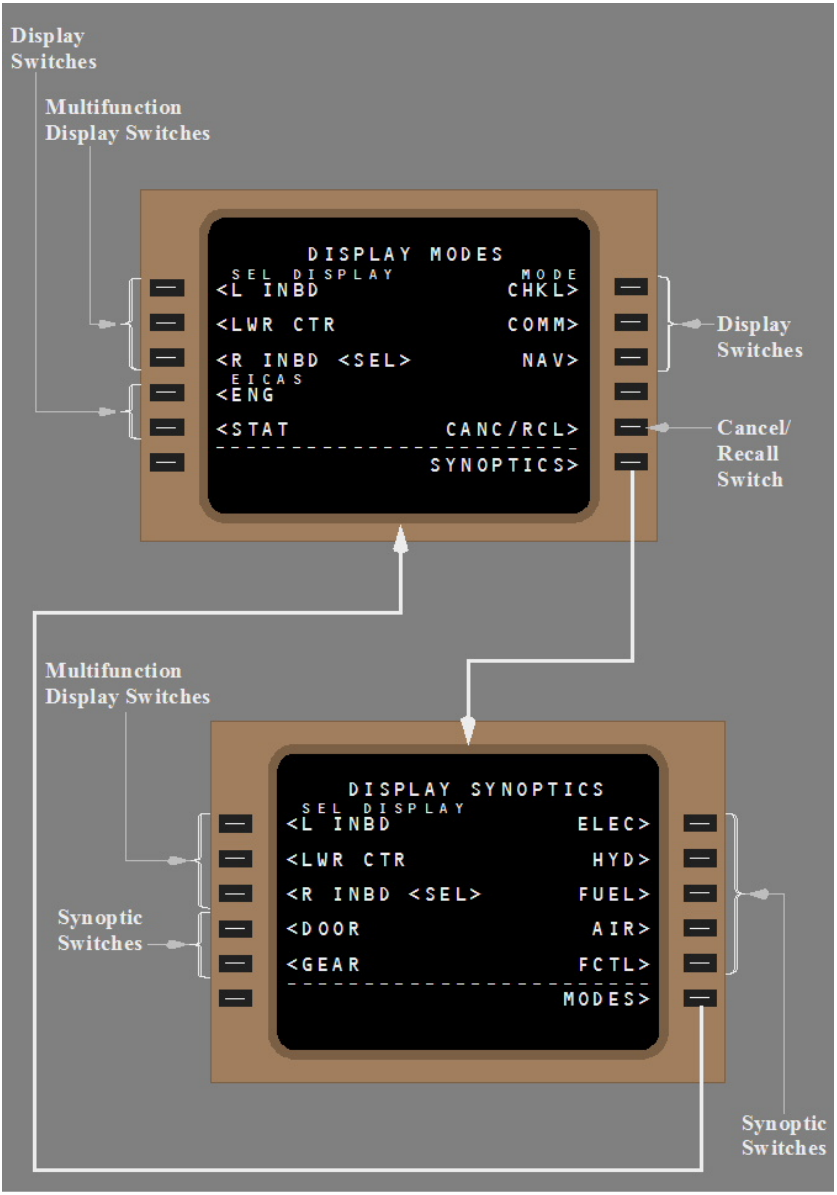
Display Select CDU Pages



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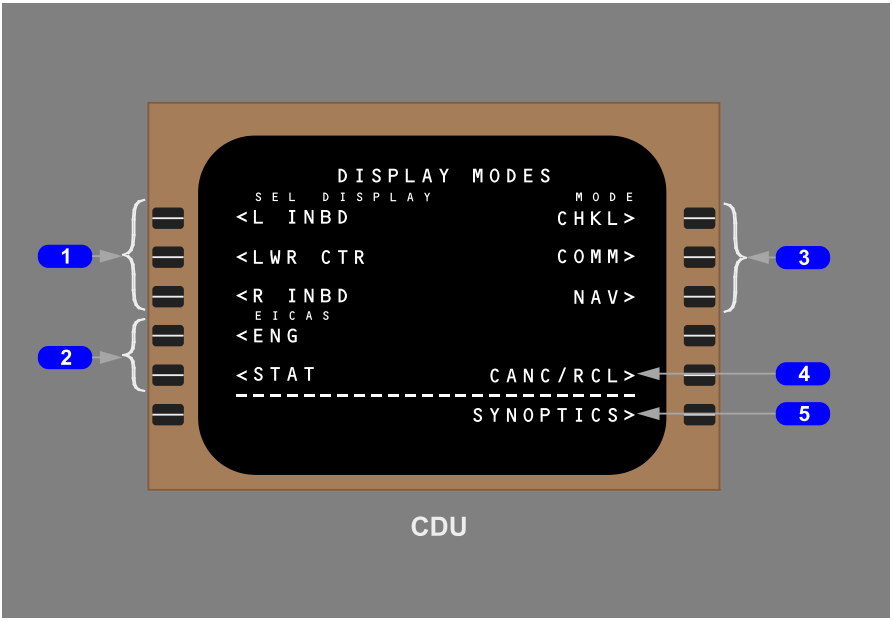
Display Modes Page



1 SEL DISPLAY

Push—selects display to be used.

2 EICAS

Push—selects EICAS display mode.

3 MODE

Push—selects display mode.

4 CANC/RCL

Push—cancels/recalls EICAS messages. See Display Select Panel on page 15.10.3.

5 SYNOPTICS

Push—selects DISPLAY SYNOPTICS page.

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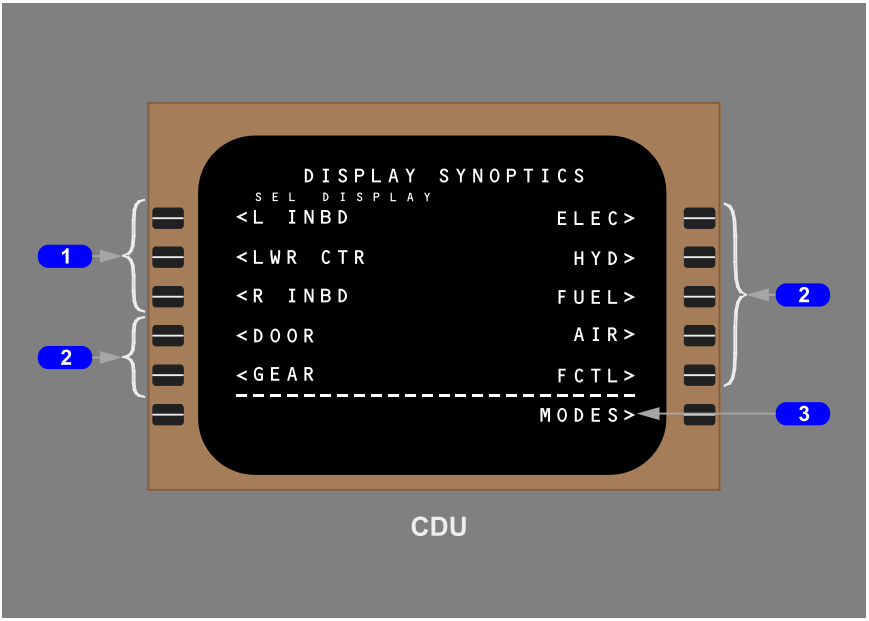
Display Synoptics Page



1 SEL DISPLAYS

Push—selects display to be used.

2 Synoptics

Push—selects desired synoptic.

3 MODES

Push—selects DISPLAY MODES page.

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Introduction

The flight instruments and displays supply information to the flight crew on six flat panel liquid crystal display units:

- Captain and First Officer primary flight display (PFD)
- Captain and First Officer navigation display (ND)
- the engine indication and crew alerting system (EICAS)
- the multifunction display (MFD).

Detailed information on the following subjects is found in other sections of this chapter:

- PFD—Section 30
- ND—Section 40
- Electronic Checklist—Sections 50 and 60.

Display Selection and Control

During normal operations:

- the inboard display selectors are set to MFD
- PFDs are displayed on the two outboard display units
- NDs are displayed on the two inboard display units
- EICAS is displayed on the upper center display unit
- the display select panel–selected MFD information is displayed on the lower center display unit, or the display is blank. (The secondary engine display is the default display at power–up.)

Inboard Display Selectors

The inboard display selectors are used to select PFD, ND (NAV position), MFD, or EICAS displays on the inboard display units.

The normal position is MFD. With MFD selected, ND information is displayed on the inboard display units if NAV is selected on the display select panel (see Display Select Panel (DSP) on page 10.10.43).

In the ND, PFD, and EICAS positions, only the selected displays can appear on the inboard display units.

With MFD selected on the inboard display selector, the following ND and EFIS control logic applies:

- if both pilots have an ND on the inboard displays, then each EFIS control panel controls its corresponding ND display
- if there is an ND display on one inboard display unit and on the lower center display unit, then the pilot who does not have an ND on the inboard display unit controls the ND on the lower center display unit

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- if neither pilot has an ND display on the inboard display unit, and there is an ND display on the lower center display unit, then the left EFIS control panel controls the lower center display unit
- if both pilots have an ND display on the inboard display unit, and there is an ND on the lower center display unit, then the left EFIS control panel controls the left inboard display unit and the lower center display unit. The ND on the left inboard and the lower center display units are identical.

EFIS Control Panels

The EFIS control panels control display options, mode, and range for the respective PFDs and NDs. See Primary Flight Display (PFD) on page 10.10.1 and see Navigation Display (ND) on page 10.10.21.

If an EFIS control panel fails, the displays can be controlled through the related CDU. This CDU capability is available at all times, but inhibits inputs from the respective EFIS control panel.

Display Select Panel

The display select panel controls the MFD format on the left and right inboard display units and the lower center display unit. The selected display is indicated by the illuminated annunciator light on the display select panel (L INBD, R INBD, LWR CTR).

TJA,B,C,D,G,H,TJR to TJW

After a display unit is selected, the appropriate display is selected (ENG, STAT, ELEC, HYD, FUEL, AIR, DOOR, GEAR, FCTL, CHKL, COMM, or NAV).

TKA to TKF

After a display unit is selected, the appropriate display is selected (ENG, STAT, ELEC, HYD, FUEL, AIR, DOOR, GEAR, FCTL, CAM, CHKL, COMM, or NAV).

TKK to TKR, TKU to TKZ

After a display unit is selected, the appropriate display is selected (ENG, STAT, ELEC, HYD, FUEL, AIR, DOOR, GEAR, FCTL, CAM, CHKL, COMM, or NAV on the DSP, or FDEVSS by the DSPL switch on the flight deck entry video panel).

A new display selection automatically replaces the previous one. A second selection of the same display for the lower center display unit blanks the display. A second selection of the same display on either inboard display causes display of the ND. If there is more than one page of messages, pushing STAT pages through the messages.

Pushing the COMM or CHKL switch for either inboard display unit shows the selected display. The cursor automatically appears on the selected display.

Display select panel control is also available through any CDU. This capability is available at all times. Once display select panel control is selected on one CDU, it cannot be selected on the other two CDUs.

When used as an MFD, the lower center display unit and the two inboard display units can display the following displays:

- ND (NAV switch)

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- status page (STAT switch)
- secondary engine EICAS (ENG switch)
- system synoptics (ELEC, HYD, FUEL AIR, DOOR, GEAR, FCTL switches)
- communications pages (COMM switch)
- electronic checklist (CHKL switch)
- flight deck entry video security system (flight deck entry video panel DSPL switch) TKK to TKR, TKU to TKZ
- ground maneuver camera system display (CAM switch). TKA to TKF, TKK to TKR, TKU to TKZ

When an inboard display selector is in the PFD position, new displays selected from the display select panel to that inboard display are inhibited. The annunciator light above the associated display select panel switch is also inhibited.

When an inboard display selector is in the EICAS position, only the ENG, AIR, and FUEL switches can affect the display. Pushing one of those switches causes the display of the respective compacted blocks of information on the EICAS display. The cancel/recall switch operates normally. For more information on compact EICAS displays, see Duct Pressure and Pressurization System Indications on page 2.10.6, see Compact Engine Indications on page 7.10.19 and see Fuel Indications on page 12.10.3.

The inboard display selectors have no effect on the inboard displays if an outboard display unit fails; the PFD automatically moves to the inboard display unit regardless of the position of the inboard display selector.

Upper center display unit failure automatically switches the EICAS display to the lower center display unit. A subsequent EICAS selection on either of the inboard display selectors brings the EICAS display to that inboard display unit, and assuming no latched condition exists, the lower center display unit initially displays secondary engine instruments. Following this initial display configuration, the lower center display unit can be used in its usual MFD mode.

Display Brightness Control

The MASTER BRIGHTNESS control provides simultaneous brightness adjustment for all displays and panel lighting. Also, each display unit has an individual control with limited range control when master brightness is on, and full range control when master brightness is off.

Two remote light sensors, located left and right on the top of the glareshield, measure brightness in the forward field of view and adjust the overall display brightness as required. Individual sensors on the front of each display unit also affect display brightness. The CDUs, mode control panel displays, standby flight instruments, and aisle stand panel displays are also controlled by the automatic display brightness control system.

Note: If display brightness cannot be set as desired when master brightness is on, pushing the MASTER BRIGHTNESS switch off may allow setting

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display brightness to an appropriate level using individual brightness controls.

Instrument Display Source Selection

The display system automatically reconfigures to compensate for most faults. The instrument display source select panels provide manual switches for the pilots to use if certain faults are not corrected automatically.

Instrument source select switches provide alternate information sources for the PFDs and NDs. These switches provide automatic source selection when in the off position (switch out, with the ALTN and CDU switch annunciations not visible).

If there is an undetected source failure (a display is missing or parts of a display appear faulty), the non–normal (ALTN or CDU) position provides the capability for manual selection of PFD and ND sources.

Undetected display source failures, such as missing/faulty display information or intermittent display blanking, may not result in automatic switching. The CDU position of the NAV switch or the ALTN position of the DSPL CTRL or AIR DATA/ATT switches provide the capability to manually select PFD and ND sources.

A center display control source switch is provided for the center displays.

Display Selection and Control Examples

The following examples show display selections.

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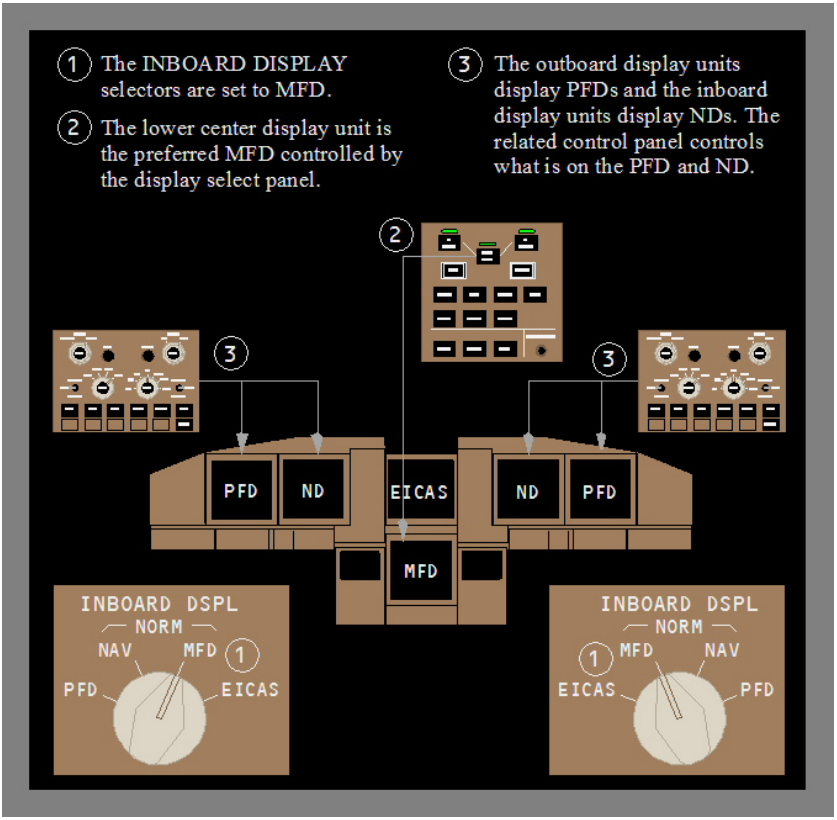
Normal Display Configuration



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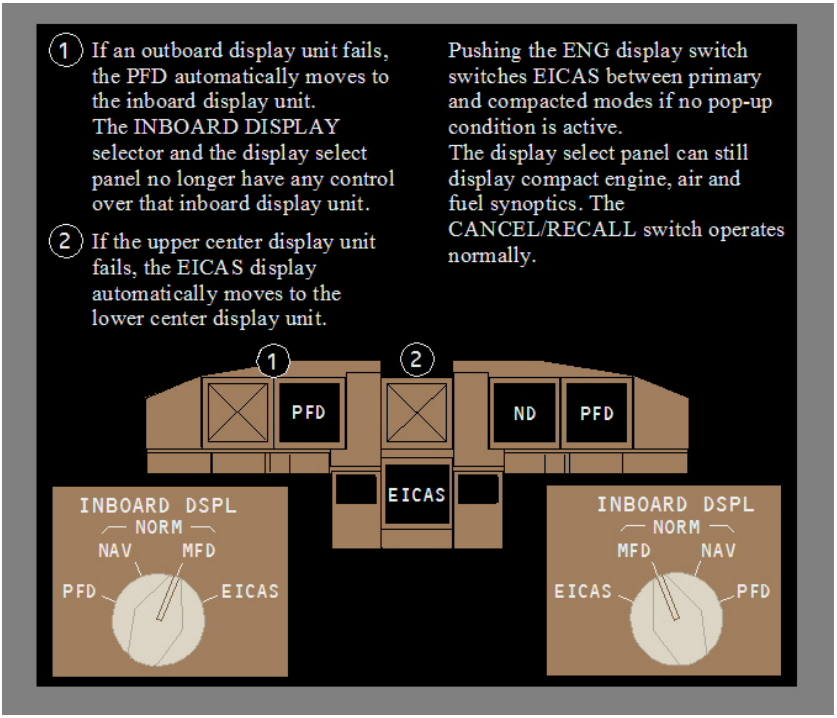
Display Unit Failure Automatic Switching



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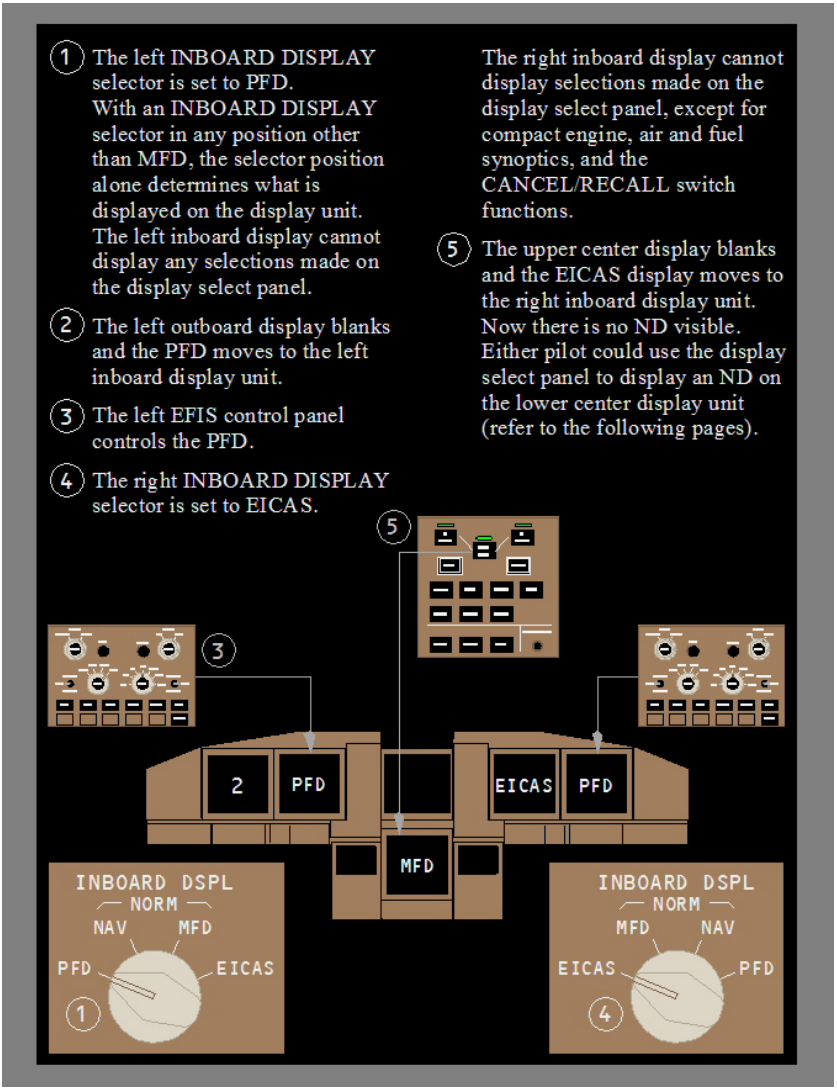
Inboard Display Switching



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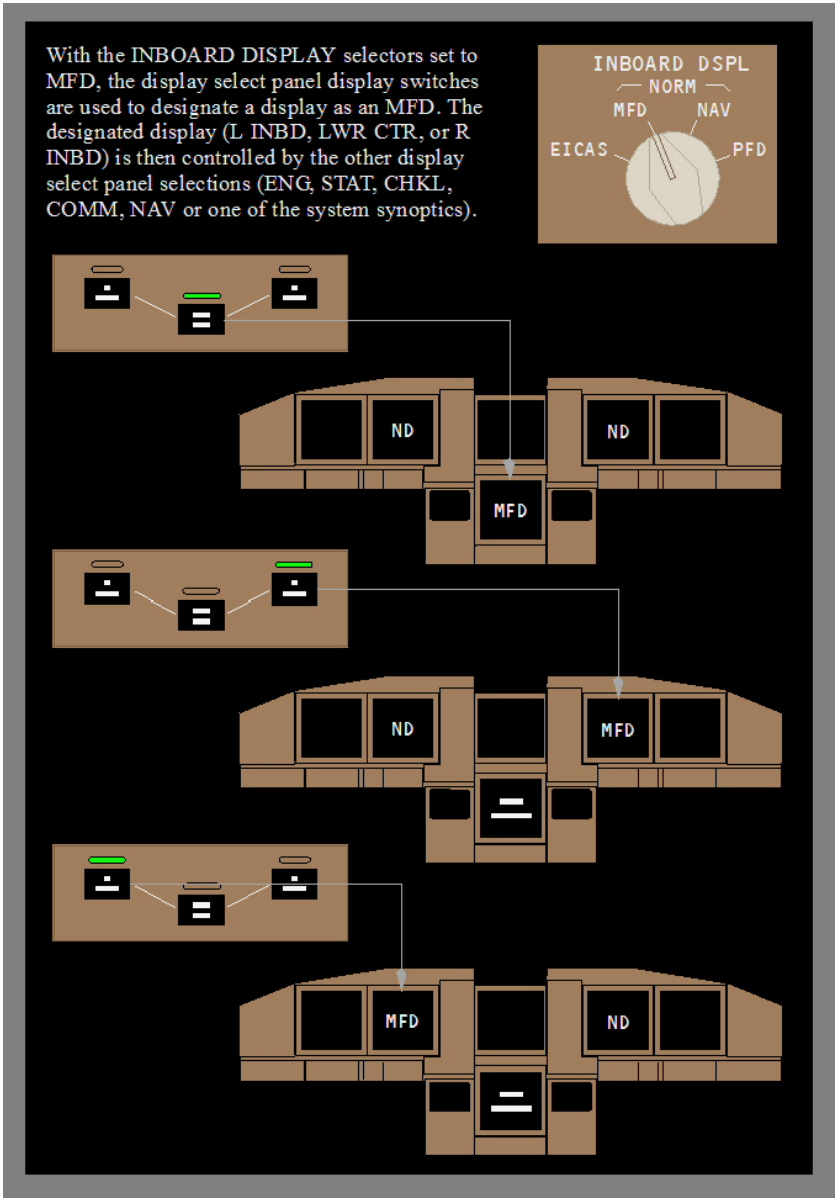
Display Select Panel MFD Selection



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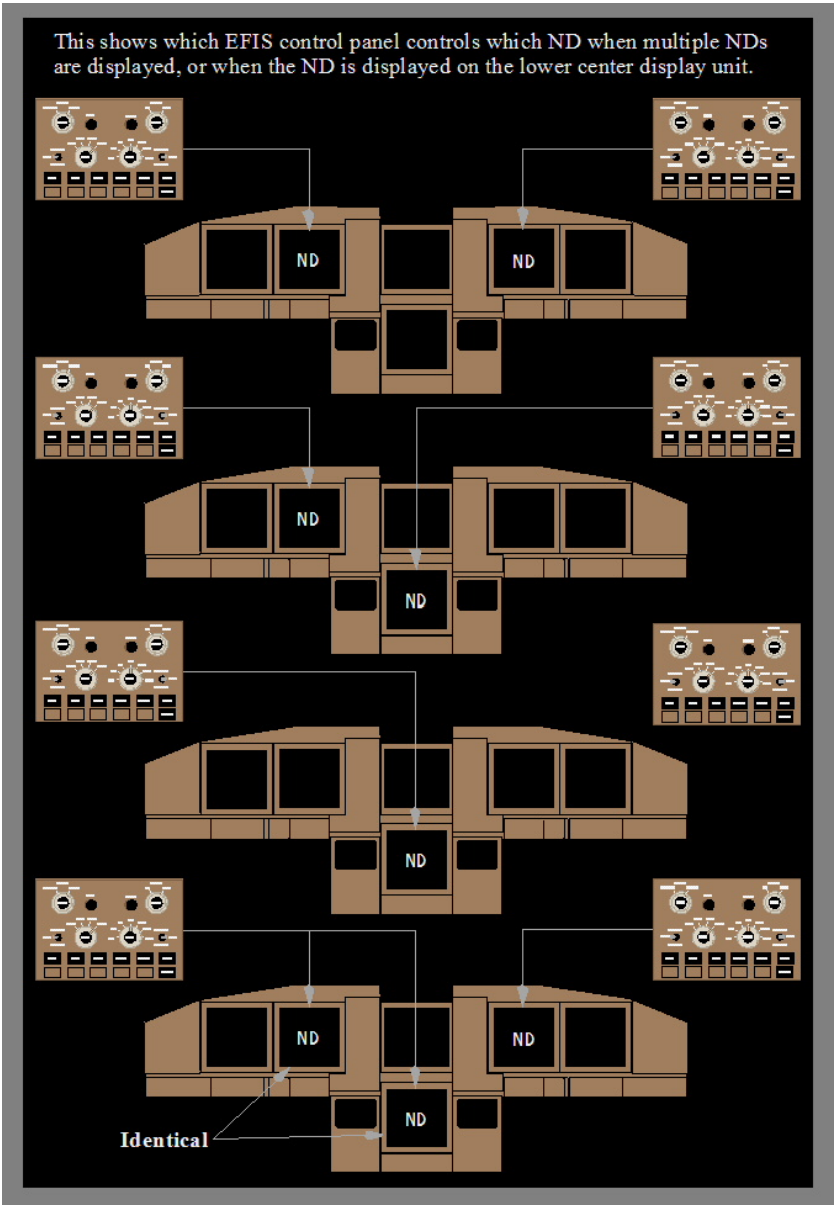
EFIS Control Panel Multiple ND Control



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TKA to TKF, TKK to TKR, TKU to TKZ

Ground Maneuver Camera System

The ground maneuver camera system provides the flight crew with views of the nose gear and main gear areas during taxi operations.

The system has three cameras. The cameras supply a color image to a three–way split screen display on any multifunction display (MFD).

The nose landing gear camera is on the lower side of the fuselage. The nose landing gear camera video is displayed on the upper section of the MFD ground maneuver camera display.

The left and right main landing gear cameras are on the leading edges of the respective horizontal stabilizer. The left and right main landing gear camera video is displayed on the lower section of the ground maneuver camera display. The system automatically compensates for approximately 80 percent of stabilizer movement to keep the cameras pointed correctly.

A black stripe is painted on the top of each wing to provide guidance when the tires are in shadow. The outboard edge of each stripe corresponds to the location of the outboard tire faces on each main landing gear.

The camera windows are heated to prevent the formation of ice, frost, or condensation from blocking the camera view. Window heat operates automatically when the cameras are operating.

TKA to TKF

The camera (CAM) display switch on the display select panel (DSP) is pushed display the ground maneuver camera system video on a multifunction display (MFD). The system is powered whenever airplane DC electrical power is available.

TKK to TKR, TKU to TKZ

The camera (CAM) display switch on the display select panel (DSP) is pushed to display the ground maneuver camera system video on a multifunction display (MFD). The system is powered whenever airplane DC and AC electrical power is available and the In-Flight Entertainment System/Passenger Seats (IFE/PASS SEATS) Power Switch is ON.

TKK to TKR, TKU to TKZ

To display ground maneuvering camera system video images while viewing surveillance video, select an appropriate MFD, and press CAM on the display select panel twice.

Ground maneuver camera lights can be turned on with the CAMERA LTS switch on the overhead panel. The BEACON switch must be on and the nose landing gear down for the camera lights to operate. The lights are located on the outboard flap track fairing of each wing and on the aft side of the nose landing gear strut.

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Flight Deck Entry Video Surveillance System (FDEVSS)

The flight deck entry video surveillance system provides video images of the flight deck door entrance area under all lighting conditions, enabling positive identification of anyone requesting access to the flight deck.

The system consists of three cameras with infrared illumination, a flight deck entry video panel, and a video interface unit.

The cameras are mounted in the forward cabin and are positioned to capture different viewing angles of anyone near the flight deck door entrance area.

TKK to TKR, TKU to TKZ

The flight deck entry video panel is located on the aft aisle stand. Surveillance video may be displayed on one of the L INBD, LWR CTR, or R INBD MFDs or all of them simultaneously.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF, TKK to TKR, TKU to TKZ

The flight deck entry video panel is located on the aft aisle stand. Surveillance video can be display on the LCD monitor located on the overhead panel.

Control and Operation

The IFE/PASS SEATS switch controls power to the flight deck entry video surveillance system. The MFD switches on the DSP are used to select a display unit. If selecting an inboard display, the appropriate left or right INBOARD DSPL selector must be set to MFD.

The flight deck entry video panel consists of a display switch and a camera selector. Pushing the display switch activates display of surveillance video on the selected MFD. Rotating the camera selector allows selection of the desired viewing angle. By repeating the selection process, different surveillance videos may be displayed on different MFDs simultaneously. To display surveillance video while displaying ground maneuvering camera video, select an MFD and press DSPL on the Flight Deck Entry Video Panel twice. Once displayed, pushing the display switch cancels surveillance video on the selected MFD and causes the display unit to either blank (LWR CTR) or revert to ND (L or R INBD). Pushing any DSP display/synoptic switch also cancels surveillance video on the selected MFD.

Cursor Control Devices (CCD)

The CCDs provide control of the display cursor.

For detailed information on the following subjects, see MFD Communications Functions on page 5.40.1 and see Electronic Checklist Displays on page 10.50.1.

CCD Touch Pad

The CCD uses a touch pad. Touching the pad translates the touch location coordinates to the affected display, placing a cursor at those coordinates on the selected display.

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The cursor moves relative to finger movement across the touch pad. Except for the four corners of the touch pad, lifting the finger off the touch pad and touching a different location does not move the cursor. Only finger motion in contact with the touch pad moves the cursor.

Touching a corner immediately places the cursor in the corresponding corner of the display. This helps the pilot quickly locate the cursor and speeds access to the selections at the four corners of the display.

CCD Cursor Location Control

Selecting a menu, communications, or checklist function requires the use of the cursor location switches.

If a new function is selected on an inboard display that requires a communication, checklist, or maintenance function, then the system automatically selects the respective cursor control device to that display.

If a new function requiring a cursor is selected on the lower center display, then the system automatically selects the CCD not currently being used on an inboard display to the lower center display. If neither cursor is in use, it selects the CCD cursor that was previously displayed on the lower center display. Cursor selection defaults to the left CCD on power-up.

The cursor location light above the switch illuminates to indicate the selected display unit.

Selecting a display where there is no function requiring a cursor has no effect. For example, if the inboard display does not display a communications or checklist page, pushing an INBD cursor location switch has no effect on the selected inboard display.

Only one CCD can access a given display at a time. The last pilot who selects the cursor on the selected MFD has control. The other cursor disappears from the display and the cursor location light on that CCD extinguishes. The cursors are visually different so the pilots know who is currently in control of the cursor on a display.

If both pilots are accessing the same checklist or communications functions on different displays, both are forced to the same page, with that page controlled by the pilot with cursor control.

Standby Flight Instruments

The standby flight instruments include:

- integrated standby flight display
- standby magnetic compass.

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Integrated Standby Flight Display (ISFD)

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

The ISFD displays attitude, airspeed, altitude, ILS, and magnetic heading information. The ISFD receives airspeed and altitude from a dedicated pitot and static air data module. Attitude information is provided by internal inertial sensors. ILS information is provided by the center ILS receiver. The display receives its heading information from the same source as the captain's primary flight display. Heading information is not available in polar regions.

TKK to TKR, TKU to TKZ

The ISFD displays attitude, airspeed, altitude, ILS, and heading information. The ISFD receives airspeed and altitude from a dedicated pitot and static air data module. Attitude information is provided by internal inertial sensors. ILS information is provided by the center ILS receiver. The display receives its heading information from the same source as the captain's primary flight display. In non-polar regions, the ISFD displays magnetic heading. In polar regions, the ISFD displays true heading with TRU displayed on the left side of the compass rose.

Note: The standby magnetic compass must be used to validate heading information.

The left flight control DC bus powers the ISFD. The left flight control DC bus is initially powered when the main ac busses are powered and remains powered with the main busses out. Ten seconds after receiving power, a 90 second initialization sequence begins. ATT and INIT 90s messages display during initialization. Initialization will stop if airplane movement is excessive and will resume when airplane movement is acceptable for initialization. Upon completion of the initialization sequence, attitude information displays.

Detection of a momentary out-of-limit ISFD condition may cause the attitude display to blank and the WAIT ATT or ATT:RST message to display. When the ATT:RST message displays, pushing the Attitude Reset switch resets the horizon line with the airplane symbol.

On the ground, pushing the Attitude Reset switch must be accomplished with the airplane stationary. In flight, pushing the Attitude Reset switch must be accomplished with the airplane in wings level, non-accelerated flight. During attitude reset, the ATT 10s message displays. Failure to maintain straight and level flight for 10 seconds may result in an ATT:RST message. If attitude reset is unsuccessful, the ATT:RST message remains displayed and the attitude will not be displayed.

Standby Magnetic Compass

A standard liquid–damped magnetic standby compass is provided. A card located near the compass provides heading correction factors.

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Radio Altimeter (RA)

The radio altimeter measures airplane altitude above terrain. Radio altitude is displayed on the PFD.

There are three radio altimeter systems: left, center, and right. If all three radio altimeter systems are inoperative or degraded, the RA flag is displayed on the PFD. The radio altimeter systems send data to:

- autopilot flight director
- autothrottle
- GPWS
- TCAS
- weather radar
- primary flight control system.

Clocks

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF,K

A clock is located on each forward panel. Each clock displays airplane information management system (AIMS) generated UTC time and date, or manually set time and date. The AIMS UTC time comes from the global positioning system (GPS). In addition to time, the clocks also provide alternating day-month and year, elapsed time, and chronograph functions.

TKL to TKR, TKU to TKZ

Clock information is displayed on the lower left and right corners of each PFD. GPS generated UTC time and date are displayed on the lower right corner. Elapsed time and chronograph are displayed on the lower left corner. The CLOCK switch alternately selects activation of the chronograph (reset/start/stop) and return to elapsed time. Elapsed time begins advancing at lift-off and stops advancing at touchdown. Elapsed time is reset to zero at initial power-up, or when both FUEL CONTROL switches are moved to RUN on the ground, or at lift-off.

The STATUS page also provides UTC time, day-month-year, and elapsed time.

Display System Information Sources

Air Data Inertial Reference System (ADIRS)

The ADIRS provides:

- primary, secondary and standby air data
- inertial reference information.

The major components of the ADIRS are:

- one air data inertial reference unit (ADIRU)
- one secondary attitude air data reference unit (SAARU)
- eight air data modules
- six static ports

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- three pitot probes
- two angle-of-attack vanes
- one total air temperature probe.

Air Data Inertial Reference Unit (ADIRU)

The ADIRU is the primary source for speed, altitude, attitude and inertial navigation position information. The ADIRU processes information measured by its internal gyros and accelerometers, and from air data module inputs, angle-of-attack vanes and other systems.

The ADIRU is described in Chapter 11, Flight Management, Navigation.

Secondary Attitude Air Data Reference Unit (SAARU)

The SAARU is the secondary source for speed, altitude, and attitude information. The SAARU processes information measured by its internal gyros and accelerometers, and from air data module inputs, angle-of-attack vanes, and other systems.

The SAARU does not provide navigational position data. The SAARU is described in Chapter 11, Flight Management, Navigation.

Air Data

Three static ports are located on the left side of the airplane and three static ports are located on the right side of the airplane. Left and right static ports are paired through pneumatic tubing to each of the left, center and right air data modules. The air data modules convert static air pressure to a digital output for use by other systems. The center static ports are also connected to an independent air data module to provide static pressure measurement to the ISFD.

Two pitot probes (right and center) are mounted on the right forward section of the airplane. One pitot probe (left) is mounted on the left forward section of the airplane. An air data module is connected to each pitot probe. These air data modules convert dynamic air pressure to a digital output for use by other systems. The center pitot probe also provides dynamic pressure to the standby air data module to provide dynamic pressure measurement to the ISFD.

Angle-of-Attack

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

A total air temperature probe is mounted outside the airplane to sense air mass temperature. The temperature sensed by the probe is used by the ADIRU and the SAARU to compute total air temperature.

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Static Air Temperature

Static air temperature, displayed on the CDU PROGRESS page, comes from the ADIRU, using total air temperature probe information. In the event the ADIRU value is invalid, the SAARU computed value is displayed

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Introduction

The PFDs present a dynamic color display of all the parameters necessary for flight path control. The PFDs provide the following information:

- flight mode annunciation
- airspeed
- ground speed
- altitude
- vertical speed
- attitude
- steering information
- radio altitude
- instrument landing system display
- approach minimums
- heading/track indications
- engine fail, GPWS, and PWS alerts
- clock, elapsed time, and chronograph
- Navigation Performance Scales. TKL to TKR, TKU to TKZ TKK to TKR, TKU to TKZ

Failure flags are displayed 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.

Airspeed

Airspeed is displayed on a tape and in a digital window on the left side of the PFD. The current Mach number is digitally displayed below the airspeed tape when the current Mach number is greater than 0.40. An airspeed trend vector indicates predicted airspeed in 10 seconds. Selected airspeed is displayed above the airspeed tape.

Takeoff and landing reference speeds and flap maneuvering speeds are shown along the right edge of the airspeed tape. Maximum and minimum airspeeds are also displayed along the right edge of the airspeed tape.

CAUTION: Reduced maneuver capability exists when operating within the amber regions below the minimum maneuvering speed or above the maximum maneuvering speed. During non-normal conditions the target speed may be below the minimum maneuvering speed.

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Ground Speed

Ground speed is digitally displayed below the airspeed tape when the Mach number is less than 0.40.

Altitude

Altitude is displayed on an altitude tape along the right side of the PFD. It is also shown digitally in a window in the middle of the tape. When meters is selected on the EFIS control panel:

- current altitude in meters is also shown above the altitude window
- selected altitude in meters is displayed above the altitude tape.

Selected altitude is displayed above the altitude tape and is boxed when approaching the selected altitude. Selected altitude is also depicted with a bug on the altitude tape.

The selected barometric approach minimum is indicated on the altitude tape with a triangular pointer and green line.

The current barometric reference is displayed below the altitude tape. A preselected barometric reference can be displayed when STD is displayed.

Landing reference is selectable between QNH and QFE on the APPROACH REF page of the FMC. QNH is the normal operating mode. Selecting QFE sets the destination landing altitude indication to zero altitude. With the landing reference set to QFE, changing the barometric setting from STD to QFE changes the PFD altitude tape background color to green. With QFE selected and climb mode active, changing the barometric setting from QFE to STD causes the landing reference to toggle from QFE to QNH and the altitude tape background color changing from green back to normal. A description of QFE operation is contained in the Landing Reference description in Chapter 11, Flight Management, Navigation.

Vertical Speed

Vertical speed is displayed to the right of the altitude tape with a tape and pointer. Vertical speed is digitally displayed above or below the vertical speed display when vertical speed is greater than 400 feet per minute. It is displayed above with positive vertical speed and below with negative vertical speed. The selected vertical speed bug shows the selected vertical speed when in the AFDS vertical speed (V/S) pitch mode.

Attitude

The attitude indication displays the airplane pitch and roll attitude referenced to the horizon.

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Pitch attitude is displayed by an airplane symbol against a pitch scale. The pitch scale is in 2.5° increments.

A pointer indicates bank angle in increments of 10°, 20°, and 30°. Single marks indicate 45° and 60° of bank. A small rectangle under the bank angle pointer indicates slip and skid conditions. Bank angle is also represented by the attitude of the airplane symbol against the horizon line and pitch scale.

A pitch limit indication is displayed at low speeds when the flaps are up and at all times when the flaps are down.

Steering Indications

The flight director steering indications are displayed when the associated flight director switch is on.

TCAS resolution advisories are displayed in the attitude indication area. See TCAS PFD Vertical Guidance on page 15.10.10.

The flight path vector (FPV) symbol represents airplane flight path angle vertically and drift angle laterally. The flight path vector is displayed on the PFD when the EFIS control panel FPV switch is selected on, or the MCP FPA reference switch is selected on. The FPV shows the Flight Path Angle (FPA) above or below the horizon line and drift angle left or right of the pitch scale's center. The FPA uses inertial and barometric altitude inputs. The vertical FPA is unreliable with unreliable primary altitude displays.

The flight path angle (FPA) symbol shows the selected flight path angle when the MCP FPA reference switch is selected on and either the flight director or autopilot is engaged.

The FPV and FPA symbols are displayed in two sizes and brightness levels. The large, bright FPV/FPA symbols are displayed when the previously stated selections are made and the flight director is off. The small, dim FPV/FPA symbols are displayed when the previously stated selections are made and the flight director is displayed.

Radio Altitude

The current radio altitude is displayed in the bottom center of the attitude indication area when radio altitude is below 2,500 feet AGL.

Instrument Landing System Indications

ILS glide slope and localizer deviation, frequency/identification, DME, course, and marker beacon indications are provided.

The approach reference information appears above and to the left of the attitude display. The ILS station identification or frequency, course, and (if available) DME are displayed.

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The marker beacon indication (OM—outer marker, IM—inner marker, or MM—middle marker) is displayed in the upper right corner of the attitude display area.

The glideslope pointer and scale appear on the right side of the attitude indication.

The localizer pointer and scale appear at the bottom of the attitude indication.

TJR to TJW, TKK to TKR, TKU to TKZ

Below 2,500 feet radio altitude, with the localizer pointer in view, a rising runway symbol comes into view. The symbol provides lateral guidance. At 200 feet radio altitude, the symbol rises toward the airplane symbol.

Approach Minimums

The selected radio altitude or barometric approach minimums set on the EFIS control panel are displayed near the bottom left of the altitude display.

Heading/Track Indications

Selected heading/track information is displayed in the bottom section of the PFD on a section of the compass rose. Current heading is displayed under a pointer at the top of the compass rose. The MCP selected heading bug is displayed on the outside of the compass rose. The MCP selected track bug is displayed on the inside of the compass rose.

Heading or track is displayed based on the position of the MCP HDG/TRK reference switch. The selected heading or selected track is annunciated in the left half of the compass rose. The current heading/track reference (MAG/TRU) is shown in the right half of the compass rose. A line drawn perpendicular to the edge of the compass rose from the invisible center depicts the current airplane track.

Engine Fail, GPWS, and PWS Alerts

Engine fail, GPWS, and PWS alerts are displayed in large capital letters between the attitude display and the heading/track compass rose. See Alerts on PFD on page 15.10.4.

Typical PFD Displays

Typical PFD configurations for six phases of flight follow. The autopilot, LNAV, and VNAV are engaged for climb, cruise, descent, approach, and landing. The AFDS approach mode is used for approach and landing.

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PFD Takeoff Display

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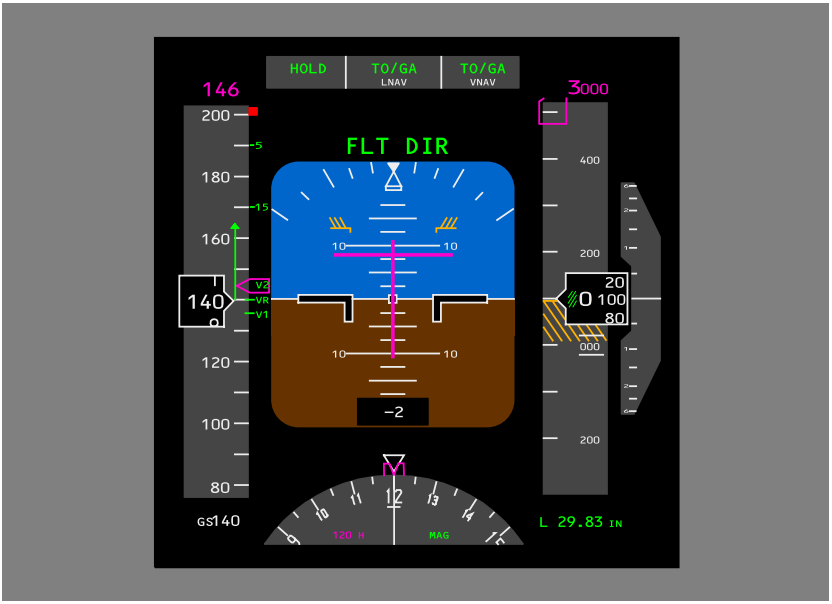
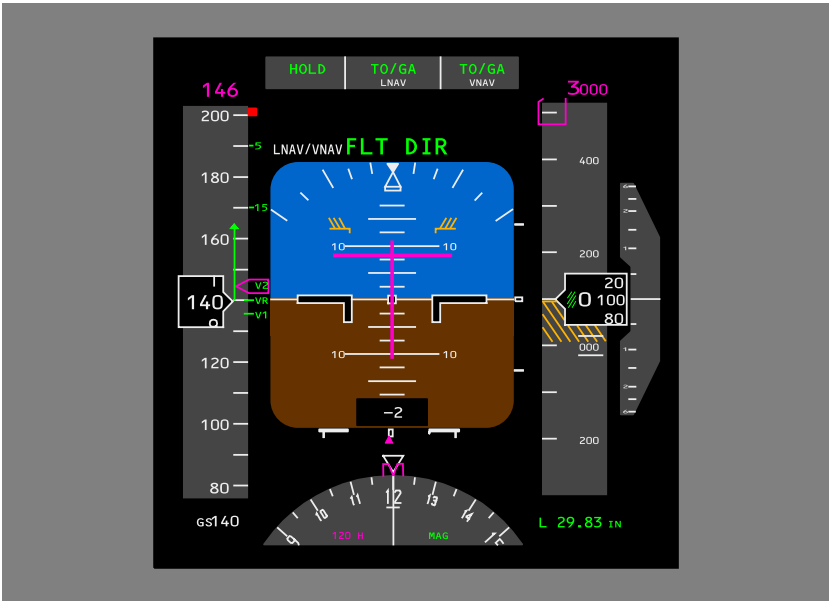
TKA to TKF



TKK



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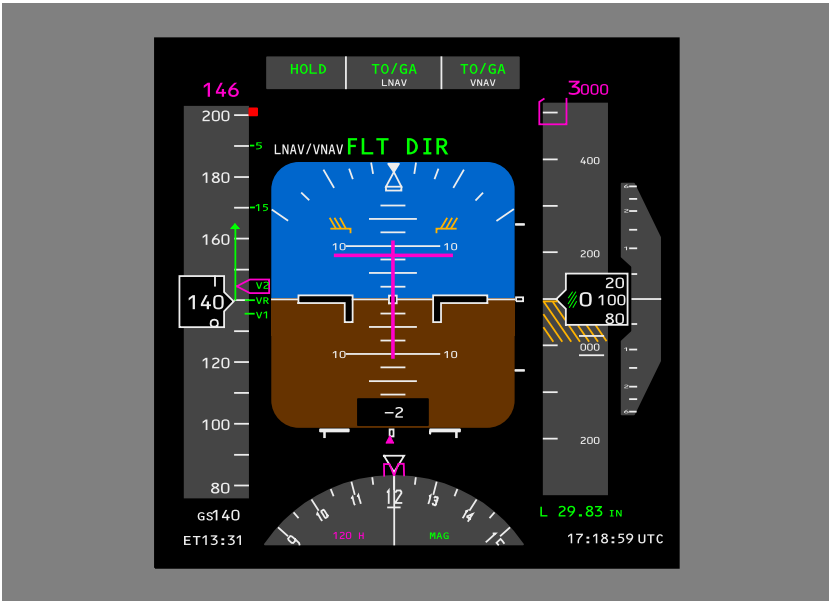
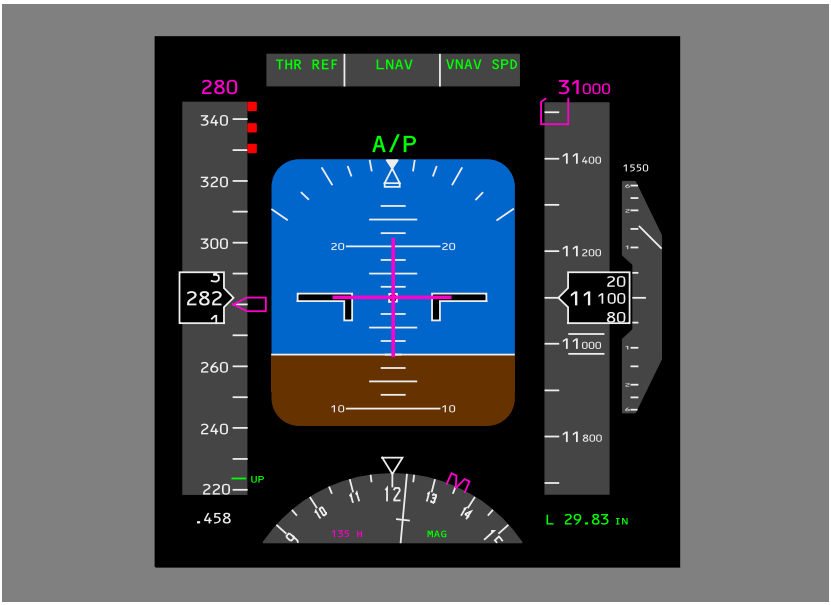
TKL to TKR, TKU to TKZ



PFD Climb Display

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



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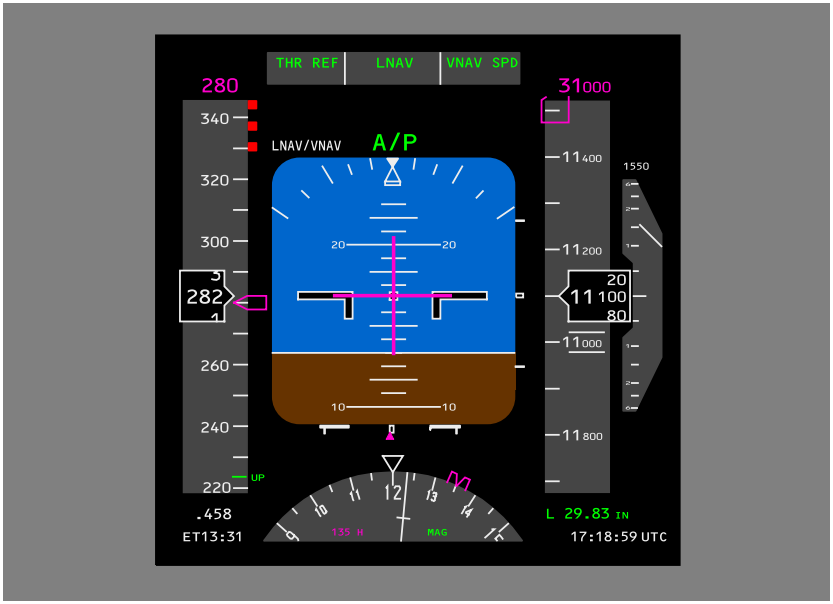
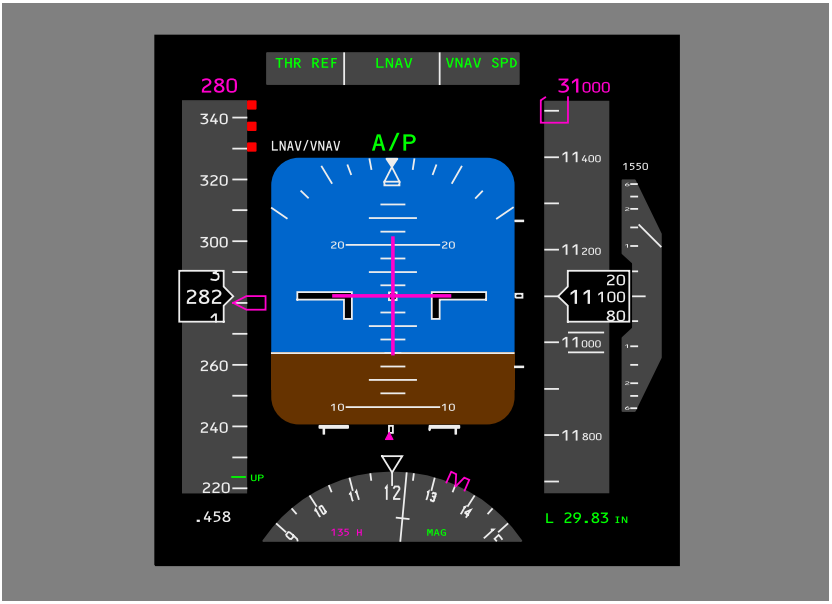
TKU to TKZ



TKK



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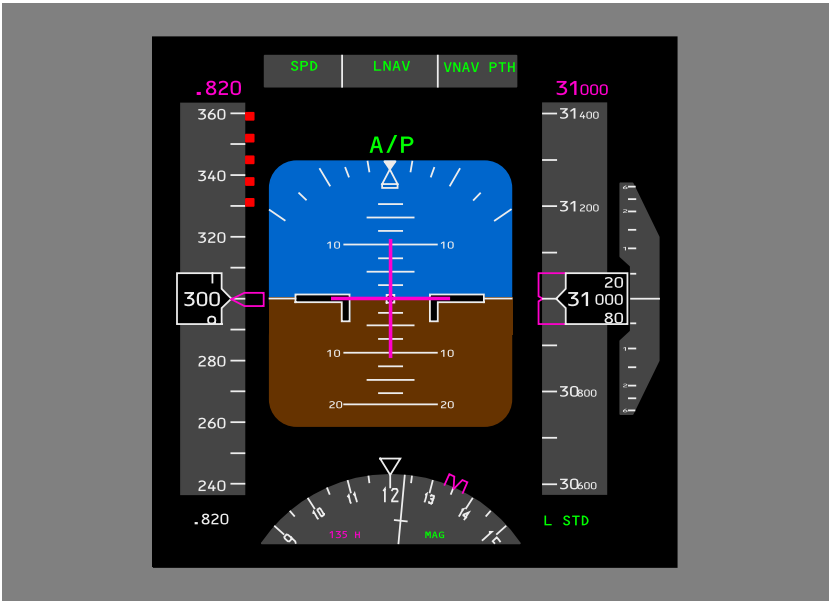
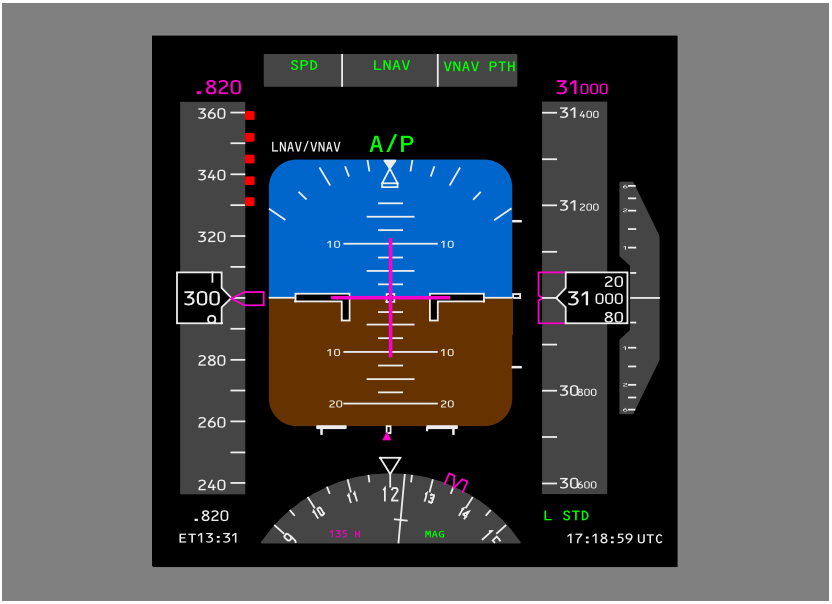
PFD Cruise Display

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



TKL to TKR, TKU to TKZ



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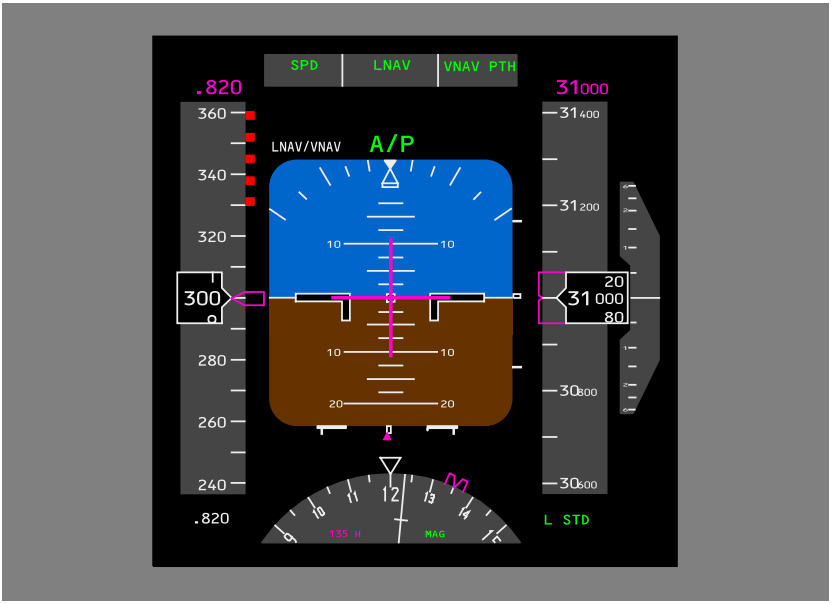
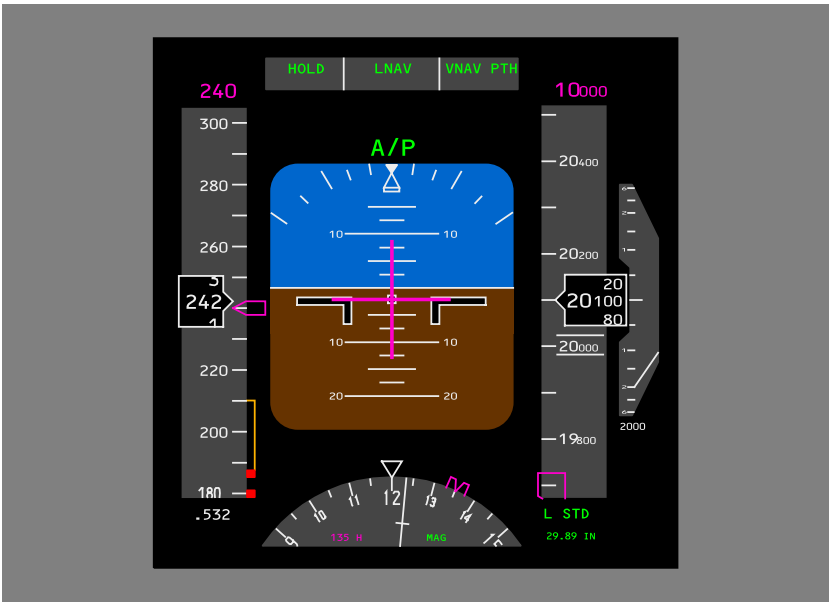
TKK



PFD Descent Display

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF



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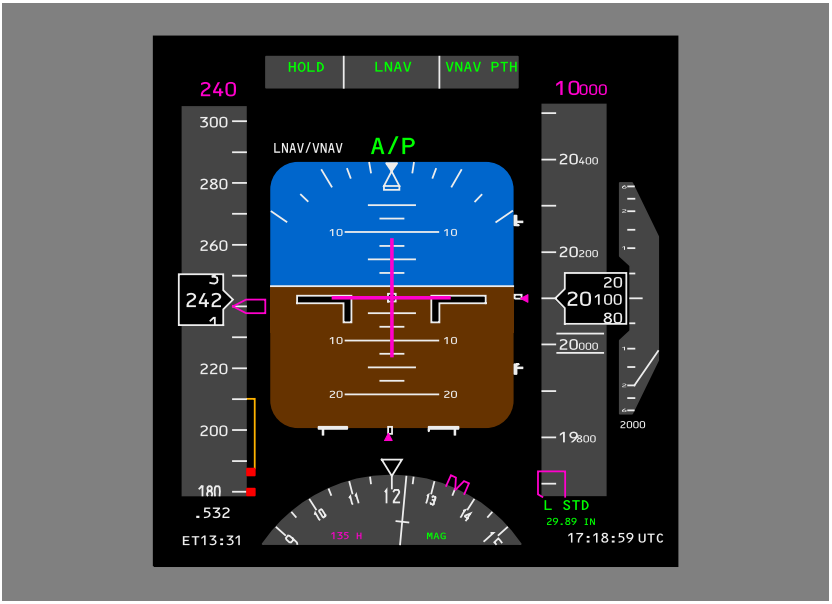
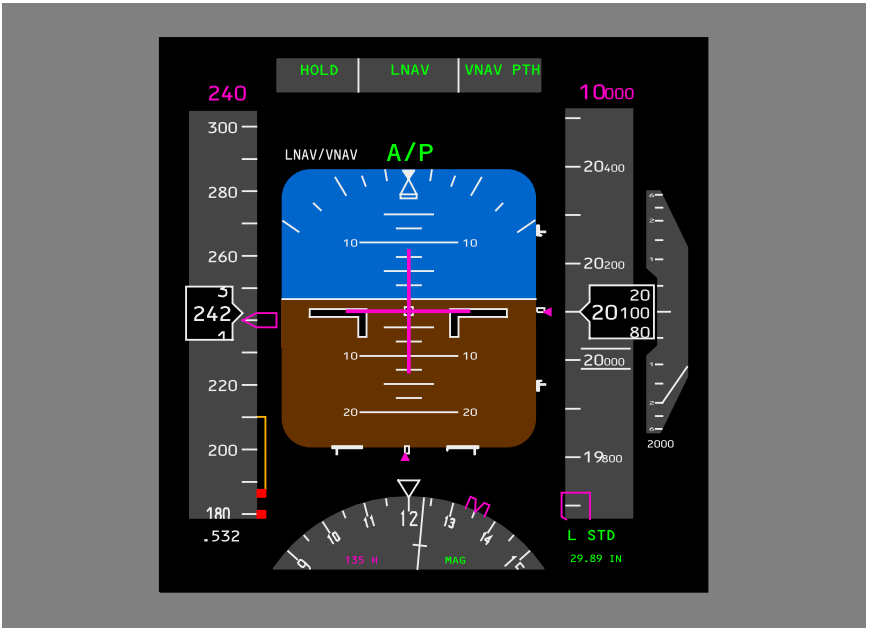
TKL to TKR,
TKU to TKZ



TKK



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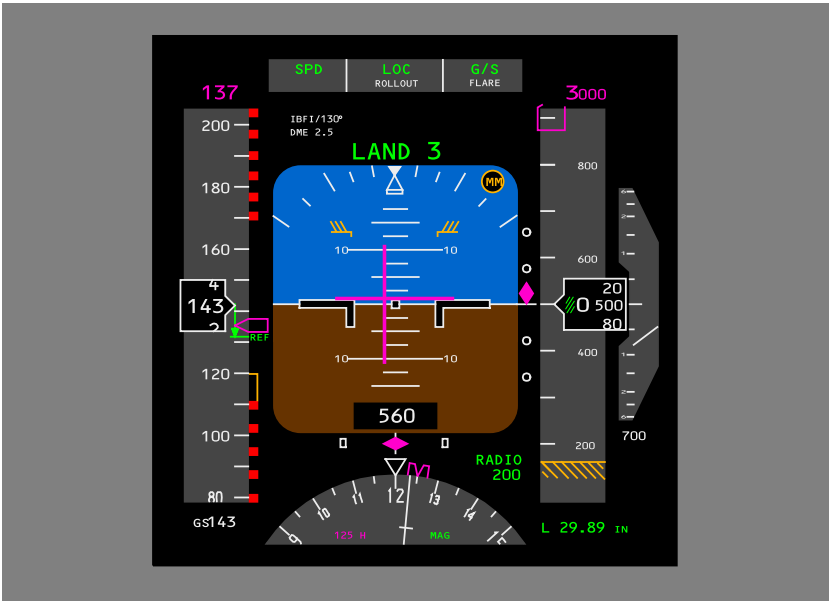
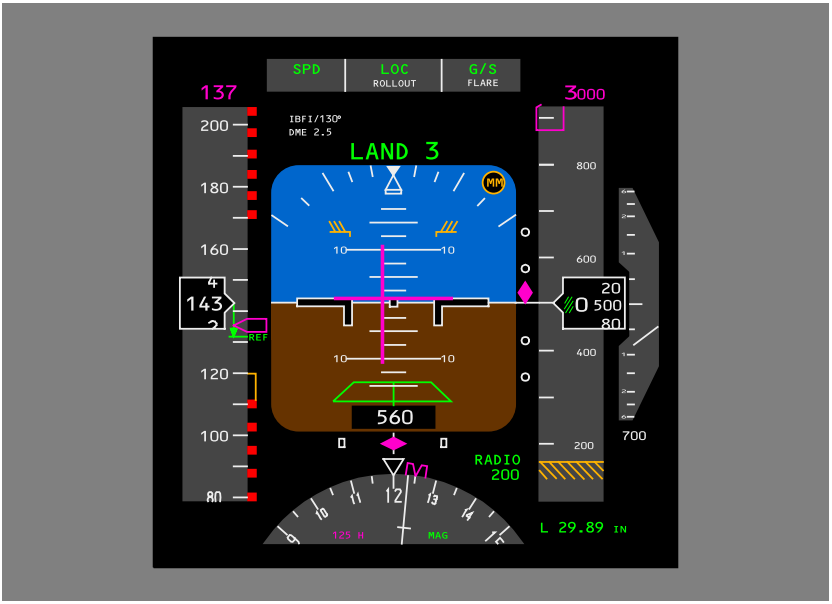
PFD Approach Display

TJA,B,C,D,G,H,TKA to TKF



TJR to TJW



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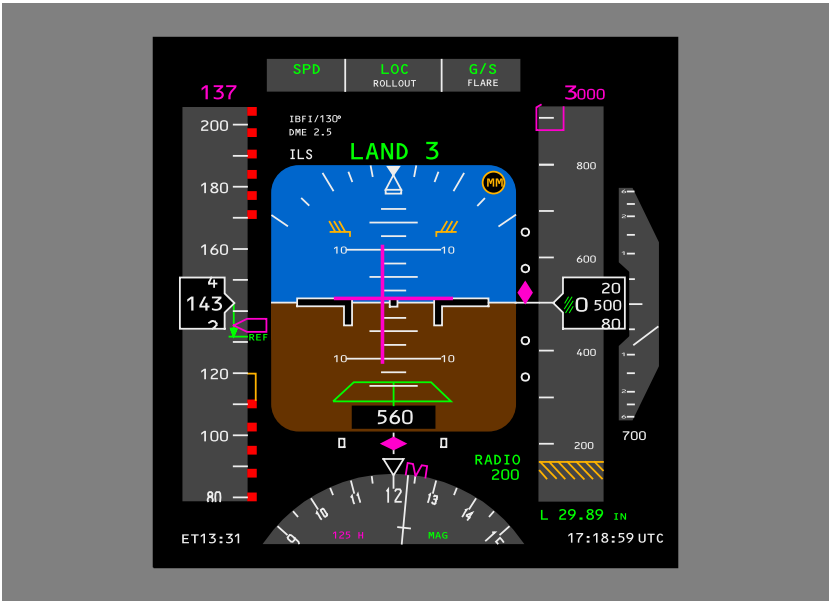
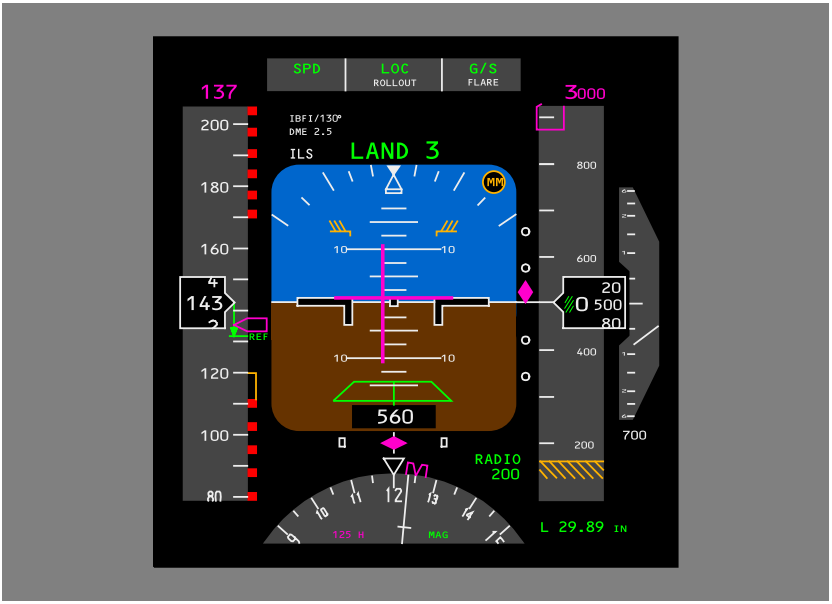
TKL to TKR,
TKU to TKZ



TKK



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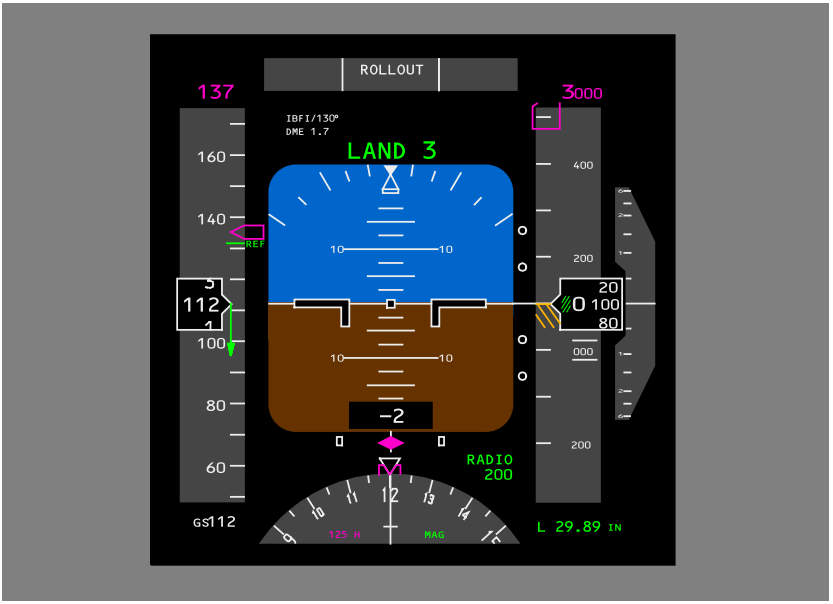
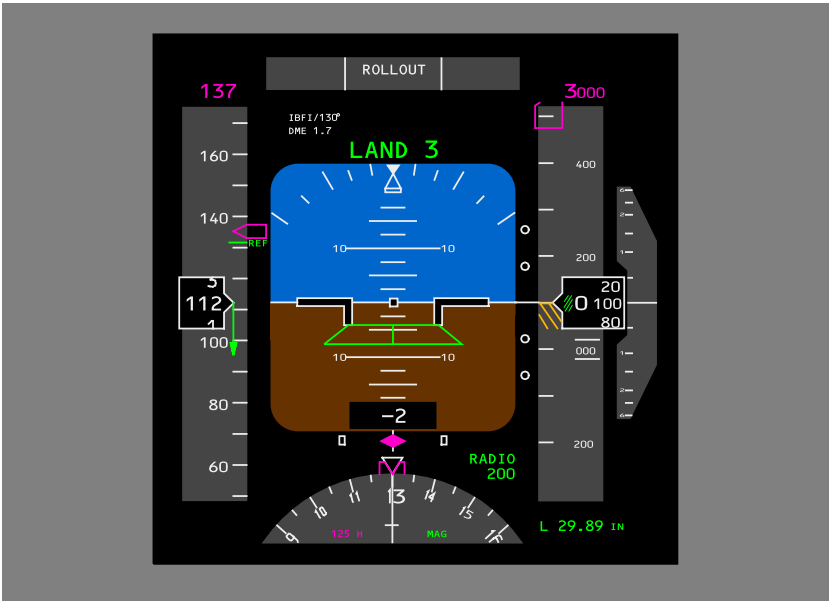
PFD Landing Display

TJA,B,C,D,G,H,TKA to TKF



TJR to TJW



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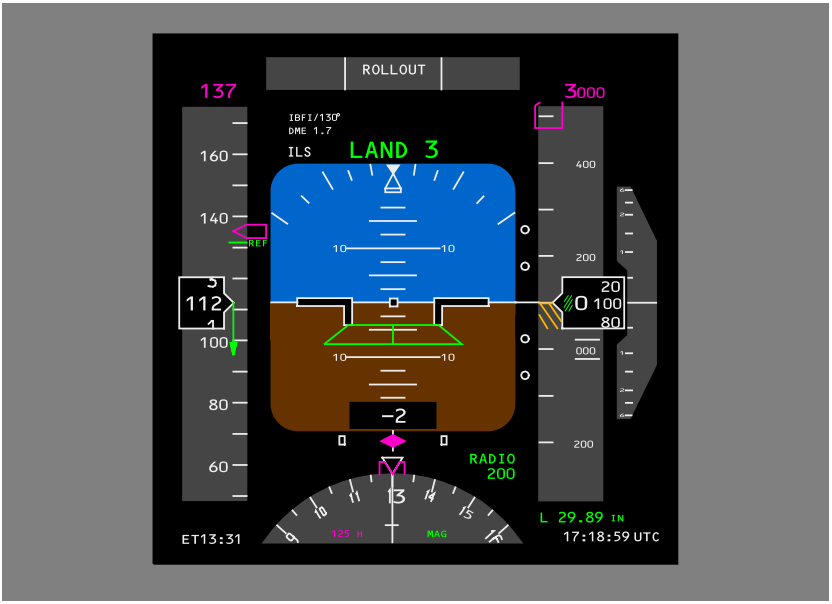
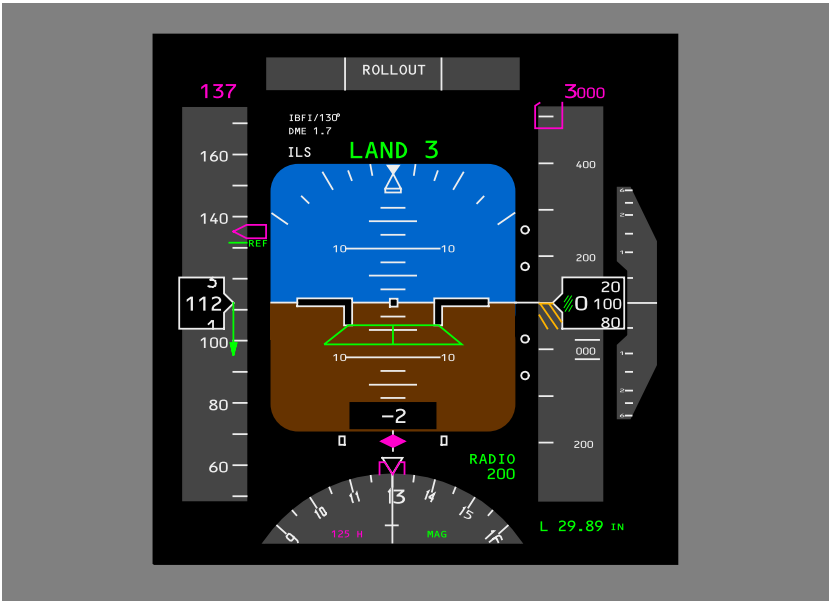
TKL to TKR,
TKU to TKZ



TKK



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Introduction

The NDs provide a mode–selectable color flight progress display. The modes are:

- MAP
- VOR
- APP (approach)
- PLN (plan).

The 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

The MAP mode is recommended for most phases of flight.

Presented heading up, this mode shows airplane position relative to the route of flight against a moving map background.

Displayed information can include:

- selected and current track
- selected and current heading
- 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.

Navigation Data Points

Additional navigation facility (STA), waypoint (WPT), airport (ARPT), route progress (DATA) and position (POS) data are available for display on the ND in both the expanded and center map modes.

VOR and Approach Modes

The VOR and APP modes are presented heading up. The VOR and APP modes display track, heading, and wind speed and direction with VOR navigation or ILS approach information.

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Plan Mode

The PLN mode is presented true north up. The active route may be viewed using the STEP prompt on the CDU LEGS pages.

ND Information

Heading

Heading is supplied by the FMC or air data inertial reference system (ADIRS). 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 is automatically referenced to true north when the airplane is north of 82° north or south of 82° south latitude, or near the magnetic poles with the heading reference switch in NORM.

Track

Track is supplied by the FMC during normal operation and by the CDU when 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 can be displayed on the ND. The weather radar system is described in Chapter 11, Flight Management, Navigation.

Failure Flags and Messages

Failure flags are displayed for system failures or invalid information. Indications are removed or replaced by dashes when source system information is not available.

The message EXCESS DATA is displayed if the amount of information sent to the ND exceeds the display capability. When this occurs, the primary display system removes information from the center of the display outward; information near the outer selected range area is still displayed. The message can be removed by:

- reducing the amount of map information
- reducing range, or
- deselecting one or more of the EFIS control panel map switches (STA, WPT, ARPT, DATA, POS).

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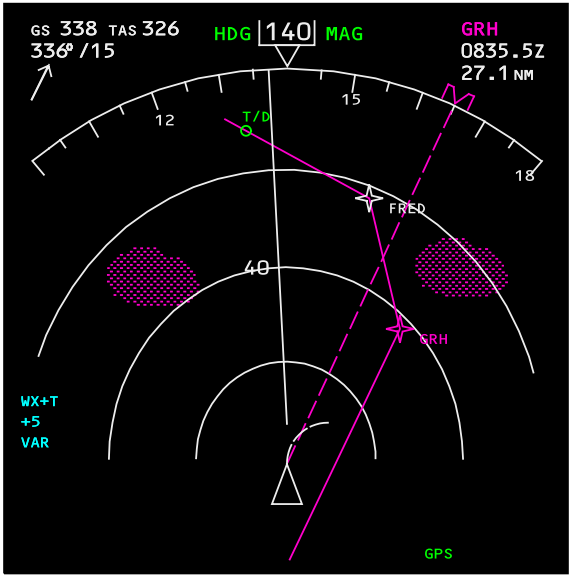
Typical ND Map Displays

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.

ND Expanded Map Displays

TJA,B,C,D,G, H,TKA to TKF



WXR (weather radar) map switch selected.

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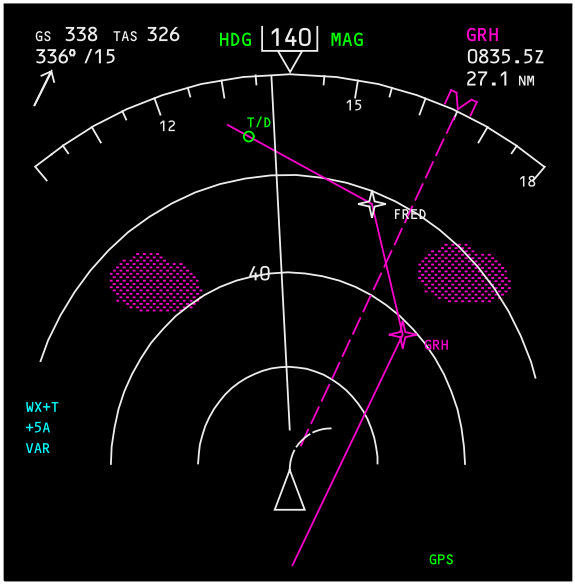
TJR to TJW



WXR (weather radar) map switch selected.

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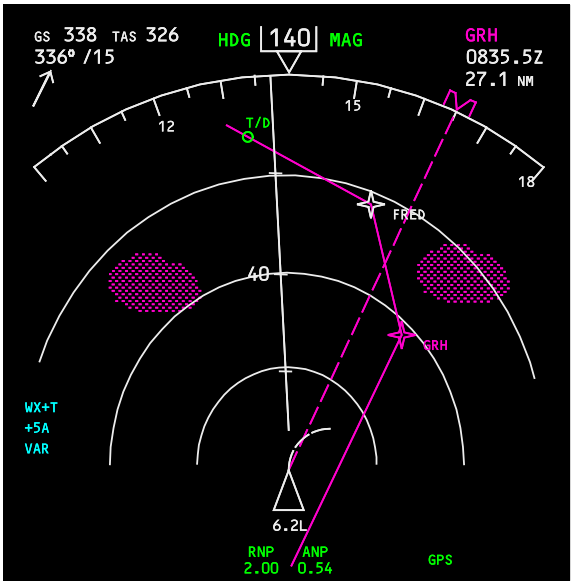
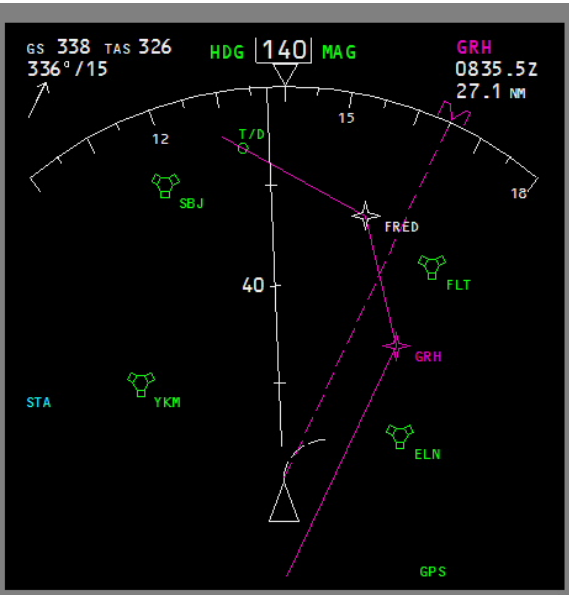
TKK to TKR,
TKU to TKZ



WXR (weather radar) map switch selected.

TJA,B,C,D,G,
H,
TJR to TJW,
TKA to TKF

STA (station) map switch selected.



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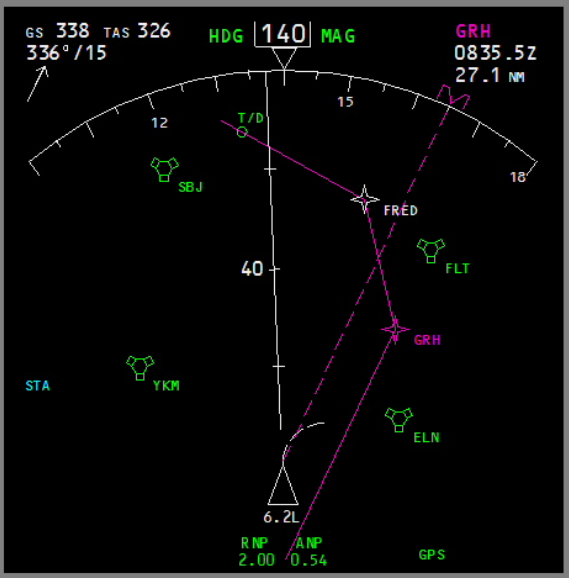
TKK to TKR,
TKU to TKZ

STA (station) map switch selected.



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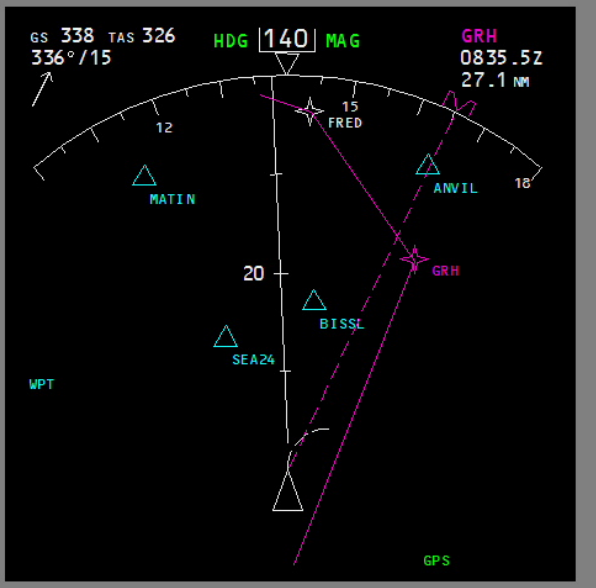
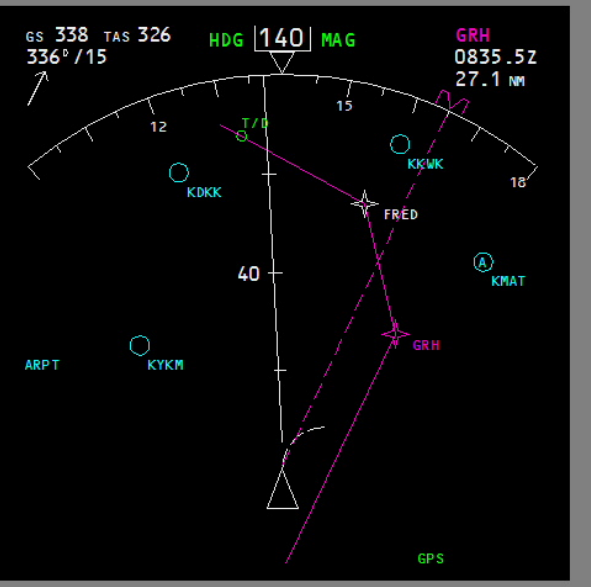
TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

WPT (waypoint) map switch selected.



ARPT (airport) map switch selected.



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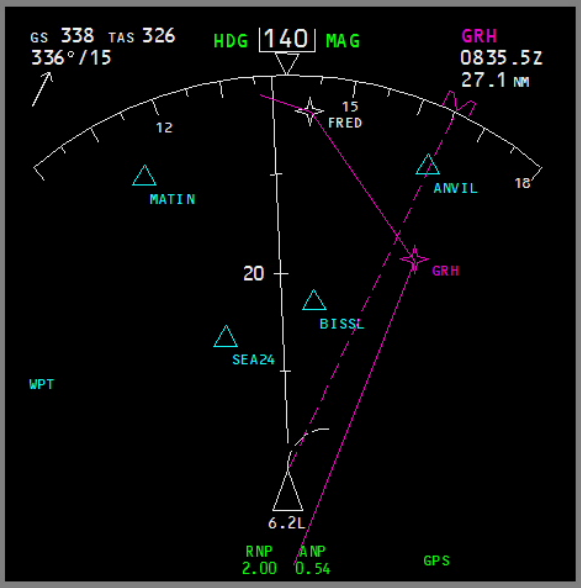
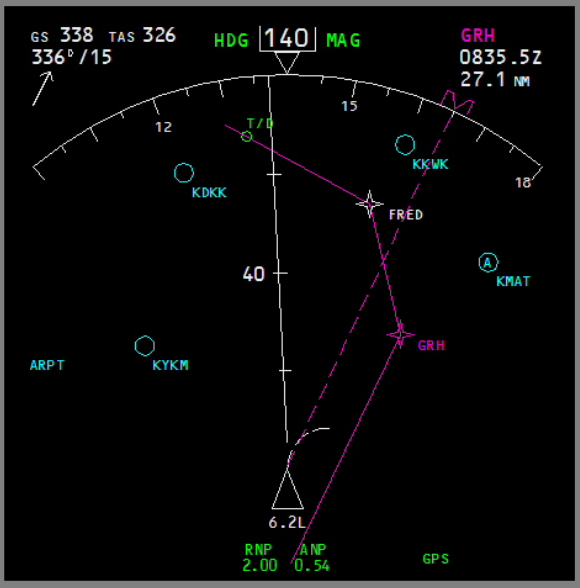
TKK to TKR,
TKU to TKZ

WPT (waypoint) map switch selected.



ARPT (airport) map switch selected.



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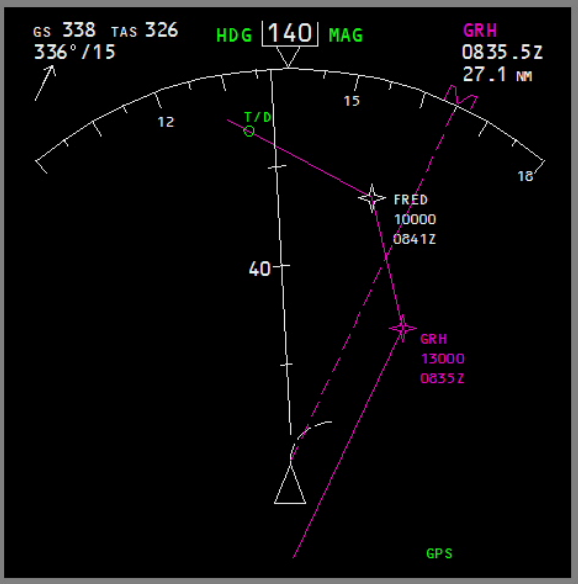
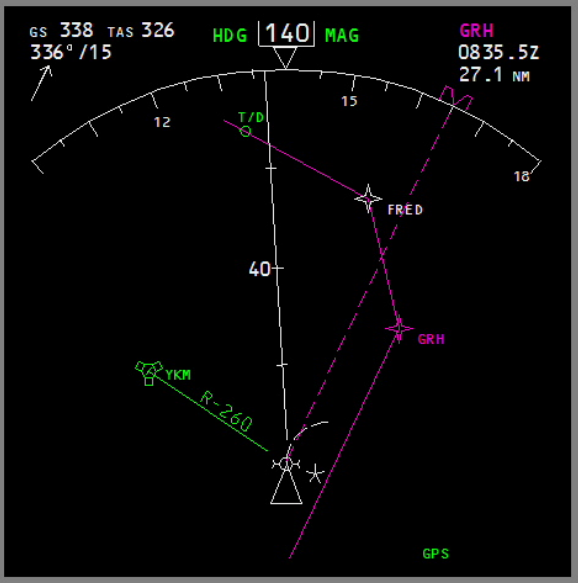
TJA,B,C,D,G, H,
TJR to TJW, TKA to TKF

DATA map switch selected.



POS (position) map switch selected.



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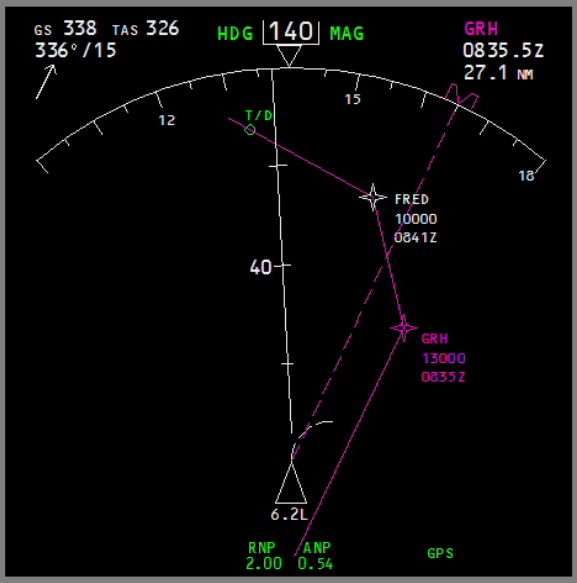
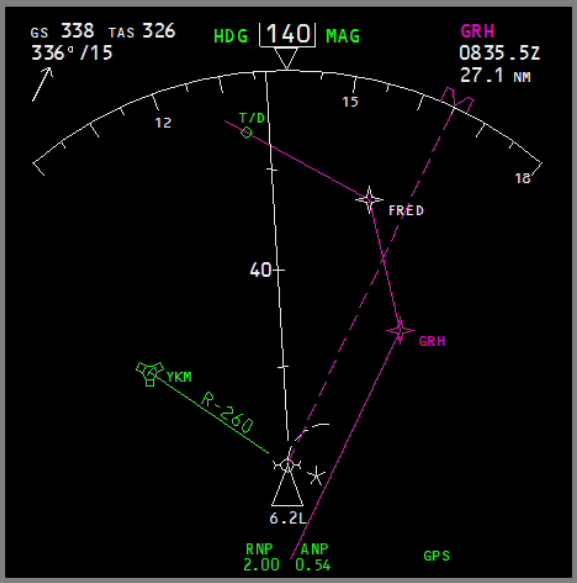
TKK to TKR,
TKU to TKZ

DATA map switch selected.



POS (position) map switch selected.



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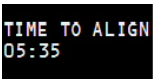
ND Symbology

The following symbols can be displayed on each ND, depending on EFIS control panel switch selections. Colors indicate the following:

W (white)	present status, range scales
G (green)	dynamic conditions
M (magenta)	command information, pointers, symbols, fly–to condition
B (blue or cyan)	inactive or background information
A (amber)	cautions, faults, flags
R (red)	warnings.

Heading, Track, and Speed

Symbol	Name	ND Mode	Remarks
	Heading orientation (G), current heading (W), heading reference (G), and heading pointer (W)	Shows heading up for all modes	Displays HDG as the display orientation, current heading, MAG or TRU as the heading reference, and points to the heading on the compass rose.
	Grid heading (W)	MAP, MAP CTR, PLAN	Displays above 70° latitude. TJR to TJW, TKK to TKR, TKU to TKZ
	ADIRU time to align (W)	All	Indicates time remaining for IRU alignment. Replaces wind direction/ speed and wind arrow, on the ground, during alignment.
	Selected heading bug (M)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Displays the MCP–selected heading. A dashed line (M) may extend from the marker to the airplane symbol. In the MAP mode with LNAV, LOC, or ROLLOUT engaged, the dashed line is removed 10 seconds after the selected heading bug is moved.
	Selected track bug (M)	MAP, MAP CTR, VOR, VOR CTR,	Displays the MCP–selected track. A dashed line (M) may extend from

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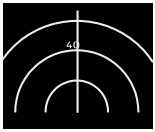
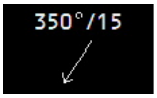
Symbol	Name	ND Mode	Remarks
		APP, APP CTR	the marker to the airplane symbol.
	Track line and range scale (W)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Indicates current track. Number indicates range (VOR CTR and APP CTR do not display range).
	Range arcs (W)	MAP, MAP CTR, VOR CTR, APP CTR	Replaces the range scale when TCAS, weather radar, or terrain is selected.
	Heading/track reference (G) box (W) in TRU, box (A) if TRU displayed in descent	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Indicates heading/ track is referenced to magnetic north or true north. Switching from TRU to MAG displays a box around MAG for 10 seconds.
	Expanded compass (W)	MAP, APP, VOR	Displays 90° of compass rose.
	Current heading pointer (W)	MAP, MAP CTR	Points to current heading on the compass rose.
	Groundspeed (W)	All	Current ground speed.
	True airspeed (W)	All	Current true airspeed displayed above 100 knots.
	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 the PLAN map mode.

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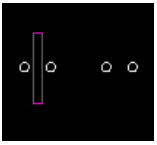
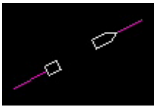
Radio Navigation

Symbol	Name	ND Mode	Remarks
	Reference receiver (G)	VOR, VOR CTR, APP, APP CTR	Indicates the selected receiver as the display reference.
	ILS (W)/VOR (W) Reference receiver frequency or identifier display	VOR, VOR CTR, APP, APP CTR	Located in the upper corner. Frequency displayed before the identifier is decoded. The decoded identifier replaces the frequency. Medium size characters for VOR, small size characters for DME only.
	DME distance (W)	VOR, VOR CTR, APP, APP CTR	Located in the upper corner. Indicates DME distance to the reference navaid.
	Reference ILS or VOR course (W)	VOR, VOR CTR, APP, APP CTR	Indicates the VOR course or ILS localizer course.
	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 ½ dots from center.
	Selected course pointer (W) and line (M)	VOR, VOR CTR, APP, APP CTR	Displays CDU–selected course.
	Glide slope pointer (M) and scale (W)	APP, APP CTR	Displays glideslope position and deviation. Deviation indicator fills (M) when less than 2 ½ dots from center.
	To/from indication (W)	VORCTR	Located near airplane symbol. Displays VOR TO/FROM indication.

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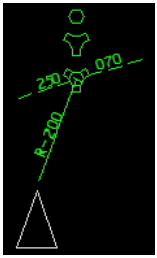
Symbol	Name	ND Mode	Remarks
	To/from indication (W)	VOR, VOR CTR	Displays VOR to/from indication.
	VOR (B, G), DME/TACAN (B, G), VORTAC (B, G)	MAP, MAP CTR	When the EFIS control panel STA map switch is selected on, appropriate navaids are displayed (B). Tuned VHF navaids are displayed in green, regardless of switch selection. When a navaid is manually tuned, the selected course and reciprocal are displayed.
	VOR/DME raw data radial and distance (G)		When the POS map switch is selected on, the station radial extends to the airplane.
	Left VOR (G) or ADF (B) pointer head and tail	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Indicates bearing to (head) or from (tail) the tuned station, if selected on the respective EFIS control panel.
	Right VOR (G) or ADF (B) pointer head and tail		
	VOR (G) selection	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Located lower left or right corner. Represents VOR position of the EFIS control panel VOR/ADF switches.
	ADF (B) selection	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Located lower left or right corner. Represents ADF position of the EFIS control panel VOR/ADF switches.
	VOR frequency or identifier (G)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Located lower left or right corner. Frequency is displayed before identifier is decoded. Decoded identifier replaces the frequency. Small size characters indicate only

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Symbol	Name	ND Mode	Remarks
			DME information is being received.
	ADF frequency or identifier (B)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Located lower left or right corner. Frequency is displayed before identifier is decoded. Decoded identifier replaces the frequency.
	DME distance (G)	MAP, MAP CTR, VOR, VOR CTR, APP, APP CTR	Located in the lower corners. Indicates DME distance to the referenced navaid.

Map

Symbol	Name	ND Mode	Remarks
	Airplane symbol (W)	MAP, MAP CTR, VOR, APP	Current airplane position is at the apex of the triangle.
	Airplane symbol (W)	VOR CTR, APP CTR	Current airplane position is at the center of the symbol.
	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.
	Airplane symbol (W)	PLAN	Indicates actual position and track along the flight plan route in plan mode only.

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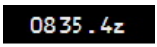
Symbol	Name	ND Mode	Remarks
			Inhibited north of 82N latitude and south of 82S latitude.
	Active waypoint identifier (M)	MAP, MAP CTR, PLAN	Indicates the active flight plan waypoint, the next waypoint on the route of flight.
	Active waypoint distance (W)	MAP, MAP CTR, PLAN	Distance to the active waypoint.
	Active waypoint time to go during alternate navigation (W)	MAP, MAP CTR, PLAN	Indicates CDU calculated time to go in hours and minutes to active waypoint during alternate navigation.
	Active waypoint ETA (W)	MAP, MAP CTR, PLAN	Indicates ETA at the active waypoint. Time is based on distance to go and ground speed. It does not consider FMC performance predictions and may differ from other FMC ETAs that do.
	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	When the EFIS control panel WPT map switch is selected on, waypoints not on the selected route are displayed, in ND ranges of 10, 20, or 40.

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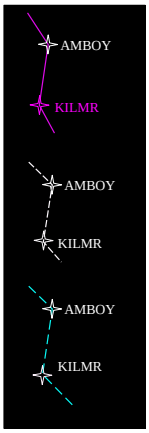
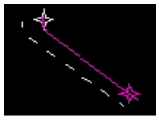
Symbol	Name	ND Mode	Remarks
	Flight plan route: active (M), modified (W), inactive (B)	MAP, MAP CTR, PLAN	The active route is displayed with a continuous line (M) between waypoints. Active route modifications are displayed with short dashes (W) between waypoints. Inactive routes are displayed with long 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	When the EFIS control panel DATA map switch is selected on, entered or procedural altitude and ETAs for route waypoints are displayed. Times consider FMC performance predictions and wind data.
	Altitude range arc (G)	MAP, MAP CTR	Based on vertical speed and groundspeed, indicates the approximate map position where the MCP altitude will be reached.
	Altitude profile point and identifier (G)	MAP, MAP CTR	Indicates the approximate map position of the FMC–calculated T/C (top–of–climb), T/D (top–of–descent), S/C (step climb), and E/D (end of descent) points.

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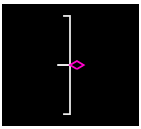
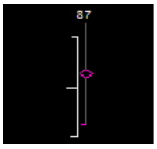
Symbol	Name	ND Mode	Remarks
			Predicted altitude/ETA points entered on the FIX page display the altitude/ETA along with the profile point. Deceleration points have no identifier.
TJA,B,C,D,G, H, TJR to TJW, TKA to TKF 	VNAV path pointer (M) and deviation scale (W)	MAP, MAP CTR	Displays vertical deviation from selected VNAV PATH during descent only. Scale indicates ±400 feet deviation. Digital display is provided when the pointer indicates more than ±400 feet.
TKK to TKR, TKU to TKZ 	VNAV path pointer (M) deviation scale (W) digital vertical path deviation (W) vertical path deviation band (M)	MAP, MAP CTR	Displays vertical deviation from selected VNAV PATH during descent only. Scale indicates ±400 feet deviation. Digital display is provided when the pointer indicates more than ±20 feet.
	Airport and runway (W)	MAP, MAP CTR, PLAN	Displayed when selected as the origin or destination and ND range is 80, 160, 320, or 640 NM.
	Airport (B)	MAP, MAP CTR, PLAN	Displayed on MAP or MAP CTR mode when the EFIS control panel ARPT map switch is selected on. Display of origin and destination airports on MAP, MAP CTR, or PLAN mode is not affected by ARPT map switch selection.
	Airport and runway (W)	MAP, MAP CTR, PLAN	Displayed when selected as the origin or destination and ND range is 10, 20, or 40 NM. Dashed runway centerlines extend 14.2 NM.

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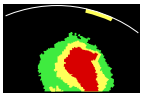
Symbol	Name	ND Mode	Remarks
	Energy management circles (B, W)	MAP, MAP CTR	Indicates clean (B) and speedbrake (W) energy management circles as defined on the CDU OFFPATH DES page.
	Selected reference point and bearing distance information (G)	MAP, MAP CTR, PLAN	Displays the reference point selected on the CDU FIX page. Bearing and/or distance from the fix are displayed with dashes (G).
	FMC position update status (G)	MAP, MAP CTR	Indicates the system providing FMC position update.
	GPS position (W)	MAP, MAP CTR	When the EFIS POS map switch is selected on, indicates GPS position relative to FMC position.
	ADIRU position (W)	MAP, MAP CTR	When the EFIS control panel POS map switch is selected on, the star indicates ADIRU position relative to FMC position.
	Weather radar returns (R, A, G, M)	MAP, MAP CTR, VOR, APP	The most intense areas are displayed in red, lesser intensity in amber, and lowest intensity green. Turbulence is displayed in magenta.
	Weather radar Path Attenuation Compensation (A)	MAP, MAP CTR, VOR, APP	Attenuated region behind rainfall (radar shadow) is indicated by amber arc on outer range ring.
	Selected map options (B)	MAP, MAP CTR	Displays EFIS control panel selected map options.

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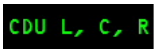
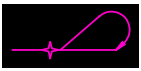
Symbol	Name	ND Mode	Remarks
	North up arrow (G)	PLAN	Indicates map background is oriented and referenced to true north.
	Map source annunciation (G)	MAP, MAP CTR	Displays ND source if: • CDU is selected on respective navigation source select switch • both FMCs fail, or • a manually selected FMC fails.
	Holding pattern: active route (M), modified route (W), inactive route (B)	MAP, MAP CTR, PLAN	A holding pattern appears when in the flight plan. Depicts entry path until entry completed.
	Procedure turn: active route (M), modified route (W), inactive route (B)	MAP, MAP CTR, PLAN	A procedure turn appears when in the flight plan. It increases in size upon entering the procedure turn. Also used for procedure hold course reversal.
	Alternate airports (B)	MAP, MAP CTR, PLAN	PLAN: displays up to four alternate airports. When 640 NM range is selected, offscale airports are displayed with a directional arrow relative to PLAN center point and distance blanked. MAP, MAP CTR: displays FMC or pilot selected primary alternate airport. When EFIS control panel APRT map switch is selected on, displays up to four alternate airports. When 640 NM range is selected, offscale airports are displayed with a directional arrow and distance relative to airplane position.

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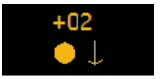
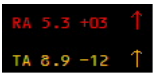
TCAS

See Traffic Alert and Collision Avoidance System (TCAS) on page 15.20.11 for more information.

Symbol	Name	ND Mode
	TCAS resolution advisory (RA), relative altitude (R)	MAP, MAP CTR, APP, VOR
	TCAS traffic advisory (TA), relative altitude (A)	MAP, MAP CTR, APP, VOR
	TCAS proximate traffic, relative altitude (W)	MAP, MAP CTR, APP, VOR
	TCAS other traffic, relative altitude (W)	MAP, MAP CTR, APP, VOR
	TCAS TA, absolute altitude	MAP, MAP CTR, APP, VOR
	TCAS no bearing message (RA–R, TA–A)	MAP, MAP CTR, APP, VOR
	TCAS traffic alert message (RA–R, TA–A)	All
	TCAS off scale message (RA–R, TA–A)	MAP, MAP CTR, APP, VOR
	TCAS mode (B)	MAP, MAP CTR, APP, VOR
	TCAS mode (B)	All
	TCAS mode (B)	All

TKK to TKR, TKU to TKZ

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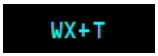
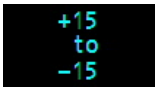
Symbol	Name	ND Mode
	TCAS mode (A)	MAP, MAP CTR, APP, VOR
	TCAS mode (A)	MAP, MAP CTR, APP, VOR

Radar

See Weather Radar on page 11.20.11 for more information.

Symbol	Name	ND Mode
	Weather radar test mode (B) (A)	MAP, MAP CTR, APP, VOR
	Precipitation only mode (B)	MAP, MAP CTR, APP, VOR
	WXR and turbulence mode (B)	MAP, MAP CTR, APP, VOR
	WXR receiver gain (B)	MAP, MAP CTR, APP, VOR
	Mode used with down–tilt, when ground mapping (B)	MAP, MAP CTR, APP, VOR
TJA,B,C,D,G, H,TKA to TKF 	WXR antenna tilt (B)	MAP, MAP CTR, APP, VOR
TJR to TJW, TKK to TKR, TKU to TKZ	WXR antenna automatic tilt mode selected (B)	MAP, MAP CTR, APP, VOR
TJR to TJW, TKK to TKR, TKU to TKZ	WXR antenna manual tilt mode selected (B)	MAP, MAP CTR, APP, VOR
	WXR system failure (A)	MAP, MAP CTR, APP, VOR
	WXR receiver transmitter failure (A)	MAP, MAP CTR, APP, VOR

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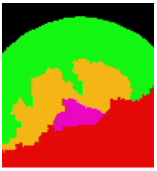
Symbol	Name	ND Mode
	WXR antenna fault (A)	MAP, MAP CTR, APP, VOR
	Automatic tilt mode failure (A)	MAP, MAP CTR, APP, VOR
	WXR control panel failure (A)	MAP, MAP CTR, APP, VOR
	WXR loss of attitude data (A)	MAP, MAP CTR, APP, VOR
	WXR calibration fault (A)	MAP, MAP CTR, APP, VOR

TJR to TJW, TKK to TKR, TKU to TKZ

Look-Ahead Terrain

See Look-Ahead Obstacles and Peaks Terrain Alerting System on page 15.20.16 for more information.

Symbol	Name	ND Mode
	Obstacle display (R, A, G)	MAP, MAP CTR, APP, VOR
	Terrain display (R, A, G, M)	MAP, MAP CTR, APP, VOR
	Obstacle annunciation (R, A)	All
	Terrain mode annunciation (C) and highest and lowest terrain or obstacle altitudes (R, A, G, M)	MAP, MAP CTR, APP, VOR

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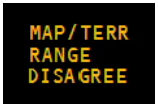
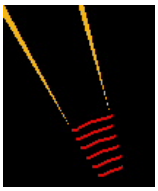
Symbol	Name	ND Mode
	Terrain test mode annunciation (C)	All
	Terrain annunciation (R, A)	All
	Terrain status annunciation (A)	MAP, MAP CTR, APP, VOR
	Terrain status annunciation (A)	MAP, MAP CTR, APP, VOR
	Terrain status annunciation (A)	MAP, MAP CTR, APP, VOR
	Terrain range status annunciation (A)	MAP, MAP CTR, APP, VOR
	Terrain range status annunciation (A)	MAP, MAP CTR

Predictive Windshear

See Predictive Windshear (PWS) and Immediate Windshear Alerting Systems on page 15.20.19 for more information.

Symbol	Name	ND Mode
	Predictive windshear symbol (R, B, A)	MAP, MAP CTR, APP, VOR
	Windshear annunciation (R, A)	All

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Normal Checklist

1 Open Loop Indicator

Indicates the line item is an open loop action item. Requires flight crew confirmation to become complete.

2 Cursor Selection Box

Highlights the cursor selection area.

3 Complete Indicator

Indicates line item is complete.

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4 NORMAL Checklist (NORMAL) Key

Select—

- shows the next incomplete normal checklist
- shows normal checklists menu page when all normal checklists are complete.

5 Line Item Override (ITEM OVRD) Key

Select—overrides line item in current line item box. Item shows cyan.

6 Checklist Line Item

Shows (white)—the action item is incomplete.

Shows (green)—the action item is complete.

Shows (cyan)—the action item is inactive or overridden.

7 Current Line Item Box

Highlights current incomplete line item.

8 Checklist Reset (CHKL RESET) Key

Select—starts the current checklist from the beginning. All line items become incomplete and the current line item box, the cursor selection box, and the cursor move to first incomplete line item.

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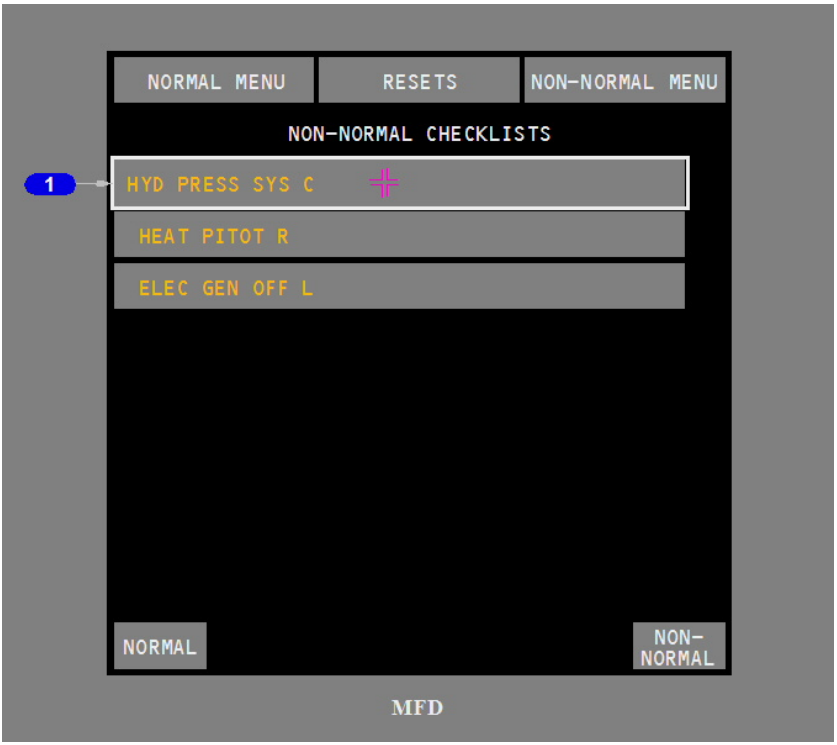
Non-Normal Checklist Queue



1 Checklist Key

Select—shows the checklist for the title on the key.

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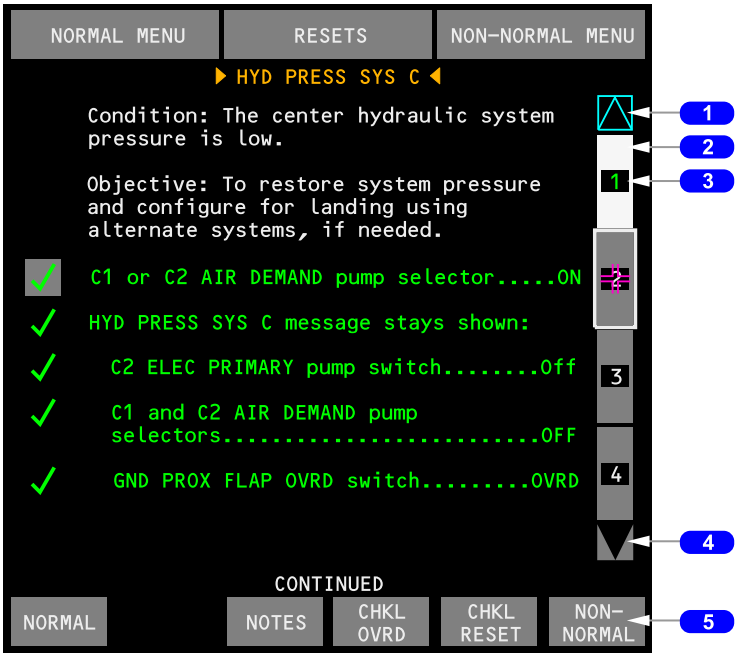
Non-Normal Checklist



MFD

1 Previous Page Key

Select—shows the previous checklist page.

Shows (gray)—the previous page is available.

Shows (cyan)—the key is inactive. The first page of checklist is shown.

2 Checklist Page Key

Select—shows the checklist page corresponding to the page number on the key.

Shows (white)—the checklist page corresponding to the page number on the key is currently shown.

Shows (gray)—the checklist page corresponding to the page number on the key is not currently shown.

3 Checklist Page Number

Shows (white)—the checklist page is incomplete.

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Shows (green)—the checklist page is complete.

4 Next Page Key

Select—shows the next checklist page.

Shows (gray)—the next page is available.

Shows (cyan)—the key is inactive. The last page of the checklist is shown.

5 Non-Normal checklist (NON-NORMAL) Key

Shows when there are additional incomplete non-normal checklists in the checklist queue.

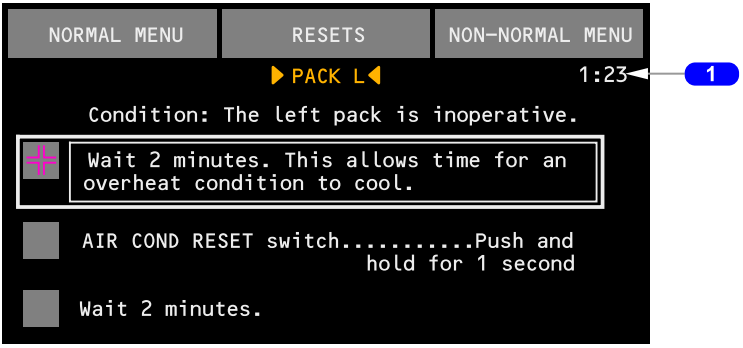
Select—

- shows the next incomplete non-normal checklist when one incomplete non-normal checklist is in the checklist queue
- shows the non-normal checklist queue when more than one incomplete non-normal checklist is in the checklist queue

Shows (white)—an incomplete non-normal checklist has not been shown.

Shows (amber)—an incomplete non-normal checklist has been shown but is not currently shown.

Checklist Timer



MFD

1 Timer

Shows the time remaining of a time delay for the current line item. If the line item is complete, the current line item box stays on the line item until the timer expires.

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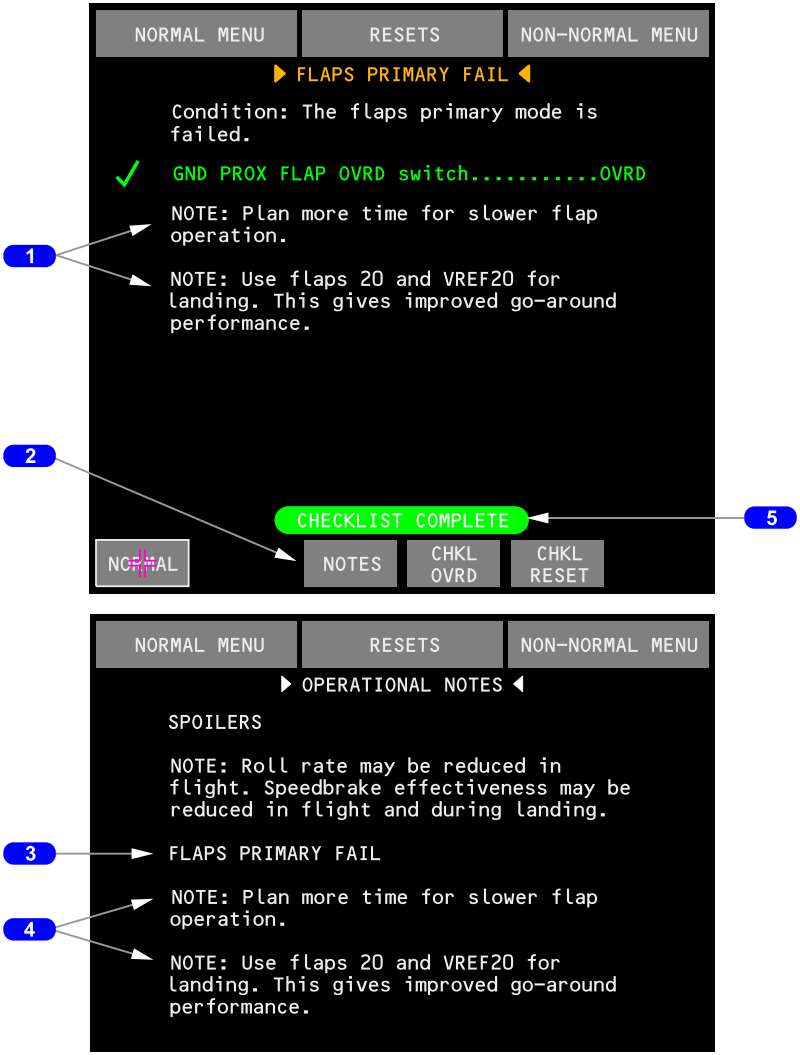
Operational Note



MFD

1 Operational Notes

Shown in non-normal checklist.

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2 Operational Notes (NOTES) Key

Select—shows the operational notes page.

3 Checklist Reference

Indicates the non-normal checklist from which operational notes originated.

4 Operational Notes

Shown on operational notes page.

5 CHECKLIST COMPLETE Indicator

Shows when all of the line items are ether complete, inactive, or overridden, and all the pages have been shown.

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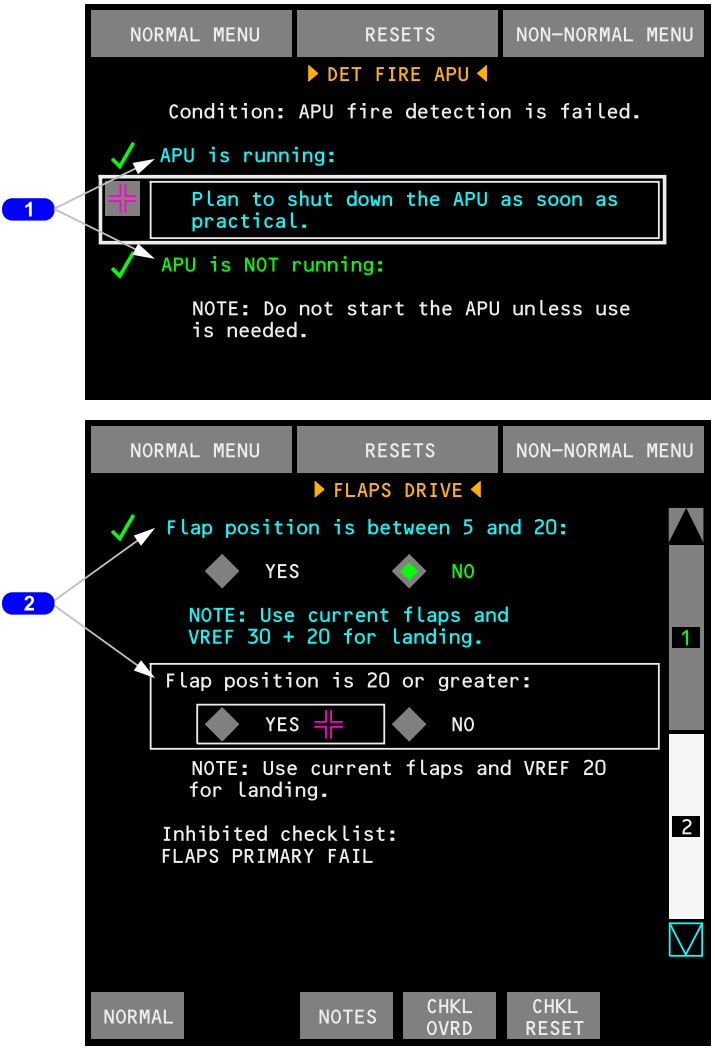
Conditional Line Item



MFD

1 Closed Loop Conditional Line Items

Shows (white)—the conditional line item is incomplete.

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Shows (cyan)—the conditional line item is sensed false. All line items indented below the conditional line item become inactive and show cyan. The current line item box, cursor selection box, and cursor skip the inactive items and move to the next incomplete line item.

Shows (green)—the conditional line item is sensed true. The current line item box, cursor selection box, and cursor move to the next incomplete line item.

2 Open Loop Conditional Line Items

Shown (white)—the conditional line item is incomplete.

Shows (cyan)—the conditional line item is selected NO. All line items indented below the conditional line item become inactive and show cyan. The current line item box, cursor selection box, and cursor skip the inactive items and move to the next incomplete line item.

Shows (green)—the conditional line item is selected YES. The current line item box, cursor selection box, and cursor move to the next incomplete line item.

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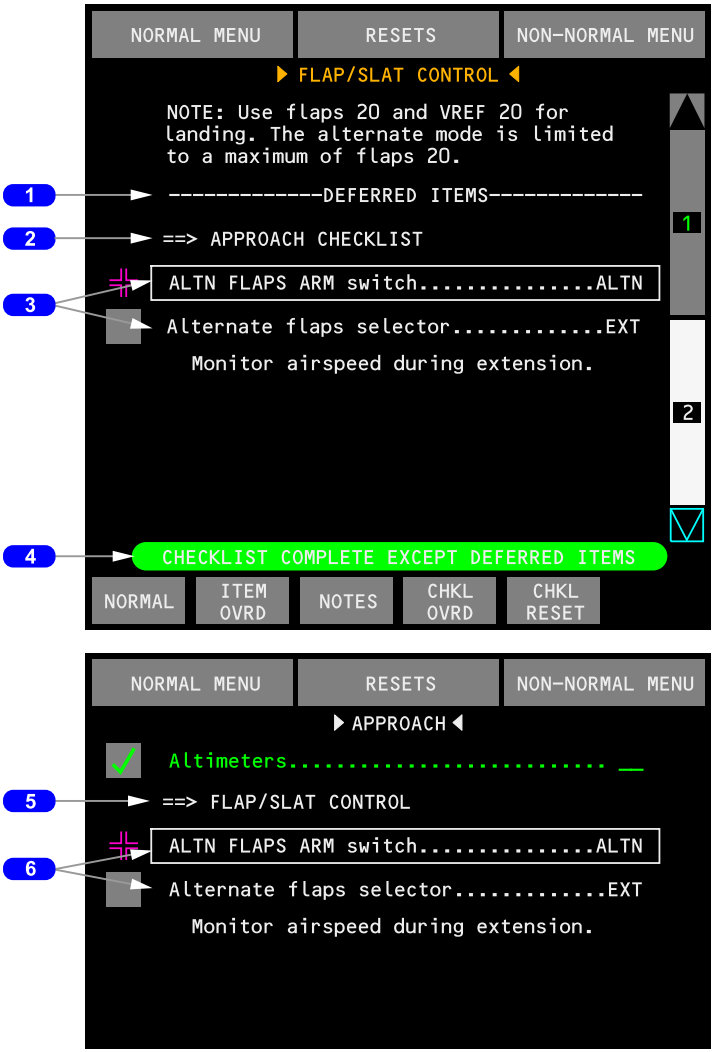
Deferred Line Item



MFD

1 Deferred Line Items Separator

Separates deferred line items from non-normal checklist line items. All the line items below separator are deferred.

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2 Checklist Reference

Indicates the normal checklist to which deferred line items go.

3 Deferred Line Items

Shown in non-normal checklist.

4 CHECKLIST COMPLETE EXCEPT DEFERRED ITEMS Indicator

Shows when all line items except deferred line items are either complete, inactive, or overridden, and all pages before the deferred line items separator have been shown.

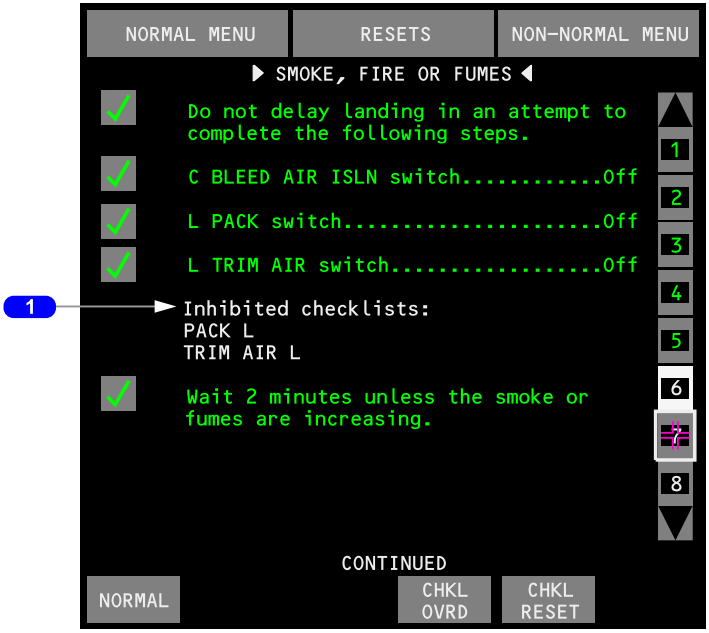
5 Checklist Reference

Indicates the non-normal checklist from which deferred line items originated.

6 Deferred Line Items

Shown in normal checklist.

Inhibit Checklist Line Item



MFD

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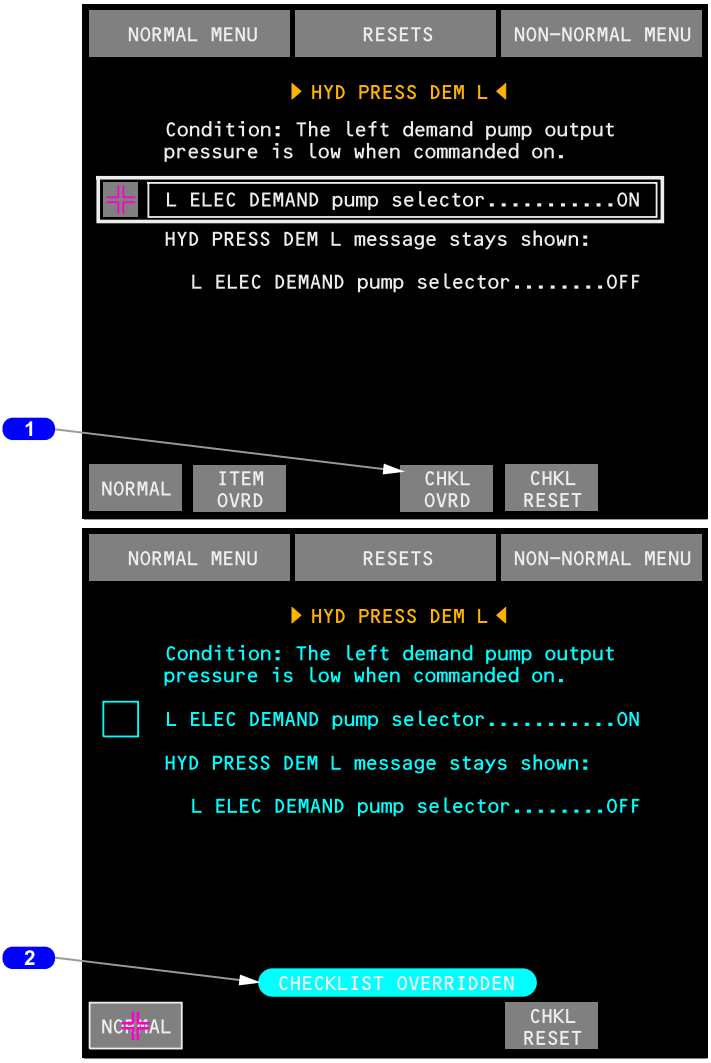
1 Inhibit Checklist Line Item

Shows checklists which are inhibited or removed from the checklist queue and whose checklist icons are inhibited or removed from the EICAS display.

Checklist Override



MFD

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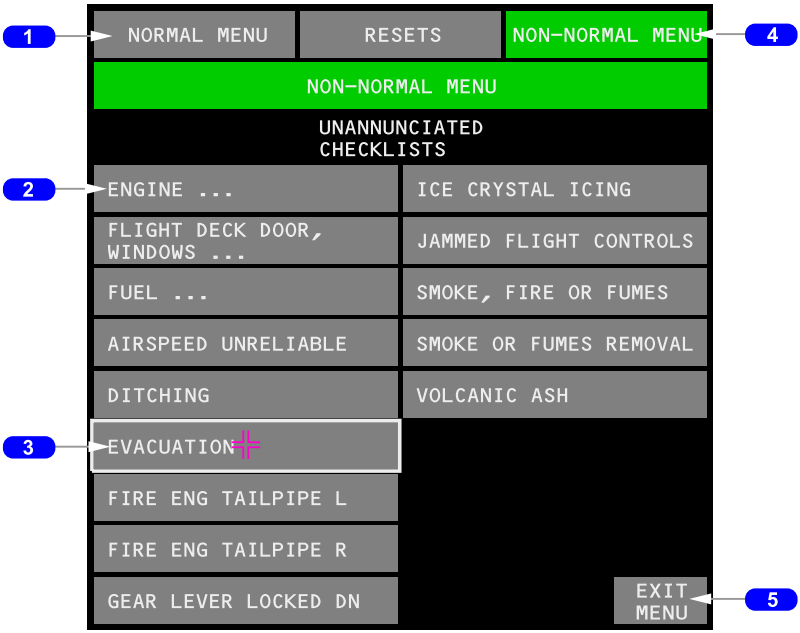
1 Checklist Override (CHKL OVRD) Key

Select—overrides the current checklist.

2 CHECKLIST OVERRIDDEN Indicator

Shows when the checklist is overridden. All the line items show cyan.

Checklists Menu Page



MFD

1 Normal Menu (NORMAL MENU) Key

Select—shows the normal checklists menu. The menu contains checklist keys for the normal checklists.

2 Menu Key

Indicated by three dots following menu title.

Select—shows the checklists menu page for the title on the key.

3 Checklist Key

Select—shows the checklist for the title on the key.

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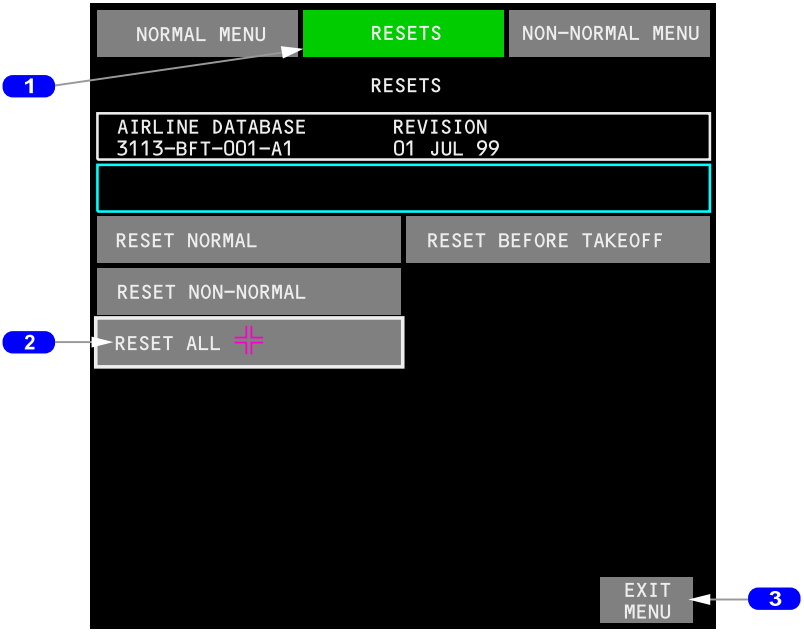
4 Non-Normal Menu (NON-NORMAL MENU) Key

Select—shows the non-normal checklists menu page. The page contains menu keys for the airplane systems.

5 Exit Menu (EXIT MENU) Key

Select—exits page for access to the normal and non-normal checklist keys.

Resets Menu Page



MFD

1 Resets Menu (RESETS) Key

Select—shows the checklist resets page.

2 Reset Key

Select—resets checklists corresponding to the title on the key. All affected checklists become incomplete.

3 Exit Menu (EXIT MENU) Key

Select—exits page for access to the normal and non-normal checklist keys.

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Introduction

The electronic checklist (ECL) system shows normal and non-normal checklists on a multifunction display (MFD). The electronic checklist system is not required for dispatch, and a paper checklist or other approved backup checklist must be available on the flight deck.

The checklist display switch on the display select panel opens the electronic checklist. The flight crew operates the checklist with the cursor control devices (CCDs). Cursor control devices and MFD selection are described in the System Description section of this chapter.

Electronic Checklist Operation

Pushing the checklist display switch on the display select panel shows the correct checklist (see Checklist Priority on page 10.60.6 for the checklist priority order). Only one checklist can show at a time.

Three types of checklists can be shown:

- normal
- non-normal for an EICAS message (annunciated)
- non-normal for a condition without an EICAS message (unannunciated).

After each normal checklist is complete, pushing the checklist display switch twice or selecting the normal key shows the next normal checklist in sequence.

Some checklist steps must be checked-off by the flight crew to show as complete. Other checklist steps are automatically checked off from sensed flight deck control positions, airplane system status, or EICAS messages.

Checklist Pages

A checklist can have one or more pages. If a checklist is longer than one page, page keys show on the right side of the page.

When a checklist has more than one page and the line items on the current page are complete, the cursor moves to the checklist page key for the next page. CONTINUED shows at the bottom of the page. Pressing the CCD cursor select switch shows the next checklist page.

When a checklist is complete and there are no additional checklists in the non-normal checklist queue, the cursor automatically moves to the normal checklist key in the lower left corner of the page. Pressing the CCD cursor select switch shows the next normal checklist in sequence. If there are checklists in the non-normal queue, the cursor moves to the non-normal key in the lower right corner of the page. Pressing the CCD cursor select switch shows the next non-normal checklist (if only one is in the queue) or the non-normal checklist queue.

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Checklist Status

The checklist complete indicator shows at the bottom of all pages of the checklist when all of the line items are either complete, inactive, or overridden, and every page has been shown. If the flight crew chooses not to do a line item, the line item can be overridden with the line item override key at the bottom of the page. When a line item is overridden, the text changes color to cyan and the current line item box moves down to the next incomplete line item. If the flight crew chooses to not complete a checklist, the checklist can be overridden by selecting the checklist override key at the bottom of the page. When a checklist is overridden, the text of the entire checklist changes color to cyan, and the checklist overridden indicator shows at the bottom of all pages.

Checklist Line Items

A checklist has one or more line items. These are the types of line items:

- free text
- action item
- operational note
- conditional line item
- inhibit checklist
- deferred item
- timer.

Free text items show text and have no further function. The other line item types are described below.

Incomplete line items have white text. Complete line items have green text with a complete indicator (a green check mark) to the left. Overridden and inactive line items have cyan text.

When the checklist is opened, the current line item box moves to the first incomplete line item. When the cursor is on that line item, the cursor selection box encloses the current line item box. When the line item becomes complete, the cursor, the cursor selection box, and the current line item box move to the next incomplete line item.

Action Items

Each step in a checklist that requires a flight crew action is an action item. There are two types of action items: closed loop and open loop.

Closed Loop Action Items

Closed loop action items continuously monitor the position of a flight deck switch, lever, or selector. In a few cases, actual system state, such as flap or landing gear position, is monitored. When the control is in the required position, the action item color changes to green and the complete indicator shows to the left of

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the action item. The current line item box then moves to the next incomplete line item.

Open Loop Action Items

Open loop action items require the flight crew to manually confirm completion with the CCD. Open loop action items do not monitor control position or system state. Open loop action items look different from closed loop action items. Open loop action items have an open loop indicator, a gray box to the left of the line item. When the cursor is within the current line item box or the open loop indicator, and the CCD cursor select switch is pushed, the action item color changes from white to green and a complete indicator shows on the open loop indicator. The current line item box then moves to the next incomplete line item.

Operational Notes

Operational notes are for the ongoing consequences of a non-normal condition, such as inoperative equipment or operational limitations. The flight crew should read all operational notes, but the current line item box does not stop on an operational note because no immediate flight crew action is required. Operational notes have white text, unless inactive or overridden.

The operational notes page stores active operational notes for easy access and review by the flight crew later in flight. After a non-normal checklist that has operational notes is opened, the operational notes are available for the rest of the flight on the operational notes page. Access to the operational notes page is by the operational notes key at the bottom of the checklist page. Operational notes on the operational notes page have a checklist reference with the title of the checklist from which they came.

If there are more than one page of operational notes, page keys show.

The status of an operational note is based on the status of the EICAS message for the checklist with the note. If the EICAS message blanks, unneeded notes can also blank from the notes page.

Conditional Line Items

Conditional line items control the path through a complex checklist. The current line item box steps through line items or it skips line items based on a condition.

There are two types of conditional line items: open loop and closed loop.

Open Loop Conditional Line Items

Open loop conditional line items have choices labeled YES and NO. When the conditional line item becomes the current line item, the cursor moves to the YES - NO line. The flight crew uses the CCD to select the correct answer.

If the flight crew selects YES, the line items indented below the conditional line item become active. The current line item box moves to the first incomplete line item.

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If the flight crew selects NO, the line items indented below the conditional line item become inactive and change color to cyan. The current line item box skips the inactive items. Inactive operational notes are removed from the operational notes page. Inactive deferred line items are removed from their normal checklist. Inactive inhibit checklist line items have no effect.

The YES - NO choices remain available after a selection is made. The flight crew can change selections at any time.

A group of two or more open loop conditional line items can be a mutually exclusive set. When the flight crew selects YES on any one of the items in the exclusive set, all of the other items are automatically set to NO. However, the opposite is not true. If all but one of the items are selected NO, the last item is not automatically set to YES. The flight crew must manually select YES on one of the conditional line items in the exclusive set.

Closed Loop Conditional Line Items

A closed loop conditional line item works the same as an open loop item except the choice is made automatically based On a monitored flight deck control, an EICAS message, or an airplane system state. If the condition is true, the conditional line item changes color to green and the line items indented below it become active. If the condition is false, the conditional line item and the line items indented below it become inactive and change color to cyan. The current line item box skips the inactive items.

Inhibit Checklist Line Items

One airplane system failure can cause more than one EICAS alert message (a primary message and one or more consequential messages). The flight crew should do the checklist for the primary message not the consequential messages. Inhibit checklist line items remove unneeded non-normal checklists (consequential checklists) from the checklist queue.

Consequential EICAS alert messages can show for a primary failure condition. For example, the AUTO SPEEDBRAKE message shows due to a HYD PRESS SYS C condition. Consequential EICAS alert messages can also show due to flight crew actions in a non-normal checklist. For example, a PACK L message shows when the flight crew selects the pack off in the SMOKE, FIRE AND FUMES checklist. An inhibit checklist line item in the primary checklist inhibits the consequential checklists.

The inhibit checklist line item shows the consequential checklists which are inhibited. The inhibit has the following effects on a consequential checklist:

- the checklist icon is removed from the consequential EICAS message
- the consequential checklist is removed from the checklist queue
- operational notes from the consequential checklist are removed from the operational notes page
- deferred line items are removed from the normal checklists.

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If a consequential checklist has steps, notes, and information that are needed for the primary failure condition,then these are included in the primary checklist.

An inhibit checklist line item becomes active when the message for the primary condition shows, before its checklist is opened.

In the paper checklist, an inhibit checklist line item shows as "Do not accomplish the following checklist".

Deferred Line Items

Deferred line items are items that are part of a non-normal checklist, but must be done later in the flight, usually during approach.

When a non-normal checklist that has deferred line items is opened, the deferred line items are automatically added to the end of a normal checklist. Deferred line items in a normal checklist have a checklist reference with the title of the checklist from which they came. Any type of line item can be a deferred line item.

A non-normal checklist that has deferred line items is complete when all line items before the deferred line items are complete. The checklist complete except deferred items indicator shows at the bottom of the page.

If the non-normal condition occurs after completion of the normal checklist that would get the deferred line items, the non-normal checklist is complete when all line items, including the deferred line items, are complete.

Timers

Timers help the flight crew keep track of time delays that are part of checklists. The timer shows in the upper right hand corner of the checklist page. All timers are countdown timers. Timers can be part of action items or conditional line items.

A timer on a line item starts when the line item just before it is complete. Timers run in the background. This allows the flight crew to leave the checklist to accomplish other tasks and then return to the checklist. Timers are white when they are running. When the timer is done, it shows ":00" and the color changes to amber.

The current line item box does not move to the next incomplete line item until the line item with the timer is complete and the timer is done.

Checklist Menu Operation

Usually, the flight crew uses the checklist display switch on the display select panel and the normal and non-normal keys to select checklists. Checklists can also be selected and opened with menus. The normal menu, the resets page, and the non-normal menu can be selected with the keys at the top of the checklist page, using the CCD.

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An exit menu key is in the lower right corner of all menu pages. This exits the menu page to allow access to the normal and non-normal checklist keys.

Normal Menu

Normal checklists are arranged in the menu in sequence. Selecting the NORMAL menu key or the checklist display switch results in the display of the next incomplete normal checklist in sequence.

Non-Normal Menu

The non-normal menu has submenus by airplane system. An airplane system submenu has the checklists for that system. If a system has more checklists than can fit on a page, additional submenus group checklists by name. Submenu titles end with "...".

Resets Page

The resets page shows the checklist database part number and revision information and the following manual resets:

- RESET NORMAL
- RESET NON-NORMAL
- RESET ALL.

Other manual resets can also be on this page. These can reset more than one checklist. See Checklist Resets on page 10.60.9 in this section.

Note: RESET NORMAL, RESET NON-NORMAL, and RESET ALL are intended for ground use only. If used in flight, RESET NON-NORMAL and RESET ALL will reset completed non-normal checklists, requiring the crew to start the checklist over. It can also cause needed operational notes and deferred line items to be lost.

Checklist Priority

Air/ground logic, fuel control switch position and start selector position, and EICAS message level determine the priority for checklists when the checklist display switch is pushed.

On the ground with both fuel control switches in CUTOFF and both engine start selectors in NORM, the priority is:

- checklists for EICAS warning messages
- NORMAL checklists (incomplete or not yet opened).

On the ground with one or both fuel control switches in RUN, one or both engine start selectors in START; or in the air, the priority is:

- checklists for any EICAS alert messages that have icons
- incomplete unannunciated checklists
- NORMAL checklists.

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Normal Checklists

Normal electronic checklists are used the same way as paper checklists. The flight crew does the normal procedures from memory, then they read the checklist to confirm the actions.

Normal Checklist Access

The checklists are sequenced as stated in QRH, Normal Checklists (Chapter NC).

When each normal checklist is complete, the normal checklist key shows the next incomplete normal checklist in the sequence.

The flight crew can open any normal checklist from the normal menu. If a completed normal checklist is opened from the menu, it is reset.

Normal Checklist Completion

When all of the line items in a checklist are complete, the checklist complete indicator (white text on a green background) shows at the bottom of the checklist page.

When a checklist is overridden, the checklist overridden indicator (white text on a cyan background) shows at the bottom of the checklist page.

Incomplete Normal Checklist Alerting

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The EICAS caution message CHKL INCOMPLETE NORM shows to alert the crew when critical line items in a checklist are not complete before the corresponding phase of flight. Also, the normal checklist key changes color to amber to show that one or more normal checklists are incomplete.

These are the critical flight phases:

- before takeoff phase—occurs when the airplane is on the FMC takeoff runway and aligned for takeoff
- approach phase—occurs when the airplane descends through the FMC transition altitude, and the flap handle is not in UP
- landing phase—occurs when the airplane descends below 800 feet (or 500 feet by airplane option) above the FMC landing altitude.

The CHKL INCOMPLETE NORM message shows until the normal checklist is complete or overridden. The checklist icon shows with the CHKL INCOMPLETE NORM message to alert the flight crew to open the checklist, but there is no non-normal checklist for this EICAS message.

Non-Normal Checklists

Non-normal electronic checklists are used the same way as paper checklists. Non-normal checklists are done by read-and-do. If a checklist has memory steps, the flight crew does those steps before opening the checklist.

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Non-Normal Checklist Access and Checklist Icon

Usually, the flight crew opens annunciated non-normal checklists by pushing the checklist display switch. Any non-normal checklist can be opened using the nonnormal menu.

EICAS messages determine which non-normal checklist shows automatically. If the checklist for an EICAS alert message has not been opened or is incomplete, the message has an icon, a white box to the left of the message. (See Electronic Checklist Displays on page 10.50.1 for information about the checklist icon.)

If an EICAS alert message has no icon, the checklist is complete, there is no checklist for the message, or another checklist inhibits the icon.

If one EICAS alert message with an icon shows, pushing the checklist display switch shows the checklist for that message. If more than one EICAS alert message with an icon shows, pushing the checklist display switch shows a list with the non-normal checklist queue. If there are more than ten checklists in the queue, the queue has more than one page.

Checklists in the queue are in the same order as the messages show on EICAS. If there are any active unannunciated checklists, they show in the queue after all of the annunciated checklists.

When an EICAS alert message shows, its checklist automatically goes into the queue. When the checklist is complete, the EICAS alert message can still show, but the checklist is removed from the queue. A checklist is also removed from the queue when it is inhibited by another checklist that becomes active.

The flight crew uses the CCD to select a checklist from the queue. When a checklist is open, the non-normal checklist key returns to the queue if there are other non-normal checklists in the queue.

If EICAS alert messages show or blank while the checklist queue is shown, the queue does not change automatically. The flight crew must exit the queue and open it again to see the checklists for the new EICAS messages.

Non-Normal Unannunciated Checklists

Non-normal checklists for conditions that do not have EICAS messages are unannunciated checklists. Unannunciated checklists can be opened only from menus. UNANNUNCIATED CHECKLISTS is the first submenu on the non-normal menu. This submenu provides quick access to all unannunciated checklists.

When an unannunciated checklist is opened, it remains in the checklist queue until it is complete.

If the flight crew opens an unannunciated checklist and chooses not to complete it, the checklist must be overridden.

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Non-Normal Checklist Completion

When all of the line items in a checklist are complete or inactive, the checklist complete indicator (white text on a green background) shows at the bottom of the checklist page.

When all of the line items in a checklist are complete or inactive, except for the deferred items, the checklist complete except deferred items indicator (white text on a green background) shows at the bottom of the checklist page.

When a checklist is overridden, the checklist overridden indicator (white text on a cyan background) shows at the bottom of the checklist page.

If a checklist is opened and not completed,then another checklist is opened, the text in the non-normal checklist key changes color to amber.

Hidden Non-Normal Checklist Alerting

TJR to TJW, TKK to TKR, TKU to TKZ

The EICAS advisory message CHKL NON-NORMAL shows when there is a non-normal checklist in the queue, its EICAS message is blank, and ECL is not open. The CHKL NON-NORMAL message alerts the flight crew to open ECL and complete the checklist. The message blanks when ECL is opened.

The hidden checklist condition usually occurs when the flight crew completes checklist memory items (for example, in response to an engine fire) that cause the EICAS message to blank, but there is still a checklist in the queue that must be completed. It also occurs when an unannunciated checklist is partially completed, then ECL is closed.

The checklist icon shows with the CHKL NON-NORMAL message to alert the flight crew to open the checklist, but there is no non-normal checklist for this EICAS message.

Checklist Resets

If a checklist is complete or partially complete and the flight crew wishes to begin the checklist again, the checklist can be reset. Selecting the checklist reset key at the bottom of the page resets the checklist: all action items and conditionals become incomplete. The current line item box moves to the first incomplete line item.

For some conditions, such as go-around, resets set the normal checklists back to a previous phase of flight. There are automatic resets and manual resets.

Normal Checklist Automatic Reset Conditions

Automatic checklist resets occur for the following conditions:

- go-around—if the airplane is in the air, the landing gear is not up, and TO/GA is selected, then all normal checklists beginning with the AFTER TAKEOFF checklist automatically reset

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- touch-and-go—if the airplane has transitioned from air to ground, takeoff thrust is reached with ground speed greater than 80 knots, and the thrust reversers not deployed, then all normal checklists beginning with the AFTER TAKEOFF checklist automatically reset
- normal menu selection—if a previously completed normal checklist is opened from the normal menu, it automatically resets.

Normal Checklist Manual Resets

The following manual resets are available for normal checklists:

- reset normal—the RESET NORMAL key resets all normal checklists. The flight sequence begins again
- individual checklist reset—the checklist reset key at the bottom of a checklist page resets the current checklist. The checklist can be started again.

Non-Normal Checklist Manual Resets

The following manual resets are available for non-normal checklists:

- reset non-normal—the RESET NON-NORMAL key resets all non-normal checklists. Icons show on any active EICAS messages with checklists that were previously completed. Use of the RESET NON-NORMAL function in flight is not recommended
- individual checklist reset—the checklist reset key at the bottom of a checklist page resets the current checklist. The checklist can be started again.

Manual Reset All

The RESET ALL key resets all normal and non-normal checklists. The flight sequence begins again for normal checklists. Icons show on any active EICAS messages with checklists that were previously completed. Use of the RESET ALL function in flight is not recommended.

Overrides

There are two types of override functions: item override and checklist override.

Item Override

The flight crew uses item override when they choose not to complete an action item. If the action has been done but the closed-loop sensing does not show the action item as complete, the flight crew can override the action item. This allows the checklist to be complete.

The line item override key is available on all checklists. When an item is overridden the color changes to cyan. Closed loop and open loop action items can be overridden.

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Conditional line items (open loop or closed loop) cannot be overridden. Action items indented below a conditional line item can be overridden.

Checklist Override

The flight crew uses checklist override when a checklist in the non-normal queue will not be completed or if the flight crew opens a checklist from a menu but chooses not to complete it.

The checklist override key overrides the current checklist. All of the line items change color to cyan. The checklist overridden indicator shows at the bottom of the page. For a non-normal checklist, all of its operational notes are removed from the operational notes page, deferred line items are removed from their normal checklists, and inhibit checklist line items become inactive.

Electronic Checklist System Inoperative

If the checklist display switch is pushed and the electronic checklist system is inoperative, the message CHECKLIST NOT AVAILABLE shows on the MFD. If the electronic checklist system has been disabled by maintenance, the message CHECKLIST DISABLED shows on the MFD.

When the electronic checklist system is inoperative or disabled, checklist icons do not show with any EICAS messages.

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EICAS Alert Messages

Note: The OVERSPEED warning and the ALTITUDE ALERT caution messages are covered in Chapter 15, Warning Systems.

Message	Level	Aural	Message Logic
ALTN ATTITUDE	Advisory		Both AIR DATA/ATTITUDE source switches are in the ALTN position.
BARO SET DISAGREE	Advisory		Captain's and first officer's barometric settings disagree.
CHKL INCOMPLETE NORM	Caution	Beeper	A normal checklist needs to be completed.
CHKL NON-NORMAL	Advisory		A non-normal checklist is not complete, the ECL is not displayed, and the related EICAS message is not shown.
DISPLAY SELECT PNL	Advisory		Left, center, or right CDU control of the display select panel is active.
EFIS CONTROL PNL L, R	Advisory		EFIS control panel is inoperative or CDU control of the EFIS control panel is active.
SGL SOURCE AIR DATA	Advisory		Both PFDs are receiving air data from the same single channel source.
SGL SOURCE DISPLAYS	Caution	Beeper	A single source of display information is being used by some or all display units.
SGL SOURCE RAD ALT	Advisory		Both PFDs are using the same source for radio altimeter information.
SINGLE SOURCE F/D	Advisory		Both PFDs are using the same source for flight director information.
VMO GEAR DOWN	Memo		Vmo value set for dispatch with landing gear extended.

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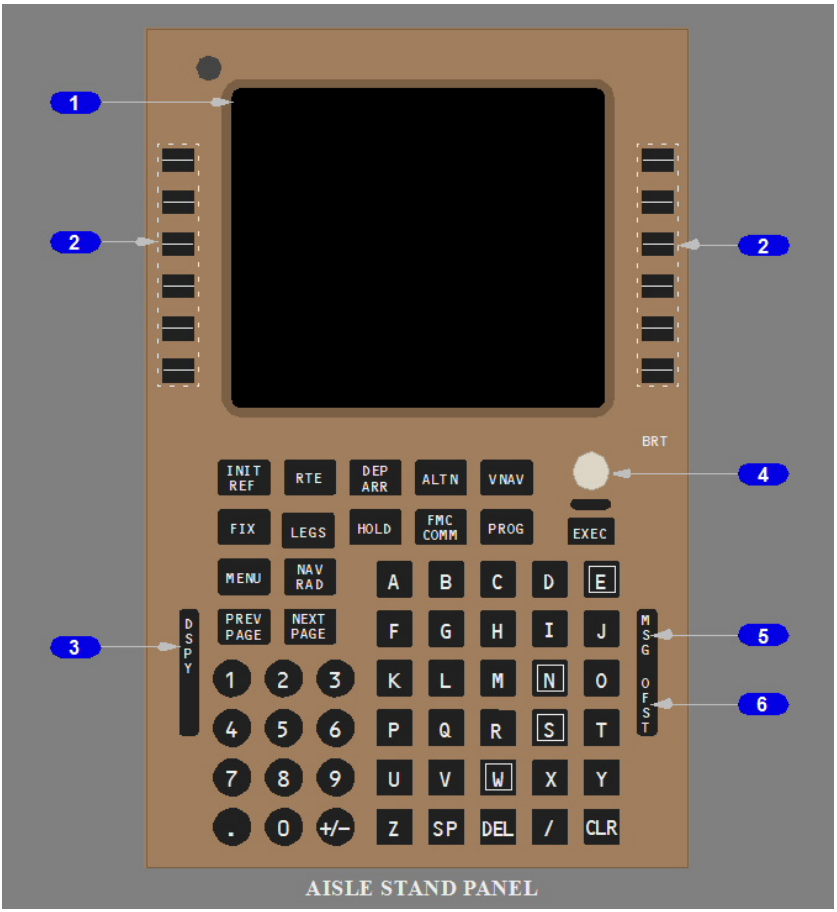
Flight Management System

Control Display Unit (CDU)

TJA,B,C,D,G,H,TKA to TKF



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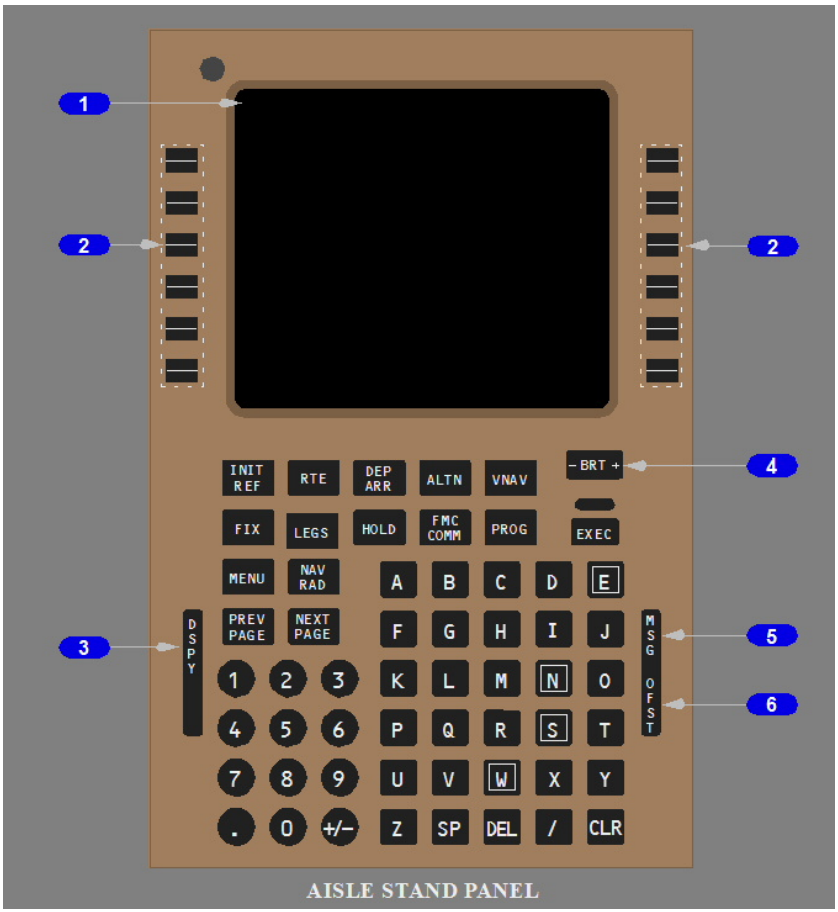
TJR to TJW,
TKK to TKR,
TKU to TKZ



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 displays in scratchpad.

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Conventions—

- scratchpad must be blank for line select transfer
- data can not be transferred to a blank line
- a blank scratchpad can not be transferred to a line
- not all data can be modified
- message displays if inappropriate entries attempted.

3 Display (DSPY) Light

Illuminated (white)—

- when RTE page 3 or greater, RTE LEGS page 2 or greater, RTE DATA page 2 or greater is displayed
- when airplane is not in holding pattern shown on HOLD page
- when modification is in progress, and any RTE, RTE LEGS, RTE DATA, HOLD, or VNAV page is shown.

4 Brightness (BRT) Control

Rotate—controls display brightness.

TJA,B,C,D,G, H,TKA to TKF

Push—

TJR to TJW, TKK to TKR, TKU to TKZ

- "+" increases brightness
- "–" decreases brightness
- 24 segment light brightness bar displays in the scratchpad and remains displayed for 2 seconds after release of the + or – push. Existing scratchpad information is saved and displays following fade of the brightness bar.

5 Message (MSG) Light

Illuminated (white)—

- scratchpad displays message
- pushing clear key extinguishes light and clears message.

6 Offset (OFST) Light

Illuminated (white)—LNAV gives guidance for lateral route offset.

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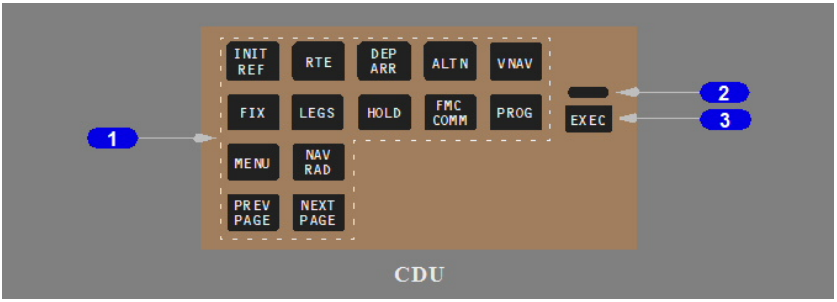
Function and Execute Keys



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
ALTN	displays page to modify destination and route for alternate diversion
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 the ND
HOLD	displays page to create holding patterns and display holding pattern data, or to exit holding pattern
FMC COMM	displays FMC data link status page
PROG	displays page to view dynamic flight and navigation data, including waypoint and destination ETAs, fuel remaining, arrival estimates, and RTA and RNP information
MENU	displays page to choose subsystems controlled by CDU
NAV RAD	displays page to view or control navigation radio tuning
PREV PAGE	displays previous page of multiple page displays (for example, LEGS pages)
NEXT PAGE	displays next page of multiple page displays.

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2 Execute Light

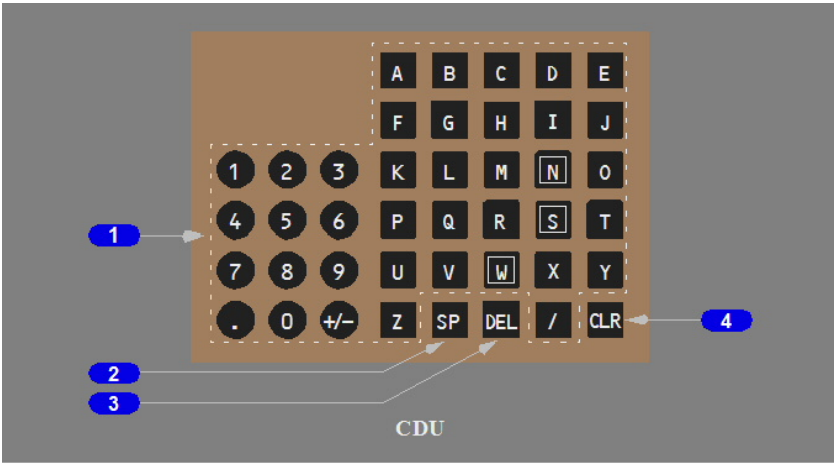
Illuminated (white)—active data is modified but not executed.

3 Execute (EXEC) Key

Push—

- activates data modification(s)
- extinguishes execute light.

Alpha/Numeric and Miscellaneous Keys



1 Alpha/Numeric Keys

Push—

- puts 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 space in scratchpad
- enters underscore character "_" in scratchpad when CDU is used as input device for systems other than FMC.

3 Delete (DEL) Key

Push—enters "DELETE" in scratchpad.

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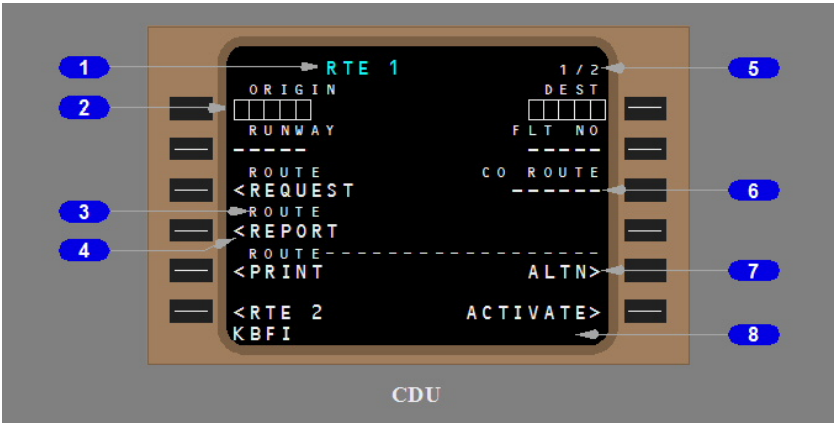
4 Clear (CLR) Key

Push—

- clears last scratchpad character
- clears scratchpad message.

Push and hold—clears all scratchpad data.

CDU Page Components



1 Page Title

Subject or name of data displayed on page.

ACT (active) or MOD (modified) indicates whether page contains active or modified data.

2 Boxes

Data input is mandatory.

3 Line Title

Title of data on line below.

4 Data Line

Displays—

- prompts
- selectors
- data associated with line title.

Large font indicates crew entered or verified data. Small font indicates FMC computed data.

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5 Page Number

Left number is page number. Right number is total number of related pages. Page number is blank when only one page exists.

6 Dashes

Data input is optional.

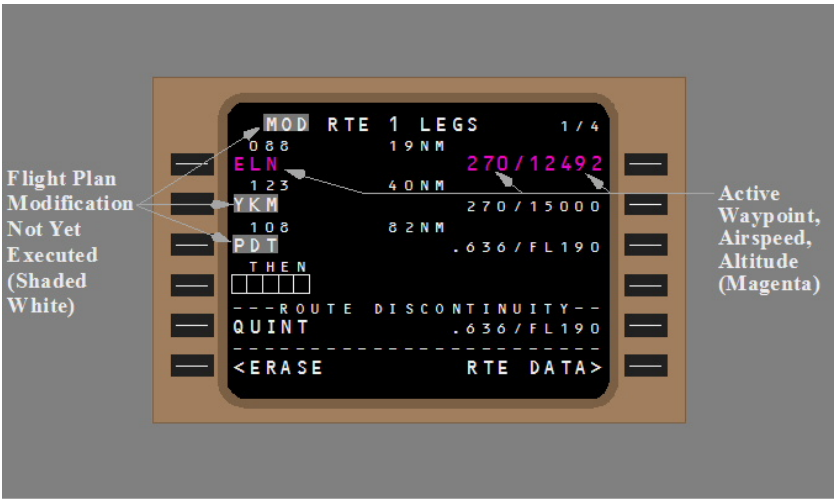
7 Prompts

Display pages, select modes, and control displays. Caret “<” or “>” is before or after prompt.

8 Scratchpad

Displays messages, alphanumeric entries, or line selected data.

CDU Page Color



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Color is used as follows:

- black—background color of page
- cyan—
  - ADF frequencies
  - inactive RTE page title
- green—
  - navigation radio data
  - active state of two–position and three–position selectors
- magenta—data used by FMC for lateral and vertical flight commands
  - active waypoint
  - active airspeed
  - active altitude
- shaded white—
  - modifications
  - MOD precedes page titles of modified pages
- White—most data.

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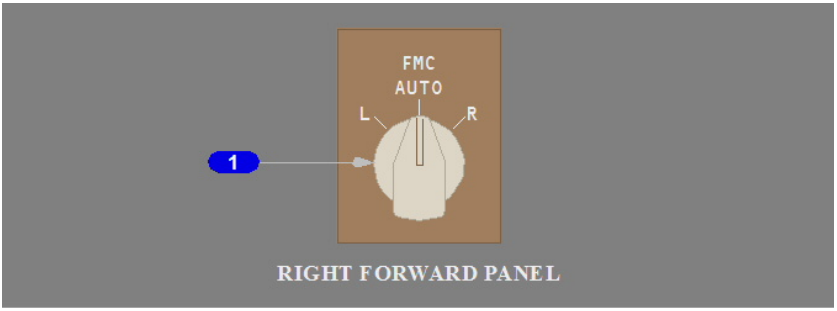
FMC Selector



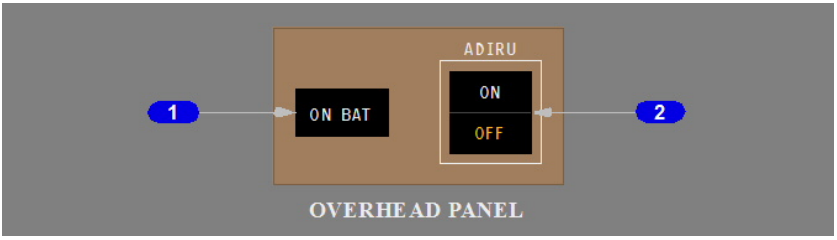
1 FMC Selector

L—selects left FMC to provide guidance commands.

AUTO—automatically selects other FMC if one FMC fails.

R—selects right FMC to provide guidance commands.

Air Data Inertial Reference System (ADIRU)



1 On Battery (ON BAT) Light

Illuminated (white)—airplane battery powers ADIRU.

Note: The ON BAT light illuminates when the ADIRU switch is selected ON and ground power or primary power is subsequently removed or fails (battery power only remains).

2 ADIRU Switch

ON—applies power to ADIRU.

OFF—removes power when airspeed is less than 30 knots.

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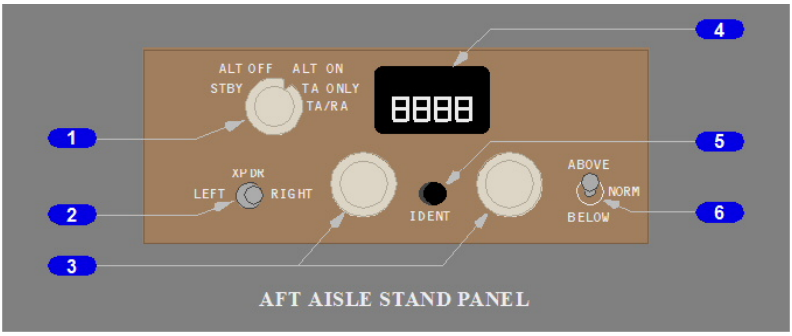
Transponder Panel

TJA,B,C,D,G,H,TKA to TKF



1 Transponder Mode Selector

STBY (standby)—
- transponder disabled
- ADS-B out disabled.

ALT OFF (altitude)—
- transponder enabled in modes A and S
- altitude reporting disabled
- ADS-B out enabled.

ALT ON (altitude)—
- transponder enabled in modes A, C, and S
- in flight, altitude reporting enabled
- ADS-B out enabled.

TA ONLY (traffic advisory) and TA/RA (traffic advisory/resolution advisory)—see TCAS Controls (Transponder Panel) on page 15.10.5.

2 Transponder (XPDR) Switch

LEFT—selects left transponder and ADIRU as source for transponder altitude reporting.

RIGHT—selects right transponder and SAARU as source for transponder altitude reporting.

3 Transponder Code Selectors

Rotate—sets transponder code.

4 Transponder Code Display

Displays transponder code.

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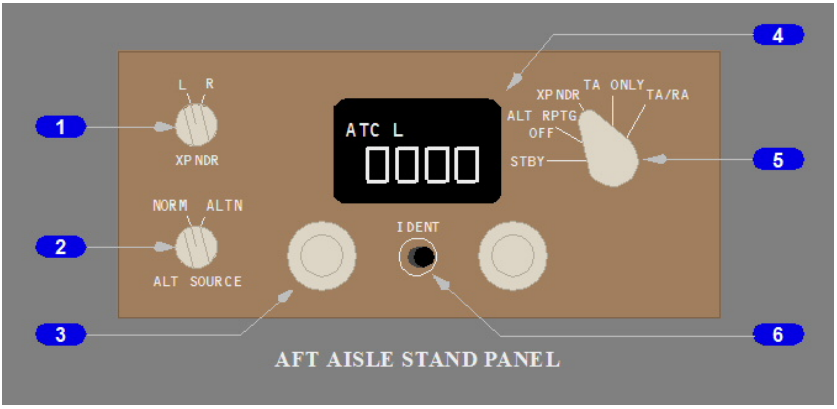
5 Identification (IDENT) Switch

Push—transmits ident signal.

6 TCAS Airspace Switch

See TCAS Controls (Transponder Panel) on page 15.10.5.

TJR to TJW



1 Transponder (XPNDR) Selector

L—selects left transponder.

R—selects right transponder.

2 Altitude (ALT) SOURCE Selector

NORM (normal)—selects ADIRU as source for altitude reporting.

ALTN (alternate)—selects SAARU as source for altitude reporting.

3 Transponder Code Selectors

Rotate—Sets transponder code in transponder.

4 Transponder Code Window

ATC L, ATC R—transponder selected.

Displays transponder code.

5 Transponder Mode Selector

STBY (standby)—transponder not active.

- transponder disabled
- ADS-B out disabled.

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ALT RPTG (altitude reporting) OFF—

- transponder enabled in modes A and S
- altitude reporting disabled
- ADS-B out enabled.

XPNDR (transponder)—

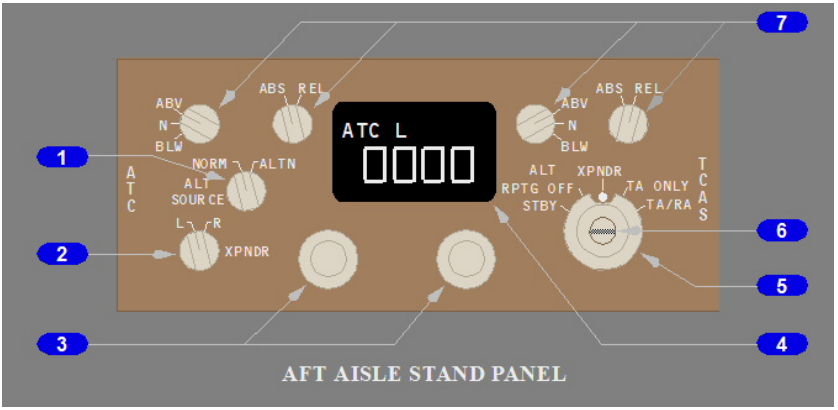
- transponder enabled in modes A, C, and S
- in flight, altitude reporting enabled
- ADS-B out enabled.

TA (traffic advisory) ONLY and TA/RA (resolution advisory)—see TCAS Controls (Transponder Panel) on page 15.10.5.

6 Identification (IDENT) Switch

Push—transmits an identification signal.

TKK to TKR, TKU to TKZ



1 Altitude (ALT) SOURCE Selector

NORM (normal)—selects ADIRU as source for altitude reporting.

ALTN (alternate)—selects SAARU as source for altitude reporting.

2 Transponder (XPNDR) Selector

L—selects left transponder.

R—selects right transponder.

3 Transponder Code Selectors

Rotate—Sets transponder code in transponder.

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4 Transponder Code Window

ATC L, ATC R—transponder selected.

Displays transponder code.

5 Transponder Mode Selector

STBY (standby)—transponder not active.

- transponder disabled
- ADS-B out disabled.

ALT RPTG (altitude reporting) OFF—

- transponder enabled in modes A and S
- altitude reporting disabled
- ADS-B out enabled.

XPNDR (transponder)—

- transponder enabled in modes A, C, and S
- in flight, altitude reporting enabled
- ADS-B out enabled.

TA (traffic advisory) ONLY and TA/RA (resolution advisory)—see TCAS Controls (Transponder Panel) on page 15.10.5.

6 Identification (IDENT) Switch

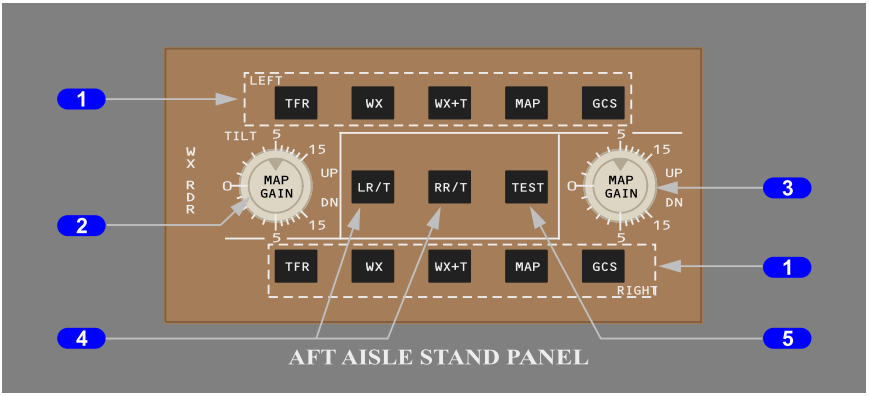
Push—transmits an identification signal.

7 TCAS Controls

See TCAS Controls (Transponder Panel) on page 15.10.5.

Weather Radar Panel

TJA,B,C,D,G, H,TKA to TKF



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1 Mode Switches

Push—selects mode.

LEFT—controls displays on left ND.

RIGHT—controls displays on right ND.

TFR (transfer)—transfers other ND display selections to related ND.

Note: Selecting both TFR switches at the same time results in the TEST mode; test pattern displays.

WX—displays weather radar returns at selected gain level.

WX+T (turbulence)—displays weather returns and turbulence within precipitation at calibrated gain level. Turbulence display available with display ranges of 40 nm or less. Selecting a range greater than 40 nm changes mode to WX.

Note: Turbulence detection requires presence of detectable precipitation. Clear air turbulence cannot be detected by radar.

MAP—displays ground returns at selected gain level.

GCS (ground clutter suppression)

- IN—reduces amount of ground returns
- OUT—displays ground returns.

Note: Continuous operation is not recommended because weather return intensity may be reduced.

2 MAP GAIN Control

Rotate inner knob—sets receiver sensitivity in MAP mode on related ND. Full clockwise sets receiver sensitivity at the preset calibrated level.

3 Tilt Control

Rotate outer knob clockwise—tilts radar antenna up.

Rotate outer knob counterclockwise—tilts radar antenna down.

4 Receiver/Transmitter (R/T) Switches

Push—

- LR/T—selects left R/T. Pushes out RR/T switch.
- RR/T—selects right R/T. Pushes out LR/T switch.

5 TEST Switch

Push—

- tests weather radar system operation without transmitting

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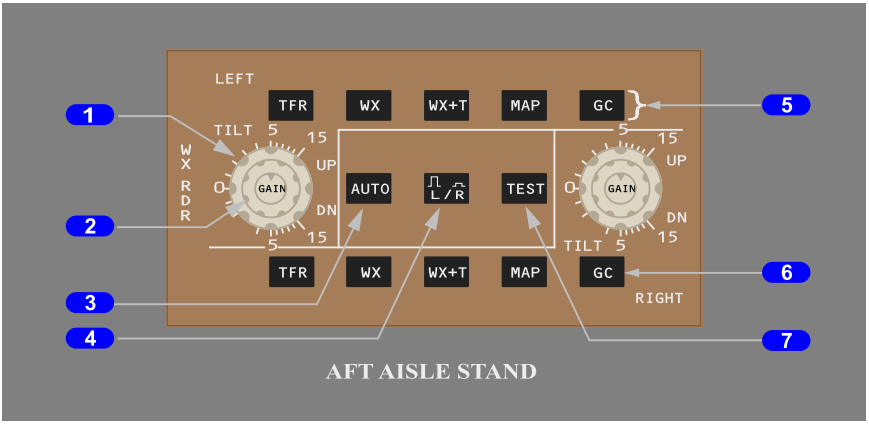
- displays test pattern and PWS symbol at the end of the test and any fault message on ND with WXR selected (except in PLAN, CTR VOR, and CTR APP modes).
- when on the ground, selecting WXR on the EFIS control panel and TEST on the weather radar control panel activates a 12 second test. Initially, the amber WINDSHEAR annunciation displays and the aural MONITOR RADAR DISPLAY sounds. Next, the 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
- 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.

TJR to TJW, TKK to TKR, TKU to TKZ



1 TILT Control

Rotate outer knob clockwise—tilts radar antenna up.

Rotate outer knob counterclockwise—tilts radar antenna down.

2 GAIN Control

Rotate inner knob—adjusts receiver sensitivity (by detent) in MAP, WX, and WX+T modes. The 12 o'clock position sets radar sensitivity to the standard calibrated reflectivity level and is the recommended position for normal operation. Rotating the control clockwise increases sensitivity; rotating counterclockwise decreases sensitivity.

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3 AUTO Switch

IN—both Captain's and First Officer's controls operate in automatic mode to optimize long and short range weather detection. Ground clutter suppression is operative. Manual tilt control is not available.

OUT—both Captain's and First Officer's controls operate manually. Ground clutter suppression is not available.

4 System Select Switch

IN—selects right system.

OUT—selects left system.

5 Mode Switches

Control display on respective ND.

Push—

TFR (transfer)—selects opposite display.

Note: Selecting both TFR switches at the same time results in the TEST mode; test pattern displays.

WX (weather)—displays weather returns.

WX+T (weather+turbulence)—displays weather returns and turbulence within precipitation. Turbulence displays out to 40 nm for all selected ranges.

Note: Turbulence detection requires presence of detectable precipitation. Clear air turbulence cannot be detected by radar.

MAP—displays ground returns at selected gain level.

6 Ground Clutter (GC) Switch

Push—allows ground clutter to display when pushed and held.

7 TEST Switch

Push—

- tests weather radar system operation without transmitting
- 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)
- 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

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displays. Finally, the red WINDSHEAR annunciation displays and the aural GO AROUND WINDSHEAR AHEAD, and then WINDSHEAR AHEAD, WINDSHEAR AHEAD sounds

- 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.

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Introduction

Navigation systems include global positioning system (GPS), air data inertial reference system (ADIRS), 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

See Flight Instruments, Displays on page 10.10.1 for flight instrument display system operations and typical instrument displays.

Global Positioning System (GPS)

Left and right GPS receivers are independent and supply very accurate position data to the FMC. GPS tuning is automatic.

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.

When the POS (position) switch on the EFIS control panel is selected, the ND map displays the left and right GPS symbols. The GPS symbols are identical and display as a single symbol when the GPS receivers calculate the same position.

GPS Data

If the ADIRU becomes inoperative during flight, the EICAS displays the message NAV ADIRU INERTIAL and the FMC uses only GPS data to navigate.

Use the GPS NAV prompt on the POS REF page to inhibit GPS navigation data. The EICAS message GPS alerts the crew when both GPS systems have failed.

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 other operations unless a specific state requires the use of other update provisions within their airspace (eg, to accommodate a non-WGS reference datum or other reason).

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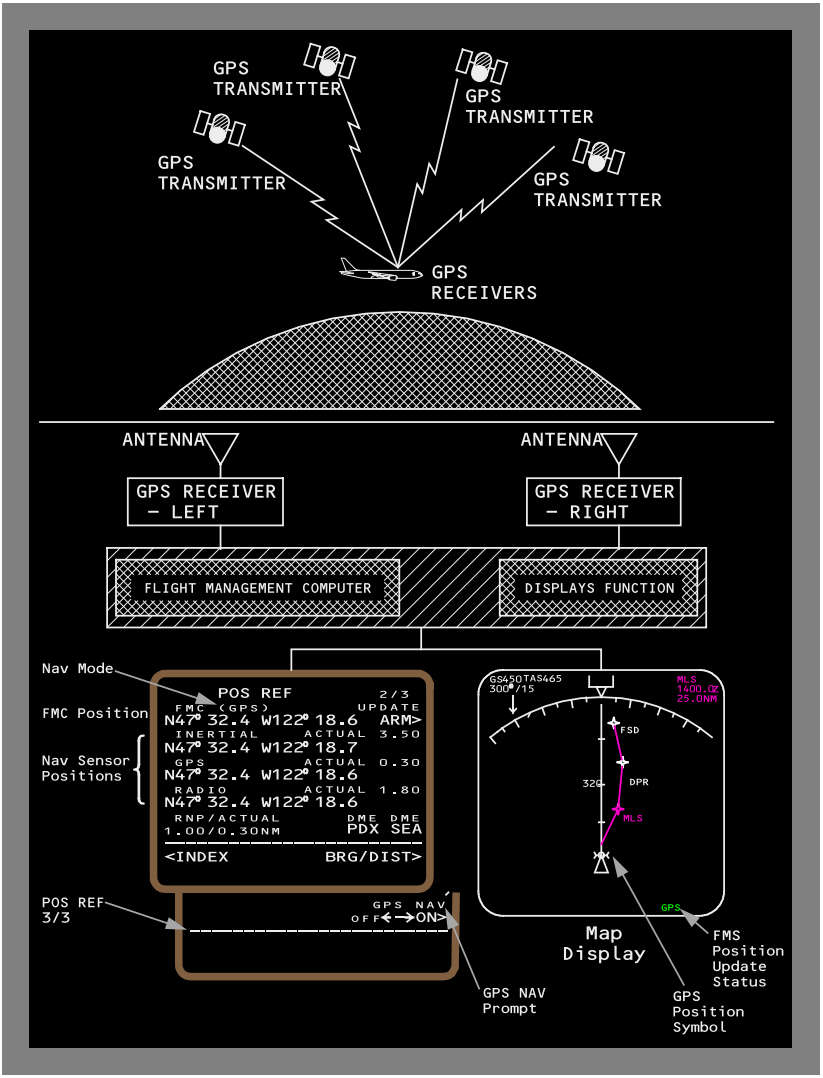
GPS System Schematic



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Inertial System

Air Data Inertial Reference System (ADIRS)

The ADIRS calculates airplane altitude, airspeed, attitude, heading, and position data for the displays, flight management system, flight controls, engine controls, and other systems. The major components of ADIRS are the air data inertial reference unit (ADIRU), secondary attitude and air data reference unit (SAARU), and air data modules.

Air Data Inertial Reference Unit (ADIRU)

The ADIRU supplies primary flight data, inertial reference, and air data. The ADIRU is fault-tolerant and fully redundant.

ADIRU Power

Initial power-up requires battery bus power and the ADIRU switch to be ON. If the ADIRU is switched off, it must complete a full realignment cycle before the airplane can be moved.

If electrical power is subsequently removed from the airplane and the Battery switch is switched OFF, the hot battery bus continues to supply electrical power to the ADIRU. The ON BAT light illuminates, and the horn in the landing gear wheel well sounds to alert maintenance personnel the ADIRU is on battery power.

When the ADIRU switch is OFF, the ADIRU remains powered for a few seconds.

In flight, system logic prevents the ADIRU from becoming unpowered if the ADIRU switch is inadvertently switched OFF.

ADIRU Alignment

On initial power-up, the ADIRU enters the align mode. The EICAS memo message ADIRU ALIGN MODE displays. Attitude or heading/track data is removed from the PFDs. Airplane latitude/longitude position must be entered on the CDU POS INIT page. The airplane should not move until alignment is complete.

If the latitude/longitude position is not close to the position of the origin airport, the scratchpad message INERTIAL/ORIGIN DISAGREE displays. If the crew–entered latitude/longitude position does not pass internal ADIRU comparison tests, the scratchpad message ENTER INERTIAL POSITION displays.

If a new airplane present position entry fails the internal check twice, the scratchpad message ALIGNMENT REINITIATED displays. The system automatically starts a new alignment cycle.

In rare cases, a new airplane present position update of the ADIRU may cause the EICAS message NAV UNABLE RNP to momentarily display. This occurs if the entered ADIRU position is far different than the GPS position. The message

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displays until the FMC reconciles the difference between the new ADIRU position and the GPS position.

When the alignment is complete, the ADIRU changes to the navigate mode and the airplane can be moved. If the airplane stops for an extended period, the ADIRU changes to the automatic realign mode and refines the alignment until the airplane moves again.

In the automatic realign mode, ADIRU velocity and acceleration errors are reset to zero. The inertial position can be manually updated when the ADIRU is in the automatic realign mode by entering a new latitude/longitude position on the POS INIT 1/3 page. The ADIRU cannot be realigned in flight.

Note: A position update is recommended if the total time in the navigation mode is expected to exceed 24 hours.

Secondary Attitude and Air Data Reference Unit (SAARU)

The SAARU is a secondary source of critical flight data for displays, flight control systems, and other systems. If the ADIRU fails, the SAARU automatically supplies attitude, heading, and air data. SAARU heading must be manually set to the standby compass magnetic heading periodically.

If ADIRU inertial data fails, the EICAS caution message NAV ADIRU INERTIAL displays. The SAARU supplies attitude data to the PFD and three minutes of backup heading. The heading is based on ADIRU heading prior to failure. The CDU POS INIT page displays the SET HDG prompt three minutes after ADIRU failure. Use the SET HDG prompt to periodically set the SAARU heading to the standby compass magnetic heading. There are no other prompts to remind the crew to enter or to update the SAARU heading.

The following functions are inoperative after failure of the inertial reference portion of the ADIRU:

AFDS Modes:

- LNAV
- VNAV
- TO/GA
- LOC
- GS
- FPA
- TRK HOLD/SEL
- HDG HOLD/SEL*.

Navigation Functions:

- FMC VNAV pages
- FMC Performance Predictions
- Wind Direction and Speed (wind arrow).

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PFD Functions:

- Flap Maneuver Speeds
- PFD Heading*.

Notes: 1. * This function is operative when standby magnetic compass heading is entered on the POS INIT page.

2. ND map mode display following ADIRU failure references TRK.

3. The autobrake is also inoperative.

The following additional functions are inoperative after failure of the inertial reference portion of the ADIRU and loss of GPS information:

- ND Map (center and expanded)
- CDU active leg course and distance
- CDU direct-to a waypoint
- FMC Alternate Airport DIVERT NOW
- FMC navigation radio autotuning.

Restoration of the SAARU heading allows navigation in the ND VOR mode using radio navigation data. The FMC navigation data LNAV/VNAV guidance is no longer available when the ADIRU fails.

SAARU power-up is completely automatic at airplane power-up. There are no SAARU controls.

Air Data and Attitude Sources

The ADIRU and SAARU receive air data from the same three sources. The ADIRU and SAARU validate the air data before it may be used for navigation.

The three air data sources are the left, center, and right pitot and static systems. Air data is valid when two or more sources agree in the ADIRU, SAARU, or both.

When ADIRU air data is invalid and the AIR DATA/ATT switch is in the off position, valid SAARU air data is used. See Instrument Source Select Panels on page 10.10.39 for a description of the AIR DATA/ATT switch.

Single channel operation occurs when the ADIRU and SAARU air data are invalid. The left PFD displays the ADIRU air data from the left pitot static system (left channel). The right PFD displays the SAARU air data from the right pitot static system (right channel).

The EICAS message AIR DATA SYS displays. *

DELETION

The air data modules are remote sensors for the air data functions within the ADIRU and SAARU. They measure static and pitot pressure. Both the ADIRU and SAARU receive data from all air data modules. In addition, the ADIRU and SAARU each receive data from the two angle of attack vanes and a dual element total air temperature probe.

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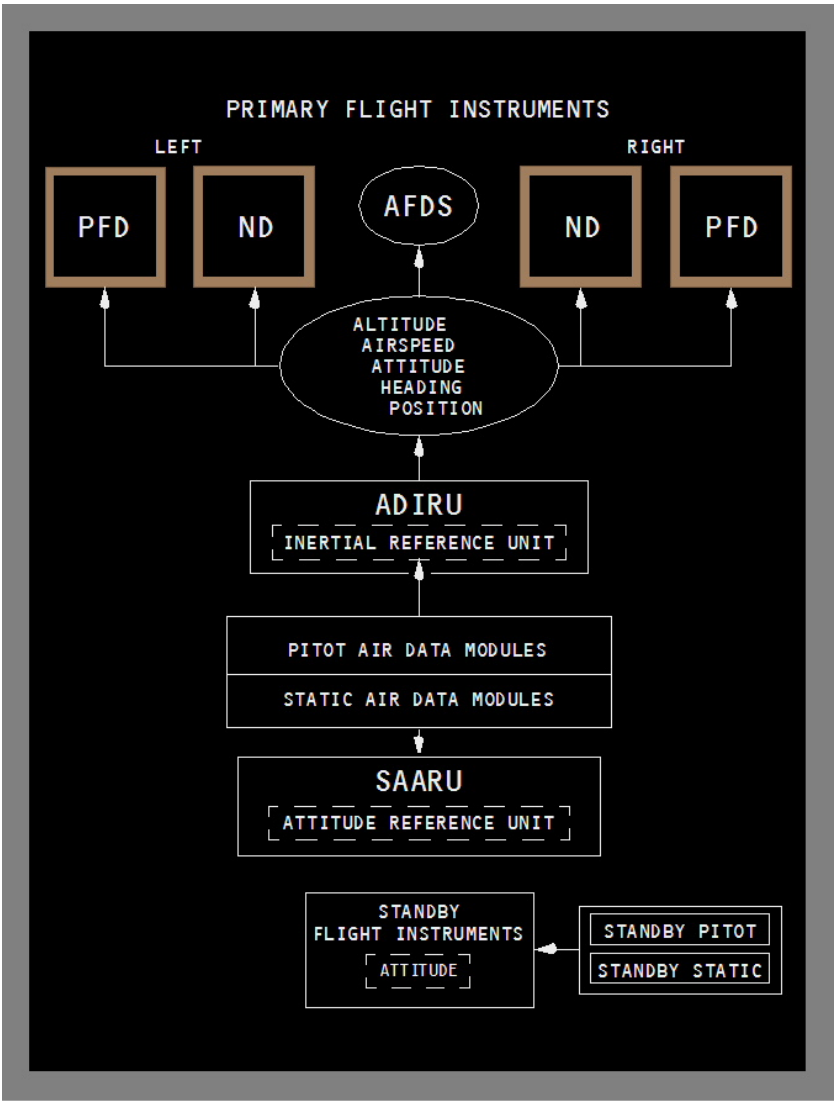
The standby flight instrument displays receive data from the center pitot and static ports through standby air data modules. Altitude, attitude, and airspeed are independent of ADIRU and SAARU values.

ADIRS Schematic, Normal Mode



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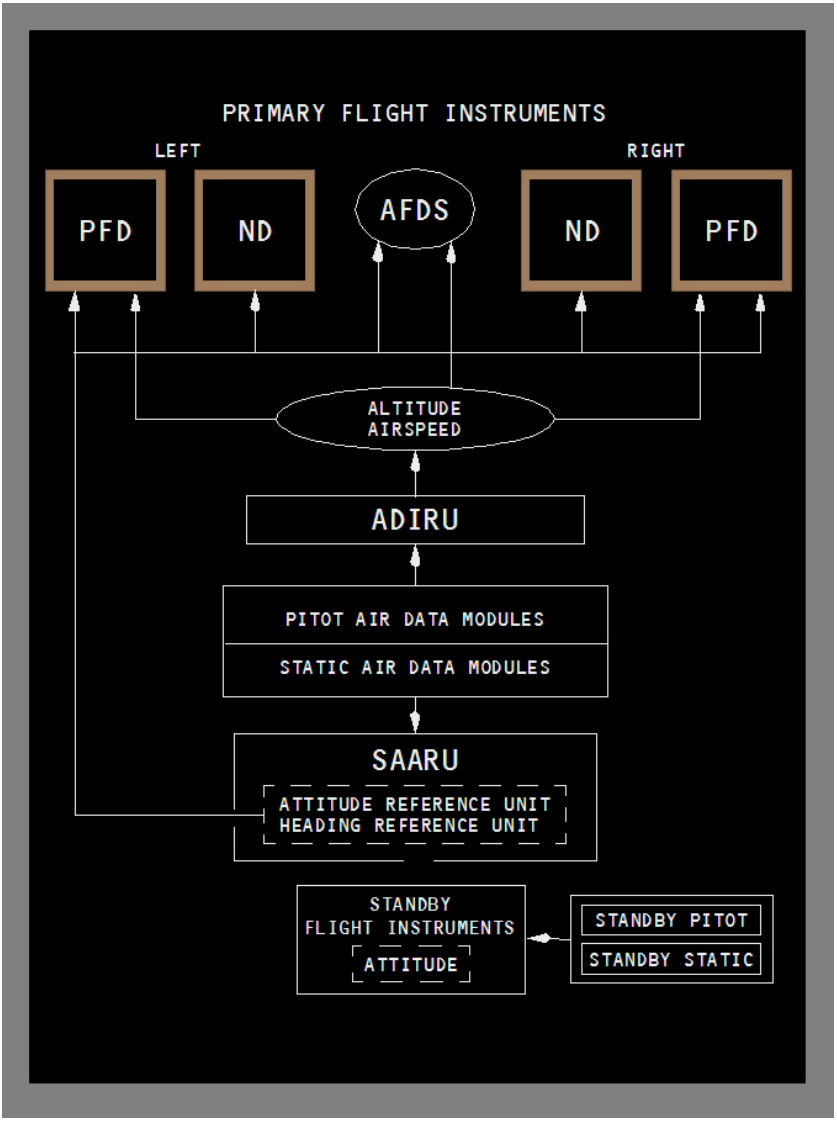
ADIRS Schematic, With NAV ADIRU INERTIAL Message



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Radio Navigation Systems

Automatic Direction Finding (ADF)

Two ADF systems are installed. Either ADF 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 related VOR/ADF switch is in the ADF position. ADF data is cyan.

If both FMCs fail, the left and right ADF radios are tuned on the related left and right CDU ALTN NAV RADIO page.

Distance Measuring Equipment (DME)

Two DME systems are installed. The DMEs are usually tuned by the FMC, but may be tuned manually.

DME Tuning

DME is tuned manually when the VOR portion of a VOR/DME pair is entered on the NAV RADIO page. The FMC tunes DME as necessary for radio position updates. Manual DME tuning does not inhibit FMC DME tuning.

The FMC uses two DMEs for position updates. DME/DME position updates are usually more accurate than VOR/DME updates. The FMC cannot tune specific DMEs if the navaids are inhibited on the REF NAV DATA page.

After dual FMC failure, the left DME is tuned with the left CDU and the right DME is tuned with the right CDU. Each DME is tuned to the VOR displayed on the CDU unless the related EFIS control panel ND mode selector is set to APP. In APP, the DME is tuned to the ILS.

DME Displays

DME distance displays on the ND map when operating in the VOR mode. DME distances also display when the ND mode selector is in the VOR or APP position, and either or both VOR L or VOR R switches are selected. DME distance also displays on the PFD when the ILS receivers are tuned to a collocated DME and localizer facility.

POS REF page 2/3 displays the identifiers of the DME stations used for FMC position updates.

Instrument Landing System (ILS)

Three ILS receivers are installed. They are usually tuned by the FMC, but can be tuned manually on the NAV RADIO page.

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ILS Tuning

Two conditions must be met for FMC ILS autotuning to occur:

- an ILS, LOC, back course, LDA (localizer–type directional aid), or SDF (simplified directional facility) approach have been selected to the active route, and
- the airplane is within 50 NM from the top of descent, 150 NM of the landing runway threshold, or the FMC is in descent mode.

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 to 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 at anytime 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
- Only 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° of the localizer front course, and ground speed is greater than 40 knots.

ILS tuning is again enabled when:

- either TO/GA switch is pushed
- the autopilot is disengaged and both flight director switches are switched off, or
- the MCP approach mode is deselected above 1,500 feet radio altitude.

The ILS frequency is automatically retuned when ILS tuning is enabled and a new approach is selected on the CDU.

After dual FMC failure, the left and center ILS receivers are tuned with the left CDU on the ALTN NAV RADIO page. The right ILS receiver is tuned with the right CDU on the ALTN NAV RADIO page.

ILS Displays

The tuned ILS frequency displays on the PFD and on the ND in the approach mode.

Localizer and glideslope deviation display on the PFD. Localizer and glideslope deviation, and selected course display on the ND when that ND is in the approach mode. Front or back course deviation is determined from airplane heading.

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Navaid Identifier Decoding

The Morse code identifier of a tuned VOR, ILS, DME, or ADF can be converted to alpha characters. The decoded identifier then displays on the PFD and ND. The crew should monitor this identifier for 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 display as “KAI”, or the Boeing Field ILS may display as “QBFI” or “TTTT” instead of “IBFI.”

Pilots should verify the identity of the tuned navigation station from the audio Morse code when the tuned frequency remains displayed or an incorrect identifier displays.

VOR

Two VOR receivers are usually tuned by the FMC but, can be tuned manually by the crew. The tuned VORs display on the ND and may be used for position updates.

VOR Tuning

The crew manually tunes VORs on the NAV RADIO page.

The FMC can tune a VOR and a collocated DME for position updates. The FMC uses VOR/DME radio position updates 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 on the NAV RADIO page, then the FMC cannot tune any other station for VOR/DME updates.

After dual FMC failure, the VOR radios can be manually tuned on the CDU ALTN NAV RADIO page. The left VOR is tuned with the left CDU and the right VOR is tuned with the right CDU.

VOR Displays

The NAV RADIO page displays FMC–tuned or manually–tuned VOR data. POS REF page 2/3 displays the identifier of the VOR and DME pair used for position updates.

The ND displays the identifier or frequency of the VORs tuned on the NAV RADIO page. The FMC usually tunes the same VOR in the left and the right. The ND VOR L VOR R data are usually the same.

Left and right VOR bearings display on the ND map when the related EFIS control panel VOR/ADF switch is in the VOR position. VOR bearings also display when the ND mode selector is in the VOR or APP position, and either or both VOR L or VOR R switches are selected. The VOR frequency and selected course display in the upper right hand corner of the ND when operating in the

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VOR mode. The ND also displays course deviation when operating in the VOR mode.

Transponder

TJR to TJW, TKK to TKR, TKU to TKZ

The transponder panel controls two ATC transponders and the traffic alert and collision avoidance system (TCAS). Traffic displays if the transponder mode selector is in TA ONLY or TA/RA. The transponder responds to Mode S interrogations in all modes except STBY; and when on the ground, it provides airport position. In flight, the selected transponder activates beacon and altitude reporting when the transponder mode selector is in XPNDR, TA ONLY, or TA/RA. The EICAS advisory message TRANSPONDER L or TRANSPONDER R displays if a transponder fails. If altitude reporting fails, the transponder can be switched to the alternate altitude source. See Traffic Alert and Collision Avoidance System (TCAS) on page 15.20.11 for a description of TCAS.

TJA,B,C,D,G, H,TKA to TKF

The transponder panel controls two ATC transponders and the traffic alert and collision avoidance system (TCAS). Traffic displays if the transponder mode selector is in TA ONLY or TA/RA. The transponder responds to Mode S interrogations in all modes except STBY; and when on the ground, it provides airport position. In flight, the selected transponder activates beacon and altitude reporting when the transponder mode selector is in ALT ON, TA ONLY, or TA/RA. The EICAS advisory message TRANSPONDER L or TRANSPONDER R displays if a transponder fails. If altitude reporting fails, the transponder can be switched to the alternate altitude source by positioning the transponder selector to R. See Traffic Alert and Collision Avoidance System (TCAS) on page 15.20.11 for a description of TCAS.

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). 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.

The left (right) GPS is connected to the left (right) transponder. If GPS input to the selected transponder is unavailable, ADS-B Out position reporting is lost or degraded and ATC is alerted. If advised by ATC ADS-B Out communications are lost or degraded, selection of the other transponder restores communications and reporting.

Weather Radar

The weather radar system consists of receiver–transmitter unit, antenna, and control panel. Radar returns display on the ND in all modes except:

- plan

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- 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 automatically adjusts to the ND range selected on the EFIS control panel.

The weather radar system performs various levels of self test on power up, during each sweep, and when descending through 2,300 feet AGL.

TJR to TJW, TKK to TKR, TKU to TKZ

Multiscan weather radars collect data from different scans and merge the information into a total weather picture. Special software eliminates ground clutter resulting in clutter-free viewing of significant weather out to 320 nm. When operating in the automatic mode, multiple radar scans at pre-selected tilt angles detect short, mid, and long range weather. Tilt and gain inputs are not required. This results in weather detection at all ranges and in all phases of flight. Additional processing ensures data from thunderstorm tops within 5,000 feet of the airplane remain on the radar display until it no longer poses a danger; thus, enabling flight around thunderstorms that may not be visible otherwise.

The CDU can control the EFIS control panel functions, including the WXR. The weather radar operating modes and fault conditions display on the ND.

Turbulence can be sensed by the weather radar only when there is sufficient precipitation. Clear air turbulence cannot be sensed by radar.

The weather radar also provides predictive windshear alerting (see Predictive Windshear (PWS) and Immediate Windshear Alerting Systems on page 15.20.19).

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Introduction

The flight management system (FMS) aids the flight crew with navigation, in–flight performance optimization, automatic fuel monitoring, and flight deck displays. 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 in flying 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, 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 (FMC)

The basis of the flight management system is the flight management computer function. Since the term FMC is universally understood, it is used here for standardization and simplification.

Under normal conditions, one FMC accomplishes the flight management tasks while the other FMC monitors. The second FMC is ready to replace the first FMC if system faults occur.

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. 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. See Automatic Flight on page 4.10.1 and see Flight Instruments, Displays on page 10.10.1 for operation of these other systems.

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.

Control Display Units (CDUs)

The flight crew controls the FMC using three CDUs. The CDUs give alternate display, communications control, and navigation capability if there is a dual FMC failure (see FMS Alternate Navigation System Description on page 11.50.1). The center CDU is a backup for the left or right CDU in case of a failure and automatically takes over functionality of the failed CDU. Only the left and right CDUs tune navigation radios when alternate navigation is active.

Left and right CDUs provide backup to the left and right EFIS control panels, while the center CDU provides EFIS control panel backup for a failed left or right CDU. If the EFIS control panel or the display select panel fails, a manual selection of the CDU backup mode can be made on the MENU page.

See EFIS Control Panels and Display Select Panel (DSP)—CDU Alternate Control on page 10.10.59 for a description of alternate display control. See MFD Communications Functions on page 5.40.1 for a description of communications control.

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Introduction

When first powered, the FMS is in the preflight phase. When completing a phase, the FMS changes to the next phase in this order:

1. preflight
2. takeoff
3. climb
4. cruise
5. descent
6. approach
7. flight complete.

Preflight

During preflight, the flight crew enters the flight plan and load sheet data into the CDU. Some data can be entered by data link. 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.

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 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

The 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 (see Autopilot Flight Director Roll and Pitch Controls on page 4.10.6).

Climb

The climb phase starts at thrust reduction for climb and terminates at the top of climb (T/C) point. The T/C is where the airplane reaches the cruise altitude entered on the PERF INIT page.

Cruise

The cruise phase starts at the T/C point and terminates at the top of descent (T/D) point. Cruise can include step climbs and en route descents.

Descent

The descent phase starts at the T/D point or when the VNAV descent page becomes active, and terminates at the start of the approach phase.

Approach

The 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, the 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 the 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 monitored for errors following:

- activation of a new data base
- power interruption

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- ADIRU 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/FROM procedures.

When a waypoint is in the route more than once, certain route modifications (such as DIRECT TO and HOLD) use the first waypoint in the 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/FROM procedures can be used to start waypoint sequencing beyond the vectors leg.

When entering airways in a route page, the start and end waypoints must be in the data base. A route segment must be entered as a DIRECT leg.

During a climb or descent, changing the altimeter setting near the planned level off can cause altitude capture to fail, and the aircraft may continue to climb or descend past the planned level off altitude.

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 the ACTIVATE prompt
- pushing the execute (EXEC) key

Altitude constraint — A crossing restriction at a waypoint.

Delete — Using the DELETE key removes FMC data and reverts to default values, dash or box prompts, or a blank entry.

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Econ	A speed schedule calculated to minimize operating cost. The 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.
Purge	Select the PURGE prompt to remove all airports uplinked to the ALTN LIST.
Select	Pushing a key to obtain the necessary data or action, or to copy selected data to the scratchpad.
Speed restriction	An airspeed limit associated with a specified altitude entered by the flight crew.
Speed transition	An airspeed limit associated with a specified altitude entered by the FMC.
Waypoint	A point on the route or in the navigation database. It can be a fixed point such as a latitude and longitude, VOR

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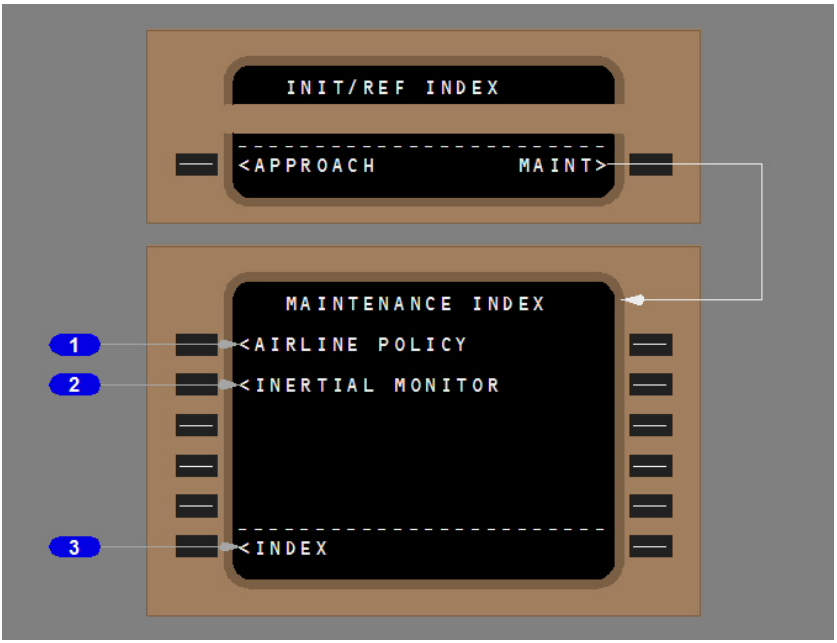
or ADF station, or an airway intersection. A conditional waypoint is not associated with a land reference; it is based on a time or altitude requirement. An example of a conditional waypoint is “when reaching 4,000 feet”.

Maintenance Index

The MAINTENANCE INDEX page prompts are used only on the ground.



1 AIRLINE POLICY

The airline policy pages display operating parameters kept in the airline maintained file. The FMC references this file for data before it calculates default values. These pages are not usually used by the flight crew.

2 INERTIAL MONITOR

This is a maintenance function.

3 INDEX

Push—displays the INIT/REF INDEX page.

Navigation Position

The FMC position is determined from GPS, navigation radio, and ADIRS systems. When receiving reliable GPS data, the FMC position 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 enabled. Further, if navigation radios are not available or not reliable, the FMC position is the inertial (ADIRU) position.

FMC Position Update

FMC position may be manually updated to any of the navigation system positions. This update is accomplished on POS REF page 2.

On the ground, the FMC calculates present position based on ADIRU and/or the GPS data.

If GPS updating is not available due to loss of signals, 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 NAV ON, the TO/GA update is inhibited.

In flight, the FMC position is the ADIRU inertial position updated by GPS source data to compensate for inertial reference errors. Radio navaid updating can be activated by selecting the RAD NAV INHIBIT toggle to OFF on the REF NAV DATA page. Updating priority is based on the availability of valid data from these sources. With all ADIRUs failed and GPS operative and valid, the FMC position is the GPS position.

The FMC automatically tunes VOR, DME, and ILS radios for position updating and displays them on the ND and NAV RADIO page. Selection is related to the active route and any procedure (SID, STAR, etc.) in the active route. Manually selecting VOR frequencies or identifiers precludes the FMC from autotuning other VOR/DME frequencies for position updating; however, the FMC continues to tune DME-DME pairs for position updating.

When available, GPS is the ADIRU inertial position updating source. With GPS inoperative or inhibited and with NAV RAD INHIBIT selected to OFF, ADIRU inertial position updating occurs in the following priority order:

- LOC and DME-DME
- LOC and collocated VOR/DME
- LOC
- DME-DME
- collocated VOR/DME.

The station identifiers in use by the FMC for navigation radio updating display on the POS REF page 2. Radio navaid updating is inhibited unless the RAD NAV INHIBIT toggle is selected to OFF on the REF NAV DATA page.

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Primary FMC Position Update Source	POS REF page 2/3	ND Annunciation
GPS	GPS	GPS
LOC, DME DME valid; GPS invalid*	LOC–RADIO	LOC–DME–DME
LOC, VOR DME valid; GPS invalid*	LOC–RADIO	LOC–VOR–DME
LOC valid; GPS, DME, VOR invalid*	LOC-INERTIAL	LOC
DME valid; GPS invalid	RADIO	DME–DME
VOR DME valid; GPS invalid	RADIO	VOR–DME
GPS, VOR, DME invalid	INERTIAL	INERTIAL
GPS valid, ADIRU failed	GPS	GPS
GPS invalid; ADIRU failed	blank	map not available

Localizer updating is inhibited when GPS/INERTIAL is the navigation update mode.

*** 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 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

When entering the polar region, automatic switching to a true north reference is annunciated by a white box around the word TRU on the ND. A TRUE heading reference can be selected with the heading reference switch inside or outside the polar region. The ND displays a green box around the word MAG to annunciate the change back to magnetic reference when leaving the polar region. If the heading reference is TRU in the descent phase, the ND displays a flashing amber box around the word TRU.

The current GRID heading displays near the top of both NDs when the airplane is north of 70°N or south of 70°S. The GRID heading is not used by any airplane system. TJR to TJW, TKK to TKR, TKU to TKZ

Notes:

1. When operating the autopilot in the polar region in other than LNAV, the TRUE position on the heading reference switch must be selected.
2. When operating north of 82°N or south of 82°S using the ND PLAN mode, the airplane position symbol does not display.
3. If the ADIRU fails in a polar region, the EICAS message NAV ADIRU INERTIAL displays and all autopilot and AFDS roll modes fail. When

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heading information is restored by entry of a reference heading on the POS INIT page, HDG SEL and HDG HOLD roll modes are restored. GPS continues to provide navigation data to the FMC and active route information displays on the ND. When operating in this degraded mode, heading on the POS INIT page may be referenced to magnetic, true, or grid heading. The heading display drifts significantly under these conditions. Periodic updating of the heading reference on the POS INIT page should be accomplished at least every 10 minutes.

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FMC Polar Regions

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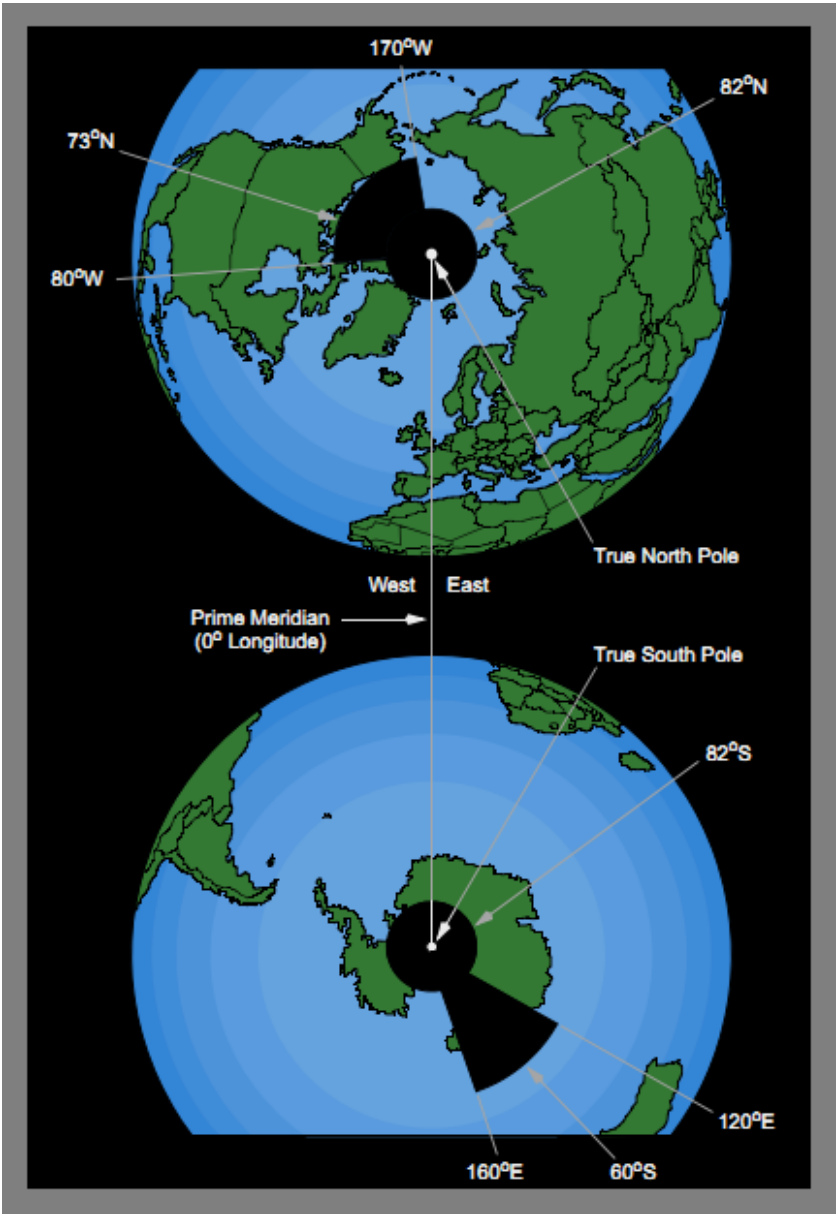
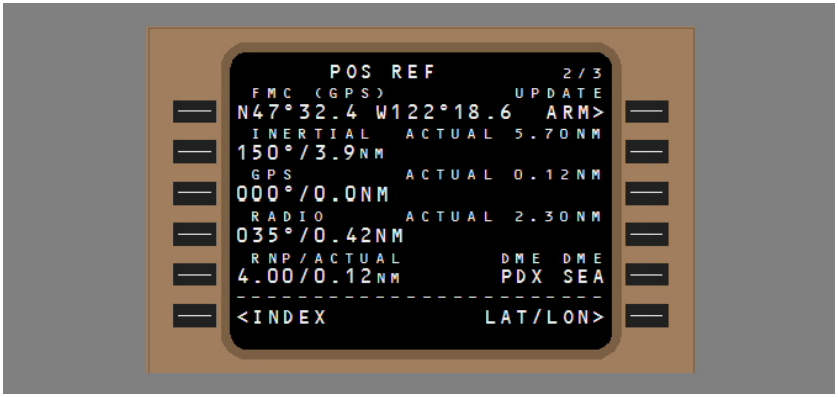
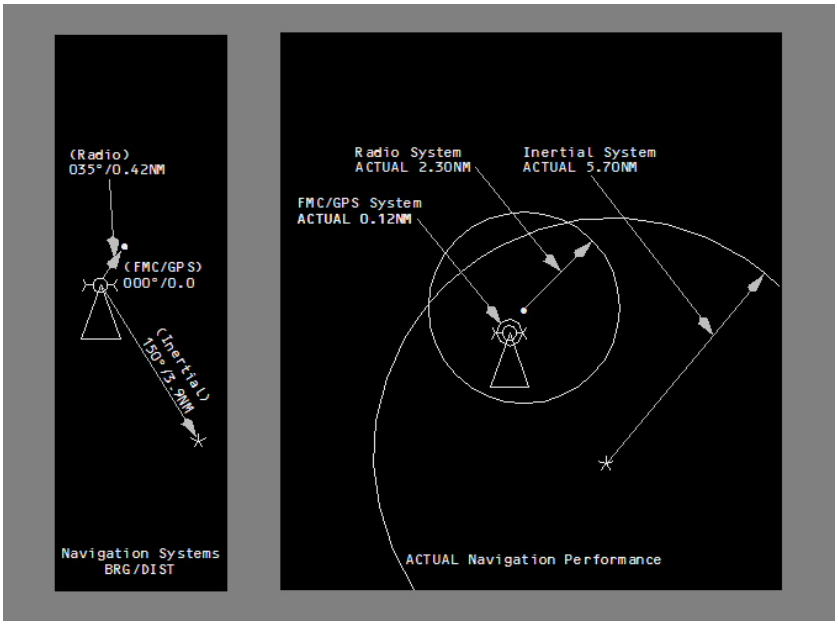


Navigation Performance





The FMC uses data from the navigation systems to accurately calculate the position of the airplane. The current FMC position displays on line 1 of the POS REF page 2. The primary source of update displays in parentheses above the FMC position.

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Navigation system positions display on the left side of lines 2 through 4. The bearing/distance is from the FMC position to the individual navigation system position.

The FMC position displays on the ND at the tip of the triangle. All other positions display relative to the FMC. The RADIO position is shown above as a •, but is not shown on the ND. The ACTUAL navigation performance circles shown above do not display on the ND.

Actual Navigation Performance

Actual navigation performance (ANP) is the FMC position accuracy. It displays on the POS REF page 2, lines 1-3, for the navigation source displayed on the left side. 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.

After a manual position update using the ARM function on the POS REF page 2, the ACTUAL navigation performance of the FMC changes to the ACTUAL navigation performance of the selected navigation source. In the example above, selection of the NOW> prompt on the INERTIAL line would change the FMC ACTUAL navigation performance to 5.7 NM. The FMC then updates from the best available navigation system and eventually, the manual update has no effect on position calculation. Some automatic updates can be inhibited; GPS on POS REF page 3 and VOR/DME updates on the REF NAV DATA page.

Radio navaid updating is inhibited unless the RAD NAV INHIBIT toggle is selected to OFF on the REF NAV DATA page.

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, if required. RNP displays on POS REF page 2.

Lateral Navigation (LNAV)

LNAV provides steering commands to the next waypoint or the selected route intercept point. When armed on takeoff, LNAV engages at or above 50 feet, when laterally within 2.5 nautical miles of the active route leg. FMC LNAV guidance normally provides great circle courses between waypoints. However, when an arrival or approach from the FMC data base is entered into the active route, the FMC commands a heading, track, or a DME arc to comply with the procedure.

The FMC creates a path allowing the airplane to turn before reaching a "fly-by" waypoint. When a waypoint is defined as a "fly-over", the FMC directs the

airplane to fly directly over the waypoint before turning. The flight path shows on the ND using reduced range.

Waypoints

Waypoint (navigation fix) identifiers display on the CDU and navigation display.

The CDU message NOT IN DATABASE displays if a manually entered waypoint identifier is not kept in the data base. The waypoint can still be entered as a latitude/longitude, place-bearing/distance or place-bearing/place-bearing waypoint.

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. Examples:

- Los Angeles VORTAC—LAX
- Tyndall TACAN—PAM
- Riga Engure, Latvia—AN.

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. Examples:

- DOT
- ACRA
- 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.

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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. Examples:

- CLEAR LAKE becomes CLAKE
- ROUGH ROAD becomes RROAD.

Unnamed Waypoints

If 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 the 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.

Waypoint 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 Waypoint Names

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
- 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
- Middle Marker 21 = MM21.

Runway-related fixes—waypoints located at unnamed runway–related fixes are identified by adding a two–letter prefix to the runway number. The following list is used to determine the applicable prefix:

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

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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 as follows:

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.

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Duplicate Waypoints

When a waypoint which has a duplicate identifier in the navigation database is entered, the SELECT DESIRED WPT page displays. The page lists the latitude/longitude of duplicate waypoints and the fix type.

DELETION

* Entering a waypoint identifier in the route a second time displays the SELECT DESIRED WPT page. The page lists the latitude/longitude of duplicate waypoints and fix type. Line selecting the latitude/longitude of the desired waypoint enters that waypoint on the page from which the SELECT DESIRED WPT was accessed.

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.

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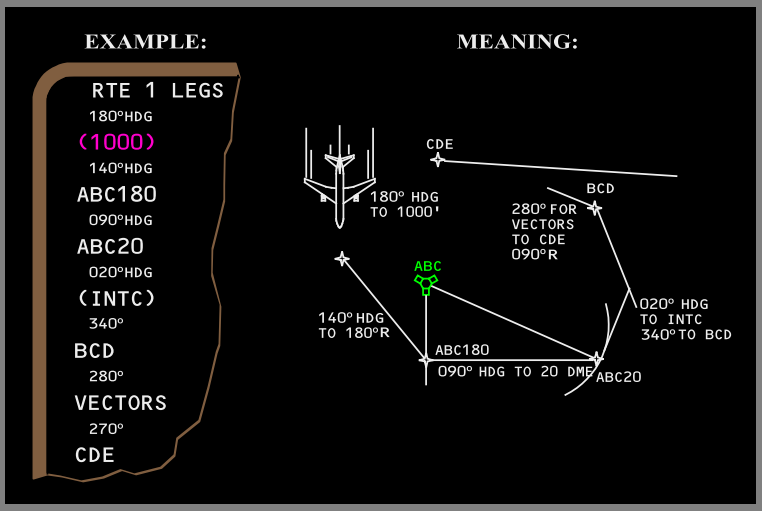

Note: All waypoints except BCD and CDE are examples of conditional waypoints.

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 displays as N47W008
- N47° 15.4’ W008° 3.4’ is entered as N4715.4W00803.4 and displays 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:

DELETION

For AIMS BP V16 and later:

- SEA330/10 becomes SEA-01
- SEA330/OLM020 becomes SEA-02.

The two digit sequence numbers reserved for RTE1 are 01 through 49. The two digit sequence numbers reserved for RTE2 are 51 through 99.

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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.

Manually Entered Latitude or Longitude Reporting Point Waypoints

Latitude or longitude reporting waypoints are entered as the full latitude or longitude followed by a dash, then the increment chosen for the following multiple 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 when they are created.

Along-track waypoints are entered 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:

DELETION

* For AIMS BP V16 and later:

- VAMPS/25 is 25 miles after VAMPS on the present route and displays as VAM-01
- ELN/-30 is 30 miles before ELN on the present route and displays as ELN-01.

ND Map Displays

The route displays on the ND in the map, map center, and plan modes. The display color and format represent the following status:

- an inactive route displays as a dashed, cyan line
- a pending active route displays as a dashed, white line
- the active route displays in magenta

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- 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 GPS or radio 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 that is 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. Three VNAV CDU pages correspond to these flight phases. Pressing the VNAV function key displays the active phase page. Other VNAV pages display using the next or previous keys.

Vertical Actual Navigation Performance (VANP)

TKK to TKR, TKU to TKZ

Vertical Actual Navigation Performance is the FMC estimate of the quality of altitude determination. It displays on the RNP PROGRESS page. VANP is the estimated maximum altitude error. The FMC computes the vertical path and the certainty the actual altitude is within a vertical range equal to plus or minus the displayed VANP value.

Note: VANP is calculated from the baro-corrected altitude provided by the Air Data System. The pilot must set the baro setting reported by ATIS or by the setting given in the approach clearance for the display to be valid.

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 are shown in large font. FMC predicted values do not act as constraints, and display in small font.

A waypoint constraint is magenta when it is active. The constraint does not have to be in line 1 to be active. Waypoints can have altitude or airspeed/altitude constraints.

Modified waypoint constraints are shaded white until they are executed. Speed constraint entries require an altitude constraint at the same waypoint. All speed constraints are considered by the FMC as at or below constraints.

At or above altitude constraints are entered with a suffix letter A (example: 220A). At or below altitude constraints are entered with a suffix letter B (example: 240B). Mandatory altitude constraints are entered without any suffix letter (example: 270).

Altitude constraints with two altitudes may be entered in either order. The lower altitude constraint, followed by a suffix letter A, and the upper altitude constraint, followed by a suffix letter B (example: 220A240B or 240B220A).

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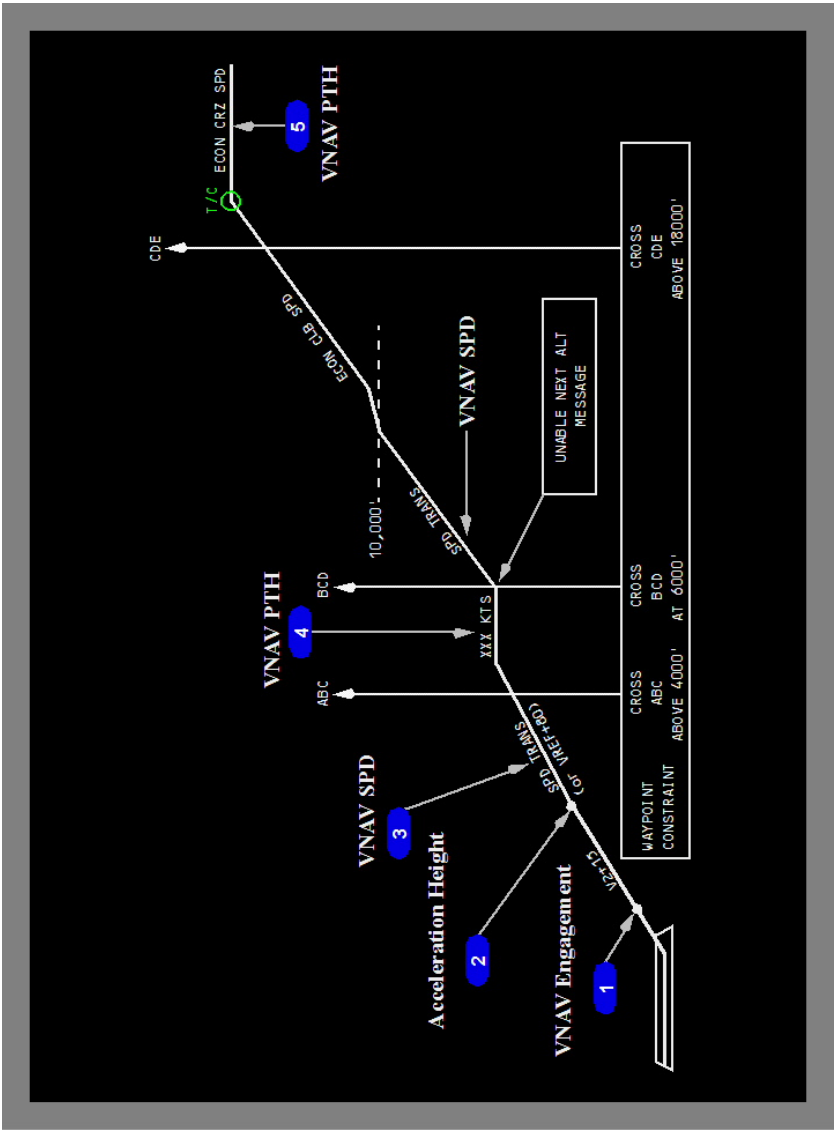
Takeoff and Climb



1 Takeoff

If 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 + 15 and V2 + 25 knots.

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 + 80 knots or the speed transition associated with the origin airport, limited by configuration.

The FMC changes the thrust reference limit to the selected climb thrust at the thrust reduction point.

3 VNAV Climb

VNAV climb profile uses VNAV SPD or VNAV PTH at 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 ALT 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 the 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 open circle with the label T/C.

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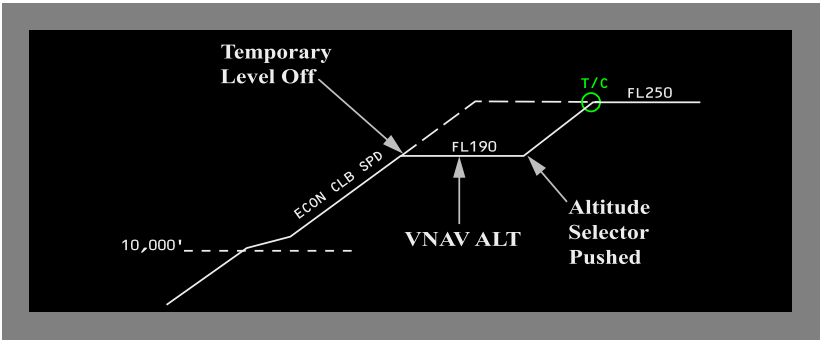
MCP Altitude Intervention



Whenever the airplane levels off 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 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 then levels at FL250 in cruise.

Cruise

During cruise, the FMC commands economy cruise speed or the pilot entered speed until reaching the top-of-descent (T/D) point. Other cruise speed options are:

- long range (LRC)
- engine out (ENG OUT)
- flight crew entered speed
- flight crew entered constant Mach between two or more waypoints
- 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.

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Step Climb

Fuel and ETA calculations assume the airplane climbs at each calculated step climb point as airplane weight decreases. FMC calculated 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 TO altitude on the CRZ page or "S" on a waypoint on the LEGS page overrides FMC step climb calculations. Entry of a step altitude on the LEGS page overrides a STEP TO entry made on the CRZ page.

Calculated step altitudes display on the LEGS page. The distance and ETA to the next step point (calculated or flight crew entered) display on the CRZ and PROGRESS pages. They also display on the ND map display with a green circle and "S/C".

The FMC calculates step climb locations and altitudes as a function of lateral flight plan, current cruise speed mode and altitude, entered forecast winds and temperatures, step size, cruise cg, and gross weight.

The primary factor affecting step climb calculation is the entry of accurate forecast cruise winds and temperatures on the WINDS page. Unless enroute winds are entered, all step climb locations and altitudes are calculated assuming zero wind. IRS winds are not used in the calculation of step climb data.

For ECON cruise, step climbs are optimized to provide minimum trip cost according to the entered Cost Index. For other selected speeds, calculated step climbs minimize trip fuel.

Calculated step locations display on the ND (S/C); the next step displays on the ECON CRZ page. Flight plan calculations of time and fuel at destination are based on executing step climbs as calculated. Legs page waypoint altitudes reflect the optimum step climb profile.

Inflight entry of a STEP TO altitude in 1R causes the FMC to use the entered enroute winds and temperatures to calculate the optimum location for a climb to the step altitude; the ETA and DTG for the step display in 2R. Following entry of an altitude in 1R, the FMC uses only that altitude to calculate data for 2R. When the FMC calculates an immediate step climb to the entered altitude is optimal, 2R displays NOW. If the FMC determines remaining at the current altitude for the duration of the flight is more optimal than flying at the entered altitude, 2R displays NONE.

Planned step climb points (S/C) may be entered on the Legs page at selected waypoints. In this case, both altitude and step location are constrained. With planned step climb points entered, flight plan calculations assume a constant cruise altitude until reaching the planned step waypoint. Optimized step climb calculations resume after passing the last planned step climb waypoint.

When the last planned step is a step descent, step climb are no longer calculated.

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Optimum (OPT) altitude calculation does not use forecast or IRS winds and temperatures. Recommended (RECMD) altitude calculation is based on step size, current CRZ ALT, and entered forecast enroute winds and temperatures.

All altitude calculations are limited by maximum (MAX) altitude.

If a climb is not initiated within 5 minutes after passing a planned or calculated step climb point, the EICAS message VNAV STEP CLIMB displays.

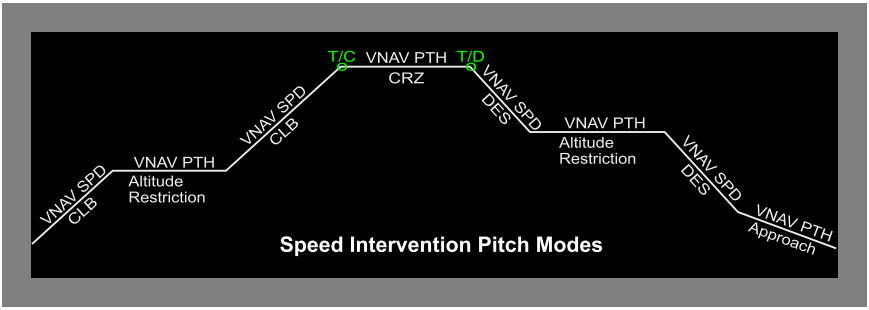
Cruise Descent

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.

Required Time of Arrival (RTA)

VNAV controls cruise speed to arrive at a specified waypoint within ±30 seconds of a specified time. If the RTA is not achievable, the FMC displays the scratchpad message UNABLE RTA.

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.

In a VNAV descent after the T/D, VNAV PTH changes to VNAV SPD during speed intervention. In all other phases, the pitch mode does not change with speed intervention. Pitch controls speed in VNAV SPD mode, and during the

VNAV PTH descent prior to speed intervention. Otherwise, thrust controls speed in VNAV PTH mode.

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 will not transition to approach phase when passing the first waypoint of the approach.

Descent

The FMC calculates a descent path based on airspeed and altitude constraints and the end of descent (E/D) point. 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. A green circle T/D symbol displays on the ND at the start descent phase point. The FMC displays a T/D symbol at each point in the descent profile which represents a transition from a level segment to a descent segment. 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 314 knots (VMO/MMO minus 16 knots) or a pilot entered speed greater than 319 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.

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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 314 knots (VMO/MMO minus 16 knots), the scratchpad message DRAG REQUIRED displays. The airplane may accelerate up to 319 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 314 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

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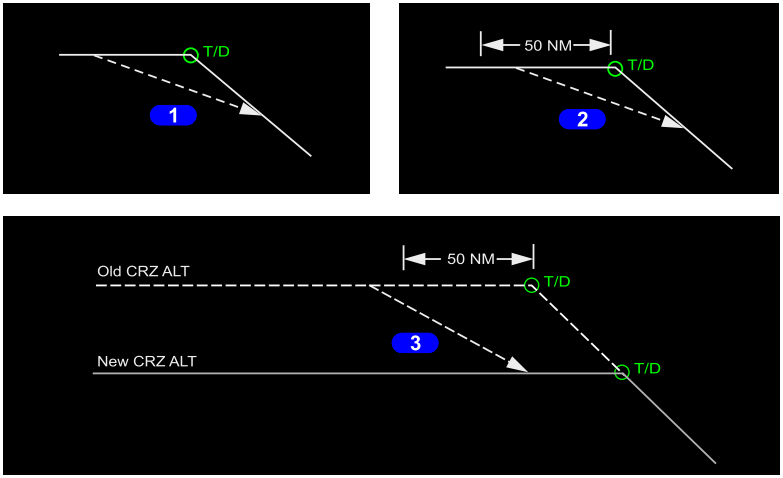
placard speed if flaps are extended. If further correction is required, VNAV may allow the airplane to rise up to 150 feet above the path to stop the acceleration. If VNAV can no longer maintain the airplane within 150 feet of the path without further acceleration, speed reversion occurs, the pitch mode 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.

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 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.

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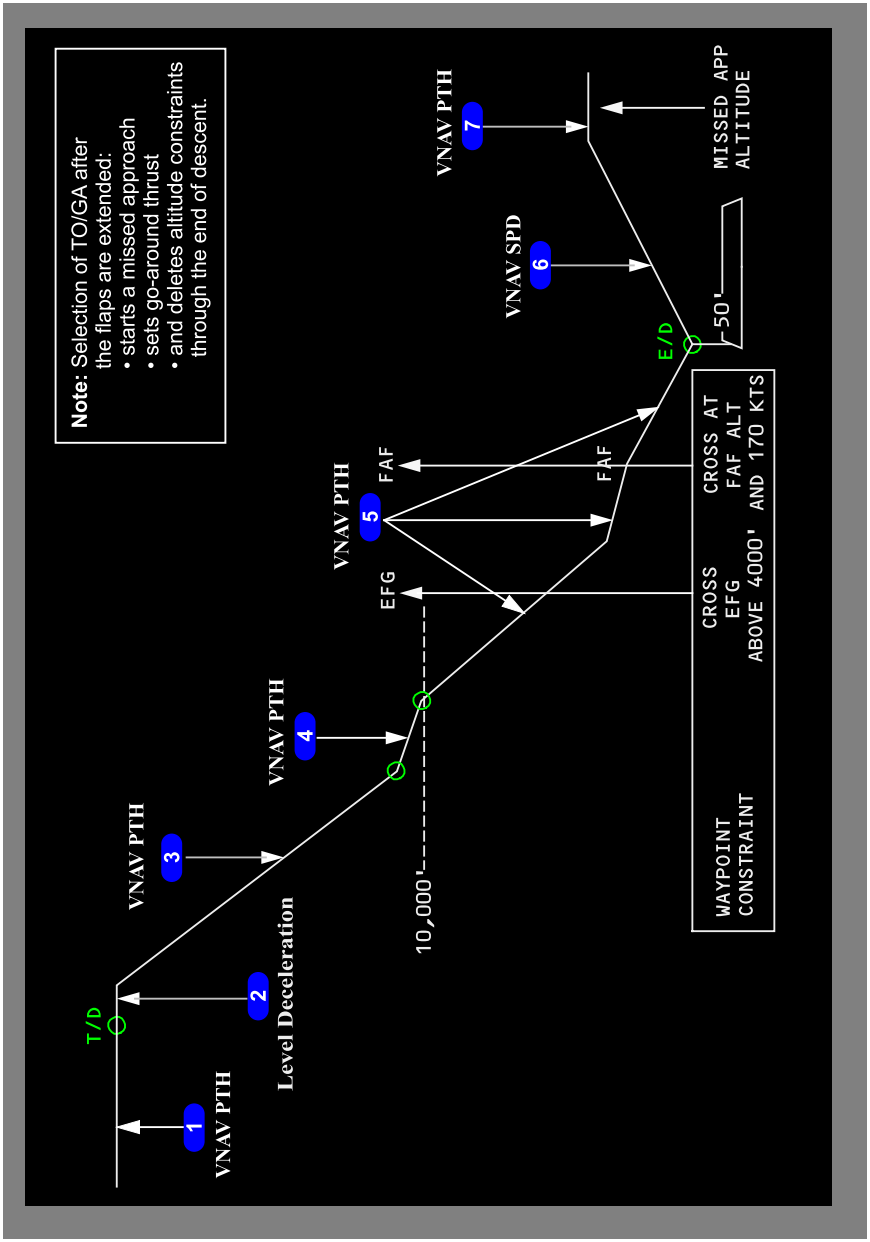
2 Within 50 NM of Top of Descent Point

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)



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1 Cruise

Before the top of descent, FMC is in cruise mode and commands VNAV PTH 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 PTH.

3 Descent

Nearing descent speed, VNAV commands a descent in VNAV PTH at ECON descent speed.

4 Descent Deceleration Phase

Before the speed restriction altitude, the 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 PTH at commanded speed. Extending flaps from UP to 1 arms go-around; EICAS displays GA as the reference thrust limit. Activation of VNAV changes the reference thrust limit to CRZ; selection of landing flaps (25 or 30) changes the reference thrust limit to GA. Prior to extending flaps to a landing position and with VNAV PTH and CRZ reference thrust limit, pressing TO/GA changes the reference thrust limit to GA.

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 PTH.

Approach

The FMC transitions to "on approach" mode for any of the following conditions:

- the descent phase is active and flaps are out of up, or
- the airplane has sequenced the first waypoint (or FAXXX) of the active approach, or
- the airplane is on a direct-to or intercept course-to the active waypoint and the distance to go is less than 12 NM, or
- the missed approach point is the active waypoint and the distance to go is less than 25 NM.

The approach condition may be delayed if the flight crew manually inserts, bypasses, or deletes an approach waypoint on the LEGS page.

The FMC transitions out of "on approach" under the following conditions:

- the pilot selects TO/GA
- the airplane lands
- the airplane flies beyond the last waypoint in the approach (missed approach waypoint or runway). The VNAV page title changes from "ACT xxxxx 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 the next logical 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 TO/GA switch. The following features are available:

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF, TKK to TKR, TKU to TKZ

- VNAV (and LNAV) can only be activated when the airplane climbs above 400 feet radio altitude

TKK to TKR, TKU to TKZ

- VNAV can only be activated when the airplane climbs above 400 feet radio altitude
- if an LNAV path is available, LNAV automatically activates:
  - above 50 feet radio altitude when autopilot is not engaged, or
  - above 200 feet radio altitude when autopilot is engaged.

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Note: Route discontinuities after the missed approach will prevent the TO/GA to LNAV function from engaging.

- 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. This transition also occurs when the airplane climbs toward the MCP altitude and flaps are retracted from a landing position (25 or 30 towards 20, or 20 towards 5). For example, when a missed approach is accomplished without pushing the TO/GA switch.
- 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).

Executing a missed approach causes the flight phase transition from descent or end of descent to climb when:

- the MCP altitude window is set to an altitude greater than current altitude, and
- the airplane is climbing at a rate greater than 600 fpm, and
- flaps have been retracted from the landing position.

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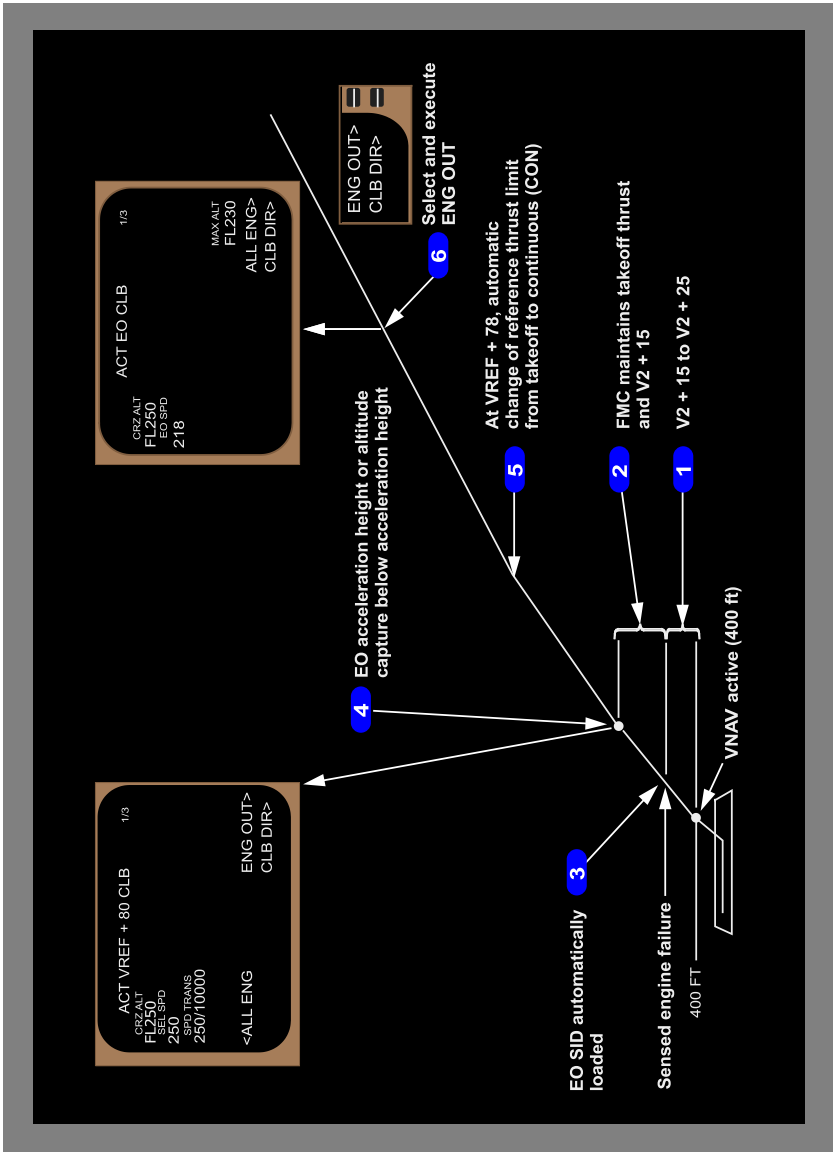
Engine Out Operation

Takeoff and Climb



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1 Takeoff

Condition: Before a sensed engine failure and above VNAV activation altitude.

Result: VNAV SPD commands a climb at V2 + 15 to V2 + 25 knots. Autothrottle annunciation is THR REF and the thrust limit is takeoff.

2 Sensed Engine Failure

Condition: After VNAV activation, engine failure is 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 V2 + 15 knots. Autothrottle remains in THR REF and the thrust limit remains takeoff (TO).

3 EO SID

Condition: Flaps out of up and an engine out standard instrument departure (EO SID) in the FMC database.

Result: FMC loads the EO SID as a flight plan modification. The modification may be either executed or erased.

4 Acceleration Height

Condition: At acceleration height or altitude capture below acceleration height.

Result: VNAV commands an acceleration to VREF + 80 knots, limited by the airplane configuration (flap placard). The VNAV climb page title displays the ACT VREF + 80 CLB page.

5 Thrust Reduction

Condition: Airplane has accelerated to VREF + 78 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.

6 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.

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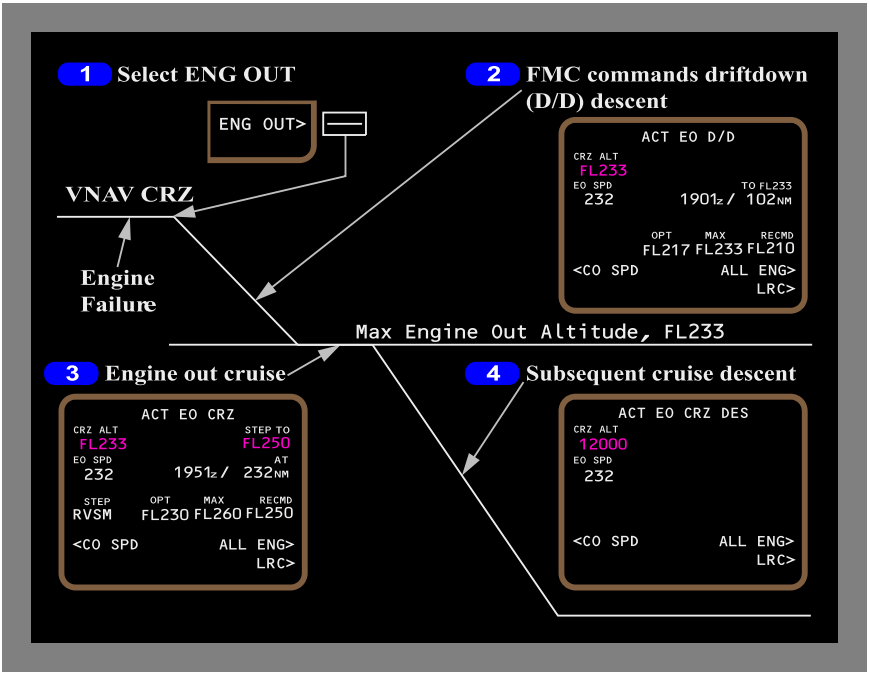
Result: The FMC engine out climb function is active, the pitch mode is VNAV SPD, the command speed is EO SPD, and the reference thrust limit is CON.

Climb (Above EO Max Alt)

When the airplane is above the engine out maximum altitude, selection of ENG OUT> on the VNAV CLB page or the XXXX ALTN page creates a modification and displays applicable engine out driftdown (D/D) performance data enabling the a descent to the engine out maximum altitude. Execution of the modification activates the engine out driftdown function.

Cruise (Above EO Max Alt)

When the airplane is above the engine out maximum altitude, selection of ENG OUT> on the VNAV CRZ page or the XXXX ALTN page creates a modification and displays applicable engine out driftdown (D/D) performance data. When executing the ENG OUT modification, the reference thrust limit becomes CON, thrust levers advance to CON, the default command speed is EO SPD, and the EO MAX altitude shows as the cruise altitude in 1L. The EO MAX altitude shown in 1L does not change with time or changes in command speed.



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1 Engine Out Modification

Select the ENG OUT> creates a modification and displays the applicable engine out driftdown (D/D) performance data.

2 Drift Down Execution

A driftdown descent can be initiated by setting the MCP altitude at or below EO MAX altitude and executing the modification.

Result:

- VNAV commands EO SPD
- when EO SPD is achieved, VNAV controls the driftdown descent rate to a minimum of 300 feet per minute (fpm)
- time and distance for the D/D to EO MAX altitude show at 2R
- VNAV captures the MCP altitude and commands EO CRZ.

Executing the ENG OUT modification without descending changes the pitch mode to VNAV ALT. A driftdown descent does not start until setting the altitude at or below EO MAX altitude and pushing the altitude selector. The result above describes the driftdown.

A normal enroute cruise descent can be initiated by setting the MCP altitude to a lower altitude and pushing the altitude selector.

Result:

- the airplane descends in a normal VNAV cruise descent at two-engine ECON speed
- the reference thrust limit is CLB/CRZ
- the airplane descends at ECON CRZ and approximately 1,250 fpm

During the enroute cruise descent, when the airplane is above EO MAX altitude, executing the ENG OUT modification commands a driftdown descent to the EO MAX altitude. The command speed is E/O SPD. The rate of descent decreases to a minimum of 300 fpm.

3 Engine Out Cruise

When VNAV captures the EO MAX altitude, the VNAV cruise page title becomes EO CRZ and the pitch annunciation is VNAV PTH, regardless of the MCP altitude window setting. Calculations for EO Step Climb display at 2R. Thrust limit remains in CON.

4 Subsequent Cruise Descent

The FMC is in engine out mode. When the airplane is more than 50 nm from T/D, setting a lower MCP altitude and pushing the altitude selector executes an engine-out cruise descent.

Result: VNAV cruise descent at approximately 1,250 fpm at EO SPD. When the EO cruise descent intersects the planned descent profile, descent mode becomes active.

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 FL 008; displays as 800
- 1,500 feet is entered as 015 or FL 015; displays as 1500
- 11,500 feet is entered as 115 or FL 115; displays as FL 115
- 25,000 feet is entered as 250 or FL 250; displays as FL 250.

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 FL 085
- 9,995 feet is entered as 09995; displays as FL 100
- 11,500 feet is entered as 11500; displays as FL 115
- 25,000 feet is entered as 25000; displays as FL 250.

Negative altitude entries are allowed to −1,000 feet.

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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.

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FMC Databases

The FMC contains three databases:

- performance
- navigation
- airline modifiable information (AMI).

The performance database supplies performance data to the flight crew. It supplies the FMC with data to calculate pitch and thrust commands. All pertinent data can be displayed on the CDU. The database includes:

- airplane drag and engine characteristics
- maximum and optimum altitudes
- maximum and minimum speeds.

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 FMC contains two sets of navigation data, each valid for 28 days. Each set corresponds to the usual 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.

The AMI file contains airline specified data. If the FMC senses a conflict in an AMI value after a new AMI data load, the scratchpad displays the message CHECK AIRLINE POLICY.

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.

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TJA,B,C,D,G,H, Thrust limits are expressed as EPR limits. Thrust equalization references EPR.

TJR to TJW, TKA to TKF Thrust limits are expressed as N1 limits. Thrust equalization references N1.

TKK to TKR, TKU to TKZ 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
G/A	go–around.

TKK to TKR, TKU to TKZ In addition, with APU-to-Pack takeoff option, “A-TO”, “A-TO 1”, or “A-TO 2” thrust setting displays.

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF 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 above EICAS EPR indications.

TKK to TKR, TKU to TKZ 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 above EICAS N1 indications.

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, an entry of 1 for Flaps 1, or an entry of 5 for flaps 5.

Reduced Thrust Takeoff

Reduced thrust takeoffs lower EGT and extend engine life.

Derate/Variable Takeoff Rating

Two fixed derates can be selected on the THRUST LIM page. TO 1 and TO 2 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.

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With both TO 1 and TO 2, 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.

Derate/variable takeoff rating can be further reduced by assumed temperature.

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. Do not use assumed temperature reduced thrust if conditions exist that affect braking, such as slush, snow, or ice on the runway, or if potential windshear conditions exist.

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.

Note: When the flight crew enters an assumed temperature resulting in thrust reduction; and, manually arms CLB, a decrease in OAT may cause the FMC to recalculate V-speeds and arm CLB 1 or 2 on the THRUST LIM page. The scratchpad message TAKEOFF SPEEDS DELETED displays.

Derated Thrust Climb

During climb, CLB 1 and CLB 2 derates are gradually removed. In cruise, the thrust reference defaults to CLB or CRZ [Airline Selectable Option]. The reference can be manually selected on the THRUST LIM page.

Two fixed climb thrust derates can be selected on the THRUST LIM page. CLB 1 uses a 10 percent derate of CLB thrust to 10,000 feet, then increases thrust linearly with altitude to CLB thrust at 12,000 feet. CLB 2 uses of a 20 percent derate of CLB thrust to 10,000 feet, then increases thrust linearly with altitude to CLB thrust at 12,000.

Use of an assumed temperature reduced thrust takeoff or takeoff derate affects automatic selection of climb derate. For a thrust reduction less than 10 percent, maximum climb thrust is automatically selected by the FMC. For takeoff thrust reductions or derates from 10 percent to less than 20 percent, CLB 1 is selected. CLB 2 is selected for all takeoff thrust reductions or derates equal to or greater than 20 percent. On the ground, the pilots may override the automatic climb derate selection after the takeoff selection is complete.

Use of derated climb thrust reduces engine maintenance costs, but increases total trip fuel.

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Fuel Monitoring

The FMC receives fuel data from the fuel quantity system or from manual entries. Fuel quantity values display on the PERF INIT page as calculated (CALC), MANUAL, or SENSED. They display on PROGRESS page 2 as TOTALIZER and CALCULATED. TOTALIZER and SENSED values are the same data with different names.

The FMC usually uses the calculated value for performance computations. Before engine start, the calculated value is set to agree with the fuel quantity indicating system value. When the FMC receives a positive fuel flow signal at engine start, the calculated value is independent of the fuel quantity system and decreases at the fuel flow rate.

During fuel jettison, the calculated value is set equal to the fuel quantity system value. When fuel jettison is completed, the calculated value is independent of the fuel quantity indicating system and decreases at the fuel flow rate. This fuel quantity value displays as CALC (calculated) on the PERF INIT page and CALCULATED on PROGRESS page 2.

If the flight crew inputs a fuel quantity, the line title changes to MANUAL and replaces the calculated value. Like the calculated value, the manual value is updated by fuel flow rate.

The calculated value is invalid if fuel flow data is invalid. The FMC uses the fuel quantity indicating system quantity for performance computations. The line title on the PERF INIT page changes to SENSED and displays as TOTALIZER on PROGRESS page 2.

The fuel used by each engine is calculated with its related fuel flow signal. FUEL USED displays on PROGRESS page 2. 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 FMC continually estimates the fuel at the destination airport when the active route is flown. The EICAS message INSUFFICIENT FUEL displays if the estimate is less than the fuel reserve value; or, if no reserve value entered, then 4,000 lbs (1,814 kgs). For a pending activation route or for the active route in a modified state, the message displays in the scratchpad.

DELETION

The EICAS message FUEL DISAGREE displays if the FMC calculates a large difference between the fuel quantity indicating system quantity and calculated value. Totalizer or calculated fuel quantity can be selected with the USE prompt on PROGRESS page 2.

Note: FMC calculated fuel predictions assume a clean configuration. Flight with gear or flaps extended cause fuel prediction errors. Fuel predictions are accurate after the gear and flaps are retracted.

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If the actual fuel temperature reaches the minimum value displayed on the PERF INIT page, the EICAS advisory message FUEL TEMP LOW displays.

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, the performance data displayed on the PERF INIT page must be re-entered. The route previously in use is available but must be reactivated.

The flight crew must modify the active waypoint to activate LNAV. Selecting the applicable active waypoint and proceeding direct or intercepting a course to the waypoint allows LNAV activation.

FMC Failure

Single FMC Failure

The scratchpad message SINGLE FMC L or SINGLE FMC R displays after loss of a single FMC. The EICAS advisory message FMC MESSAGE displays. Crew action is not necessary to change to single FMC operation. LNAV and VNAV, if active, remain active and all flight plan and performance data is retained.

A software reset may occur while in single FMC operation. The active route becomes inactive, the performance data is erased, and LNAV and VNAV (if engaged) modes fail. To regain FMC operation, activate and execute the flight plan, enter the necessary performance data, and engage LNAV and VNAV.

Note: If the MENU page and the scratchpad message TIMEOUT RESELECT display, the FMC is no longer connected to the CDU. Selecting the <FMC prompt connects the CDU to the FMC.

Dual FMC Failure

If both FMCs fail, LNAV and VNAV fail. The EICAS advisory message FMC displays. The CDUs supply route data to the NDs, and one of the CDUs supplies LNAV guidance to the autopilot. LNAV can be reselected on the mode control panel. FMS alternate navigation using the CDUs is discussed in Section 50 of this chapter.

Dual FMC failure may inhibit the autothrottle system. If it is available, it may be used in conjunction with any valid autopilot roll and/or pitch mode.

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.

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Air Traffic Control Data Link

Most Air Traffic Control data link functions are accomplished on the MFD. The CDU is used as an input keyboard for downlink message forms. Uplink messages which contain route modifications are loaded into the FMC using the LOAD FMC function on the MFD ATC page. Execution of an ATC loaded modification is accomplished using normal FMC modification procedures.

See ATC Data Link on page 5.40.18 for a description of ATC data link.

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Company Data Link

The airplane communications system enables two–way data link 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.

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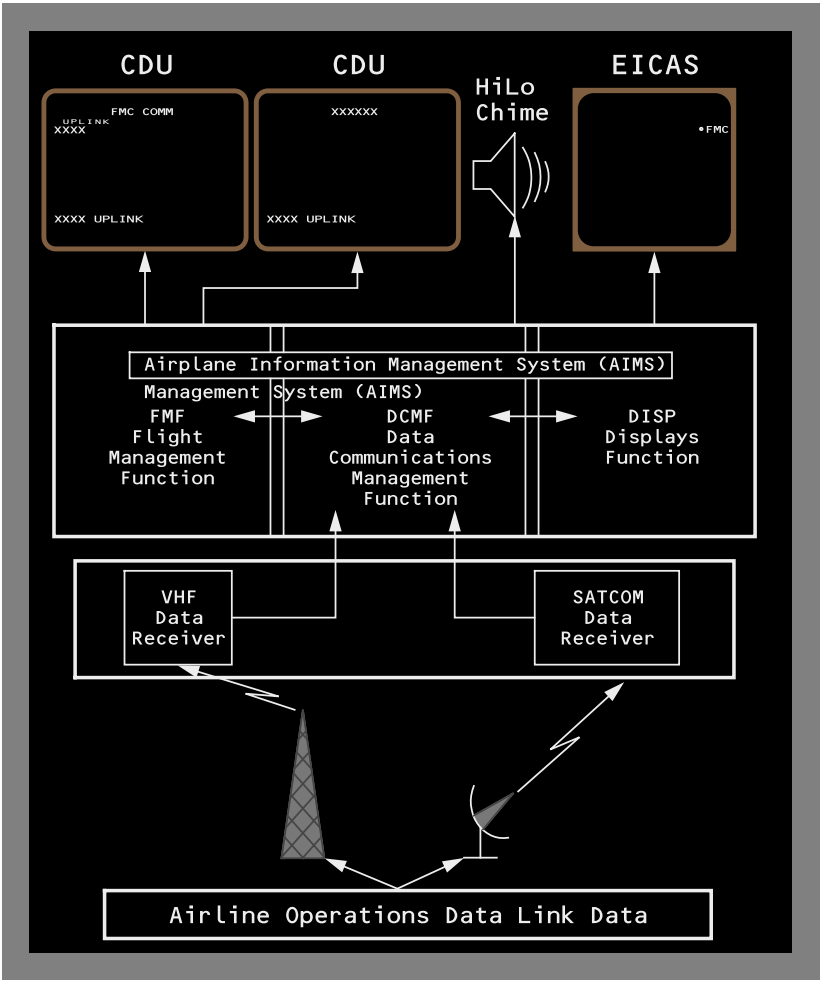

Data Link

Downlinks are data link messages transmitted to a ground station. Requests for data and reports of FMC data are two types of downlinks. Requests are made manually by the flight crew. Reports can be made manually or may occur automatically.

Uplinks are messages transmitted to the airplane. Most uplinks require manual selections by the flight crew. Some uplinks are input automatically.

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Manual Downlinks

Select a REQUEST prompt to start the downlink request for data. REQUEST prompts are on PERF INIT, DESCENT FORECAST, RTE, ALTN, ALTN LIST or RTE DATA pages. Downlink reports of the active route may be accomplished by selection of the REPORT prompt on the RTE page and a position report may be downlinked by selection of the REPORT prompt on the POS REPORT page.

When the communications function is unable to prepare FMC downlinks, the words FAIL, NO COMM, or VOICE display on CDU pages in place of REQUEST and REPORT prompts. The data link status also displays on the FMC COMM page. Radios supporting data link operations can be reconfigured by the crew through the MFD COMM function; see MFD Communications Functions on page 5.40.1.

The status messages are:

- FAIL—
  - the AIMs data communications management function is inoperative, or
  - both the VHF and SATCOM data radios have failed.
- NO COMM—
  - the VHF and SATCOM data radios are operational but not available
  - the VHF data radio has failed and the SATCOM data radio is not available, or
  - the SATCOM data radio has failed and the VHF data radio is not available.
- VOICE—all available radios are operating in the VOICE mode.

Reports

Pushing the line select key for the REPORT sends a downlink report applicable to that page. The pages below contain report prompts.

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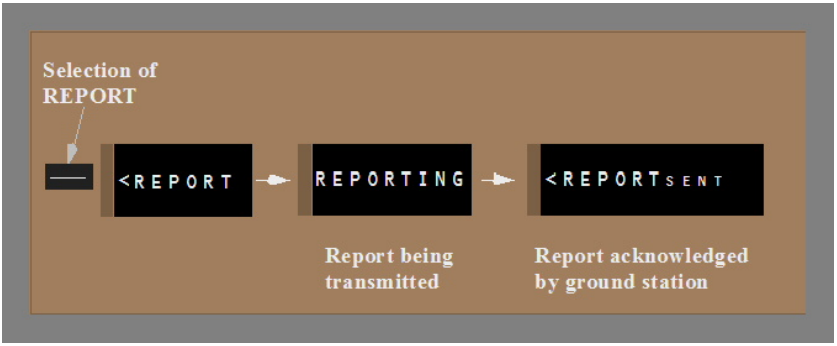
Report Status

Below is a typical sequence of status in response to sending a report.



Automatic Downlinks

The FMC can be configured by the airline to automatically transmit downlinks of FMC data at predetermined points during the flight or in response to specific data requests from the airline dispatcher. The FMC response in these cases is completely automatic and no flight crew action is necessary.

Uplinks

Uplinked data may be loaded automatically or may require flight crew action. Two uplinks automatically load data into the FMC and do not require execution. Uplinked data that waits in system memory for flight crew action are considered to be pending.

A pending uplink is included or discarded when the flight crew selects the applicable prompt. Flight crew response to an uplink depends on the type of uplink. Flight crew action is made with ACCEPT/REJECT or LOAD/PURGE prompts, FMC modification ERASE prompt or EXEC key, or when the page with the uplink is selected. Glareshield–mounted accept and reject switches operate the same as MFD ACCEPT/REJECT prompts.

Data can be uplinked from the airline dispatcher directly to the PERF INIT, DESCENT FORECAST, RTE, ALTN, ALTN LIST, and WIND pages. The uplinks are annunciated to the crew by the •FMC EICAS communications alert and a hi–lo chime. The uplink is identified by a CDU scratchpad message and by the presence of an UPLINK label over the applicable COMM page prompt.

If there is no active route, wind uplinks are not annunciated, and the <WIND prompt on the COMM page is not shown.

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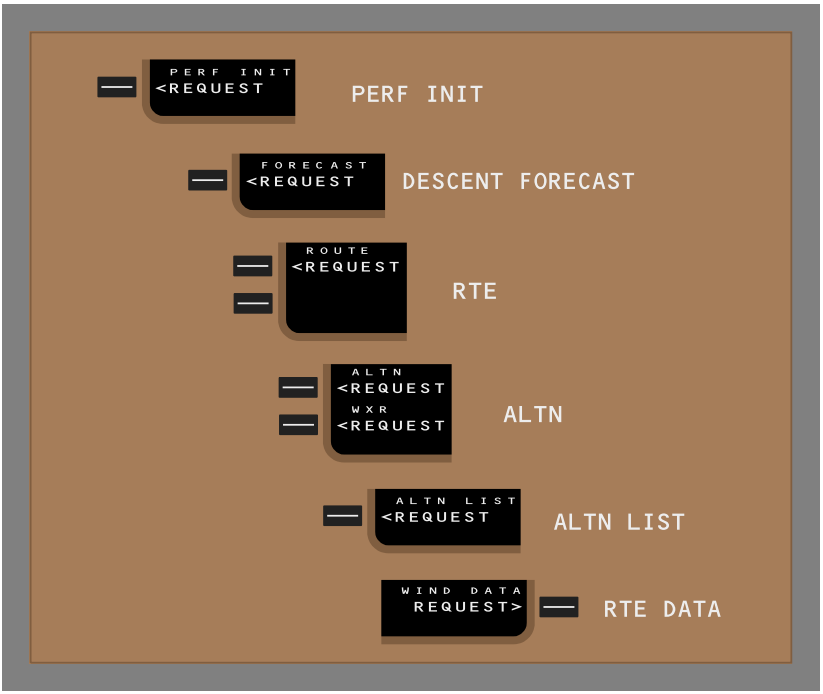
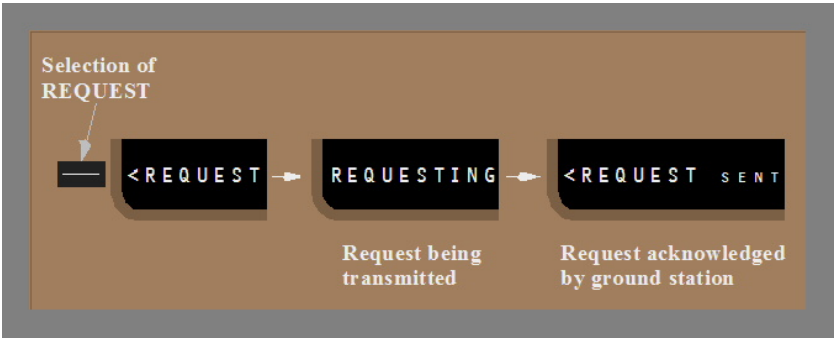
Requests

A REQUEST prompt on each page downlinks a unique request applicable to that page. The pages below contain request prompts.



Request Status

Below is a typical sequence of status in response to sending a request.



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FMC Data Link Uplinks (Accept/Reject)

ACCEPT and REJECT display on the PERF INIT, and ALTN pages after receipt of uplink data.

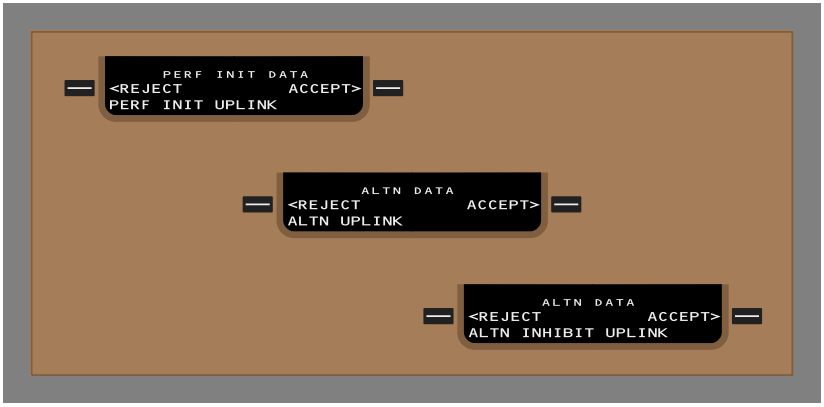
Uplink data displays initially in small font for preview.

Select ACCEPT prompt:

- displays uplinked data in large font
- replaces previous data with uplinked data
- changes page to pre-uplink format
- clears scratchpad message
- transmits a downlink accept message (if enabled).

Select REJECT prompt:

- replaces uplinked data with previous data
- changes page to pre-uplink format
- clears scratchpad message
- transmits a downlink reject message (if enabled).



FMC Data Link Uplinks (Load/Purge)

LOAD and PURGE display on the DESCENT FORECAST page after receipt of uplink data. LOAD and PURGE display on the active RTE 1 or RTE 2 page when there is an uplink to the inactive route.

Select LOAD prompt:

- loads uplinked data into FMC for viewing
- clears scratchpad message
- replaces previous data with uplinked data
- changes page to pre-uplink format

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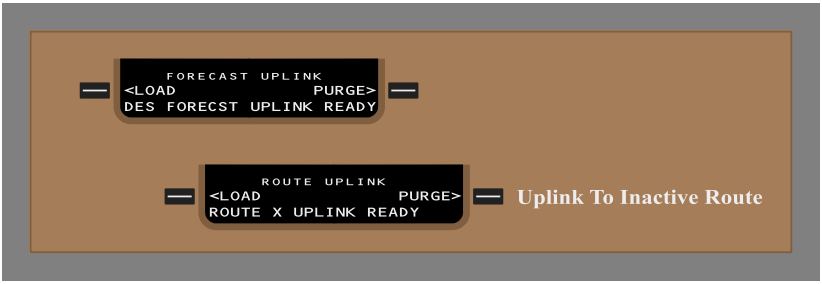
- transmits a downlink accept message (if enabled).

Select PURGE prompt:

- replaces uplinked data with previous data
- changes page to pre-uplink format
- clears scratchpad message
- transmits a downlink reject message (if enabled).



FMC Data Link Uplinks (Load/Exec-Erase)

LOAD displays on the RTE and WIND pages after receipt of uplink data.

After the uplinked data is loaded, the EXEC light illuminates and the ERASE prompt displays.

Select LOAD prompt:

- loads uplinked data into FMC
- loaded data can be viewed
- clears scratchpad message
- replaces existing data with modified uplinked data
- changes page title to MOD
- shows ERASE prompt
- illuminates EXEC light.

Push the EXEC key to:

- put modified data in active flight plan
- change page format to pre-uplink format
- transmit a downlink accept message (if enabled).

Select ERASE prompt to:

- remove modified data
- return page display to pre–uplink format
- transmit a downlink reject message (if enabled).

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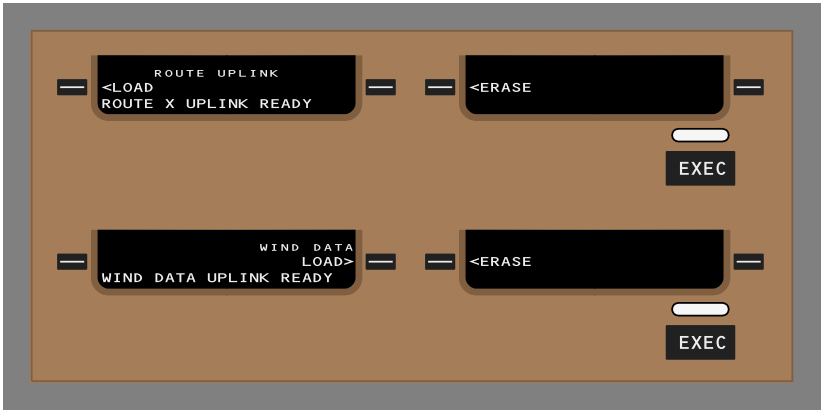

FMC Data Link Uplinks (Automatic)

FLT NO and ALTN LIST data can be automatically uplinked and loaded. FLT NO automatically loads into the RTE 1/x page without flight crew action. The list of 20 alternates automatically loads into the ALTN LIST page without flight crew action.

The scratchpad messages FLIGHT NUMBER UPLINK or ALTN LIST UPLINK stay in the scratchpad display queue until the applicable CDU page is selected.

Data Link Management

The flight crew should monitor system status of FMC data link. This is accomplished on various CDU pages or on the FMC COMM page. Changes to data link system operating modes are accomplished with the COMM function on the display select panel.

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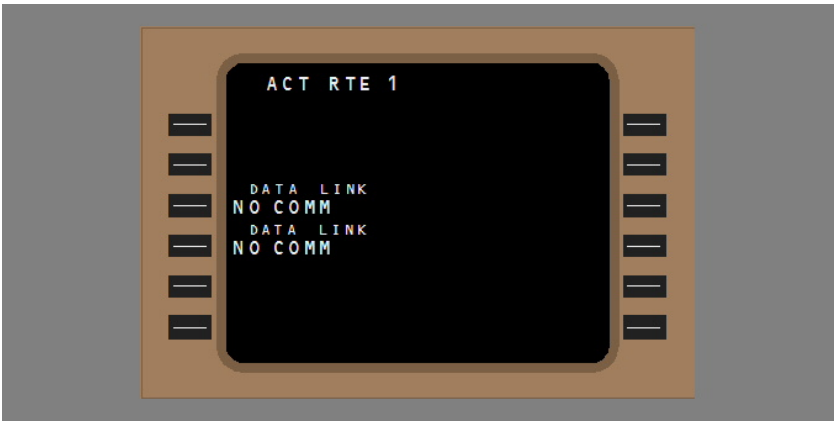
CDU Data Link Status Displays

Data link operation is verified when the correct line title displays above the prompt. In the example below, the line title ROUTE is above the REQUEST and REPORT prompts on the RTE page.

When the data link system is not operating, the CDU data line changes to NO COMM, VOICE, or FAIL and the line title changes to DATA LINK.



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FMC Communications Page

General data link status displays on the FMC COMM page. Page select prompts display for each FMC page with access to data link data.

1 Uplink Status

The page line heading displays UPLINK when an uplink message is pending and all preprocessing is complete. Preprocessing of uplinks ensures necessary data is available for display when the uplink message is selected. Examples of preprocessing include:

- RTE ALTN, ALTN LIST, PERF, and WIND uplinks are held until route activation or modifications are complete
- Subsequent uplinks of the same type are held until previous uplinks are included or discarded by the flight crew.

When both ALTN and ALTN LIST uplinks are pending, (2) displays to the right of UPLINK in the line heading.

The EICAS message •FMC displays whenever any UPLINK message is pending.

2 DATA LINK

Displays the data link system status.

System status can be:

- READY
- NO COMM

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- VOICE
- FAIL.

Page Select Prompts

Selection of any of these prompts displays the related page:

- RTE X
- ALTN
- PERF
- WIND
- DES FORECAST
- POS REPORT.

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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.

Data link can load preflight data from airline ground stations. Using data link reduces the number of required flight crew actions. Manual flight crew entries replace existing data.

Preflight Page Sequence

The identification page usually displays when power is applied to the FMC. 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.

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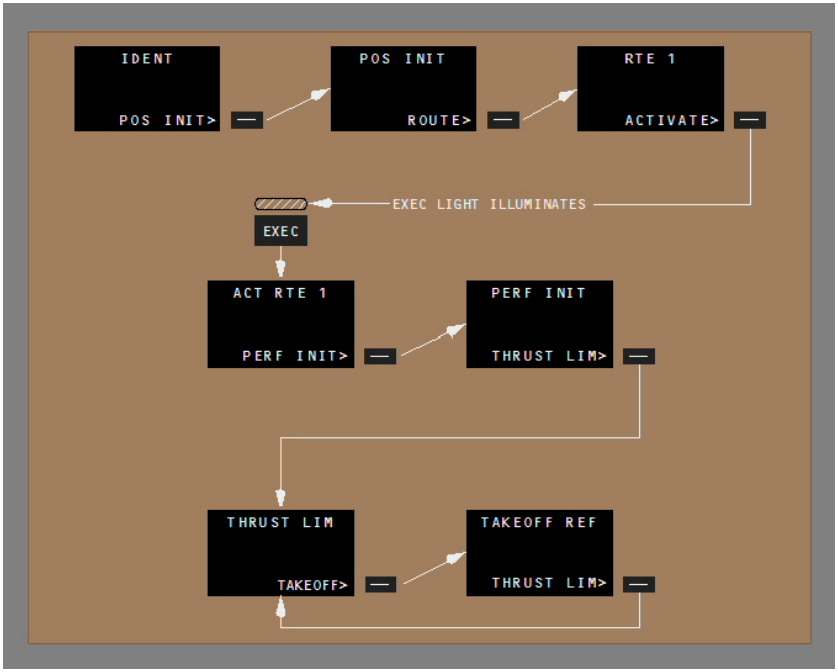
Minimum Preflight Sequence



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 the TAKEOFF page leads the flight crew to the preflight page missing data.

Airplane inertial position is necessary 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. Discussions of each page includes methods to display the page.

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When the route includes SIDs and STARs, they can be entered using the DEPARTURES or ARRIVALS pages.

Route discontinuities can be removed using the RTE LEGS pages. Similarly, speed/altitude restrictions are entered and removed on the RTE LEGS page described in the FMC Cruise section of this chapter.

Alternate airports are added on the ALTN page. The ALTN page is described in the FMC Descent/Approach section of this chapter.

Waypoints, navigation, airport, and runway data is referenced on the REF NAV DATA page. The 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 WIND page. The WIND page is described in the FMC Cruise section of this chapter.

Preflight Pages—Part 1

The preflight pages are presented in the sequence used during a typical preflight.

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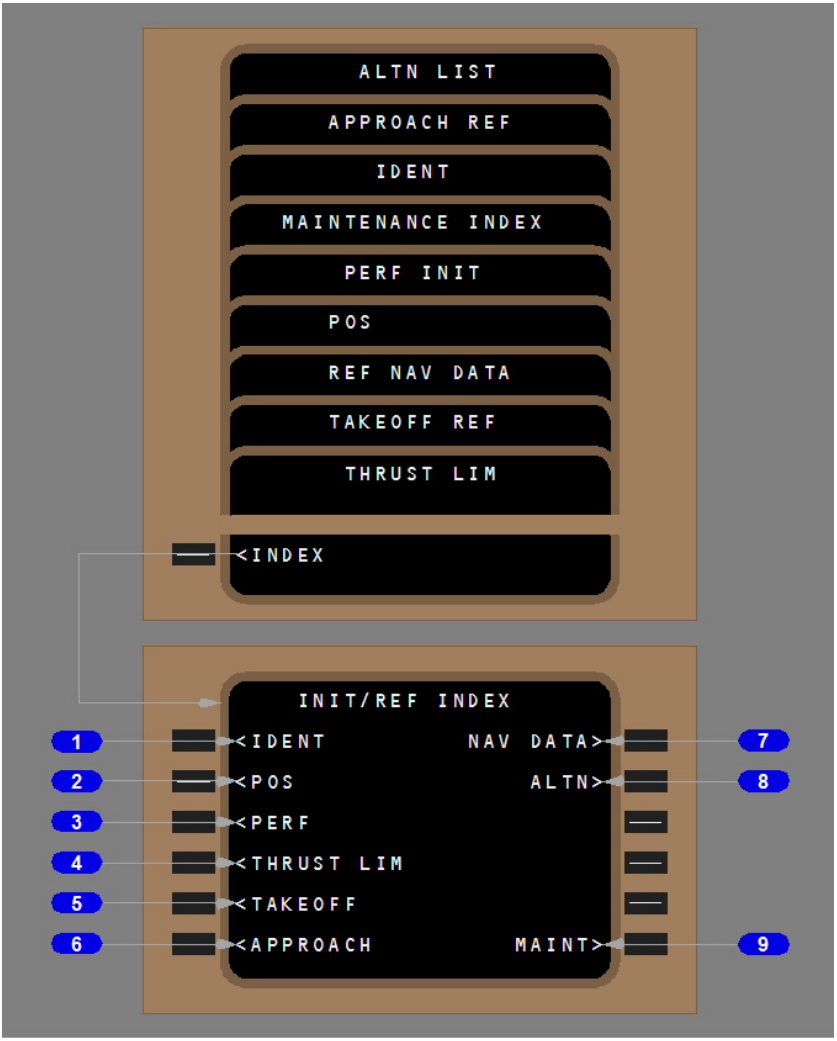
Initialization/Reference Index Page

The 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)

The IDENT page is used to verify basic airplane data and currency of the navigation database.

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2 Position (POS)

The POS INIT page is used for ADIRU initialization.

The POS INIT page is also used for initialization of SAARU heading in the event the ADIRU fails.

3 Performance (PERF)

The PERF INIT page is used for initialization of data required for VNAV operations and performance predictions.

4 Thrust Limit (THRUST LIM)

The THRUST LIM page is used to select thrust limits and derates.

5 TAKEOFF

The TAKEOFF REF page is used to enter takeoff reference data and V speeds.

6 APPROACH

The APPROACH REF page is used for entry of the approach VREF speed.

7 NAV DATA

The REF NAV DATA page is used for data on waypoints, navaids, airports, and runways. NAV DATA pages are accessible only from this page.

8 Alternate (ALTN)

The ALTN page is used for alternate airport planning and diversions.

9 Maintenance (MAINT)

For maintenance use only; displays maintenance pages.

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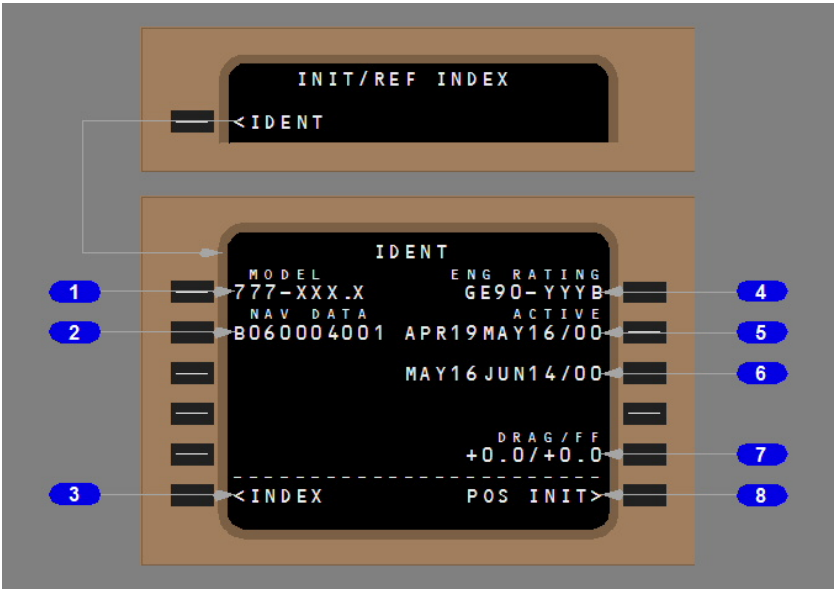
Identification Page

Most of the data on this page is for flight crew verification. The active navigation database can be selected. The drag/fuel flow accepts manual input.

TKK to TKR,
TKU to TKZ



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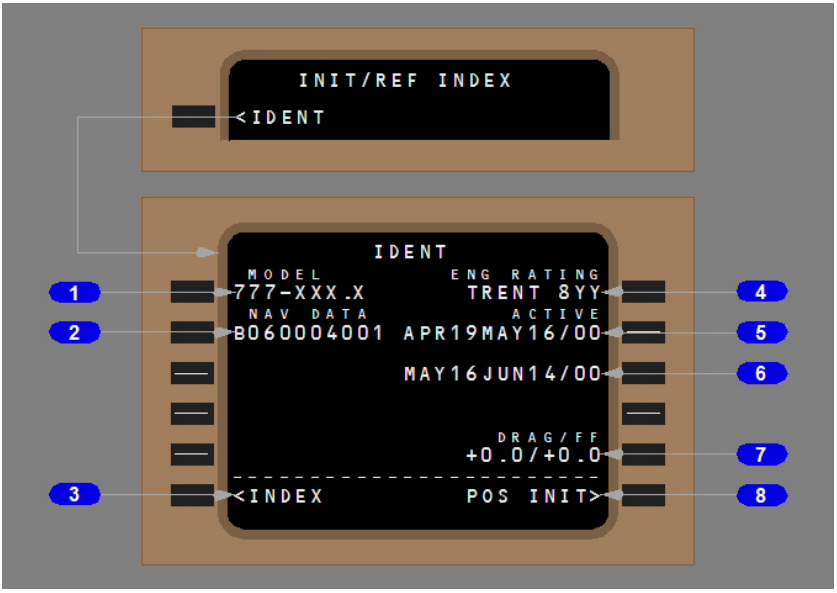
TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



1 MODEL

Displays airplane model as follows:

Ident Page Model	Airplane	
777-200	777-200	-200
777-200.3	777-200ER with extended forward CG	-200ER
777-300	777-300	-300
777-300.2	777-300ER with enhanced performance	-300ER

2 NAV DATA

Displays the navigation database identifier.

3 INDEX

Push—displays the INIT/REF INDEX page.

4 ENG RATING

Displays engine model and thrust rating. Header displays INTERMIX RATING for engine intermix installations. YY or YYY is the engine thrust rating.

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5 ACTIVE

Displays the effectivity date range for the active navigation database.

If the active navigation database is 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 up 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.

6 Inactive Date Range

Displays the effectivity date range for the inactive navigation database.

7 DRAG/FF

Displays the airplane drag and fuel flow correction factors.

8 Position Initialization (POS INIT)

Push—displays the POS INIT page.

Position Initialization Page 1/3

The position initialization page allows entry of airplane present position for ADIRU alignment. The same page is used to enter the heading for SAARU initialization when the ADIRU is inoperative.

Data on the first page is used to initialize the ADIRU. In the event the ADIRU becomes inoperative in flight, initialization of the SAARU heading is accomplished on this page.

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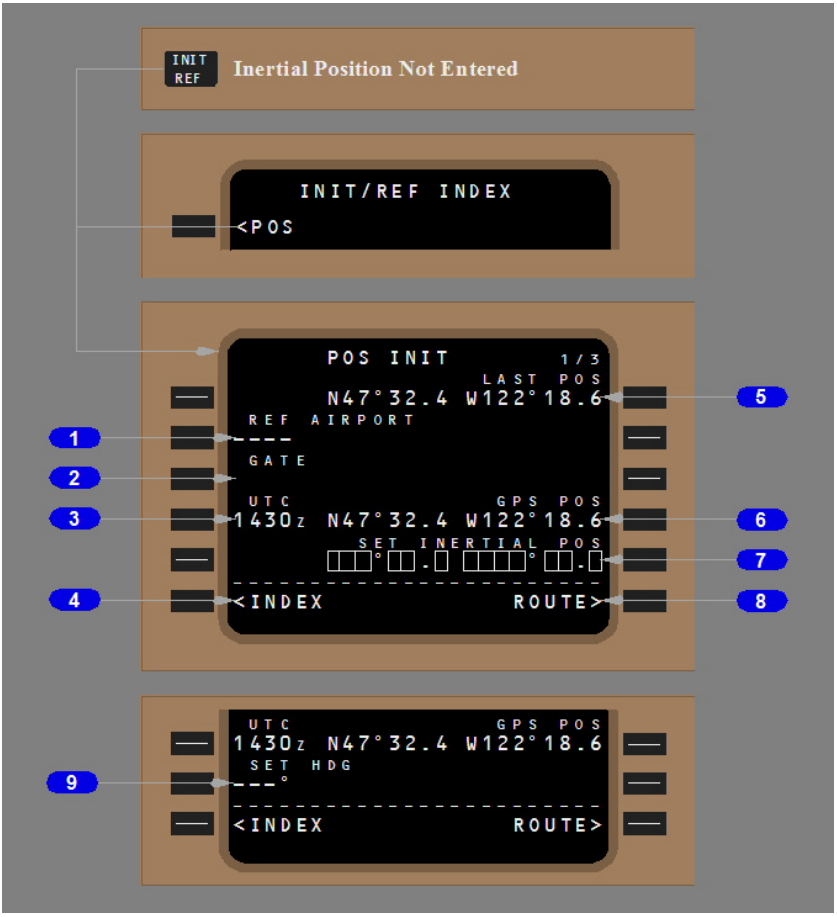

1 Reference Airport (REF AIRPORT)

Entry of the reference airport displays the airport latitude/longitude.

Optional entry.

Valid entries are ICAO four letter airport identifiers.

Removes previous GATE entry.

Entry blanks at lift-off.

2 GATE

The gate entry allows further refinement of the latitude/longitude position.

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Optional entry after reference airport entered.

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 Coordinated Universal Time (UTC)

UTC (GPS)—displays time from GPS.

UTC (MAN)—

- displays time from captain's clock when operative; otherwise, displays time from first officer's clock
- hours set by entering desired hour reference
- minutes set by resetting appropriate pilot's clock

4 INDEX

Push—displays the INIT/REF INDEX page.

5 Last Position (LAST POS)

Displays the last FMC calculated position.

6 GPS Position (GPS POS)

Displays the GPS present position. During preflight, the GPS POS may not display due to satellite availability, performance, or unfavorable geometry.

7 Set Inertial Position (SET INERTIAL POS)

The set inertial position entry is required to initialize the ADIRU. Select the most accurate latitude/longitude from LAST POS, REF AIRPORT, GATE, GPS POS, or make a manual entry to initialize the ADIRU.

If an entry is not made before the ADIRU completes the initial alignment, the scratchpad message ENTER INERTIAL POSITION displays.

If an entered position fails the ADIRU internal check, the scratchpad message ENTER INERTIAL POSITION displays. If the entered position fails the ADIRU check after the position is entered a second time, the scratchpad message ALIGNMENT REINITIATED displays.

The entered position is also compared with the FMC origin airport position. If the entered position is not within 6 NM of the FMC origin airport position, the scratchpad message INERTIAL/ORIGIN DISAGREE displays.

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Dashes display when the ADIRU is in the automatic realignment mode and can receive a new position update. Enter the most accurate inertial position to remove any accumulated ADIRU position errors.

Enter airplane position latitude and longitude.

Boxes display within one minute of ADIRU power-up.

Blanks when the ADIRU changes from the alignment to the navigation mode.

Blanks when the airplane is moving or has not been stationary for a minimum of six minutes.

Dashes display when the ADIRU enters the automatic realignment mode on the ground.

New inertial position entries can be made after dashes display during ADIRU automatic realignment. New entries display for 2 seconds. After 2 seconds, dashes display to allow entry of another position.

8 ROUTE

Push—displays the ROUTE page.

9 SET HDG

Dashes display in flight when ADIRU is inoperative.

Entry of magnetic heading initializes SAARU.

Valid entry is 0 to 360 (0 or 360 displays as 360°). Entered heading displays in large font for two seconds, followed by dashes.

Position Reference Page 2/3

Position reference page 2 displays positions calculated by the FMC, ADIRU, GPS, and radio navigation receivers. The FMC position can be updated to ADIRU, GPS, or radio position on this page.

This page displays latitude/longitude or bearing/distance. All position displays are in actual latitude and longitude, as calculated by the related system. The ADIRU, GPS, and radio position data can be changed to bearing/distance.

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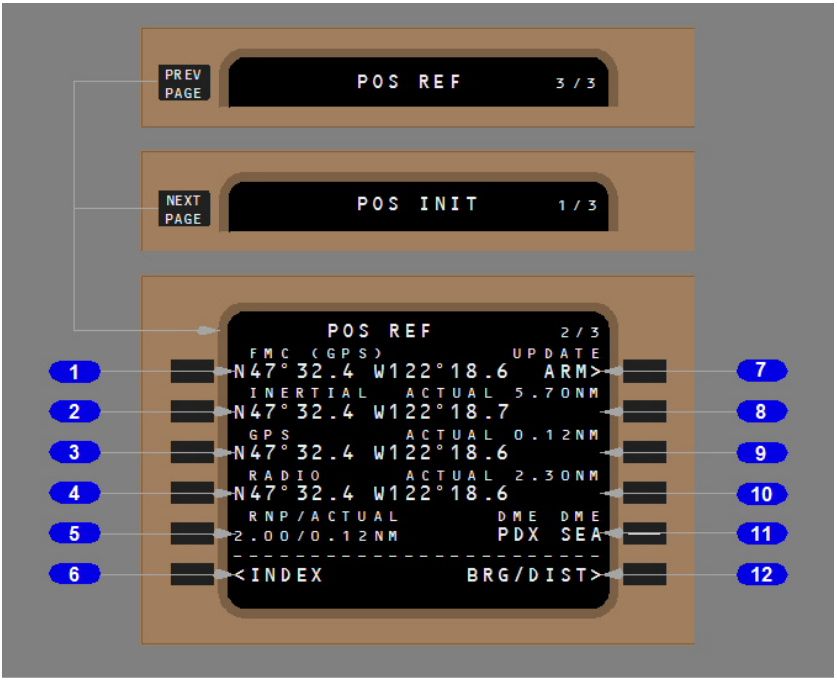

1 FMC

The source used by the active FMC for position data displays next to the FMC line title. In the example, the FMC uses GPS for position data.

Displays the FMC calculated latitude/longitude.

Identifies the source for calculating the FMC position:

- GPS—position calculated from GPS position data
- INERTIAL—position calculated from ADIRU position data
- RADIO—position calculated from navigation radio position data
- LOC-RADIO or LOC-INERTIAL—position updated by localizer data.

2 INERTIAL

Displays latitude/longitude position determined by the ADIRU.

3 GPS

Displays latitude/longitude position determined by the GPS.

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4 RADIO

After airborne, displays latitude/longitude position determined by navigation radios.

5 Required Navigation Performance and Actual Navigation Performance (RNP/ACTUAL)

Displays RNP values stored in the navigation database for departure and arrival procedures; or, if there are none, displays the default values stored within the FMC by flight phase. Also displays FMC actual navigation performance (ACTUAL).

Default RNP is in small font.

Valid RNP entries are in the range 0.01 to 99.9. Manual entry displays in large font and clear at flight completion; propagated to 2L RNP PROGRESS page 4. ACTUAL entry not allowed.

When ACTUAL exceeds RNP for the time specified in the Operational Program Configuration (OPC), the EICAS message NAV UNABLE RNP displays.

6 INDEX

Push—displays the INIT/REF INDEX page.

7 UPDATE ARM

Push—

- arms FMC position update function
- changes prompt to ARMED
- adds NOW prompts to right side of INERTIAL, GPS, and RADIO lines.

Push a NOW prompt key to update FMC position to the selected source.

8 ACTUAL—INERTIAL

Displays actual navigation performance of the ADIRU.

9 ACTUAL—GPS

Displays actual navigation performance of the GPS.

10 ACTUAL—RADIO

Displays actual navigation performance of radio updating.

11 Radio Update Station(s)/Mode

Displays radio station identifiers.

Position update mode is indicated in the line title:

- DME DME

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- VOR DME.

Selection of "VOR" at 6R on the REF NAV DATA page does not inhibit DME DME updating.

12 **Bearing/Distance (BRG/DIST) or Latitude/Longitude (LAT/LON)**

Push—alternates position data format between bearing/distance or latitude/longitude.

The page illustration is shown in the latitude/longitude display format.

Latitude/longitude format displays are actual position.

Bearing/distance format displays the bearing and distance of other position sources relative to the FMC position.

Position Reference Page 3/3

On position reference page 3, the flight crew can observe the calculated positions from the left and right GPS receivers and the left and right FMC calculations. This page also allows the flight crew to enable or disable GPS position updates.

This page can display the bearing/distance or latitude/longitude format. The bearing/distance format displays bearing and distance of the position sources relative to the active FMC position on the POS REF 2/3 page. In the example, both the left and right GPS agree with the left FMC position.

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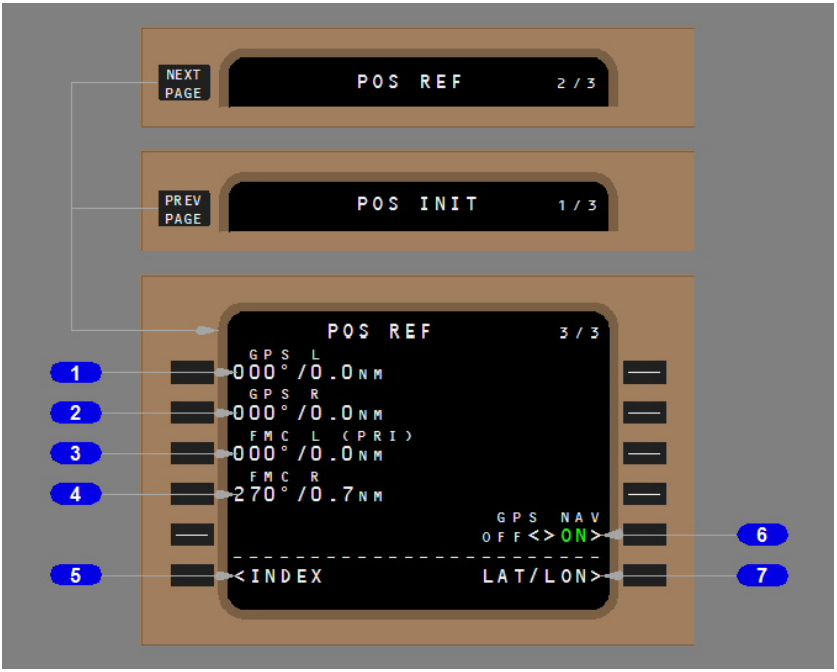

1 GPS L

Displays the left GPS position.

2 GPS R

Displays the right GPS position.

3 FMC L

Displays the left FMC calculated position.

Primary (PRI) displays when the left FMC is active and the right FMC is inactive.

4 FMC R

Displays the right FMC calculated position.

PRI displays when the right FMC is active and the left FMC is inactive.

5 INDEX

Push—displays the INIT/REF INDEX page.

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6 GPS NAV

Push—alternately selects GPS NAV ON (enabled) and OFF (disabled).

OFF—GPS position data is not available to the FMC. OFF displays in large green letters; ON displays in small white letters.

ON—GPS position data is available to the FMC. ON displays in large green letters; OFF displays in small white letters.

Note: When power is initially applied to the airplane or when engines are shut down, GPS NAV is set to ON.

7 Latitude/Longitude (LAT/LON) or Bearing/Distance (BRG/DIST)

Push—alternately changes the display of position data on POS REF 2/3 and 3/3 to latitude/longitude format or bearing/distance format.

The page illustration is shown in the bearing/distance display mode.

Route Page 1/X

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 data link. All routes have two or more pages. The first route page displays origin and destination data. Subsequent route pages display 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. When RTE 2 is active, page display logic is the same as RTE 1.

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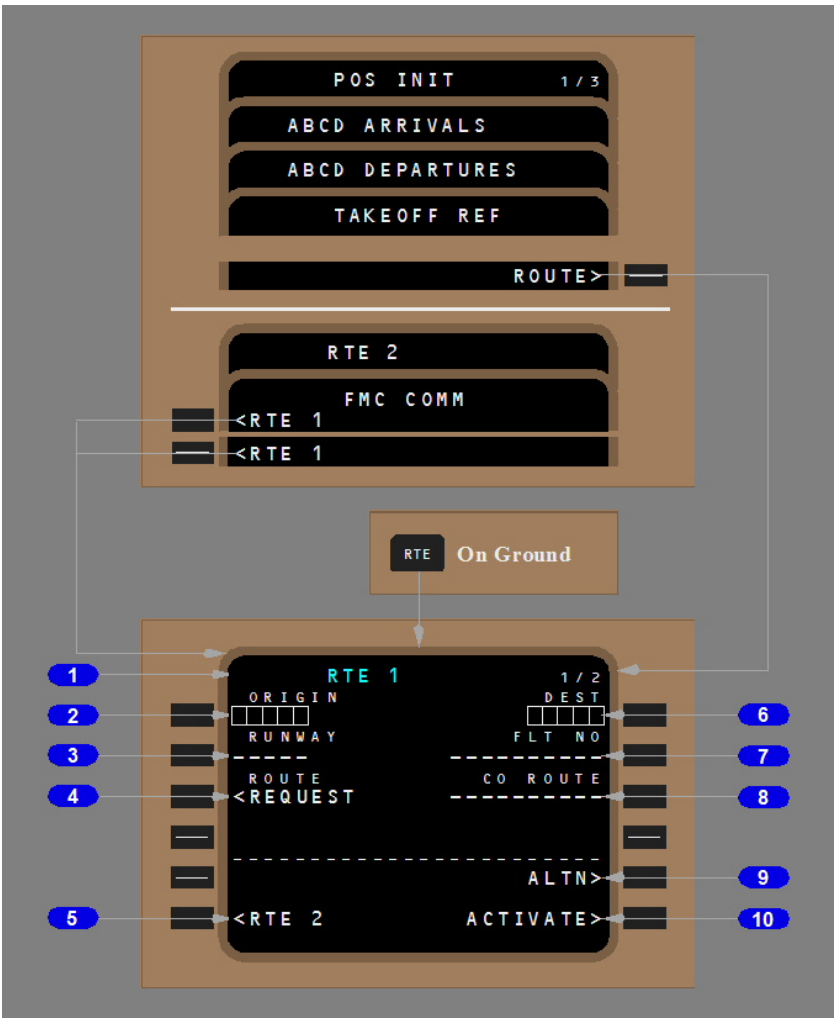

1 Page Title

White when the route is active.

Cyan when the route is inactive or pending activation.

The white shaded word MOD precedes the page title when the route is modified and the change is not executed.

Multiple route pages are indicated by the page sequence number to the right of the title. The minimum number of route pages is 2.

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2 ORIGIN

Entry:

- must be a valid ICAO identifier in the navigation database
- is made automatically when a company route is entered
- enables direct selection of departure and arrival procedures
- entry on the ground deletes route; in flight, entries are valid on the inactive route
- clears: wind levels on the WIND page, all existing company route identifiers, runways, destination airport, legs, and enroute procedures from an existing route.

3 RUNWAY

Enter the applicable runway for the origin airport. Runway must be in the navigation database. Entry is optional.

New entries on an active route cause MOD to display in the route title.

Automatically entered when part of a company route.

Can be selected on the DEPARTURES page.

FMC deletes runway after the first waypoint is crossed.

4 ROUTE REQUEST

Line title displays DATA LINK when the data link status is NO COMM, VOICE, or FAIL.

Push—transmits a data link request for a flight plan route uplink.

Flight crew can enter origin, destination, runway, flight number, company route name, or route definition to qualify request.

5 RTE 2, ERASE

RTE 2:

Push—displays the RTE 2 page 1/x.

Allows access to an inactive route for creation and modification or activation.

Inactive route modifications do not alter the active route.

Prompt changes to RTE 1 when RTE 2 is displayed.

ERASE:

Push—deletes all lateral and vertical mods to the displayed modified route. Selection of <ERASE while a pending activation route is displayed returns the inactive route.

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6 Destination (DEST)

Entry:

- must be a valid ICAO identifier in the navigation database
- is made automatically when a company route is entered
- enables selection of departure and arrival procedures.

7 Flight Number (FLT NO)

Valid entry is any ATC filed and flight crew entered, or uplinked company flight number up to 10 characters.

A pilot entry on the ATC LOGON/STATUS page propagates to the ROUTE page.

The Flight number displays in the PROGRESS pages 1/4 and 2/4 title.

Transponder transmits flight number to ATC when Eurocontrol-compliant transponder installed.

8 Company Route (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 the route of flight. All company route data is automatically entered when the route identifier is entered.

An entry is optional for activation of the route.

Enter a company route identifier.

Valid entry is any flight crew entered or uplinked 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.

Entry of a new company route replaces the previous route.

In-flight entry is inhibited for the active route.

9 Alternate (ALTN)

Push—displays the ALTN page.

10 ACTIVATE

Push the ACTIVATE key to arm the 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.

Push—prepares the selected route for execution as the active route.

Activation of a route is required for completion of the preflight.

Displayed on inactive route pages.

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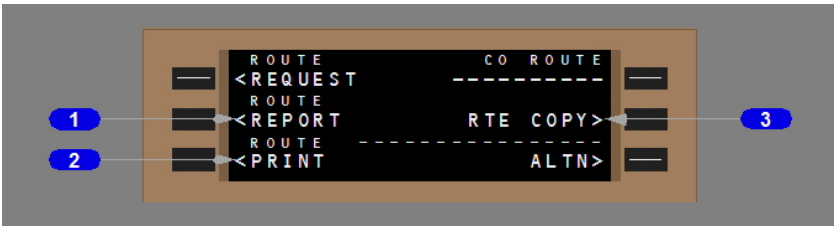
After route activation, the ACTIVATE prompt is replaced by:

- PERF INIT, when the required performance data is incomplete, or
- TAKEOFF when the required performance data is complete.

More Route Page Prompts for an Active Route



1 ROUTE REPORT

REPORT:

Push—transmits a flight plan downlink report.

LOAD:

Push – when the displayed route is inactive, it is replaced or modified by the flight plan uplink. When the displayed route is active, it is replaced or modified by the flight plan uplink and a modified route is created.

2 ROUTE PRINT

Push—sends the active route to the flight deck printer.

3 Route Copy (RTE COPY)

Push—copies the entire active route (RTE x) into the inactive route (RTE y).

Displayed only on the active route page.

Displays COMPLETE after the route is copied.

Route Page 2/X

The subsequent route pages 2/X through X/X, display 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 are shown on the RTE LEGS page.

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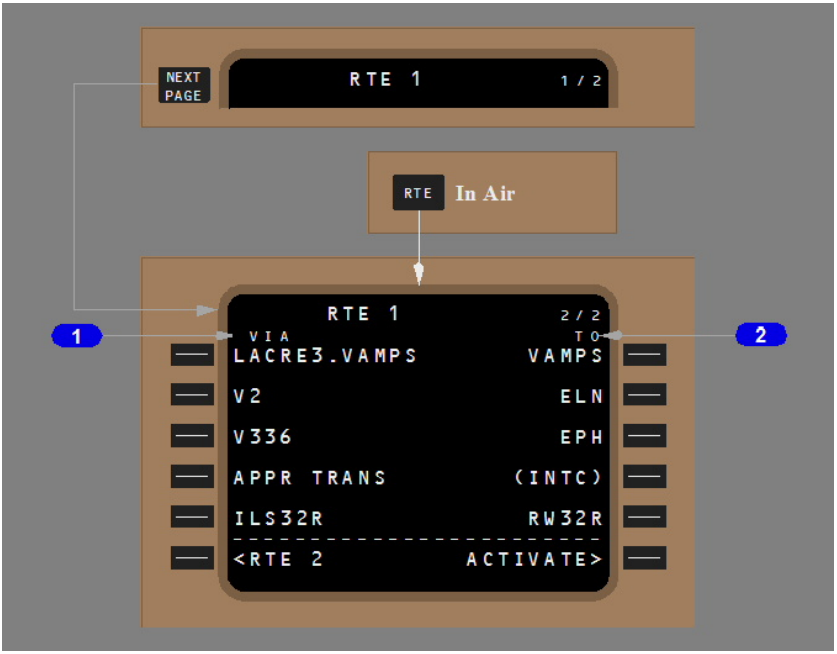

1 VIA

The VIA column displays the route segment to the waypoint or termination in the TO column. Enter the path which describes the route segment between the previous waypoint and the segment termination.

Enter an airway in the VIA column and boxes display in the TO column.

Valid entries can also include procedures or DIRECT. Procedures are usually entered through selections on DEPARTURES and ARRIVALS pages. DIRECT is usually entered as a result of 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 the TO waypoint is entered first.

Dashes display for the first VIA beyond the end of the route.

Invalid VIA entries display the scratchpad INVALID ENTRY message.

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Invalid VIA entries are:

- airways and company routes which do not contain the TO waypoint of the previous line
- airways that do not intersect the previous airway
- airways or company routes that are not in the navigation database.

The start and end waypoints determine whether the entered airway is valid. The route segment must contain the waypoint entered in the TO position. The TO waypoint of the previous route segment must be the same as the start point of the next route segment or a route discontinuity is created between the segments.

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 from the runway heading and:

- replaces the airway with dashes in the first line VIA
- shows boxes in the first line TO waypoint
- moves the airway to line 2 after the TO waypoint is entered
- enters the first fix on the airway nearest to being abeam of the departure heading in the airway line TO waypoint.

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 to change from one segment to the next. The FMC created waypoint intersection (INTC) displays in 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 STAR selection made on the APPROACH page.

ILS32R is an example of an approach selection made on the APPROACH page.

2 TO

Enter the end point of the route segment specified by the VIA entry.

Entry of a waypoint in the TO column without first entering a VIA airway shows DIRECT in the VIA column.

Data input is mandatory when boxes are displayed.

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.

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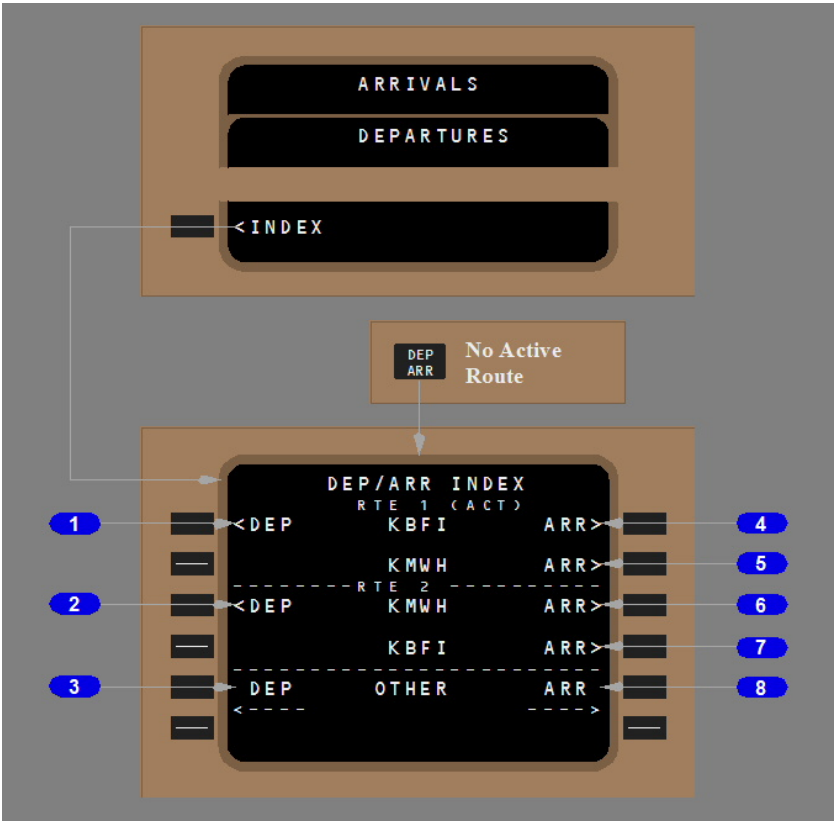
Dashes display on the first TO waypoint after the end of the route.

Departure/Arrival Index Page

The 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 also 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 the departure page for route 1 origin airport.

2 Departure (DEP)—Route 2

Push—displays the departure page for route 2 origin airport.

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3 Departure (DEP)—Other

Displays the departure page for the airport entered into this line through the scratchpad.

DEP prompt for OTHER allows display of departure data about airports that are not an origin or destination. The data can be viewed but cannot be selected because the airport is not on the route.

4 Arrival (ARR)—Route 1 Origin

Push—displays the arrival page for route 1 origin airport. Origin airport arrivals selection is used during a turn–back situation.

5 Arrival (ARR)—Route 1 Destination

Push—displays the arrival page for route 1 destination airport.

6 Arrival (ARR)—Route 2 Origin

Push—displays the arrival page for route 2 origin airport. Origin airport arrivals selection is used during a turn–back situation.

7 Arrival (ARR)—Route 2 Destination

Push—displays the arrival page for route 2 destination airport.

8 Arrival (ARR)—Other

Displays the arrival page for the airport entered in this line through the scratchpad.

ARR prompt for OTHER allows display of arrival data about airports that are not an origin or destination. The data can be viewed but cannot be selected because the airport is not on the route.

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.

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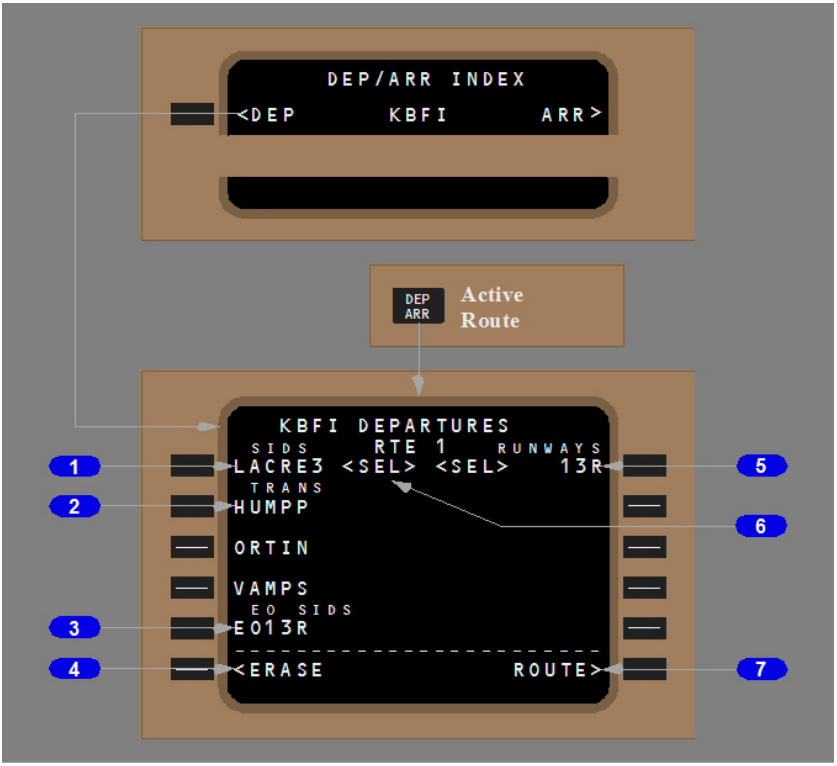

1 Standard Instrument Departures (SIDS)

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 in the route
- other transitions no longer display.

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3 Engine Out (EO) SIDS

Displays airline-defined single engine-out SIDs and all transitions for the selected runway. EO SID can be viewed before takeoff by line selecting and selecting the Legs page. EO SID automatically selected during takeoff if an engine-out detected prior to “flaps up”. The modification can be either executed or erased. If an EO SID does not exist, NONE displays.

PUSH—displays EO SID as the selected SID.

4 ERASE or INDEX

Erase displays when a route modification is pending. INDEX displays when no route modification is pending.

ERASE push—removes route modifications not executed and displays the original route.

INDEX push—displays the DEP/ARR INDEX page.

5 RUNWAYS

Displays a list of runways for the selected airport.

The 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.

6 Selecting Options

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 the <SEL> or <ACT> prompts.

7 ROUTE

Push—displays the related RTE page.

Navigation Radio Page

VOR and ILS navigation radios are normally autotuned by the FMC. ADF radios are manually tuned. The 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.

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VOR

1 VOR Frequency and Tune Status

The 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. The FMC also tunes related DMEs. The 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.

The identifier and frequencies are green and tuning status is white.

Note: When the airplane magnetic variation database and the VOR ground station assigned magnetic variation values differ, the ND VOR radial and ND POS green radial will not point directly to the VOR. This split will usually decrease as the airplane approaches the VOR.

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2 CRS

Blank when in autotune.

Valid entry is a three-digit course. Data can be entered when dashes or a course are displayed.

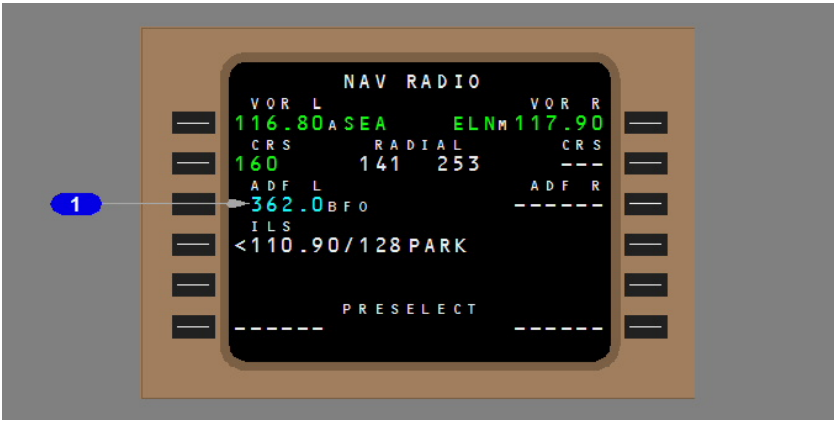
With a VOR approach selected, sequencing an IAF/FAF causes the FMC to procedure autotune the VOR frequency. When the approach has a runway waypoint, the FMC selects the inbound course.

VOR course is green. Radial is white.

3 RADIAL

Displays radial from left and right VOR stations to the airplane.

ADF



1 ADF Frequency and Tune Status

The tuning status displays adjacent to the left and right ADF frequencies. The 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.

Default tuning mode is ADF (no indication) giving both bearing data and audio.

Valid entries are XXX.X or XXXX.X.

Manual entry can be followed by A (ANT), B (BFO), or none, which defaults to the ADF mode.

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Frequency is cyan and status is white.

ILS

1 ILS Frequency/Course and Tune Status

The tuning status displays adjacent to the ILS frequency and course. The ILS receivers operate in FMC autotune or manual-tuning modes. The FMC autotunes the ILS frequency and course. When the ILS is not necessary, the FMC sets the ILS to PARK. This removes the displays from the PFD.

Airplane position on the route determines the ILS operating mode. The operating mode displays are:

- PARK—the ILS is not being used and is not tuned
- XXX.XX/YYY PARK—the ILS is tuned for the selected approach but is not being used
- “A” indicates autotuning under FMC control for approach guidance
- “M” indicates the ILS is manually tuned.

ILS autotuning is inhibited for ten minutes after takeoff and during manual-tuning. 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, the airplane heading within 45° of the localizer front course and the ground speed is greater than 40 knots.

Subsequent manual-tuning is enabled when:

- either TO/GA switch is pushed
- the autopilot is disengaged and both flight directors are switched off

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- the MCP approach switch is deselected when the airplane is above 1,500 feet radio altitude.

Valid entries:

- ILS frequency and front course (XXX.XX/YYY)
- front course, with a frequency and course already entered (/YYY).

2 PRESELECT

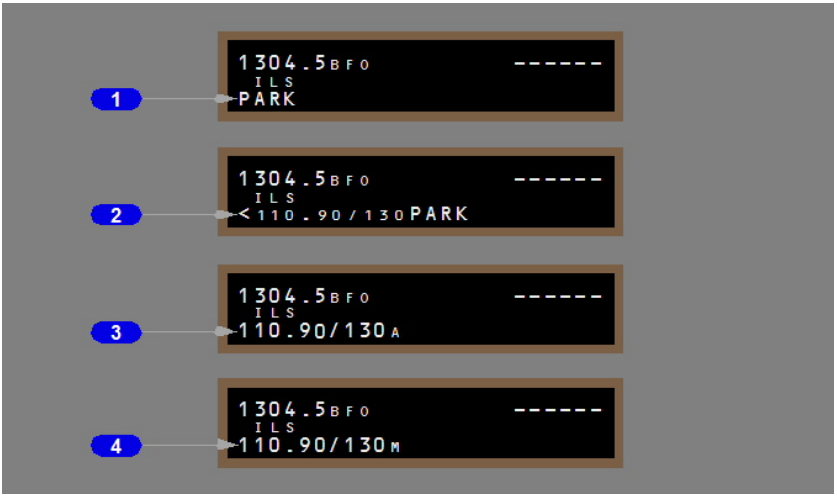
Any valid page data may be entered.

Put data into this line for later use. Data can be moved to the appropriate line when necessary.

ILS Tuning Status

The display initializes to PARK. When PARK displayed, the ILS is not tuned. The tuning status displays are:

- XXX.XX/YYY PARK—the ILS is autotuned for the selected approach but is not being used
- (autotune)—ILS is autotuned for approach guidance
- M (manual)—ILS is 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.

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2 Tuning Status—Frequency, Course, and Park

ILS frequency, front course, and PARK display when an ILS, LOC, back course, localizer-type directional aid (LDA), or simplified directional facility (SDF) 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, localizer-type directional aid (LDA), or simplified directional facility (SDF) 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.

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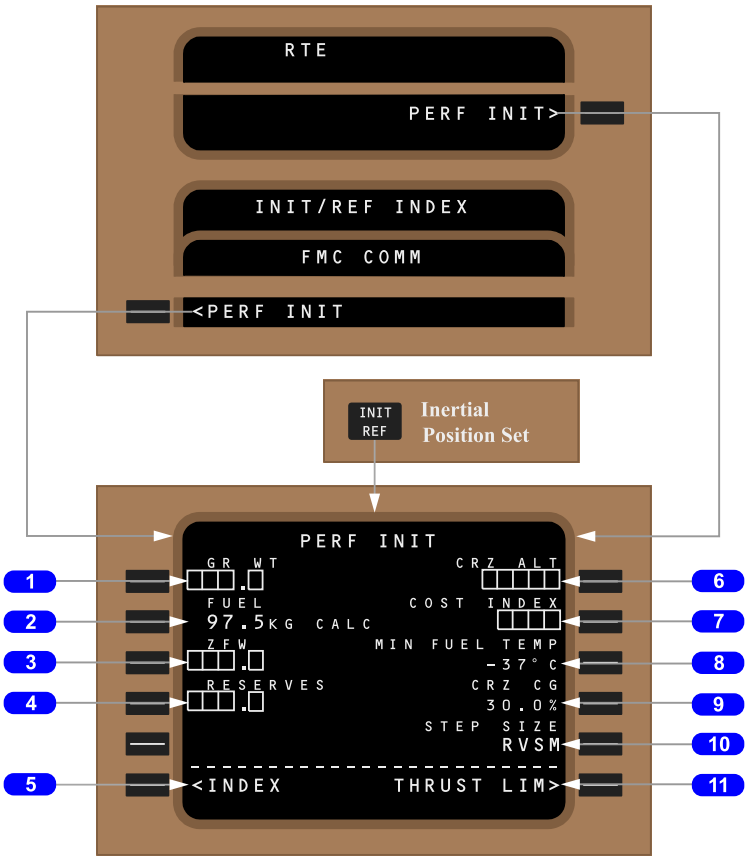
Preflight Pages—Part 2

Performance Initialization Page

The performance initialization page allows the entry of airplane and route data to initialize performance calculations. This data is required for VNAV calculations.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



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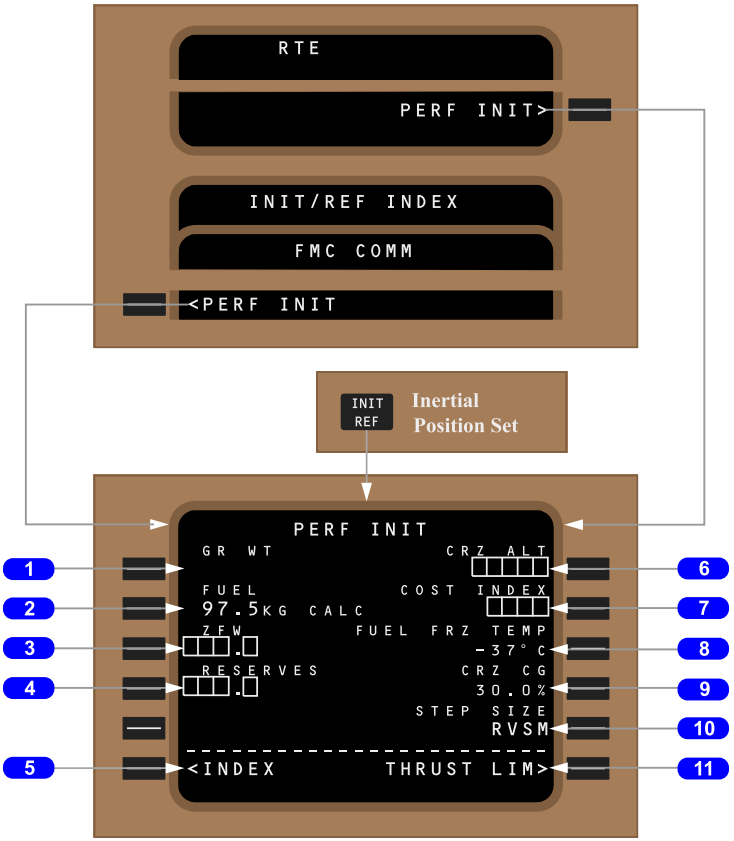
TKK to TKR, TKU to TKZ



1 Gross Weight (GR WT)

TKK to TKR, TKU to TKZ

Airplane gross weight cannot be entered by the flight crew:

- the gross weight line remains blank until zero fuel and fuel weights are available for the FMC to calculate gross weight
- can be entered by the flight crew or calculated by the FMC after entry of zero fuel weight.

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

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
- entering zero fuel weight first displays calculated gross weight

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- entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

2 FUEL

Fuel on board displays when the 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. The manual entry displays in 6R, CALCULATED, PROGRESS page 2/3.

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.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

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 removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

ZFW can be manually entered; displays in large font.

4 RESERVES

Valid entry is XXX or XXX.X.

Can be manually entered; displays in large font.

5 INDEX

Push—displays the INIT/REF INDEX page.

6 Cruise Altitude (CRZ ALT)

Cruise altitude can be entered by the flight crew or from a company route.

Entry displays this cruise altitude on the CLB and CRZ pages.

7 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.

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Valid entries are 0 to 9999.

8 Minimum Fuel Temperature (MIN FUEL TEMP)/Fuel Freeze Temperature (FUEL FRZ TEMP)

MIN FUEL TEMP: TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

- Displays minimum fuel operating temperature (3 deg. C warmer than the fuel freeze temperature for a given fuel).
- Default value from the AIRLINE POLICY page displays in small font and may not be deleted.
- Valid entries are –99 to –1 in degrees C.
- Flight crew entered value displays in large font.
- When actual fuel temperature reaches the displayed value, the EICAS advisory message FUEL TEMP LOW displays.

FUEL FRZ TEMP: TKK to TKR, TKU to TKZ

- Displays fuel freeze temperature.
- Default value from the AIRLINE POLICY page displays in small font and may not be deleted.
- Valid entries are –99 to –1 in degrees C.
- Flight crew entered value displays in large font.
- When actual fuel temperature reaches the displayed value plus 3 deg. C, the EICAS advisory message FUEL TEMP LOW displays.

9 Cruise Center of Gravity (CRZ CG)

The FMC uses the CRZ CG to calculate maximum altitude, and minimum and maximum amber band speeds. The flight crew may improve the accuracy of calculated maximum altitude and maneuver margin to buffet by entering the actual CRZ CG, when known. A flight crew entered value shows in large font. A more aft CRZ CG results in a less restrictive initial buffet envelope (higher maximum altitude, lower low-speed buffet speed, and increased high speed buffet speed).

Unless modified, the CRZ CG displays the AMI default value in small font. If the value in AMI is blank, the CHECK AIRLINE POLICY message displays.

The CRZ CG value does not change due to fuel burn.

Valid entry is 14.0 through 44.0. -200,-200ER

Valid entry is 7.5 through 44.0. -300,-300ER

10 STEP SIZE

Displays the climb altitude increment used for planning the optimum climb profile.

Default value is: RVSM, ICAO, or 0 as selected in AMI.

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Valid entries are:

- "0" to inhibit predicted step climbs, or
- altitudes from 1,000 to 9,900 in 100 foot increments, or
- "I" for ICAO, or
- "R" for RVSM.

In-flight entries are inhibited. In-flight step size changes are made on the CRZ page.

For a non-zero entry, performance predictions are based on step climbs at optimum points. For a zero entry, performance predictions are based on a constant CRZ ALT.

11 Thrust Limit (THRUST LIM)

Push—shows the THRUST LIM page.

Thrust Limit Page

The thrust limit page allows selection and display of reference thrust for takeoff. Takeoff thrust derate by use of assumed temperature is also accomplished on this page.

Additional page data displays are:

- <SEL>—identifies the selected takeoff thrust reference mode
- <ARM>—identifies the armed climb thrust reference mode.

The <ARM> prompt changes to <SEL> when the armed climb mode becomes active.

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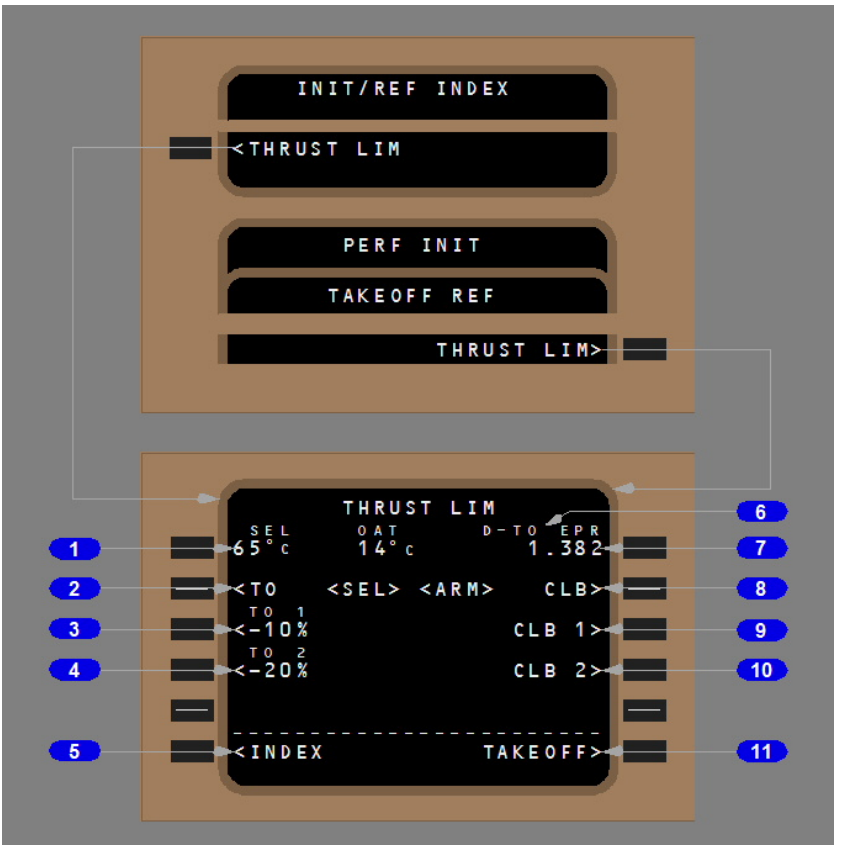
TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF



1 Assumed Temperature (SEL), Outside Air Temperature (OAT)

Entry of assumed temperature is allowed when the airplane is on the ground and dash prompts or large font temperature data is displayed.

Entry of an assumed temperature warmer than the OAT reduces takeoff thrust and displays D as part of the thrust reference mode.

Valid entries are 0 to 99 degrees Celsius (C) or 32 to 210 degrees Fahrenheit (F).

Entry of one, two, or three character temperature followed by “F” displays assumed temperature in degrees F; otherwise, assumed temperature displays in degrees C.

Uplinked temperatures display on both the THRUST LIM and TAKEOFF REF pages.

Flight crew entered or uplinked values replace previously displayed values.

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Entry of a selected temperature change greater than one degree 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.

The assumed temperature thrust derate is not the same as TO 1 and TO 2 fixed thrust derates described below. If TO 1 or TO 2 is selected and an assumed temperature is then entered, thrust is further derated.

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) for takeoff thrust limit.

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) for takeoff thrust limit.

Takeoff thrust derate can be entered by uplink.

Selecting TO 2 arms CLB 2.

5 INDEX

Push—displays the INIT/REF INDEX page.

6 Thrust Reference Mode

Displays selected takeoff thrust mode.

"D-" displays when an assumed temperature derate is active.

7 Takeoff EPR Limit

Displays the takeoff EPR calculated by the thrust management system. Displays N1 when the engines are operated in the alternate mode.

8 Climb (CLB)

Push—selects the full rated (CLB) climb thrust limit.

Pushing a climb line select key overrides an automatic selection.

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DRAFT

9 Climb 1 (CLB 1)

Push—selects a percentage derate (CLB 1) climb thrust limit.

Climb thrust derate can be entered by uplink.

10 Climb 2 (CLB 2)

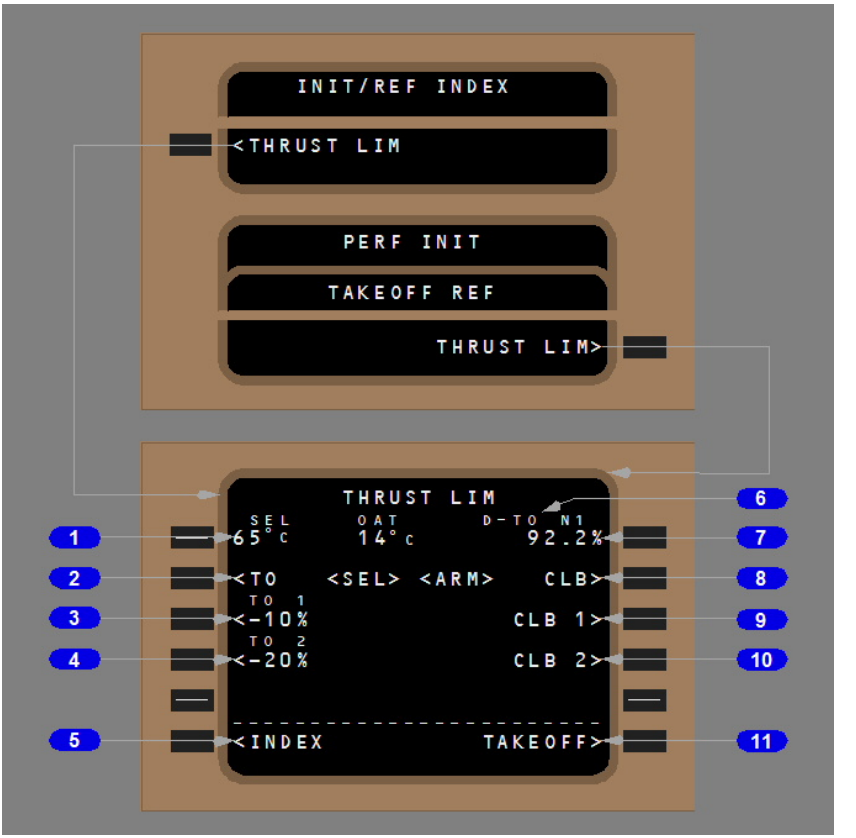
Push—selects a percentage derate (CLB 2) climb thrust limit.

Climb thrust derate can be entered by uplink.

11 TAKEOFF

Push—displays the TAKEOFF REF page.

TKK to TKR, TKU to TKZ



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1 Assumed Temperature (SEL), APU-to-Pack, Outside Air Temperature (OAT)

Entry is allowed when the airplane is on the ground and dash prompts or large font temperature data is displayed.

Entry of an assumed temperature warmer than the OAT reduces takeoff thrust and displays D as part of the thrust reference mode.

Valid entries are 0 to 99 degrees Celsius (C) or 32 to 210 degrees Fahrenheit (F).

Entry of one, two, or three character temperature followed by “F” displays assumed temperature in degrees F; otherwise, assumed temperature displays in degrees C.

Uplinked temperatures display on both the THRUST LIM and TAKEOFF REF pages.

Flight crew entered or uplinked values replace previously displayed values.

Entry of a selected temperature change greater than one degree after takeoff speeds are selected deletes V speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

“SEL-APU” displays in the header when the APU is running. Selection of “APU” from the scratchpad displays “APU” in the data line in small font representing the ARMED state. Approximately one minute after the second engine start, “APU” displays in large font representing the ACTIVE state. Entry of an assumed temperature, shutting down the APU, selecting another TO rating, or deleting the entry; deletes the APU selection.

OAT displays outside air temperature in degrees C. When SEL temperature is in degrees F, the OAT converts to degrees F.

The assumed temperature thrust derate is not the same as TO 1 and TO 2 fixed thrust derates described below. If TO 1 or TO 2 is selected and an assumed temperature is then entered, thrust is further derated.

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) for takeoff thrust limit.

Takeoff thrust derate can be entered by uplink.

TO 1 default thrust derate can be modified on the AIRLINE POLICY page.

Selecting TO 1 arms CLB 1.

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4 Takeoff 2 (TO 2)

Push—selects percentage derate (TO 2) for takeoff thrust limit.

Takeoff thrust derate can be entered by uplink.

TO 2 default thrust derate can be modified on the AIRLINE POLICY page.

Selecting TO 2 arms CLB 2.

5 INDEX

Push—displays the INIT/REF INDEX page.

6 Thrust Reference Mode

Displays selected takeoff thrust mode.

"D-" displays when an assumed temperature derate is active.

The prefix “A-” is added to the line title TO when APU-to-Pack takeoff is selected.

7 Takeoff N1 Limit

Displays takeoff N1 calculated by the thrust management system.

8 Climb (CLB)

Push—selects the full rated (CLB) climb thrust limit.

Pushing a climb line select key overrides an automatic selection.

9 Climb 1 (CLB 1)

Push—selects a percentage derate (CLB 1) climb thrust limit.

Climb thrust derate can be entered by uplink.

10 Climb 2 (CLB 2)

Push—selects a percentage derate (CLB 2) climb thrust limit.

Climb thrust derate can be entered by uplink.

11 TAKEOFF

Push—displays the TAKEOFF REF page.

Takeoff Reference Page

The takeoff reference page allows the flight crew to manage takeoff performance. Takeoff flap setting and V speeds are entered and verified. Thrust limits, takeoff position, and takeoff gross weight can be verified or changed. Preflight completion status is annunciated until complete.

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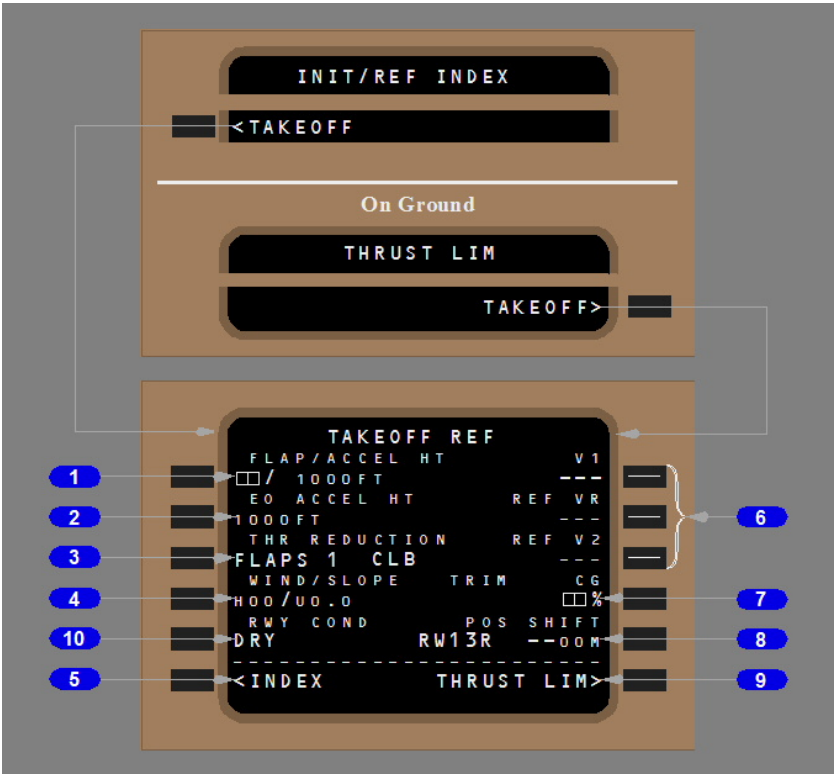
Takeoff reference page entries finish the normal preflight. The takeoff flap setting must be entered and V speeds should be set before completion.

Note: Acceleration/thrust reduction heights are added to airport elevation causing acceleration/thrust reduction at the desired MSL altitude. For example, for a runway elevation of 980 feet, an entry of 2020 acceleration height causes acceleration at 3,000 feet MSL.

TKK to TKR,
TKU to TKZ



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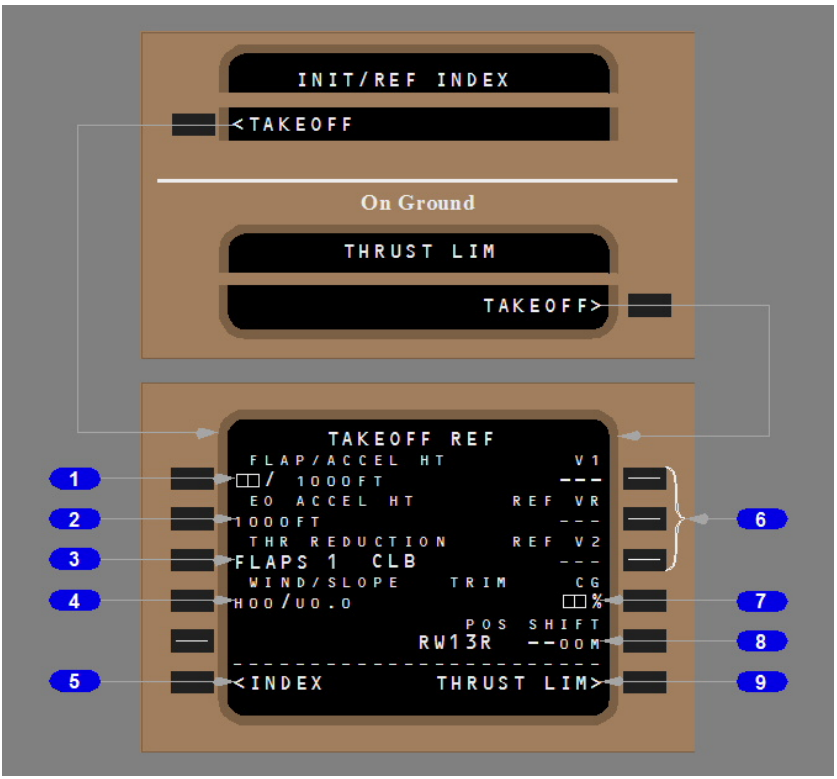
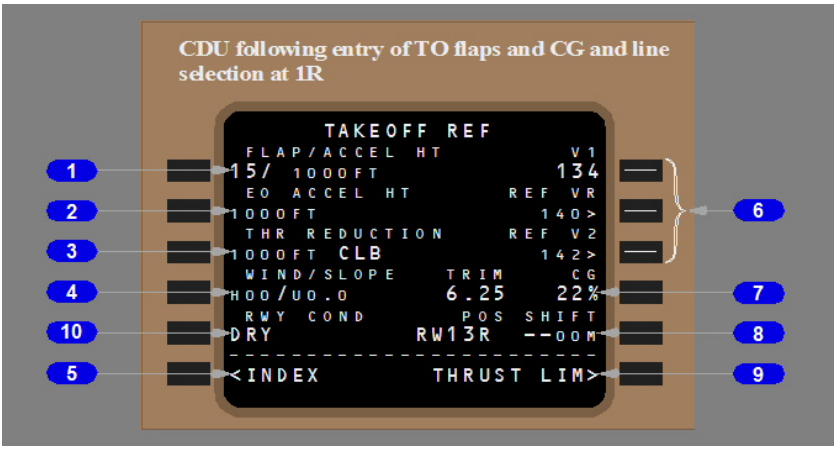
TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



TKK to TKR, TKU to TKZ



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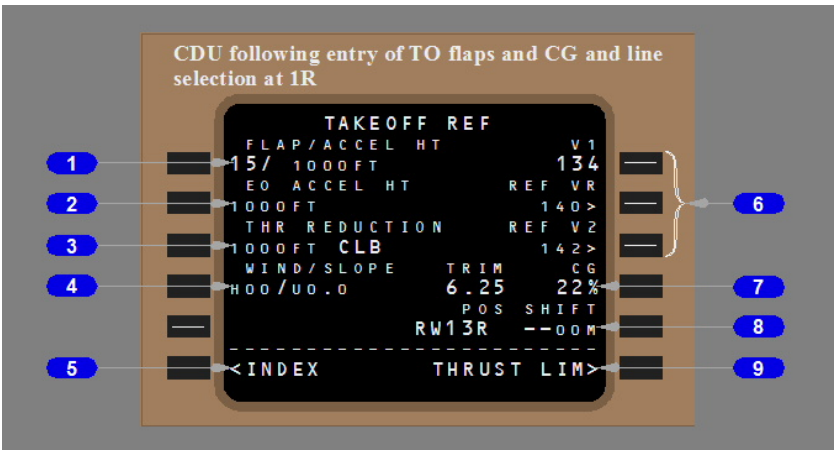
TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



1 FLAP/Acceleration Height (ACCEL HT)

Displays takeoff flap setting.

Valid entries are 5, 15, or 20.

Flap position is required for takeoff V speed calculations.

Displays acceleration height in Height Above Airport (HAA) for flap retraction.

Default value is from the airline policy file.

Valid entry is an HAA height from 400 to 9,999 feet. The FMC adds runway elevation to entered HAA acceleration height causing acceleration at an MSL altitude. For example, for a runway elevation of 980 feet, an entry of 2,020 acceleration height causes acceleration at 3,000 feet.

Entry of a value after takeoff speeds are selected removes the speeds and displays the scratchpad message TAKEOFF SPEEDS DELETED.

2 Engine Out Acceleration Height (EO ACCEL HT)

Displays acceleration height for flap retraction with an engine out.

Default value is from the airline policy file.

Valid entry is a height from 400 to 9,999 feet.

3 Thrust (THR) REDUCTION and Climb Thrust Rating

Displays flap setting or HAA height for reduction from takeoff thrust to the armed climb thrust and the armed climb thrust rating.

Default THR REDUCTION is a value from the AIRLINE POLICY file.

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Valid entries are:

- 1 for flaps 1 and 5 for flaps 5 (entry of 5 when FLAPS 5 is specified as the takeoff flap setting displays the scratchpad message INVALID ENTRY), or
- an HAA height from 400 to 9,999 feet. The FMC adds runway elevation to entered HAA thrust reduction height causing thrust reduction at an MSL altitude. For example, for a runway elevation of 980 feet, an entry of 1,020 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 the INIT/REF INDEX page.

6 V Speeds (V1, VR, V2)

Dashes display when:

- required information not entered
- performance calculations are inhibited
- ADIRU not aligned.

TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

Manually entered or selected speeds replace calculated (REF) speeds. Speeds equal to or greater than calculated speeds are allowable. Entries less than calculated minimum V1, VR, or V2 result in "MINV1", "MINVR", or "MINV2" display in line titles; minimum V1, VR, or V2 values display in large font on data lines.

TKK to TKR,
TKU to TKZ

Manually entered speeds replace calculated (REF) speeds. Speeds equal to or greater than calculated speeds are allowable. Entries less than calculated minimum V1, VR, or V2 speeds result in "MINV1", "MINVR", or "MINV2" display in line titles; minimum V1, VR, or V2 values display in large font on data lines. Minimum VR or V2 speeds may be up to five knots lower than calculated VR or V2 speeds.

The FMC Takeoff Speed Relative Value check ensures V1 is less than or equal to VR and VR is less than or equal to V2.

Entry of V speeds not passing the check results in the scratchpad message TAKEOFF SPEEDS DELETED.

Calculated speeds display in small font.

Push—

- selects V1, VR, and V2 to be sent to using systems, or

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- 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 removed from the PFD
- PFD speed tape message NO V SPD displays
- scratchpad message TAKEOFF SPEEDS DELETED displays.

Note: After an engine is started, the FMC recalculates takeoff speeds. Any combination of gross weight, OAT, or pressure altitude resulting in a takeoff speed change of two or more knots from the previously calculated speeds, causes the FMC to recalculate takeoff speeds.

7 TRIM, Center of Gravity (CG)

Initially displays boxes.

Valid entry is XX within the valid range.

After CG entered, the FMC:

- calculates and displays the stabilizer takeoff setting to the left of the CG entry (trim display is in 0.25 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.

If a position distance is entered, the FMC updates to this position when the TO/GA switch is pushed.

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 the runway threshold).

POS SHIFT update inhibited when GPS is primary FMC navigation source.

9 Thrust Limit (THRUST LIM)

Push—displays the THRUST LIM page.

TKK to TKR, TKU to TKZ

10 Runway Condition (RWY COND)

Displays runway condition.

Entry of “D” or “DRY” displays “DRY”.

Entry of “W” or “WET” displays “WET” and FMC uses separate set of V1 data.

Entry of “S” or “WET SK-R” displays “WET SK-R” and FMC computes V1 for a skid resistant runway.

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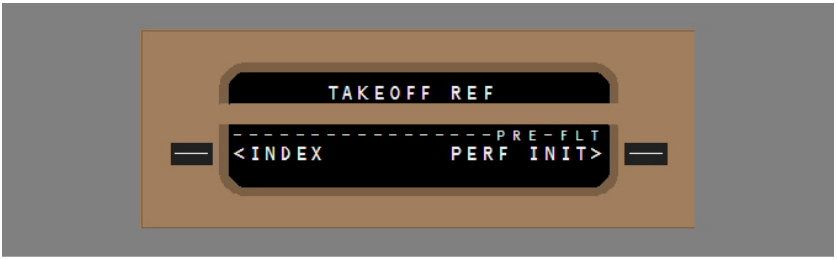
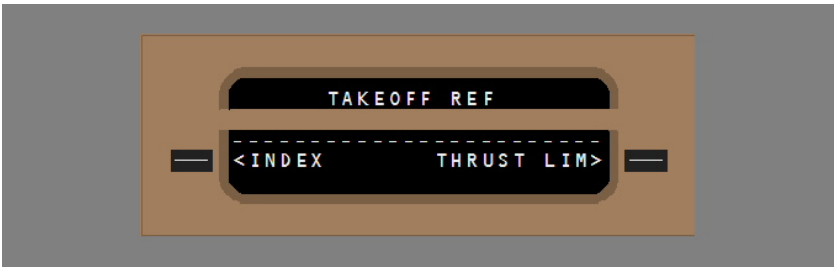
Default display is “DRY”.

Preflight Status



If the required preflight entries are not complete, the words PRE–FLT display on the right side of the dashed line. Preflight pages requiring entries display below the dashed line as prompts.



When preflight entries are complete, a dashed line displays below the takeoff reference page data. The THRUST LIM prompt displays below the dashed line.

Menu Page

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1 FMC

Push—Connects FMC to CDU.

2 Satellite Communication/Cabin Interphone (SAT/CAB INT)

See SATCOM System on page 5.20.4 and see Cabin Interphone System on page 5.30.2.

3 EFIS Control (EFIS CTL)

See EFIS Control CDU Pages on page 10.10.61.

4 EFIS

When prompt is displayed, selection displays the EFIS CONTROL page.

5 Display Select Panel Control (DSP CTL)

See Display Select CDU Pages on page 10.10.65.

6 Display (DSP)

When prompt is displayed, selection displays the DISPLAY MODES page.

7 Memory

Accessible only on the ground. For maintenance use only.

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Introduction

The FMC takeoff phase starts with the selection of takeoff/go-around (TO/GA). Preparation for this phase starts in the preflight phase and includes entry of the TAKEOFF REF page data.

The takeoff phase changes to the climb phase when the FMC commands climb thrust. The climb phase continues to the top of climb point, where the cruise phase starts.

During takeoff and climb, the specific page listed below is used to:

- TAKEOFF REF page—make last minute changes to the departure runway
- DEPARTURES page—make last minute changes to the SID
- 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 alternate climb thrust limits
- DEP/ARR INDEX page—select an approach during a turn-back.

Takeoff

When changes are made to the departure runway and SID, the TAKEOFF REF and DEPARTURES pages must be modified to agree. 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 the takeoff roll, the autothrottle commands the thrust and the FMC commands acceleration to between V2+15 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 radio altitude and commands roll to fly the active route leg. VNAV activates at 400 feet above runway elevation and commands pitch to fly the climb profile.

Climb

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

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until entering the cruise phase. Waypoint speed constraints take priority, provided they are greater than VREF+80 or the transition speed.

During the climb, VNAV complies with the LEGS page waypoint altitude and speed constraints. A temporary level-off for a crossing altitude restriction is accomplished at the commanded speed. The commanded speed is magenta.

When the climb speed profile causes an anticipated violation of a waypoint altitude constraint, the FMC displays the CDU scratchpad message UNABLE NEXT ALT. A different speed profile that gives a steeper climb angle must be manually selected.

Altitude Intervention

If an unplanned level-off is required, setting the altitude window to the required altitude causes the airplane to level at the set altitude. VNAV SPD changes to VNAV ALT. The climb can be continued by setting the altitude window to a higher altitude and pushing the altitude selector. If the altitude window is set to an altitude above other altitude constraints, each altitude constraint can be deleted by each push of the altitude selector. If cruise altitude is set in the altitude window, all waypoint altitude climb constraints to the T/C can be deleted by selection of the CLB DIR> prompt on the CLB page.

Climb Page

The climb page is used to evaluate, monitor, and modify the climb path. The data on the climb page comes from preflight entries made on the route and performance pages, and from the airline policy file.

The climb page is the first of the three pages selected with the VNAV function key. When the FMC changes to the cruise mode, the climb page data is blanked.

FMC climb can be economy, fixed speed, or engine out.

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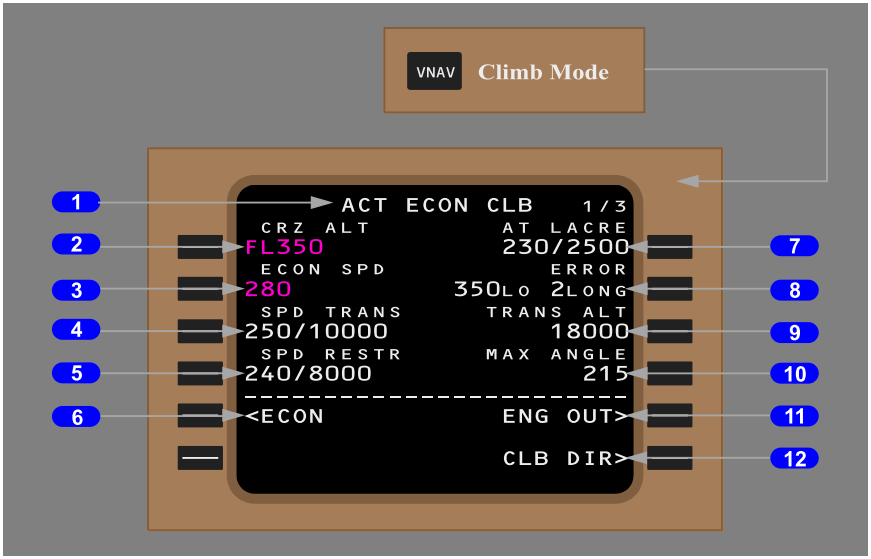

1 Page Title

The page title displays active (ACT) or modified (MOD) XXX 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 selected
- 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 constraint associated with an altitude
- waypoint speed constraints.

2 Cruise Altitude (CRZ ALT)

Displays cruise altitude entered on PERF INIT page. Displays in magenta when the altitude is the FMC target altitude.

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Valid entries are: XXX, XXXX, XXXXX, or FLXXX. Altitude displays in feet or flight level depending on transition altitude.

The altitude can be changed by two methods:

- A new cruise altitude can be manually entered from the CDU. The modified cruise altitude displays in shaded white until executed.
- A new cruise altitude can be entered in the altitude window. Pushing the altitude selector changes the cruise altitude. When intermediate altitude constraints exist between the airplane altitude and the new MCP altitude, each push deletes the next altitude constraint.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD), or Engine-Out Speed (EO SPD)

The FMC commanded speed is magenta. Below CAS/Mach transition altitude, CAS is magenta and Mach is white. Above CAS/Mach transition altitude, Mach is magenta and CAS is white.

Valid entries are CAS or Mach.

ECON SPD displays in the line title when speed is based on the cost index. The FMC commands ECON SPD at altitudes higher than waypoint constraints, speed restrictions, or speed transition altitude.

SEL SPD displays in the line title when flight crew enters speed or a speed constraint exists.

EO SPD displays in the line title when ENG OUT selected.

4 Speed Transition (SPD TRANS)

The 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+80 knots (example 250/10000).

Displays in magenta when it is the FMC command speed.

Not displayed above transition.

Can be deleted.

5 Speed Restriction (SPD RESTR)

Speed restrictions for an altitude less than the cruise altitude are manually entered on this line.

Dashes before entry by flight crew.

Valid entry is a CAS and altitude (example 240/8000).

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An entry creates a modification. Entry is shaded white until executed; magenta when it is FMC command speed.

6 Economy (ECON)

Push—changes climb speed to ECON. Must be executed.

Prompt displays when the climb speed is not ECON.

7 Waypoint Constraint (AT XXXXX)

Displays 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 are entered on RTE LEGS page.

Delete here or on RTE LEGS page.

Blank if no constraint exists.

Magenta when it is FMC command speed or altitude.

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 uses 18,000 feet if transition altitude is not available.

Manually change transition altitude here or on DESCENT FORECAST page.

Valid entries are XXX, XXXX, XXXXX, or FLXXX.

CDU altitude data change from altitudes to flight levels above the transition altitude.

10 Maximum Angle (MAX ANGLE)

Displays maximum angle of climb speed.

Entry not allowed.

11 Engine Out (ENG OUT)

Push (below speed transition or restriction altitude)—

- displays MOD EO CLB page
- deletes climb speed transition or restriction data.

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Push (below engine-out maximum altitude)—displays MOD EO CLB page.

Push (above engine-out maximum altitude)—

- displays MOD EO D/D page
- cruise altitude (1L) lowered to engine-out maximum altitude if that altitude is less than the active cruise altitude.

Shaded white until the modification executed. Upon execution, thrust reference limit becomes CON in all cases above.

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.

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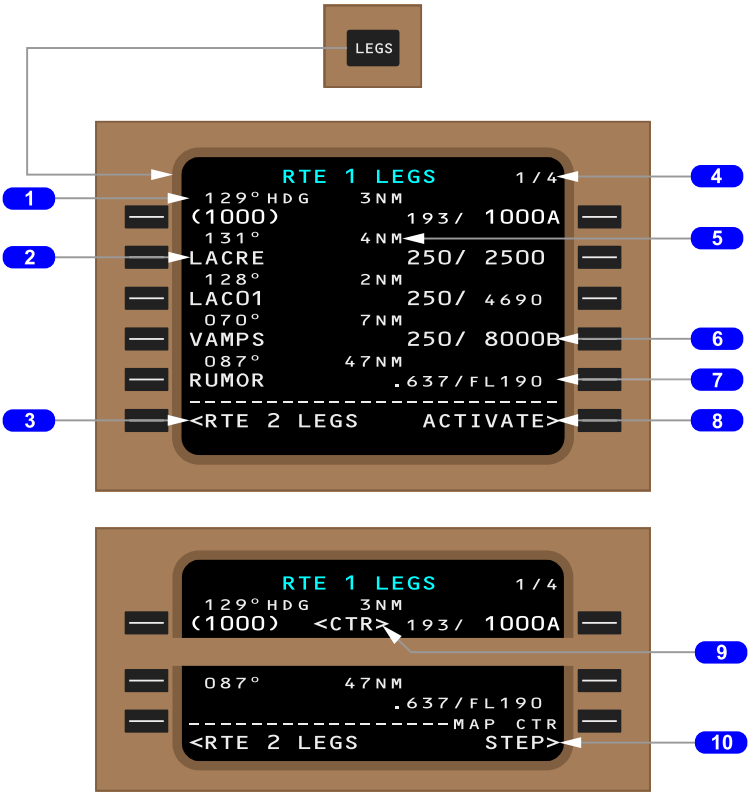
DRAFT

RTE X LEGS Page



1 Leg Direction

Leg segment data in line title:

- courses—magnetic (xxx°) or true (xxx° T)
- arcs—arc radius in miles, ARC, turn direction (example: 12 ARC L)
- heading leg segments—xxx° HDG
- track leg segments—xxx° TRK
- special procedural instructions from database—HOLD AT, PROC TURN, or PROC HOLD (FMC exits hold when crossing the fix after entry).

Calculated great circle route leg directions may be different than chart values.

Dashes display for an undefined course.

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2 Waypoint Identifier

Active leg is always the first line of the first active RTE X LEGS page.

Active waypoint is on active leg and is magenta. Modified waypoints are shaded white until executed.

All route waypoints display in flight sequence. Waypoints on an airway are included 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.

3 Route 2 Legs (RTE 2 LEGS)

Push—

- displays the RTE 2 LEGS
- when RTE 2 LEGS page displayed, prompt changes to RTE 1 LEGS.

4 Page Title

Title format displays route status:

- RTE X LEGS (cyan)—inactive route
- ACT RTE X LEGS (white)—active route
- MOD (shaded white) RTE X LEGS (white)—modified active route.

5 Distance to Waypoint

Distance (decreasing) from airplane to active waypoint or from waypoint to waypoint. Blank for some leg types (e.g. HDG or VECTORS).

6 Waypoint Speed/Altitude Constraints

Waypoint speed or altitude constraints display in large font.

Manual entry allowed in climb or descent phase. Entered by FMC when constraints are part of a procedure.

Magenta when it is an FMC commanded speed/altitude. Airspeed constraint may be magenta in one line with magenta altitude in another line.

Speed constraint is assumed to be at or below the displayed speed.

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DRAFT

Valid entries are:

- speed entry can be airspeed or Mach
- altitude entry can be thousands of feet or flight level (19000, FL190)
- XXX/XXXXX—airspeed/altitude entered simultaneously
- XXX, XXXX, XXXXX or /XXX, /XXXX, /XXXXX—altitude only.
- enter FL 190 or 19,000 feet as 190 or 19000. Enter FL 090 or 9,000 feet as 090 or 9000. Enter 900 feet as 009 or 0900. Enter 90 feet as 0090.

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 (see Planned Step Climb on page 11.42.23).

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 an altitude constraint below cruise altitude.

Manual entry allowed in climb or descent phase.

8 ACTIVATE, Route (RTE) DATA

RTE DATA displays when active or modified LEGS exist (not in PLAN mode).

ACTIVATE displays on an inactive LEGS page (not in PLAN mode).

Push—

- ACTIVATE—prepares inactive flight plan for activation; illuminates the EXEC key, and displays LEGS page 1/X with first waypoint of the route at the top. Other pages may be accessed and modifications performed before execution.
- RTE DATA—displays route data page.

MAP CTR STEP prompt displays when the EFIS control panel ND mode selector is in PLAN position.

9 Center (<CTR>)

Displays when PLAN mode selected.

Displays adjacent to the waypoint around which ND PLAN mode is centered.

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10 MAP Center (CTR) STEP

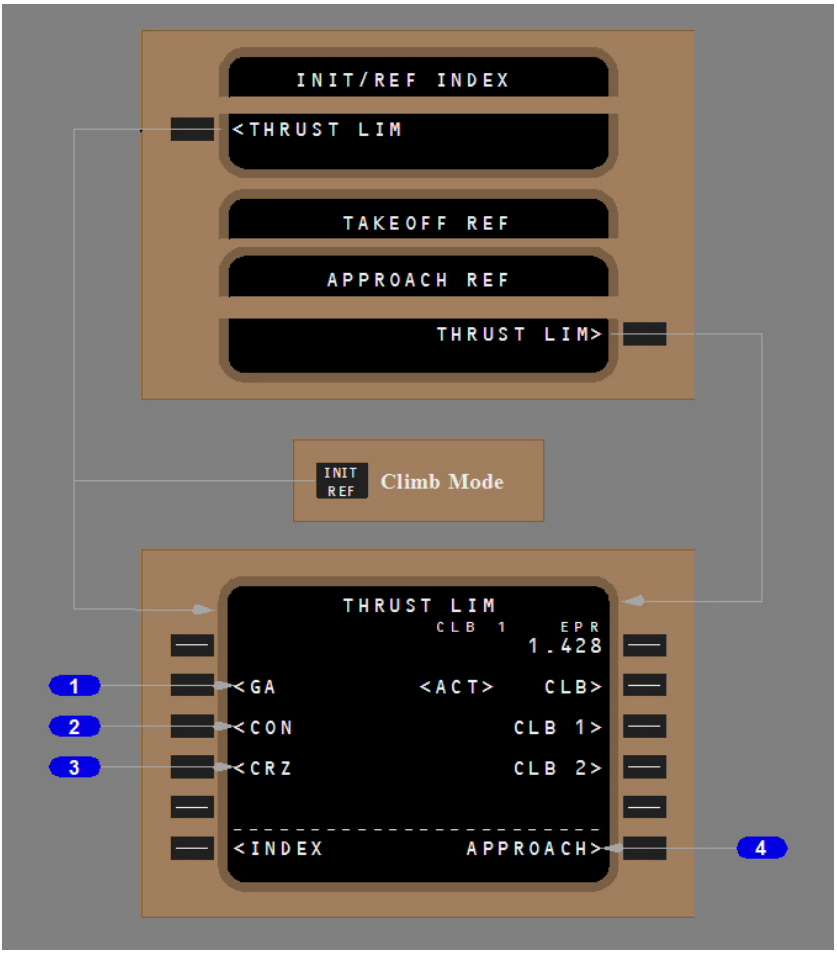
Replaces ACTIVATE or RTE DATA when PLAN mode selected.

Push—steps <CTR> to next waypoint. ND PLAN mode recenters.

Thrust Limit Page

Inflight thrust limits may be selected on this thrust limit page. When the FMC commands climb thrust; go-around, continuous, and cruise thrust limits replace takeoff thrust limits. The active thrust limit displays on the EICAS.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF



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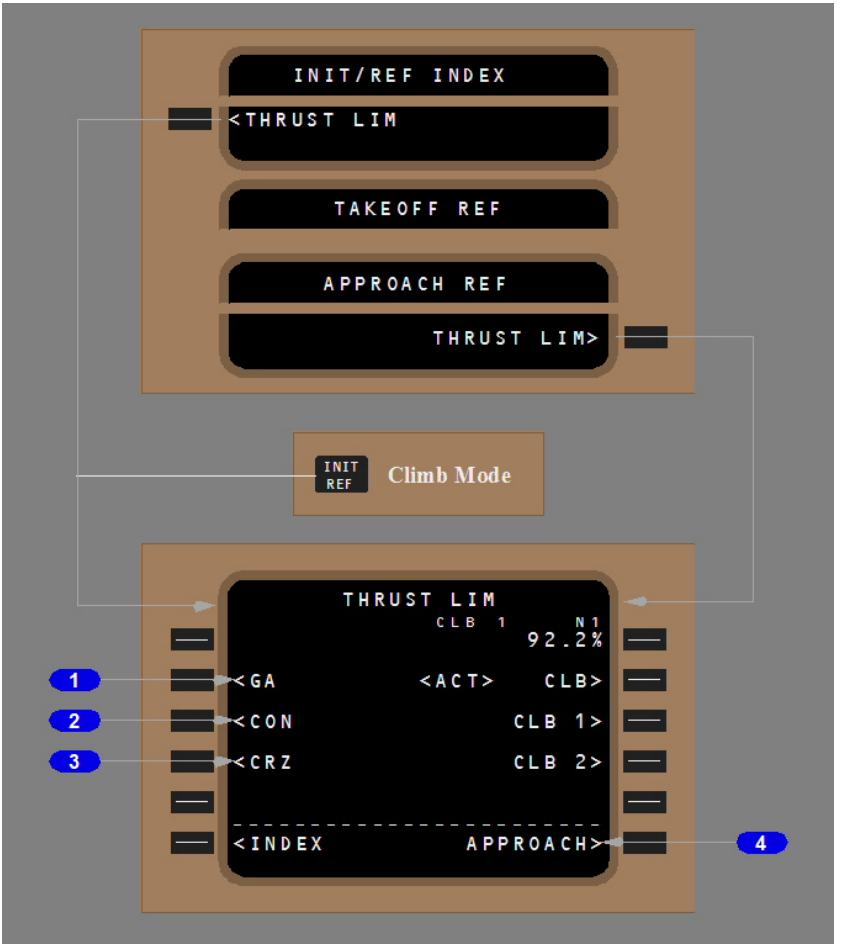
DRAFT

TKK to TKR, TKU to TKZ



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.

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4 APPROACH

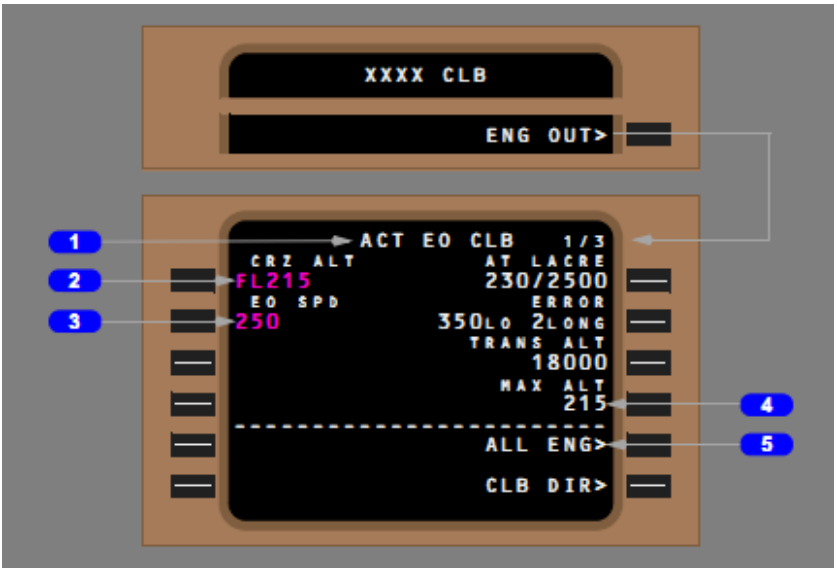
Push—displays APPROACH REF page.

Engine Out Climb

Engine out (EO) VNAV climb guidance is available on the EO CLB page. EO data with both engines operating can be displayed by selecting the ENG OUT prompt on the CLB page, without executing. Following an engine failure and selection of the ENG OUT prompt, execution displays the EO climb page.

EO CLB Page

The modified page displays engine out performance limitations. Manual entries are allowed. After execution, VNAV gives EO guidance in the climb and 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 EO CLB - engine out selected with minimum drag climb speed
- ACT EO MCP CLB - MCP speed intervention selected
- ACT EO XXXKT CLB - fixed CAS climb speed selected
- ACT EO M.XXX CLB - fixed Mach climb speed selected.

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2 Cruise Altitude (CRZ ALT)

Displays cruise altitude if less than MAX ALT.

Displays EO MAX ALT if less than cruise altitude.

Manual entry is allowed.

3 Engine Out Speed (EO SPD)

Displays engine out climb speed.

Valid entry is xxx for CAS.

Valid entry is o.xxx for Mach. Trailing zeros can be omitted.

A manual entry may cause MAX ALT to change.

4 Maximum Altitude (MAX ALT)

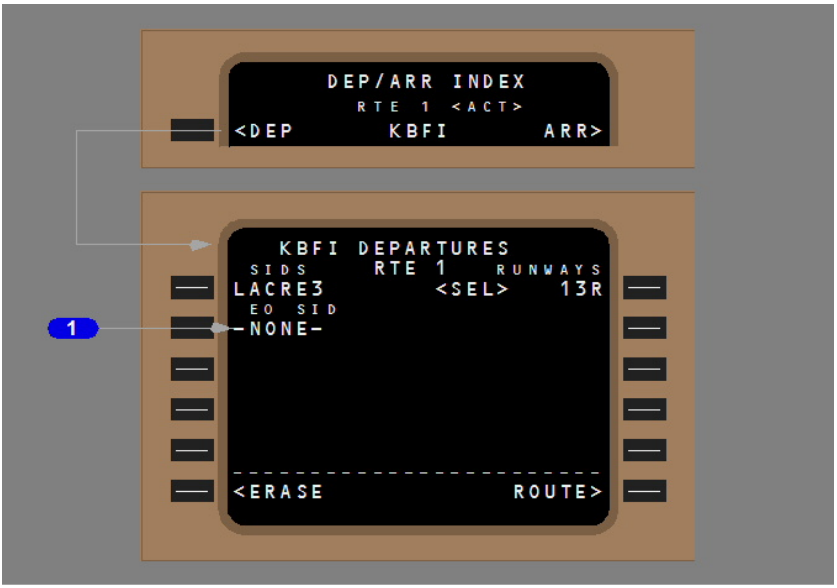
Displays lower of maximum altitude at engine out climb speed or cruise speed.

Entry not allowed.

5 ALL ENG

Push—modifies page to display all engine (ALL ENG) performance data.

Engine Out Departure



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1 Engine Out Standard Instrument Departure (EO SID)

Engine out SIDs can be created by the airline for specific runways.

The FMC puts the EO SID into the route as a modification if:

- an engine failure is sensed
- flaps extended
- and the navigation database has an EO SID for the departure runway.

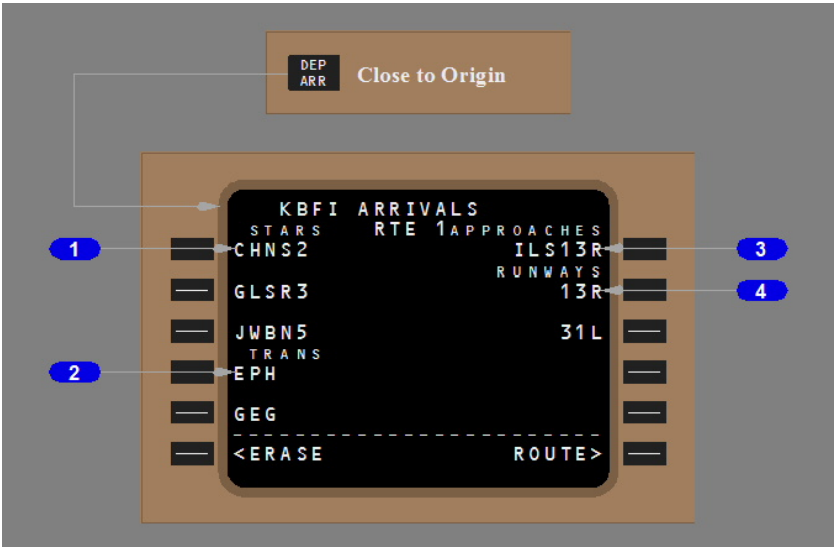
The modification can be executed or erased.

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, push the DEP ARR function key to show the ARRIVALS page for the origin airport.



1 STARS

Displays STARS for origin airport.

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2 Transitions (TRANS)

Displays transitions for origin airport.

3 APPROACHES

Displays approaches for origin airport.

4 RUNWAYS

Displays runways for origin airport.

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Introduction

The cruise phase starts at the top of climb.

During cruise, the primary FMC pages are:

- RTE X LEGS
- CRZ
- PROGRESS.

The RTE LEGS pages are used to modify the route. The CRZ pages display VNAV related data. The 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
- RTE X page—use to select a route offset
- FIX INFO page—display data about waypoints. Page data can be transferred to other pages to create new waypoints and fixes
- SELECT DESIRED WAYPOINT page—shows a list of duplicate waypoints from the navigation database. The flight crew selects the correct waypoint from the list
- POS REPORT page—display data for a position report.

The CLB page changes to CRZ at the top of climb. The CRZ CLB and CRZ DES pages change to CRZ at the new cruise altitude. The CRZ page changes to DES at top of descent.

LNAV Modifications

This section describes typical techniques to modify the route. The modifications include:

- add and delete waypoints
- change waypoint's sequence
- remove discontinuities
- intercept a course.

RTE LEGS Page Modifications

When modifications are made to a RTE LEGS page, several prompt or identifying features help the flight crew make the modifications, such as:

- ERASE

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- INTC CRS TO
- INTC CRS FROM.

Modified entries display in shaded white.

Add Waypoints

Waypoints can be added to the route at any point. Added waypoints are followed by route discontinuities.

First, enter the waypoint name in the scratchpad.

Second, locate the desired line in the flight plan and push the adjacent line select key. The scratchpad waypoint name is put into the selected line. The entered waypoint is connected to the waypoint above it via a direct route. A route discontinuity follows the waypoint.

For example, OED is typed into the scratchpad. Push line select key 2L to put OED into line 2. The FMC assumes BTG direct OED. RBL and the rest of the flight plan follow the route discontinuity.

1 Page Title

MOD (shaded white)—replaces ACT when modification in progress.

ACT (white)—replaces MOD when ERASE selected or execute key pushed.

2 Modified Waypoint

Waypoint name is shaded white until executed.

OED waypoint entered into the route after BTG. Modification creates a route discontinuity because OED was not in active route. The FMC now requires routing beyond OED.

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3 Discontinuity Waypoint

Discontinuity is removed when applicable waypoint is entered in boxes.

4 ERASE

Push—removes all modifications and shows active data.

Displays when the FMC contains modified data.

Removed when selected or modifications executed.

5 ROUTE DISCONTINUITY

Line title separates route segments when there is a discontinuity.

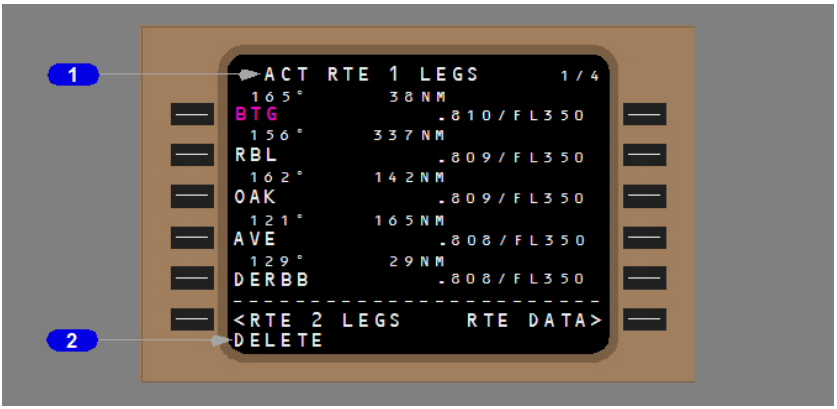
Note: Performance predictions to destination on the PROGRESS page are calculated assuming the route of flight is direct between waypoints on either side of a route discontinuity.

Delete Waypoints

Use the RTE LEGS page to remove waypoints from the route. The active waypoint can not be deleted. Two methods to remove a waypoint are:

- delete the waypoint with the DELETE function key
- change the waypoint's sequence.

The data in the route before and after the deleted waypoint does not change. A discontinuity is put in the route when the DELETE function key is used to remove a waypoint.



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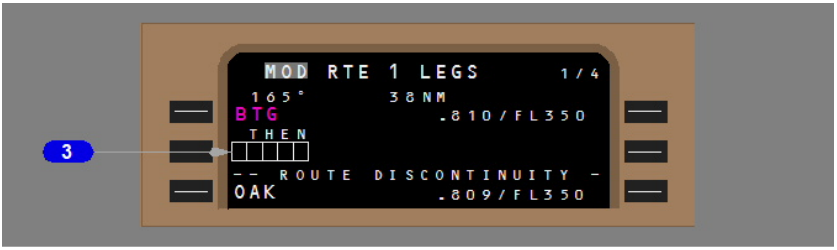

1 Active Route

The active route shows RBL followed by OAK and AVE.

2 DELETE Entry

Pushing the DEL function key arms the delete function and selects DELETE to the scratchpad.

3 Route Discontinuity

With DELETE in the scratchpad, pushing the line select key for RBL deletes the waypoint. Boxes replace RBL and a route discontinuity displays.

Change Waypoint Sequence

Waypoints moved from one position in the flight plan to another do not cause route discontinuities.

The waypoint may be typed in the scratchpad or copied from the flight plan. To copy a waypoint from the flight plan, find the applicable waypoint on one of the RTE LEGS pages. Push the line select key adjacent to the waypoint.

The example below shows the flight plan being modified to fly from BTG direct OAK. Push the line select key adjacent to OAK to put OAK in the scratchpad. Push the line select key adjacent to RBL. RBL is removed from the flight plan and the routing is direct from BTG to OAK to AVE. The modification does not cause a route discontinuity. Several waypoints can be removed from the flight plan at a time with this method.

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1 Active Route

The active route shows RBL followed by OAK and AVE. The clearance is to fly from BTG direct OAK. The OAK waypoint is selected to the scratchpad.

2 Change OAK's Sequence

OAK is selected to the waypoint after BTG. RBL is removed with no discontinuity.

Remove Discontinuities

A discontinuity exists when two waypoints are not connected by a route segment. Connect a route segment after the discontinuity to the route segment before the discontinuity to remove the discontinuity.

Copy the subsequent waypoint from the route into the scratchpad and enter it into the discontinuity, just as when adding a waypoint.

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1 Route Discontinuity

The active route has a discontinuity after BTG. The example shows how to fly direct from BTG to OAK. Copy OAK to the scratchpad. Any subsequent waypoint in the route can be selected to the scratchpad to remove the discontinuity.

2 Continuous Route

Select OAK to the boxes to remove the discontinuity.

Entering a waypoint in the boxes which does not already exist on the route moves the discontinuity one waypoint further down the route.

Direct To And Intercept Course To

If the airplane passes the last active route waypoint (or offset) or the last waypoint prior to a route discontinuity, LNAV maintains the current heading and a scratchpad message displays. If LNAV is not active, activation can be accomplished in the following three ways:

- When the airplane is within 2.5 miles of the active leg and on an intercept heading to the active leg, pushing the LNAV switch activates LNAV. The airplane turns to intercept the active leg. If the intercept angle is large, the airplane may overshoot the active leg.

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- When more than 2.5 miles from the active leg, pushing the LNAV switch when the airplane is on an intercept heading to the active leg arms LNAV. Activation occurs as necessary to intercept the active leg with no overshoot. The intercept heading must intersect the active leg inbound before the active waypoint.
- Fly direct to a waypoint or intercept a course to a waypoint. Enter a waypoint in the RTE LEGS page active waypoint line to fly direct. Use the INTC CRS TO prompt in line 6R to create an intercept course to the waypoint. Pushing the LNAV switch arms or activates LNAV, depending on the distance to the active leg.

The example below depicts the airplane being off course to the right, followed by a modification to fly direct to BTG.

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1 Leg Direction

Direct course from airplane present position to entered waypoint.

Execute to proceed direct to active waypoint.

2 Abeam Points (ABEAM PTS)

Push—

- creates place bearing distance waypoint on the Direct To leg abeam the bypassed waypoint if the bypassed waypoint was a database airport, navaid, NDB, or waypoint
- creates latitude/longitude waypoint on the Direct To leg abeam the bypassed waypoint if the bypassed waypoint was a latitude/longitude waypoint
- creates a new place bearing distance waypoint based on the original “place” on the Direct To leg abeam the bypassed waypoint if the bypassed waypoint was a place bearing distance waypoint
- creates a new latitude/longitude reporting point on the Direct To leg based on the entered latitude or longitude reporting point.
- line title displays ABEAM PTS and line data displays SELECTED
- altitude/speed constraints for bypassed waypoints are removed

ABEAM PTS prompt displays whenever the active waypoint name is modified, usually for direct–to routing.

Abeam waypoints created from designated position reporting waypoints become position reporting waypoints.

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3 Route Copy (RTE COPY)

Push—

- copies the active route into the inactive route
- erases previous inactive route
- line title displays RTE COPY and line data displays COMPLETE
- subsequent route modifications remove RTE COPY prompt.

4 Intercept Course TO (INTC CRS TO)—Select

Displays whenever the active waypoint name is modified.

Displays boxes if entered waypoint not in the active route.

Displays current route course and prompt caret if entered waypoint in the active route.

When boxes displayed, valid entry is intercept course from 000° through 360°. May be changed until executed. Entered or selected value displays in large font.

Push—

- when current route course (165°) 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.

5 Intercept Course

After pushing INTC CRS TO and prior to execution, displays direct–to inbound course at the waypoint; changed by entry in intercept course to (INTC CRS TO) line or by selecting intercept course to. After execution, displays current required track to fly inbound course to the waypoint.

6 Intercept Course TO (INTC CRS TO)

To change intercept course:

- enter the inbound intercept course (150°) in the scratchpad
- select the INTC CRS TO line to change the leg direction; intercept course to BTG of 150° is entered in the INTC CRS TO line and above the active waypoint.

Intercept Course From

The steps to create an intercept course from a waypoint are like the steps for an intercept course to. The waypoint name in the scratchpad is suffixed with the outbound course.

An intercept course can be created outbound from a waypoint in the navigation data base or from present position. The waypoint does not have to be in the route. Entering a waypoint and course pair in the active waypoint line displays the

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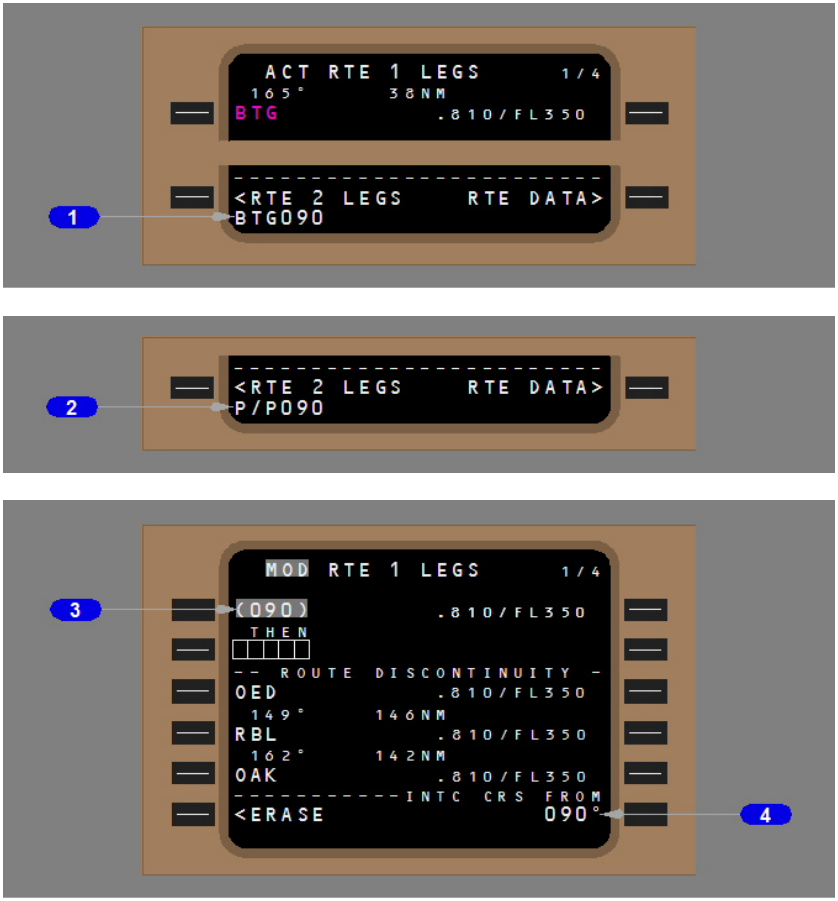
INTC CRS FROM prompt. The FMC calculates a route leg with the waypoint as the origin of the entered course.

The example shows a 090° course from BTG, entered as BTG090. When this course intercept is line selected to the active waypoint line, the course (090°) displays in the leg direction and the waypoint displays as a conditional waypoint consisting of a course intercept (090°).



1 Waypoint and Outbound Course

Enter the waypoint name and outbound course in the scratchpad.

2 Present Position and Outbound Course

Enter P/P and outbound course in the scratchpad.

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3 Active Outbound Course Entry

After the active waypoint line is selected, the outbound course displays. The waypoint name is not used.

For example, BTG090 is entered into the active waypoint line. The FMC calculates a new route leg with BTG as the origin on a outbound course of 090°.

4 Intercept Course From (INTC CRS FROM)

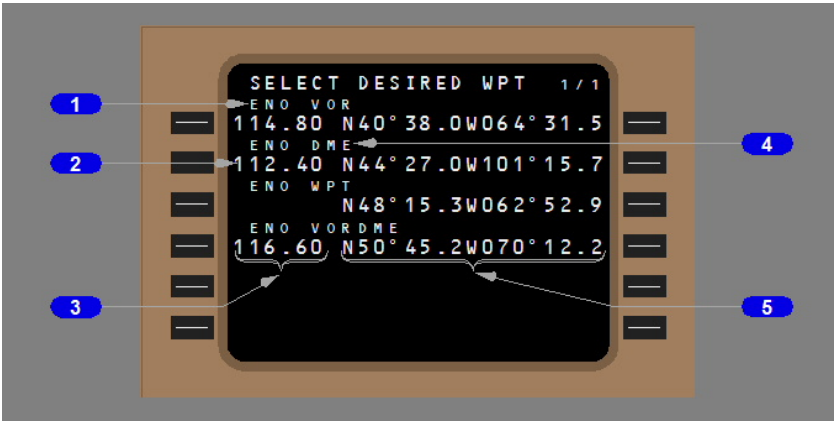
Displays outbound course from entered waypoint.

Shows the active waypoint name is modified with P/P or waypoint outbound entry.

Valid input is any course from 000° through 360°. May be changed until executed.

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. Select the correct waypoint by pushing the applicable left or right line select key.

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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; returns display to page previously in use.

Pushing any CDU function key exits page without selecting a waypoint.

3 Frequency

Displays 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.

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°

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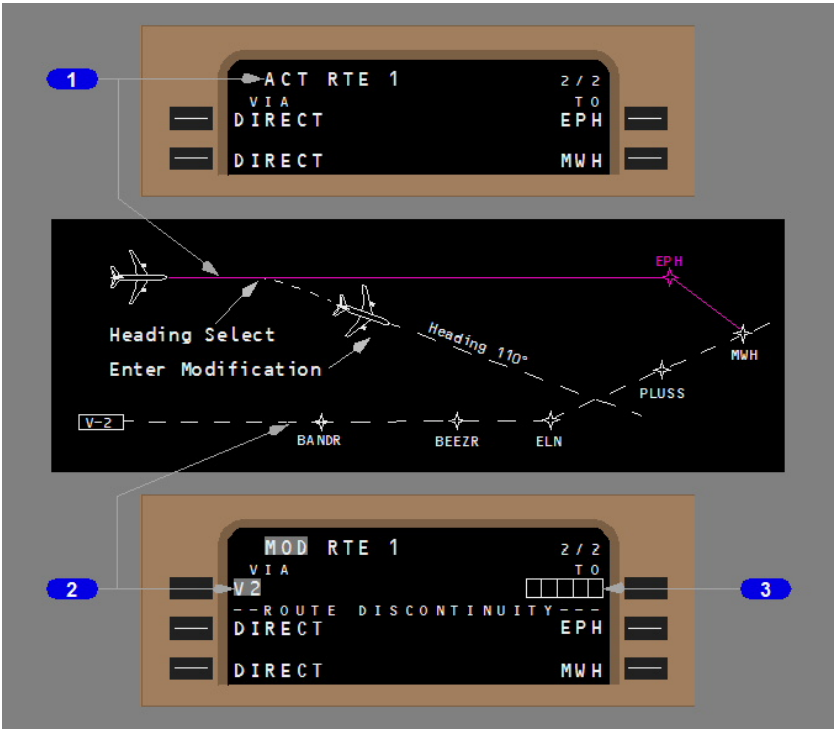
- intercept V2 to MWH.



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.

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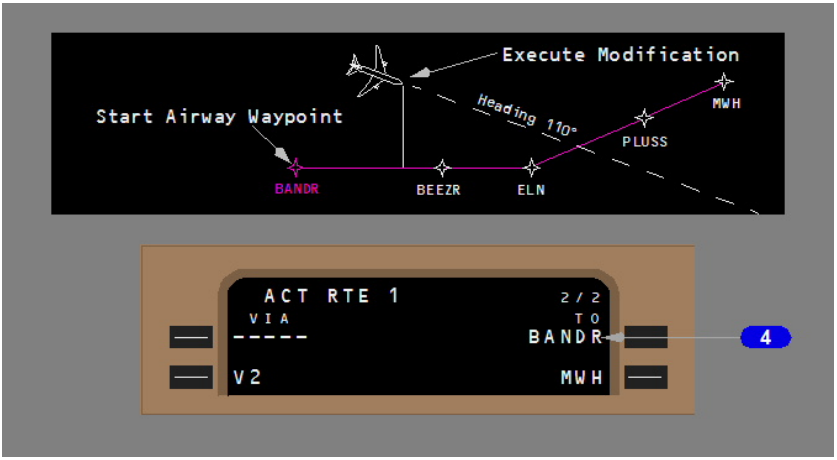
3 Airway Exit

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.

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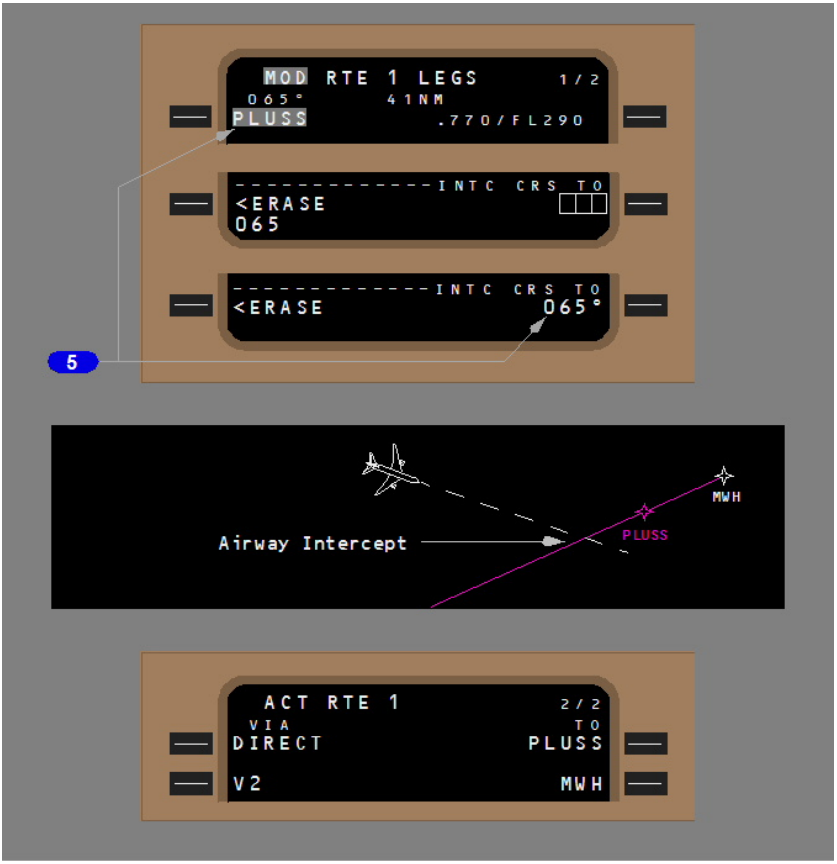

5 New Active Waypoint

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.

Route Offset

The OFFSET function is available when the airplane is in flight and not on a SID, Standard Terminal Arrival Route (STAR), or transition. The offset route displays as a white dashed line on the ND until executed or erased. An executed offset route displays as a dashed magenta line and extends along the route to a STAR, approach or approach transition, discontinuity, end of route, track change greater

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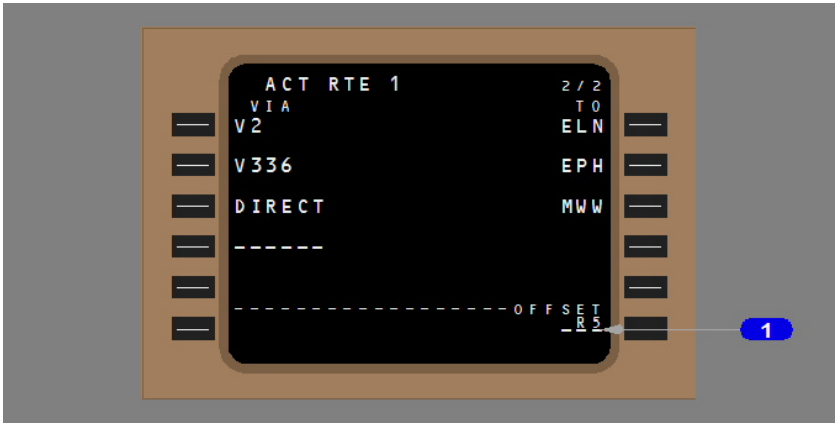
than 135°, or holding pattern. The original route displays as a solid magenta line. When executing the offset modification with LNAV active, the airplane turns to capture the offset course.

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 OFFSET

Valid entry is L (left) or R (right) XX (XX is any number from 0 to 99). When executed, the CDU OFST light illuminates.

Offset removed by deleting, entering zero,or proceeding direct to a waypoint.

Cruise Page

All Engine Cruise

The cruise page is used to monitor and change cruise altitude and speed. Speed changes can be manually selected or automatically selected with the selection of other VNAV modes. Cruise climbs, cruise descents, and step climbs can be accomplished from the cruise page.

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 the engine out mode, the data reflects airplane capabilities with one engine inoperative. The long range cruise (LRC) mode calculates speeds to maximize airplane range.

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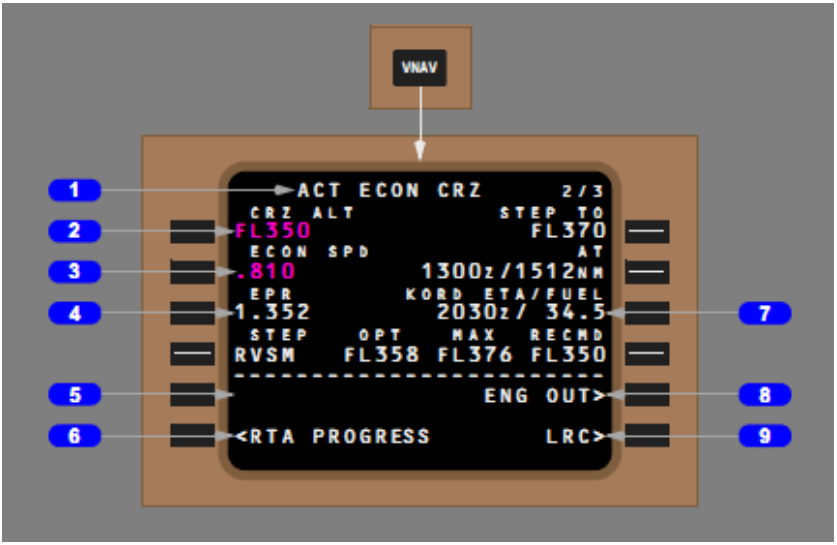
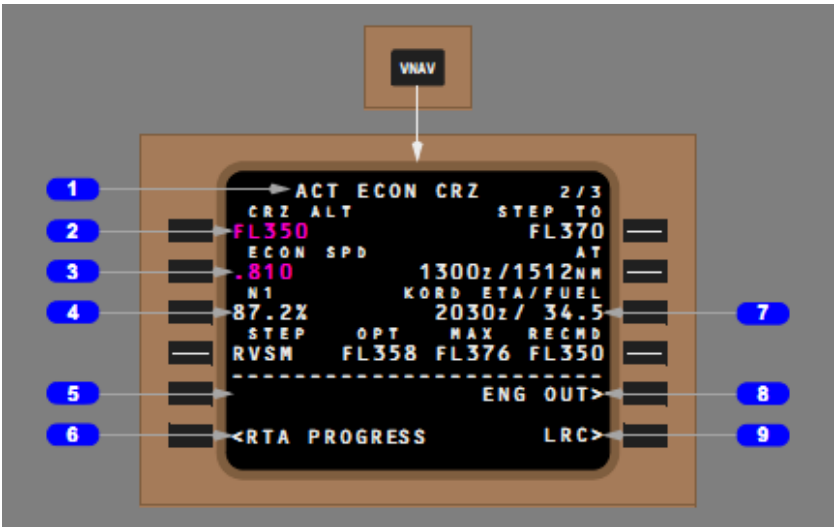
TJA,B,C,D,G,H, TJR to TJW, TKA to TKF



TKK to TKR, TKU to TKZ



1 Page Title

The page title displays active (ACT) or modified (MOD) cruise. Usually, the title contains ECON for economy cruise. Selected speeds, engine out, and long range cruise modify the title.

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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
- ATC 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
- ACT RTA CRZ—RTA cruise selected
- ACT RTA CRZ CLB—cruise climb with RTA selected.

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 the transition altitude.

Modified values display in shaded white.

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), Long Range Cruise Speed (LRC SPD), or Engine-Out Speed (EO SPD)

Displays target speed or Mach in magenta.

Valid entries are CAS or Mach.

MOD displays in the page title in shaded white until the modification is erased or executed.

ECON SPD displays in line title when speed based on the cost index.

SEL SPD displays in line title when flight crew enters speed.

LRC SPD displays in line title when LRC selected.

EO SPD displays in line title when ENG OUT selected.

COSPD displays in line title with a company defined engine-out Mach/CAS cruise speed schedule selected.

4 EPR/N1

TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

Displays EPR to maintain level flight at the target airspeed.

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Displays N1 to maintain level flight at the target airspeed.

TKK to TKR, TKU to TKZ

5 Economy Speed (ECON), Company Speed (CO SPD), or Required Time Of Arrival RTA/Economy (RTA/ECON)

ECON

Push—selects VNAV economy speed. Displays when economy is not the cruise speed target.

CO SPD

Push—selects a Mach/CAS schedule defined in the AMI. Displays when engine-out has been selected and the company policy engine-out speed is not the current cruise speed target.

RTA/ECON

Push—selects RTA speed. Displays when an RTA waypoint is in the flight plan and RTA is not the cruise speed target.

6 Required Time Of Arrival (RTA) PROGRESS or Engine-Out Speed (EO SPD)

RTA PROGRESS

Push—displays RTA PROGRESS 3/4.

EO SPD

Push—changes cruise speed to engine-out minimum drag speed.

7 XXXX (Destination) ETA/FUEL, ETA/FUEL W/MOD

Displays estimated time of arrival and calculated fuel remaining at the destination.

Line Title displays "ETA/FUEL W/MOD" when a modified route is displayed.

Displays the same data for the alternate airport when a DIVERT NOW modification is selected from the ALTN page.

Calculations are based on optimum step climbs and cruise altitudes.

8 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 EO SPD
- below engine-out maximum altitude: upon execution, thrust reference limit changes to CON and page title becomes ACT EO CRZ

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- above engine-out maximum altitude: sets CRZ ALT to engine-out maximum altitude; and upon execution, thrust reference limit becomes CON and page title becomes ACT EO D/D.

9 **Long Range Cruise (LRC)**

Push—changes cruise speed mode to LRC or EO LRC.

Engine Out Cruise

Engine out (EO) VNAV cruise guidance displays on the EO CRZ page. EO data with both engines operating can be displayed by selecting the ENG OUT prompt on the CRZ page, without executing. Following an engine failure and selection of the ENG OUT prompt, execution displays the appropriate EO CRZ page.

The modified page displays engine out performance information. When above the maximum engine out cruise altitude, VNAV calculates engine out guidance for drift down (D/D). This graphic is shown under Cruise (Above EO Max Alt), 11.31. The EO D/D page changes to the EO CRZ page when reaching the engine-out cruise altitude (shown below). LRC speed may be selected at 6R.

Subsequent engine-out cruise climb or descent is accomplished the same as two engine cruise climb or descent.

As the airplane gross weight decreases, maximum altitude increases. A step climb may be possible under these conditions.

The example is based on a cruise altitude above the maximum engine-out altitude. When ENG OUT is selected, the default target speed is EO SPD.

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1 Page Title

The page title displays active (ACT) or modified (MOD) cruise.

Page titles include:

- ACT EO CRZ—engine out selected with minimum drag cruise speed
- ACT EO MCP SPD—MCP speed intervention selected
- ACT EO XXXKT CRZ—fixed CAS cruise speed selected
- ACT EO M.XXX CRZ—fixed Mach cruise speed selected
- ACT EO D/D—engine out driftdown with EO speed
- ACT LRC D/D—engine out driftdown with LRC speed selected
- ACT EO LRC CRZ—engine out cruise with LRC speed
- ACT EO CRZ CLB/DES—cruise climb or descent with EO SPD selected

2 Cruise Altitude (CRZ ALT)

Displays altitude from MAX ALT line when current CRZ ALT above MAX ALT.

Manual entry of an altitude above maximum engine-out altitude results in the scratchpad message, “MAX ALT FLXXX”.

Valid entries are the same as all engine cruise page.

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3 Engine Out Speed (EO SPD)

Displays the target speed or Mach in magenta.

Manual entry is allowed.

Valid entries are the same as all engine cruise page.

A manually entered speed changes the line title to SEL SPD.

Selecting any speed shows engine out speed (EO SPD) as a select prompt at 6L.

Manual entries may change MAX altitude.

4 Company Speed (CO SPD)

Push—Modifies the page with company speed, engine out data from the Airline Policy page.

5 Optimum Altitude and Maximum Altitude (OPT, MAX)

OPT—calculation of OPT altitude is based on gross weight, cost index, cruise speed schedule, and cruise cg. Wind and temperature deviations from standard day are not used in the calculation. The optimum altitude is not calculated during an RTA cruise segment.

MAX—displays the maximum cruise altitude based on:

- current gross weight minus calculated fuel burn to climb to MAX altitude
- temperature
- engine out operation
- cruise reference thrust limit default set by airline (CRZ or CLB)
- speed (ECON, LRC, SEL, EO, or CO)
- residual rate of climb default set by airline (range: 100 to 999 feet per minute)
- disregards altitude or speed constraintsisregards altitude or speed constraints
- disregards altitude or speed constraints
- cruise CG.

6 ALL Engine (ENG)

Push—displays a MOD XXX CRZ page with performance based on both engines operating.

Selection and execution allows subsequent selection of two engine economy VNAV modes.

VNAV Modifications

During the cruise phase, VNAV can calculate two types of climbs: cruise and step climbs. Cruise and planned climbs can be entered by the flight crew. Optimum

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step climbs are calculated by the FMC. In all cases, the new climb altitude must be selected in the MCP altitude window before VNAV commands the climb.

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 reference thrust limit is CLB and the pitch flight mode annunciation is VNAV SPD.

Another method to accomplish a cruise climb: set a higher MCP altitude, enter the altitude in the CRZ ALT line, and execute.

1 During Cruise Climb

VNAV page title displays CRZ CLB in a climb to cruise altitude.

2 End of Cruise Climb

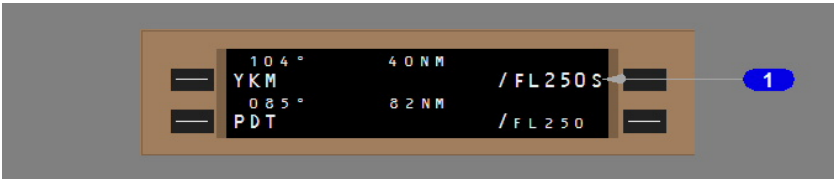
VNAV page title displays ECON CRZ after level off at cruise altitude.

Planned Step Climb

When a step climb is planned to start at a waypoint, the data can be entered on the RTE LEGS page. The FMC performance predictions assume the airplane will start the climb at the identified waypoint.

The FMC displays the distance and ETA to the step point on the PROGRESS page. The corresponding altitude profile point and identifier is shown on the ND.

If a climb is not initiated within 5 minutes after passing a planned step climb point, the EICAS message VNAV STEP CLIMB displays.



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1 Step Climb Altitude

Enter the cruise altitude as an altitude constraint and the letter S. The FMC assumes the step climb starts at the waypoint. Accomplish the step climb at the waypoint with the steps described in cruise climb.

Calculated Step Climb

With a non-zero value entered on the STEP SIZE line on the PERF INIT or CRZ page, the FMC calculates step climb points that minimize trip cost. For all speed modes, the step climb points are a function of the lateral flight plan, the entered COST INDEX (for ECON and RTA speed modes only), entered forecast winds and temperatures, CRZ ALT, gross weight, and STEP SIZE. Multiple step climbs are possible based on performance and route length. The calculated STEP TO altitude is less than or equal to the maximum altitude at the step point.

* If a climb is not initiated within 5 minutes after passing a calculated step climb point, the EICAS advisory message VNAV STEP CLIMB displays

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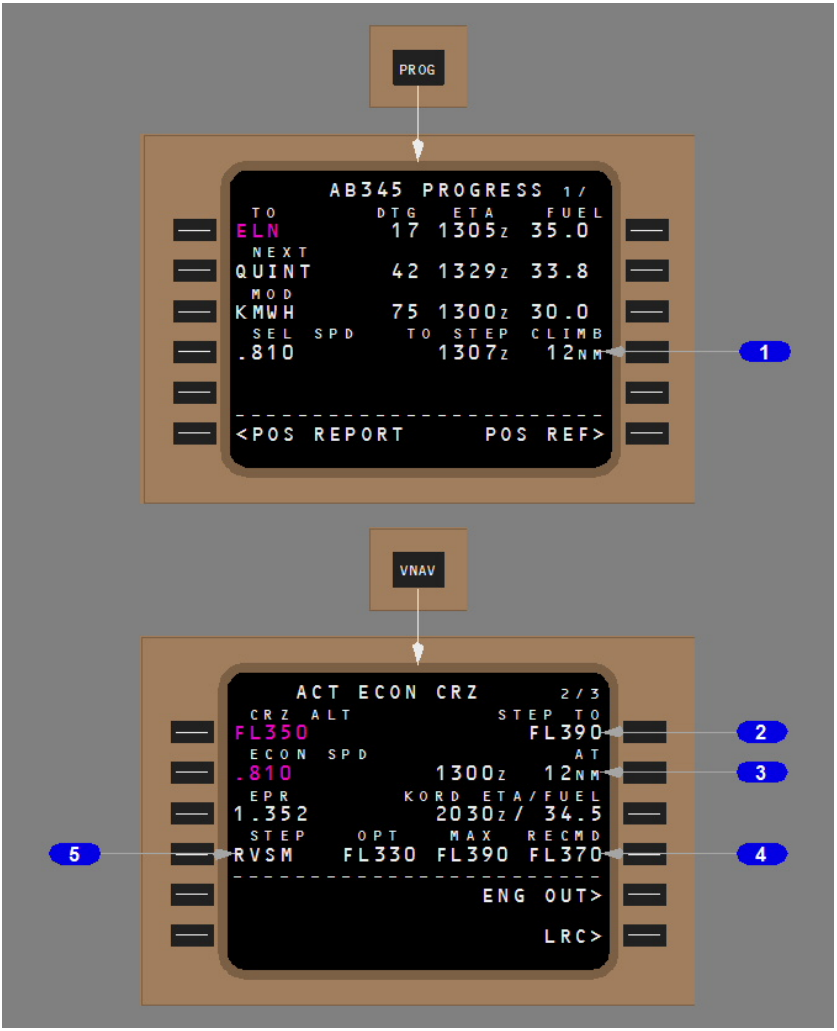
TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF



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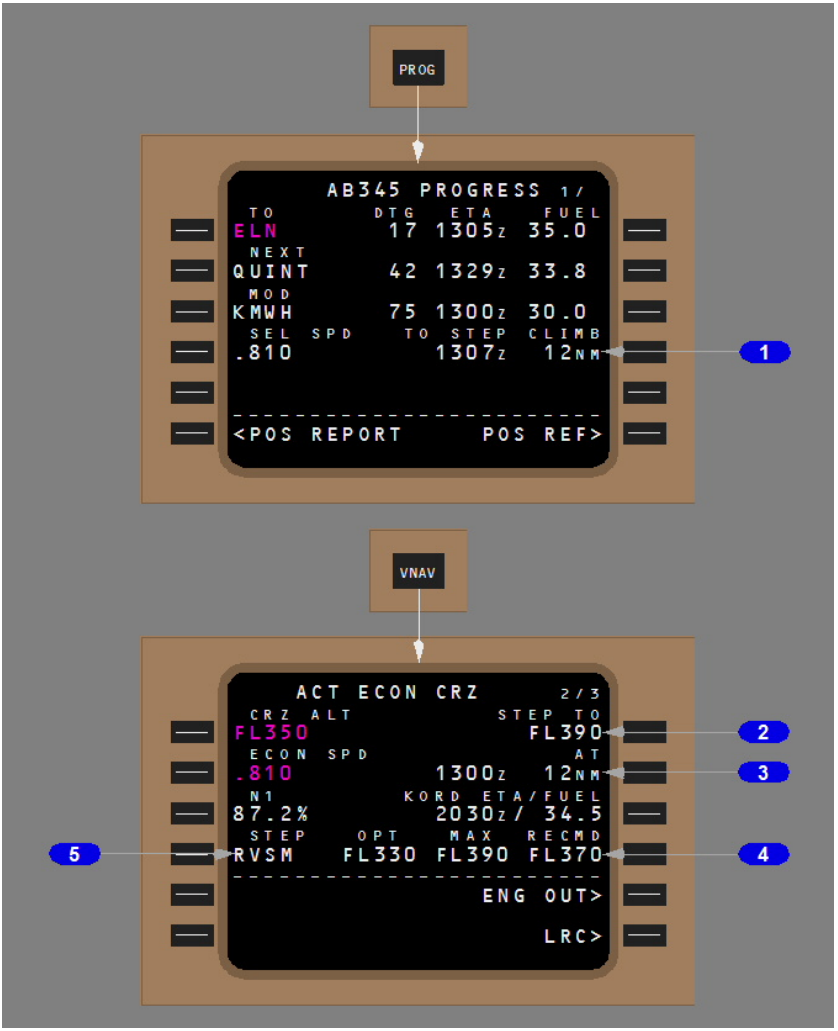
TKK to TKR,
TKU to TKZ



1 TO STEP CLIMB

When the cruise climb start point is the next VNAV event, the line title changes to TO STEP CLIMB.

Displays the ETA and DTG to the point where the step climb starts.

If the airplane passes the step climb point and has not started to climb, the ETA and DTG are replaced with the word NOW.

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When the FMC calculates a step climb is not advised, the ETA and DTG are replaced with the word NONE.

2 STEP TO

STEP TO displays when all of the following are true:

- an active route exists and no pending activation or flight plan modification exists
- the airplane is more than 200 nm from the T/D for calculated or planned step
- the airplane is more than 500 nm from the destination airport for calculated steps
- an engine out drift down in not active
- step size is not zero or a planned step exists when the step size is zero.

The FMC calculates performance based on accomplishing step climbs at calculated step climb points throughout the flight plan.

An altitude can be entered to evaluate a step climb. The FMC calculates the predicted the step climb location using entered forecast winds and temperatures and displays data on this page and on the PROGRESS page 1, 4R.

Valid entries are FLXXX (or XXX flight level) or XXXXX (feet).

Entry of zero for step size causes the FMC to calculate performance data at the entered CRZ ALT with no step climbs.

Preflight entry of a non–zero increment, ICAO, or RVSM step size causes the FMC to calculate STEP TO altitudes correct for the direction of flight based on the entered CRZ ALT. Inflight changes to CRZ ALT affect calculation of STEP TO altitudes when using ICAO or RVSM step size.

Displays STEP TO altitude based on entering "S" (following altitude) on a waypoint on the Legs page. The altitude displayed in 1R can be overwritten with a manual entry above or below CRZ ALT.

When using a non-zero step size, the STEP TO altitude is the next higher altitude, calculated by adding the step size increment to the current CRZ ALT. If step climbs have not been accomplished as calculated, multiple step increments may be used.

Entering an altitude above maximum altitude displays the scratchpad message MAX ALT FLXXX.

Blank when:

- there is no active flight plan, or
- within 200 NM of the T/D, or
- within 500 NM of the destination airport with no planned steps in the flight plan, or
- engine out drift down is active.

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3 TO FLXXX, AVAIL AT, AT XXXXXXX, AT, TO T/D, NONE

AT—displays when there is an altitude in 1R not derived from a specified climb point. Displays the ETA and DTG to the optimum climb point.

AT XXXXXXX—displays the LEGS page step climb waypoint when the FMC calculates the step climb can occur within 5 nm of the step climb waypoint. The data line displays ETA and DTG to the climb point. Displays NOW when passing the step climb point.

AVAIL AT—displays when a STEP TO the next step altitude entered on a LEGS page waypoint can not occur within 5 nm of the planned step point. The data line displays the ETA and DTG to the climb point. Displays NOW when passing the step climb point. Displays NONE when the planned step climb cannot be accomplished.

TO FLXXX—displays when the airplane is more than 200 nm from the T/D or more than 500 nm from the destination airport and engine out drift down is active. The data line displays the ETA and DTG to the climb point to the TO FLXXX altitude.

AT T/D—displays when the airplane is within 200 nm of the T/D or within 500 nm of the destination airport with no planned step climbs in the flight plan. The data line displays ETA and DTG to the T/D point.

NONE—displays when planned step climb cannot be accomplished.

4 Optimum, Maximum, and Recommended Altitude (OPT, MAX, RECMD)

Blank when RTA is active.

OPT—calculation of OPT altitude is based on gross weight, cost index, cruise speed schedule, and cruise cg. Wind and temperature deviations from standard day are not used in the calculation. The optimum altitude is not calculated during an RTA cruise segment.

MAX—displays maximum altitude based on:

- current gross weight minus calculated fuel burn to climb to MAX
- temperature
- number of engines operating
- cruise reference thrust limit default set by airline (CRZ or CLB)
- speed (ECON, LRC, SEL, EO, or CO) option
- residual rate of climb default set by airline (range: 100 to 999 feet per minute)
- disregards altitude or speed constraints
- cruise CG.

RECMD—displays the most economical altitude to fly for the next 250-500 nm based on gross weight, cruise speed schedule, and entered forecast winds and

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temperatures at cruise altitudes. The FMC evaluates altitudes between 9,000 feet below the current CRZ ALT and up to MAX altitude. Recommended altitudes are consistent with the specified step size and step climb schedule. If the step size is zero, the recommended cruise level is calculated assuming a 2,000 feet step size. The recommended altitude is set to the CRZ ALT when within 200 nm of the T/D or within 500 nm of the destination airport. The recommended altitude is not calculated during an RTA cruise segment.

5 **STEP SIZE**

Used for calculation of optimum step point and step climb predictions.

Displays default step climb size: RVSM, ICAO, or 0 as selected in AMI.

Valid entries are:

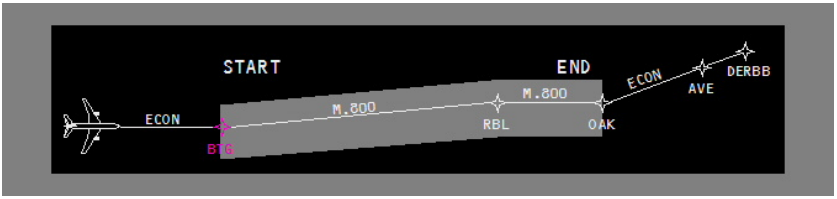
- "0" to inhibit predicted step climbs, or
- altitudes from 1000 to 9900 in 100 foot increments, or
- "I" for ICAO, or
- "R" for RVSM.

Deletion of a manual entry returns step size to the default value.

Constant Speed Cruise

A speed for a cruise segment can be specified. A cruise segment has a start waypoint and an end waypoint. The airplane maintains a constant speed between the two waypoints. The waypoints must be in the cruise phase. The FMC controls the speed after the end waypoint or top of descent.

Modification must be executed.



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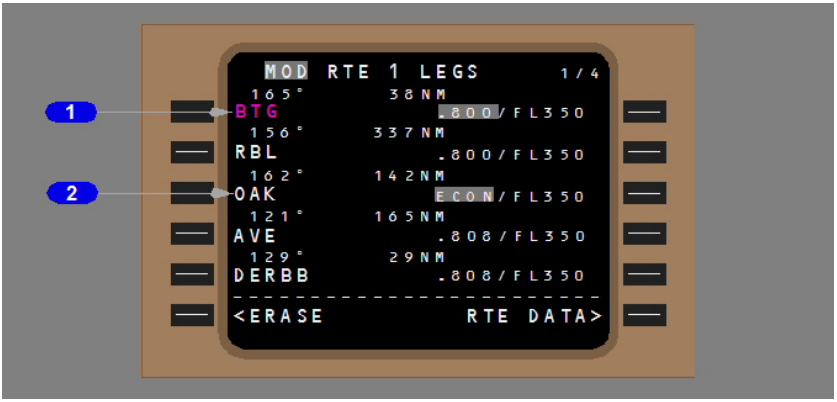

1 Start Waypoint for Constant Speed Cruise

The constant speed cruise starts at BTG at .800 Mach. Entry is in Mach.

2 End Waypoint for Constant Speed Cruise

The constant speed cruise ends at OAK then ECON speed is used. If an RTA waypoint exists at RBL or OAK, the RTA is deleted.

Entry can be a Mach number, ECON/ or E/, LRC/ or L/. If an RTA waypoint is in the flight plan, RTA/ or R/ may be entered.

If no end waypoint is specified, the constant speed terminates at top of descent.

The FMC may select the end waypoint if an RTA waypoint is entered. The FMC selects the end waypoint to allow enough distance to arrive at the RTA waypoint on time. In the example, if the FMC selected OAK as the end waypoint, RTA would replace ECON. See RTA Progress Page 3 on page 11.42.49.

Cruise Descent

Setting an altitude below the current 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 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. The autothrottle sets a calculated thrust value for an approximate 1,250 feet per minute descent. Pitch changes maintain the commanded cruise speed. Thrust levers can be manually positioned to adjust the descent rate.

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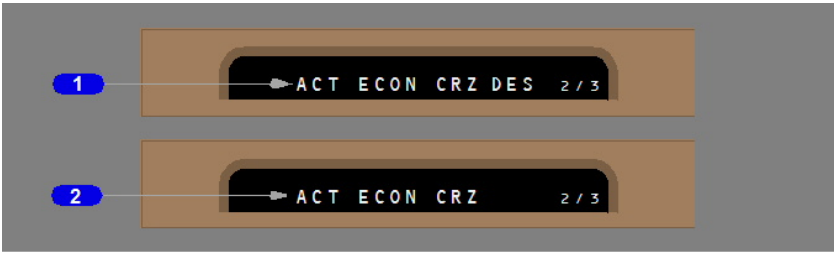


1 During Cruise Descent

VNAV page title displays cruise phase in a descent to a new cruise altitude.

2 End of Cruise Descent

VNAV page title displays cruise phase after level off at new cruise altitude.

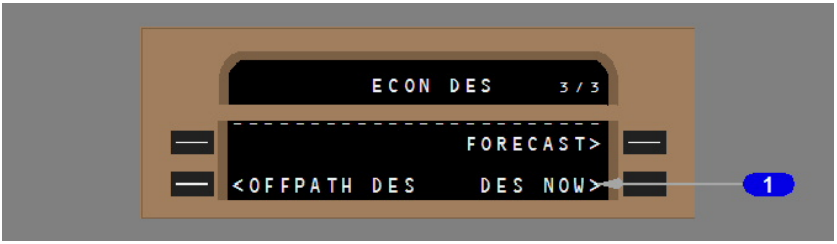
Early Descent

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 altitude in the MCP altitude window and pushing the altitude selector activates the DES NOW function when the airplane 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.

The autothrottle sets thrust to maintain the target descent rate; then annunciates HOLD. Pitch maintains the commanded speed. Thrust levers can be manually positioned to adjust the descent rate.

Another method to accomplish an early descent: set a lower MCP altitude, page forward to the VNAV DES page and line select DES NOW, and execute.



1 Descend Now (DES NOW)

The DES NOW prompt is shown on the descent page when the cruise phase is active. Selecting the DES NOW prompt and executing initiates a VNAV SPD descent of approximately 1,250 feet per minute at ECON speed.

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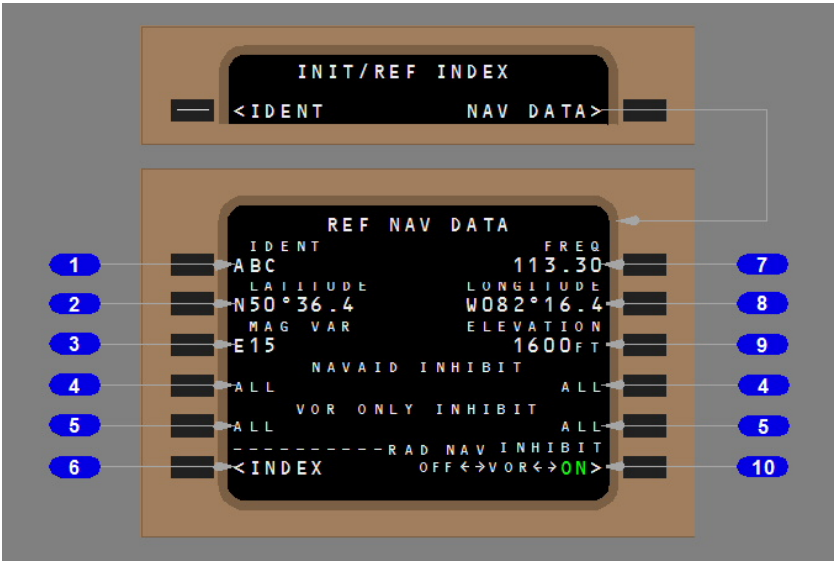
Upon reaching the planned descent path, VNAV commands pitch to capture the path and to maintain ECON speed, and sets IDLE thrust. If the airplane approaches a constraint altitude before reaching the constraint waypoint, VNAV commands level off and changes to VNAV ALT until the planned descent path is intercepted.

Navigation Data

Reference Navigation Data Page

The reference navigation data page displays data about waypoints, navaids, airports, and runways. Use this page to inhibit FMC position updates from radio navaids. The navaids are always available for manual tune, autotune and the ND.



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.

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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 database.

Entries not allowed when RAD NAV INHIBIT displays ON in large font, green letters.

Inhibits use of entered navaids for updating by both FMCs.

Entries clear at flight completion. "ALL" displays.

Deleting or overwriting removes a previous inhibit navaid.

5 VOR ONLY INHIBIT

Valid entries are VOR identifiers from the navigation database.

Entries not allowed when RAD NAV INHIBIT displays ON or VOR in large font, green letters.

Inhibits use of only VOR portion of entered navaid for updating by both FMCs. DME–DME position updating is not inhibited.

Entries clear at flight completion. "ALL" displays.

Deleting or overwriting removes a previous inhibit VOR.

6 INDEX

Push—displays the 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 RAD NAV INHIBIT

The default state of RAD NAV INHIBIT is ON; all radio updating (DME/DME, VOR/DME, LOC) is inhibited. "ALL" displays in NAVAID INHIBIT and VOR ONLY INHIBIT left and right lines. Entries are not allowed.

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Push—alternately selects RAD NAV INHIBIT: OFF, VOR, or ON.

OFF—all radio updating available to the FMC. OFF displays in large font, green letters. VOR and ON display in small font, white letters.

VOR— all VOR/DME updating inhibited. DME/DME updating is operable. VOR displays in large font, green letters. OFF and ON display in small font, white letters.

ON—all radio updating inhibited. ON displays in large font, green letters. OFF and VOR display in small font, white letters.

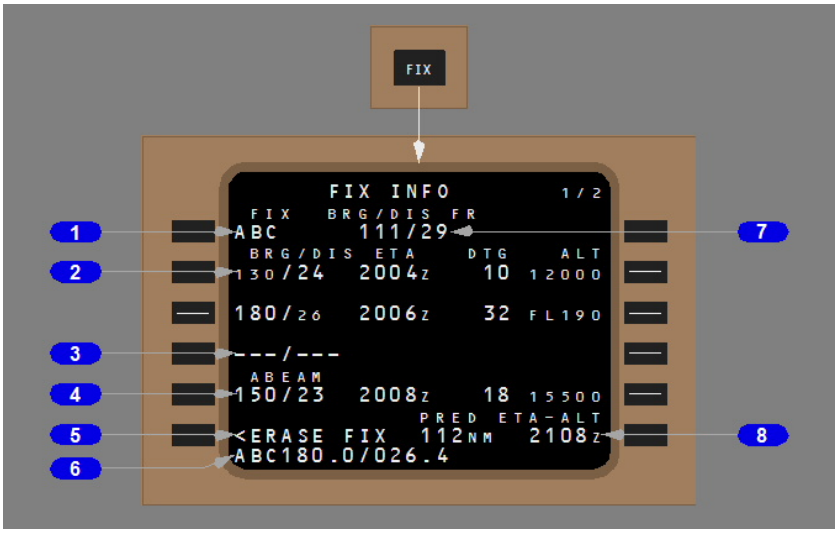
Note: When GPS is operable, radio updating is available, but is not used by the FMC for position updating.

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. The page can be cleared by selecting the ERASE FIX prompt or by using the DEL key.

Magnetic/True Bearing

Magnetic or true fix bearings depend on airplane location. See FMC Polar Operations on page 11.31.7.



1 FIX

Valid entries are airports, navaids, and waypoints from the navigation database. The selected fix displays on the ND and is highlighted by a green circle.

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2 Bearing/Distance (BRG/DIS), ETA, DTG, ALT

Valid entries are XXX/YYY:

- leading zeros can be omitted for distance entries
- distance (up to 511 nm) only entries must start with a slash (/).

Distances from the fix display on the ND as a circle around the fix.

When the circle intersects the active route, the ETA, DTG, and predicted altitude at the closest intersection display.

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 predicted altitude at the closest intersection display.

ETA—displays the estimated time if arrival to the intersection point.

DTG—displays the distance to go to the intersection point.

ALT—displays the predicted altitude at the intersection point.

Push—copies the fix place/bearing/distance into the scratchpad. This fix can be placed in the route on a LEGS or RTE page as a waypoint.

3 Bearing/Distance (BRG/DIS)—Dashes

When entering a bearing or distance from the fix, a bearing or distance circle from the fix displays on the ND. ETA, DTG, and predicted altitude also display.

When entering a bearing and distance from the fix, a bearing and distance circle from the fix display on the ND. ETA, DTG, and predicted altitude do not display. Line selection to the scratchpad and entry into the flight plan results in the creation of a waypoint.

4 ABEAM

Displays ABEAM prompt.

Note: The ABEAM prompt is only available when entering a FIX that is contained in the navigation data base (NDB). When entering a FIX in coordinates form, the ABEAM prompt will not be available.

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 into the scratchpad. This fix can be placed in the route on a LEGS or RTE page as a waypoint.

5 ERASE FIX

Push—removes all fix data from the page and the ND.

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6 Route Intersection Point Copied

Pushing the line select key for one of the BRG/DIS entries copies the fix place/bearing/distance definition into the scratchpad. This fix can be placed into the route on a LEGS page as a waypoint.

7 Bearing/Distance From (BRG/DIS FR)

Displays the bearing and distance of the airplane from the fix.

8 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. 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 the ACT RTE X LEGS page. This page also allows access to the WIND page. This page is available only for the active route.

The ETA and calculated fuel remaining at the waypoint display for each waypoint. Manual entry is not possible.

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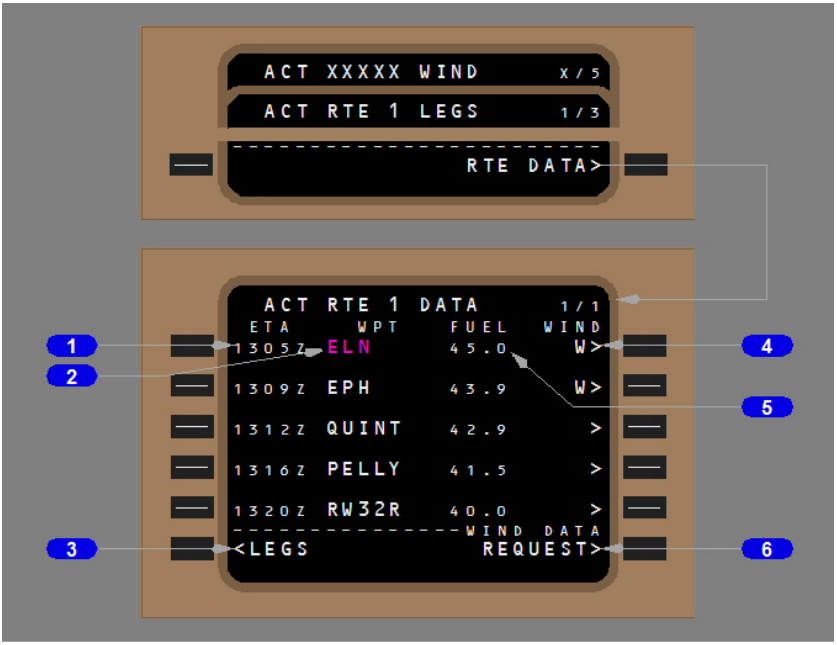

1 ETA

Displays ETA for waypoint.

2 Waypoint (WPT)

Displays identifier for waypoint.

3 LEGS

Push—displays RTE LEGS page.

4 WIND (W>/>)

W>—indicates waypoint winds have been entered.

>—winds not entered.

Push—selects WIND page for the selected waypoint.

5 FUEL

Displays the FMC calculated fuel remaining at the waypoint.

Note: ETA and estimated fuel calculations assume a direct flight across route discontinuities.

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6 WIND DATA REQUEST

Push—transmits a data link request for wind and descent forecast data.

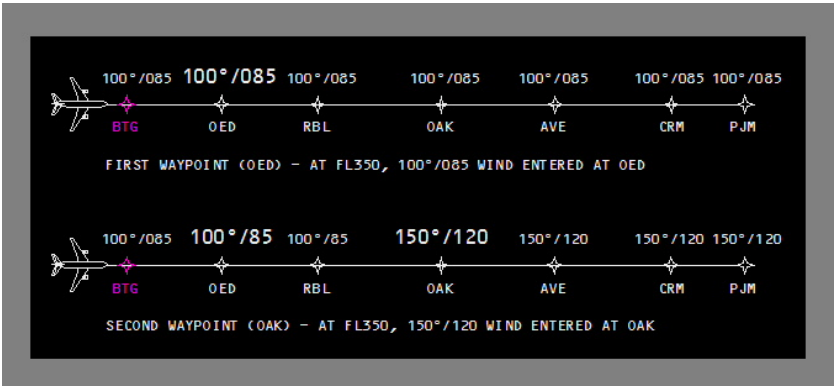
Flight crew may enter up to four altitudes on any wind page to qualify the request.

Wind Data

The FMC uses wind data to improve performance prediction accuracy. Wind data includes altitude and direction/speed.

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, enter wind data for waypoints closest to the airplane, then enter wind data for waypoints downtrack from the airplane.

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 and 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. The FMC mixes these winds for predictions in between. Sensed winds display on the progress page 2/4.

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 speed. FMC calculated ECON climb speed may fluctuate if top of climb is near a waypoint with approximately a 45° or larger track change and if a significant wind velocity has been entered or is predicted for that waypoint. This

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fluctuation does not occur when using a manually entered climb speed or speed intervention.

Wind Page

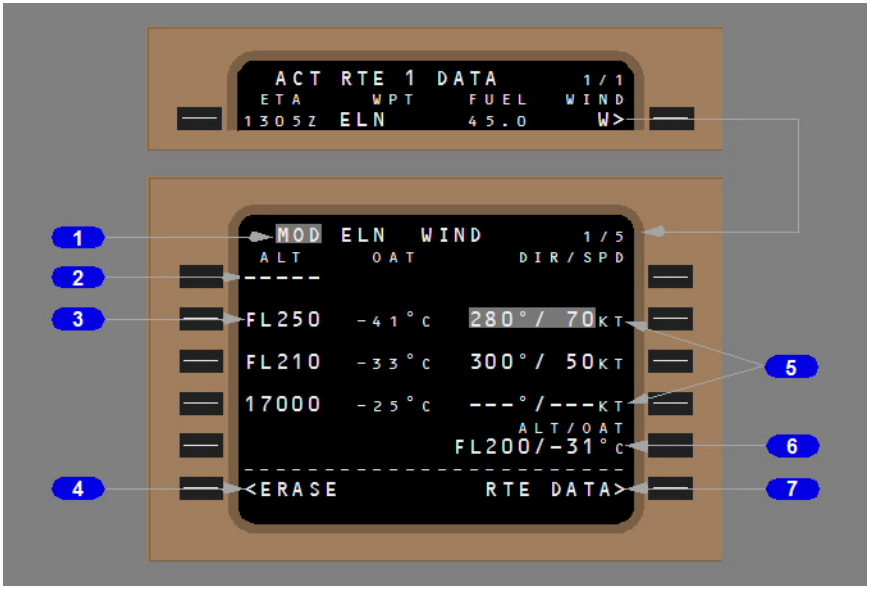
The wind page is used to enter forecast winds and temperatures at waypoints for up to four altitudes to enhance VNAV performance.

This data can be uplinked or manually entered.

Wind speed and direction are entered for the specific altitudes.

OAT can be entered for any one altitude. The FMC calculates the temperature for the entered altitudes using the standard lapse rate.

Altitudes are entered first. The altitudes can be entered in any order and are sorted and displayed in ascending order.



1 Page Title

Displays ACT XXXXX, where XXXXX is the waypoint at which winds have been entered.

When a route is being modified, MOD in shaded white as shown in the page title.

2 Altitude (ALT)

Enter altitude or flight level for wind entries. Altitude data entry possible only on line 1L.

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After data entry, data is sorted by altitude and placed 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 data can be entered.

3 Altitude/Flight Level Data

Displays the altitude or flight level for wind or OAT entries.

Data entered on 1L displays on lines 1 through 4. Data entry is not possible in lines 2L through 4L.

OAT entries made using the ALT/OAT line display in large font. Calculated OAT based on standard lapse rate display in small font.

4 ERASE

Push—removes modified data.

5 Direction and Speed (DIR/SPD)

Displays dashes after altitude/flight level entry in the ALT line. Enter wind direction and speed for the altitude.

Displays entered wind direction and speed for related altitude.

Values propagate in both directions for the first wind entered and downtrack for other entered winds. Propagated values display in small white font.

Manual entries display in shaded white until executed, then in large white font.

6 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 sign; a plus sign is optional,a minus sign is mandatory. Valid range is –99 to 60.

The altitude for OAT does not have to beone of the wind altitudes. The FMC uses standard lapse rate to calculate and display the temperature at the other altitudes.

Manual entries display in shaded white until executed.

7 Route Data (RTE DATA)

Push—displays the RTE DATA page.

Position Report Page

The position report page displays data for a position report. A position report can be data linked from the page.

The page contains reference data only. Manual entries are inhibited.

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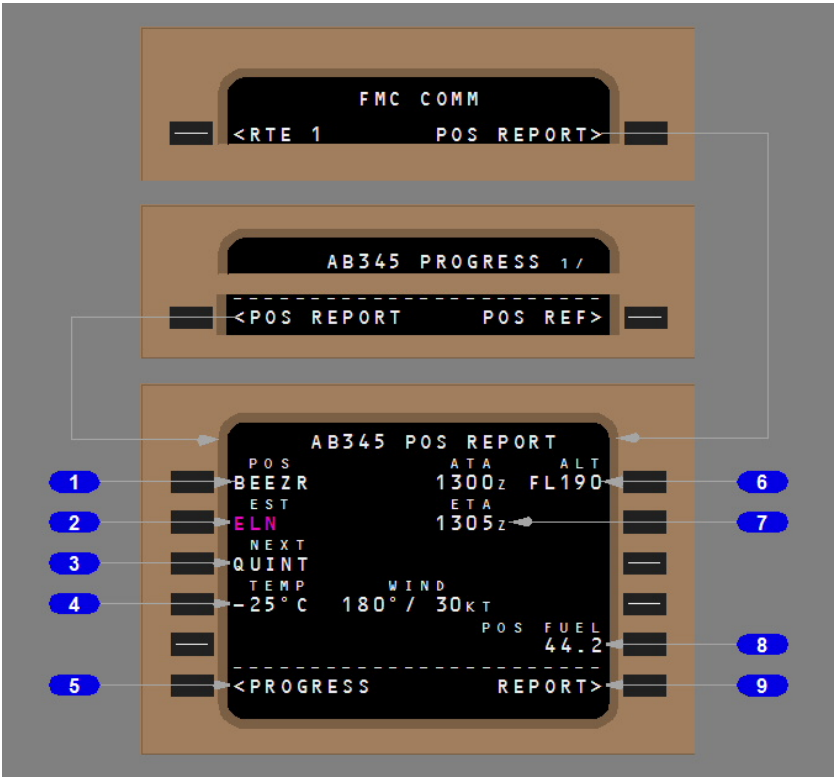

1 Position (POS)

Waypoint used to report position. This is the previous active waypoint.

2 Estimate (EST)

The active waypoint displays in magenta.

3 NEXT

Waypoint after active waypoint.

4 Temperature and Wind (TEMP WIND)

TEMP displays the OAT in degrees C.

WIND displays the wind direction and speed.

5 PROGRESS

Push—displays the PROGRESS page.

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6 Actual Time of Arrival and Altitude (ATA ALT)

ATA displays the actual time of arrival for the POS waypoint.

ALT displays the current airplane altitude.

7 ETA

Displays the estimated time of arrival for the active waypoint.

8 Position Fuel (POS FUEL)

Displays FMC calculated fuel remaining at the POS waypoint.

9 REPORT

Push—transmits a data link downlink of the data on this page.

The data link transmission of a position report requires the data link option be enabled, operational, and not in the voice or no-communications mode.

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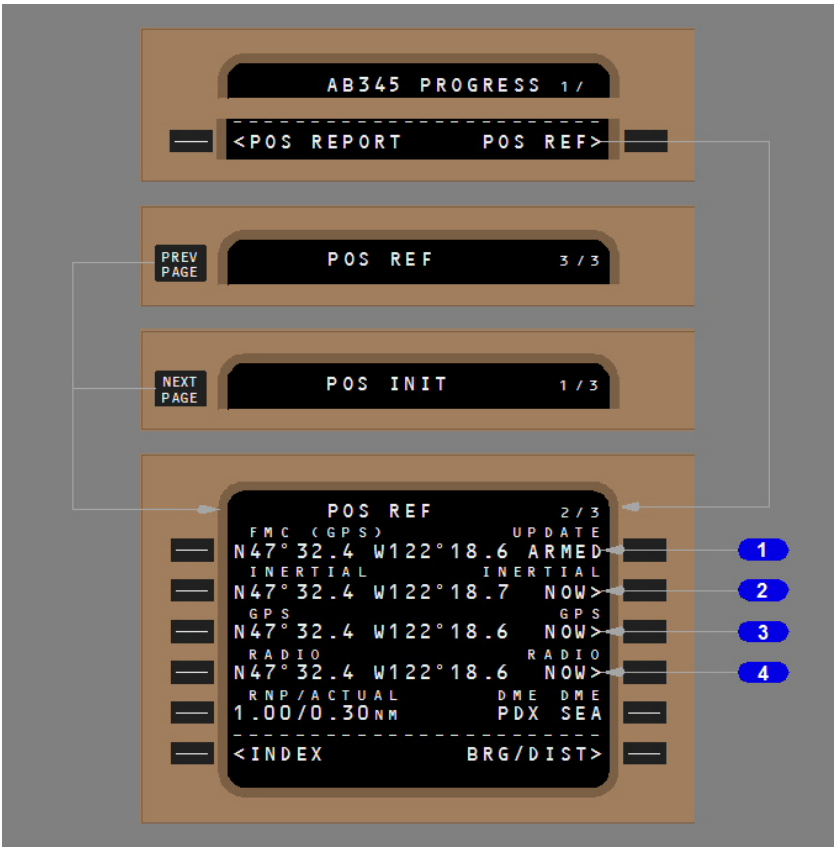
In-Flight Position Update

FMC position update can be accomplished on the POS REF 2/3 page in flight.



1 UPDATE ARMED

Pushing the ARM prompt arms the position update function. ARM changes to ARMED. Each of the position update sources have a NOW prompt.

2 INERTIAL NOW

Push—to update the FMC position from the inertial position.

3 GPS NOW

Push—to update the FMC position from the GPS position.

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4 RADIO NOW

Push—to update the FMC position from the navigation radio position.

Progress Pages

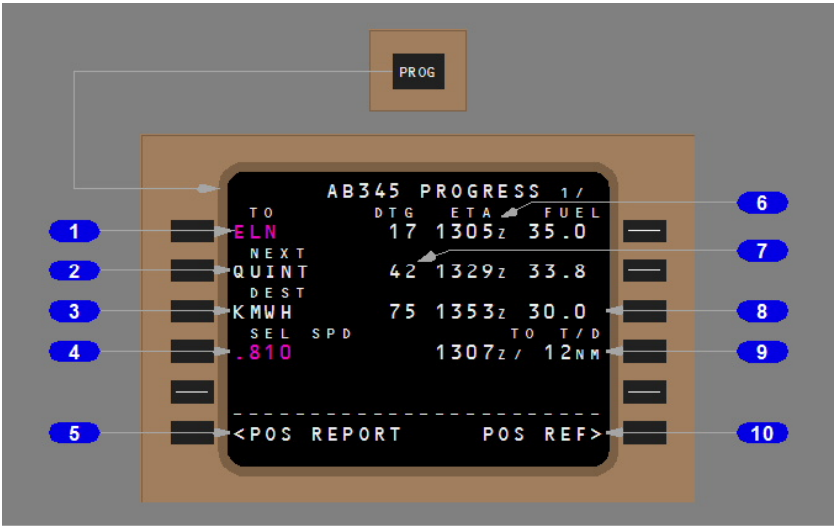
Progress Page 1

The progress page displays general flight progress data. The FMC Communication section of Chapter 5, Communications describes 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 (active and next)
- destination data
- FMC speed
- T/C, T/D, etc.



1 TO

Active waypoint displays in magenta.

Can not be modified.

2 NEXT

Waypoint after TO waypoint displays in white.

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Can not be modified

3 Destination (DEST)

Any waypoint or airport in navigation database, or any waypoint (except along track or latitude/longitude) in the active flight plan can be entered. The line titles are:

- DEST—performance predictions to destination. Default display
- DIR TO FIX—when entered waypoint is not in flight plan. Data is based on flying present position direct to the waypoint
- EN ROUTE WPT—when entered waypoint is in flight plan. Line data are 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.

4 Selected Speed (SEL SPD)

The FMC active command speed displays in magenta.

The active speed mode is the same as 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
- CO SPD—engine out operations at airline specified engine out company speed
- LIM SPD—speed is limited by VMO, MMO, flap limit, or buffet limit
- MCP SPD—MCP speed entered on the MCP IAS/MACH indicator
- VREF +80—for engine out operations during takeoff
- RTA SPD—RTA speed is active.

5 Position Report (POS REPORT)

Push—displays the POS REPORT page.

6 ETA

Estimated time of arrival at waypoint or destination.

7 Distance To Go (DTG)

Distance to go to waypoint or destination.

8 FUEL

Estimated fuel remaining at waypoint or destination.

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9 TO T/D

Data line displays ETA and DTG to line title point.

Data line displays NOW when the airplane is past the climb/descent point when STEP CLB or T/D displays in the line title.

Data line displays NONE when the line title is STEP CLB and the step has not been entered on the CRZ page or the FMC calculates a step climb is not advised.

Line titles are:

- T/C—top of climb
- 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 in Drift Down mode.

10 Position Reference (POS REF)

Push—displays position reference page.

Progress Page 2

Progress page two contains:

- wind data
- fuel data
- static air temperature
- true airspeed

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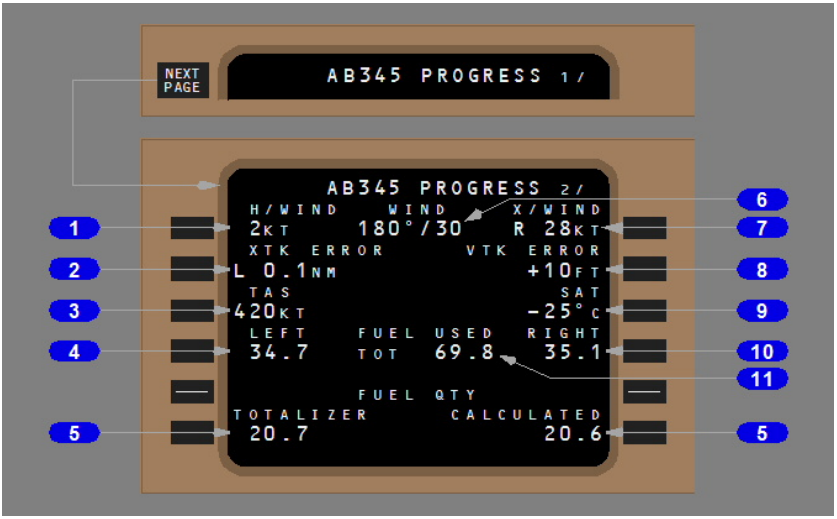
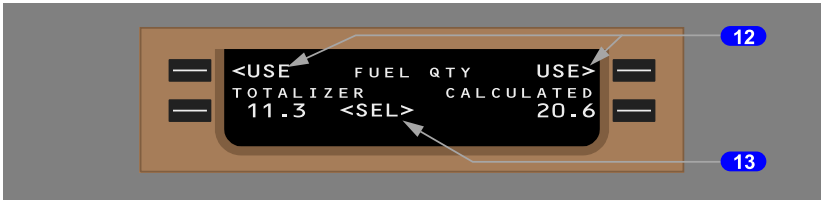
- track error data.



DELETION



1 Headwind (H/WIND), Tailwind (T/WIND)

Displays headwind (H/WIND) or tailwind (T/WIND) component.

Wind component data is relative to the airplane.

2 Crosstrack Error (XTK ERROR)

Displays crosstrack (XTK) error in nautical miles left or right of the active route.

3 TAS

Displays airplane true airspeed.

4 LEFT FUEL USED

Displays fuel used by left engine sensed by fuel flow meters.

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5 Fuel Quantity TOTALIZER, CALCULATED

DELETION

* The fuel remaining line displays two independent fuel quantities, TOTALIZER and CALCULATED. TOTALIZER is the total sum of individual fuel tank quantities computed by the Fuel Quantity Indicating System (FQIS). When the fuel quantity is manually entered on the PERF INIT page, the manually entered quantity displays in 6R, CALCULATED.

TKK to TKR, TKU to TKZ

When no manual fuel quantity entry is made on the PERF INIT page, CALCULATED displays the FMC calculated fuel quantity remaining. Before engine start, the CALCULATED value is set equal to the TOTALIZER. The displayed totalizer quantity can be between 99% and 101% of the actual fuel. After engine start, the CALCULATED fuel quantity is decreased by the fuel flow sensing system (FUEL USED). Sensed fuel flow tolerances may allow up to 40 kgs per hour CALCULATED fuel quantity variation.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF

When no manual fuel quantity entry is made on the PERF INIT page, CALCULATED displays the FMC calculated fuel quantity remaining. Before engine start, the CALCULATED value is set equal to the TOTALIZER. The displayed totalizer quantity can be between 99% and 101% of the actual fuel. After engine start, the CALCULATED fuel quantity is decreased by the fuel flow sensing system (FUEL USED). Sensed fuel flow tolerances may allow up to 73 kgs per hour CALCULATED fuel quantity variation.

After fuel jettison or after all engines are shut down, CALCULATED resets to the totalizer system fuel quantity.

6 WIND

Displays current wind direction and speed referenced to true north.

7 Crosswind (X/WIND)

Displays left (L) or right (R) crosswind component relative to airplane heading.

8 Vertical Track Error (VTK ERROR)

Displays vertical path (VTK) error above (+) or below (–) vertical path.

9 Static Air Temperature (SAT)

Displays outside static air temperature.

10 RIGHT FUEL USED

Displays fuel used by right engine sensed by fuel flow meters.

11 FUEL USED Total (TOT)

Displays sum of the LEFT and RIGHT fuel used values.

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12 USE

Push—selects method to calculate fuel quantity, either TOTALIZER or CALCULATED.

When USE is selected:

- it is used for performance computation and predictions
- The other fuel calculation method remains available for USE selection.

DELETION

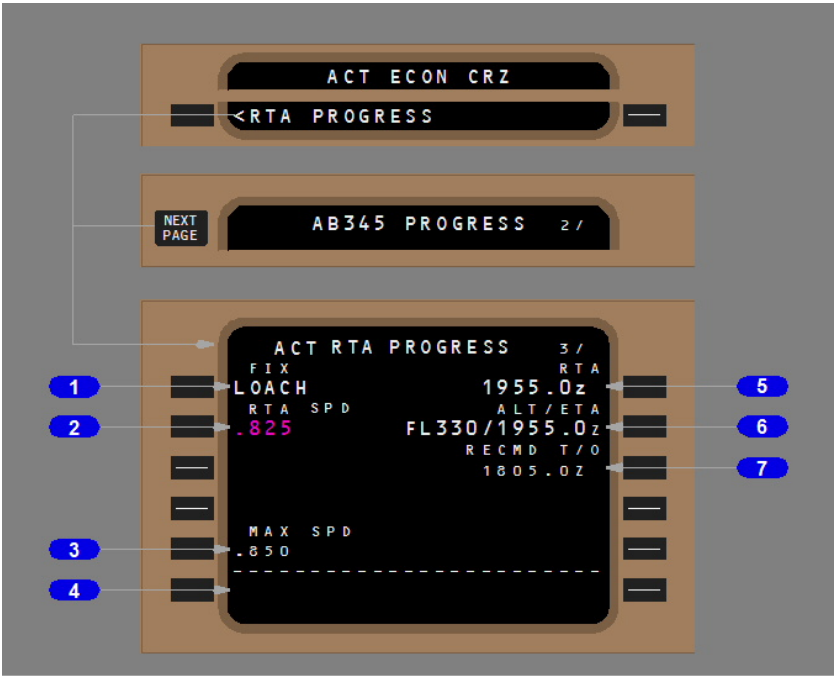
EICASmessage FUEL DISAGREE and USE prompts display when TOTALIZER and CALCULATED values disagree by a significant amount for 5 minutes.

13 Select <SEL>

<SEL> shows which method is used to calculate fuel quantity, either TOTALIZER or CALCULATED. <SEL> displays next to the fuel quantity being used. TOTALIZER or CALCULATED selected by the USE prompt.

RTA Progress Page 3

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 CRZ page title to RTA CRZ. RTA operates only in cruise.



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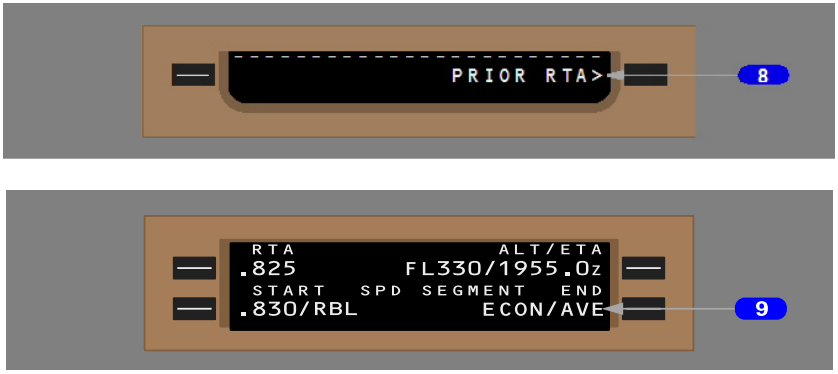

1 FIX

Valid entry is a waypoint in the active or pending active route. Waypoints defined by coordinates must be down selected to the scratchpad, then selected to the FIX line.

Entry by flight crew or data link.

Entry displays boxes in 1R and RTA in the line title and ALT/ETA in 2R line title.

When RTA active, deletion of FIX terminates RTA and resumes ECON. Display returns to boxes.

When RTA not active, deletion of FIX erases a pending RTA MOD. Display returns to boxes.

Displays boxes when an active or modified route exists.

Displays blank if engine out has been selected.

2 Required Time Of Arrival Speed (RTA SPD)

Displays FMC computed cruise speed to accomplish RTA.

Displays blank if no RTA fix or time entered.

3 Maximum Speed (MAX SPD)

Valid entry is Mach .100 to .990; displays in large font.

Deletion of entered value displays default Mach .850 in small font.

4 Displays ERASE when modification pending

Push—displays previous unmodified page, or if no previous active values, deletes RTA in 1R.

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5 Required Time Of Arrival (RTA)

Boxes display after entry of RTA 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.

Entry before takeoff causes recommended T/O time to display in small font.

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 Recommended Takeoff (RECMD T/O)

Displays T/O in line title and dashes until FIX entered.

Displays RECMD T/O in line title on the ground when a performance calculated takeoff time to met an entered FIX displays in the data line.

Displays NOW when no takeoff time has been entered and the current time is later than the calculated time to meet an RTA at ECON speed.

Blanks in flight.

Valid entry is time from 0000.0 to 2359.9. Decimal entry of .0 is optional.

8 PRIOR RTA

Displays when an RTA fix and time exists, and the RTA fix is deleted or another cruise speed mode is selected prior to sequencing the RTA fix.

Push—

- displays previous RTA fix and time
- initiates RTA flight plan modification.

9 Cruise Speed Segment

Displays cruise speed segment start and end waypoints when entered on the Legs page. Valid entries on the Legs page are: Mach, LRC or L, RTA or R, or ECON or E. The cruise speed segment shown ends at AVE and ECON airspeed is resumed. If an end waypoint has not been entered, the cruise speed segment ends at the T/D.

Entry of RTA or R after an RTA fix or entry of ECON or E before an RTA results in the scratchpad message INVALID ENTRY.

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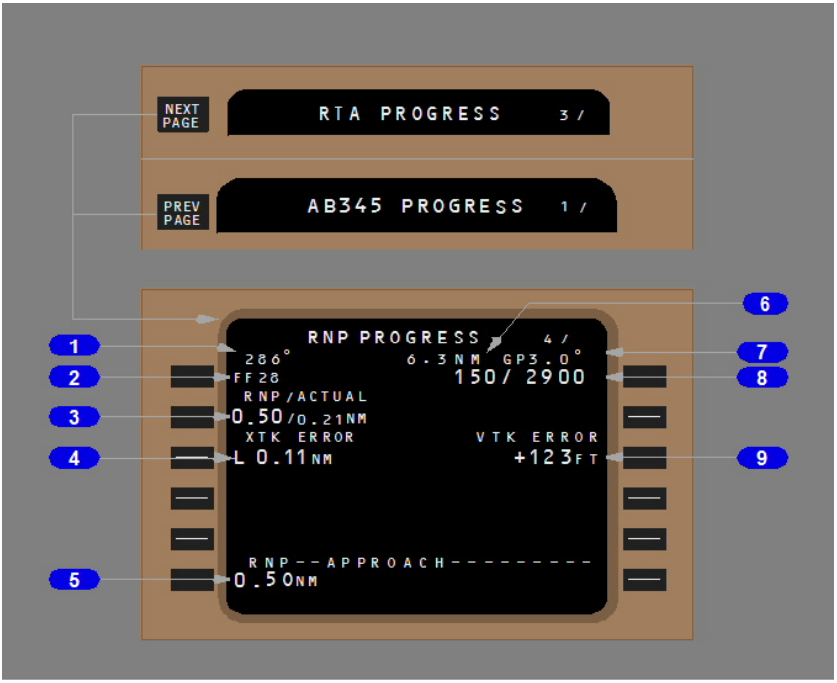
TJA,B,C,D,G,H, TJR to TJW, TKA to TKF

RNP Progress Page 4

Progress page four displays concise RNP information. Some of the information on page 2 has been repeated to display all related RNP information together.



1 Leg Direction

Leg segment data in line title:

- courses—magnetic (xxx°) or true (xxx° T)
- arcs—distance 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 (FMC exits hold when crossing the fix after entry).

Calculated great circle route leg directions may be different than chart values.

Dashes display for an undefined course.

2 Waypoint Identifier

Displays the next waypoint.

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3 Required Navigation Performance and Actual Navigation Performance (RNP /ACTUAL)

Display same as 5L POS REF 2/3. Manual entry displays in large font; propagated to 5L POS REF 2/3 page.

4 Crosstrack Error (XTK ERROR)

Displays present crosstrack error from the desired LNAV course. L or R indicates left or right of course. Blank if error is greater than 99.99 NM.

5 Lateral RNP (Approach)

Displays the lowest applicable RNP (initial, intermediate, or final segment) for the selected approach.

Entry not allowed at 6L. Manual entry at 2L displays in large font.

Displays RNP from navigation database, if available. If not available, displays the default RNP for the approach flight phase from the FMC. Both display in small font.

6 Distance To Go

Displays the distance remaining to the next waypoint.

7 Glidepath

Displays the FMC computed glidepath for the approach.

8 Waypoint Speed/Altitude

Displays waypoint speed or altitude constraints in large font. Displays FMC predicted value in small font when no restrictions have been specified.

9 Vertical Error (VTK ERROR)

Displays present vertical error from the FMC computed glidepath.

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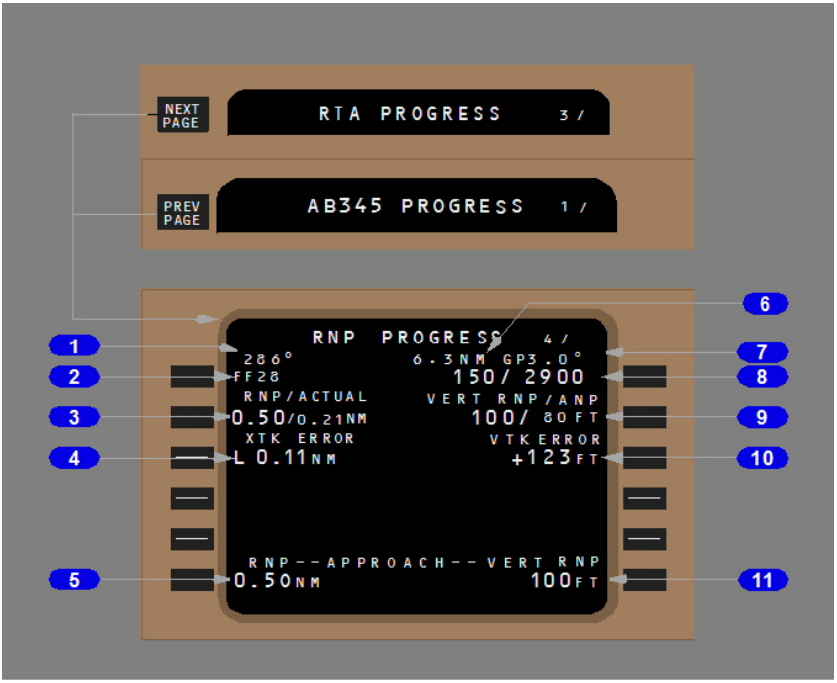
TKK to TKR, TKU to TKZ

RNP Progress Page 4

Progress page four displays concise RNP information. Some of the information on page 2 has been repeated to display all related RNP information together.



1 Leg Direction

Leg segment data in line title:

- courses—magnetic (xxx°) or true (xxx° T)
- arcs—distance 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 (FMC exits hold when crossing the fix after entry).

Calculated great circle route leg directions may be different than chart values.

Dashes display for an undefined course.

2 Waypoint Identifier

Displays the next waypoint.

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3 Required Navigation Performance and Actual Navigation Performance (RNP /ACTUAL)

Display same as 5L POS REF 2/3. Manual entry displays in large font; propagated to 5L POS REF 2/3 page.

4 Crosstrack Error (XTK ERROR)

Displays present crosstrack error from the desired LNAV course. L or R indicates left or right of course. Blank if error is greater than 99.9 NM.

5 Lateral RNP (Approach)

Displays the lowest applicable RNP (initial, intermediate, or final segment) for the selected approach.

Entry not allowed at 6L. Manual entry at 2L displays in large font.

Displays RNP from navigation database, if available. If not available, displays the default RNP for the approach flight phase from the FMC. Both display in small font.

6 Distance To Go

Displays the distance remaining to the next waypoint.

7 Glidepath

Displays the FMC computed glidepath for the approach.

8 Waypoint Speed/Altitude

Displays waypoint speed or altitude constraints in large font. Displays FMC predicted value in small font when no restrictions have been specified.

9 Vertical Navigation Performance

Displays both vertical RNP and ANP for the current leg.

Valid display range for vertical ANP is 0 to 999 feet.

Manual entries are allowed and display in large font.

Valid entries are 10 to 999 feet and may be suffixed with an optional "/".

Entries clear at flight completion.

Values from the navigation database display in small font.

10 Vertical Error (VTK ERROR)

Displays present vertical error from the FMC computed glidepath.

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11 Vertical RNP (Approach)

Displays the lowest applicable vertical RNP for the approach.

Manual entries (entered in 2R) display in large font.

Values from the navigation database display in small font.

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Introduction

The descent phase starts at the top of descent point and continues to the end of descent point. Planning for the descent phase starts during cruise.

The approach phase starts when the airplane is in the descent phase and flaps are out of up. In general, the approach starts no later than sequencing the final approach fix. For a detailed explanation of “on approach” see Approach on page 11.31.2.

Alternates are available from preflight through approach phase of flight and can be selected or updated at any time. Diversion to an alternate can be accomplished during all phases of flight.

The only automatic page change in the descent/approach phases is the VNAV selected page change from cruise to descent at the top of descent.

Early Descent

See Early Descent on page 11.42.31.

Descent

During descent, LNAV is managed using the RTE LEGS and PROGRESS pages, as in the cruise phase. VNAV descent management is accomplished primarily on the DES page.

During descent, the specific page listed below is 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
- ALTN page—manage the selection of alternate airports and diversions.

Altitude Intervention

If an unplanned level-off is required, setting the altitude window to the required altitude causes the airplane to level at the set altitude. VNAV PTH changes to VNAV ALT. The descent can be continued by setting the altitude window to a lower altitude and pushing the altitude selector. If the altitude window is set to an altitude below other altitude constraints, each altitude constraint can be deleted by each push of the altitude selector. Or, all waypoint altitude constraints between the current airplane altitude and the altitude window setting can be deleted by selection of the DES DIR> prompt on the DES page.

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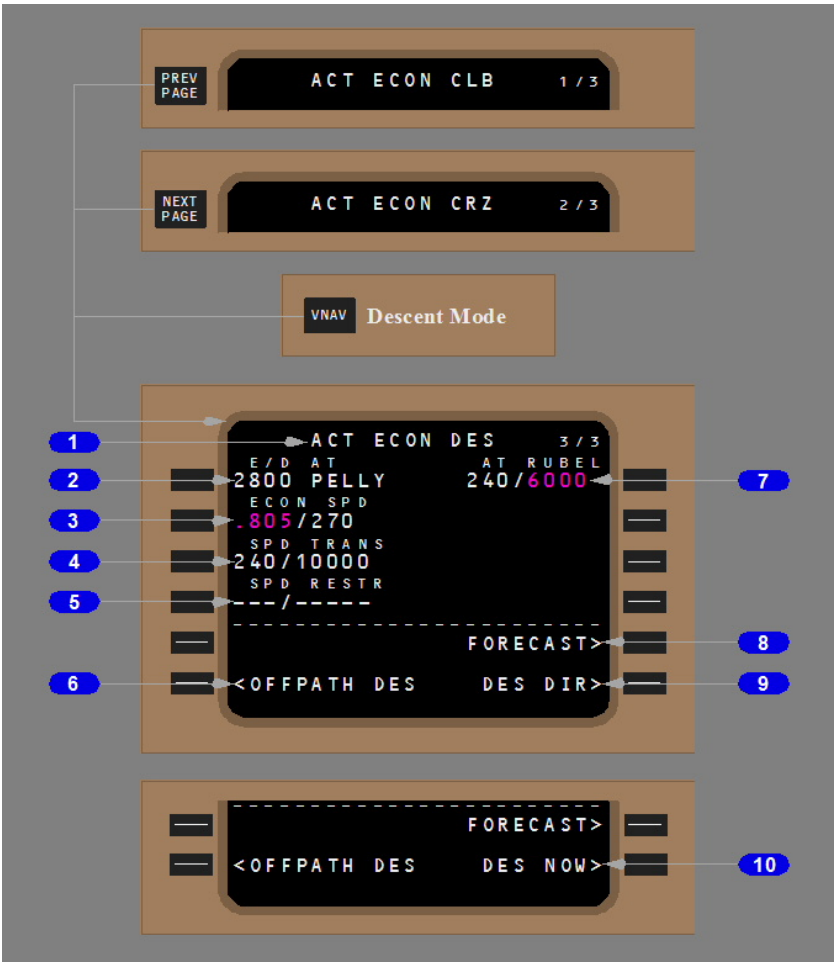
Descent Page

The descent page is used to monitor and revise the descent path. Descent speeds are economy (ECON) and fixed speed (SEL). The default VNAV descent mode is ECON. A fixed speed descent is flown when speed intervention is used or a speed is entered on the DES page. The descent page is blank with DES as the title until an altitude constraint below the cruise altitude is entered.

This page title includes the VNAV speed mode. The ECON mode controls descent speed at the economy speed until reaching a lower speed restriction. The fixed speed mode controls descent speed at the fixed speed until a lower speed restriction is reached.



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1 Page Title

The page title displays active (ACT) or modified (MOD) descent. Usually, the title displays ECON for economy descent. Fixed speed descents modify the title.

The page title displays the type of descent:

- ACT ECON—speed based on a cost index
- ACT MCP SPD DES—MCP speed intervention is selected
- ACT XXXKT DES—fixed CAS descent speed profile
- ACT M.XXX DES—fixed Mach descent speed profile
- ACT LIM SPD DES—speed based on an envelope limiting speed
- ACT END OF DES—airplane has sequenced E/D constraint.

Fixed descent speeds are for:

- a flight crew entered 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 the end of descent altitude and waypoint.

The end of descent point is a waypoint in the descent phase with the lowest altitude constraint.

The altitude displays in magenta when altitude becomes the FMC altitude target.

Page is blank if no E/D point exists.

3 Economy Speed (ECON SPD), Selected Speed (SEL SPD)

Both CAS and Mach values display.

The FMC commanded speed is magenta. Initially, Mach is magenta and CAS is white. Below CAS/Mach transition altitude, CAS is magenta and Mach is white.

Valid entries are CAS or Mach.

ECON SPD displays in the line title when speed is based on cost index.

SEL SPD displays in the line title when flight crew enters speed or when transitioning into a selected speed segment (waypoint speed constraint, SPD RESTR, or SPD TRANS).

4 Speed Transition (SPD TRANS)

The 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. The transition altitude is the point the

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transition speed is active for the destination airport. When no altitude exists in the navigation database, the default of 10,000 feet displays.

Speed displays in magenta when it is the FMC speed target.

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 altitudes higher than E/D altitude and not associated with specific waypoints are manually entered on this line.

Valid entry is a CAS and altitude (example 240/8000). Entry may be deleted.

Magenta when it is FMC command speed.

6 Off Path Descent (OFFPATH DES)

Push—displays the OFFPATH DES page.

7 AT XXXXX

Displays the next waypoint constraint from the RTE LEGS page.

XXXX is:

- the waypoint identifier
- HOLD AT XXXXX
- AT VECTORS
- AT (INTC).

The constraint is speed/altitude. Blank when no constraint exists.

Can be deleted on this page.

VNAV commands the lesser of constraint speed or present performance speed.

Speed and/or altitude display in magenta when they are the FMC target values.

8 FORECAST

Push—displays the DESCENT FORECAST page.

9 Descend Direct (DES DIR)

Push—deletes all waypoint altitude constraints between the airplane altitude and the MCP altitude. FMC cruise altitude is not affected.

Displays in descent phase with altitude constraint between airplane and E/D.

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10 Descend Now (DES NOW)

Push—

- starts a 1,250 feet per minute descent schedule until intercepting the planned descent path
- activates the FMC descent phase.

Displays when the descent phase is not active.

Descent Forecast Page

The 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.

The primary entries are wind direction and speed for up to four descent altitudes, and the altitude that anti-ice is turned on.

1 Transition Level (TRANS LVL)

Displays the transition level.

The transition level can be specified by the arrival procedure. The default transition level is FL 180.

Above transition level, altitudes are in flight levels. Below transition level, altitudes are in thousands of feet.

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Valid entry is an altitude or flight level.

2 Altitude (ALT)

Enter altitude of forecast wind data.

Altitudes and flight levels can be entered in any order. Entries are not sorted.

Execute not necessary.

3 FORECAST REQUEST

Push—transmits a data link request for descent wind data.

4 Thermal Anti-Ice On Altitude (TAI/ON ALT)

Enter the altitude where anti-ice is first turned on during the descent.

5 Wind Direction/Speed (WIND DIR/SPD)

Enter the wind direction/speed for the specified altitude. Initial entry must have wind direction and speed, subsequent entries may have one or the other.

Execute not necessary.

6 Descent (DES)

Push—displays the DES page.

Offpath Descent Page

The offpath descent page allows the analysis of descent performance off the present route of flight, direct to a selected waypoint. Data entered on the page shows clean and drag descent ranges on the page and on the ND. The ranges are based on an entered waypoint and altitude constraint. The range can be used to determine if the altitude constraint can be met in a direct descent to the waypoint.

The FMC puts the last descent waypoint with an altitude constraint into DES TO.

The ECON SPD, SPD TRANS, SPD RESTR, and DES data are the same as the DES page.

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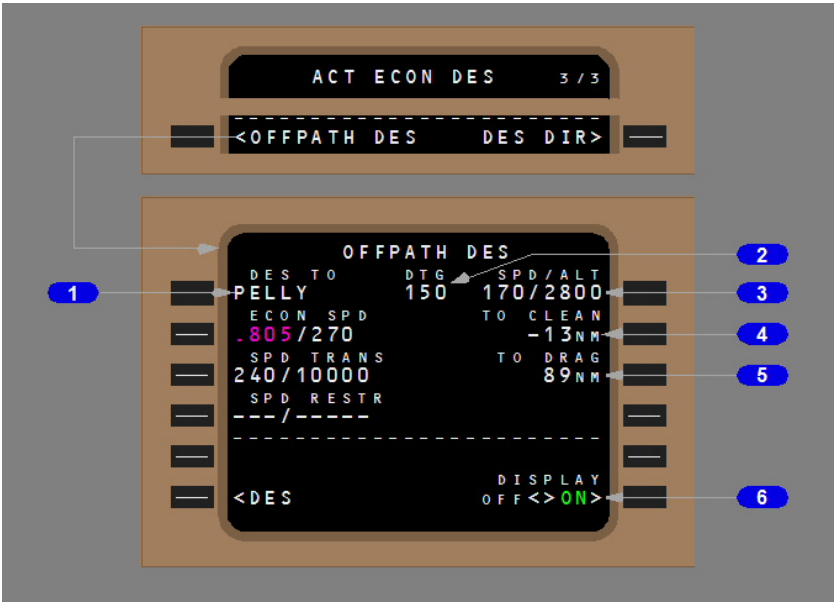

1 Descend To (DES TO)

The waypoint for a direct-to descent. Usually, this is the E/D waypoint from the active route. Manual entry of waypoints on or off of the route are allowed. The DTG calculations are for a descent direct to the selected waypoint.

When within 150 feet of the DES TO altitude for a waypoint other than the E/D waypoint, the display automatically changes the DES TO waypoint to the E/D waypoint from the DES page.

A waypoint is entered for direct-to analysis.

2 Distance To Go (DTG)

Displays the straight line distance to the entered waypoint.

3 Speed/Altitude (SPD/ALT)

Displays the speed/altitude constraint for the entered waypoint.

A manual waypoint entry displays boxes for manual speed and altitude entry.

4 TO CLEAN

Distance to the clean descent circle. The distance is negative when a clean descent is no longer possible.

A clean circle assumes no drag devices are used for descent.

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A direct descent to the DES TO waypoint at a SPD/ALT constraint is possible when the airplane is outside the clean circle. The clean circle displays on the ND when the DISPLAY prompt is ON.

5 TO DRAG

Distance to the drag descent circle. The 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. The drag circle displays on the ND when the DISPLAY prompt is ON and the airplane is inside the clean circle.

6 DISPLAY

Push—alternates between ON and OFF.

ON—displays the clean and drag circles on the ND. The drag circle does not display until the airplane position is inside the clean circle.

OFF—removes the clean and drag circles from the ND.

Selected state is large green font, otherwise small white font.

Automatically changes to OFF within 150 feet of the waypoint constraint altitude.

Engine Out Descent

There are no specific engine out pages for descent. Use the two engine descent planning features and pages.

Approach

During approach, roll and pitch modes usually change to the approach guidance supplied by navigation radios. The FMC continues to calculate and show present position and can supply LNAV and VNAV approach guidance for certain types of approaches when radio navigation is not used.

The RTE LEGS and PROGRESS pages are used to manage the airplane until other approach guidance becomes active. Other pages which support approaches are:

- ARRIVALS page—to select arrival and approach procedures
- APPROACH REF page—to specify approach flap settings and set the approach VREF
- HOLD page—to manage holding patterns.

Holding is described in this section but it can be used during any phase of flight.

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

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destination airport. Prior to 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

The arrivals page allows selection of a runway, approach, approach transition, standard terminal arrival route (STAR) or profile descent, and an arrival transition to the destination airport.The INDEX key accesses the DEP/ARR INDEX and provides arrival/departure data for any other airport in the navigation database. Route 1 and route 2 have separate arrival pages.

Airports are using multiple RNAV/ILS approaches to the same runway. ICAO has developed a naming convention which adds an additional character to the approach name; Z, Y, X, ... in the approach title following the guidance source. The primary approach is identified as the “Z” approach; all subsequent procedures (normally with different missed approach paths) use the alpha characters in reverse order beginning with Y. This change requires approach names with up to eight characters, rather than the current maximum of six, to be encoded in the navigation database.

Selecting Options

Selecting a runway, approach, approach transition, STAR/profile descent, or arrival transition displays <SEL> inboard of the selection and displays MOD in the page title. The other options within the same category are removed from the list. When the modification is executed, <SEL> changes to <ACT>. Selecting another page and returning to ARRIVALS displays all options; the applicable <SEL> or <ACT> prompts display.

When a STAR is selected followed by selection of an approach or runway and a transition exists in the navigation database, the transition waypoints with associated speed/altitude constraints are inserted into the flight plan linking the STAR to the approach or runway. If more than one transition exists, selection of the applicable transition is made under TRANS on the left side of the page. Some STARs serve more than one runway. If a STAR and runway are selected and subsequently a different runway is selected, and if the STAR is compatible with the new runway, the transition waypoints are inserted into the flight plan linking the STAR to the runway.

If a different STAR, runway, or STAR-runway combination is desired, selecting another page and returning to the ARRIVALS displays all options.

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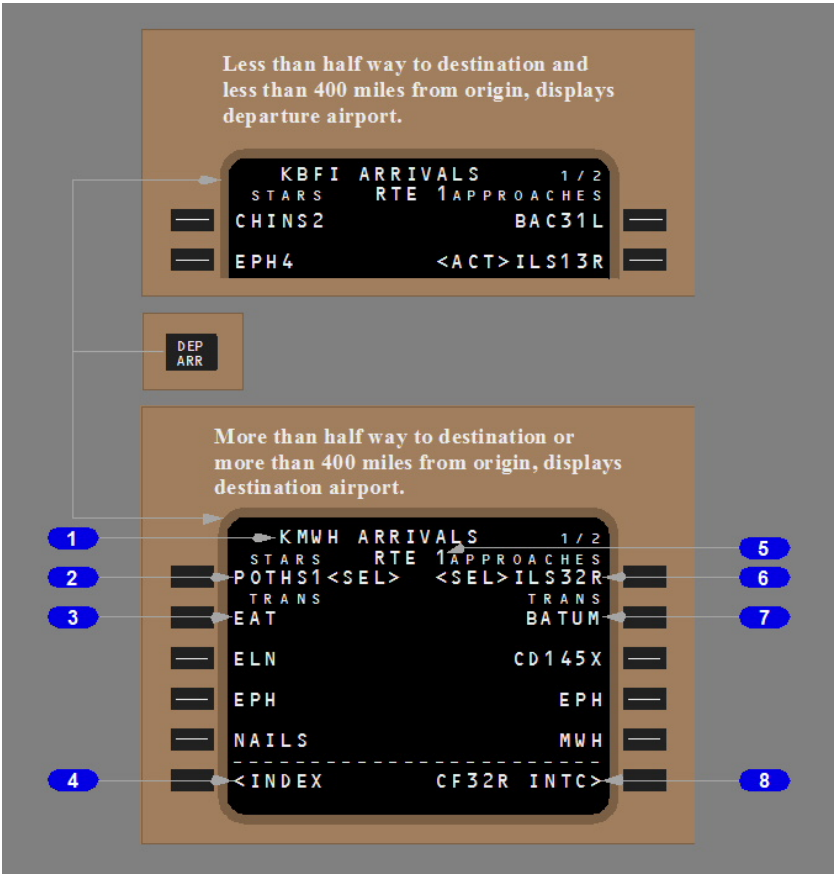
Arrivals Page—IFR Approaches

TJA,B,C,D,G,H,TKA to TKF



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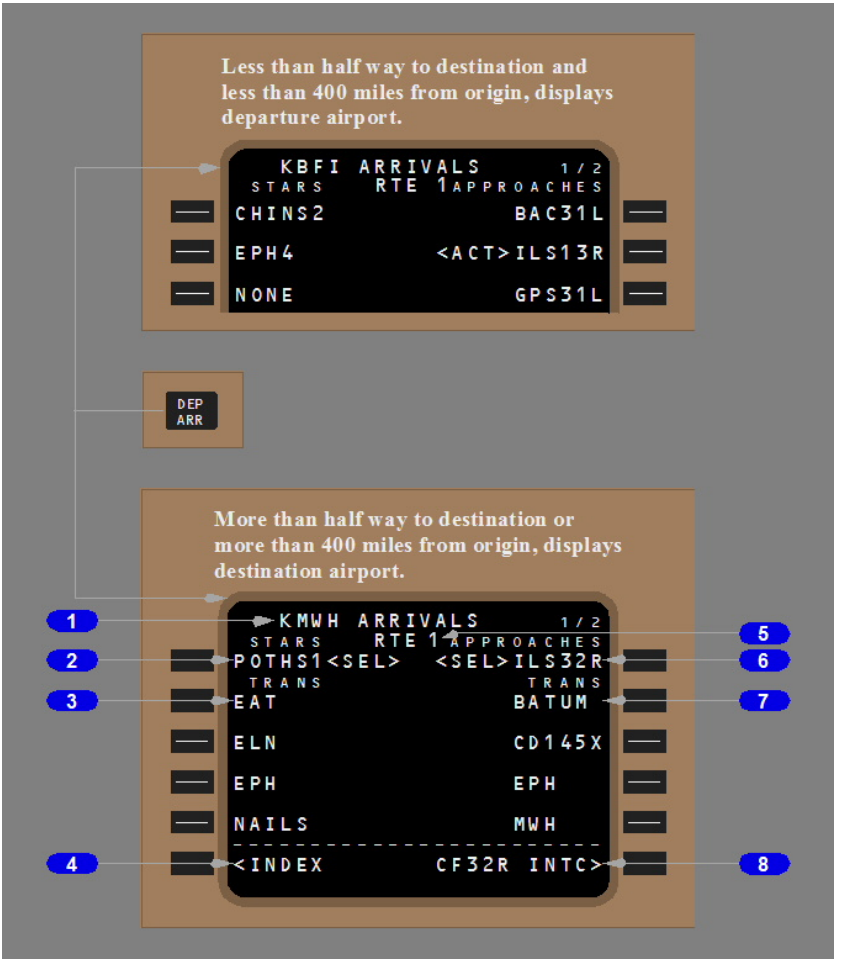
TJR to TJW, TKK to TKR, TKU to TKZ



1 Page Title

The destination airport identifier displays in the title.

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.

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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 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.

4 INDEX

Push—displays the DEP/ARR INDEX page.

5 Route 1 (RTE 1)

Displays the active route number (RTE 1 or RTE 2).

6 APPROACHES

Displays the destination airport approaches.

Selection and execution of an ILS approach autotunes the ILS receivers and displays the course. Selection and execution of a back course (BAC) approach autotunes the ILS and displays the front course. BAC approaches cannot be flown in the MCP LOC or APP mode.

Push—

- selects approach for entry into the route; <SEL> displays; TRANS replaces RUNWAYS
- displays profile descents for the selected approach; deletes all other approaches and runways
- displays INTC prompt for the selected approach
- displays ERASE prompt.

7 Approach Transitions (TRANS)

Displays a list of transitions to the selected approach.

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).

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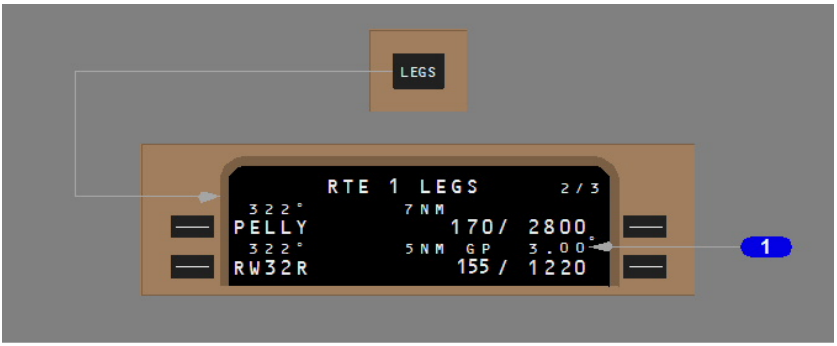
Push—

- selects transition for entry into the route
- deletes all other transitions
- displays INTC prompt for selected transition.

8 Final Approach Fix Intercept (XXXXX INTC)

Selecting the prompt displays a modified RTE LEGS page with an intercept course to the approach transition fix (usually the IAF) for the selected approach.

Arrivals Legs Page



1 Glide Path Display

Displays the glide path angle used by VNAV on final approach to the runway. If the runway was selected as part of a published approach, the displayed angle will be close to the published glide path angle, but may differ slightly.

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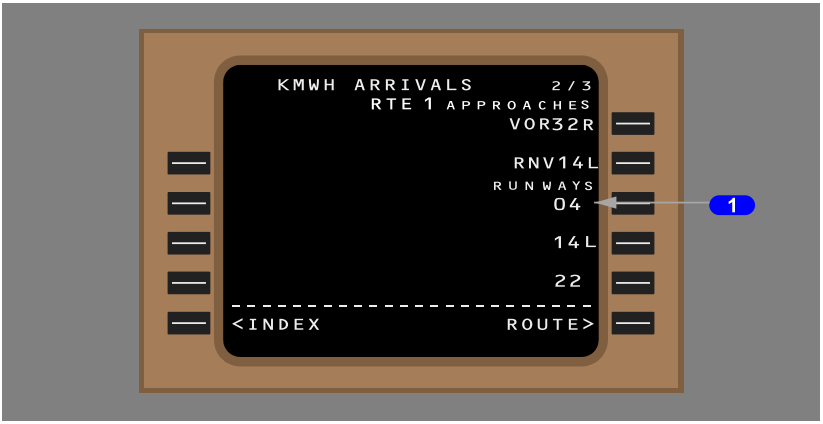
Arrivals Page—VFR Approaches



1 RUNWAYS

Displays list of runways for destination airport.

Push—

- selects runway for entry into the route; <SEL> displays
- deletes previously selected approach
- displays runway extension; and, VFR APPR when enabled in the navigation database
- no longer displays other runways and approaches
- displays approach intercept fix for selected runway.

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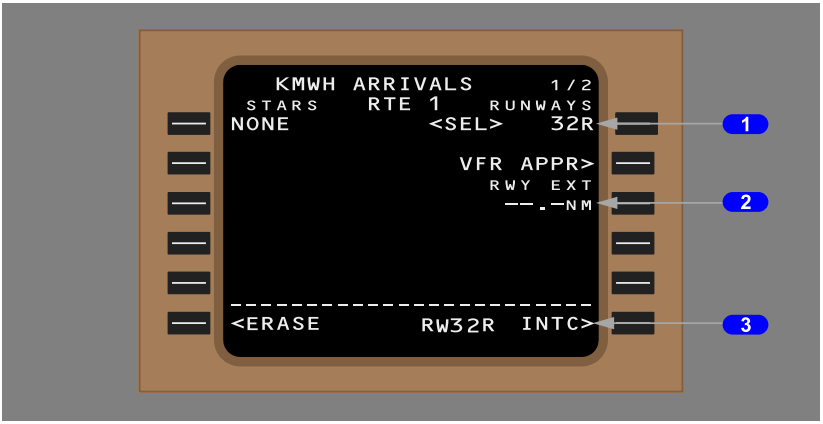
Arrivals Page With Runway Selected



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 elevation.

The VFR approach ends with a runway altitude constraint of 50 feet.

Displays RWY EXT 8.0 NM and FPA of 3.0°.

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.

Entry 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.

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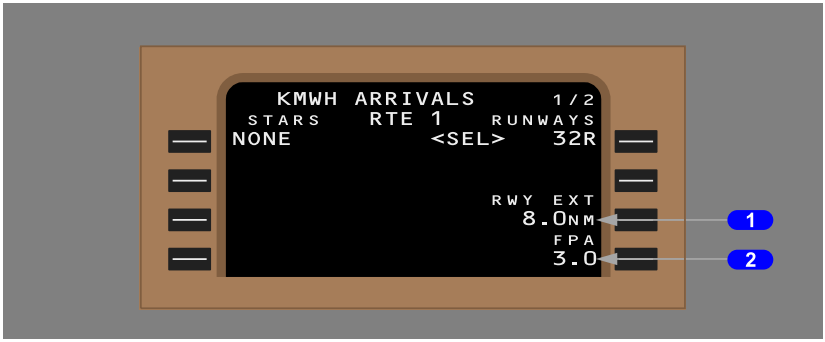
Arrivals Page With VFR Approach Selected



1 Runway Extension (RWY EXT)

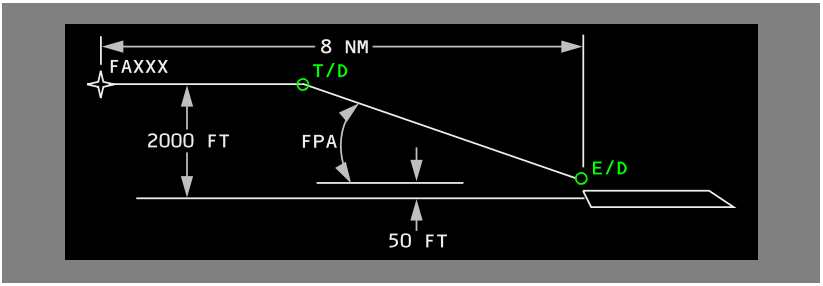
Following selection of a runway, the RWY EXT 8.0 waypoint, FAXXX, displays as part of the VFR APPR. Distance cannot be changed.

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.

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Arrivals Page With Manually Entered Runway Extension

1 Runway Extension (RWY EXT)

Valid entries are from 1.0 to 25.0 miles 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 the waypoint.

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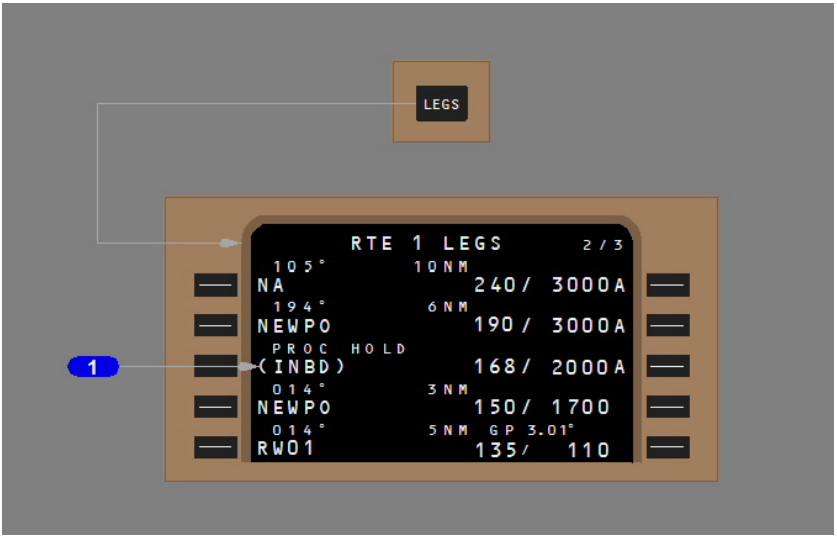
Procedure Hold (in lieu of procedure turn) Legs Page



1 Inbound Waypoint

A conditional waypoint (“INBD”) is created at the end of the procedure turn. This waypoint displays on the ND as a small circle. The next line displays inbound heading and distance to the holding fix. The procedure hold is not displayed on a Hold page.

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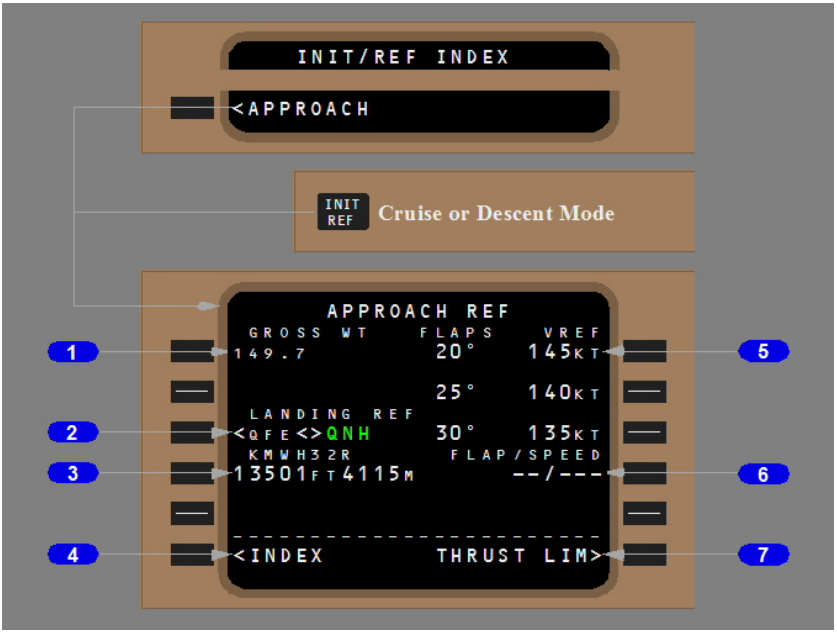
Approach Reference Page

The approach reference page displays approach planning data and approach reference speed (VREF) selection.



1 Gross Weight (GROSS WT)

FMC calculated airplane gross weight usually displays.

Manual entry is allowed in case the FMC calculated gross weight is unavailable or invalid, or to allow previewing recommended approach speeds at other than the calculated FMC gross weight. The manually entered gross weight will become the FMC calculated gross weight when a different page is selected and the APPROACH REF page is reselected. Permanent changes to gross weight result in recalculation of all performance data and may only be made on the PERF INIT page.

Displays boxes when gross weight is not available from the FMC.

Valid entry is XXX.X.

2 Landing Reference (LANDING REF)

Landing reference is selectable between QNH and QFE. Usually, QNH is the operating mode.

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Selecting QFE sets the cabin pressurization schedule, and the destination landing altitude indication to zero altitude. With the landing reference set to QFE, changing the barometric setting from STD to QFE changes the PFD altitude tape background color to green. With QFE selected and climb phase active, changing the barometric setting from QFE to STD causes the landing reference to toggle from QFE to QNH and the green background color is removed.

For QFE operations, see QFE Operation on page SP.10.1.

Toggles between QFE and QNH. The active mode displays in large green font. The inactive mode displays in small white font.

3 Runway Length

The displayed runway reference changes based on distance along the planned FMC route. The destination airport is the reference when the present position is more than halfway or more than 400 NM from the origin airport along the planned route. The origin airport is the reference when the present position is less than halfway or less than 400 NM from the origin airport along the planned route.

Displays the length in feet and meters of the referenced runway.

4 INDEX

Push—displays the INIT/REF INDEX page.

5 FLAPS VREF

A gross weight is necessary for VREF speed calculation. Push the applicable line select key to select the correct VREF speed. The three VREF speeds are based on landing flap setting.

The displayed VREF speeds change based on distance along the planned FMC route and are a function of displayed gross weight, airport altitude and flap settings. The destination airport is the reference when the present position is more than halfway along the planned route. The origin airport is the reference when the present position is less than halfway from the origin airport along the planned route.

Displays the calculated reference speed for flaps 20°, 25°, and 30°.

The display is blank until a gross weight is displayed.

6 FLAP/SPEED

The flap position and VREF speed is entered for landing.

The VREF speed displays on the PFD.

Deletion of the data removes VREF from the PFD.

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7 **Thrust Limit (THRUST LIM)**

Push—displays the THRUST LIM page.

Alternate Airport Diversions

ALTN page 1/2 data aids the flight crew in finding a suitable alternate airport. The page displays four airports in an ETA sequence. Each airport on the list has an XXXX ALTN page with more data. Select the XXXX ALTN page with a caret. ALTN LIST page 2/2 may contain a list of uplinked alternate airports.

Three alternate airport uplinks can be received. ALTN LIST page 1/2 can get an uplink for the entire page or for just the ALTN INHIB line. ALTN LIST page 2/2 can receive an uplink of alternate airport names.

Alternate Page 1/2

The first alternate page displays alternate airport data. An alternate airport can be selected to change the flight plan destination.

The source of alternate airports can be:

- an uplink directly to this page
- automatic selection from the ALTN LIST page
- automatic selection from the navigation database
- manual entry.

Alternate airports automatically selected from the alternate list or the navigation database display in small font. All four alternates display on the ND in cyan. The alternate airport symbols display when the ND is in the plan mode. The selected alternate airport displays at all times on the ND map. Other alternates display on the ND when the ARPT switch is on.

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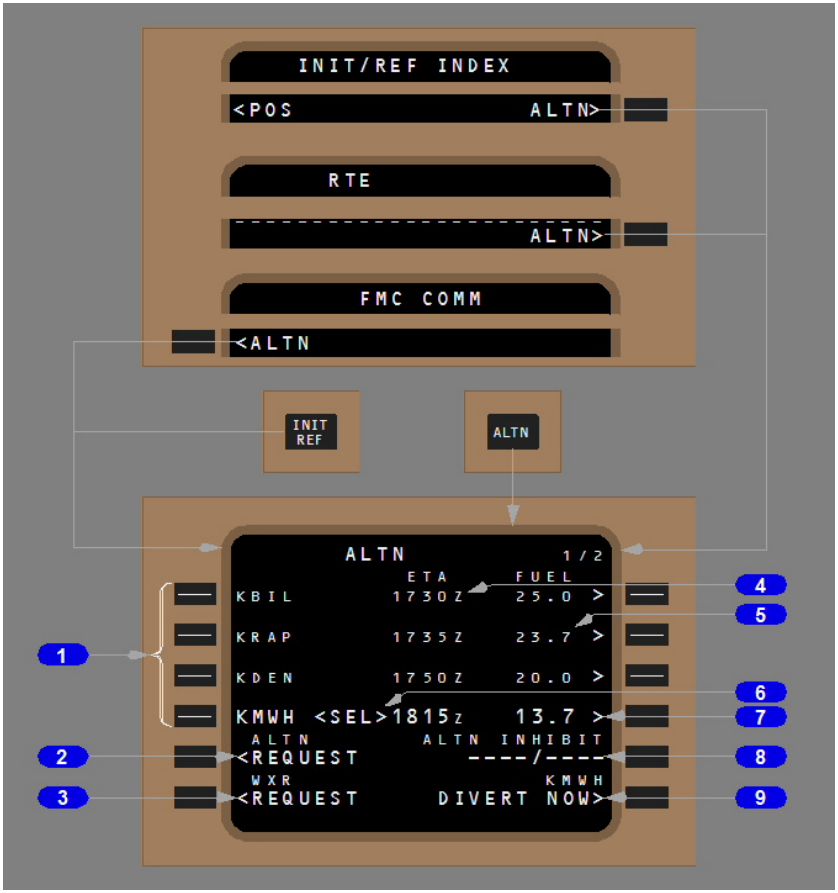

1 Alternate Airports

Displays the identifier of the four alternate airports in ETA order in flight; and, in distance order on the ground.

Valid manual entry is an airport from the navigation database.

A manual entry into a field displaying a small font value overwrites the small font value, but does not delete it from the Alternates Candidates list. After predictions are complete, the overwritten small font value is placed on the list according to ETA order. A manual entry into a field displaying a large font value overwrites the large font value. Manual entries display in large font.

The DELETE function key can be used to remove manually entered alternate airports from the ALTN page.

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2 Alternate Request (ALTN REQUEST)

Push—transmits a data link request for a preferred list of alternates (up to four).

Uplinked airports display in ETA order but are assigned a preference number by the transmitting site. The scratchpad displays the message ALTN UPLINK when the alternate airport data arrives.

3 Weather Request (WXR REQUEST)

Push—transmits a data link request for alternate airport weather data.

Uplinked weather is sent to the flight deck printer.

4 ETA

ETA is calculated based on the routing, altitude, and speed displayed on the XXXX ALTN page. ETA is blank when the airplane is on the ground.

Displays the alternate airport ETA.

Blank when airplane is on the ground.

5 FUEL

Predicted arrival fuel is calculated based on the routing, altitude, and speed displayed on the XXXX ALTN page. The message UNABLE FUEL displays in the FUEL column if the predicted arrival fuel is less than zero.

Fuel values are blank when the airplane is on the ground.

Displays the alternate airport predicted arrival fuel.

6 Selected (<SEL>)

The selected alternate is identified with an <A> or <SEL> to the right of the airport identifier. Usually, the closest alternate is selected and identified with <A>. Manually selecting an alternate places <SEL> to the right of the airport identifier. The selected alternate identifier displays in the line title of the DIVERT NOW prompt.

The FMC selects the alternate airport with the earliest ETA. FMC selected alternates display <A> to the right of the airport identifier.

Entering a new airport into the list of four does not select the new airport.

Use the DELETE function key on a manually selected alternate to remove <SEL>. The automatic selection function selects a new alternate.

7 Alternate Select

Push—displays the XXXX ALTN page for the alternate airport adjacent to the > prompt.

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8 Alternate Inhibit (ALTN INHIBIT)

An airport will not be one of the four alternate airports if entered into the alternate inhibit line.

One or two airports can be entered.

Alternate inhibits can be manually entered or uplinked. The inhibited airports may be uplinked with the ALTN UPLINK or separately. If uplinked separately, the scratchpad displays the message ALTN INHIBIT UPLINK.

Valid entries are airports from the navigation database.

9 DIVERT NOW

Selecting DIVERT NOW displays the route from the present position to the selected alternate using the route displayed on the XXXX ALTN page for the diversion airport. The details of the route can be confirmed or modified before the diversion is executed.

Execution of the diversion:

- changes the route destination airport
- includes the route modification into the active flight plan
- deletes all parts of the original route that are not part of the diversion
- if a descent path exists, deletes all descent constraints (the scratchpad message DESCENT PATH DELETED displays when DIVERT NOW is selected).

After a divert is executed the XXXX ALTN page is not updated until all CDUs are selected off of the XXXX ALTN page.

Push—

- makes an LNAV route modification for a divert to the selected alternate
- displays the MOD XXXX ALTN page for the selected alternate
- displays SELECTED in place of DIVERT NOW
- blank on ground
- blank in the air when a diversion is not permitted.

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Alternate List Page 2/2

The second alternate page displays a list of previously uplinked alternate airports. The alternates on the ALTN 1/2 page are selected from this list or from the navigation database when a list does not exist.

1 Alternate Airports List

These four lines contain up to 20 airports from which alternates can be selected and displayed on ALTN page 1/2 when preferred uplinked airports do not use all four lines.

The list is uplinked directly to this page. No manual entry is allowed. Manual airport entries are accomplished on the ALTN 1/2 page.

2 Alternate List Request (ALTN LIST REQUEST)

Push—transmits a data link request for an alternate airport list uplink.

3 INDEX

Push—displays the INIT/REF INDEX page.

4 Alternate List Purge/Confirm (ALTN LIST PURGE/CONFIRM)

When no list exists, alternate airports can be selected from the navigation database.

Selecting the PURGE prompt arms the purge function and displays a CONFIRM prompt before the list is deleted.

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Push—deletes all airports from the list.

A new list must be uplinked after a purge.

XXXX Alternate Page

Each of the four alternate airports displayed on the ALTN page 1/2 has a related XXXX ALTN page. The XXXX ALTN pages display specific data about alternate airports, the route used for a diversion, and the conditions on which the ETA and fuel calculations are based. All data on the page is related to the alternate airport displayed in the page title.

Three route options to the airport can be selected:

- DIRECT TO—— direct to alternate
- OFFSET—flight plan route with an offset
- OVERHEAD—flight plan route to a waypoint, then direct to alternate.

The selected route option has an effect on ETA and fuel remaining. It is identified by <SEL>. Selection of a route option for one alternate selects the same route option for the other three alternates.

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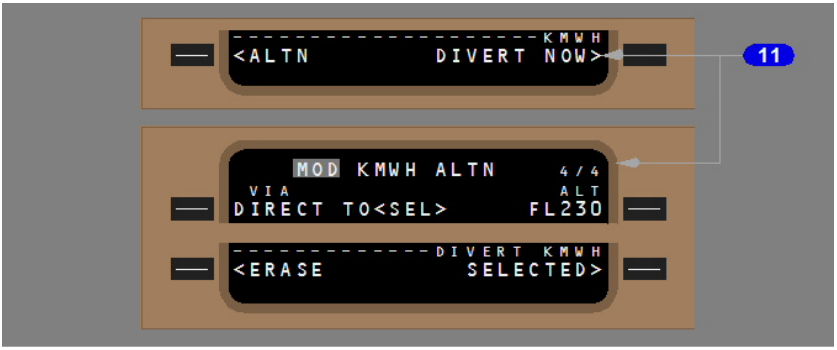

1 VIA DIRECT TO

Push—selects DIRECT TO route option.

All flight plan waypoints are deleted.

2 VIA OFFSET

Push—

- with scratchpad empty, selects OFFSET route option
- with offset data in scratchpad, enters offset data. Does not select offset option.

Entry and exit to the offset is the same as for the RTE page offset. Flight plan waypoints are retained.

3 VIA OVERHEAD

Push—

- with scratchpad empty, selects OVERHEAD option
- with overhead data in scratchpad, enters overhead data. Does not select overhead route option.

Displays active waypoint in flight plan.

The waypoints up to the selected or entered overhead waypoint are retained, then routing is direct to the alternate airport. All waypoints after overhead waypoint are deleted.

Enter any waypoint in the active or modified route.

4 Engine Out (ENG OUT)

This prompt performs the same function as described on the cruise page in the FMC Cruise section. It can be selected before or after the diversion is selected.

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5 Alternate (ALTN)

Push—displays the ALTN 1/2 page.

6 Altitude (ALT)

Entry of any valid altitude or flight level into this line causes a recomputation of ETA and arrival fuel. Altitude entries do not become part of the diversion modification. Altitude entries apply to all four alternates.

Displays the altitude for which ETA and arrival fuel are calculated.

The scratchpad message UNABLE ALT displays if the entry is above maximum altitude or the top of climb point for divert is after top of descent point for divert.

7 Speed (SPD)

Entry of speed or Mach number into this line causes a recomputation of ETA and arrival fuel. Speed entries do not become part of the diversion modification. Speed entries apply to all four alternates.

Speed modes available are:

- ECON (economy)
- LRC (long range cruise)
- EO (engine out)
- EO LRC (engine out long range cruise)
- CO (company speed)
- any CAS or Mach.

8 WIND

Entry of data causes recomputation of ETA and arrival fuel. A wind entry can be made for each of the four alternates. A wind entry applies to only one alternate.

Valid entry is a direction in degrees/speed in knots from 1 to 250.

9 Altitude/Outside Air Temperature (ALT/OAT)

Entry of data into these lines causes a recomputation of ETA and arrival fuel. A separate ALT/OAT entry may be made for each of the four alternates.

Displays the OAT for a specific altitude.

Valid entry is an altitude/temperature in degrees C.

10 Alternate Airport ETA/Fuel (XXXX ETA/FUEL)

Displays calculated airport ETA and arrival fuel based on the selected route, altitude, and speed displayed on this page.

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11 XXXX DIVERT NOW

This prompt performs the same function as described on the ALTN 1/2 page.

Note: After a divert is executed, the XXXX ALTN page data is not updated until all CDUs change to a page other than the XXXX ALTN page.

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° 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° offset angle.

Holding Entry

Airplane track to the holding fix determines the entry type; direct, teardrop, or parallel. To make efficient use of the holding airspace, lateral guidance may direct the initial turn to the holding pattern prior to crossing the holding fix (fly-by). The holding entry path displays on the ND. For all holding entry types, lateral guidance directs the airplane to fly-by or fly-over the holding fix and to remain on the holding side of the inbound holding course. Depending on the entry track for a direct entry, the flight path may extend slightly beyond the displayed outbound holding turn. For teardrop and parallel entries, the flight path remains within the confines of the depicted holding pattern displayed on the ND. Remaining within the prescribed holding airspace requires the airplane to be at holding airspeed at the holding fix.

Hold Page (First Hold)

The hold page is used to enter a holding pattern in the route.

When the flight plan does not contain a holding pattern, pushing the HOLD function key displays the RTE X LEGS page with the HOLD AT line.

Two versions of the hold page are possible:

- an airway or procedure holding pattern

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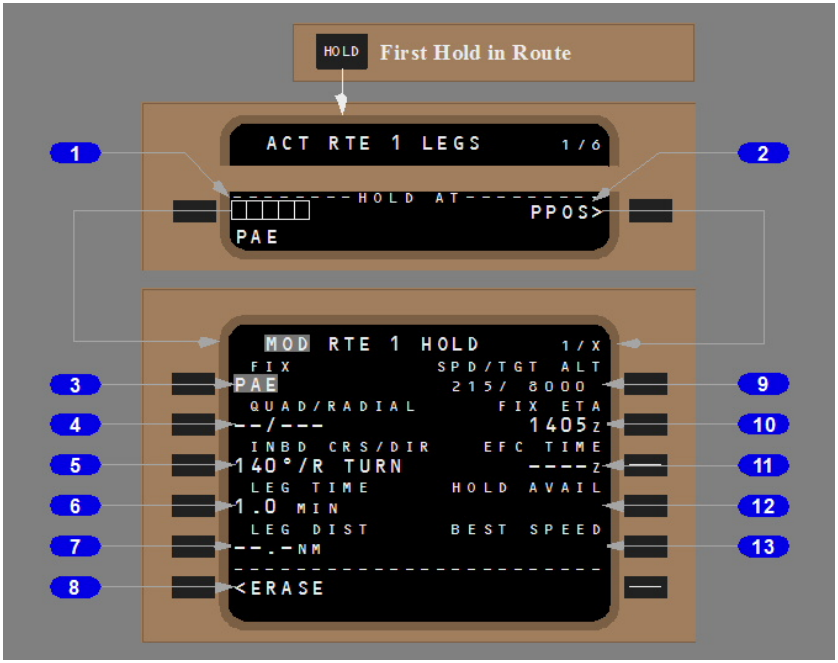
- a flight crew–entered holding pattern.

The holding page displays actual or default data about the holding pattern.

Entries modify the route. Modifications can be erased or executed.

Active holding patterns are magenta on the ND.



1 HOLD AT

Displays boxes to enter the holding fix: a RTE LEGS, database, or pilot-defined waypoint; a navaid or airport identifier; or a FAF already in the flight plan.

Entering a holding fix displays the RTE X HOLD page.

2 HOLD AT Present Position (PPOS)

Push—

- creates a holding pattern at present position
- execution establishes the holding fix at the position when EXEC is pushed and displays RTE HOLD.

3 Holding FIX

Displays the holding fix.

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4 Quadrant/Radial (QUAD/RADIAL)

Normally displays dashes.

Valid entry is X/XXX, XX/XXX, or /XXX. Example: NW/330.

Entry changes INBD CRS/DIR to agree.

5 Inbound Course/Direction (INBD CRS/DIR)

Displays inbound course and turn direction.

Valid entry is XXX (inbound course), XXX/X (inbound course/turn direction), /X or X (turn direction).

Entry changes QUAD/RADIAL to agree.

Displays magenta when the holding fix is the active waypoint.

6 Leg Time (LEG TIME)

Displays 1.0 MIN (minute) at or below 14,000 feet.

Displays 1.5 MIN above 14,000 feet.

Displays dashes when an entry made on LEG DIST line.

Valid entry is X, X.X, or .X.

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).

7 Leg Distance (LEG DIST)

Normally displays dashes. Allows entry of leg distance for hold.

Entry displays dashed on LEG TIME line.

Valid entry is XX.X or X.X.

8 ERASE

Erases all FMC modifications.

9 Speed/Target Altitude (SPD/TGT ALT)

Dashes display or fix speed/altitude constraint from the RTE LEGS page.

Manual entries are in large font.

During cruise, entry of a target altitude lower than CRZ ALT modifies the DESCENT page and displays a T/D. After T/D, the DESCENT page remains active unless a new cruise altitude is entered.

Altitude, or speed and altitude may be entered.

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Note: When descending to a HOLD with VNAV active and the entry altitude is expected to be above the clearance holding altitude, the clearance altitude must be entered in 1R to prevent the airplane from leveling when sequencing the holding fix.

10 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.

11 Expect Further Clearance Time (EFC TIME)

Normally displays dashes.

Valid entry is XXXX (time).

Entry changes performance predictions for the route after holding.

12 Hold Available (HOLD AVAIL)

Displays holding time available before requiring reserve fuel to reach the destination.

13 BEST SPEED

Displays the best holding speed for the airplane gross weight, altitude, and flap setting.

Note: May exceed ICAO limit speed.

HOLD Page (Existing Hold)

When one or more holding patterns exist in the route, push the HOLD key to display the hold page for the first holding pattern. When the hold is the next LNAV event, active commands display in magenta. Holding parameters can be monitored and changed on this page. New holding patterns are added using the NEXT HOLD prompt.

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.

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Following execution of the exit hold, only the remaining portion of the holding pattern back to the holding fix displays. Exit from the holding pattern may occur prior to crossing the holding fix (“fly-by”) if the course to the next waypoint is not closely aligned with the holding inbound course. The exiting flight path will remain within the confines of the protected holding airspace. The exit flight path displays on the ND. At high groundspeed and extreme exit track angles (angle between the course to the next route waypoint and the inbound course to the holding fix), a path discontinuity, typically in the shape of a “Z”, may display on the ND as the exit flight path. In all instances, LNAV provides appropriate lateral guidance to intercept the active leg to the next route waypoint.

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 NEXT HOLD

Push—displays a new hold page for a new holding pattern entry.

2 EXIT HOLD

Push—

- arms a holding pattern exit

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- EXIT ARMED displays in shaded white; when executed, airplane returns to the holding fix via the inbound course for holding pattern exit.

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Introduction

The CDUs can be used as an alternate navigation system if both FMCs fail. The CDUs calculate lateral navigation for the autopilot flight director system (AFDS). Pushing the LNAV switch engages the lateral steering commands. A master CDU is selected and uses ADIRU position data for navigation. VNAV is not available. Autothrottles may be available. The CDU can be used to tune the 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. Active flight plan data from one CDU is copied to the other CDUs. Modifications display on the CDU used for the modifications. The other CDU displays the changes after execution.

All three CDUs receive inputs from the ADIRU. 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 is automatically selected after failure of the left or right CDU.

The autopilot selects a master CDU for lateral steering commands in this order:

1. left CDU if functioning, then
2. center CDU if functioning, then
3. 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, holding patterns, and missed approach waypoints. 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.

Alternate Lateral Navigation

All CDU calculations are based on a great-circle course between waypoints. The CDU does not accept undefined waypoints or conditional waypoints. Complete departure or arrival/approach procedures cannot be manually entered or cross–loaded from the FMC if they contain undefined or conditional waypoints. The CDU makes a discontinuity at those waypoints. However, individual legs of a procedure can be manually entered or cross-loaded if they constitute a great-circle course.

Route Changes

Route changes are made on the ALTERNATE NAVIGATION LEGS page in almost the same manner as 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 displays on the other CDUs when the modification is executed.

Course Reference

The ADIRU 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 left and right CDUs in alternate navigation. The left CDU tunes the left VOR, DME, ADF, and left and center ILS. The right CDU tunes the right VOR, DME, ADF, and right ILS. Manual tuning is accomplished on the ALTERNATE NAVIGATION RADIO page.

Alternate Navigation CDU Pages

The alternate navigation system operates from three CDU pages:

- ALTERNATE NAVIGATION LEGS
- ALTERNATE NAVIGATION PROGRESS
- ALTERNATE NAVIGATION RADIO.

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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 Page Title

If the ACT ALTN NAV LEGS page is modified, MOD ALTN NAV LEGS displays until the EXEC key is pushed.

2 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.

3 Waypoint Identifier

Displays the waypoint by name or latitude/longitude.

Valid entries are waypoint names in the route or latitude/longitude for new waypoints.

4 Distance to Waypoint

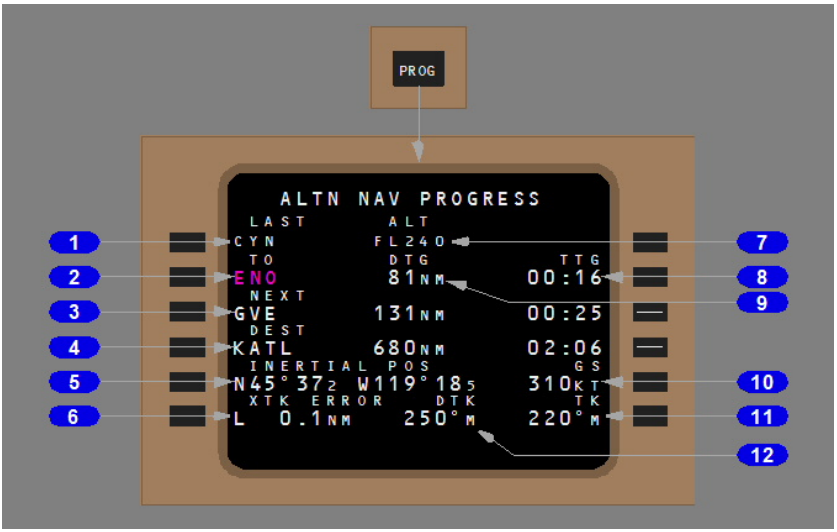
Displays the great circle distance between waypoints.

5 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. The waypoint identifier displays in magenta. This distance and time to go display to the right of the waypoint.

3 NEXT

Displays the waypoint after the TO waypoint. NEXT data displays in white.

4 Destination (DEST)

Displays the identifier for the 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

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- 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 present position along the flight plan route to the entered 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 (INERTIAL POS)

Displays ADIRU present 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 associated waypoint or destination.

9 Distance to Go (DTG)

Displays distance to go to associated waypoint or destination.

10 Ground Speed (GS)

Displays ADIRU 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. If both FMCs fail, access is by the NAV RAD key on the left and right CDUs only. Autotune is not available. The CDUs operate independently for navigation radio tuning:

- the left CDU tunes the left radios and center ILS
- the right CDU tunes the right radios.

1 VOR

Displays last selected VOR frequency. Tuning status displays as manual (M).

Valid entry is VOR frequency or VOR frequency/course.

Entry tunes related DME frequency.

2 Course (CRS)

Displays selected VOR course.

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

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- front course only (a frequency must already be displayed).

Notes:
1. If the ILS was in autotune at the time of the FMC failure, the frequency and course are automatically copied to the ALTN NAV RADIO page.
2. The ILS frequency displays PARK when no frequency is tuned. Deleting the ILS frequency parks a tuned ILS.
3. ILS course and frequency must be entered on the left, center, and right ALTN NAV RADIO page.

The line title is L & C on the left CDU and R on the right CDU.

DME data for the ILS displays when the EFIS control panel ND mode selector is set to APP.

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.

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EICAS Alert Messages

Message	Level	Aural	Message Logic
ADIRU ALIGN MODE	Memo		ADIRU is in align mode.
ADS-B OUT L, R	Advisory		Position data is not available to the transponder. TKN to TKR, TKU to TKZ*
AIR DATA SYS	Caution	Beeper	Information from the air data sources is no longer being combined for display. *
FMC	Advisory		Both FMCs have failed or FMC selector is in L with left FMC failed or in R with right FMC failed.
FMC L, R	Advisory		Affected FMC has failed. TJR to TJW, TKK to TKR, TKU to TKZ
FMC MESSAGE	Advisory		A message is in the FMC scratchpad.
GPS	Advisory		GPS has failed. DELETION
ILS ANTENNA	Caution	Beeper	Two or more ILS receivers are not using the correct antennas for best reception.
INSUFFICIENT FUEL	Advisory		When active route is not in a modified state, FMC estimated fuel at destination is less than the entered RESERVES fuel. *
NAV ADIRU INERTIAL	Caution	Beeper	ADIRU is not capable of providing valid attitude, position, heading, track, and groundspeed.
NAV UNABLE RNP	Caution	Beeper	Navigation performance does not meet required accuracy during all phases of flight. DELETION
SINGLE SOURCE ILS	Caution	Beeper	Both PFDs and NDs are using the same source for ILS information.
TRANSPONDER L, R	Advisory		Affected transponder has failed.
VNAV STEP CLIMB	Advisory		The airplane is 5 minutes past a step climb point and no climb has been started. *

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FMC Messages

FMC messages indicate: degraded system operation, data input errors, or data link status. The messages are categorized as:

- alerting messages
- communications messages
- advisory messages
- entry-error advisory messages.

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.

The EICAS displays the advisory message FMC MESSAGE when there is an FMC alerting message. The EICAS displays the message •FMC when there is an FMC communications message. All FMC messages illuminate the CDU message (MSG) light. Clear the message or correct the condition to cancel the message.

FMC Alerting Messages

FMC alerting messages:

- display in the CDU scratchpad
- cause the EICAS advisory message FMC MESSAGE to display
- illuminate the CDU message light (MSG).

Use the CLEAR key or correct the condition responsible for the message to remove the message. The message is temporarily removed from the scratchpad when manually entering data. The message returns when the data is removed from the scratchpad.

ALIGNMENT REINITIATED—ADIRU alignment has automatically restarted due to airplane motion, or if the flight crew-entered initial position fails the alignment comparison tests.

CHECK ALT TGT—VNAV activates when the airplane is between the MCP and FMC altitudes. VNAV maintains level flight.

CHECK AIRLINE POLICY—after loading a new airline modifiable information file, the FMC determines a parameter is invalid. The FMC uses the loaded value and notifies the flight crew of the difference. This is a maintenance function.

Note: If the scratchpad message is cleared, it does not display again for that load.

DESCENT PATH DELETED—VNAV active and all waypoint altitude constraints defining the descent profile deleted.

Note: This message displays before execution of the modification which deletes the descent path.

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DISCONTINUITY—LNAV active and the route is not defined after the waypoint (except when the waypoint is before a manually terminated leg, such as FM, VM, HM legs).

- FM—a course from a fix to a flight crew entered manual route termination
- VM—a heading leg from a fix to a flight crew entered manual route termination
- HM—a holding pattern to a flight crew entered manual route termination.

DRAG REQUIRED—VNAV active and additional drag required or autothrottle off and less thrust required to maintain the VNAV descent path.

END OF OFFSET—LNAV active and two minutes 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 INERTIAL POSITION—the flight crew-entered present position did not pass one of the ADIRU comparison checks, or the ADIRU is ready to change to navigate mode and has not received a present position entry. Use the CLEAR key to remove this message.

ILS TUNE INHIBIT—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.

INERTIAL/ORIGIN DISAGREE—the airplane is on the ground and one of these conditions exist:

- The inertial position entered on the POS INIT page differs from the position of the origin airport in the active route by more than 6 NM.
- A route is activated and executed containing an origin airport with a position that differs from the ADIRU inertial position by more than 6 NM.

DELETION

INSUFFICIENT FUEL—applies to a pending activation route or to the active route in a modified state and estimated fuel at destination is less than the entered RESERVES value.

LIMIT ALT FLXXX—the flight crew– or FMC–selected altitude is greater than the VNAV limit altitude.

LNAV BANK ANGLE LIMITED—before entering or while flying a curved path or holding pattern, the FMC predicts the LNAV roll command will be limited by thrust or buffet based roll limits.

NAV DATA OUT OF DATE—the clock calendar date is after the active navigation database valid calendar cycle.

NAV INVALID–TUNE XXXX—RNAV or VOR approach procedures must have a specific navaid tuned. It is either not tuned or a valid signal is not being received.

NO ACTIVE ROUTE—LNAV selected and no active route activated.

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NO ROUTE DATA—in ALTN NAV, LNAV selected and the CDU does not have an active lateral route.

PERF/VNAV UNAVAILABLE—VNAV selected and gross weight, cost index, or cruise altitude are not entered.

RESET MCP ALT—2 minutes prior to the top of descent point with VNAV active and MCP not set to altitude below cruise altitude.

RTA FIX DELETED—RTA fix has been deleted from the modified flight plan.

RW/ILS CRS ERROR—

- the airplane is within ILS automatic tuning range and the tuned ILS course does not match the course for the active arrival runway, or
- the FMC is not receiving valid course data from the same ILS the FMC is using for frequency data
- inhibited if scratchpad message ILS TUNE INHIBITED–MCP displayed.

RW/ILS FREQ ERROR—

- the airplane is within ILS automatic tuning range and the tuned ILS frequency does not match the frequency for the active arrival runway, or
- the FMC is not receiving valid frequency data from either ILS
- inhibited if scratchpad message ILS TUNE INHIBITED – MCP displayed.

SINGLE FMC L OPERATION—the right FMC is not operational.

SINGLE FMC R OPERATION—the left FMC is not operational.

TAKEOFF SPEEDS DELETED—selected V speeds are invalid.

THRUST REQUIRED—VNAV active, autothrottle disconnected, and additional thrust required to track VNAV descent path and maintain speed.

UNABLE FLXXX AT RTA FIX—predicted crossing altitude at RTA fix less than FLXXX, but predicted ETA within tolerance.

UNABLE HOLD AIRSPACE—the radius of the holding pattern calculated by the FMC exceeds the FMC maximum protected airspace limits.

UNABLE RTA—RTA not achievable within applicable arrival time tolerance.

UNABLE NEXT ALT—VNAV active and climb not sufficient to comply with waypoint altitude constraint.

VERIFY POSITION—the FMC calculation of airplane present position is based on conflicting data. The possible conflicts are:

- the primary and secondary FMC positions differ by more than the greater of RNP or 0.4 NM for 5 seconds, or
- the difference between the FMC and the navigation aid being used (GPS, DME, VOR, or inertial) positions is greater than 12 NM for 5 seconds.

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VERIFY RNP—POS REF 2/3—the default RNP has changed due to a change in flight phase and the flight crew entered RNP value exceeds the new default RNP value.

VIA OFFSET INVALID—flight conditions invalidate the modification with a divert to an alternate airport via OFFSET.

FMC Communications Messages

FMC communications messages:

- display in the CDU scratchpad
- cause the EICAS communications message •FMC to display
- illuminate the CDU message light (MSG)
- cause the communications aural high–low chime to sound.

ALTN UPLINK—Up to four company–preferred alternate airports and associated data has been received and is available for preview on the ALTN page.

ALTN INHIBIT UPLINK—uplink contains two airports for the ALTN page 1/2 ALTN INHIB line.

ALTN LIST UPLINK—a company list of up to 20 alternate airports has been received and is available on the ALTN LIST page.

DES FORECST UPLINK READY—descent forecast data has been received and is available for loading on the DESCENT FORECAST page.

FLT NUMBER UPLINK—a new flight number has been received and is available on the RTE page 1/X.

INVALID TAKEOFF XXX/YYY—takeoff data for up to six runways or runway intersection pairs has been received but some data for one runway or runway intersection pair (RWXXX/YYY) is invalid.

PARTIAL ROUTE X UPLINK—a new route has been uplinked to the FMC but a portion of the route could not be loaded.

PERF INIT UPLINK—performance initialization data has been received and is available for preview on the PERF INIT page.

ROUTE X UPLINK READY—a new route or route modification has been received and is available for loading on the RTE X page.

WIND DATA UPLINK READY—wind data has been received and is available for loading into the active route.

FMC Advisory Messages

FMC advisory messages display:

- on the CDU scratchpad
- and illuminate the CDU message light (MSG).

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DELETE—DELETE key pushed.

HOLD AT XXXX—a waypoint not contained in the active route is entered into the HOLD AT box on the RTE LEGS page, after selection of the HOLD function key. Selection of HOLD AT XXXX into a RTE LEGS page waypoint line makes a holding fix at the XXXX waypoint.

INVALID ALTN UPLINK—a company–preferred list of alternate airports and associated alternate data has been received; the data is not valid and cannot be displayed.

INVALID ALTN LIST UPLINK—a company list of up to 20 alternate airports has been received; the data is not valid and cannot be displayed.

INVALID FLT NO UPLINK—a new flight number has been received; the data is not valid and cannot be displayed.

INVALID FORECAST UPLINK—descent forecast data has been received; the data is not valid and cannot be displayed.

INVALID PERF INIT UPLINK—performance initialization data has been received; the data is not valid and cannot be displayed.

INVALID ROUTE UPLINK—a new flight plan route or modification to the active flight plan route has been received; the data is not valid and cannot be displayed.

INVALID TAKEOFF UPLINK—takeoff data for up to six runways or runway–intersection pairs has been received; the data is not valid and cannot be displayed.

INVALID WIND DATA UPLINK—enroute wind data has been received; the data is not valid and cannot be displayed.

MAX ALT FLXXX—the altitude entry on any CDU page is above the performance calculated maximum altitude.

NOT ON INTERCEPT HEADING—LNAV selected and the airplane is outside active capture criteria and the present heading will not intercept the active leg.

ROUTE X UPLINK LOADING—a new flight plan route or modification to the active flight plan route has been received and is being loaded after flight crew selection of the LOAD prompt.

STANDBY ONE—the FMC requires more than 4 seconds to display data.

TIMEOUT–RESELECT—communication between the FMC and the CDU has failed. The flight crew must reselect FMC on the CDU MENU page.

UNABLE CRZ ALT—performance predicts a zero cruise time at the entered cruise altitude.

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FMC Entry Error Messages

FMC entry–error messages:

- display in the CDU scratchpad
- illuminate the CDU message light (MSG)
- push the CLEAR key to remove the message before any data can be entered into the scratchpad.

ARR N/A FOR RUNWAY—the runway/approach selected is not compatible with arrival selected.

CRS REVERSAL AT FA FIX—a conflict exists between the default final approach (FA) waypoint (result of a runway or VFR approach selection) and the flight plan before it.

ENG OUT SID MOD—an engine failure is sensed after takeoff before the flaps are fully retracted; the FMC has automatically loaded an available engine out standard instrument departure as a route modification to the active route.

ILS TUNE INHIBITED—MCP—ILS tuning is inhibited with the:

- autopilot engaged, and localizer or glideslope captured
- only the flight director is engaged and either the localizer or the glideslope is captured, and the airplane is below 500 feet radio altitude.

Any attempt to manually change the ILS frequency or select another ILS approach on the CDU displays this message. To make the necessary changes:

- above 1500 feet radio altitude—deselect approach on the MCP
- below 1500 feet radio altitude—select TO/GA

or,

- disengage the autopilot
- turn both flight directors OFF, and
- turn at least one flight director ON.

INVALID DELETE—deletion of selected data is 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 navigation database.

NOT IN DATABASE—data is not in the route or the navigation database.

ROUTE FULL—the route is filled to the allowable capacity.

RUNWAY N/A FOR SID—selected runway not compatible with SID.

TAKEOFF FLAPS DELETED—the FMC has deleted the takeoff flap setting on the TAKEOFF REF page. This occurs when the THRUST REDUCTION value is changed to the same value as the takeoff flap setting.

STANDBY ONE—the FMC temporarily prevents further CDU inputs.

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UNABLE TO SEND MSG—the selected data link message cannot be transmitted.

V–SPEEDS UNAVAILABLE—for certain high thrust/low gross weight or low thrust/high gross weight takeoff conditions, FMC V—speeds are not calculated. Adjust gross weight and/or takeoff thrust limit to enable V—speed calculations.

VERIFY RNP ENTRY—the entered RNP value is greater than the default RNP value for the present flight phase or, less than the present Actual Navigation Performance.

CDU Annunciator Lights

These annunciator lights illuminate when certain conditions exists.

DSPY—a flight plan modification is pending and the RTE, RTE LEGS, RTE DATA, or RTE HOLD page not containing the active leg or route segment is displayed, or a VNAV page (CLB, CRZ, or DES) not corresponding to the active VNAV mode is displayed.

OFST—an offset path has been entered and executed.

MSG—an FMC message is waiting to display or is displayed.

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Fuel — Chapter 12

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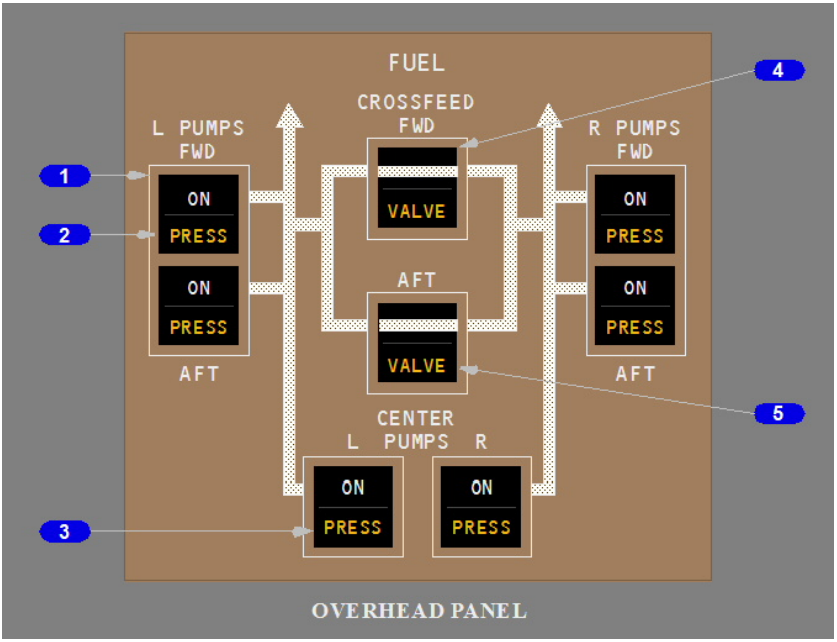
Fuel System



1 Fuel PUMP Switches

ON—the fuel pump is commanded on.

2 Forward and Aft Fuel Pump Pressure (PRESS) Lights

Illuminated (amber)—fuel pump output pressure is low.

3 Center Fuel Pump Pressure (PRESS) Lights

Illuminated (amber)—

- fuel pump output pressure is low with the pump commanded on
- illumination is inhibited when the center tank fuel pump switch is off.

4 Fuel CROSSFEED Switches

On (bar visible)—the crossfeed valve is commanded open.

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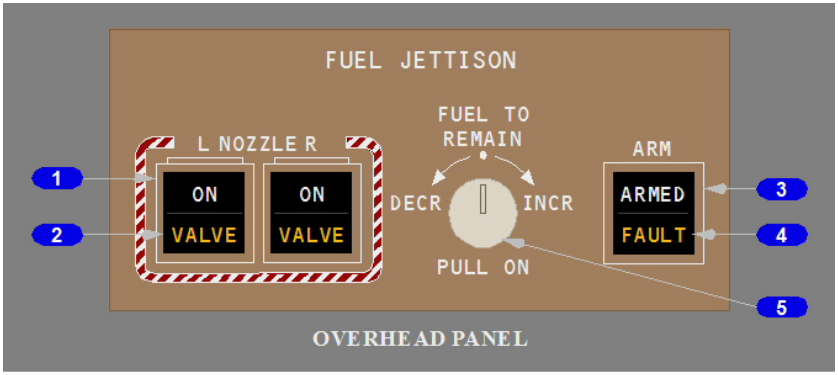
5 Fuel Crossfeed VALVE Lights

Illuminated (amber)—the crossfeed valve is not in the commanded position.

Fuel Jettison System



1 Fuel Jettison NOZZLE Switches

ON— in flight, with the Fuel Jettison Arm switch in ARMED, and the total fuel quantity is greater than the fuel-to-remain:

- the center tank fuel jettison isolation valves, the main tank jettison pumps, and the fuel jettison nozzle valves are commanded by the fuel jettison to jettison fuel
- when both CENTER PUMPS switches are off, fuel will not be jettisoned from the center tank.

2 Fuel Jettison Nozzle VALVE Lights

Illuminated (amber)—the jettison nozzle valve is not in the commanded position.

3 Fuel Jettison ARM Switch

ARMED—

- arms the fuel jettison system
- sets the fuel-to-remain to the maximum landing weight (MLW) quantity.

4 Fuel Jettison FAULT Light

Illuminated (amber)—

- a system fault has occurred
- the fuel jettison system is inoperative.

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5 FUEL TO REMAIN Selector

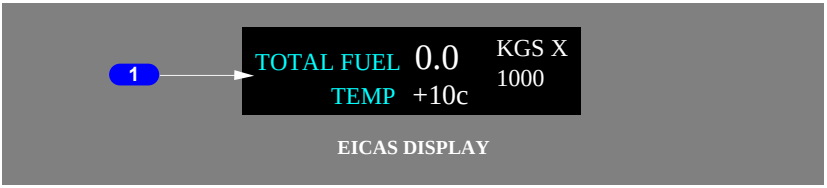
PULL ON—

- changes the mode from MLW to MAN.
- rotate (spring loaded to 12 o'clock position)—
  - (first detent)—decreases (DECR) or increases (INCR) the MAN fuel-to-remain quantity at the slow set rate
  - (second detent)—decreases (DECR) or increases (INCR) the MAN fuel-to-remain quantity at the fast set rate.

Off—sets the fuel-to-remain to the FMC maximum landing weight (MLW) fuel quantity.

Fuel Indications

Normal Fuel Indications



EICAS DISPLAY

1 Normal Fuel Indications

Total fuel quantity (kilograms × 1000).

With fuel alerting improvement:

- (white)—FMC estimated fuel at the destination is sufficient.
- (amber)—FMC estimated fuel at the destination is less than the entered reserves fuel.

Fuel temperature (degrees Celsius).

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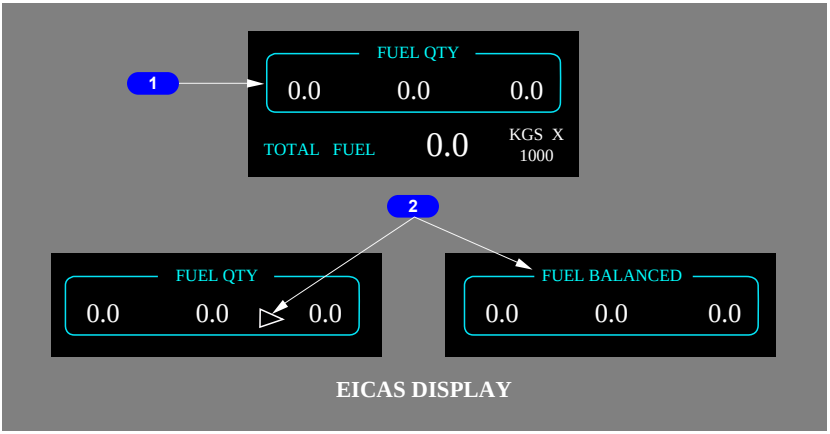
Expanded Fuel Indications



1 Expanded Fuel Indications

The expanded FUEL QUANTITY display (left main, center, and right main tank quantities) appears for any of the following conditions:

- one or both crossfeed valves open
- one or more fuel tank quantity indications are inoperative
- the FUEL IN CENTER alert message is displayed (center tank quantity is amber)
- the FUEL QTY LOW alert message is displayed (low main tank quantity is amber)
- the FUEL IMBALANCE alert message is displayed
- the airplane is on the ground and one or both engine(s) off
- the airplane is on the ground both engines off
- the FUEL FLOW ENG L, R alert message is displayed.

2 Fuel Imbalance Indications

A fuel imbalance pointer is displayed on the expanded fuel quantity display next to the low tank quantity for the following imbalance conditions.

A solid white pointer is displayed if:

- main tank fuel differs more than 500 kilograms
- main tank fuel differs more than 100 kilograms and a crossfeed valve is open.

A solid amber fuel imbalance pointer replaces the white pointer if the FUEL IMBALANCE message is displayed.

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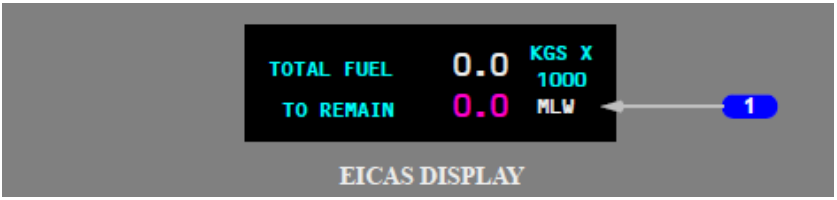
The difference in fuel quantity which causes the FUEL IMBALANCE message to be displayed varies with total main tank fuel quantity.

The fuel imbalance pointer flashes if fuel balancing is going in the wrong direction.

When fuel is back in balance within 100 kilograms between the main tanks – FUEL BALANCED replaces FUEL QTY on the expanded fuel quantity display and flashes for 5 seconds.

Fuel Jettison Indications



1 Fuel Jettison Indications

Fuel to remain (MLW displayed):

- fuel jettison system is ARMED
- the fuel to remain defaults to a fuel quantity that will leave the airplane at maximum landing weight when jettison is complete
- the fuel to remain display replaces the fuel temperature display.

Fuel to remain (MAN displayed):

- fuel jettison system is ARMED
- the FUEL TO REMAIN selector is pulled on
- the quantity to remain can be changed by rotating the FUEL TO REMAIN selector to the slow or fast rate position.

EICAS Fuel Synoptic Display

The EICAS fuel synoptic is displayed by pushing the FUEL Synoptic switch on the Display Select panel (see Display Select Panel on page 10.20.2.)

Fuel flow bars are displayed from a configuration of valve positions, switch positions, and pump status. Actual fuel flow and fuel pressure is not sensed or displayed, therefore fuel flow bars do not represent actual system operation.

The EICAS fuel synoptic display of valve, pump, and fuel flow bars are not included in the MEL. The EICAS fuel synoptic display of valve, and pump positions and status is not required for any flight crew normal or non-normal procedure.

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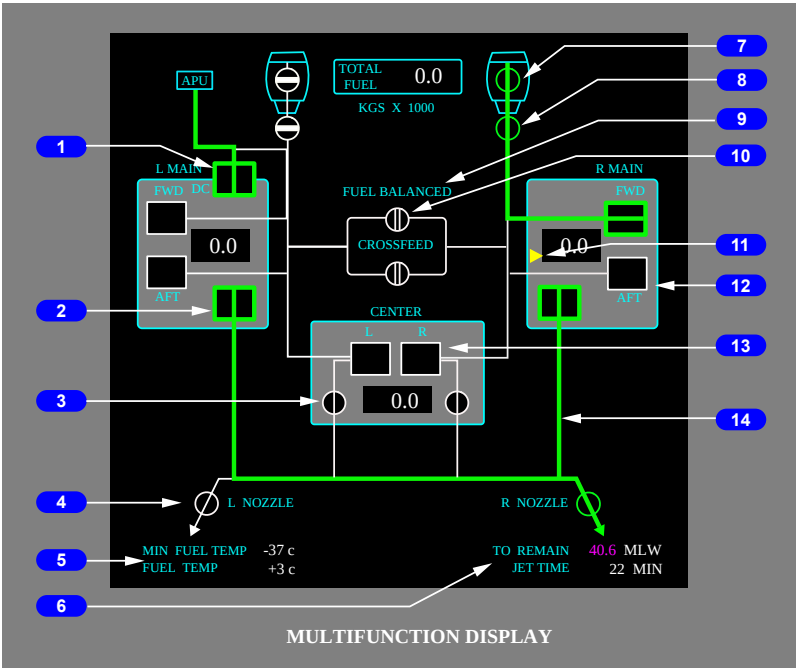

MULTIFUNCTION DISPLAY

1 APU DC Fuel Pump

Status of the APU DC fuel pump.

2 Main Tank Jettison Fuel Pumps

Status of the main tank jettison pump.

3 Center Tank Jettison Fuel Valves

Position of the center tank jettison valve.

4 Fuel Jettison NOZZLE Valves

Position of the fuel jettison nozzle valve.

5 Fuel Temperature

Minimum (MIN) FUEL Temperature (TEMP)—white

- See Performance Initialization Page on page 11.40.32 for description of minimum fuel temperature
- minimum fuel temperature display is invalid—blank.

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FUEL Temperature (TEMP)—temperature of the left main tank fuel

- normal temperature range—white
- high temperature—amber with "+"
- low temperature—amber with "–"
- fuel temperature display is invalid—blank.

6 Fuel Jettision Indications

Fuel TO REMAIN (kg):

- maximum landing weight (MLW)—white
- manual (MAN)—amber.

Jettison (JET) TIME minutes (MIN)—white.

7 Engine Fuel Valves

Position of the engine fuel valve.

8 Spar Fuel Valves

Position of the spar fuel valve.

9 FUEL BALANCED

When fuel balance is re-established, the fuel balance indication flashes for five seconds when the fuel is within 100 kgs of balanced fuel—white.

10 CROSS FEED Fuel Valves

Position of the cross feed fuel valve.

11 Fuel Imbalance Pointer

Points toward the main tank with the lower quantity:

- main tank fuel differs more than 500 kgs—white
- a cross feed swith is on and main tank fuel differs more than 100 kgs—white
- if EICAS advisory message FUEL IMBALANCE is displayed—amber
- if fuel balancing is going the wrong direction—flashing amber.

12 Main Tank Fuel Pumps

Status of the main tank fuel pump.

13 Center Tank Overrride/Jettison Fuel Pumps

Status of the override/jettision fuel pump.

14 Configuration for Fuel Flow Bars

- Pressure flow—green
- Suction flow—amber.

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Position of fuel system valves is displayed as:

- open—green circle with bars in-line with flow
- closed—white circle with bars across flow
- valve in transit—green circle with white bars
- failed open—amber valve open symbol with amber X
- failed closed—amber valve closed symbol with amber X
- valve position data is not available—white circle with no bars
- valve not in commanded position—amber valve symbol with amber X.

Operating status of the main tank fuel pumps, center tank override/jettision fuel pumps. jettison fuel pumps, and the APU DC fuel punp is displayed as:

- powered and low pressure is not detected—green
- not powered or pump status is not available—white
- pump switch is ON and low pressure is detected or pump is failed—amber with amber X.
- power or pump pressure is invalid—gray.

Fuel quantity is displayed as:

- normal indication—white
- if EICAS advisory message FUEL IN CENTER is displayed—amber
- if EICAS advisory message FUEL LOW CENTER is displayed—amber
- if EICAS caution message FUEL QTY LOW is displayed—amber
- if EICAS advisory message INSUFFICIENT FUEL is displayed—amber
- invalid fuel quantity indication—blank

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Introduction

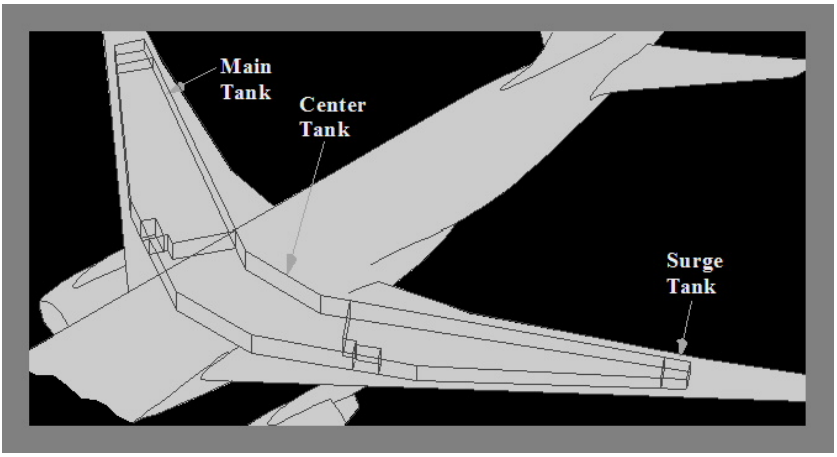
The fuel system supplies fuel to the engines and the APU. The fuel is contained in a center tank, and left and right main tanks.

See Engine Fuel System on page 7.20.14 for a description of the engine fuel system.

Fuel Tank Locations and Capacities

Fuel Tank Locations

-200ER,-300, -300ER



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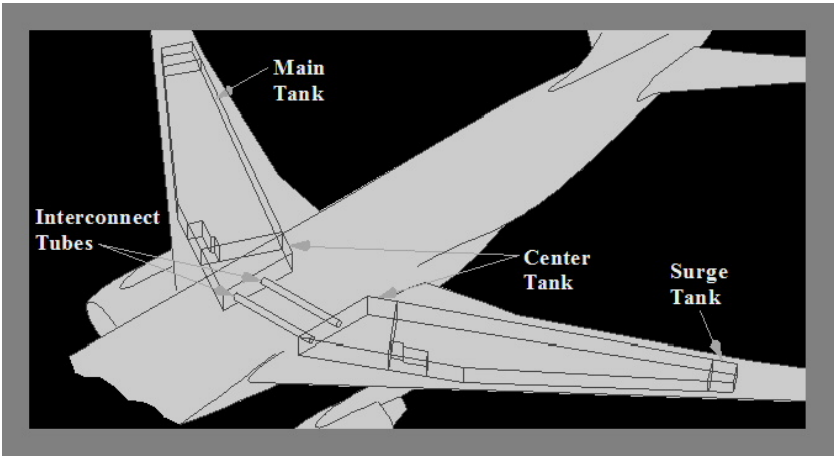
-200



Fuel Tank Capacities

-200

Tank	Liters	Kilograms*
Left Main	35,200	28,300
Right Main	35,200	28,300
Center	46,900	37,700
Total	117,300	94,300
*** Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.**		

-200ER,-300

Tank	Liters	Kilograms*
Left Main	36,200	29,100
Right Main	36,200	29,100
Center	98,790	79,300
Total	171,190	137,500
*** Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.**		

-300ER

Tank	Liters	Kilograms*
Left Main	38,990	31,300
Right Main	38,990	31,300
Center	103,290	82,900
Total	181,270	145,500
*** Usable fuel at level attitude, fuel density = 0.8029 kilograms per liter.**		

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Fuel Quantity

Fuel quantity is measured by sensors in each tank. Total fuel quantity is displayed on the primary EICAS display. Tank quantities and total fuel quantity are displayed on the FUEL synoptic display.

Expanded fuel indications showing the left main, center, and right main tank quantities are displayed when non-normal conditions occur.

Fuel Temperature

Fuel temperature is displayed on the primary EICAS display. The temperature is normally displayed in white. It is displayed in amber when the fuel temperature approaches the fuel freeze temperature entered on the flight management system CDU. During jettison, the TO REMAIN quantity replaces the EICAS display fuel temperature indication.

Fuel temperature and minimum fuel temperature are also displayed on the fuel synoptic display.

Nitrogen Generation System (NGS)

TKK to TKR,
TKU to TKZ

The NGS converts bleed air to nitrogen-enriched air to reduce flammability of center wing tank fuel during all phases of flight and for a brief period after landing. To reduce bleed air demand NGS is shut down for engine out operation. NGS is also shut down when the Equipment Cooling switch is off or a Cargo Fire Arm switch is ARMED.

Fuel Pumps

Each fuel tank contains two AC–powered fuel pumps. A single pump can supply sufficient fuel to operate one engine under all conditions.

The two center tank fuel pumps are override/jettison pumps. The pumps have higher output pressure than the left and right main tank fuel pumps. The center tank override/jettison pumps override the main tank pumps so the center tank fuel is used before wing tank fuel.

The center tank fuel pumps will shut off automatically after 15 seconds of continuous low pressure. Automatic center tank fuel pump shutoff is inhibited during jettison.

When the main tank fuel pump switches are off, the switch PRESS lights illuminate and the EICAS advisory messages FUEL PUMP (L, R, FWD, or AFT) display. When the center fuel pump switches are off, the switch PRESS lights and pump pressure EICAS messages are inhibited.

On the ground, both center fuel pumps operate only when two electrical power sources are available. With only one power source available and the center

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fuel pump switches on, the switch PRESS light on the non-powered side is illuminated and the pump pressure EICAS message is inhibited.

The left main tank contains a DC–powered fuel pump. It has no controls or indicators, other than the fuel synoptic display. The DC pump operates automatically to provide fuel to the APU when AC power is not available and the APU selector is ON.

Surge tanks are provided in each wing, outboard of each main tank. Fuel in the surge tanks and fuel remaining in the refueling manifold is drained into the main tanks.

Fuel Pump Operations

During flight, the FUEL IN CENTER message displays when both center fuel pump switches are off with fuel in the center tank. The FUEL LOW CENTER message displays when one or both center pump switches are ON and center tank quantity is low.

If a center pump has low output pressure, the fuel pump switch PRESS light illuminates and the message FUEL PUMP CENTER (L or R) displays.

TKO,P,Q,R, TKU to TKZ

Center Tank Fuel Scavenge System

The fuel scavenge system uses the main tank fuel jettison pumps to transfer the fuel remaining in the center tank when the center tank pumps are not operating.

To ensure the non-normal procedure FUEL LEAK may be accomplished, fuel scavenge is inhibited for 45 minutes after the FUEL CENTER PUMPS switches are Off.

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF,K, L,M,N

Center Tank Fuel Scavenge System

When the main tank pumps are operating the fuel scavenge system transfers the fuel remaining in the center tank into the main tanks.

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 should effectively operate on suction feed.

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Fuel pressure can be provided from a main tank with operating fuel pumps to both engines by opening the fuel crossfeed valve(s). Continued crossfeed use will result in a progressive fuel imbalance.

Fuel Crossfeed and Fuel Imbalance

The fuel crossfeed system enables fuel to be supplied to either engine from any fuel tank. With both crossfeed valves closed, the left and right fuel tank to engine systems are isolated. With at least one crossfeed valve open in any phase of flight, fuel feed to either engine can be supplied from the opposite fuel tank.

If the fuel quantity in left and right main tanks differ by an excessive quantity, the EICAS alert message FUEL IMBALANCE is displayed.

If a fuel crossfeed valve position does not agree with the switch position, the CROSSFEED switch VALVE light illuminates and the EICAS advisory message FUEL CROSSFEED is displayed.

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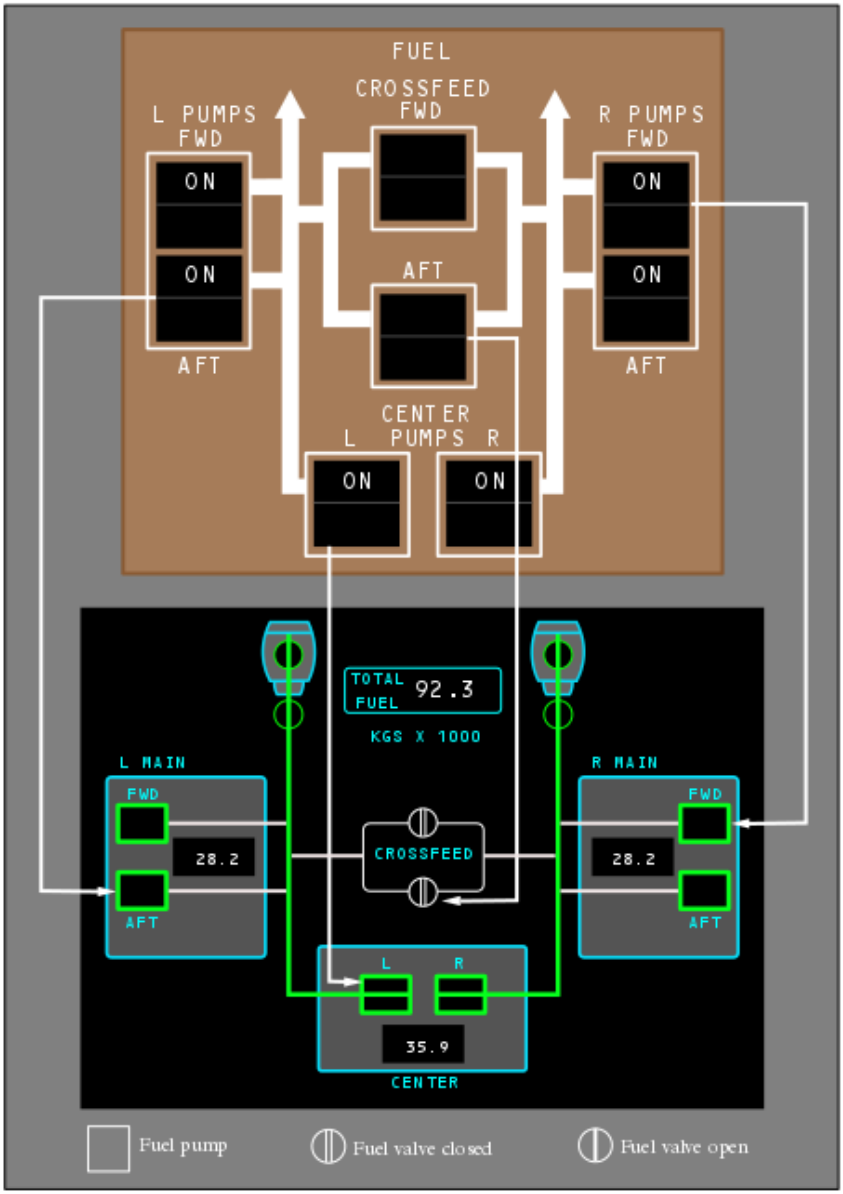
Fuel System Schematic



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APU Fuel Feed

APU fuel is supplied from the left fuel manifold. APU fuel can be provided by any AC fuel pump supplying fuel to the left fuel manifold or by the left main tank DC fuel pump.

On the ground, with the APU switch ON and no AC power available, the DC pump runs automatically. With AC power available, the left forward AC fuel pump operates automatically, regardless of fuel pump switch position, and the DC fuel pump turns off.

In flight, the DC fuel pump operates automatically for quick left engine relight with the loss of both engines and all AC power.

Fuel Jettison

The fuel jettison system allows jettison from all fuel tanks. Fuel is jettisoned through jettison nozzle valves inboard of each aileron. Jettison pumps in the main tanks and override/jettison pumps in the center tank pump fuel overboard through the jettison nozzle valves.

Fuel jettison is initiated by pushing the FUEL JETTISON ARM switch to select ARMED. The jettison system automatically sets the fuel-to-remain to the MLW fuel quantity. The TO REMAIN quantity replaces fuel temperature on the EICAS display.

Pull on and rotate the FUEL TO REMAIN selector to manually decrease or increase the TO REMAIN quantity.

Main tank jettison begins when:

- the FUEL JETTISON NOZZLE switches are pushed ON
- the jettison nozzle valves open, and
- the main tank jettison pumps operate.

If the center tank override/jettison pumps are on, center tank fuel also jettisons. Center tank fuel will not jettison if the center tank override/jettison pumps are off.

The nozzles cannot open on the ground, regardless of switch positions.

In flight, jettison time displays in minutes on the fuel synoptic when the FUEL JETTISON ARM switch is ARMED. Jettison time increases with an increase in altitude. Jettison automatically stops when a value just above the TO REMAIN quantity is reached. The system shuts off the main tank jettison pumps and closes the center tank jettison isolation valves.

-200ER,-300, -300ER

When the airplane is heavy and loaded near the forward CG, fuel is jettisoned from the center tank first to keep CG within limits; main tank jettison pump operation is delayed. The computed jettison time is automatically adjusted to reflect the increased jettison time.

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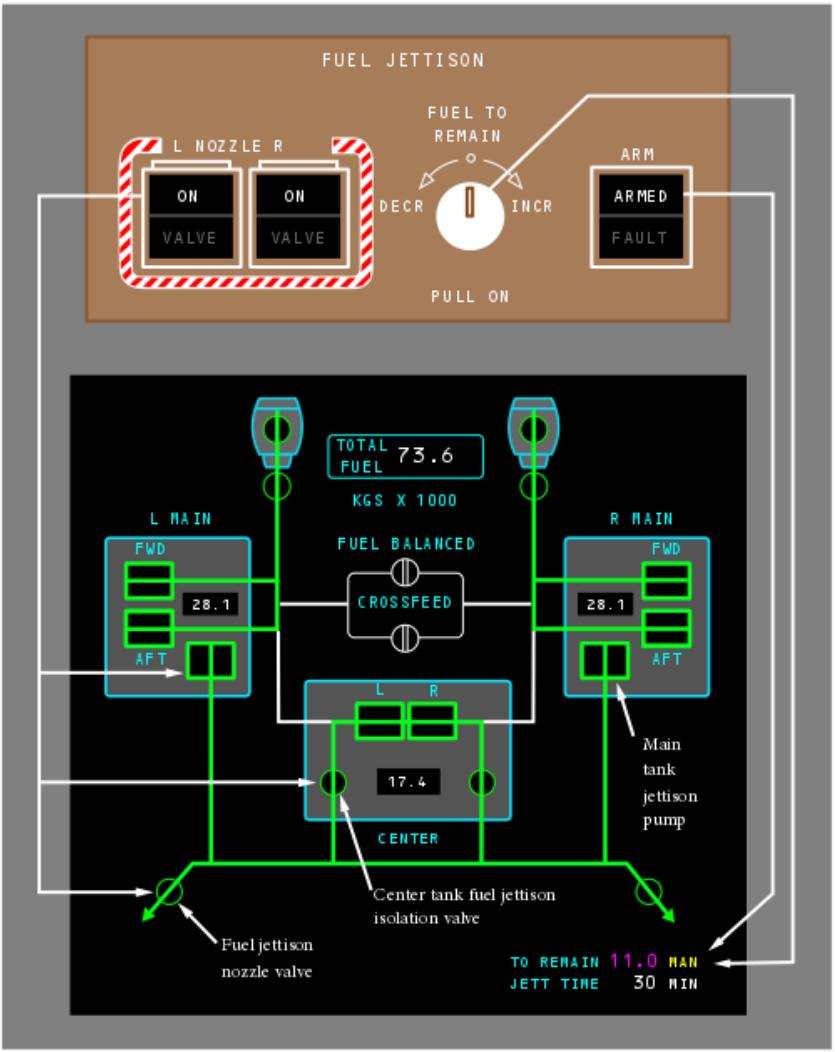
TJA,B,C,D,G,H,
TJR to TJW,
TKA to TKF

At least 5,200 kilograms of fuel remains in each main tank after jettison is complete.

TKK to TKR,
TKU to TKZ

At least 3,800 kilograms of fuel remains in each main tank after jettison is complete.

Fuel Jettison Schematic



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EICAS Alert Messages

Message	Level	Aural	Message Logic
FUEL AUTO JETTISON	Caution	Beeper	Total fuel quantity is less than or equal to the selected TO REMAIN quantity and a nozzle valve is open, or the fuel jettison automatic shutoff is failed.
FUEL CROSSFEED AFT, FWD	Advisory		Crossfeed valve is not in the commanded position.
FUEL DISAGREE	Advisory		Totalizer fuel quantity and FMC calculated fuel quantity disagree.
FUEL FLOW ENG L, R	Advisory		Engine fuel flow is abnormally high. *
FUEL IMBALANCE	Advisory		Fuel imbalance between the main tanks is excessive.
FUEL IN CENTER	Advisory		Both center fuel pump switches are OFF with fuel in the center tank.
FUEL JETT NOZZLE L, R	Advisory		Jettison nozzle valve in not in the commanded position.
FUEL JETTISON MAIN	Advisory		Fuel jettison from the main tanks is inoperative.
FUEL JETTISON SYS	Caution	Beeper	Fuel jettison system is inoperative.
FUEL LOW CENTER	Advisory		One or both CENTER PUMPS switches are ON and center tank quantity is low.
FUEL PRESS ENG L, R	Caution	Beeper	Engine is on suction feed.
FUEL PRESS ENG L +R	Advisory		Fuel pressure to both engines is low on the ground with the engines shut down.
FUEL PUMP CENTER L, R	Advisory		Center fuel pump output pressure is low.
FUEL PUMP L AFT, FWD	Advisory		Left aft or forward fuel pump output pressure is low.
FUEL PUMP R AFT, FWD	Advisory		Right aft or forward fuel pump output pressure is low.

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Message	Level	Aural	Message Logic
FUEL QTY LOW	Caution	Beeper	Fuel quantity is low in either main tank.
-200,-200ER, -300 FUEL SCAVENGE SYS	Advisory		Either main tank is less than 6,400 kgs and the center tank quantity is greater than 200 kgs for 15 minutes.
-300ER FUEL SCAVENGE SYS	Advisory		Either main tank is less than 8,200 kgs and the center tank quantity is greater than 200 kgs for 15 minutes.
FUEL TEMP LOW	Advisory		Fuel temperature is approaching minimum.
FUEL VALVE APU	Advisory		APU fuel valve is not in the commanded position.
* INSUFFICIENT FUEL	Advisory		FMC-estimated fuel at destination is less then entered RESERVES fuel.

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Hydraulics — Chapter 13
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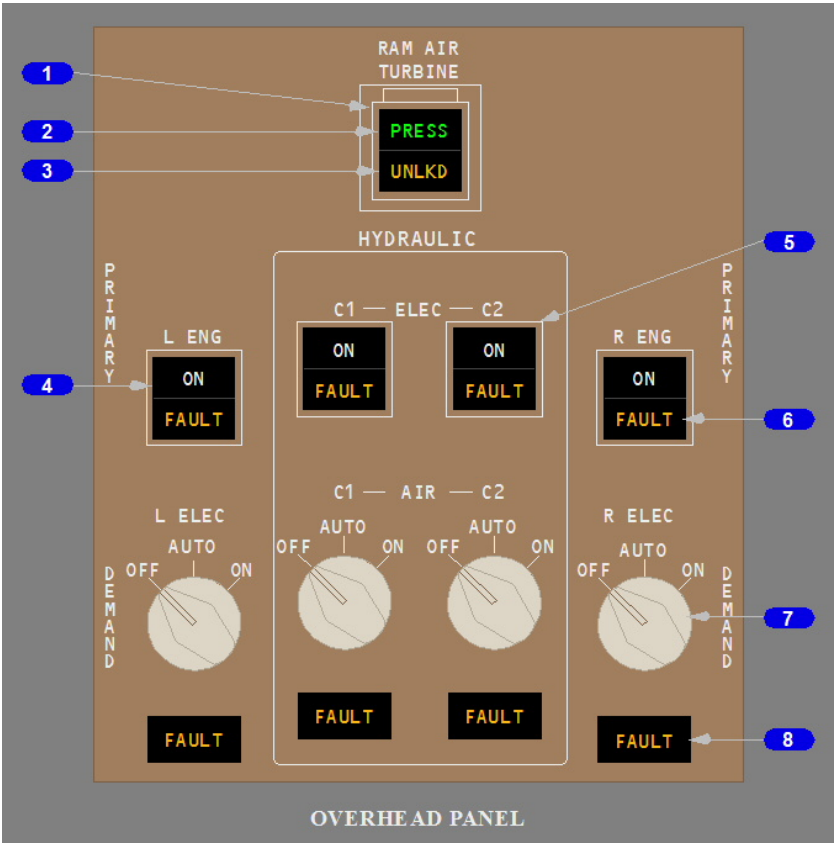
Hydraulic Panel



1 RAM AIR TURBINE (RAT) Switch

Push—deploys the RAT.

2 Ram Air Turbine Pressure (PRESS) Light

Illuminated (green)—

- the RAT is deployed
- center system primary flight control hydraulic pressure is greater than 1,500 psi.

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3 Ram Air Turbine Unlocked (UNLKD) Light

Illuminated (amber)—the RAT is not in the stowed position.

4 Left/Right Engine (L/R ENG) PRIMARY Pump Switches

ON—the engine–driven hydraulic pump pressurizes the related left or right hydraulic system when the engine rotates.

Off (ON not visible)—the engine-driven hydraulic pump is turned off and depressurized.

5 C1/C2 Electrical (C1/C2 ELEC) PRIMARY Pump Switches

ON—

- the electric motor-driven hydraulic pump operates
- pressurizes the center hydraulic system.

Off (ON not visible)—the electric motor-driven hydraulic pump is turned off.

6 Primary Pump FAULT Lights

Illuminated (amber)—

- low primary pump pressure
- excessive primary pump fluid temperature, or
- pump selected OFF.

7 DEMAND Pump Selectors

ON—the pump runs continuously.

AUTO—the pump operates when system and/or primary pump(s) pressure is low, or when control logic anticipates a large system demand.

OFF—the pump is off.

Note: If both air-driven pumps are selected to ON, only air-driven pump C1 operates; the two air-driven pumps cannot operate simultaneously when both are selected ON.

8 Demand Pump FAULT Lights

Illuminated (amber)—

- low demand pump output pressure
- excessive demand pump fluid temperature, or
- demand pump is selected OFF.

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

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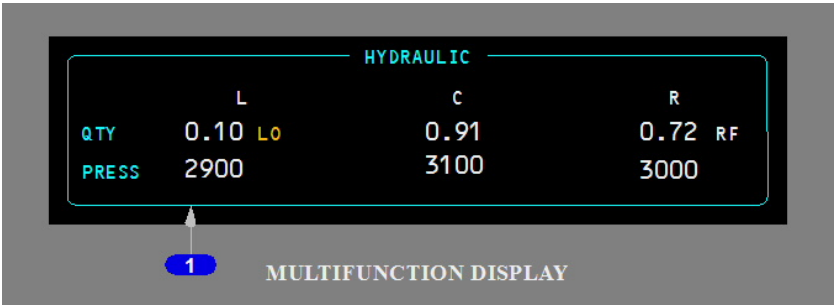
on the display select panel. Display select panel operation is described in Chapter 10, Flight Instruments, Displays.

Status Display



1 Hydraulic Display

QTY—

- displays system reservoir quantity as a percentage of the normal service level (1.00 is the normal service level)
- LO (amber)—displayed when the reservoir quantity is low
- OF (white)—displayed when the reservoir is over-full (inhibited in flight)
- RF (white)—displayed when the reservoir requires refilling (inhibited in flight).

PRESS—displays hydraulic pressure in pounds per square inch of the pump with the highest pressure.

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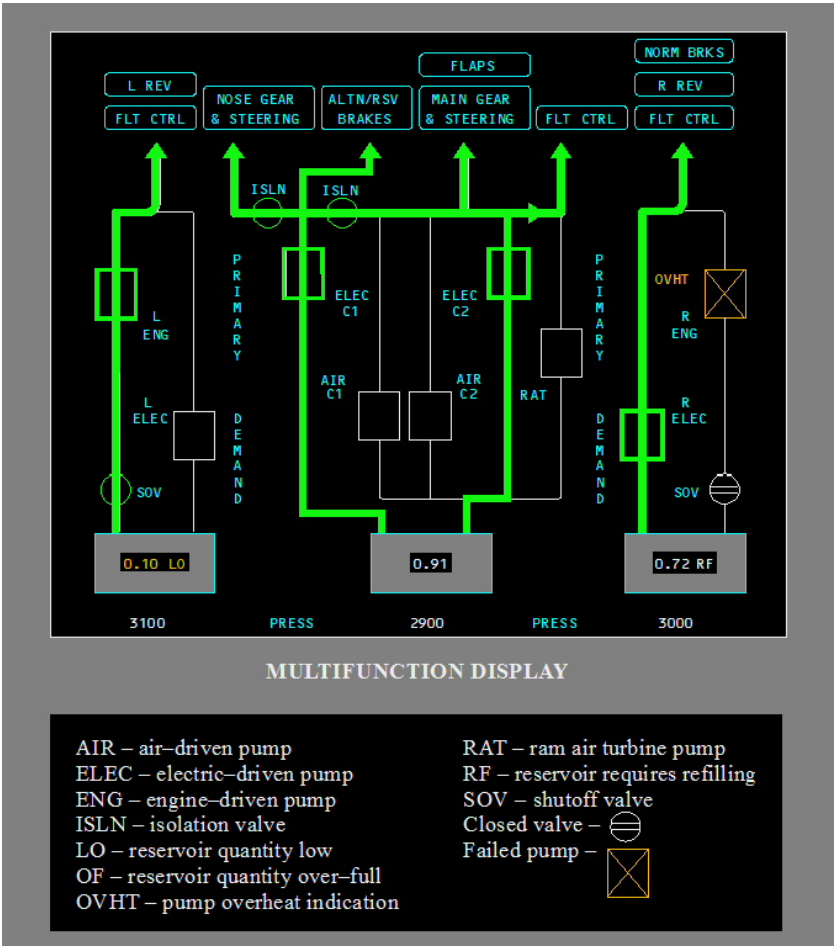
Hydraulic Synoptic Display



Status of the hydraulic pumps, system valves and RAT are displayed as:

- pressurized—wide green line
- unpressurized—thin white line
- flow direction—green arrow head
- hydraulic system valves not in the commanded position-amber X in the circle
- hydraulic system valves with valve sensor data not valid—valve symbol is low intensity white

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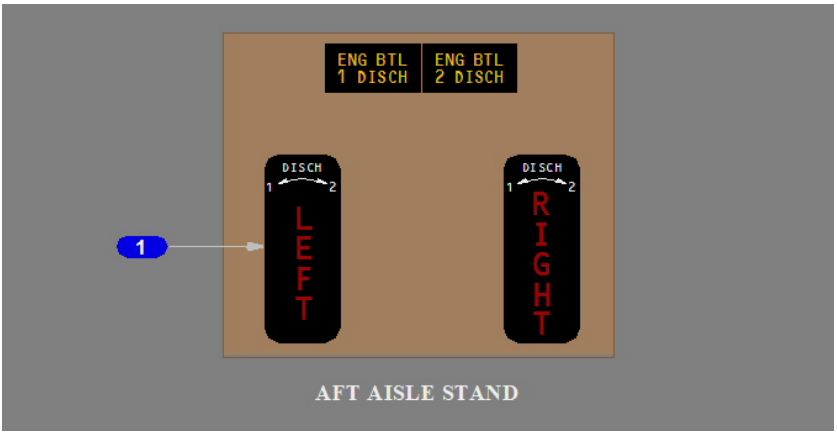
- for hydraulic pumps that are commanded on and the pump pressure low-amber X in the box symbol
- for hydraulic pumps that are commanded on and the pump sensor indicates normal pressure—green flow line through the pump.
- for the activated RAT and pressure low-amber X in the box.
- for the activated RAT and pressure sensor data not valid—RAT symbol is low intensity white.

Miscellaneous Hydraulic System Controls

Engine Fire Panel



1 Engine Fire Switches

Pull—

- closes the engine-driven pump hydraulic supply shutoff valve
- depressurizes the engine-driven pump.

Flight Control Hydraulic Power Switches

Note: No flight crew normal or non-normal procedures require operation of the flight control shutoff switches. These switches are for ground maintenance use only.

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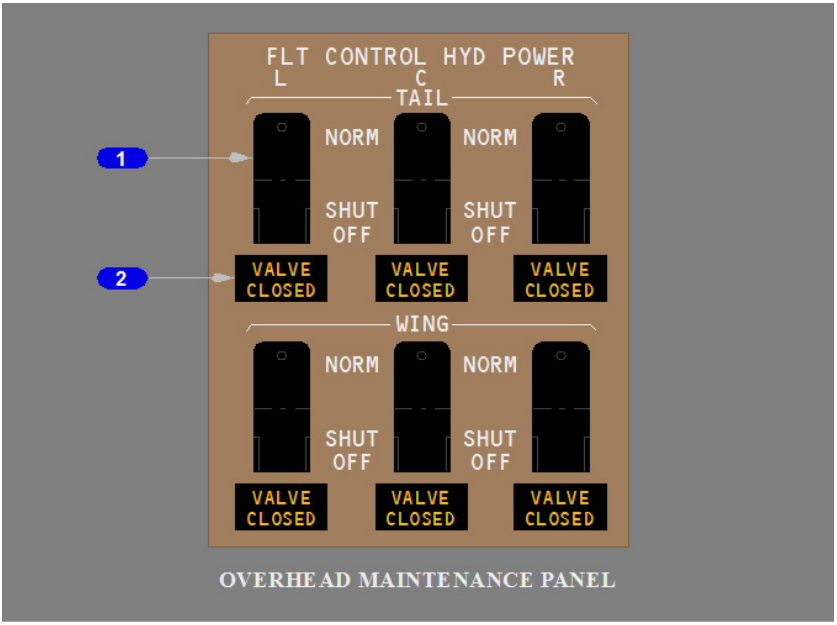

1 Flight Control Hydraulic Power Shutoff Switches

NORM—hydraulic system power is available to the flight control actuators.

SHUT OFF—hydraulic system power to the flight control actuators is shut off.

Note: In flight, the center system flight control shut off valves are isolated from electrical power and cannot be closed.

2 Flight Control Hydraulic Power VALVE CLOSED Lights

Illuminated (amber)—the related valve is closed.

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Introduction

The airplane has three independent hydraulic systems: left, right, and center. The hydraulic systems power the:

- flight controls
- leading edge slats
- trailing edge flaps
- landing gear
- wheel brakes
- nose and main gear steering
- thrust reversers.

Flight control system components are distributed so that any one hydraulic system can provide adequate airplane controllability.

Hydraulic fluid is supplied to each hydraulic pump from the associated system reservoir. The reservoirs are pressurized by the bleed air system.

Left and Right Hydraulic Systems

The left and right hydraulic systems are identical. They differ only in the components they power.

The left hydraulic system powers:

- flight controls
- the left engine thrust reverser.

The right hydraulic system powers:

- flight controls
- normal brakes
- the right thrust reverser.

Left and Right Hydraulic System Primary Pumps

The left and right hydraulic systems each have a primary pump. The left and right primary pumps are engine-driven by the related left and right engines.

Left and Right Hydraulic System Demand Pumps

The left and right hydraulic systems each have a demand pump. The demand pumps are electric motor-driven. The demand pumps provide supplementary hydraulic power for periods of high system demand. The demand pumps also provide a backup hydraulic power source for the engine-driven primary pumps.

The pumps are controlled by the DEMAND L and R pump selectors. In the AUTO position, the L and R demand pumps operate for takeoff, landing, and when

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system or primary pump pressure is low. In the ON position, the demand pump runs continuously.

Note: In the AUTO position the right demand pump operates continuously when the airplane is on the ground.

Center Hydraulic System

The center hydraulic system powers:

- flight controls
- leading edge slats
- trailing edge flaps
- landing gear actuation
- alternate brakes
- nose gear steering
- main gear steering.

The ram air turbine (RAT) can provide hydraulic power to the center hydraulic system primary flight control components only.

Center Hydraulic System Primary Pumps

Two electric motor–driven primary pumps are the primary hydraulic power sources for the center hydraulic system. The PRIMARY C1 and C2 pump switches control pump operation.

On the ground:

With only a single ground power source, including the APU, the C2 pump will not run if the C1 pump is selected. The pump will not be load shed if one engine generator is operating, or the following sources are operating:

- primary external power and secondary external power or
- APU generator and primary external power.

In flight:

The C2 pump may be load shed by the electrical load management system when the following conditions exist:

- all other electric pumps are running
- there is a single source of electrical power
- generator capacity is exceeded.

The pump will start automatically when the conditions that shed the pump no longer exist.

Center Hydraulic System Demand Pumps

The center hydraulic system has two air-driven demand pumps. The demand pumps provide supplementary hydraulic power for periods of high system

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demand. The demand pumps also provide a backup hydraulic power source for the center system electric motor-driven primary pumps.

The pumps are controlled by the DEMAND C1 and C2 pump selectors. In the AUTO position, a demand pump operates when system and/or primary pumps pressure is low, or when system logic anticipates a large demand. In the ON position, the demand pump runs continuously. Selecting both demand pumps ON results in only pump C1 operating. Both pumps cannot operate simultaneously when ON is selected for both pumps.

Center Hydraulic System Non-Normal Operation

If center hydraulic system quantity is sensed to be low and airspeed is greater than 60 knots the:

- alternate brakes are isolated from the center system and remain operable using reserve fluid
- nose gear actuation and steering are isolated
- leading edge slats are isolated and not allowed to operate in the primary (hydraulic) mode.

The leading edge slats are reconnected to the center hydraulic system and allowed to operate in primary mode when:

- center hydraulic fluid quantity recovers to normal for 5 seconds, and
- the system determines that both engines have been running for more than 30 seconds.

Nose gear actuation and steering are reconnected when:

- airspeed decreases below 60 knots, or
- hydraulic pressure to the center system flight controls is low, or
- the landing gear is selected down, both engines are normal, and both engine-driven pumps are providing pressure.

Ram Air Turbine (RAT)

The RAT, when deployed, provides hydraulic power only to the primary flight control components connected to the center hydraulic system. The RAT provides hydraulic and electrical power throughout the flight envelope. In flight, the RAT deploys automatically if:

- both engines are failed and center system pressure is low, or
- both AC transfer busses are unpowered, or
- all three hydraulic system pressures are low.

The RAT can be deployed manually by pushing the RAM AIR TURBINE switch. The hot battery or APU battery bus must be powered. The center hydraulic system does not need to be powered. The RAT is deployed by a compressed spring. Once deployed, the RAT cannot be stowed in flight.

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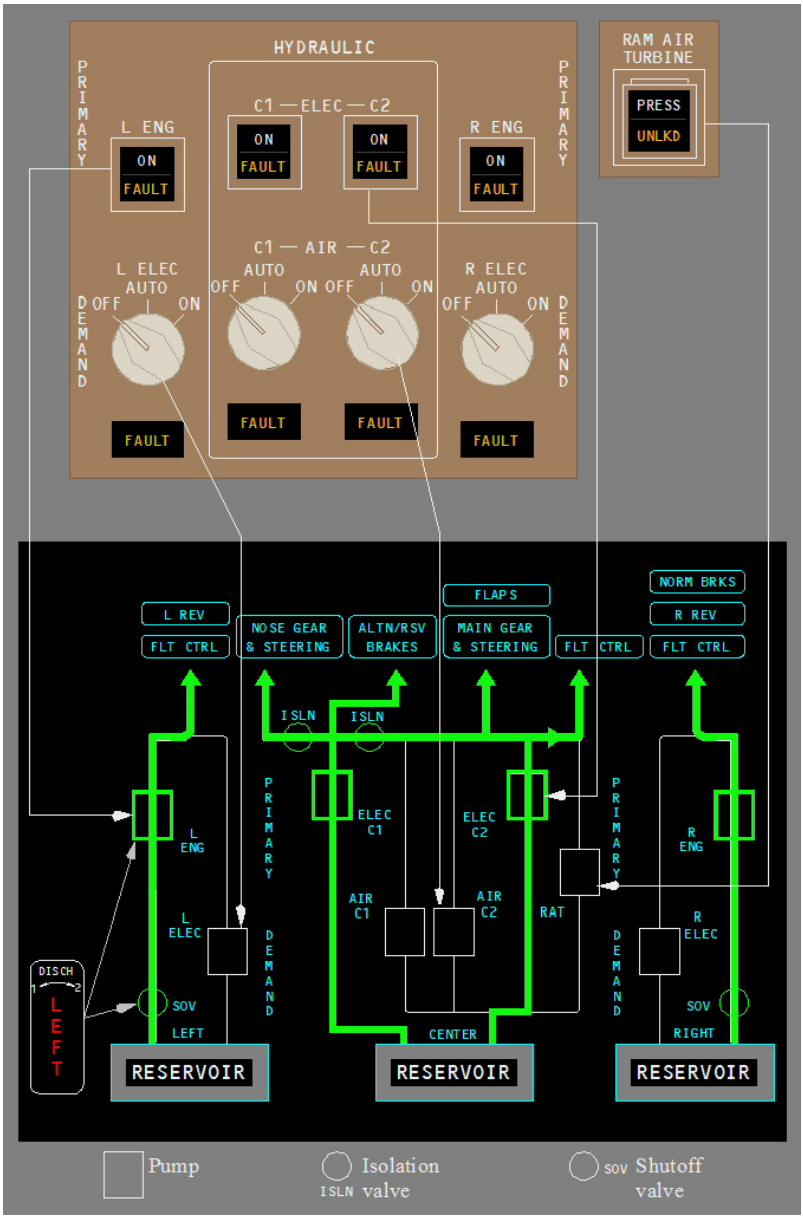
Hydraulic Systems Schematic



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EICAS Alert Messages

Message	Level	Aural	Message Logic
HYD AUTO CONTROL C	Advisory		Both center demand pump AUTO functions and all center hydraulic system indications are inoperative.
HYD AUTO CONTROL L, R	Advisory		Demand pump AUTO function and all left or right system indications are inoperative.
HYD OVERHEAT DEM C1, C2, L, R	Advisory		Demand pump temperature is high.
HYD OVERHEAT PRI C1, C2, L, R	Advisory		Primary pump temperature is high.
HYD PRESS DEM C1, C2, L, R	Advisory		Demand pump output pressure is low when commanded on.
HYD PRESS PRI C1, C2	Advisory		Primary pump output pressure is low.
HYD PRESS PRI L, R	Advisory		Primary pump output pressure is low.
HYD PRESS SYS C	Caution	Beeper	Center hydraulic system pressure is low.
HYD PRESS SYS L	Caution	Beeper	Left hydraulic system pressure is low.
HYD PRESS SYS L+C	Caution	Beeper	Left and center hydraulic system pressures are low.
HYD PRESS SYS L+R	Caution	Beeper	Left and right hydraulic system pressures are low.
HYD PRESS SYS L+C +R	Caution	Beeper	All hydraulic system pressures are low.
HYD PRESS SYS R	Caution	Beeper	Right hydraulic system pressure is low.
HYD PRESS SYS R+C	Caution	Beeper	Right and center hydraulic system pressures are low.
HYD QTY LOW C	Advisory		Center hydraulic system quantity is low.
HYD QTY LOW L, R	Advisory		Hydraulic quantity is low.

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Message	Level	Aural	Message Logic
HYD QTY LOW L+C	Caution	Beeper	Left and center hydraulic system quantities are low.
HYD QTY LOW L+C +R	Caution	Beeper	All three hydraulic system quantities are low.
HYD QTY LOW L+R	Caution	Beeper	Left and right system quantities are low.
HYD QTY LOW R+C	Caution	Beeper	Right and center system quantities are low.
RAT UNLOCKED	Advisory		RAT is not stowed and locked.

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Landing Gear — Chapter 14

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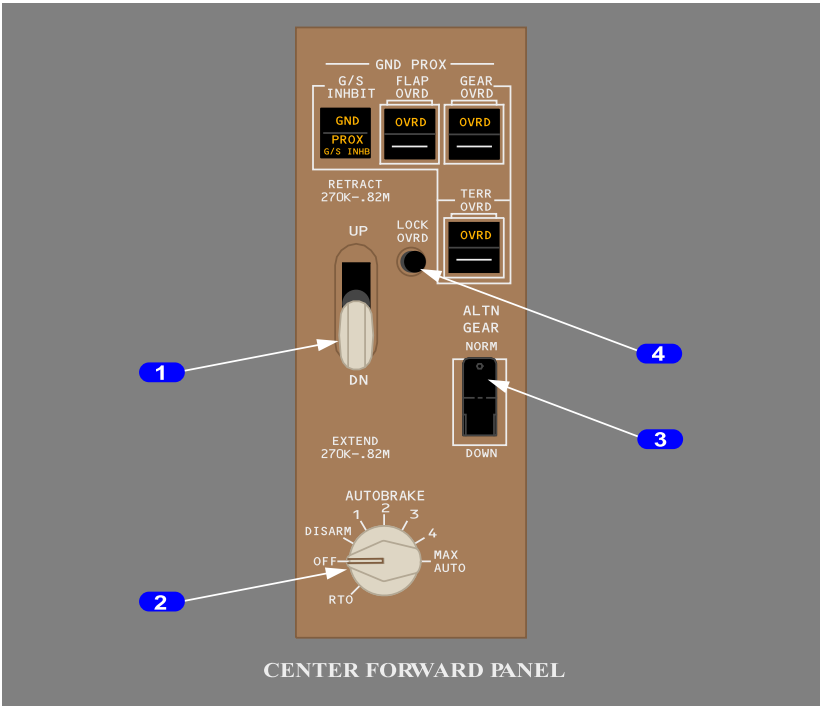
Landing Gear Panel



1 Landing Gear Lever

UP—the landing gear retracts.

DN—the landing gear extends.

2 AUTOBRAKE Selector

OFF—deactivates and resets the autobrake system.

DISARM—

- disengages the autobrake system
- releases brake pressure.

1, 2, 3, 4, MAX AUTO—selects the desired deceleration rate.

RTO—automatically applies maximum brake pressure when the thrust levers are retarded to idle above 85 knots.

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3 Alternate Gear (ALTN GEAR) Switch

NORM—the landing gear lever operates normally.

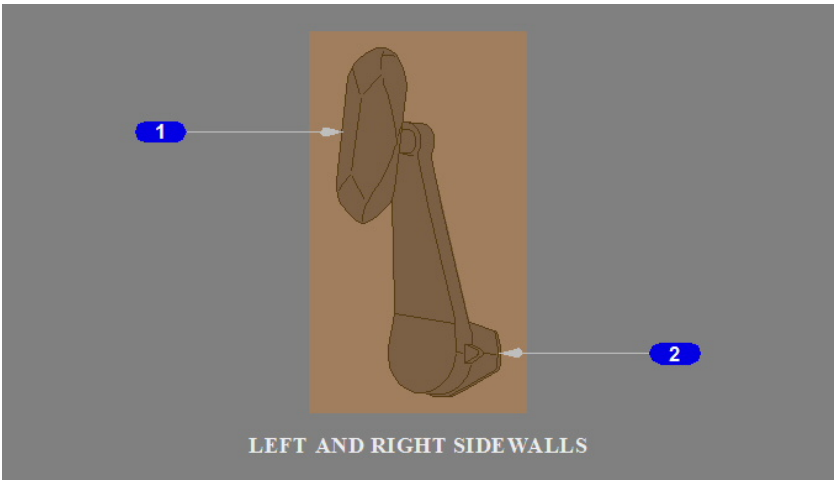
DOWN—the landing gear extends by the alternate extension system.

Note: Alternate extension may be selected with the landing gear lever in any position.

4 Landing Gear Lever Lock Override (LOCK OVRD) Switch

Push—releases the landing gear lever lock.

Nose Wheel Steering Tiller



1 Nose Wheel Steering Tiller

Rotate—

- turns the nose wheels up to 70° in either direction
- overrides rudder pedal steering
- main gear aft axle steering is slaved to nose wheel steering.

2 Tiller Position Indicator

Shows tiller displacement from the straight-ahead, neutral position.

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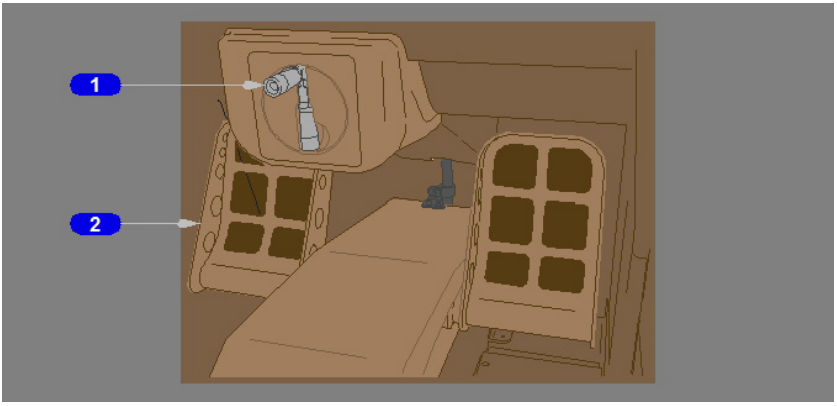
Brake System

Rudder/Brake Pedals



1 Rudder Pedal Adjust Crank

Adjusts the rudder pedals forward or aft.

Note: To avoid inadvertent rudder pedal movement, the crank handle should be stowed when not in use.

2 Rudder/Brake Pedals

Push the full pedal—

- turns the nose wheel up to 7° in either direction
- does not activate main gear steering.

Push the top of the pedals—actuates the wheel brakes.

See Rudder/Brake Pedals on page 9.10.6 for the description of rudder operation.

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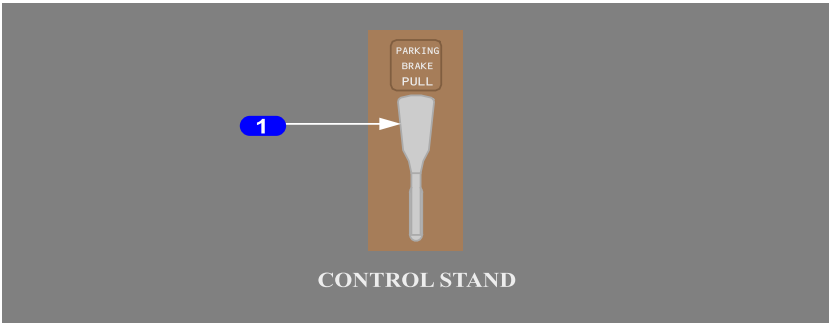
Parking Brake Lever

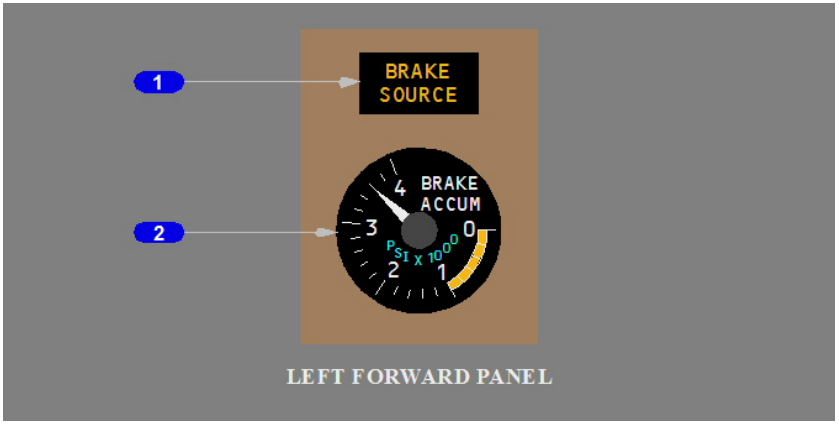


1 Parking Brake Lever

Pull—sets the parking brake when both brake pedals are simultaneously depressed.

Release—simultaneously depress both brake pedals.

Brake Accumulator Pressure Indicator



1 BRAKE SOURCE Light

Illuminated (amber)—both active brake hydraulic sources (right and center/reserve hydraulic systems) have low pressure.

2 BRAKE Accumulator (ACCUM) Pressure Indicator

Indicates brake accumulator pressure.

Amber Band—brake accumulator pressure is low.

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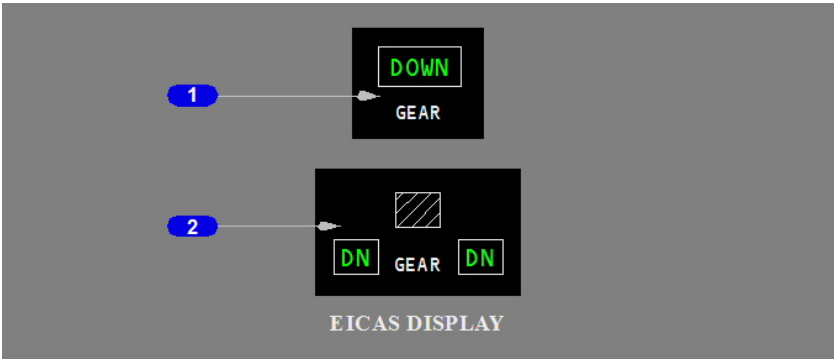
Landing Gear System Indications

Landing Gear Position Indications



1 GEAR Position Indication (Normal Display)

DOWN (green)—all landing gear are down and locked.

Crosshatched (white)—one or more landing gear are in transit.

UP (white)—all landing gear are up and locked (blanks after 10 seconds).

Empty box (white)—all landing gear position indicators are inoperative.

2 Expanded GEAR Position Indication (Non-Normal Display)

DN (green)—the associated landing gear is down and locked.

Crosshatched (white)—the associated landing gear is in transit.

UP (white)—the associated landing gear is up and locked.

Empty box(es) (white)—the associated landing gear position indicators are inoperative.

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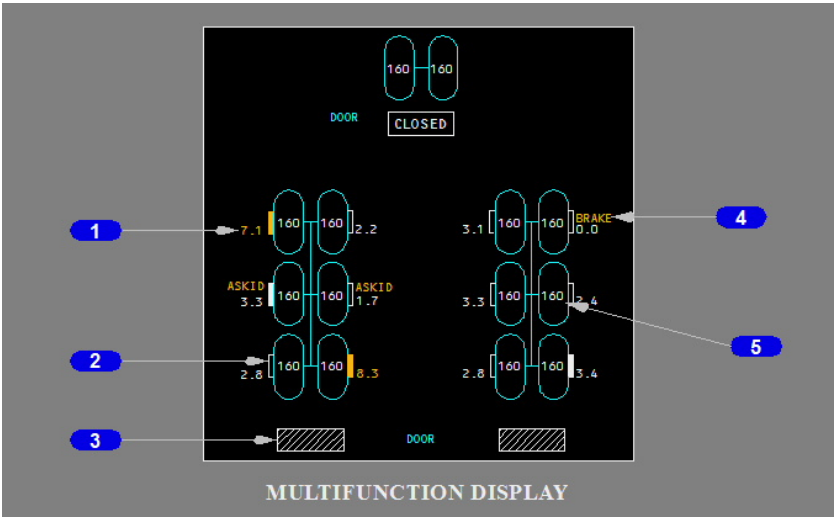
Gear Synoptic Display

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.



1 Brake Temperature

Indicates a relative value of wheel brake temperature:

- values range from 0.0 to 9.9
- white—normal range
- amber—high range.

2 Brake Symbol

Blank box indicates any brake less than 3.0.

Solid white box indicates hottest brake on each main gear within range of 3.0 to 4.9.

Solid amber box indicates brake overheat condition on each wheel within range of 5.0 to 9.9.

3 Gear Door Status

Crosshatched—the door is not closed.

CLOSED (white)—the door is closed.

Empty box(es) (white)—the associated landing gear door position indicators are inoperative.

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4 Fault Indication (amber)

BRAKE—indicates brake deactivation on the associated wheel.

ASKID—indicates antiskid fault on the associated wheel.

5 Tire Pressure Indication

Displays individual tire pressures:

- white—normal range
- amber—abnormal high or low range.

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Introduction

The airplane has two main landing gear and a single nose gear. The nose gear is a conventional steerable two-wheel unit. Each main gear has six wheels in tandem pairs. To improve turning radius, the aft axle of each main gear is steerable.

Hydraulic power for retraction, extension, and steering is supplied by the center hydraulic system. An alternate extension system is also provided.

The normal brake system is powered by the right hydraulic system. The alternate brake system is powered by the center/reserve hydraulic system. Antiskid protection is provided with both systems, but the autobrake system is available only through the normal system. A brake temperature monitor system and tire pressure indication system displays each brake temperature and tire pressure 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.

The system receives air/ground logic signals from sensors located on each main landing gear beam. These signals are used to configure the airplane systems to the appropriate air or ground status.

Landing Gear Operation

The landing gear are normally controlled by the landing gear lever. On the ground, the lever is held in the DN position by an automatic lever lock. The lever lock can be manually overridden by pushing and holding the landing gear lever LOCK OVERRIDE switch. In flight, the lever lock is automatically released through air/ground sensing.

Landing Gear Retraction

When the landing gear lever is moved to UP, the landing gear begins to retract. The landing gear doors open and the main gear wheels tilt to the retract position. 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 landing gear are held up by uplocks. The EICAS landing gear position indication changes to UP for 10 seconds and then blanks. With the landing gear retracted and all doors closed, the landing gear hydraulic system is automatically depressurized.

If any gear is not up and locked up after the normal transit time, the EICAS caution message GEAR DISAGREE is displayed. The EICAS gear position

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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. The EICAS advisory message GEAR DOOR is displayed if any hydraulically actuated door is not closed after normal transit time.

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 free-fall without hydraulic power 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.

The EICAS caution message GEAR DISAGREE is displayed if any gear is not locked down (side and drag brace on the same main gear not locked, or nose gear drag brace not locked) 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).

If only one brace on a main gear is locked (either drag or side brace not locked) after the normal transit time, the EICAS caution message MAIN GEAR BRACE L or R is displayed for the affected gear. The EICAS gear position indication changes to the expanded non-normal format, with the affected gear displayed as in transit. The EICAS advisory message GEAR DOOR displays if any hydraulically actuated door is not closed after the normal transit time.

Landing Gear Alternate Extension

The alternate landing gear extension system uses a dedicated DC powered electric hydraulic pump and center hydraulic system fluid to extend the landing gear. Selecting DOWN on the ALTERNATE GEAR switch releases all door and gear uplocks. The landing gear free-fall to the down and locked position. The landing gear lever position has no effect on landing gear alternate extension.

The EICAS landing gear position indication displays the expanded gear position indication when the alternate extension system is used. During alternate extension, the EICAS message GEAR DOOR is displayed because all the hydraulically powered gear doors remain open.

Following an alternate extension, the landing gear can be retracted by the normal system, if it is operating. Select DN then UP to retract the landing gear using the normal system.

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TKK to TKR, TKU to TKZ

Semi-Levered Gear

The semi-levered gear consists of an additional hydraulic actuator that connects the forward end of each main gear truck to the shock strut. During takeoff, the actuator locks to restrict rotation of the main gear truck and allow takeoff rotation about the aft wheel axle, thereby improving airplane performance capability. During landing, the actuator is unlocked to permit rotation of the main gear truck and provide additional damping.

Nose Wheel and Main Gear Aft Axle Steering

The airplane is equipped with nose wheel steering and main gear aft axle steering.

Nose wheel steering is powered by the center/reserve hydraulic system. Main gear aft axle steering is powered by the center hydraulic system.

Primary 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° 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° in either direction. Tiller inputs override rudder pedal inputs.

Main gear aft axle steering is automatically enabled when the nose gear steering angle exceeds 13°. The main gear aft axles turn proportionally in the opposite direction to reduce turn radius and tire scrubbing.

The EICAS warning message CONFIG GEAR STEERING, accompanied by the takeoff configuration aural alert, is displayed if the main gear aft axles are not centered and locked when takeoff thrust is applied. The EICAS advisory message MAIN GEAR STEERING is displayed if the main gear steering actuators are not locked in the centered position when commanded to the center position.

Brake System

The airplane has two brake systems: normal and alternate. Each main gear wheel has a multiple disc carbon brake operated by either system. The nose wheels have no brakes.

The brake systems use the right and center/reserve hydraulic systems. The EICAS advisory message BRAKE SOURCE displays and the BRAKE SOURCE light illuminates if both the right and center/reserve hydraulic system pressures are low.

Normal Brake System

The normal brake system is powered by the right hydraulic system. The brake pedals provide independent control of the left and right brakes.

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Brake Accumulator

The brake accumulator is located in the normal brake system. The brake accumulator extends parking brake holding time, stabilizes normal brake hydraulic system pressure during initial application and antiskid cycling, and supplies hydraulic pressure for several braking applications or parking brake application if right and center hydraulic systems are lost.

The brake accumulator is pressurized by the right hydraulic system. Accumulator pressure is shown on the BRAKE ACCUMULATOR PRESSURE indicator.

Alternate Brake System

Alternate brake system selection is automatic. If the right hydraulic system pressure is low, the center hydraulic system automatically supplies pressure to the alternate brake system.

Reserve Brakes and Steering

The fluid below the standpipe in the center hydraulic reservoir is used by the primary C1 pump as a reserve hydraulic source to power the alternate brakes and nose wheel steering.

Antiskid Protection

Antiskid protection is provided in the normal and alternate brake systems. Antiskid protection is also provided when the brake system is being supplied pressure only from the brake accumulator.

The normal brake 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 system provides antiskid protection to tandem wheel pairs for the forward and middle axle wheels. The aft axle wheels remain individually controlled.

Touchdown and hydroplaning protection is provided using airplane inertial ground speed. Locked wheel protection is provided using a comparison with other wheel speeds.

The EICAS advisory message ANTISKID is displayed if an antiskid fault affecting the brake system in use is detected, the parking brake valve is not fully open with the parking brake released, or the system is completely inoperative.

Autobrake System

The autobrake system provides automatic braking at preselected deceleration rates for landing and full pressure for rejected takeoff. The system operates only when the normal brake system is functioning. Antiskid system protection is provided during autobrake operation.

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EICAS memo messages display the selected autobrake settings:

- AUTOBRAKE 1 through 4
- AUTOBRAKE MAX
- AUTOBRAKE RTO.

The EICAS advisory message AUTOBRAKE is displayed if the autobrake system is disarmed or inoperative, or autobrake solenoid valve pressure is high when not commanded on.

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
- both thrust levers are retarded to idle.

Maximum braking is obtained in this mode. If an RTO is initiated below 85 knots, the RTO autobrake function does not operate.

Taxi Brake Release

During each taxi brake application, the antiskid system releases the brakes of one axle pair of each main landing gear (if wheel speeds are less than 45 knots). The system sequences through the axle pairs at each brake application, thereby reducing the number of brake applications by each brake. This extends service life and reduces brake sensitivity during taxi.

All active brakes are applied for a heavy brake application, landing rollout, RTO, or when setting the parking brake.

The taxi brake release system operates only with the normal brake system.

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:

- both thrust levers are retarded to idle, and
- the wheels have spun up.

Autobrake application occurs slightly after main gear touchdown. If MAX AUTO is selected, deceleration is limited to the AUTOBRAKE 4 level until pitch angle is less than one degree, then deceleration is increased to the MAX AUTO level. The deceleration level can be changed (without disarming the system) by rotating the selector.

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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 autobrake system disarms and the EICAS advisory message AUTOBRAKE is displayed if any of the following occur:

- pedal braking applied
- either thrust lever advanced after landing
- speedbrake lever is moved to the DOWN detent after the speedbrakes have deployed on the ground
- DISARM or OFF position selected on the AUTOBRAKE selector
- autobrake fault
- normal antiskid system fault
- loss of inertial data from the ADIRU
- the autobrake is applied after loss of normal brake hydraulic pressure.

When the autobrake system disarms after landing, the AUTOBRAKE selector automatically moves to the DISARM position, and removes power from the autobrake system.

When the autobrake system disarms during takeoff, the AUTOBRAKE selector remains in the RTO position, but automatically moves to OFF after takeoff.

Parking Brake

The parking brake can be set with the normal or alternate brake system pressurized. If the normal and alternate brake systems are not pressurized, parking brake pressure is maintained by the brake accumulator.

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.

The parking brake is released by depressing the pedals until the parking brake lever releases.

When the parking brake is set, the EICAS memo message PARKING BRAKE SET is displayed. If the parking brake is set and either engine is set to takeoff thrust, the takeoff configuration aural alert sounds and the EICAS warning message CONFIG PARKING BRAKE is displayed.

Brake Temperature Indication

Wheel brake temperatures are displayed on the GEAR synoptic display. Numerical values related to wheel brake temperature are displayed adjacent to

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each wheel/brake symbol. These values range from 0.0 to 9.9 in increments of 0.1. The values tend to increase after the brakes are used.

Normal range values of 0 to 4.9 are white. For values of 3.0 to 4.9, the brake symbol for the hottest brake becomes solid white. Values of 5.0 and above are amber. For values of 5.0 and above, the EICAS advisory message BRAKE TEMP is displayed.

Tire Pressure Indication

Individual tire pressures, from 0 to 400 PSI, are displayed inside the individual wheel symbols on the GEAR synoptic display.

The EICAS advisory message TIRE PRESS is displayed if any tire pressure is above or below the normal range, or there is an excessive pressure difference between two tires on the same axle.

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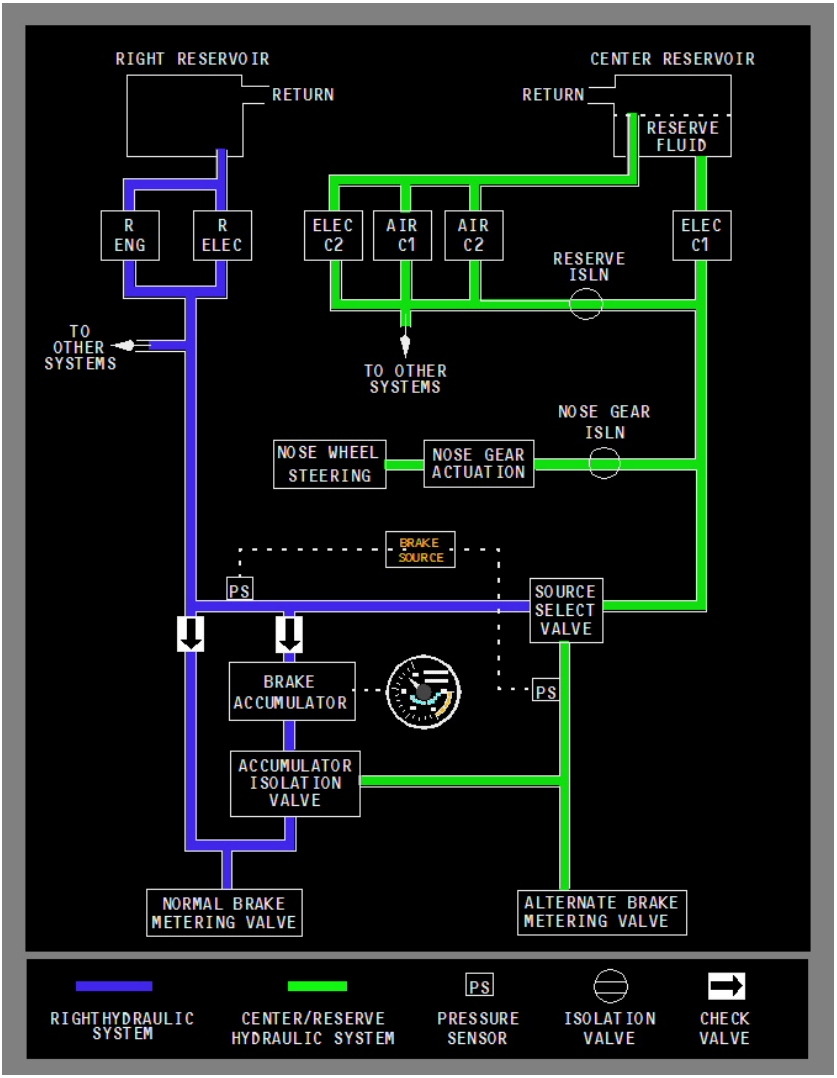
Brake System Schematic



TKA to TKF, TKK to TKR

Tail Skid

The airplane is equipped with a tail skid system. The tail skid extends for takeoff and landing and retracts during flight. It helps protect the pressurized part of the

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airplane from contact with the runway. The tail skid uses the main landing gear actuation system.

The EICAS advisory message TAIL SKID is displayed when the tail skid is not in the correct position.

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EICAS Alert Messages

Note: Configuration warning messages are covered in Chapter 15, Warning Systems.

Brakes

Message	Level	Aural	Message Logic
ANTISKID	Advisory		A fault is detected in the antiskid system.
AUTOBRAKE	Advisory		Autobrake is disarmed or inoperative.
AUTOBRAKE 1, 2, 3, 4, MAX, RTO	Memo		Indicates selected autobrake level.
BRAKE SOURCE	Advisory		Normal and alternate brake system pressures are low, and reserve hydraulic source for alternate brake system is low.
BRAKE TEMP	Advisory		Temperature of one or more brakes is excessive.
PARKING BRAKE SET	Memo		The parking brake lever is up and the parking brake valve is closed.
RESERVE BRAKES/ STRG	Advisory		Alternate brakes from the reserve hydraulic source, normal nose gear extension, or nose wheel steering may not be available.

Landing Gear

Message	Level	Aural	Message Logic
GEAR DISAGREE	Caution	Beeper	Gear position disagrees with landing gear lever position.
GEAR DOOR	Advisory		One or more gear doors are not closed.
MAIN GEAR BRACE L, R	Caution	Beeper	Affected main gear is down with one brace unlocked.
MAIN GEAR STEERING	Advisory		Main gear steering is unlocked when centered.
VMO GEAR DOWN			See EICAS messages on page 10.70.1.

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TKA to TKF, TKK to TKR

Tail Skid

Message	Level	Aural	Message Logic
TAIL SKID	Advisory		Tail skid position disagrees with landing gear lever position.

Tires

Message	Level	Aural	Message Logic
TIRE PRESS	Advisory		One or more tire pressures are not normal.

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Warning Systems — Chapter 15

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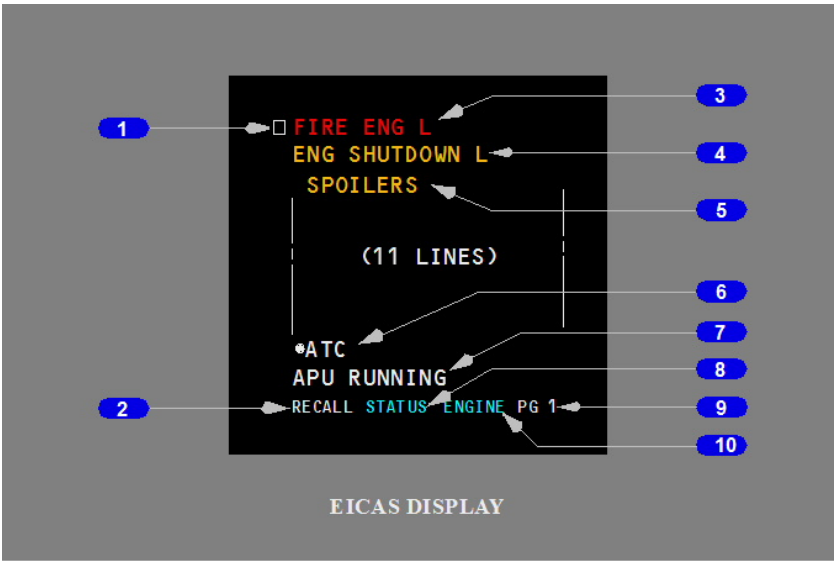
Engine Indication and Crew Alerting System (EICAS)

EICAS Messages



1 Checklist Icon

Displayed (white)—

- when checklist with procedural steps, notes, or other information of which the crew must be made aware exists for respective message
- no longer displayed when checklist complete
- no longer displayed when inhibited by checklist of another message.

2 RECALL Indication

Displayed (white)—

- when CANC/RCL switch pushed
- remains displayed for one second after switch released.

3 Warning Messages

Displayed (red)—

- highest priority alert messages

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- red alert messages remain displayed and cannot be canceled by pushing the CANC/RCL switch.

4 Caution Messages

Displayed (amber)—

- next highest priority alert messages after warning messages
- amber alert messages can be canceled or recalled by pushing the CANC/RCL switch.

5 Advisory Messages

Displayed (amber)—

- lowest priority alert messages; indented one space
- amber alert messages can be canceled or recalled by pushing the CANC/RCL switch.

6 Communication Messages

Displayed (white)—

- prefaced with white dot
- COMM low messages indented one space
- cannot be canceled by pushing the CANC/RCL switch.

7 Memo Messages

Displayed (white)—

- reminder of selected state of controls or systems
- cannot be canceled by pushing the CANC/RCL 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.

8 STATUS Cue

Displayed (cyan)—

- new status message exists
- no longer displayed when status display selected
- inhibited from beginning of first engine start until 30 minutes after lift-off.

9 Page (PG) Number

Displayed (white)—

- more than one page of alert or memo messages exists
- indicates number of page selected.

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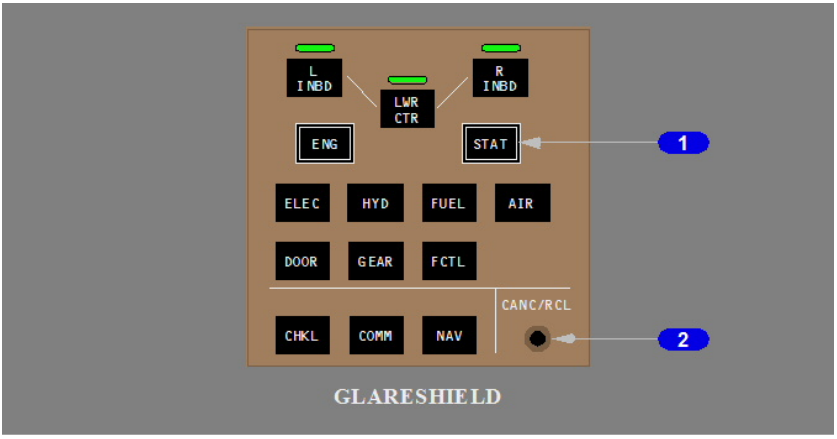
10 ENGINE Exceedance Cue

Displayed (cyan)—

- engine parameter on secondary engine display is exceeded
- displayed until displayed parameter returns to normal operating range.

Display Select Panel



1 Status (STAT) Display Switch

Push—displays status display on selected MFD.

Subsequent pushes—

- displays next page of status messages when additional pages exist
- lower center MFD blanks when last page of status messages displayed
- inboard MFDs return to NAV display after last page of status messages displayed.

2 Cancel/Recall (CANC/RCL) Switch

Push (when EICAS caution or advisory messages displayed)—

- displays the next page of EICAS messages when additional pages exist
- cancels caution and advisory messages when last page displayed; warning, memo, and communications messages remain displayed
- cancels red box for any engine parameter previously exceeded when displayed parameter no longer exceeds the limit.

Push (when no EICAS caution or advisory messages displayed)—

- redisplays all caution and advisory EICAS messages, when non-normal condition exists
- displays first page of messages when multiple pages exist

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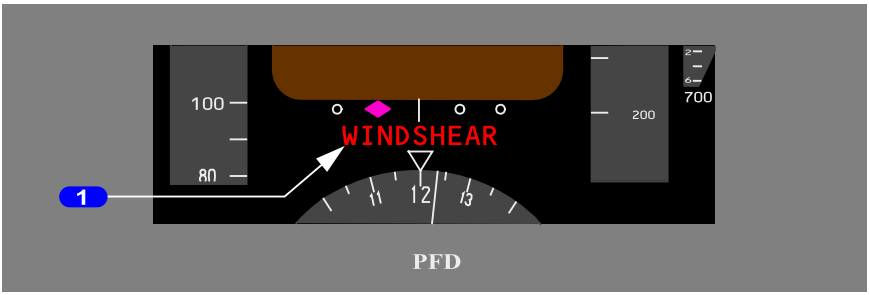
- redisplays red box for parameters previously exceeded.

Alerts on PFD



1 Alert

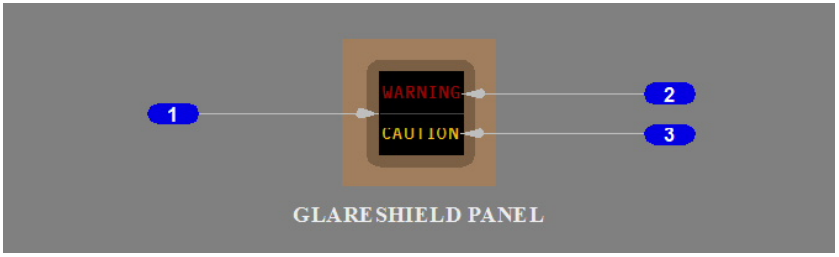
ENG FAIL (red)—ENGINE FAIL alert is occurring.

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.

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 that accompanies the EICAS warning messages:
  - CABIN ALTITUDE

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- CONFIG GEAR, if displayed because landing gear not down andlocked, any thrust lever below thrust required for level flight, and radio altitude less than 800 feet
- FIRE
- OVERSPEED
- PILOT RESPONSE
- STABILIZER.

2 Master WARNING Light

Illuminated (red)—

- new EICAS warning message displayed, or
- ENGINE FAIL, 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)

TJA,B,C,D,G,H,TKA to TKF

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 enable.

2 TCAS Airspace Switch

ABOVE—altitude reporting traffic from 2,700 feet below to 9,000 feet above current altitude displayed.

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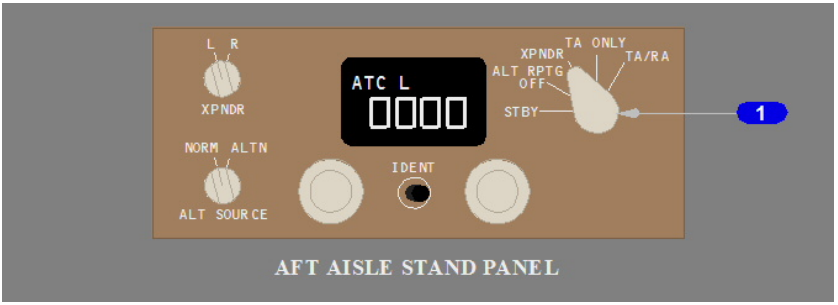
NORM (normal)—altitude reporting traffic from 2,700 feet below to 2,700 feet above current altitude displayed.

BELOW—altitude reporting traffic 9,000 feet below to 2,700 feet above current altitude displayed.

TJR to TJW



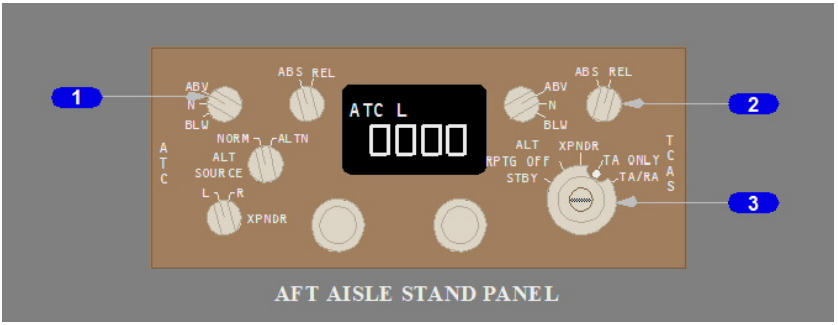
1 Transponder Mode Selector

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 enable.

TKK to TKR, TKU to TKZ



1 TCAS Airspace Selector

Left switch controls Captain TCAS display. Right switch controls First Officer TCAS display.

ABV (above)—altitude reporting traffic from 2,700 feet below to 7,000 feet above current altitude displayed.

N (normal)—altitude reporting traffic from 2,700 feet below to 2,700 feet above current altitude displayed.

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BLW (below)—altitude reporting traffic 7,000 feet below to 2,700 feet above current altitude displayed.

2 TCAS Absolute/Relative (ABS/REL) Altitude Selector

Left switch controls Captain TCAS display. Right switch controls First Officer TCAS display.

ABS (absolute)—absolute altitude displayed in TCAS traffic symbol data tags.

REL (relative)—relative altitude displayed in TCAS traffic symbol data tags.

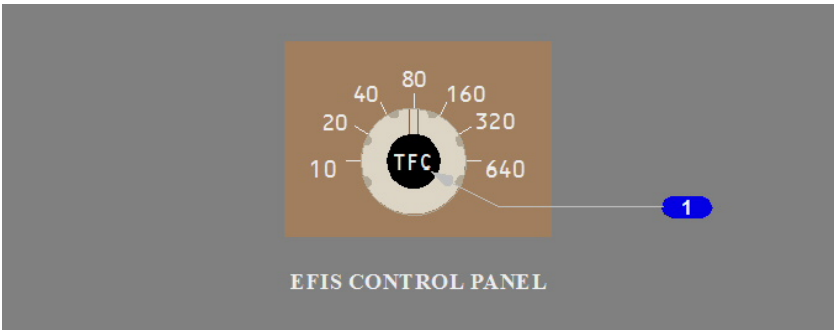
3 Transponder Mode Selector

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 enable.

TCAS Controls (EFIS Control Panel)



1 ND Traffic (TFC) Switch (inner)

Push—

- TCAS traffic displayed on ND
- range information displayed when in the expanded APP or VOR modes.

TCAS Traffic and TCAS Alert Message TRAFFIC Display

TCAS Traffic Display

Displayed when TFC selected and respective ND is in MAP, MAP CTR, VOR, or APP mode.

Displayed automatically when:

- a RA or TA is occurring, and

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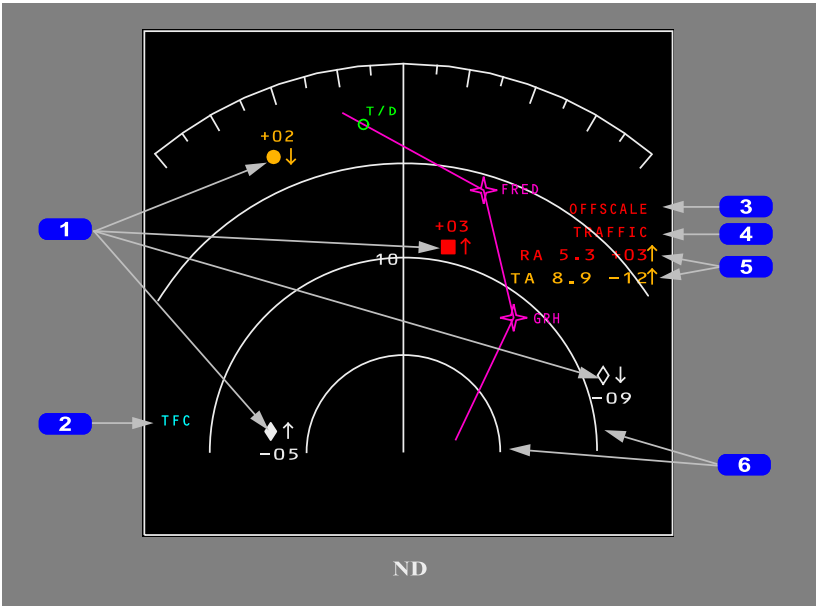
- TFC not selected on either ND, and
- respective ND is in MAP, MAP CTR, VOR, or APP mode.



1 Traffic Targets

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

TKK to TKR, TKU to TKZ
- number is relative or absolute altitude of traffic in hundreds and thousands of feet; not displayed when altitude unknown

TJA,B,C,D,G, H, TJR to TJW, TKA to TKF
- number is relative altitude of traffic in hundreds of feet; not displayed when altitude unknown
- 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.

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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.

Displayed (amber)—TA is beyond selected map range.

4 TRAFFIC Alert Message

Displayed (red)—RA is occurring.

Displayed (amber)—TA is occurring, and RA is not occurring.

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.

6 TCAS/Weather Radar Range Arcs

Displayed when TCAS or weather radar selected; replace range scale tics.

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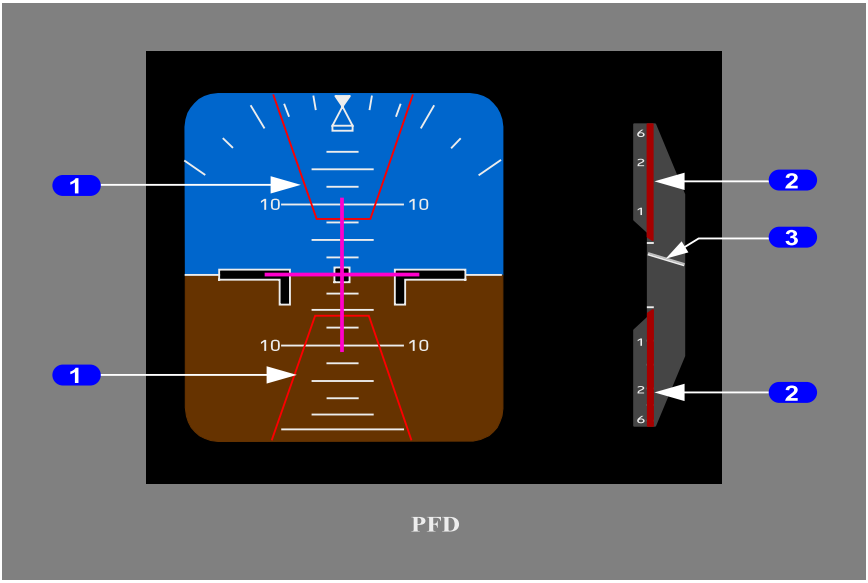
TCAS PFD Vertical Guidance



1 RA Pitch Region To Avoid (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.

2 RA Vertical Speed Region to Avoid (red)

To ensure vertical separation, vertical speed must be outside the red RA vertical speed region to avoid.

3 Vertical Speed Pointer

Red—present vertical speed does not ensure RA traffic is avoided.

White—present vertical speed ensures RA traffic is avoided.

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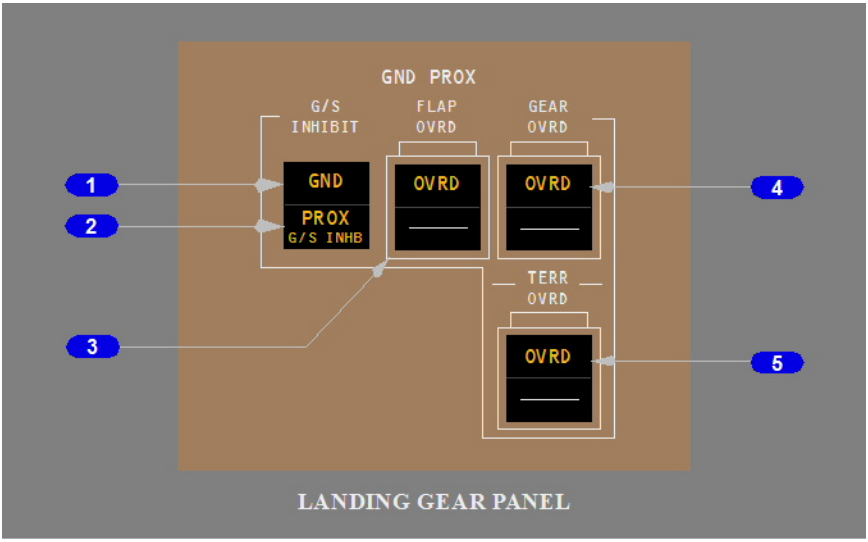
Ground Proximity Warning System (GPWS) Controls

Ground Proximity Panel



1 Ground Proximity (GND PROX) Glideslope (G/S) INHIBIT (INHIB) Switch

Push—iinhibits GLIDE SLOPE alert when pushed below 1,000 feet radio altitude.

2 Ground Proximity (GND PROX) Light

Illuminated (amber)—

- GPWS DON'T SINK, GLIDE SLOPE, SINKRATE, TERRAIN, TOO LOW FLAPS, TOO LOW GEAR, TOO LOW TERRAIN immediate alert is occurring
- inhibited for GLIDE SLOPE, or TOO LOW FLAPS, or TOO LOW GEAR alert when respective inhibit or override switch is pushed.

3 Ground Proximity (GND PROX) FLAP Override (OVRD) Switch

Push (OVRD visible)—

- 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.

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4 Ground Proximity (GND PROX) GEAR Override (OVRD) Switch

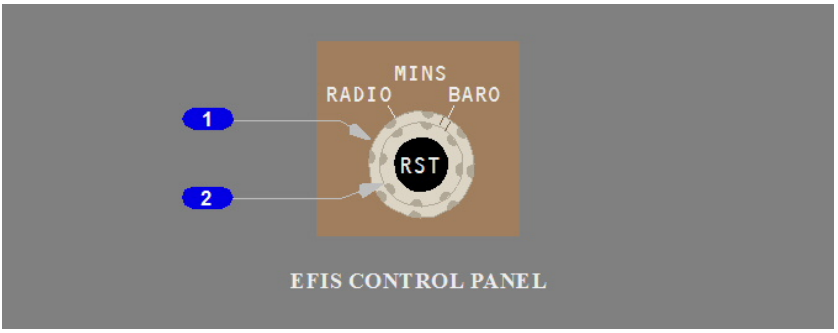
Push (OVRD visible)—

- 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.

5 Ground Proximity (GND PROX) Terrain (TERR) Override (OVRD) Switch

Push (OVRD visible)—inhibits look–ahead obstacle and terrain alerts and display.

Radio Altitude/Barometric Altitude Control



1 Minimums (MINS) Selector (outer)

RADIO—sets RADIO display on PFD and Captain's control sets RADIO reference for GPWS minimums voice annunciation; BARO not displayed.

BARO—sets BARO pointer and BARO display on PFD and Captain's control sets BARO reference for GPWS minimums voice annunciation; RADIO not displayed.

2 RADIO Altitude/Barometric (BARO) Altitude Control (middle)

Rotate—

- when RADIO selected on MINS selector, sets RADIO altitude displayed on PFD
- When BARO selected on MINS selector, sets BARO pointer and BARO display on PFD
- Captain's control sets radio or barometric altitude reference for GPWS minimums voice annunciation.

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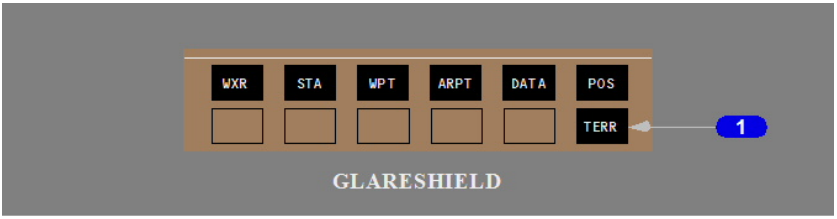
GPWS Look-Ahead Terrain Alerting Display and Annunciations

GPWS Terrain Display Select Switch



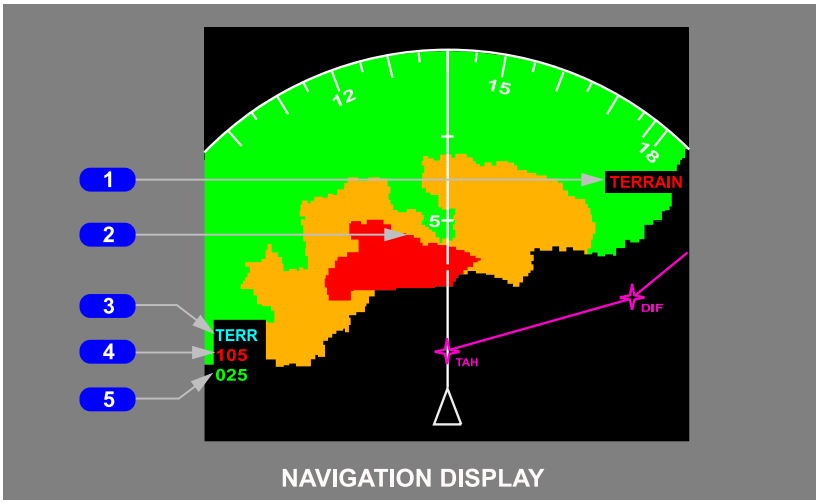
1 Terrain (TERR) Display Select Switch

Push—

- terrain data displayed in MAP, MAP CTR, VOR, and APP modes
- deselects weather radar display regardless of switch position.

Second push—deselects terrain data display.

Terrain Display



1 OBSTACLE and TERRAIN Annunciation

OBSTACLE (amber)—obstacle caution alert is occurring.

OBSTACLE (red)—obstacle warning alert is occurring.

TERRAIN (amber)—look-ahead terrain caution alert is occurring.

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TERRAIN (red)—look-ahead terrain warning alert is occurring.

Displayed in all ND display modes.

2 Obstacle and Terrain Display

When airplane is higher than 2,000 feet above terrain, density based on obstacle height, peaks height, and airplane altitude:

- solid green—highest obstacles or peaks displayed
- high density green—intermediate height obstacles or terrain peaks displayed
- low density green—lowest obstacles or terrain peaks displayed.

When airplane is lower than 2,000 feet above terrain, color and density based on obstacle height, terrain height, and airplane altitude:

- dotted green—obstacles or terrain from 2,000 feet below to 500 feet (250 feet with gear down) below airplane altitude
- dotted amber—obstacles or terrain 500 feet (250 feet with gear down) below to 2,000 feet above airplane altitude
- dotted red—obstacles or 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.

Notes:

1. In areas without obstacle or terrain data, look-ahead terrain alerting and display functions not available. GPWS immediate alerts function normally.

TJR to TJW, TKK to TKR, TKU to TKZ

2. Terrain within 200 feet of the nearest airport runway elevation is not displayed.

TJA,B,C,D,G, H,TKA to TKF

3. Terrain within 400 feet of the nearest airport runway elevation is not displayed.

Displayed automatically when:

- a look-ahead obstacle or 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.

4 Highest Elevation of Obstacle or Terrain Displayed

Color (amber, green, or red) same as color of corresponding obstacle or terrain displayed.

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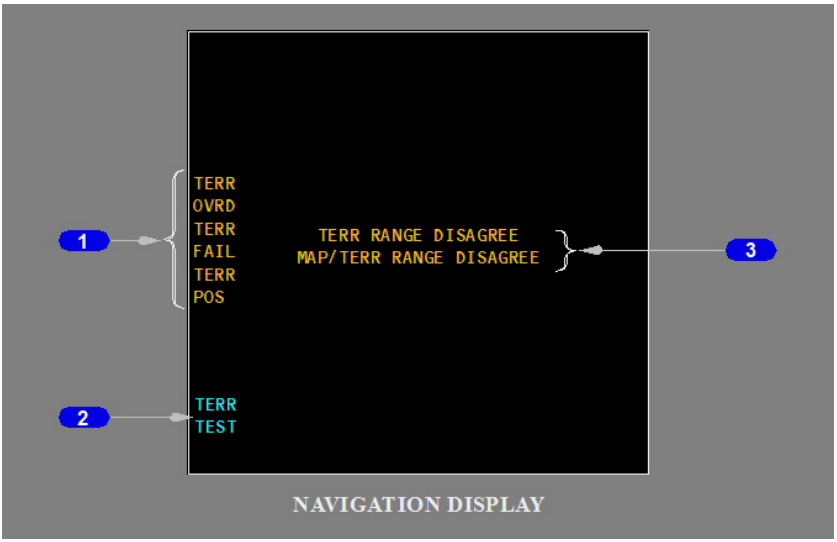
5 Lowest Elevation of Obstacle or Terrain Displayed

Color (amber, green, or red) same as color of corresponding obstacle or terrain displayed.

The highest and lowest elevations of the obstacles and terrain displayed are inhibited for obstacles and terrain further than 320 nm. The highest and lowest elevations of obstacles and terrain displayed are also inhibited for some obstacles and terrain that are directly abeam of the airplane heading and closer than 320 nm.

Terrain Navigation Display Annunciations



1 Terrain Status Annunciation

TERR FAIL (amber)—Look-ahead terrain alerting and display failed.

TERR OVRD (amber)—TERR OVRD switch pushed.

TERR POS (amber)—Look-ahead terrain alerting and display unavailable due to GPS position uncertainty. During time between GPS position failure and display of TERR POS message, ADIRS provides position for look-ahead terrain alerting and display.

2 Terrain Mode Annunciation

TERR TEST (cyan)—GPWS operating in self-test mode.

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3 Terrain Range Status Annunciation

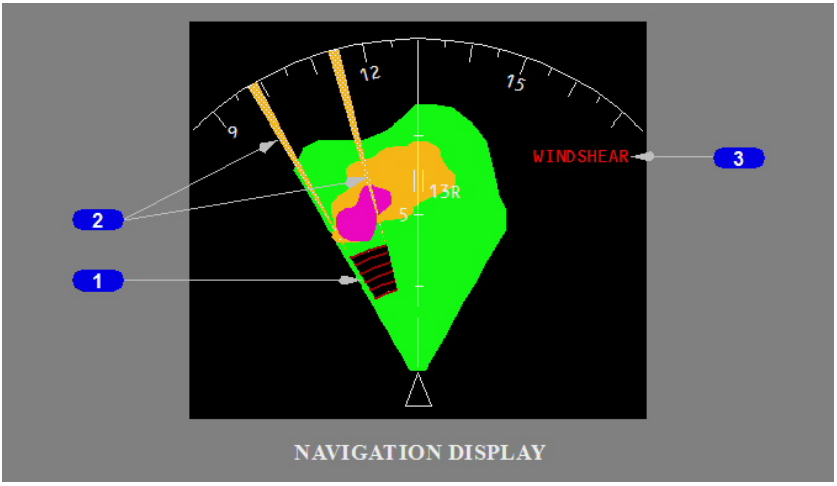
TERR RANGE DISAGREE (amber)—

- 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



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.

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2 PWS Radials

Displayed (amber)—

- PWS alert is occurring
- extend from PWS symbol to help locate windshear event.

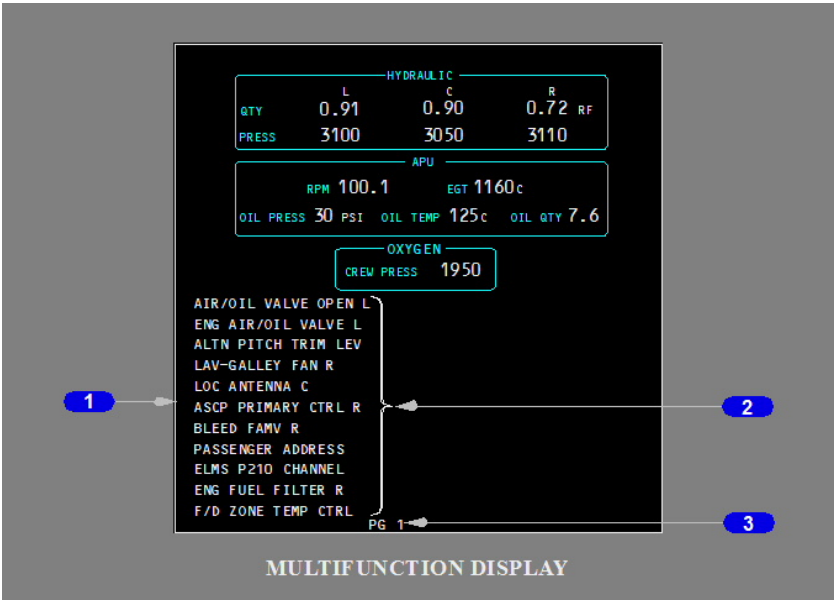
3 WINDSHEAR Annunciation

WINDSHEAR (amber)—PWS caution alert is occurring.

WINDSHEAR (red)—PWS warning alert is occurring.

Displayed in all navigation display modes.

Status Display



1 Status Display

Displays hydraulic, APU, and oxygen system indications and status messages.

2 Status Messages

Status messages indicate equipment faults requiring MEL reference for dispatch.

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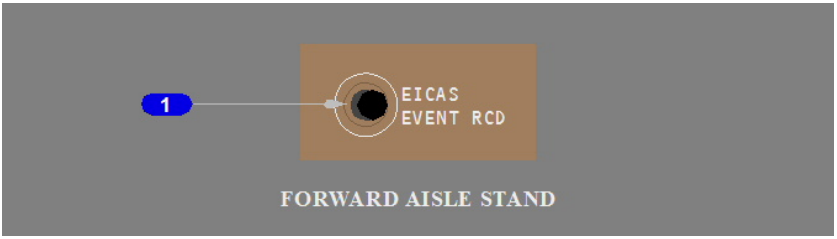
3 Page (PG) Number

Displayed—

- additional pages of status messages exist
- displays number of page selected.

EICAS Event Record Switch



1 EICAS EVENT Record (RCD) Switch

Push—records up to five EICAS events into memory.

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Introduction

Warning systems consist of:

- engine indication and crew alerting system (EICAS)
- airspeed alerts
- tail strike detection system
- takeoff and landing configuration warning system
- MCP selected altitude alerts
- crew alertness monitor
- traffic alert and collision avoidance system (TCAS)
- windshear alerts
- ground proximity warning system (GPWS).

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.

EICAS is normally displayed on the upper center display.

Crew Alerting and EICAS Message Design Philosphy

Time Critical Warings

Time critical warnings alert the flight crew to a non-normal operational condition requiring immediate crew awareness and immediate corrective action. Time critical alerts include aural alerts, messages and indications on the PFD, Master WARNING/CAUTION lights, voice annunciation alerts, and stick shakers.

Warnings

Warnings alert the flight crew to a non-normal operational or system condition requiring immediate crew awareness and corrective action.

Cautions

Cautions alert the flight crew to a non-normal operational or system condition requiring immediate crew awareness. Corrctive action may be required.

Advisories

Advisories alert the flight crew to a non-normal operational or system condition requiring routine crew awareness. Corrctive action may be required.

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EICAS Messages

Systems conditions and configuration information is provided to the crew by four types of EICAS messages:

- EICAS alert messages are the primary method to alert the crew to non-normal conditions
- EICAS communication messages direct the crew to normal communication conditions and messages
- EICAS memo messages are crew reminders of certain flight crew selected normal conditions
- EICAS status messages indicate equipment faults which may affect airplane dispatch capability.

An EICAS alert, communications, 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 rectangular symbol [ ] prefaces an alert message that has procedural steps. The rectangular symbol [ ] also prefaces EICAS alert messages for checklists that have notes or information of which the crew must be made aware.

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 CANC/RCL switch. Amber EICAS alert messages can be canceled and recalled by pushing the CANC/RCL switch.

EICAS Communication Messages

EICAS communication messages direct crew attention to normal communication conditions which may require crew attention. There is a crew action for each EICAS communications message.

EICAS communications messages are grouped into three priority levels: high, medium, and low. Prioritization is an aid to flight crew decision making when more than one message is displayed.

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EICAS communications messages are displayed in white below EICAS alert messages. Communication messages can not be cancelled by pushing the CANC/RCL switch.

EICAS Memo Messages

EICAS memo messages are crew reminders of certain flight crew selected normal conditions. They are displayed in white at the bottom of the last page of EICAS alert messages on the primary EICAS display.

Pushing the CANC/RCL 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 Dispatch Deviation Guide (DDG) or airline equivalent and provide a cross reference to the Minimum Equipment List (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 CANC/RCL 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 CANC/RCL switch displays the next page of EICAS caution and advisory messages. EICAS warning messages are displayed at the top of each page.

Pushing the CANC/RCL 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.

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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 CANC/RCL 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 CANC/RCL 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 communication 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 communication condition no longer exists, all messages previously displayed move up one display line.

The most recent EICAS memo message is displayed at the top of the memo messages.

The STATUS cue is displayed on primary EICAS when a new EICAS status message is displayed. When the STAT 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 STAT switch controls the display of single and multiple pages of status messages in a manner similar to the way the CANC/RCL switch controls the display of EICAS alert messages.

Aurals, Master WARNING/CAUTION Switches and Lights, and GND PROX Light

Aurals, two master WARNING and CAUTION lights, and the GND PROX light call attention to the following alerts:

- in the following table, parentheses ( ) describe crew action to silence the aural 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: – FIRE APU – FIRE CARGO AFT, FWD – FIRE ENG L, R – FIRE WHEEL WELL.
Siren	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	EICAS warning message: – AUTOPILOT DISC – CONFIG DOORS – CONFIG FLAPS

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Aural	Light	Calls Attention To:
		– CONFIG GEAR STEERING – CONFIG PARKING BRAKE – CONFIG RUDDER – CONFIG SPOILERS – CONFIG STABILIZER.
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 – STABILIZER.
Voice annunciation: – VEE ONE.	None	Airspeed at V1 during takeoff.
Voice annunciation: – ENGINE FAIL.	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	Red ENG FAIL on both PFDs.
Beeper	Master CAUTION lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	New EICAS caution message, except: – ENG SHUTDOWN – ENG SHUTDOWN L – ENG SHUTDOWN R.
High-low chime	None	New EICAS medium level communication message.
Voice annunciation: – DON'T SINK, DON'T SINK – TOO LOW, TERRAIN.	GND PROX light	GPWS immediate alert.
Voice annunciation: – TRAFFIC, TRAFFIC.	None	Amber TRAFFIC message and TCAS TA traffic display on ND.
Voice annunciation: – CLIMB, CLIMB – CLIMB, CLIMB NOW, CLIMB, CLIMB NOW	None	Red regions to avoid on PFD.

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Aural	Light	Calls Attention To:
– 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 – LEVEL OFF, LEVEL OFF – MAINTAIN VERTICAL SPEED, MAINTAIN – MAINTAIN VERTICAL SPEED CROSSING, MAINTAIN – MONITOR VERTICAL SPEED.		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.
Voice annunciation: – OBSTACLE, OBSTACLE, PULL UP – TERRAIN, TERRAIN, PULL UP.	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	Red PULL UP on both PFDs. Red OBSTACLE or TERRAIN message and obstacle or terrain display on ND.

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Aural	Light	Calls Attention To:
Voice annunciation: – CAUTION OBSTACLE – CAUTION TERRAIN.	GND PROX light	Amber OBSTACLE or TERRAIN message and obstacle or terrain display on ND.
Voice annunciation: – WINDSHEAR AHEAD – GO AROUND, WINDSHEAR AHEAD.	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset 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 Reset switch)	Red WINDSHEAR on both PFDs.
Voice annunciation: – PULL UP.	Master WARNING lights (Extinguish by pushing Master WARNING/CAUTION Reset switch)	Red PULL UP on both PFDs.
Siren (If caused by Thrust lever at idle, silence by pushing Master WARNING/ CAUTION Reset switch)	Master WARNING lights (If caused by Thrust lever at idle, extinguish by pushing Master WARNING/ CAUTION Reset 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: – SINK RATE – TERRAIN.	GND PROX light	GPWS immediate alert.
Voice annunciation: – GLIDE SLOPE – TOO LOW, FLAPS – TOO LOW, GEAR.	GND PROX light (Inhibited by pushing the respective GND PROX OVRD switch)	GPWS immediate alert.

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Aural	Light	Calls Attention To:
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 Voice Annunciations and Alerts

Takeoff V1 Airspeed

The voice annunciation VEE ONE sounds when airspeed reaches V1 during takeoff.

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 if airspeed is below minimum maneuvering speed.

Overspeed Warning

The EICAS warning message OVERSPEED is displayed if airspeed is greater than VMO/MMO. 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 are based on maximum gear extended speed.

Tail Strike Detection System

The tail strike alert system detects ground contact which could damage the airplane pressure hull. A two inch blade target and two proximity sensors are installed on the aft body of the airplane. The EICAS caution message TAIL STRIKE is displayed when a tail strike is detected.

Takeoff and Landing Configuration Warning System

The takeoff and landing configuration warning system alerts the crew that the airplane is not configured for normal takeoff or normal landing.

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Takeoff Configuration Warnings

The respective EICAS warning message CONFIG is displayed if:

- airplane is on the ground, and
- FUEL CONTROL switches are in RUN position, and
- either engine thrust is in takeoff range, and
- thrust reversers are not unlocked or deployed, and
- airspeed is less than V1, or airspeed is less than 80 knots for EICAS warning message CONFIG GEAR STEERING, and
- any of the following configurations exist:
  - an entry, forward cargo, or aft cargo door not closed, latched, and locked, or
  - flaps or slats not in takeoff position, or
  - main gear steering not locked, or
  - parking brake set, or
  - rudder trim not centered, or
  - SPEED BRAKE lever not in DOWN detent, or
  - stabilizer trim not in green band.

If thrust is decreased below takeoff range and airspeed is less than V1 but the airplane is still not configured for takeoff, the Master WARNING lights are extinguished and the siren is silenced. The CONFIG message remains displayed until airspeed is less than V1 and for 10 seconds.

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:
  - either thrust lever below a nominal glideslope thrust, and below 800 feet, or
  - FLAP lever in landing position.

If the message is displayed because a thrust lever below a nominal glideslope thrust 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 FLAP lever is in landing position, the message remains displayed until the landing gear is down and locked.

Speedbrake Lever Extend Beyond ARM During Climb

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In flight, the EICAS warning message CONFIG SPOILERS is displayed if:

- the SPEEDBRAKE lever is extended beyond ARMED, and

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- climb or higher thrust is set on either thrust levers.

The message remains displayed until:

- the SPEEDBRAKE lever is DOWN or at ARMED, or
- both thrust levers are set below climb thrust.

Configuration Warning System Non-Normal Operation

If the takeoff and landing warning system fails, the EICAS advisory message CONFIG WARN SYS 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 SYS message, the CONFIG messages may not be correct.

MCP Selected Altitude Alert

Altitude alerting is provided when approaching or departing the altitude selected in the MCP altitude window.

Approaching MCP Selected Altitude

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 200 feet of the selected altitude.

Departing MCP Selected Altitude

When departing the selected altitude by 200 feet, the EICAS alert message ALTITUDE ALERT is displayed, and a highlighted amber box is displayed around the current altitude. The message and amber highlight is no longer displayed when:

- subsequently reapproaching to within 200 feet of the selected altitude, or
- a new MCP altitude is selected, or
- departing more than 900 feet from the selected altitude.

Departing MCP Selected Altitude Alert Inhibits

Departing MCP selected altitude alerts are inhibited when:

- glideslope captured, or
- landing flaps selected and landing gear down and locked.

Crew Alertness Monitor

The FMC continuously monitors switch action on the MCP, EFIS control panel, display select panel, CDUs, and radio transmitter microphone switches. When a predefined time elapses after the last switch action was detected, the EICAS alert message PILOT RESPONSE is displayed.

The message is inhibited:

- below 20,000 feet, during climb, and

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- 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 airplanes, tracks the other airplanes by analyzing the transponder replies, and predicts the flight paths and positions. TCAS provides TCAS ND messages, voice annunciations, PFD vertical flight path guidance, and traffic displays of the other airplanes 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.

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:

- 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

An RA is a prediction that another airplane will enter the TCAS conflict airspace within approximately 15 to 35 seconds. If altitude data from the other airplane is not available, no RA can be provided.

When TCAS predicts an RA:

- the TCAS red message TRAFFIC is displayed on the ND
- a TCAS voice annunciation sounds
- TCAS PFD vertical guidance is displayed.

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.

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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 red 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 20 to 48 seconds. TAs assist the flight crew in establishing visual contact with the other aircraft.

When TCAS predicts a TA:

- the TCAS amber message TRAFFIC is displayed on the ND
- the TCAS voice annunciation TRAFFIC, TRAFFIC sounds once.

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 airplane 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.

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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

When TCAS predicts an RA, TCAS vertical guidance is displayed on the PFD for a maneuver to ensure vertical separation. Traffic avoidance is ensured by adjusting or maintaining a pitch attitude and vertical speed outside the red RA regions.

If the traffic airplane 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.
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

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ND Message	Color	Description
		TCAS information cannot be displayed on ND.
TCAS OFF	Amber	TFC 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

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 regions.	Continue to keep pitch attitude and vertical speed outside the red RA regions.
MAINTAIN VERTICAL SPEED, MAINTAIN	New RA, initial voice annunciation Present pitch attitude and vertical speed are outside the red RA regions.	
MAINTAIN VERTICAL SPEED CROSSING, MAINTAIN	New RA, initial voice annunciation. Present pitch attitude and vertical speed are outside the red RA regions. 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 regions.	Increase pitch attitude and vertical speed to remain outside the red RA regions.
CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA regions.	

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Voice Annunciation	Condition	Response
	Airplane will climb through the altitude of the traffic.	
DESCEND, DESCEND	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA regions.	Decrease pitch attitude and vertical speed to remain outside the red RA regions.
DESCEND, CROSSING DESCEND DESCEND, CROSSING DESCEND	New RA, initial voice annunciation. Present pitch attitude and vertical speed are within the red RA regions. Airplane will descend through the altitude of the traffic.	
LEVEL OFF, LEVEL OFF	Present pitch attitude and vertical speed are within the red RA regions.	Reduce vertical speed to zero. Adjust pitch attitude and vertical speed to remain outside the red RA regions.
INCREASE CLIMB, INCREASE CLIMB INCREASE DESCENT, INCREASE DESCENT	Existing RA, TCAS requires change in vertical rate. Present pitch attitude and vertical speed are within the red RA regions.	Adjust pitch attitude and vertical speed to remain outside the red RA regions.
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 regions.	Decrease pitch attitude and vertical speed to remain outside the red RA regions.
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 regions.	Increase pitch attitude and vertical speed to remain outside the red RA regions.
CLEAR OF CONFLICT	TCAS PFD vertical guidance is no longer	Attempt to visually locate the traffic.

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Voice Annunciation	Condition	Response
	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.	

TCAS Normal Operation

TCAS is controlled from the transponder panel. TA/RA is normally selected. However, it is sometimes necessary to select TA ONLY to prevent nuisance RAs.

TA ONLY is selected during engine out operations to prevent RAs when adequate thrust is not available to follow the RA commands.

TCAS Non-Normal Operation

The EICAS advisory message TCAS is displayed and the amber TCAS FAIL message is displayed on both NDs if TCAS is failed.

The EICAS advisory message TCAS OFF is displayed and the amber TCAS OFF message is displayed on both NDs if TCAS if the TFC switch is pushed when the airplane is below 400 feet radio altitude. TCAS remains in standby mode.

The respective EICAS advisory message TCAS RA CAPTAIN or TCAS RA F/O is displayed if RA guidance cannot be displayed on the respective PFD. The ND traffic displays and voice alerts are unaffected.

Ground Proximity Warning System (GPWS) and Predictive Windshear (PWS)

Introduction

GPWS and PWS provide:

- look-ahead obstacle and terrain alerts for potentially hazardous flight conditions involving impact with the obstacles and the ground
- predictive windshear alerts and immediate windshear alerts
- altitude voice annunciations during approach
- bank angle voice alerts.

TJR to TJW, TKK to TKR, TKU to TKZ

Look-Ahead Obstacles and Peaks Terrain Alerting System

Look-ahead obstacles and peaks terrain alerts are provided by monitoring obstacle and terrain proximity using a world-wide terrain data base and an

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obstacle data base. The obstacle data base is not yet worldwide. Terrain data is not designed to be an independent navigation aid.

Proximate obstacle and terrain data may be displayed on the ND. If there is a potential obstacle or terrain hazard, 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 path is not considered in the estimated time to impact.

Altitude 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: Obstacles or terrain ahead of the airplane may exceed available climb performance. A GPWS caution or warning does not guarantee obstacle or terrain clearance.

When the TERR switch is pushed on, the TERR symbol is displayed on the ND and obstacle and terrain contours may be displayed.

When obstacle and terrain contours are displayed, the altitudes of the highest and lowest displayed obstacle or terrain are displayed below the TERR symbol. The color of each altitude corresponds to the altitude of the respective contour.

The highest and lowest elevations of the obstacles and terrain displayed are inhibited for obstacles and terrain further than 320 nm. The highest and lowest elevations of obstacles and terrain displayed are also inhibited for some obstacles and terrain that are directly abeam of the airplane heading and closer than 320 nm.

When the airplane is higher than 2,000 feet above the terrain, obstacles and terrain peaks are displayed using solid, high density, and low density contours of green. The highest obstacles or terrain is represented by solid green, and the lowest obstacles or terrain displayed is represented by low density green.

When the airplane is lower than 2,000 feet above the terrain, all obstacles and terrain within 2,000 feet of airplane barometric altitude is displayed on the navigation display.

When an obstacle or terrain alert occurs, the respective message is displayed on the ND. When an OBSTACLE alert occurs while a TERRAIN alert message is displayed, the OBSTACLE alert message replaces the TERRAIN alert message. Both messages will not be displayed at the same time.

The terrain display is correlated to GPS position, or to ADIRU position if GPS position is intermittently unavailable.

Terrain and weather radar cannot be simultaneously displayed on the ND. When one pilot selects terrain and the other pilot selects weather radar, each display updates on alternating sweeps.

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GPWS Look-Ahead Obstacle and Peaks Terrain Alerts

Voice Annunciation	PFD and ND Display and Light	Description
OBSTACLE, OBSTACLE, PULL UP	Red PULL UP on both PFDs Master WARNING lights Red OBSTACLE message on both NDs Solid red obstacle on ND	20 to 30 seconds from projected impact with obstacle. Pushing the GND PROX TERR OVRD switch to OVRD inhibits the alert.
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 OBSTACLE	Amber OBSTACLE message on both NDs Solid amber obstacle on ND GND PROX light	40 to 60 seconds from projected impact with obstacle. 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	Amber TERRAIN message on both NDs 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.

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Predictive Windshear (PWS) and Immediate Windshear Alerting Systems

Windshear alerts are enabled during takeoff, approach, and landing.

- PWS provides windshear alerts when an excessive windshear condition is detected ahead of the airplane
- Immediate windshear alerts are provided when an excessive downdraft or tailwind is occurring.

PWS Alerting System

Weather radar uses radar imaging to detect disturbed air ahead of the airplane.

PWS is enabled to provide windshear alerts 12 seconds after weather radar begins scanning for windshear.

When PWS is scanning for windshear, radar antenna scan sweep is reduced.

Prior to takeoff, PWS alerts can be enabled by pushing the WXR switch on the EFIS control panel. On the ground with the WXR switch pushed or not pushed, weather radar begins scanning for windshear when the thrust of either engine is in the takeoff range and thrust reversers are not unlocked or deployed.

In flight with the WXR 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 WXR on the EFIS control panel is pushed.

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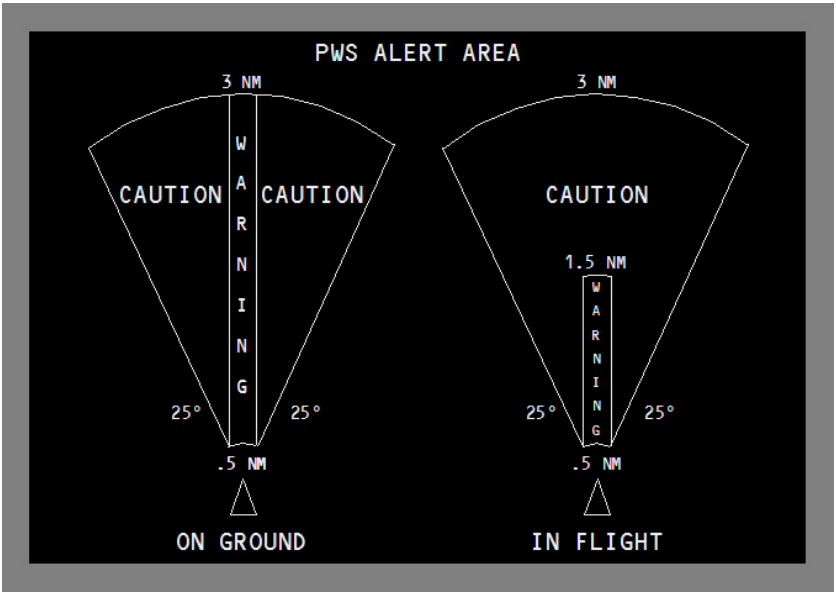

PWS Alerts

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.
GO AROUND, WINDSHEAR AHEAD	Red WINDSHEAR on both PFDs Master WARNING lights Red WINDSHEAR message on both NDs	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.

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Voice Annunciation	PFD and ND Display and Light	Description
	RED windshear symbol on ND	
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.

Notes: 1. Weather radar provides windshear alerts for windshear events containing some level of moisture or particulate matter.

2. 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 Alerts

Voice Annunciation	PFD 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 Voice Annunciations

TJR to TJW, TKK to TKR, TKU to TKZ

The voice alert BANK ANGLE sounds if bank angle exceeds 35°, 40°, and 45°. The voice alert BANK ANGLE also sounds at low altitudes during takeoff and landing for bank angles as small as 10°.

Immediate Alerting System

Voice Annunciation	PFD and ND Display and Light	Description
DON'T SINK	GND PROX light	Altitude loss with flaps and/or gear up after takeoff or go-around.
GLIDE SLOPE	GND PROX light	Excessive deviation below glide slope. Volume and repetition rate increase as deviation increases.

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Voice Annunciation	PFD and ND Display and Light	Description
		Pushing the GND PROX G/S INHIB switch inhibits the alert when pushed below 1,000 feet radio altitude.
PULL UP	Red PULL UP message 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	GND PROX light	Excessive descent rate.
TERRAIN	GND PROX light	Excessive terrain closing rate.
TOO LOW, FLAPS	GND PROX light	Unsafe terrain clearance with flaps not in landing configuration at low altitude and airspeed. Pushing the GRND PROX FLAP OVRD switch to OVRD inhibits the alert.
TOO LOW, GEAR	GND PROX light	Unsafe terrain clearance with gear not in landing configuration at low altitude and airspeed with gear not down. Pushing the GRND PROX GEAR OVRD switch to OVRD inhibits the alert.
TOO LOW, TERRAIN	GND PROX 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 GRND PROX FLAP OVRD switch to OVRD inhibits the alert, when the alert is due to flaps not in landing position. Pushing the GRND PROX GEAR OVRD switch to OVRD inhibits the alert, when the alert is due to gear not down.

Altitude Voice Annunciations During Approach

GPWS provides the following altitude voice annunciations during approach:

- 2,500 feet—TWENTY-FIVE HUNDRED
- 1,000 feet—ONE THOUSAND

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- 500 feet—FIVE HUNDRED, when glideslope or localizer not received, or glideslope or localizer deviation greater than two dots
- 50 feet—FIFTY
- 40 feet—FORTY
- 30 feet—THIRTY
- 20 feet—TWENTY
- 10 feet—TEN.

Minimums Voice Annunciation

GPWS provides the voice annunciation PLUS HUNDRED at 100 feet above the altitude set by the Captain's MINS selector on the EFIS Control Panel and the voice annunciation MINIMUMS at the altitude set.

GPWS Non-Normal Operation

Altitude Voice Annunciations During Approach Non-Normal Operation

If there is a fault in voice annunciations during the approach system, the EICAS advisory message ALT CALLOUTS is displayed and GPWS annunciations during the approach are inhibited.

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.

Look-Ahead Alert Non-Normal Operation

If there is a fault in look-ahead terrain alert, the respective terrain status annunciation TERR is displayed.

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 and landing to prevent distracting the crew.

GPWS immediate windshear alert inhibits all PWS, TCAS, and other GPWS alerts.

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When TA/RA is selected on the transponder panel and a GPWS or PWS warning alert occurs, TCAS automatically inhibits RA mode. During the inhibit, all aircraft that would have been predicted as an RA are predicted as a TA. When GPWS and PWS warning alerts are no longer occurring, the RA mode inhibit ends.

Alert Messages Inhibited During Normal System Operation

Certain EICAS alert messages are time delayed, even though related flight deck panel annunciator lights are illuminated. Time delay inhibits prevent normal in-transit indications from being displayed as EICAS alert messages. For example, valves are generally only sensed open or closed, not in-transit. When a valve is in-transit, the 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 time delay, the respective EICAS alert message is displayed.

Alert Messages Inhibited By Other Alert Messages

Some EICAS alert messages are inhibited if another related alert message is displayed. For example, individual hydraulic pump pressure messages are inhibited if a hydraulic system pressure 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 could occur.

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.

Immediate windshear alert inhibits the automatic display of a new TCAS, look-ahead terrain, or PWS alerts.

TCAS traffic can be displayed concurrently with either TERR and WXR display.

New TCAS TRAFFIC TA or RA alerts:

- When both NDs are in MAP, MAP CTR, VOR, or APP mode and a new TCAS TA or RA alert occurs, TFC is selected automatically for both NDs and TCAS traffic is displayed 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, TFC is selected automatically for that ND and TCAS traffic is displayed. The ND not in MAP, MAP CTR, VOR, or APP mode is armed for TCAS display and TFC will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected.

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- 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 and TFC will be selected automatically when MAP, MAP CTR, VOR, or APP mode is selected.

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.

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.
- 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.
- 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.

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 both FUEL CONTROL switches in CUTOFF
Respective EICAS messages: • BLEED OFF	For EICAS caution messages: • ENG SHUTDOWN L	On the ground, and both FUEL CONTROL switches in CUTOFF

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Alert Inhibited	For Message	Inhibit Occurs
• ELEC BACKUP GEN • ELEC DRIVE • ELEC GEN OFF • ENG OIL PRESS • HYD PRESS PRI.	• ENG SHUTDOWN R • ENG SHUTDOWN.	

Alerts Inhibited During Engine Start

Alert Inhibited	Inhibit Begins	Inhibit Ends
All new EICAS caution and advisory messages, except: • APU LIMIT • APU SHUTDOWN • ENG AUTOSTART • ENG FUEL VALVE • ENG SHUTDOWN • ENG START VALVE • ENG STARTER CUTOUT • OVERHEAT ENG.	ENGINE START selector to START	Engine reaches idle RPM, or start is aborted, or five minutes elapse.

Alerts Inhibited During Takeoff

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
EICAS advisory message TCAS OFF	Messages are inhibited	On ground	400 feet radio altitude
TCAS TA voice alerts	TCAS TAs	On ground	Approximately 500 feet radio altitude
All TCAS RAs	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.	On ground	Approximately 1,000 feet radio altitude

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Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
TCAS DESCEND RAs	Alerts are inhibited	On ground	Approximately 1,100 feet radio altitude
Red ENG FAIL on PFD	Engines not producing commanded thrust and rate of thrust increase insufficient; same condition as EICAS messages ENG THRUST L, R	Engine start	65 knots airspeed
EICAS caution message ENG THRUST L, R	Messages are inhibited	Engine start	Six knots before V1
STATUS cue	All EICAS status messages	Engine start	30 minutes after lift-off.
All EICAS communication messages except: CABIN ALERT Hi-Lo Chime	Messages are inhibited	Either engine in takeoff thrust range	400 feet radio altitude or 20 seconds after lift-off, whichever occurs first, or on the ground and thrust on both engines reduced below takeoff thrust range
EICAS warning message CONFIG GEAR STEERING	Message is inhibited	80 knots airspeed	Landing
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	New EICAS caution messages displayed during inhibit.	80 knots airspeed	400 feet radio altitude or 20 seconds after lift-off, whichever occurs first. If rejected takeoff initiated above 80 knots, inhibit continues until airspeed is less than 75 knots.

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Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
will sound when the inhibit ends.			
All EICAS advisory messages	Messages are inhibited	80 knots airspeed	400 feet radio altitude or 20 seconds after lift-off, whichever occurs first, or if takeoff thrust not selected on both engines. If rejected takeoff initiated above 80 knots, inhibit continues until airspeed is less than 75 knots.
New PWS caution alerts	Messages are inhibited	80 knots airspeed	400 feet radio altitude
New PWS warning alerts	Messages are inhibited	100 knots airspeed	50 feet radio altitude
New red ENG FAIL on PFD	EICAS caution message ENG THRUST L, R	Six knots before V1	Landing
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.	New EICAS warning messages FIRE displayed during inhibit.	V1 or rotation, whichever occurs first.	400 feet radio altitude or 25 seconds after inhibit began, whichever occurs first.
Master WARNING lights Siren If the Master WARNING lights illuminate and siren	New EICAS warning messages displayed during inhibit, except FIRE	V1 or rotation, whichever occurs first.	

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Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
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.			
EICAS warning messages CONFIG, except CONFIG GEAR STEERING, for takeoff configuration warnings	Messages are inhibited.	V1 or rotation, whichever occurs first.	Landing.
Master WARNING lights Siren	EICAS warning message CONFIG GEAR	Gear unlock for retraction	825 feet radio altitude or 150 seconds after inhibit began, whichever occurs first.
All PWS alerts	Messages are inhibited	1,200 feet radio altitude	Approach

Alerts Inhibited During Landing

Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
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
All TCAS RAs	Alerts are inhibited When RA selected on panel, TCAS switches automatically to TA	Approximately 1,000 feet radio altitude	Go-around at approximately 1,000 feet radio altitude

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Alert Inhibited	For Message	Inhibit Begins	Inhibit Ends
	only mode and TCAS message TA ONLY is displayed on ND		
All EICAS communication messages, except: CABIN ALERT	Messages are inhibited	800 feet radio altitude	75 knots airspeed
STATUS cue	All EICAS status messages		
TCAS voice alerts	TCAS TAs	Approximately 500 feet radio altitude	Go-around at approximately 500 feet radio altitude
New PWS caution alerts	Alerts are inhibited	400 feet radio altitude	80 knots airspeed
EICAS alert message WINDSHEAR SYS	Message is inhibited		
EICAS advisory message TCAS OFF			Go-around at 400 feet radio altitude
Master CAUTION lights Beeper	All EICAS caution messages, except: • AUTOPILOT • AUTOTHROTTLE DISC • NO AUTOLAND • SPEEDBRAKE EXTENDED.	LAND 2 or LAND 3 displayed on PFD, and 200 feet radio attitude	80 knots ground speed, or 40 seconds elapse, or 800 feet radio altitude
New PWS warning alerts	Alerts are inhibited	50 feet radio altitude	100 knots airspeed

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.

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EICAS Alert Messages

Message	Level	Aural	Message Logic
AIRSPEED LOW	Caution	Beeper	Airspeed is below minimum maneuvering speed.
ALTITUDE ALERT	Caution	Beeper	Airplane has deviated from MCP selected altitude.
ALTITUDE CALLOUTS	Advisory		Altitude and minimums voice annunciations during approach are no longer provided.
CONFIG DOORS	Warning	Siren	An entry, forward cargo, or aft cargo door is not closed, latched, and locked when either engine's thrust is in the takeoff range on the ground.
CONFIG FLAPS	Warning	Siren	Flaps or slats are not in a takeoff position when either engine's thrust is in the takeoff range on the ground.
CONFIG GEAR	Warning	Siren	Any landing gear is not down and locked when either thrust lever is closed below 800 feet radio altitude or when flaps are in a landing position.
CONFIG GEAR STEERING	Warning	Siren	Main gear steering is unlocked when either engine's thrust is in the takeoff range on the ground.
CONFIG PARKING BRAKE	Warning	Siren	Parking brake is set when either engine's thrust is in the takeoff range on the ground.
CONFIG RUDDER	Warning	Siren	Rudder trim is not centered when either engine's thrust is in the takeoff range on the ground.
CONFIG SPOILERS	Warning	Siren	Speedbrake lever is not DOWN when either engine's thrust is in the takeoff range on the ground; or, speedbrake lever extended beyond ARMED in flight, and climb thrust or greater set on either thrust lever.

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TJA,B,C,D,G,H,TKA to TKF

Message	Level	Aural	Message Logic
CONFIG SPOILERS	Warning	Siren	Speedbrake lever not DOWN when either engine's thrust is in the takeoff range on the ground.
CONFIG STABILIZER	Warning	Siren	Stabilizer is not within the greenband when either engine's thrust is in the takeoff range on the ground.
CONFIG WARNING SYS	Advisory		A fault is detected in the configuration warning system.
GNDPROXSYS	Advisory		Ground proximity alerts are no longer provided.
OVERSPEED	Warning	Siren	Airspeed has exceeded Vmo/Mmo.
PILOT RESPONSE	Warning	Siren	After caution message PILOT RESPONSE displayed, FMC does not detect crew activity in monitored area within a specified time.
PILOT RESPONSE	Caution	Beeper	After advisory message PILOT RESPONSE displayed, FMC does not detect crew activity in monitored area within a specified time.
PILOT RESPONSE	Advisory		FMC does not detect crew activity in monitored area within a specific time.
TAIL STRIKE	Caution	Beeper	A tail strike has been detected.
TCAS	Advisory		TCAS has failed.
TCAS OFF	Advisory		TCAS is in standby mode.
TCAS RA CAPTAIN, F/O	Advisory		TCAS cannot display RA guidance on the affected PFD.
TERROVRD	Advisory		Ground proximity terrain override switch is in OVRD.
TERRPOS	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.

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Message	Level	Aural	Message Logic
WINDSHEAR SYS	Advisory		Windshear alerts may not be provided.

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